

Modern Club Passing

May 23, 2026

PDF and web version with animations at <https://modernpassing.com>

This is an incomplete draft of the book and very much work in progress. Feedback is welcome.

A printable PDF of the first chapters is available at ckaestne.github.io/modernpassing/book.pdf

With this short book (and corresponding website), my goal is to provide an opinionated introduction to the fascinating world of modern club passing. Like many areas of juggling, club passing has its own community that continuously pushes the field and invents and shares new patterns and new styles of passing. I have learned many things from this community and tremendously enjoy patterns that go beyond traditional 6-club four-count (“every others”), 7-club two-count, and two-count/four-count feeds. In passing corners at juggling festivals and at festivals dedicated to passing, it is now common to find ambidextrous 4-handed siteswaps with zaps and triple selfs, and Roundabout-style manipulator patterns of various difficulty with 3 to 5 people.

Getting into modern club passing can be intimidating and overwhelming. There are so many patterns, notations, and video collections that it can be difficult to know where to start, where to go next, and how to even figure out what’s going on. I try to provide a clear guide, laying out possible paths to learn patterns and skills that incrementally build on each other and increase in difficulty. Along the way, I’ll briefly introduce the necessary notation and concepts, which allows sharing and explaining individual patterns more compactly.

I try to curate and guide in a short book, rather than create a comprehensive repository. With this book, you will learn the essentials that are broadly known in the passing community – at any level, you will likely find people to pass interesting and challenging patterns with. You will find plenty of patterns beyond the basics to push yourself, and also gain the skill to find, read, and create other patterns.

What is modern club passing? Modern club passing is ambidextrous. Modern club passing combines passes at different heights (zaps, singles, doubles) with zips, flips, heffs, and triple selfs. Modern club passing is about slowing down and controlling the pattern. Modern club passing embraces manipulator and walking patterns with 3 or more people. Modern club passing is for the passer and not for an audience. Modern club passing constantly pushes the boundaries and tries more challenging patterns, even when they all look the same from the outside. Modern club passing is not a fixed concept but a term I embrace for the kind of passing that I and many others in the community enjoy.

– Christian Kästner

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Getting Started

1. Learn to pass / teach to pass

Next: Synchronous passing notation or Four-handed siteswap notation

5-club one-count

The most effective way to teach beginners passing is to teach them *5-club one-count*. Especially if one passer is more experienced, it is possible to teach almost everybody passing within minutes and get them to experience success, even if they have never tried to juggle clubs before. As it allows for more control and feedback and trains both hands equally, this approach is much more effective than the traditional approach of first requiring a solo cascade pattern and then learning 6-club four-count as the first pattern. This approach was first introduced by Amiel Martin and published on passingpedagogy.com it has since been widely taught in workshops.

In the following, I assume a more experienced *teacher* and a less experienced *student*. While it is easier to get to success with a more experienced *teacher*, who can throw good passes and recover from weak responses, the same sequence also works with two beginners.

Step 1: Practicing passing throws in isolation. The teacher has a single club, the student has two empty hands. The teacher throws a lofty crossing pass from the right hand with a single spin. Ideally the student can catch the club comfortably with the right hand at about shoulder height. The student then throws a lofty straight pass back to the teacher, from the student's right hand to the teacher's left hand. This is followed by a lofty crossing pass from the teacher's left hand to the student's left hand, and finally followed by a lofty straight pass from the student's left hand to the teacher's right hand.

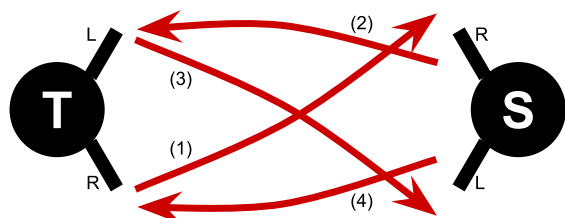


Illustration of the four passes between the teacher (T) and the student (S).

Use this first step to practice passes, watch them land, and correct with the next throw if needed. Passes will often be too spinny, too short, too fast, or too low. Passes should be lofty and should be caught with an open hand facing the other passer roughly at shoulder height, maybe 10 to 20 cm (4-8 inches) diagonally in front of the shoulder. It is a good exercise for the teacher (a) to hold the empty hand where they want to catch the club as a reference point for the student to aim for, and (b) to provide feedback on what to correct.

[TODO: Photo of where to catch]

When throwing the pass, *avoid spinning the club from the wrist* – keep the wrist fixed. Adjust height and length of the throw primarily by controlling how much to move the lower arm (bending at the elbow) and when to release the club. For extra far throws, the upper arm might also be involved (moving from the shoulder joint), but that is rarely needed. If the club is not spinning enough, correct by throwing it higher, not by spinning it more. Without wrist spin, it does not matter much where exactly to grip the club; usually grab it anywhere comfortably at the

handle, though some people like to slide it down to the knob for every pass.

[TODO: Photo or graphic with the path of a club]

Step 2: Responding to a pass with a pass. The teacher has a single club in the right hand and the student has one club in each hand. The teacher throws a lofty crossing pass and the student responds by throwing a lofty straight pass from the right hand back to the teacher's left hand, before catching the club with the now empty right hand. Students often want to throw their responding pass very early – delay it as long as possible – it is thrown when the incoming club starts to descend, more than halfway across the pattern. The responding pass is thrown *underneath* the incoming pass, not outside of it. Once both clubs are caught, the teacher repeats the sequence on the other side.

The teacher needs to throw lofty passes that are high and wide enough for the student to comfortably pass underneath – good lofty crossing passes are more critical for the pattern than good straight passes, which is why we have the teacher throw them. The student's straight passes should be wide enough that the teacher can comfortably pass on the inside. If there are collision problems, the incoming pass is likely too short or too low. The student may need a few attempts to get comfortable with the timing while still throwing good responding passes; practice on both sides, and go back to step 1 if needed. Find a rhythm that is slow and comfortable.

Step 3: Continue the pattern. Adding one more club, both teacher and student now start with one club in each hand. The teacher again starts with a lofty crossing pass, the student responds with a straight pass, and now the teacher continues by responding with another lofty crossing pass, forcing the student to another response on the other side, which is caught by the teacher's empty hand. That is, we now have a sequence of four passes, involving all hands, teaching the speed of responding with alternating passes from both hands. Continue to pay attention to clean throws and catches and a generally slow rhythm.

If this is working well, a more experienced teacher can take a shortcut to *5-club one-count* without telling the student by always handing the caught pass to the other hand to continue the pattern indefinitely (this is technically the four-handed siteswap 720). This can be done without any announcement and will often surprise the student about what they can do; adding another club for the final step will not make a difference from the student's perspective.

Finally: 5-club one-count. Adding one more club again, the teacher starts with two clubs in the right hand and one club in the left hand, the student still has one club in each hand. The teacher starts with a lofty crossing pass and the rest is a continuous sequence of responses. This is it. This is *5-club one-count*. The student can also practice starting with three clubs, but should continue to do straight passes, unless they want to get ready to teach somebody else.

Onward to 6-club one-count and 7-club one-count

With an experienced teacher, most students can learn *6-club one-count* on their first day, and some even see first success with *7-club one-count*. Both patterns will likely still be easier than learning *6-club four-count*.

To warm up for *6-club one-count*, first pass three clubs between the teacher's left hand and the student's right hand. All passes are straight and thrown a little from the inside to the outside. Try to keep passes lofty. The responding passes are thrown *underneath* incoming passes, and collisions indicate too short or too low passes. Once this works, switch sides and pass three clubs between the teacher's right hand and the student's left hand.

Finally, combine both sides, alternating right-hand and left-hand passes. The most common start is for both passers to have two clubs in their right hand and one club in their left hand and to start at the same time with a right-handed pass – a more experienced teacher might start with four clubs and a left-handed pass, whereas the student starts responding one beat later with a right-hand pass.

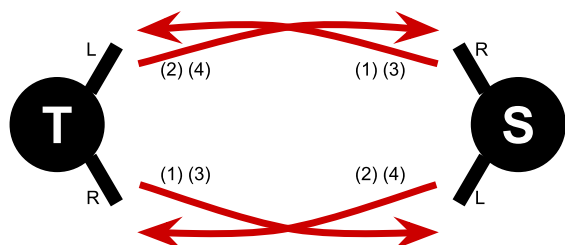


Illustration of the passes between the teacher (T) and the student (S) in 6-club one-count. Both passers throw at the same time, alternating their right and left hand.

If the teacher is comfortable with *7-club one-count*, transitioning from *6-club one-count* to *7-club one-count* is a fairly small step for the student. The student continues a one-count pattern with lofty straight single passes, now at a marginally faster pace (most students speed up too much going from 6 to 7 clubs; it is really not much faster). The teacher, however, has to carry the pattern with lofty crossing passes, typically starting with four clubs and a lofty crossing pass from the left hand slightly before the student's right-handed start.

What's next?

One-counts are great beginner patterns because the learner can focus entirely on passes, rather than on separating passes from self throws. An experienced teacher can carry the pattern, so most incoming clubs for the student will be fairly stable, whereas other patterns often fall apart from bad self throws. One-counts also provide a good foundation for passing slow and lofty and for passing with both hands.

On the one hand, one-counts provide a good entry point for four-handed siteswaps (actually *5-club one-count* and *7-club one-count* are four-handed siteswaps: 744 and 7). To go this route, learn about the notation and start with the beginner patterns, slowly introducing zips, flips, and selfs. For beginners, zips are easier to introduce than selfs, so good patterns to try next are 777742 (see compatible siteswaps) and 77722 (*Parsnip*, see beginner patterns).

On the other hand, most other passers will have learned *6-club four-count* first and other synchronous patterns next. To have a wider range of passing partners at all levels, it is useful to learn those patterns too. They are also the foundation for most group patterns. Depending on how stable their cascade is, some beginners might find it easier to learn patterns with more selfs, like *six-count*, while others might prefer starting with patterns with fewer selfs, such as *pass-pass-self*.

Synchronous Passing Patterns

2. Introduction to synchronous passing & notation

Most traditional passing patterns, including *6-club four-count*, *three-count*, and *pass-pass-self*, as well as *7-club two-count*, are synchronous patterns in that both passers throw at the same time. This is where a lot of people start passing, though we recommend a different first pattern (see learning to pass).

Many passers explore only a small number of traditional synchronous patterns, usually with many selfs and with most or all passes thrown from the right hand, making it harder only by adding more clubs. It is not surprising that many soon find this boring. But there are many synchronous patterns to explore, both one-sided (e.g., *six-count popcorn*) and ambidextrous (e.g., *Jim's three-count*), and then there is also the whole world of four-handed siteswaps.

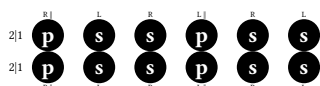
Notation

Learning a specialized notation can make reading and understanding different patterns much easier than trying to decipher textual descriptions. There are many different notations and they are not used consistently, since they emphasize different things; some notations are overly complex for simple patterns. Here, we adopt a consistent notation for all synchronous patterns based on solo siteswaps and visualize them in simple diagrams.

We use the following symbols for different throws:

Symbol	Description	Solo-siteswap equivalent
z	Zip / hand-across: Directly handing a club from one hand to the other without throwing it	1
f	Flip / hold: Holding a club in a hand without throwing it, or flipping it quickly in place	2
s	Self as in a normal cascade	3
p	Single-spin pass, usually straight	3p
h	Heff: A double-spun self to the same hand, as in a four-club solo fountain	4
d	Double-spin pass, usually crossing	4p
t	Trelf: A triple-spun self to the other hand	5
r	Triple-spin pass, usually straight	5p

A pattern where both passers make the same throws at the same time can now be written as a sequence of throws, such as "p s s" or just "pss" for *6-club three-count*, where both passers pass on every third beat. This can also be visualized as follows:



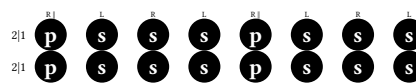
In such a visualization, we show two rows, one row for each passer. Time progresses from left to right. Usually both passers start at the same time with the right hand and then alternate hands, as indicated by the "R" and "L" labels for right- and left-handed throws. The numbers on the left indicate how many clubs each passer has in their right and left hand at the start ("right|left"), and the "||" and "X" next to a pass indicate whether that pass is thrown straight (i.e., right to left or left to right hand) or crossing (i.e., right to right or left to left hand).

3. Basic 6-club synchronous passing patterns

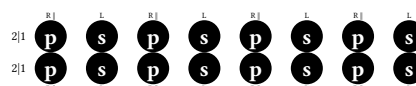
Prerequisite: Learning to pass | **Next:** Jim's patterns, synchronous 7-club and 8-club patterns, tedious patterns, four-handed siteswaps, or introduce takeouts

In all these 6-club patterns, both passers start with two clubs in the right and one club in the left hand. Both passers start at the same time with a straight single pass. It is customary to synchronize the start with an *up-down-pass* sequence where both passers lift the club without throwing it.

6-club four-count (pass-self-self-self) and two-count (pass-self). *Four-count* (old name *every others*) and *two-count* (old name *everies*) are probably the most common patterns used as a basis for group patterns, trick throws, and performances, but they are both one-sided, with all passes thrown from the right hand. I consider this as traditional passing, not modern passing. In *four-count*, every other right-hand throw is a pass.



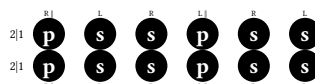
In *two-count*, every right-hand throw is a pass; the left hand only throws selfs.



For a more modern version, try *6-club three-count* or *6-club one-count* instead, or the beginner four-handed siteswaps.

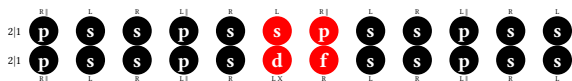
6-club one-count. The *6-club one-count* from learning to pass (also known as *ultimates*, old name *thundershower*) is the easiest synchronous pattern for beginners to learn when they have a stronger passer as a partner, because all throws are the same. Both passers pass from their right hand at the same time and then again from the left hand at the same time.

6-club three-count (pass-self-self). A good pattern to introduce selfs after one-count is *three-count* (old name *waltz*), with both passers counting pass-self-self. The pattern is ambidextrous, so it has both right-hand and left-hand passes. Note that two clubs are always passed and the other clubs are always selfed – each club received as a pass gets thrown back as a pass. Using two clubs of a different color to highlight the passes can help beginners remember when to pass.

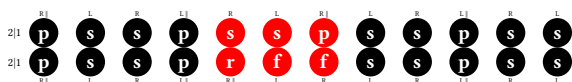


Pass-pass-self, bookends (pass-pass-self-pass-self), and countdowns. Any other sequence of passes and selfs is possible. *Pass-pass-self* (old name *two-thirds-count*), *pass-pass-self-pass-self* (known as *bookends*), and various *countdowns* are common sequences to introduce some challenges. The countdown *pass-self-self-pass-self-pass-self-pass-self* can be remembered as the sequence three-count, two-count, one-count, two-count. Another common countdown is to start with a four-count and count down to a one-count and back up for the ambidextrous pattern *pass-self-self-pass-self-pass-self-pass-self-pass-self-pass-self*.

Early doubles and triples. In all patterns (except one-count), instead of a self-pass combination, we can throw a *crossing* double pass followed by a wait (or flip) – that is, replace any 3 3p with 4p 2. This works because the double is thrown one beat before the single pass would have been, and is thrown to the same hand. For the receiving passer, if the double is thrown well, this should not make a difference – the early double can be thrown to replace any single pass and does not need to be announced. It may, however, require some practice to get the timing and placement right.

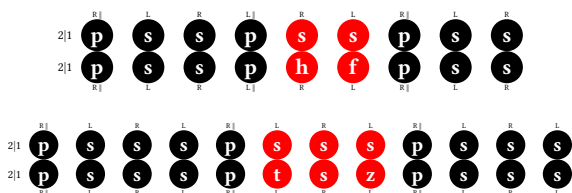


The same idea also works with triple passes. Any self-self-pass combination can be replaced with a straight triple pass and two waiting beats (triple-flip-flip) – that is, replace any 3 3 3p with 5p 2 2.



When first learning doubles and triples, focus on throwing them high and at the same distance as the singles. Again, avoid spinning clubs from the wrist – if the pass arrives underspun, add height by moving the entire lower arm.

Variations on selfs. As solo jugglers might know, every two selfs can be replaced by heff-flip (as in solo siteswap 342) and every three selfs can be replaced by trelf-self-zip or heff-heff-zip (as in solo siteswaps 531 and 441). These can be easily integrated as tricks in *three-count* and *four-count*.

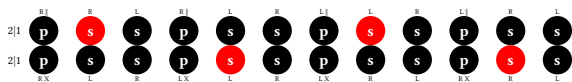


4. Jim's patterns (sync)

Prerequisite: Basic synchronous passing patterns | **Next:** Four-handed siteswaps or synchronous 7-club and 8-club patterns

Jim's patterns are a common variation on basic synchronous patterns that mess with the timing and the hand sequence. They turn one-sided patterns into ambidextrous patterns. The basic idea is that one passer throws crossing passes while the other passer keeps throwing straight passes. As a consequence, passers will sometimes receive an incoming pass to a hand that they do not expect, but they accommodate by quickly making the next throw from that hand instead. This forced, quick action from an unexpected hand is known as a *hurry*.

Jim's three-count. If passer B throws crossing passes, passer A will receive their first pass to the right hand, rather than to the left. Hence, they also throw their first self from the right hand, very quickly after the right-handed pass; their next pass is again from the right hand. Notice how the hands do not always alternate in this diagram – the hurries are highlighted. Overall, each passer throws two right-handed passes and then two left-handed passes before the pattern repeats.

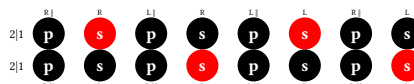


Even with the hurries, both passers should throw passes and selfs at roughly the same time. The pattern is synchronous and simply

fudges the timing by rushing two throws from the same hand. It is also possible to throw the pattern as a four-handed siteswap without hurries, but with time for a flip, as shown among the beginner four-handed siteswaps.

See also the asynchronous version with a flip in beginner four-handed siteswaps.

Jim's four-count and two-count. The same idea of crossing passes turns the one-sided *four-count* and *two-count* patterns into ambidextrous patterns with hurries. Here is the diagram and hand sequence for *Jim's two-count*.



Jim's two-count is compatible with *why not* (see below) and can be useful to stabilize the pattern when learning *why not*. There are also 7-club versions of both that change sides with a hurry after every three double passes.

Brainstorming (Jim's pass-pass-self-pass-self). This pattern is a tricky milestone for many passers. It may not be physically hard, but it requires a lot of concentration. It is a long sequence that only repeats after 20 beats. Rather than memorizing the entire sequence, just count the pass-pass-self-pass-self sequence (aloud) and make those throws regardless of which hand is next.



This pattern can be juggled as the four-handed siteswap 7747746677466.

Why not. The pattern *why not* is another popular after-the-basics pattern for many passers. It can be considered a trick throw in *Jim's two-count*: Instead of the hurried self, the passer throws a heff-zip combination with a hurried zip. Rather than fudging the timing in a synchronous pattern, we recommend learning *why not* as a four-handed siteswap.

Other patterns to try: Every synchronous pattern can be *jimsified* by throwing a club to the wrong hand with the receiver reacting with a hurry. For example, *Jim's one-count* is a fast sequence with many hurries; *Jim's pass-pass-self* turns out to be a one-sided pattern; *Jim's countdown* requires a lot of patience. It is possible to cross only some but not all passes, or even to throw some doubles or selfs to the wrong hand. Both passers can also decide whether and when to throw crossing passes, though this is collision-prone when done without coordination. None of the variations beyond the ones described above are very common, but there is a huge space for experimentation.

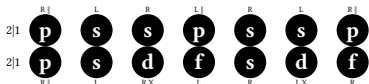
5. Common 7-club and 8-club patterns

Prerequisite: Basic synchronous passing patterns | **Next:** Four-handed siteswaps or tedious synchronous patterns

There are many more variations of synchronous patterns, especially when exploring 7-club and 8-club patterns. They are still all synchronous in that both passers throw at the same time,

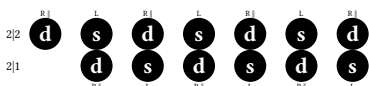
but they may not both make the same throw, or throw from the same hand.

We already introduced *early doubles* as a crossing double pass in basic 6-club synchronous patterns. Those are a good way to practice double passes. In fact, continuous early doubles in *6-club three-count* (after a first normal pass) are a good way to practice doubles with both hands:



7-club two-count. Many passers learn *7-club two-count* as a milestone. Because it is one-sided, I consider it traditional passing, not modern passing, and recommend the four-handed siteswap *7-club three-count* instead.

The conventional setup is the following: Both passers throw straight double passes from every right hand; passer A starts with four clubs and a double pass as the first throw; passer B starts with three clubs and a double pass on the *second* beat. That is, passer B throws a right-hand pass when passer A throws a left-handed self, and vice versa.



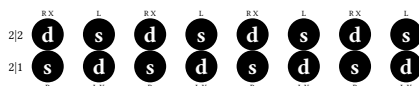
When learning *7-club two-count*, aim for consistent passes. Since both passers cannot easily see their passes land, provide feedback on placement and spin. A good strategy is to remember the spot on the ceiling where the first club peaks, and then try throwing all following passes such that they peak in the same place – consistency is usually more important than the exact placement.

See also the galloped version *7-club two-count on singles*. Also consider the four-handed siteswaps *7-club one-count* and *7-club three-count* for a more modern introduction to 7-club patterns.

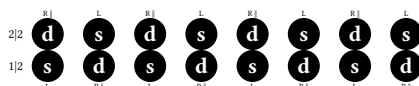
A tiny bit of theory. Why are early doubles crossing when doubles in *7-club two-count* are straight? Why do passers start on different beats in *7-club two-count*?

The patterns are indeed from the same family. By default, passers in synchronous patterns both start with the same hand and throw their singles straight and their doubles crossing. However, it is also possible to throw singles crossing and doubles straight when one passer starts with the opposite hand.

Strictly following the theory, the most obvious approach for *7-club two-count* would be for both passers to cross their doubles and to start at the same time with a right-hand throw, which is a right-handed pass for passer A and a right-handed self for passer B. This is actually a fairly nice pattern to let one passer practice left-handed doubles.

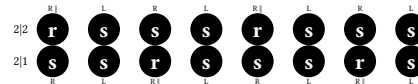


By flipping straight and crossing passes and having passer B start with the left hand, we get a pattern with straight doubles.

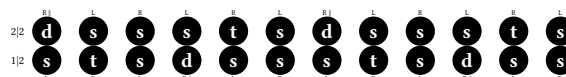


In practice, passer B often leaves out that first left-handed self to start on a right-handed pass one beat later, resulting in the conventional start shown above. However, starting with a left-handed self can help with timing.

7-club four-count. To explore one-sided triple passes, *7-club four-count* is a well-known, albeit boring, pattern.

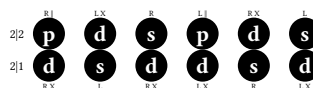


Six-count popcorn. This is one of several one-sided *popcorn* patterns – named after the trelfs that pop up on alternating sides. It can also be thrown with heff-heff instead of trelf-self, which many find easier to learn. Notice that, conventionally, we again throw the double passes straight and passer B starts with the left hand (but often skips the first self).

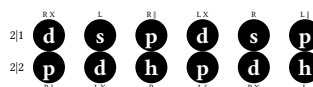


See five-count popcorn with heffs and five-count popcorn with trelfs for ambidextrous versions.

7-club pass-pass-self. With odd-length patterns, there are no synchronous patterns where both passers throw the same sequence. The most common *7-club pass-pass-self* pattern has passer A throw *single-double-self* and passer B throw *double-self-double* (3p 4p 3 vs. 4p 3 4p):



Another common variation is *double-self-single* versus *single-double-heff* (4p 3 3p vs. 3p 4p 4):



As discussed above, all of these can also be passed with crossing single passes and straight double passes if one passer starts left-handed.

Other variations of *7-club pass-pass-self*, often with one side being substantially harder than the other, are:

- 3p 3 3p vs. 4 4p 4p
- 3p 3p 4 vs. 4p 4p 3
- 3p 3p 4 vs. 4p 4 3p
- 3 3p 4p vs. 5 3p 3p
- 3p 3p 4 vs. 5 3p 3p
- 4p 4p 1 vs. 4p 5 3p

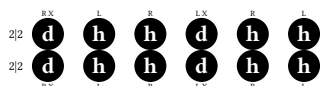
See *8-club pass-pass-self* in both the synchronous version below and the four-handed siteswap 996 for pass-pass-self patterns that are the same for both passers.

7-club synchronous three-counts. For three-counts that are not four-handed siteswaps, there are many possible variations that again combine two different throw sequences; none of them are common patterns:

- 3p 3 4 vs. 4 4 3p
- 3p 4 4 vs. 4p 3 3
- 3 4 4p vs. 4p 3 3
- 3 3p 3 vs. 4p 4 4
- 3 3p 3 vs. 5 3p 4

Try also *techno*, *7-club three-count* (966), and *French three-count* (786) for other three-count patterns with 7 clubs.

8-club patterns (not two-count). For eight clubs, there are obvious sequences of doubles and heffs that mirror standard 6-club patterns: *4p 4 4* (a *three-count*), *4p 4p 4* (a *pass-pass-self* pattern), *4p* (a *one-count*), and *4p 4 4 4* (a *four-count*). These are usually passed with crossing doubles, but can also be passed with straight doubles if one passer starts left-handed. For passers used to 9s in four-handed siteswaps, it may be useful to lower the double passes a bit.



Try also the siteswap 8-club pass-pass-self (996) with only one passer crossing and 8-club one-count on singles versus doubles (97).

6. Beyond classic synchronous patterns

Prerequisite: 7-club and 8-club patterns | **Next:** Four-handed siteswaps

There are a number of patterns that generally fit with the theme of traditional synchronous patterns, but they go beyond the original patterns by modifying the throwing rhythm to squeeze the timing, resulting in throws that are lower than in the initially described notation. We use an asterisk to note that these throws are lower than they should be if they were juggled as traditional synchronous patterns:

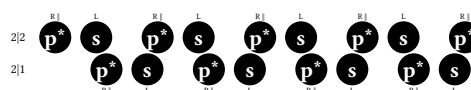
Symbol	Description	Solo-siteswap equivalent without fudging the timing
l*	Heffling: Single-spin self to the same hand, like a single-spun heff or a lofty flip (instead of a heff)	4
s*	Lofty single-spin self	4x
p*	Lofty single-spin pass (instead of a double pass)	4p
h*	Heff: Double-spin self to the same hand	6
d*	Double-spin pass (instead of a triple pass)	5p in gallop, 6p in all sync
r*	Triple-spin pass (instead of a quad pass)	6p in gallop

Gallops

For a number of one-sided patterns, it is common to juggle them lower than standard timing would require, but to fudge the timing by *galloping* the pattern – that is, throwing a fast left-hand self quickly after the right-hand throw.

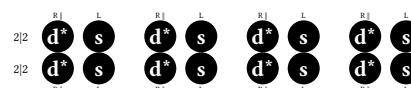
7-club two-count on singles and 8-club two-count on doubles.

The most common galloped patterns are to throw *7-club two-count* with lofty singles instead of doubles, followed quickly by a fast self from the left hand, and to throw *8-club two-count* on doubles (instead of the triple needed for a non-galloped pattern).



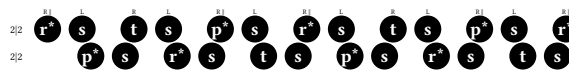
(Technically, we fudge the timing and throw lofty singles instead of doubles. By default, we would expect crossing passes, but just as in 7-club two-count on doubles, it is most common to throw all straight passes from the right hand for both passers by swapping straight and crossing and starting hands.)

8-club two-count follows the same idea:



Six-count popcorn on singles. The standard six-count popcorn can be juggled on singles and with a double-self instead of trelf if the pattern is galloped.

Long Beach popcorn. This 8-club pattern has the right-hand sequence lofty-triple pass (instead of a quad), double-self (instead of a trelf), lofty single pass (instead of a double), while all left-hand actions are quick, galloped selfs.

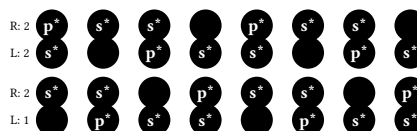


See Will Murray's pattern collection¹ for many more galloped patterns and theory of how to create more of them.

Fully synchronized patterns

There are several patterns where a passer's left and right hand always throw at the same time – similar to synchronous throws in solo siteswaps.² That is, all four hands always throw at the same time. This effectively doubles the speed, as there are two actions on every beat, rather than one; passers usually compensate with lofty selfs and lofty passes to slow down to a manageable speed.

Techno. In this *7-club three-count* variation, a single pass and a self are thrown from both hands at the same time, followed by a single self on the next beat, before it all repeats on the other side. One passer crosses their passes. This pattern is helped by throwing very lofty passes and delaying passer B's start as long as possible. Technically, all hands from both passers throw at the same time, though in practice a slight gallop might help to learn the pattern.



Video: <https://www.juggle.org/tricks-in-three-count-causal-diagrams/>

8-club two-count on singles, swing, and variations. There are many variations on the fully synchronous *8-club two-count on singles*. Again, all four hands throw at the same time, one hand throwing a self and one hand throwing a single pass. This pattern

¹<https://home.csulb.edu/~wmurray/jugglingArticles/WillPatterns.pdf>
²<https://en.wikipedia.org/wiki/Siteswap#Synchronous>

The most common variation is for passer A to throw crossing-crossing-straight-crossing-straight (counting only the passes) and for passer B to do the opposite. This pattern has a lot of hurries and only repeats after 120 beats.

For four-handed siteswaps, randomness is very difficult since both passers do different actions, but consider trying very long siteswaps, such as 796827726867726 or 777928892296626.

8. Improve your passing

There are a number of common problems in passing patterns and the community has collected various tips and exercises to improve.

Slow down. Most patterns become easier to juggle if the pattern is slower and passes are lofty. Go back to *5-club one-count* (see learning to pass) to practice lofty single passes and experiment with early doubles (see basic synchronous patterns) to practice double passes. Similarly, beginners often throw heffs and trelfs fairly low and thus fast, rushing the rest of the pattern.

About 110 to 120 beats per minute is a typical reasonable speed for synchronous 6-club patterns, 90 beats per minute is reachable when deliberately slowing down, and 130–160 beats per minute would be on the fast end. For galloped patterns, these higher speeds are common, and for fully synchronized patterns, 100–120 beats per minute is normal (i.e., effectively twice the speed of a normal pattern).

Count out loud to synchronize timing. If running into problems where passers go at different speeds, count the passing sequence aloud (“pass-self-self-pass-self-self”) to synchronize both passers. Some might find it useful to find music with a strong beat at the right pace – some music apps for runners let you select music by speed or have playlists for specific speeds (a 200bpm song works well for 100bpm passing).

Control spin with the arm, not the wrist. A passer can control the motion of a throw at three points: the wrist, the elbow joint, and the shoulder joint. Flicking motions from the wrist can create very fast-spinning clubs, and throwing with a long outstretched arm from the shoulder joint allows very high throws with a single spin – try this solo to get a feel for the different spins.

To throw slow and lofty passes, entirely avoid spinning the club from the wrist, but mostly throw from the elbow – the same holds for heffs, lofty doubles, crossing double selfs, and trelfs. If the pass arrives underspun, correct it by throwing it higher, not by adding spin from the wrist. If the pass is too short, release it earlier or add a little force from the shoulder joint. It is much easier to get consistent throws with the arm than with the wrist. By not throwing from the wrist, the position where the club is held (e.g., near the knob or near the center) matters much less.

In synchronous patterns, with both passers doing the same thing, it is perfectly fine to throw very lofty passes that are slower than selfs, even if the beats may not be perfectly spaced out in time. The main exceptions are patterns where passers do different throws on different beats (see early doubles and synchronous 7-club pass-pass-self patterns), where it may be necessary to speed up double passes a bit – here, lowering the doubles with a little spin from the wrist might help keep an even rhythm.

Wide selfs, pass to the outside. Passes should be thrown *under* an incoming self or an incoming pass. Ideally, there should be no collision problem and no need to throw a pass from far inside (in a scooping motion), or from far outside, or far in front. High and

wide selfs are helpful to provide the space. Nonetheless, passes are usually thrown slightly to the outside, so that the partner can comfortably pass underneath and slightly inside of them. Collisions are typically a symptom of passes that are too short or too low.

Provide feedback. Even if a poor throw is recoverable – for example, caught underspun or caught upside down but fixed with an extra half spin on the next throw – provide feedback to the other passer, especially if a problem is recurring or consistent. Use consistent terminology, either always describing what is wrong (e.g., “overspun”, “too short”) or, more constructively, describing how to change (e.g., “a little bit more spin”, “longer”). It can be helpful to provide feedback during the pattern, when the problem is occurring, rather than after the pattern has fallen apart. Unfortunately, good passers have a tendency to just correct for problems without saying anything – explicitly and repeatedly ask for feedback.

Watch outgoing passes. Practice seeing “through” the pattern and watching the other passer juggle. In addition to helping with timing, this allows a passer to see how their own passes land and to make corrections without asking for feedback. Start with easier patterns, like *6-club three-count*, and start watching the other passer more and more, until it is possible to constantly look at their pattern. With enough practice it will be possible to watch passes land even in many more difficult patterns like *7-club three-count* (966) and even *holy grail* (975).

Learn to recognize what an underspun and an overspun pass look like when caught. Underspun passes are often caught (if caught) with the palm of the hand pointing up, and overspun passes are often caught with the hand snapping down quickly. Intentionally throw under- and overspun passes to observe this and practice adjusting throws accordingly.

Do not neglect the left hand. Doing only right-hand passes will become limiting very quickly, making it harder to progress beyond *four-count* and *two-count*. Practice ambidextrous patterns, such as *three-count* and *pass-pass-self* or *Jim’s two-count*, from the beginning.

Start at the same time. Even on patterns with doubles, like *7-club two-count* and *six-count popcorn*, it can be helpful to start at the same time with the common *up-down-pass* start, even if it means that passer B has to start with a left-handed self. This can make it easier to get the timing consistent, rather than waiting to start “as late as possible”.

Let the club slide to the knob. This is somewhat controversial but may be helpful to some: Before a pass, in the downward motion, let the club slide down to the knob. That is, still fully grip the handle (i.e., do not swing from the knob), but do this at the far end of the club. This can ensure some consistency in the throws, which is particularly important when spinning clubs from the wrist, but it is less important when spinning a club with the arm.

Four-Handed Siteswaps

9. Introduction to Four-Handed Siteswaps & Notation

Prerequisite: 5-club one-count | **Next:** Beginner four-handed siteswaps

Four-handed siteswaps describe a large class of two-person passing patterns. They are all ambidextrous and symmetric, performing the same sequence both on the right and the left side. They are all characterized by an asynchronous beat where both passers juggle the same sequence but offset from each other and by having one passer throw crossing passes.

Four-handed siteswaps come at all difficulty levels and can be learned as the first patterns, before synchronous patterns. We strongly recommend first learning here how to read the notation and then trying the beginner patterns. After that, doubles, heffs, zaps, and trelfs can be added in any order.

Notation

Here we only describe how to read a pattern; for understanding why the notation works this way and why some passes are crossing, see four-handed siteswap theory.

A four-handed siteswap is written as a sequence of numbers such as 744, 77722 or 8686777. Similarly to the letters used for synchronous patterns, each number denotes a throw:

Nr	Name	Description
2	Zip	Hand-across without rotation; 1 in solo siteswap
4	Flip	Holding or flipping a club in the same hand; 2 in solo siteswap
5	Zap	Fast, low pass with a half rotation; crossing for passer A, straight for passer B
6	Self	Normal self; 3 in solo siteswap
7	Single	Lofty pass with a single rotation; straight for passer A, crossing for passer B
8	Heff	Double-spin self to the same hand, as in a basic four-club solo pattern; 4 in solo siteswap
9	Double	Double-spin pass; crossing for passer A, straight for passer B
a	Trelf	Triple-spin self

The number sequence describes the infinitely-repeating alternating actions of two passers; the first digit is the first action of passer A, the second digit is the first action of passer B, the third digit is the second action of passer A, and so forth. A common and helpful way to think of (and write) siteswaps is to repeat a siteswap twice and alternate the numbers between two rows. Now we can read the actions of each passer in separate rows – for example, seeing that passer A starts with the sequence 7-8-4-5-6 (single-heff-flip-zap-self) in the siteswap 75864:



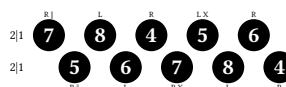
Note how both passers do the same sequence of throws in the same order, but start in different places of the sequence.

What about other numbers? The numbers 1 and 3 are conceptually passes that are not used in popular patterns, because it would be difficult to impossible to pass fast enough. The number 0 for an empty hand can be used, but most people avoid such patterns, simply because having an empty hand for a beat is awkward. Higher numbers are possible – for example, *b* for a triple pass – but less common.

Starting a pattern

Passer A always starts the pattern with a right-hand action (the first digit of the siteswap) and passer B always follows *slightly afterward* with a right-hand action (the second digit of the siteswap). Technically, passer B should start between passer A's first and second action; in practice most patterns are fairly forgiving to fudge the timing a bit.

It is possible to start a siteswap on any beat of the sequence, or conversely to shift siteswaps – for example, 786 is the same pattern as 867 and 678. Here, we write all featured siteswaps as they would usually be started and we indicate how many clubs are in each hand (read “right|left”) – see the theory section for how to select a start and figure out clubs or use an online tool like passist.org). We additionally include hints about which hand does the action for the initial throws (R and L for right and left), whether to throw a pass straight (|) or crossing (X), and how many clubs are in each hand at the start ():



10. Beginner four-handed siteswaps

Prerequisites: 5-club one-count and four-handed siteswap notation | **Helpful:** 6-club one-count and bookends | **Next:** Add doubles, heffs, or zaps

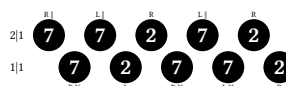
5-club one-count (744 and 726). Note how 5-club one-count (from learn to pass) is actually the four-handed siteswap 744



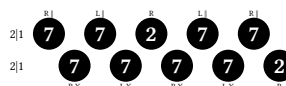
When you get more comfortable with the pattern, try flipping the 4s or throw self-zip instead:



Parsnip (77722). Another good beginner pattern is *parsnip*. Notice that we often automatically do zips without noticing them; it might be easier to focus on the passes, of which there will always be three from the same hand, before changing sides.

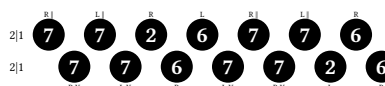


Martin's one-count (77772). If you are comfortable with *parsnip*, add a club, resulting in 4 passes and a (fairly automatic) zip.

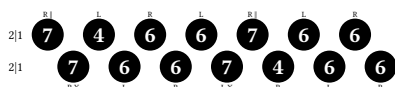


7-club one-count (7). Now add another club and leave out the zips. Especially the crossing singles should be lofty. If you drop a club, continue in 77772 if you drop another one, continue in 77722 or 77272.

Mild madness (7777266). A well-known juggling pattern, often juggled synchronously with fudged timing, makes a nice easy sideswap with selfs.



Jim's three-count, async (7746666). A four-handed siteswap version of *Jim's three-count* (see Jim's patterns) without a hurry. Notice the extra time for a flip after every second pass from the asynchronous nature of four-handed siteswaps. (There are siteswap versions for all Jim's patterns.)

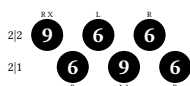


Other similar patterns to try. 77272, 774, *Jim's two-count* (77466), 7742744, 7747746

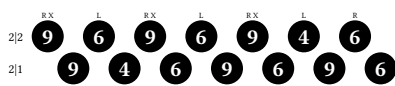
11. Doubles

Prerequisite: *Beginner four-handed siteswaps* | **Helpful:** *Synchronous 7-club and 8-club patterns* | **Next:** *Add heffs or zaps*

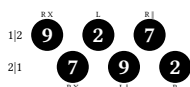
7-club three-count (966). A good pattern to practice doubles. Provide feedback about incoming doubles (e.g., over/under-spun, short/long, high/low, wide/narrow). As the pattern gets more stable, try to look down to see your passes land.



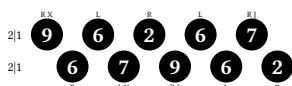
7-club Jim's two-count (9964966).



972. A great pattern to combine singles and doubles, one of them crossing, so both thrown to the same hand ("stacks"). Note: Passer A starts with one club in the right hand and two in the left.



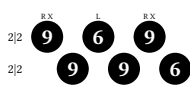
Not likely (96672). Doubles in period-5 patterns can be tricky; make sure they are lofty and use the self-zip-self to stabilize.



Funky bookends friend (96677). Harder version of *not likely*, keep the double high.



8-club pass-pass-self (996). A great introduction to ambidextrous 8 clubs.



Other similar patterns to try. *Maybe not* (96627), *Odnom* (9647772), *Placebo* (9669667), *Moscow Mule* (9797926)

12. Heffs

Prerequisites: *Beginner four-handed siteswaps and notation* | **Next:** *Add doubles, zaps, trelfs, or introduce takeouts*

Why not (78627). *Why not* is probably the first pattern with heffs for most passers. It is a widely known 6-club pattern, with

lots of videos⁴ and good video tutorials.⁵ Many passers fudge the timing with a fast zip (like in Jim's patterns) and juggle it synchronously. The most common and easiest to learn start is to have passer B start with two clubs and react to the first pass with heff-zip-pass-self-pass.



There is also a 5-club version (78622) and the similar pattern *not why* (72867).

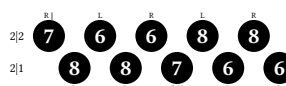
French three-count (786). A very common 7-club pattern and a great foundation for many harder siteswaps.



Funky bookends (77786). Another common, well-known pattern.

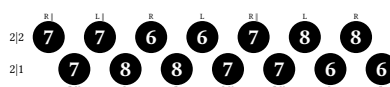


Five-count popcorn with heffs (78686). While the original popcorn patterns arguably have trelfs in them, this is a common easier version.



Notice that *French three-count* (786), *five-count popcorn* (78686), and *seven-count popcorn* (7868686) all follow a common idea.

Vitoria (7778686). Essentially a combination of funky bookends and popcorn, named after the city Vitoria-Gasteiz where EJC was held in 2009.



Other similar patterns to try. *not why* (72867), *maybe* (72786), *Mojito* (8677777), *seven-count popcorn* (7868686), *seven-count popcorn variation* (7888882).

13. Zaps

Prerequisites: *Beginner four-handed siteswaps and notation* | **Next:** *Add doubles, heffs, or trelfs, or introduce takeouts*

Zaps are low, fast passes that only spin half a rotation. They open a whole new group of interesting patterns. Look at a video⁶ or an animation⁷ for examples. They are usually thrown with an extended arm, letting the club slide down to the knob, without any spin from the wrist, aiming quite a bit behind the person catching the zap. Most of these patterns do not have commonly used names and are simply known by their numbers.

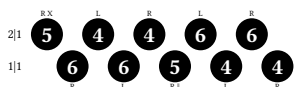
Getting started with zaps (56464). This is a great warmup pattern to learn and practice zaps. Hold the 4s and think of it as *self-self-zap-wait-wait*, starting with the *self-self* when it is necessary to free a hand to catch the zap. The zap is always the same club and there is plenty of time to watch the throw.

⁴https://www.youtube.com/results?search_query=why+not+club+passing+ija

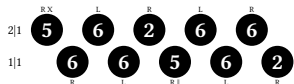
⁵<https://www.youtube.com/watch?v=6GKvM23fexE>

⁶<https://www.youtube.com/watch?v=fXyLoK-KhxQ>

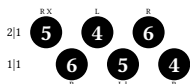
⁷<https://passist.org/siteswap/564?jugglers=2>



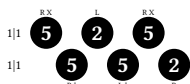
Once this is stable, replace the *wait-wait* with a *self-zip* (56662) to make it feel like an actual juggling pattern. Throw the self from the hand that did *not* just throw the zap.



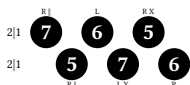
Killer bunny (564). The next good practice pattern is shorter and slightly more challenging – think of it as *self-zap-hold* or *self-zap-flip*. Once the pattern is more stable, flipping rather than holding the club will help with timing.



552, 522, and 5. Nice warm-up patterns to lean into zaps with 4, 3, and 5 clubs. In 522, try doing one of the zips behind the back. 5 is simply a very fast one-count with 5 clubs.



756. This is a well-known 6-club pattern and a great milestone in combining zaps and singles. Each passer throws a zap and then a single (a “stack”) to the *same* hand (crossing one of the passes), and then, after a self, a zap and a single to the other hand. Ensure the zaps are fast and the singles are lofty.



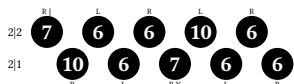
Other patterns to try. 56252, 75666, Katzi (75724), Funky magazine rack (55564), 75625.

14. Trelfs

Prerequisites: Beginner four-handed siteswaps and notation | **Next:** Add doubles and heffs and look for combinations among common named patterns

Trelfs are triple selfs, introducing the artificial term to distinguish them from triple passes. They are common in solo juggling, for example, the solo siteswap 543 with single, double, and triple spins is a good solo practice pattern.

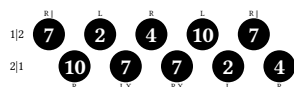
Five-count popcorn (7a666). A well-known, popular 7-club pattern. Some might find it easier to first throw *trelf-self* as a trick instead of *heff-heff* in 78686 (see heffs). Note that the trelf is always the same club.



a77. This 8-club pattern is substantially harder since there are two trelfs in the air at any time.



A decent warmup pattern is 7a274:



Other patterns to try. 74a, 7a2a6 (popcorn variation), aa7 (9-club three-count).

15. Advanced patterns

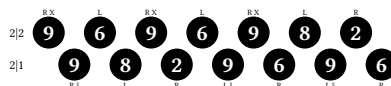
Prerequisites: Beginner four-handed siteswaps, notation, doubles, zaps, and heffs | **Next:** Holy grail sequence, compatible siteswaps, and the full siteswap list

Once comfortable with basic siteswaps and multiple additional kinds of throws, like zaps, heffs, doubles, and trelfs, there is a whole world of siteswaps that combine these. The following is far from comprehensive but highlights common popular patterns, many with names:

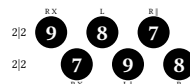
Heffs and Doubles

There are lots and lots of 7 and 8-club patterns that include plenty of heffs and doubles in all kinds of sequences.

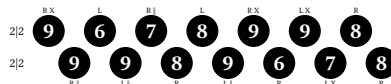
7-club why not (9968926).



978. Warm up with the 6-club pattern 972 (see doubles).



Poem (9969788). A challenging, well-known 8-club pattern.

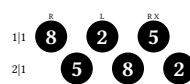
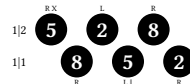


Other patterns to try. *The One to Concentrate* (97428), *Aspirin* (9667867), *Good morning* (9792688), 8-club *Vitoria* (9797888)

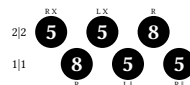
Zaps and Heffs

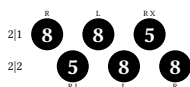
Many patterns combining zaps and heffs require very stable heffs that can be caught almost blind, which will probably take a bit of practice.

582 and 852. Two nice and beginner-friendly 5-club patterns. 582 feels familiar from *why not* and 852 is substantially more challenging because it requires catching a zap under a heff.



585 and 858. More challenging 6 and 7 club patterns that require precise zaps and stable heffs. Most passers prefer straight zaps wide (to throw heffs inside) and crossing zaps narrow (to throw heffs outside), but check with your partner.



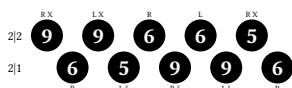


52585 and 57585. A nice introduction to longer sequences and combining zaps, heffs, and also singles.

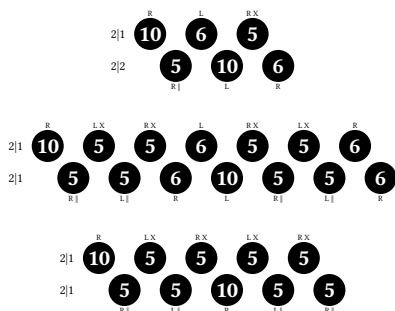


Zaps with Doubles or Trelfs

96956. Combining zaps and doubles usually requires fast zaps and slow doubles.



a56 to a555. Combining zaps with trelfs makes for rather challenging patterns, requiring very reliable trelfs. Especially a5555 has very limited time to look up – here, a555566 is a decent warmup pattern with the self in a strategic location.



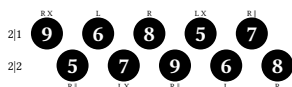
Other patterns to try. 89562 and see holy grail patterns for more tricky combinations of zaps and doubles.

Sequences

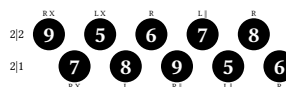
There are a large number of patterns that consist of a sequence of increasing numbers including all kinds of throws: for example, 456, 567, 789, 45678, 56789, 6789a, 456789a, and 56789ab. Those all make valid siteswaps that all tend to stack passes and selfs. They are usually interesting to pass, because they combine so many different throws.

For each siteswap sequence of 5 consecutive numbers, there are actually two additional permutations that make valid siteswaps too: one where each passer passes the sequence counting up (locally) and one where they pass the sequence (locally) counting down; for longer periods there are even more permutations.

95678. The sequence 56789 is probably the best-known sequence pattern. This 7-club pattern produces a large stack: a sequence of zap, single, and double pass, all to the same hand – as in holy grail.



The permutations are 97586 (each passer counting up) and 96857 (each passer counting down):

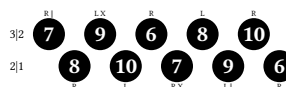


Suicide bunny (56784). This 6-club sequence from 4 to 8 is challenging at first, but usually more for remembering the many different throws than for the actual physical difficulty.



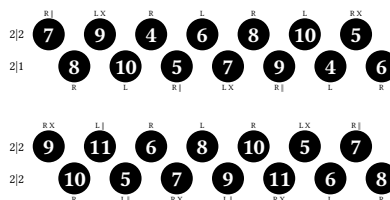
The permutations are 75864 and 57468.

789a6. This 8-club pattern from 6 to a combines a stack with the common solo siteswap 345.



The permutations are 97a86 and a7968.

789a456 and 9ab5678. These long sequences, with 7 clubs from 4 to a or with 8 clubs from 5 to b, make the stacking really noticeable.



Both have permutations following the same recipe (each passer counting up or down) and several more, too many to list here.

16. Holy grail sequence

Prerequisites: Beginner four-handed siteswaps, doubles, and zaps | Next: Advanced patterns and takeouts in 4-handed siteswaps

Holy grail (975). Holy grail is a difficult 7-club one-count pattern that combines zaps, singles, and doubles. What makes this pattern particularly challenging to learn is a double-zap combination, known as dragon (“the dragon to slay on the way to the holy grail”), where the double is thrown first, but the zap arrives first – that is, to catch a dragon, you cannot look up for the incoming double until catching the zap. While it was considered nearly impossible 15 years ago and only few people could run a few cycles, there are now quite a few people who have a stable pattern.

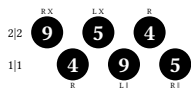


Warm-up. Holy grail requires solid zaps, singles, and doubles.

For zaps, it is useful to try the various easier zap patterns until zaps feel comfortable, even under stress. Then, the pattern 756 is a great warm-up pattern for every holy grail session.

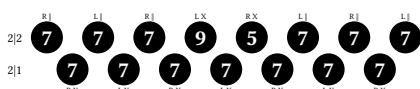
The double is probably the most difficult throw in holy grail. 7-club three-count (966) and 972 (see doubles) are good warm-up patterns. Provide detailed feedback on all double passes to your partner (length, spin, height) and practice looking down to see the passes landing in 7-club three-count to calibrate without feedback.

Finally, the most important warm-up pattern is *945*, to dial in the dragons (just hold the 4 without a flip). Again, focus on giving good feedback on the doubles or watching your own double throws land (which is rather difficult). This pattern is hard, nearly as hard as *holy grail*, and not a good pattern to learn dragons. Use it as a warm-up pattern or come back to this if *holy grail* is unstable. From this one to *holy grail*, use the same start but passer B adds a club for the additional single pass.

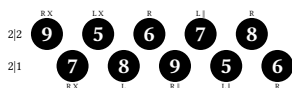
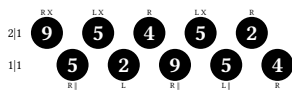
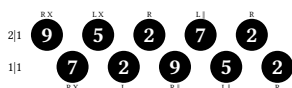


Learning dragons. Practice dragons first with only two clubs: Passer A throws double-zap (both crossing), the other tries to catch it, and then throws it back (both straight). Vary hands occasionally.

A next step is often to throw a dragon as a trick in *7-club one-count*, something like:



There are several siteswaps that include dragons that are likely easier than *945*. Nice examples are the 5-club patterns *Dragonfly* (97522) and *Dragoncat* (95524), the 6-club pattern *Hidden dragon* (7772955), and the 7-club permuted sequence pattern *97586*.



Tips for learning holy grail. This pattern is hard, but possible. Keep practicing.

- Zaps and singles should be fairly automatic and clean. Practice *756* until it is fully automatic and very stable. Try to intentionally throw bad passes in *756* and try to recover.
- The throw most likely to break the pattern is the double. Focus on clean doubles. Warm up with *966*, *972*, and *945*, and go back to those patterns if doubles are rough in *holy grail*.
- Practice *945*. Every single time. This is the most important practice pattern for *holy grail*. *97522* and other dragon patterns can be good practice to learn dragons initially, but are less useful when actually working on *holy grail* (they introduce their own challenges with doubles in period 5 patterns that are not important for mastering *holy grail* see improve your siteswap passing).
- Throw double-zap in quick succession and throw fast zaps to make the dragons easier to catch. It may help to gallop the entire pattern a bit by throwing double-zap-single fast and then waiting a moment before throwing the next double-zap-single round.
- Communicate. It is difficult to see how throws land. Provide feedback about poor throws, especially doubles.

- As passer A, throw the crossing zaps narrow; as passer B, throw the straight zaps wide. This avoids collisions and gives the other passer space to throw good double passes. Other collision problems are often a sign of too short passes.
- Both sides of *holy grail* (passer A and passer B) feel quite different. If you have a stable practice partner, it might be worth learning the pattern on one side first to identify and fix problems.
- Slow down and throw lofty passes (except the zaps). Breathe.

17. Compatible Siteswaps

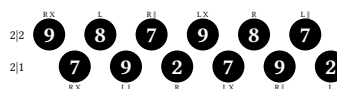
Prerequisites: *Beginner four-handed siteswaps and notation*

In four-handed siteswaps, usually both passers juggle the same sequence, just offset from each other. However, this is not necessary – just like there are many synchronous passing patterns that match different patterns, such as throwing an early double (see basic synchronous patterns).

Matching an easier and a harder four-handed siteswap allows passers with different skills to both juggle interesting patterns. A good example is matching the easy *5-club one-count* (744) with the harder 7-club pattern *French three-count* (786):



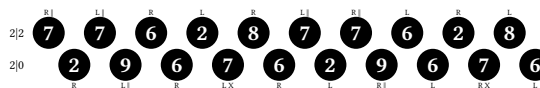
Matching compatible siteswaps also helps to stabilize passes for a passing partner when learning hard patterns. A common example is learning the 8-club pattern *978*, where one passer at a time can drop a club to switch to *972*, which usually provides them with much more room to recover and still provide good passes.



Theory: What makes two siteswaps compatible?

Two patterns are compatible if they have the same length and the same sequence of *catching* passes and non-passes. The sequence of catching passes and non-passes is the *interface*. For example, *744* and *786* both require catching one pass followed by two non-passes (interface *pxx*), and *972* and *978* require catching two passes followed by one non-pass (interface *ppx*).

Importantly, it does not matter when clubs are thrown, but when they land, since it only matters whether an incoming club comes from another passer or oneself. For example, in *maybe* (72786), the passer throws two consecutive singles, but in *maybe not* (96627), the passer throws a double and a single pass apart – nevertheless, in both cases the passes arrive on consecutive beats, so they are compatible with the interface *ppxxx*.



Note that *ppxxx*, *xppxx*, *xxppx*, and so forth are all the same interface, simply by shifting where to start each siteswap.

Unfortunately, figuring out the interface of a siteswap is nontrivial and often requires pen and paper (see theory) – or simply look it up with a tool like passist.org. Many standard siteswap transformations preserve the interface. Figuring out how to start is also not always obvious and may require some trial and error or scribbling of causal diagrams (see siteswap theory).

Compatible Common Patterns

Here is a table with the compatibility of some common period 1, 3, and 5 siteswaps – all patterns in the same row are compatible:

Interface	4 and 5 club patterns	6 and 7 club patterns	8 and 9 club patterns
pxx	5-club one-count (744), 726, 564, 582, 528	French three-count (786), 7-club three-count (966), 588, 56a	a89, a7a
ppx	552	756, 774, 558, 945, 972	996, a77
ppp	555	777, holy grail (975)	999
pxxxx	5-club why not (78622), 56464	five-count (78686, 7a666)	aaa69, aaaa5
ppxxx	72722	maybe (72786), maybe not (79662), 747a2	969a6
pxpxx	inverted parsnip (72227)	Jim's two-count (77466), why not (77862), not why (77286), not likely (96672), suicide bunny (56784)	789a6
pppxx	Kaatzi (75724), Dragon cat (95524)	99692, 96956, 96857	
pppxx	Parsnip (77722), funky magazin rack (55564), Dragonfly (97522)	Funky bookends (77786), funky bookends friend (77966), 95678, 97586	999a8
ppppx		Martin's one-count (77772), 75756, 57585, a5555	97978

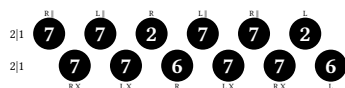
Even-length siteswaps

In siteswaps of an even length, both passers perform their own sequence. The most common example of this is *8-club one-count on singles versus doubles*, which is simply the siteswap *97*:

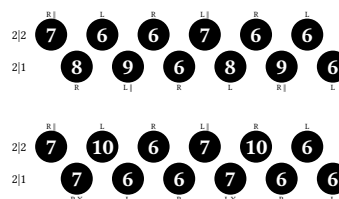


All combinations of two odd-length siteswaps, discussed above, turn into even-length siteswaps. For example, the combination of *maybe* (72786) and *maybe not* (96627) turns into the siteswap *7279662786*, as visible in the diagram above. Since it is interleaving the *local* actions of each passer and requires finding the right start, doing this combination manually is nontrivial.

More interestingly, even-length siteswaps open possibilities for combining two sequences that are *not* a valid four-handed siteswap on their own. A typical example is *777726*, where the passers throw pass-pass-zip (very good for beginners after one-counts) versus pass-pass-self:



Such patterns are fairly uncommon in the passing community right now, but there is a large space of possible patterns to explore. This includes the possibility of finding patterns that work against pass-self-self and thus feel like traditional 6-club three-count on one side, such as *786966* and *77a666*:



To find more patterns, use any siteswap generator (such as passist.org)⁸ to generate patterns with an even length and exclude any patterns with 1s or 3s.

Hijacking / Programming

TODO

7->77772->77722

77[s,h,7...]

common combination

18. Improve your siteswaps

Prerequisites: Beginner four-handed siteswaps, notation, and doubles | **Helpful:** Improve your passing

This is a collection of advice for common problems in four-handed siteswaps.

Slow down. The single pass in four-handed siteswaps should be slow and lofty. In particular, the crossing single should be high enough that the partner can comfortably pass below the incoming passes. Return to *5-club one-count* (744 or 726) to calibrate singles or practice with increasingly fewer zips from *Parsnip* (77722) to *Martin's one-count* (77772) to *7-club one-count* (7).

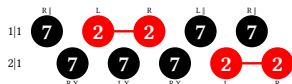
Request feedback. Most passers are not good about giving feedback, and it often gets worse as they get better and can catch more poor passes. Explicitly request feedback, possibly direct feedback on every pass while juggling the pattern.

Watch your passes land. Conversely, aim to rely less on feedback by watching your passes land where possible. This will not work for all patterns, but for many. For example, set it as a goal to watch doubles land in siteswaps of length 3 (e.g., *966*, *972*) – this is challenging but eventually possible when the incoming passes are decent.

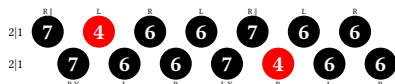
When learning a siteswap, switch starts. When it is difficult to get a full round of a pattern, it often helps to have both passers start with the same throws but start left-handed. This allows them to practice the second side of the pattern and come afterward to the already-practiced first side.

Make zips and flips a full beat. Zips often happen very fast and automatically. Many passers may not even notice that they are doing them, which can make a pattern like *Parsnip* (77722) tricky to learn. Passers who have learned *why not* (78627) and *Jim's two-count* (74667) as synchronous patterns are used to very quick zips. Since zips are so fast, they are often used to fudge the timing, which on the one hand can help make patterns like *972* much more forgiving, but on the other hand can also screw up the timing of a pattern. Try to make zips a full beat; to force this, try to hand the zip behind the back. In particular, patterns with two consecutive zips, like *77272* and *522*, can be fun by handing one zip in the back and the other in the front.

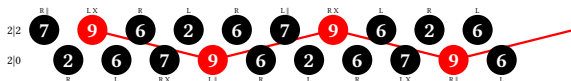
⁸<https://passist.org/siteswap-generator>



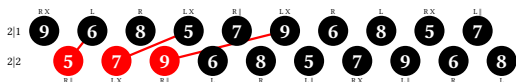
Similarly, patterns with 4s are easier to juggle in a consistent rhythm if the club is flipped rather than just held. For example, actually flip the club in the pause of *Jim's three-count* (774666) to juggle the pattern as a fully asynchronous siteswap rather than a (nearly) synchronous pattern with hurries.



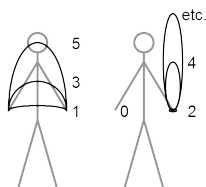
Focus on doubles in siteswaps of length 5. Double passes in siteswaps with 5 beats can be challenging. Those double passes force each other – that is, each double pass gets thrown under an incoming double pass to free the hand for that incoming pass. If a double pass is too low or too fast, the pattern can quickly degrade, because the receiving passer has little time to throw a good double pass. The best strategy to rescue the pattern from falling apart is to respond to a low double pass with an extra-high one. *Not likely* (72966, see doubles) is a good pattern to practice recovery (it is extra forgiving with the zip) – intentionally throw low doubles occasionally and try to recover.



Separate passes in stacks. Many patterns throw multiple consecutive passes to the same hand, such as zap and single in 756, single and double in 972, and zap, single, and double in 95678 (and other sequences). Separate those passes clearly in height, which means fast zaps, lofty singles (substantially higher than in synchronous patterns), and lofty doubles. At the same time, make sure that all passes of a stack land in roughly the same location and can be caught at the same height.



19. A bit of siteswap theory and lore



Visualization of traditional solo siteswap throws by Hyacinth⁹

Siteswap basics

Siteswap notation dates back to the 1980s. It describes a sequence of throws with numbers, where each number represents how many beats later a thrown object will be thrown again. For example, a 4 describes that the object thrown now will be thrown again four beats later after three other throws. Traditional siteswaps assume a single juggler with two hands who alternates throws from both hands, so a siteswap 441 would be read as a right-handed 4 throw, followed by a left-handed 4 throw, followed by a right-handed 1 throw, then repeating on the other side. As a consequence, any odd-numbered throw crosses from one hand to the other (i.e., it gets rethrown an odd number of beats later when

it is the other hand's turn) and all even-numbered throws return to the same hand.

N-handed siteswaps

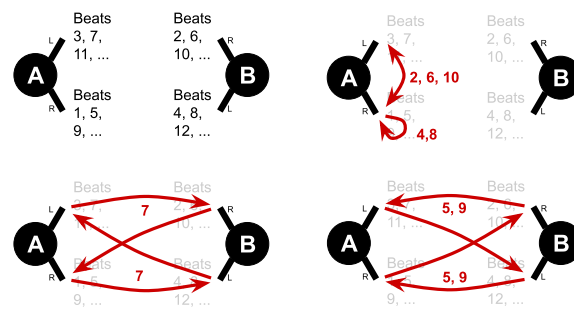
Nothing in the siteswap notation or theory requires juggling with two hands. Siteswaps merely describe after how many beats an object is thrown again, and based on which hand's turn it is on that beat, we figure out where we need to throw the object. Patterns can be juggled with 1 hand, 3 hands, or 16 hands; we do not even need to assume that the hands always alternate.

Four-handed siteswaps are one way to interpret siteswaps for two passers with four hands total: We assume two passers facing each other with passer A throwing with the right hand on beat 1, passer B throwing with the right hand on beat 2, passer A throwing with the left hand on beat 3, and passer B throwing with the left hand on beat 4, before it all repeats on beats 5, 6, 7, and 8 – as shown in the diagram below. That is, all odd beats are thrown by passer A and all even beats by passer B.

From this, all the standard throws in four-handed siteswaps can be derived:

- A 4 (flip) gets rethrown four beats later from the same hand, but there is only a single beat from the same passer before then. An 8 (heff) gets rethrown eight beats later from the same hand, while that same hand has another throw before then, four beats later.
- A 6 (self) gets rethrown six beats later from the passer's other hand, a 2 (zip) two beats later with the passer's next throw, and an a (trell) gets rethrown 10 beats later.
- A 7 (single pass) gets rethrown seven beats later by the other passer. The straight/crossing passes approach where passer A throws straight single passes and passer B throws crossing single passes follows directly from the hand sequence: A right-hand single pass from passer A on beat one gets rethrown on beat 8, which is a left-hand throw from passer B, whereas a right-hand single pass from passer B on beat 2 is rethrown on beat 9 which is a right-hand throw from passer A.
- A 5 (zap) and 9 (double pass) are crossing for passer A and straight for passer B, following the same mechanism.
- A 1 would be a very, very fast pass (faster than a zip) that gets immediately rethrown on the next beat by the other passer; there is no plausible way of juggling this. A 3 is a very fast pass, which is technically feasible if slowing everything down a lot, but not commonly juggled. Hence, lists of four-handed siteswaps generally exclude patterns with 1s and 3s.

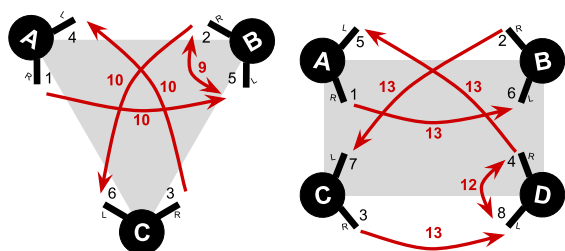
Assuming that both passers juggle at a normal speed, all numbers are twice as high as in solo (two-handed) siteswaps, as we have twice the number of beats in the same time.



The same way we define a four-hand sequence for two passers, we can define a six-hand sequence for three passers, an eight-hand sequence for four passers, and so forth. We now have much higher numbers, as there are even more beats in the same amount of time. In the following, we illustrate the hand sequence and the throws that represent selfs and single passes. For example, as a

⁹https://commons.wikimedia.org/wiki/File:Siteswap_relative_visualized.png

start, try the 6-handed siteswaps *a899* and *aa79* or the 8-handed siteswap *fcc* (“three-count friction”).



Transforming siteswaps

There are a number of common transformations that can be used to transform a pattern into other patterns.

Adding/removing clubs. It is possible to add the length of the siteswap to any individual throw to get a pattern with one more object. For example, the 6-club pattern *972* of length 3 can be transformed into the 7-club pattern *975* (*holy grail*) by adding 3 to the last throw, and then be transformed into the 8-club pattern *978* by adding 3 to that throw again, which can then be transformed into the 9-club pattern *9a8* by adding 3 to the second throw. Conversely, removing the length of the pattern from any throw yields a pattern with one club less, such as transforming the 6-club pattern *972* into the 5-club patterns *672* (*5-club one-count*) or *942*.

This transformation is useful in many passing patterns to make them incrementally harder (or easier) without changing the pattern otherwise. In siteswaps of length 3, all zips can be turned into zaps, all zaps can be turned into heffs, all flips into singles, all singles into trelfs, and all selfs into doubles – and vice versa. In siteswaps of length 5, all zips can be turned into singles (e.g., *77722* to *77772* and *52585* to *87585*), and, in siteswaps of length 7, all zips can be turned into doubles.

It is also possible to add 1 to every throw to add a club to the pattern, for example, turning the 6-club pattern *45678* into the 7-club pattern *56789* and turning *77786* (*funky bookends*) into *88897*. However, this usually changes the character of the pattern substantially.

Swapping throws. Siteswaps get their name from a manipulation that *swaps* the landing places of two throw *sites*. Any two throws in a pattern can be changed such that the first throw lands where the second would have landed and the second lands where the first would have landed. This is the logic behind *early doubles*: Throw a higher pass earlier to where the normal pass would have landed and then make up for it with a lower throw later instead of the original pass – the two throws have swapped their landing sites. Generally, two throws *x* and *y* that are *n* beats apart can swap into *y+n* and *x-n* – for example, transforming solo siteswap *441* into *531* and *531* into *333*.

This transformation is commonly useful in four-handed siteswaps to think of compatible variations of a pattern, such as early doubles or extra trelfs, either as a one-time trick throw or as a different pattern. In practice, we are usually interested in transformations from the perspective of one passer, thus transforming two consecutive throws of one passer, which are two beats apart in the siteswap. For example, we can turn the local sequence single-single into double-zap (e.g., *77722* to *97522*) or heff-pass into double-self (e.g., *77867* to *77966*).

Repeating and shifting the pattern. It is probably obvious at this point, but *7*, *77*, and *777* are effectively the same pattern, as are *786* and *786786*. Also, *786*, *867*, and *678* are the same pattern,

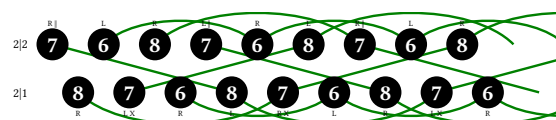
just shifting the start. In lists, siteswaps are usually normalized – without repetitions and starting with the highest throw – rather than selected for a convenient start.

To create compatible siteswaps, it is useful to repeat an odd-length siteswap twice and then manipulate the resulting even-length siteswap with another transformation. For example, *786786* can be transformed by swapping the landings of 4 and 6, resulting in *786885*, that is, creating the compatible siteswaps *786* and *858*.

Diagrams

Several diagrams are common to depict siteswaps, usually developed for solo siteswaps. For example, just like we illustrate passer A and passer B on separate lines, in a solo siteswap a diagram may show the alternating actions of the right and left hand in two lines.

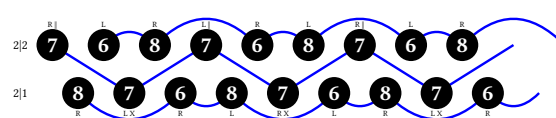
Moreover, there are two common ways of showing the throws in a pattern as lines: ladder diagrams and causal diagrams. In a *ladder diagram*, a line illustrates the path of an object from where it is thrown to where it is thrown again next. This is a ladder diagram for *French three-count* (*786*):



In such a diagram, we can observe the path that a club takes, for example, that the self in *786* is always the same club and that all heffs turn into passes.

Note that a throw lands quite a bit before it gets thrown again. It lands somewhere between the beat it is thrown again and the previous action of the same hand happening 4 beats earlier in a four-handed siteswap. This previous action is necessary to empty the hand to catch the incoming throw – we say that that action was *caused* by the incoming throw.

A *causal diagram* illustrates how throws cause the passer to do other actions to empty their hands, that is, they illustrate which throw triggers which other throw rather than illustrating the path of individual objects. This is the causal diagram for the same pattern *French three-count* (*786*):



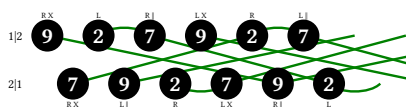
We can see that we always throw a single pass to catch an incoming single pass (i.e., 7 causes 7), and we always throw a self to catch a heff (8 causes 6) and vice versa. The fact that singles cause singles in patterns of length 3 (and doubles cause doubles in patterns of length 5) is why these patterns easily fall apart when those passes are too low and fast (see *Improve your siteswap passing*).

In the passing community, ladder diagrams are rarely used other than for determining starts and color coding (see below), but causal diagrams are more common, especially for reasoning about takeouts.

How to start a pattern

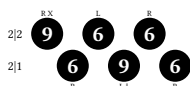
Determining starting hands. In a ladder diagram, it is very easy to see which hand starts with how many clubs, simply by counting the beats in the beginning without incoming lines. In the ladder diagram for *French three-count* diagram above, we can see that passer A throws four throws (two right and two left handed) before throwing the first caught club (a self) and passer B throws three throws before rethrowing a caught club.

This also works for less intuitive starts like the start of 972, where we can see that passer A has only one right-handed throw without an incoming club but two left-handed throws:



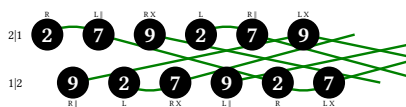
Similarly, we can count the hand without incoming lines in a causal diagram and add one club to each hand (one less if the very first action is a zip).

Avoid skipping initial beats. Some common patterns are often taught with starts that skip the first beat for the second passer. For example, it is common to start 7-club three-count with a right-handed straight double, and for the other passer to start “as late as possible” with a right-handed crossing double, which should be *three beats later*. This works but requires practicing a new timing. We argue it is better to start all four-handed siteswaps one beat apart, that is, passer A should start with a crossing double from the right hand and passer B should start just afterward with a self from the right hand, followed by a straight double from the left hand as clearly indicated by the notation:



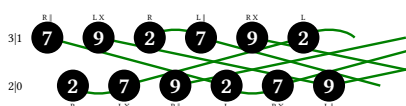
Selecting a beat to start. Since siteswaps can be shifted, it is possible to start on every beat. There is no single right way to start a siteswap, but some starts are usually better than others.

We usually do not consider starts where a club would need to be caught with a non-empty hand, such as the first throw of starting 972 on the 2:



Beyond that, we usually prefer starts where (1) the first throw of passer A is a pass, (2) the first throw of passer B is a pass, (3) the number of starting clubs is the same in both hands or the right hand has one more club, and (4) the number of starting clubs is relatively balanced between the passers.

It is not always possible to satisfy all four preferences. For example, among the two remaining starts of 972, both violate at least one preference: Starting with the double requires passer A to start with two clubs in the left hand (violating preference 3). Starting with the single requires passer B to start with a non-pass, with two clubs in the right and an empty left hand (violating preferences 2 and 3). Despite not satisfying all preferences, the start with the double seems overall the better start.

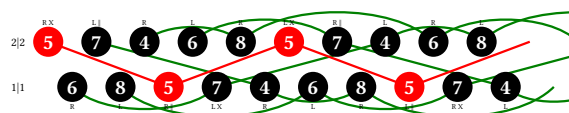


With a siteswap animator like passist.org it is easy to cycle through the various starts and pick a nice one.

Orbits and color coding

Following a pass in a ladder diagram identifies its orbit, that is, the sequence of throws until the club repeats the same path through the pattern. Clubs that always repeat only a single action are called magic and can be highlighted by using a club of a different color. Zaps and trelfs in siteswaps of length 5 are always

magic, and so are selfs and doubles in siteswaps of length 3 and singles in siteswaps of length 7.



Terminology

The passing community has now adopted a couple of terms that may not be broadly known among beginners or people who learned passing a long time ago. Some terms simply became popular and spread through the community.

A *heff* is not an abbreviation but was simply a random short term or a misheard version of the letter *f* for fountain, depending on who you ask. It has spread because “double self to the same hand” really needs a shorter alternative.

A *trelf* is a more recent attempt to disambiguate triple selfs from triple passes with a short term. It is not as broadly used, but I adopt it to have a distinct short word for all throws.

The *zap* was originally discovered when playing with the early passing animator JoePass!¹⁰ Based on the software’s name, they were sometimes called *joe passes*, but now the name zap is much more common.

In this book, I use *passer A* and *passer B* and assume that passer A starts and throws straight single passes and crossing zaps and doubles. This is arbitrary. When agreeing on a side, it is common to negotiate who is throwing straight and crossing passes. As a running gag, some in the community have adopted “*James*” as the name for the passer with straight singles and “*Not James*” as the name for the passer with crossing singles. Alternatively, some have suggested “*James*” and “*Jim’s*,” because the latter throws crossing singles as in *Jim’s three-count*.

¹⁰http://koelvention.de/w/?page_id=151

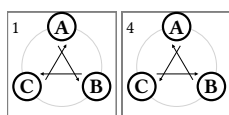
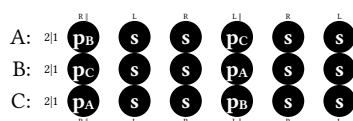
Group Patterns

20. Passing with 3+ People

There are many different ways to include more than two passers in a pattern. In this part, we will discuss both **static patterns**, in which multiple passers stand in specific locations such as in a triangle to exchange passes, and **moving patterns**, in which some or all passers change their positions during the pattern, usually while they continue to juggle and pass. In addition to static and moving patterns, in the next part, we will discuss another popular class of group patterns, **manipulator patterns** (also known as takeout patterns), in which one or more additional jugglers steal and replace clubs out of a static or moving pattern, often swapping places with those passers in the process. These group patterns can be learned in many orders, but static patterns are usually a good starting point before adding movement, manipulators, or both.

Notation. To describe a group pattern, we need two parts: (a) the actions of each passer over time and (b) the positions where the passers stand or move. The actions of each passer are usually described using the notation of synchronous patterns or four-handed siteswaps for two passers. Although it is not always needed, we add an index to the notation of all passes indicating which passer to pass to. The positions are usually shown with diagrams showing locations as seen with a bird's-eye view from above; for moving patterns, often multiple diagrams are used to show changing positions throughout the pattern.

Here is an example of three passers passing *three-count* in a triangle:

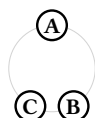


Keep group patterns small. Most group patterns are best with 3 or 4 passers, and there are some interesting patterns with 5 passers. Larger groups are usually better off by splitting into smaller separate groups. While it can be fun to pass with many people at the same time, and there are some patterns that scale to very large numbers of passers, it can be very difficult to keep even simple patterns going with large groups. In patterns with 10 or more passers, even with very good passers, somebody will drop fairly early, resulting in frequent stops and resets. Because it is so challenging to keep large group patterns going, large groups usually pick patterns that are not particularly challenging or interesting for each passer individually.

21. Feeds

Prerequisite: Basic synchronous passing patterns or compatible four-handed siteswaps | **Next:** Static group patterns, moving patterns, or takeouts

Feeds are a common and simple way to involve three or more passers. A passer acting as the *feeder* (A) will pass with multiple *feedees* (B, C, ...). Each feedee will only pass with the feeder, but not with other feedees.

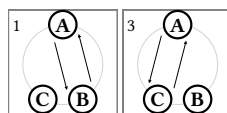
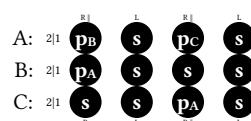


Feeders and feedees generally juggle different patterns that are compatible when merged together. Feeders usually have the more difficult job as they receive (possibly inconsistently thrown and inconsistently timed) passes from multiple feedees and need to aim their passes at multiple different positions. Unless the intention is to integrate weaker passers in easier positions, it is common to try a feed and then rotate positions clockwise until everybody has tried every position.

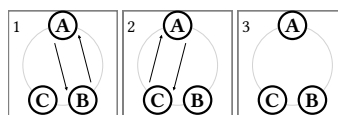
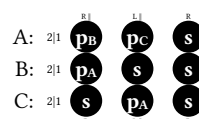
Synchronous feeds

The basic idea of a feed based on synchronous 6-club patterns is simple: The feeder juggles a repeating sequence of selfs and passes where different passes in the sequence may go to different feedees; the feedees each juggle selfs and passes so that they pass to the feeder on exactly those beats that the feeder passes to them.

Basic feeds. The traditional standard pattern is to feed two feedees on *6-club four-count* (starting two beats offset) with *6-club two-count* alternating between the two feedees:

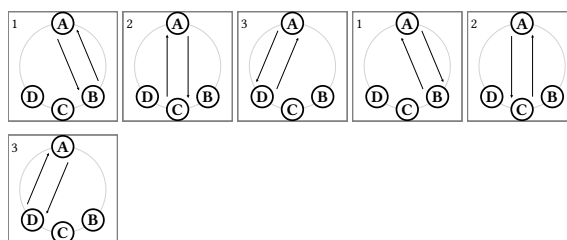
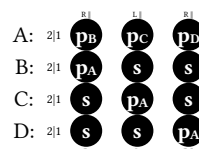


As usual, we instead recommend an ambidextrous pattern as a modern starting point: *6-club three-count* vs *6-club pass-pass-self*:



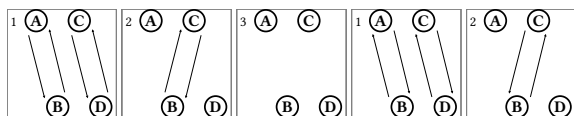
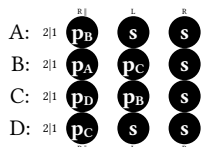
(From the feeder's perspective, it can be helpful to think *inside-inside-self-outside-outside-self* for the fact that the first pair of passes goes in between the two feedees and the second pair goes to the outside hands.)

For four passers, this can be easily extended to a feeder juggling *6-club one-count* and alternating passes to three feedees each juggling *6-club three-count*:

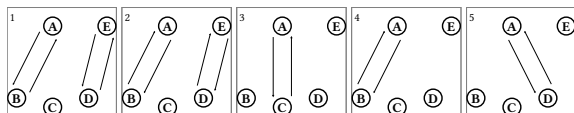
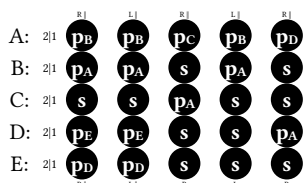


As another beginner-friendly feed, a feeder juggling *6-club one-count* can alternate passes to two feedees in *6-club two-count* – with one of them juggling left-handed two-count.

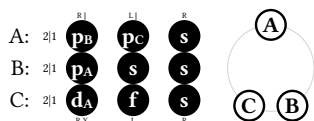
Chaining multiple feeds. To integrate more passers, it is possible to have more than one feeder in a pattern, producing N-shaped or W-shaped layouts. For example, here is a pattern with two feeders (B, C):



Getting creative. It is easily possible to come up with various different variations by deciding whether and to whom the feeders should pass on each beat. For example, a feeder juggling *6-club one-count* could pass to one feedee in *bookends* (*pass-pass-self-pass-self*) and to two more feedees in *five-count*. To further extend this, one of those feedees could act as a feeder themselves, feeding the first feeder in *five-count* and a fifth passer in *pass-pass-self-self-self*:

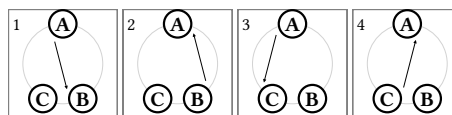
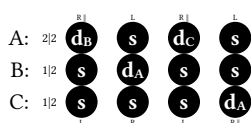


It is similarly possible to introduce (crossing) double passes as early doubles, either as a trick throw or continuously. For example:



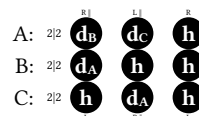
It is also possible to feed Jim's patterns, but we recommend treating them as four-handed siteswaps, see below.

Adding clubs to synchronous feeds. It is possible to add extra clubs to a feed. The most common traditional pattern is a feeder passing *7-club two-count* to two feedees passing *7-club four-count* on doubles:



(Note that, as for *7-club two-count*, rather than crossing all doubles, the feedees conventionally start left-handed or a beat late. The two feedees also each juggle a pattern that would not work with two passers, since they split the extra club between them.)

8-club pass-pass-self can also straightforwardly feed two feedees juggling *8-club three-count*:



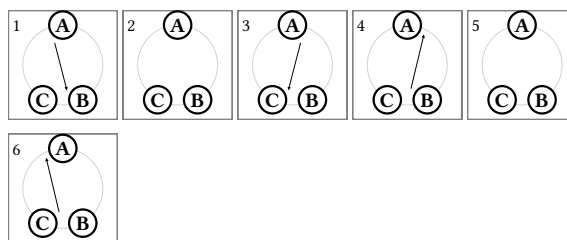
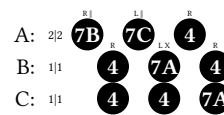
(As with *6-club* patterns above, any sequence of double passes to feedees and heffs can be combined to create more patterns.)

Beyond this, extra-club synchronous feeds become a bit obscure. Any *6-club* or *8-club pass-pass-self* pattern can feed any pair of two compatible *7-club three-count* patterns, and many additional strategies can be found to distribute one or two extra clubs across feeds with three or more passers. None of these are common, and we recommend exploring feeds with four-handed siteswaps instead.

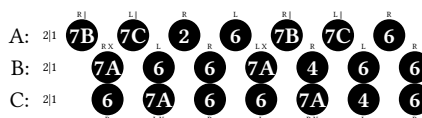
Feeding four-handed siteswaps

There are many common feeds of four-handed siteswaps and it is easy to create more. N-shaped and W-shaped patterns with more than one feeder are possible, but not common. Who throws straight and who throws crossing passes can be negotiated – usually the feeder gets to throw the (easier) straight passes and the feedees throw crossing passes (which can be harder as they may require extra wide angles to go all the way across the pattern).

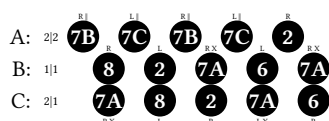
774 vs. 5-club one-count. To integrate beginners into a feed, it is possible for a more experienced passer to feed two passers in *5-club one-count* with *774* or three passers in *5-club one-count* with *7-club one-count*.



Mild madness vs. Jim's three-count. Many passers learning *Jim's three-count* then learn that it can be fed with *Martin's mildness* (*pass-pass-self-pass-pass-zip-self*). This works well when considering both of them as the four-handed siteswaps *7767746* and *7777266*:

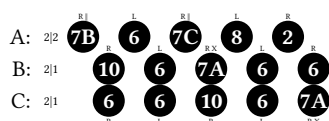


Martin's one-count vs. why not. For more experienced feedees, *Martin's one-count* (pass-pass-pass-pass-zip) feeding two passers passing why not (or the asynchronous Jim's two-count) is a good introduction to feeding with four-handed siteswaps. Having the feeder start with 5 clubs and the feedees wait for an incoming pass to trigger their heff is the easiest-to-remember start.



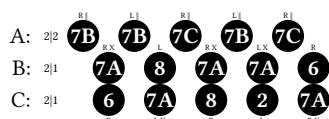
[TODO: change shown start]

Why not vs. five-count popcorn. This feed is roughly of similar difficulty for all passers; as usual, *five-count popcorn* can be juggled with either heffs or trelfs.

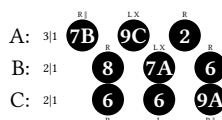


7-club one-count vs. funky bookends and why not.

Combining three different patterns, the feeder needs to remember the passing sequence B-B-C-B-C independent of whether throwing with the left or right hand.

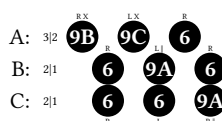


9/2 vs. 7-club three-count and French three-count. In this pattern, the feeder passes double passes with one feedee and single passes with the other.



(It is possible for the feeder to throw both singles and doubles as straight passes if both feedees cross their passes.)

8-club pass-pass-self vs. 7-club three-count. The siteswap 996 can naturally feed two feedees passing 966 for a total of 11 clubs.



For a challenge, add a club and have the feeder juggle *9-club one-count* (on doubles) against one feedee passing 996 and another passing 966. Or pass *9-club one-count* against three feedees each passing 966.

Creating custom siteswap feeds. With the theory of compatible siteswaps it is easy to create many more feeds. The key point is to arrange three or more patterns so that the combined interface of the feedees' patterns matches the interface of the feeder's pattern.

Generally the two feedees always throw at the same time, but they must not pass such that their passes arrive on the same beat. For example, two feedees can pass *why not* with the interface *pxpx*, but they must be offset from each other by one beat so that their combined interface toward the feeder is *pppx* – that is, either one of them will pass on every beat except the last. The feeder can pass any pattern that is compatible with the combined

interface of the feedees; in the example, any pattern with interface *pppx*, such as *Martin's one-count*, can feed two *why not* feedees. As another example from above, *funky bookends* has the interface *pppx* and can be combined with *why not's* interface *pxpx* when started two beats later for a combined interface of *pppx*, which is compatible with *7-club one-count* by the feeder. It is possible to combine patterns with throws of different heights and of very different difficulty levels as long as their interfaces can be combined. Following this principle, we can find many unusual feeds of common four-handed siteswaps, such as:

- *7-club one-count (ppp)* vs. *765 (ppx)* and *582 (pxx)*
- *parsnip* or *funky bookends (pppx)* vs. *Jim's two-count (async, 77466) (pxpxx)* and *five-count popcorn (pxxxx)*
- *945 (ppx)* vs. *French three-count (pxx)* and *5-club one-count (pxx)*
- *7-club one-count (ppp)* vs. *74a (pxx)* and *77a (ppx)*

As with all compatible siteswaps, identifying starts can be a bit tricky and may require pen and paper as described in the theory section. The total number of clubs needed for the feed is the sum of the clubs for each pattern divided by two, since each passer passes half of each siteswap. The following heuristic to figure out the start often works: Let the feeder start with their pattern with a convenient start and identify when each feedee will receive their first pass. Usually each feedee can identify how they usually would start their pattern in reaction to an incoming pass. For example, it is common to start *French three-count* with a heff on the beat after the first incoming single pass is thrown. If the first incoming pass is at a different height than usually expected in the feedee's pattern (e.g., an incoming zap instead of a single pass for a feedee's *French three-count*), this start would be adjusted correspondingly to start a beat earlier or later. In many cases, the second feedee may need to wait a beat or two for their first incoming pass; they can either wait for their usual start or backtrack and identify the throws before; the throw before might include a pass to the feeder. In many cases, it is possible to identify the start this way with only a few attempts to figure out what works; if it does not work, go back to the pen and paper method. See the patterns above for some examples of starts.

22. Static Group Patterns

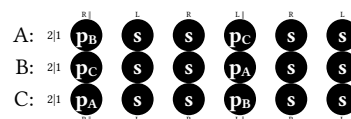
Prerequisite: Basic synchronous passing patterns | **Next:** Feeds, moving patterns, and takeouts

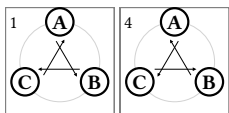
Beyond feeds, there are many static group patterns for different sizes of groups and different difficulty levels. We group them roughly by the number of passers and shape of the positions. Almost all of these patterns are based on the basic synchronous 6-club passing patterns. Most of these patterns are easy to medium difficulty.

Triangles (3 passers)

Triangle patterns are conceptually simple and versatile. In contrast to feeds, they are usually symmetric in that all passers juggle the same pattern.

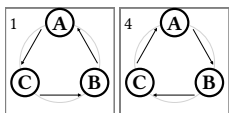
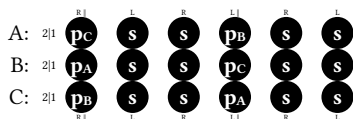
Three-count, insides. A good first pattern is to juggle *three-count* with *inside* throws, that is, right-handed passes go to the left hand of the passer on the left and left-handed passes to the right hand of the passer on the right. Everybody passes at the same time; count out loud if necessary to synchronize timing and avoid collisions.





Once this works, there are many more variations to explore that are interestingly different without drastically increasing difficulty.

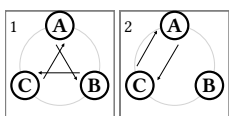
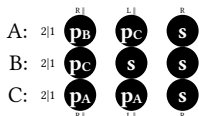
Three-count, outsides. Stay on the same *three-count* rhythm, but throw the passes *outside*, that is, right-handed passes go to the left hand of the passer on the right and left-handed passes to the right hand of the passer on the left. Outside throws tend to be less collision-prone but harder to watch due to a much wider angle – do not watch the outgoing club but look for the incoming one. Actively provide feedback about incoming passes and where you would like to receive them (usually slightly behind you), as other passers also will not see their passes land.



Three-count, outside-inside-inside-outside. Several further good variations come from exploring different sequences of inside and outside throws. For example, alternating outside and inside results in all clubs being thrown to the same person. The sequence *outside-inside-inside-outside* is interesting in that it passes to all four hands of the other two passers, from right to left.

Pass-pass-self and one-count. The same triangle idea also works for all other base patterns (including *four-count* if somebody insists). *Pass-pass-self* and *one-count* can be interesting challenges with different combinations of *inside* and *outside* throws. *Pass-pass-self* with *inside-inside-self-outside-outside-self* throws feels similar to pass-pass-self feeds. *One-count* with all *outside* passes is particularly challenging as it requires constant head movement to see incoming passes.

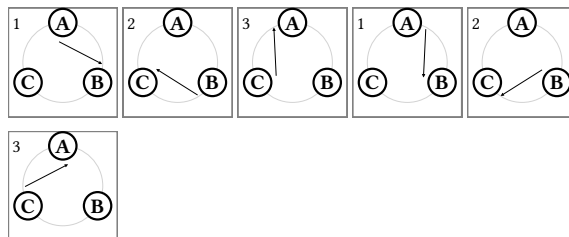
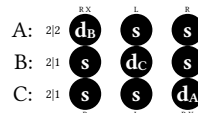
Getting creative. Similar to variations in a feed, it is possible to design many different passing sequences in a triangle. Essentially, the group needs to decide for each beat whether (a) everybody passes in a circle to the left or the right, (b) two passers exchange passes while the other does a self, or (c) everybody does a self. Here is a typical pattern where on beat one each passer passes to the right, on beat two passers A and C pass with each other, and on beat three everybody does a self, resulting in a different sequence for each passer (pass-pass-self feed, pass-pass-self to the right, three-count):



To extend this sequence for a more challenging pattern, we can swap roles after every *n* iterations. For example, a passer starts in role A (*pass-pass-self* feed) for two iterations, followed by two

iterations in role B (*three-count*), followed by two iterations in role C (*pass-pass-self* to the right); the others similarly shift through the roles but start with a different role.

Extra club three-count. With all passes thrown as crossing doubles, it is easy to add a 10th club to a triangle *three-count* pattern, with double passes all going in a circle in one direction:



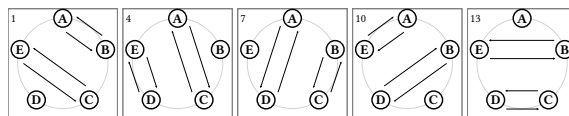
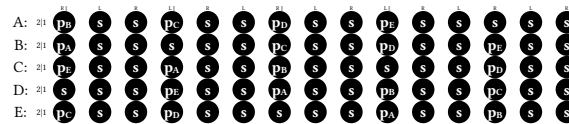
(All passers start at the same time with the same hand. Crossing passes can be awkward to throw in a triangle with left-hand passes being much longer than right-hand passes; provide feedback.)

Six-handed siteswap triangles. Six-handed siteswaps are naturally juggled in triangle positions, as described in the context of four-handed siteswap theory, but they are not commonly passed in the community. Use a siteswap generator like passist.org to find interesting patterns with “a” as single passes or “7” as zaps, such as [aaa69](https://passist.org/siteswap/aaa69)¹¹ or [a37979999](https://passist.org/siteswap/a37979999)¹² (Mayday Zap).

Feast (3+ passers)

The *feast* is an elegant and scalable pattern that theoretically works with any number of passers and on any base pattern: The passers stand in a circle. Each passer has a starting partner such that no passing lanes cross (with odd numbers of passers, one passer has no partner). On the first passing beat, each passer passes with their starting partner (or a self if they have no starting partner). On every next passing beat, they pass to the passer on the right (in the circle) of their previous pass. If the previous pass was to the last passer on the right, they do a self on the next passing beat, and continue with the passer on their left on the passing beat after. That is, everybody passes with everybody in the circle in order (including themselves).

The feast is commonly juggled on *four-count* or *two-count*, but we strongly recommend *three-count* or another ambidextrous pattern. Here is the pattern for five passers on *three-count*:



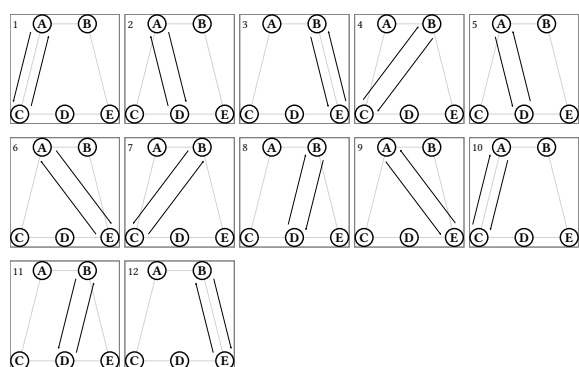
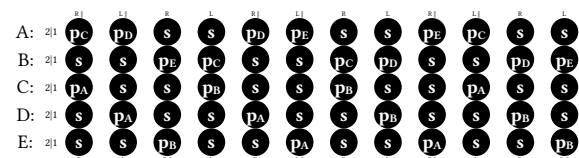
¹¹<https://passist.org/siteswap/aaa69?jugglers=3>

¹²<https://passist.org/siteswap/a37979999?jugglers=3>

doubles (efkfkf¹⁵ or lfkfkf),¹⁶ but none of these are common or intuitive to figure out.

Trapezoid (5 passers)

Chocolate box. Another common setup is two passers A and B facing three passers C, D, and E in a trapeze shape. A common pattern of intermediate difficulty is *chocolate box* where the two passers A and B each juggle *pass-pass-self-self* (which is a synchronous pattern called *chocolate bar*) and the three other passers juggle *three-count*, in the following sequence:



Rotate through all positions and let the passer who previously held a position explain the sequence to the new passer in that position.

Other Shapes for Static Patterns

There are endless variations to arrange passers in different shapes, letting them pass on different lanes, either in pairs or in longer loops. This includes formations in a Y shape, in a T shape, and in a line – some patterns include drop-back and drop-forward passes (not discussed here) – others add double passes and extra clubs. There are several pattern collections that feature many of these, including the Madison Area Jugglers Pattern Book¹⁷ and the Passing Patterns Compendium.¹⁸ The patterns in this chapter are our suggestions for beginner to intermediate patterns in a modern passing style; beyond those, we rather suggest adding movement and manipulators for variety and challenges.

23. Moving Group Patterns

Prerequisite: Basic synchronous passing patterns | **Helpful:** Static group patterns | **Next:** Takeouts

Movement adds interesting variations and challenges to group passing patterns. We mostly discuss patterns that are symmetric in that all passers cycle through all positions during the pattern. The following patterns are roughly sorted by increasing difficulty.

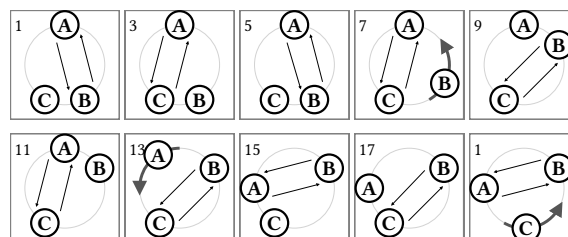
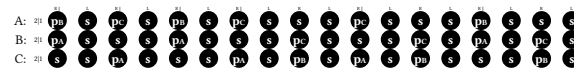
Notation and Relabeling

To notate the pattern, we usually rely on a sequence of diagrams of passer positions from above that illustrate the positions and movement. In the notation, we underline the beats where movement happens.

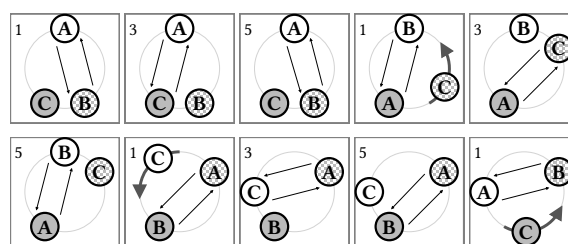
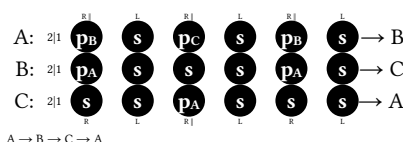
In most patterns, it takes a while until all passers cycle through all positions, to get back to the original start. However, conceptually, the pattern is usually composed of smaller repeating steps,

similarly to how siteswaps repeat over and over again even if we write the most compact version showing only the first half of the pattern. With walking and takeout patterns, it is common to write down only one transition of the pattern and then describe how it repeats.

For illustration, here is the full notation for the *rotating feed* in *two-count vs four-count* (described in more detail below). It is 18 beats long to get back to the start where passer A feeds (though the orientation in the room will have changed). However, the first six beats already describe all that is happening in the pattern. After those six beats, a different passer (who started as C before) will now feed; after another six beats the third passer will be the feeder.



Relabeling. The standard approach to notate those patterns compactly is to describe only one transition, but then explain how the roles change. That is, the same passer (identified with a colored circle in the diagram) will go through all three roles – in this pattern, first A, then B, then C. The role changes (how passers are relabeled) are indicated as arrows at the end of each line in the notation. While the relabeling approach makes patterns much more compact to notate, it can require some practice to read the notation and follow how roles change for each passer during the pattern.



Changing starts: Turning back. While learning longer patterns, it is a good idea to change the start when the first beats of the pattern work well, but the group rarely gets to later beats to practice them. The best way to change the start is to go *backward* in the pattern by one segment. This way, everybody can learn the new segment and then gets to a point that they already know (whereas turning forward, everybody gets to more unknown parts of the pattern and never practices previous parts again until getting around).

For most walking patterns, it is obvious how to turn back. However, when not obvious, this step-by-step process always works: Look at role changes in the notation. Identify which role gets relabeled *to* your current role; that's the role in the previous start – for example, in the rotating feed above, the passer with

¹⁷<https://madjugglers.com/majpatternbook/>

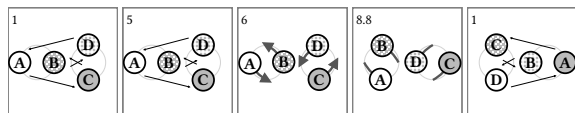
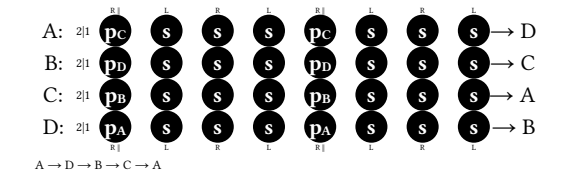
¹⁸<https://jugglgedge.com/pdf/passingpatternscompendium.pdf>

role A has role C in the previous start (because C turns into A). When everybody has identified their role, simply move to the starting positions for each role. For teaching more complicated patterns, after turning back, the passer who previously held a role can typically explain well what to do to the new passer in that role.

Rotating Y (4 passers)

A good beginner pattern with easy movement is the *Rotating Y*. The Y is a formation of two passers next to each other facing two passers behind each other (a feed with an extra passer behind the feeder). The rightmost passer throws a long pass to the passer in the back, who throws a long pass to the passer on the left, who throws a much shorter pass to the feeder in the middle, who then throws another short pass to the rightmost passer. For movement, consider that the two passers standing next to each other are on the left and right of a circle, whereas the other two passers are in the front and back of another circle; for each movement, each passer moves a quarter position counter-clockwise on their circle (all walking at the same time), yielding another Y. Note that after movement, everybody still passes to the same passer (now in a different location, possibly with a different distance) and receives from the same passer.

The rotating Y is commonly juggled in four-count with movement after every other pass or after every pass. To learn the pattern, it is common to try every position without moving during the pattern, and move to the new positions between attempts when resetting. When moving during the pattern, only fairly little movement is needed, typically only a step or two without turning, making this a good beginner pattern.



Rotating Feeds (3 passers)

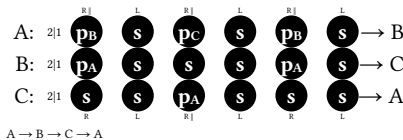
The rotating feed is a good introduction to walking and turning on a four-count (usually), which is an important foundation for many other walking and takeout patterns. So even though the rotating feed on two-count versus four-count can be rather boring, it is an important milestone.

In all these patterns, one feedee (usually the left one) is walking across the pattern while turning to a position beside the previous feeder. The other feedee becomes the new feeder, feeding the passer who just walked and the previous feeder.

Two-count vs. four-count. The standard pattern, shown already in the notation section above, is a *two-count* feed with feedees on *four-count*. This pattern is the foundation for many four-person manipulator patterns.

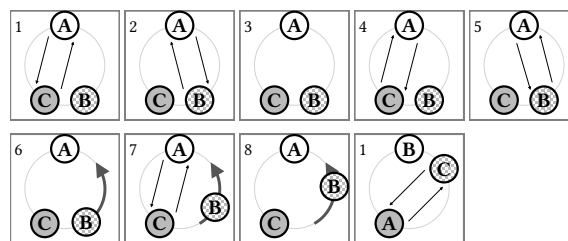
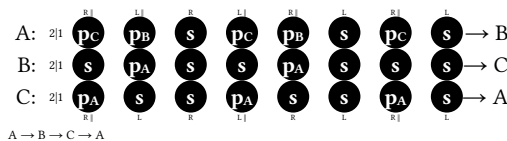
To begin, the left feedee can walk across the pattern after a pass with or without announcing it. There is enough time for both the previous feeder and the new feeder to adjust patterns; the previous feeder will simply do a self where they would have passed to the feedee who just walked, resulting in a switch to four-count; the third passer will throw a pass to the passer who just walked instead of a self, thus switching to a two-count feed.

The most common pattern is for the left feedee to walk every six beats; which passer is currently in the left feedee position will change. The feeder typically counts the two-count passes as 1 - 2 - 3 and the left feeder would start walking after the pass on 3. After this, the right feedee takes over counting (and feeding) 1 - 2 - 3 after that, which is when the next passer (the first feeder) will start walking, and so forth.

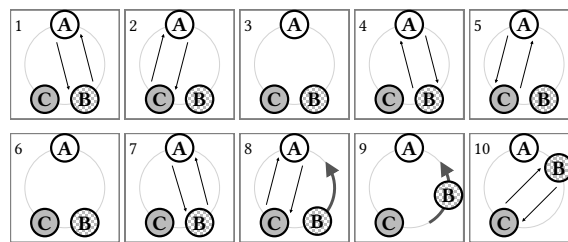
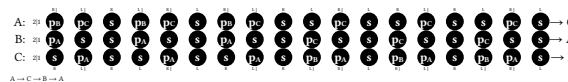


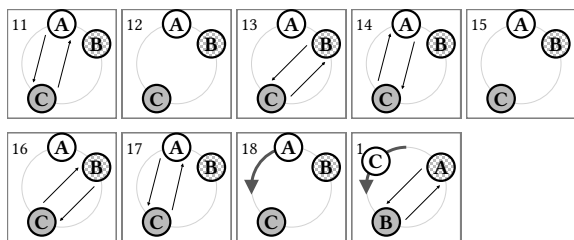
Walking and turning while juggling can initially be somewhat challenging. Usually the passer walking will walk immediately after their pass and catch the incoming pass somewhat along the way (ask the feeder to throw it shorter if necessary). It is possible to practice walking and turning while juggling alone, simply walking around while maintaining a 3-club cascade. Less confident passers can also collect all clubs and walk across the pattern holding all three clubs to then restart with a pass on the other side.

Pass-pass-self feeds. The following pattern is a nice approximation of a pass-pass-self feed (technically pass-pass-self-pass-pass-self-pass-self), which still allows walking on a right-handed four-count. That is, the pattern is ambidextrous and slightly more challenging, but the walking is the same as in the two-count vs. four-count version.



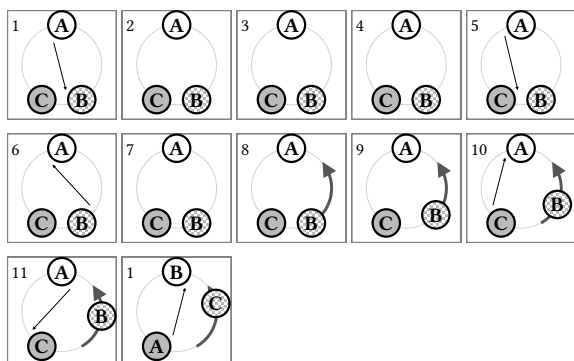
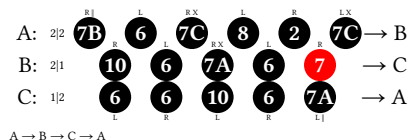
A pure pass-pass-self feed is also possible, but substantially harder. It requires walking on a three-count and alternates between walking on a right-handed three-count and a left-handed three-count. Walking after a left-handed pass is harder for most people, because it is easier to turn with the angle of the incoming pass.





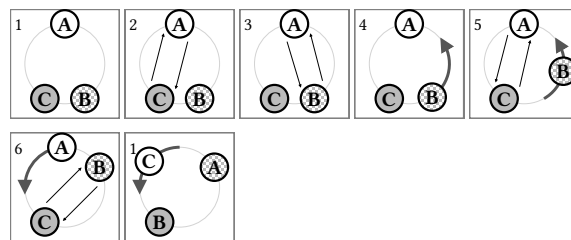
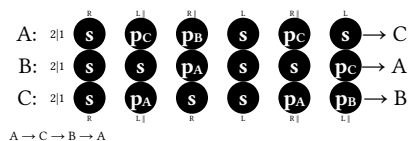
Four-handed siteswap feeds. Rotating feeds on four-handed siteswaps are not common and usually very challenging since they require changing between straight and crossing passes and accounting for the half-beat timing difference between the two sides. To make this work, the common trick is that the feeder throws straight single passes to feedee B and crossing single passes to feedee C, and feedee B responds with crossing single passes and feedee C with straight single passes. When walking, passer B juggles slightly slower (to lose half a beat; written as 7x in the notation) and maintains the crossing passes with the previous feeder, but starts throwing straight passes to the other feedee.

Here is an example of this based on a why-not vs five-count popcorn feed.



Extra club Bruno's (see below) uses the same idea. The appendix has a few more patterns to explore.

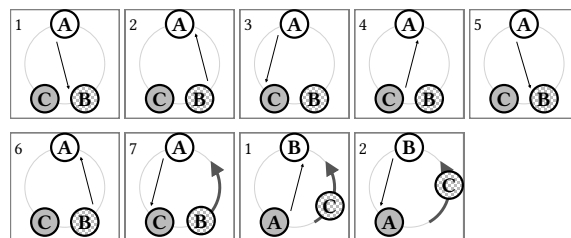
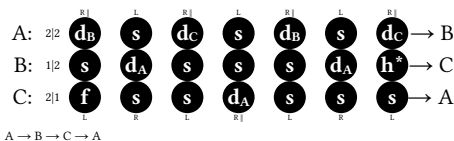
Other feeds. Generally any feed can be turned into a rotating feed if there are enough selfs to walk across. It is also possible that multiple passers walk before the pattern repeats (as in the rotating pure pass-pass-self feed above). Here is an example of a very short pattern (the base pattern for MiniEd), with a lot of walking on right-handed three-counts:



Extra Club Rotating Feed (3 passers)

The two-count vs. four-count feed with 10 clubs (see Feeds) can also be turned into a walking rotating pattern, similar to other feeds. In this pattern, on all double passes, the feeder throws one more pass to their right feedee before switching to four-count and the walk happens on a five-count (resulting locally in the sequence pass left, pass right, pass left, pass right, pass right).

To maintain the usual approach to throw all double passes straight instead of crossing, the feedees start left-handed or one beat late (see 7-club two-count and adding clubs to synchronous feeds). Since the walking technically changes from the left-handed to the right-handed side of the pattern, there can only be three selfs in the five-count and the passer walking needs to take one of these options: (a) juggle a four-count very slowly to match the speed of a five-count, (b) throw one of the three selfs of a four-count as a double self followed by a wait to gain an extra beat of time, or (c) walk on a normal four-count and throw an early triple pass followed by a wait. In either case, the timing is right if, after walking, the first pass responds to an incoming pass with the offset timing common for 7-club two-count.



With a bit of galloping, this pattern can also be juggled on single passes (see 7-club two-count on singles).

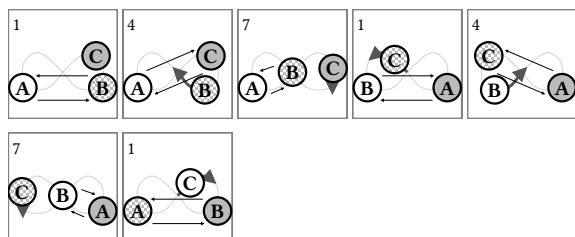
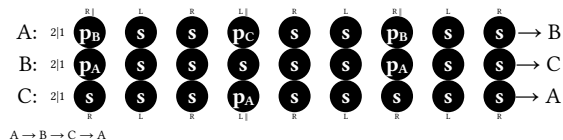
Bruno's Nightmare (3 passers)

The conceptual idea behind all "Bruno's" patterns is that the passers move as if they were balls thrown by a giant. In the basic Bruno's nightmare pattern, the passers move in a simple cascade pattern, being "thrown" to one side of the room and then "falling" back down to the other (see the diagram below). Many other patterns, including passing patterns, are possible beyond a simple three-ball cascade. While the passers are moving in the shape of a juggling pattern, they exchange clubs.

In the basic Bruno's nightmare pattern, the passers start in a V shape and one feedee walks *through* the middle of the pattern to arrive at the opposite side of the former feeder to where they would have walked in a rotating feed; during that time the other feedee "falls down" to take the place of the feedee who just walked from where they will feed next. The initial feeder first throws to the feedee walking, then to the other feedee, and then

once more to the feedee walking while they are in the middle of the pattern. From here the pattern repeats with the previous feeder now walking through the pattern, the previous “falling” feedee now feeding, and the passer who previously walked falling down.

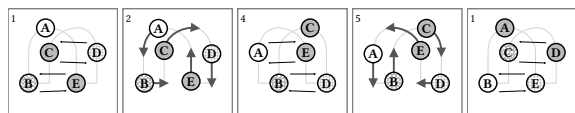
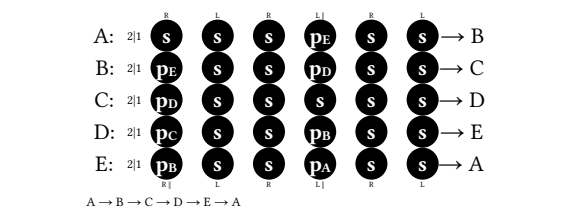
The standard way to juggle this pattern is on *three-count vs. six-count*, which gives passers a lot of time to walk and turn.



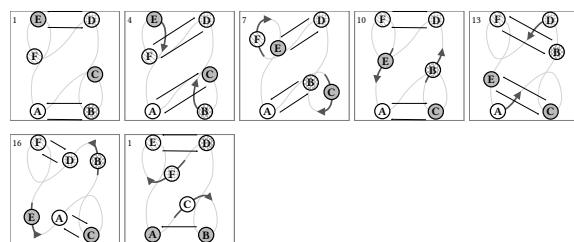
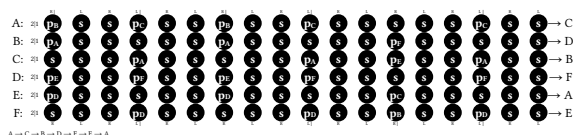
The pattern can also be juggled on many other baseline beats. Feeding two-count vs. four-count is fairly common too, but since the pattern requires turning both clockwise and counter-clockwise, one of those turns is usually more challenging. A much slower version has five instead of three passes before it repeats, where the walking passer passes twice while walking through the middle of the pattern. Less conventional base patterns are pass-pass-self or pass-pass-self-pass-self feeds. See the appendix for illustrations of these.

Beyond the cascade. The idea of a giant juggling passers can be conceptually extended to other base patterns. Walking can follow any solo pattern as a base pattern, such as 423, 441, 33441, and the box for three passers, or 534 and 531 for four passers (see the appendix for an example). There is no principled way to decide when to pass and to whom to pass (that I am aware of), so it is easy to create lots of different patterns by first picking a pattern for the walking and then fitting passes in there.

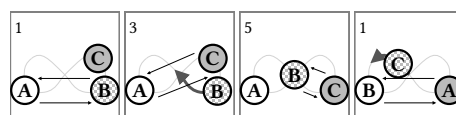
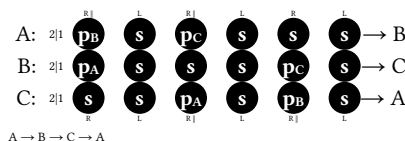
This is an easy pattern based on the five-ball cascade:



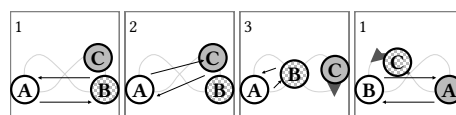
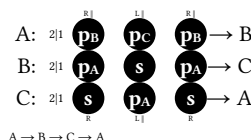
Beyond solo patterns, Bruno’s patterns can also be extended to passing patterns, when imagining two giants facing each other passing with each other. The most common of these (known as *Magermix* when juggled in one-count, see below) is a six-person pattern where the passers move as if they were passed in two-count:



Turbo. Turbo is a Bruno’s variation (same walking paths) where the walking passer turns around to pass back to the passer who started next to them when walking through the pattern, after which they back up to their target position. While it looks like a feed setup at the start, the passer “in the air” (in the Bruno’s analogy of juggling people) starts as feeder one pass into the pattern. Again, Turbo can be juggled on different baseline patterns, but *two-count vs. four-count* is the most common.



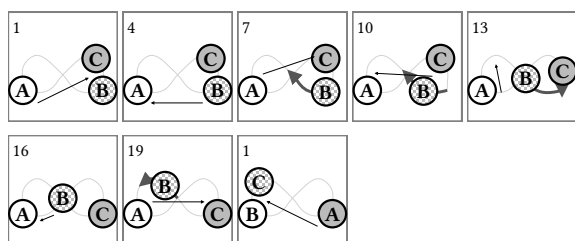
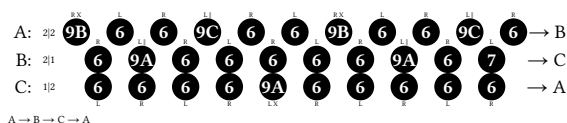
Bruno’s one-count. A particularly challenging variation of Bruno’s nightmare is Bruno’s nightmare on one-count vs. two-count, usually known as *Bruno’s one-count*. This pattern usually requires very lofty passes and lofty selfs, fast turns under a single self, and fairly precise passes.



This pattern is very difficult to learn from scratch. By far the best way to learn this pattern is with two passers who can run it. Here are a couple of hints: Juggle very lofty and slow; count out loud to synchronize. After the first pass of the feed, the walking passer should take a step forward to give the “falling” passer space, but should not yet move sideways. The second pass of the feed needs to be long to avoid collisions with the short pass after; for the passer walking through the pattern, this is the first pass on the other side after turning (likely the most difficult pass of the pattern); collisions are most commonly caused by the walking passer’s pass being too short here. The third pass of the feed needs to be lofty but very short; usually the feeder is leading the walking passer quite a bit; the outgoing and incoming passes usually cross, and the walking passer should aim to the nose or even the wrong hand of the feeder. For the feeder, the second and third pass are usually roughly in the same direction; the third pass is just much shorter. The walking passer has a single self to turn all the way around; usually they already turn a lot after throwing their short pass before catching the incoming short pass, so that they need to turn much less under the self.

Bruno's one-count is possible on all the other variations, like *Magermix* for six passers moving as if they were thrown in *two-count* (see above) and various three-ball siteswaps like *441* and *33441* (known as *Babymix*). See the appendix for illustrations of these.

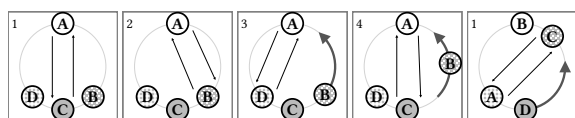
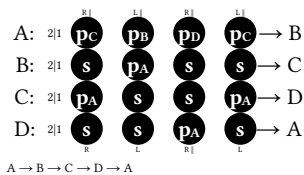
Extra club Bruno's. Similar to the rotating feed, it is possible to add a club and juggle the entire pattern on doubles. However, since this is juggled on a four-handed siteswap feed, the walking and notation is somewhat unusual: The feeder always throws crossing passes to the feedee walking and straight passes to the other one; the first pass after walking is always crossing, and the passes while walking are always straight. Feedee B walks on 7.5 beats, but the half beat is barely noticeable and it can be juggled as a normal seven-count (in the notation, the extra half beat is visible in the 7 on the last beat of B, which is a slow self (!) to make up for switching the half beat between sides).



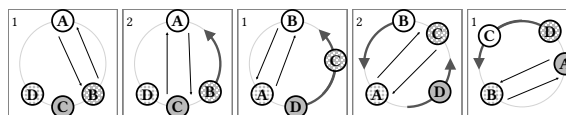
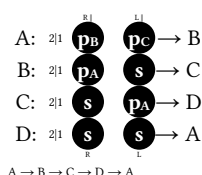
(Technically the approach also works for 10-club *Bruno's one-count* by leaving out the extra selfs.)

El Niño (4 passers)

El Niño is a version of a rotating feed for 4 passers, based on the feeder passing *one-count* to three feedees in *three-count*. The feeder feeds the feedees in the following order: middle feedee, left feedee, right feedee, and middle feedee. First the left feedee walks in three-count after their pass, and then the middle feedee after their second pass, turning the right feedee into the new feeder. The pattern is usually started left-handed so that all walking happens after right-hand passes.

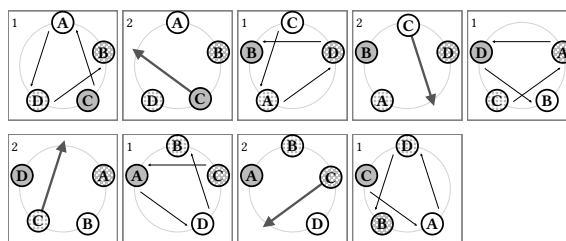
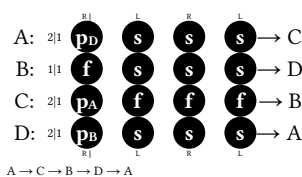


And a much faster version of the same idea (requires walking both on left and right-handed passes):



Shooting Star (4 passers)

The shooting star describes a family of patterns in which one passer is missing from a standard 5-person star pattern. Since one passer is missing, one passer (role C) will not receive clubs and one passer (role B) would pass into a hole. In the standard four-count version, passer B, who would pass into the hole, starts with two clubs and skips the first pass, whereas passer C, who does not receive clubs, walks immediately after their first pass through the middle of the pattern to the hole while holding two clubs; they receive the next pass there when they arrive. On the next beat, another passer does not receive a club and walks to the hole, and so forth.



Note: The passer with role C starts with two clubs.

Variations: It is possible to remove clubs and walk with one club or no clubs to slow down the pattern.

- Walking with one club: Removing one more club, passer B (facing the hole) starts with *one* club and passer C (not receiving clubs) passes until they are down to a single club for walking.
- Walking the last pass: As before, passer B starts with one club. After their first pass, passer C is down to two clubs and walks their last pass to passer A, to then walk (run) around behind A with their last club to their target position in the hole.
- Walking without clubs: Passer B (facing the hole) starts without clubs and passer C (not receiving clubs) walks without any clubs after passing their last club. This slows down the pattern and results in walking only every other or every third pass.

Two-count shooting star. In the two-count version of the shooting star, the person moving stops in the middle to let passes go by before making it to the hole. Typically they walk when they have one club, but they can also walk to the middle with two and pass a last one from the middle.

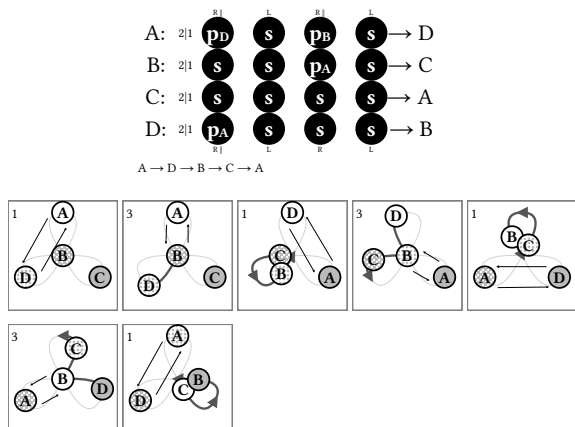
Other Classic Patterns (4 passers)

The Madison Area Jugglers Pattern Book¹⁹ has a huge number of walking patterns, including *Turbo* and *El Niño* discussed above. Here are two more common patterns from that collection that are also the basis for many other variations.

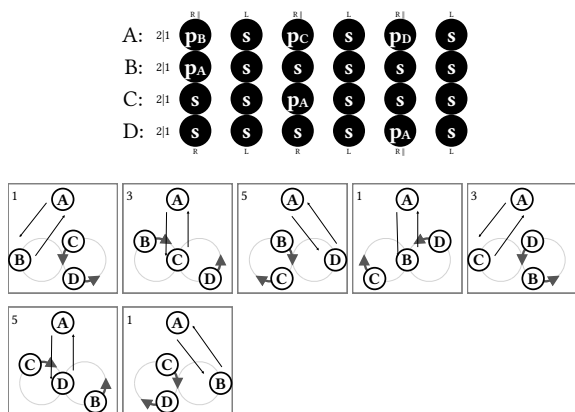
3-leaf clover. In this pattern, all passers continuously walk in and out of the middle of the pattern, through three loops (see

¹⁹<https://madjugglers.com/majpatternbook/>

diagram below). Essentially, a feeder throws two-count to three feedees in six-count. The Madison book has many more variations, including ambidextrous ones.



The weave. In the weave, three passers walk in a figure of 8 on six-count all while facing a feeder outside the pattern who feeds them in two-count. This pattern does not cycle through all positions, since the feeder stays fixed, but it is intuitive and easy to learn and there are many variations (including ambidextrous ones) in the Madison book.



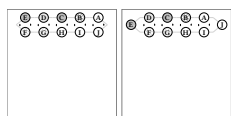
24. Large Patterns

For large groups of passers, it is almost always better to break up into smaller groups. However, here are some ideas to include many passers.

Speed Passing

Speed passing is speed dating for passers. This is commonly run as a workshop early in a juggling festival so that passers find who else attending the festival is interested in passing.

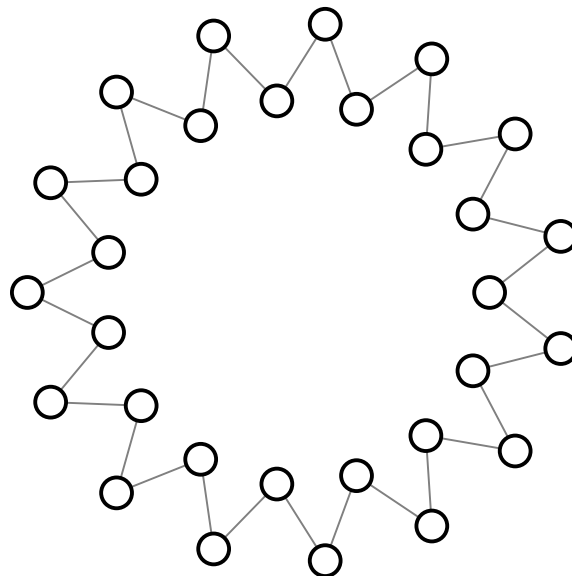
In a long line through the gym, passers meet in pairs. The passers in each pair introduce each other and decide on a pattern to try. An organizer keeps the time and signals to change partners every 60 to 120 seconds (a whistle and a tabata workout timer work well for this). On each partner change, each passer moves a step to the right to pass with the next passer in line. At the end of the line, passers have a break for one round and then continue on the other side on the next partner change. This continues until everybody has passed with everybody else, or time runs out.



Hints: Encourage passers to try ambitious patterns and to regularly switch patterns when they switch partners. If passers want to drop out early, they ideally do so only at the ends or together with their current partner.

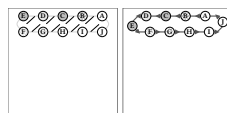
Very Long Feeds

As shown earlier, it is possible to chain multiple feeds. The simplest way to scale this with similar-length passes is to extend the feed in a zig-zag line, where everybody feeds two other feeders, except for the two feedees at the very end. With very large numbers of passers, this zig-zag line can even be bent into a large circle to connect the ends, so that everybody feeds. This can be juggled on any base pattern.



Skinny Loopy Feast

The Feast pattern conceptually works for any number of passers, but with enough passers the circle will be very large and some passes will be exceedingly far while others are very short. One way to solve the problem is to turn the feast pattern into a walking pattern with two lines that maintains all passes at a similar length:



Beyond these, the Madison Area Jugglers Pattern Book²⁰ has many more patterns for large groups of passers.

²⁰<https://madjugglers.com/majpatternbook/>

Appendix

25. Appendix: List of Siteswaps

The following list contains all four-handed siteswaps with throws up to an a and a length of up to 7 throws (excluding 0s, 1s, 3s, and local 4-4 sequences). The patterns are grouped by length, compatibility interface (see compatible siteswaps), and number of clubs, and are sorted by the highest throw. Note that the siteswaps here are normalized to start with the highest throw, which is not necessarily the best start for actually juggling the pattern (see siteswap theory).

The website <https://www.cs.cmu.edu/~ckaestne/siteswaps.xhtml> has a version of this list that can be filtered by throws.

pxx

3 clubs: 522

5 clubs: 645, 726, 825, 852, 942

7 clubs: 867, 885, 948, 966, a29, a47, a56, a74

9 clubs: a89, aa7

ppx

4 clubs: 552

6 clubs: 756, 774, 855, 945, 972

8 clubs: 978, 996, a59, a77

ppp

5 clubs: 555

7 clubs: 777, 975

9 clubs: 999

pxxxx

3 clubs: 52242, 72222

5 clubs: 66625, 72466, 74662, 84562, 85246, 86227, 86272, 86425, 86722, 88522, 92428, 92446, 92842, 96622, a2247, a2292, a2445, a2562, a2742, a5244, a6252, a7242

7 clubs: 86867, 88586, 88847, 92888, 94688, 96686, 96884, a2788, a2968, a5668, a6289, a6469, a64a5, a6667, a6685, a6784, a67a2, a6964, a7288, a7468, a7a62, a8449, a8458, a8584, a85a2, a8647, a8692, a8944, a8a52, aa249, aa258, aa294, aa564, aa645, aa744

9 clubs: a8a89, aa7a8, aaa69, aaaa5

ppxxx

4 clubs: 62525, 72425, 72722, 92522

6 clubs: 85746, 85845, 86727, 88572, 92586, 92847, 92928, 94692, 95628, 95646, 95844, 96627, 96924, a2495, a2585, a2747, a2792, a2945, a5249, a5258, a5645, a5744, a6257, a7247

8 clubs: a6969, a69a5, a7968, a7a67, a8949, a8958, a8a57, aa5a5, aa695, aa794

pxpxx

4 clubs: 55244, 74252, 75224, 77222

6 clubs: 75666, 77466, 84567, 85566, 86277, 86475, 86772, 88527, 92478, 94458, 96456, 96672, 96852, 97428, 97446, 97842, 99642, a2297, a2567, a5294, a5564, a6455, a6752, a7292, a7445, a7562, a7742, a8552

8 clubs: 97888, 99688, a6789, a7788, a8499, a8589, a85a7, a8697, a8994, aa299, aa569, aa749, aa758, aaaa5

pppxx

5 clubs: 75625, 75724, 77272, 85525, 92527, 92572, 95524

7 clubs: 95858, 95894, 96857, 96956, 97847, 97928, 97946, 99584, 99692, a2797, a2995, a5695, a5749, a5758, a5794, a5a55, a6757, a6955, a7747, a7945

ppxpx

5 clubs: 64555, 74455, 75256, 75274, 77425, 77722, 94552, 97522

7 clubs: 86777, 88577, 95678, 96677, 97478, 97496, 97586, 97892, 99458, 99647, 99944, a5299, a5569, a7297, a7495, a7567, a7585, a7792, a8557, aa555

9 clubs: a8999, aa799

ppppx

6 clubs: 75756, 77475, 77772, 85575, 92577, 94557, 95556, 95574, 97527, 97572, 99552, a5555

8 clubs: 97978, 99697, 99958, 99994, a5799, a7797, a7995

ppppp

5 clubs: 55555

7 clubs: 77777, 97577, 99557

9 clubs: 99999

pxxxxxx

3 clubs: 6222522, 7222242, 9222222

5 clubs: 6662564, 6662645, 7266266, 7446662, 8244566, 8246726, 8256266, 8258246, 8274266, 8278226, 8426627, 8446625, 8526626, 8526824, 8622584, 8622647, 8626256, 8626274, 8627246, 8642564, 8642645, 8642744, 8672264, 8682245, 8822627, 8824256, 8824274, 8827226, 8842625, 8842724, 8852264, 8882225, 9222488, 9224486, 9224882, 9244862, 9248822, 9262268, 9264266, 9268226, 9448622, 9488222, 9622682, 9642662, 9662264, 9682262, a425248, a426229, a426292, a426427, a426922, a446722, a448522, a456262, a458242, a466225, a478222, a496222, a522448, a522a42, a526426, a526822, a622249, a622447, a622582, a622942, a625246, a626272, a629242, a642562, a642742, a662245, a672262, a692242, a722248, a726226, a822229, a822292, a822427, a822922, a824272, a825226, a829222, a842722, a852262, a862225, a892222, aa42522, aa52242, aa72222

7 clubs: 8686867, 8858686, 8884786, 8884867, 8884885, 8888827, 9268888, 9468688, 9488488, 9668686, 9668884, 9688486, 9688822, a466788, a466968, a468588, a468948, a478488, a47a468, a496488, a49a448, a566868, a568848, a568a46, a626889, a646869, a6468a5, a648849, a666786, a666867, a666885, a666966, a668586, a668847, a668946, a66a566, a678486, a678882, a67a466, a696486, a696882, a69a446, a6a6269, a6a62a5, a6a6467, a6a6485, a6a6782, a6a6962, a726888, a746868, a746a66, a748848, a748a46, a7a6268, a824889, a8248a7, a8249a6, a825888, a829488, a82a478, a82a496, a82a829, a842a69, a8447a6, a844869, a8448a5, a845868, a845a66, a848829, a848892, a848a72, a849a62, a8582a6, a858486, a858882, a85a466, a862788, a862968, a862a67, a862a85, a864786, a864867, a864885, a864966, a868278, a868296, a868827, a868926, a869268, a86a726, a86a825, a892488, a892a82, a8942a6, a894486, a894882, a89a426, a89a822, a8a4269, a8a42a5, a8a4467, a8a4485, a8a4782, a8a4962, a8a5268, a8a8229, a8a8292, a8a8427, a8a8922, aa425a8, aa42a49, aa445a6, aa45848, aa45a46, aa46829, aa46892, aa46a72, aa49a42, aa562a6, aa56486, aa56882, aa5a446, aa5a842, aa62588, aa62948, aa62a47, aa64586, aa66278, aa66296, aa66827, aa66926, aa69248, aa6a526, aa722a8, aa72488, aa72a82, aa742a6, aa74486, aa74882, aa7a426, aa7a822, aaa4582, aaa5248, aaa6229, aaa6292, aaa6427, aaa6922, aaaa522

9 clubs: a8a8a89, aa7a8a8, aaa69a8, aaa6a89, aaa6aa7, aaaa5a8, aaaaa49

ppxxxxx

4 clubs: 6262525, 7242562, 7272262, 8242525, 8272225, 9242722, 9252262, 9262225, 9292222

6 clubs: 8672685, 8672784, 8682585, 8682747, 8858274, 8882727, 9258486, 9258882, 9262788, 9264786, 9264885, 9292488, 9448692, 9458682, 9488292, 9662685, 9662784, 9682485, 9682782, 9692682, a425948, a426929, a448592, a458582, a466727, a466925, a478292, a47a425, a496427, a496922, a522a49, a525848, a525a46, a526829, a562748, a562a45, a566726, a566825, a592448, a592a42, a596426, a596822, a622949, a625847, a625946, a6425a5, a662585, a662747, a662945, a6722a5, a672485, a672782, a692447, a692582, a692942, a722948, a722a47, a726827, a726926, a822929, a825827, a825926, a829292, a858272, a859262, a862727, a862925, a892427, a892922, aa42592, aa52582, aa56272, aa59242, aa72292

8 clubs: a6a6969, a6a69a5, a7a6968, a7a6a67, a8948a7, a8949a6, a8a47a7, a8a4969, a8a49a5, a8a5968, a8a5a67, a8a8929, aa5a5a6, aa6a596, aa7a496, aa7a892, aaa5948, aaa5a47, aaa6929, aaaa592

pxpxxxx

4 clubs: 6252445, 7262245, 7426252, 7427242, 8222527, 8252245, 8522524, 9222427, 9224272, 9229222, 9522622, a522522

6 clubs: 8574666, 8584566, 8626857, 8627847, 8648574, 8672667, 8678274, 8682567, 8824857, 8827827, 8852685, 8852784, 8857266, 8858256, 9264867, 9268278, 9268827, 9269268, 9468627, 9488427, 9488922, 9562668, 9564666, 9564864, 9568626, 9568824, 9582468, 9584466, 9584862, 9588426, 9588822, 9648672, 9662667, 9662964, 9668274, 9669264, 9682467, 9682962, 9688272, 9689262, a445748, a446729, a446792, a456485, a456782, a45a445, a466295, a468527, a478427, a478922, a495248, a496229, a496292, a562568, a564566, a568526, a572468, a574466, a574862, a578426, a578822, a5a4562, a626279, a629249, a629582, a62a572, a642749, a645746, a645845, a648572, a649562, a662567, a672467, a672962, a678272, a679262, a692249, a695246, a6a5245, a726278, a729248, a742748, a742a45, a746726, a746825, a792248, a796226, a7a6225, a824279, a825278, a829229, a842729, a842792, a845726, a845825, a8522a5, a852485, a852782, a862295, a892229, a892292, a895226, a8a5225, aa44572, aa49522, aa62527, aa72427, aa72922, aa74272, aa79222

8 clubs: a696889, a6a6789, a796888, a7a6788, a848a79, a849a69, a85a7a6, a86a796, a894889, a895888, a895a86, a89a496, a89a829, a89a892, a8a4789, a8a5788, a8a5a85, aa46a79, aa495a8, aa49a49, aa69588, aa6a578, aa729a8, aa748a7, aa749a6, aa792a8, aa79488, aa79a82, aa7a478, aa7a72, aaa45a7

pxpxxxx

4 clubs: 6622552, 7225246, 7522642, 7722244, 9225226, 9427222, 9622252, 9722224, 9922222

6 clubs: 7566666, 7746666, 8456667, 8556666, 8626677, 8646675, 8646756, 8646774, 8646855, 8647566, 8647746, 8647845, 8648556, 8677266, 8678256, 8686275, 8824677, 8844675, 8844756, 8844774, 8844855, 8847726, 8847825, 8852667, 8884275, 9225888, 9245868, 9425688, 9427488, 9445668, 9467268, 9468258, 9485268, 9625686, 9625884, 9627486, 9627882, 9645666, 9645864, 9647862, 9648852, 9667266, 9668256, 9685266, 9722688, 9724686, 9724884, 9742668, 9744666, 9744864, 9748626, 9748824, 9782268, 9784266, 9788226, 9922488, 9924486, 9924882, 9944862, 9948822, 9962268, 9964266, 9968226, a425588, a426299, a426497, a426992, a445568, a448529, a456269, a456467, a456962, a458249, a458447, a458942, a475268, a478229, a526478, a526496, a526892, a529448, a529a42, a556466, a556862, a558446, a558842, a622589, a625586, a626477, a626972, a629447, a629942, a642569, a645566, a646772, a649742, a666275, a669245, a672269, a675266, a696272, a699242, a722588, a724586, a726296, a72a526, a742568, a744566, a748526, a756266, a758246, a772268, a774266, a778226, a822299, a822497, a822992, a824477, a824972, a825296, a829427, a829922, a844772, a849722, a852269, a852467, a852962, a855266, a864275, a869225, a894272, a899222, aa42529, aa45526, aa52249, aa52447, aa52942, aa55246, aa72229, aa75226

8 clubs: 9788888, 9968888, a678889, a778888, a848899, a858889, a8588a7, a8589a6, a868897, a868978, a868996, a868a77, a869788, a869968, a869a67, a869a85, a86a778, a899488, a899a82, a89a478, a8a8299, a8a8497, a8a8992, aa46899, aa56889, aa568a7, aa569a6, aa5a849, aa66897, aa66978, aa66996, aa66a77, aa69948, aa69a47, aa72a89, aa74889, aa75888, aa75a86, aa7a829, aaa4589, aaa5588, aaa6299, aaa6497, aaa6992, aaaa529

pppxxxx

5 clubs: 8272727, 8572625, 8572724, 8582525, 9252485, 9252782, 9258272, 9262727, 9262925, 9292427, 9292922, 9562625, 9562724, 9582425, 9582722, 9592622, a562525, a572425, a572722, a592522

7 clubs: a495948, a495a47, a496929, a592a49, a595848, a595a46, a596829, a5a5748, a5a5a45, a6729a5, a692949, a695847, a695946, a6a5747, a6a5945, a792948, a792a47, a796827, a796926, a7a6727, a7a6925, a892929, a895827, a895926, a8a5727, a8a5925, aa49592, aa59582, aa5a572, aa79292

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5 clubs: 7562564, 7572662, 7726256, 7727246, 8252567, 8252675, 8552564, 9245726, 9245825, 9252467, 9445625, 9485225, 9522692, 9552662, 9627272, 9629252, 9742625, 9742724, 9782225, 9792224, 9924272, 9929222, a445525, a475225, a522592, a552562, a742525, a772225

7 clubs: 9485788, 9568894, 9588892, 9685786, 9685885, 9695686, 9695884, 9782788, 9784786, 9784885, 9792688, 9794686, 9794884, 9929488, 9968278, 9969268, a468597, a475788, a478497, a478992, a495588, a529a49, a568596, a578496, a578892, a626979, a629949, a672789, a675786, a675885, a692589, a695586, a6a5585, a726978, a729948, a729a47, a772788, a774786, a774885, a77a726, a792588, a794586, a79a526, a7a4585, a824979, a825978, a825a77, a829929, a849792, a8592a5, a859485, a859782, a85a475, a85a772, a869295, a899292, aa525a7, aa62597, aa72497, aa72992

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5 clubs: 6662555, 7245566, 7525646, 7526672, 7742564, 7772264, 8447525, 8477225, 8642555, 8672255, 9255266, 9425258, 9447722, 9467225, 9625256, 9642752, 9662255, 9692252, 9722258, 9722294, 9724256, 9727226, 9752264, 9925226, 9942722, 9962225, 9992222

7 clubs: 8686777, 8858677, 8884777, 9467788, 9667786, 9667885, 9727888, 9747868, 9748696, 9748858, 9748894, 9758686, 9758884, 9788296, 9925888, 9945868, 9962788, 9964786, 9964885, 9992488, 9994486, 9994882, a426999, a448599, a456969, a458589, a458949, a478299, a526899, a556869, a558849, a566778, a569748, a569a45, a596478, a599448, a599a42, a666777, a666975, a669747, a669945, a696477, a696972, a699447, a699942, a726897, a726996, a72a596, a748596, a756867, a756966, a758586, a758847, a758946, a75a566, a778296, a822999, a825897, a825996, a829497, a829992, a852969, a855867, a855966, a858477, a858972, a859467, a859962, a864777, a864975, a869727, a869925, a894477, a894972, a899427, a899922, aa42599, aa45596, aa52589, aa52949, aa55586, aa55847, aa55946, aa56477, aa56972, aa59447, aa59942, aa72299, aa75296

9 clubs: a8a8999, aa7a899, aaa6999, aaaa599

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5 clubs: 7562645, 7562744, 7726274, 8244575, 8252747, 8274275, 8552645, 8552744, 9225827, 9244772, 9264275, 9269225, 9425627, 9427292, 9457262, 9458252, 9525626, 9525824, 9722627, 9722924, 9922292, 9952262, a425527, a522529, a525526, a552445, a552742, a722527

7 clubs: 9585868, 9685867, 9685966, 9689485, 9782968, 9784867, 9784966, 9788827, 9788926, 9948892, 9958486, 9958882, 9968296, a466797, a466995, a475968, a478929, a496497, a496992, a566796, a566895, a574869, a575868, a578829, a596496, a596892, a5a4569, a5a5568, a6495a5, a669585, a66a575, a672969, a675867, a675966,

a6792a5, a679485, a679782, a67a475, a699582, a69a572, a6a5567, a772968, a772a67, a774867, a774966, a778827, a778926, a7a4567, a829299, a8527a7, a8529a5, a858279, a859269, a862797, a862995, a892497, a892992, aa56279, aa59249, aa72929, aa75827, aa75926, aaa5527

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5 clubs: 6456455, 7445645, 7466255, 7467245, 7526456, 7527446, 7742645, 7742744, 8224577, 8427527, 8456255, 8457245, 8524556, 8524574, 8527526, 8622557, 8852255, 9224477, 9225278, 9427427, 9427922, 9522458, 9524456, 9524672, 9524852, 9527426, 9527822, 9622457, 9622952, 9625274, 9724274, 9729224, 9922427, 9922922, a455245, a524572, a529522, a752245

7 clubs: 8678677, 8857786, 8857867, 8858857, 9567868, 9568678, 9568858, 9588478, 9589468, 9667867, 9668677, 9668857, 9668956, 9669667, 9688477, 9689467, 9729688, 9748678, 9749668, 9788278, 9789268, 9962968, 9964867, 9964966, 9968827, 9968926, a446799, a456789, a496299, a568578, a569568, a578478, a579468, a629589, a62a579, a646779, a648579, a649569, a649749, a668577, a669567, a678279, a678477, a678972, a679269, a679467, a679962, a696279, a699249, a729588, a72a578, a746778, a746796, a746895, a748578, a749568, a749748, a749a45, a756786, a756885, a75a746, a778278, a779268, a796278, a796296, a799248, a7a6295, a842799, a844779, a845778, a845796, a845895, a845a75, a849729, a852789, a855786, a855885, a892299, a894279, a895278, a895296, a899229, a8a5295, aa44579, aa45578, aa49529, aa64577, aa69527, aa74279, aa74477, aa74972, aa75278, aa79229, aa79427, aa79922

9 clubs: a89a899, aa799a8, aa79a89, aa7aa79

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6 clubs: 9485727, 9485925, 9562794, 9582792, 9585726, 9585825, 9592692, 9595626, 9595824, 9782727, 9782925, 9792627, 9792924, 9929292, 9958272, 9959262, a475727, a475925, a495527, a562595, a572495, a572729, a572792, a575726, a575825, a592529, a592592, a595526, a5a5525, a772727, a772925, a792527

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6 clubs: 8477727, 8574756, 8574855, 8577726, 8577825, 8672757, 8857275, 9255786, 9255885, 9258477, 9455685, 9467727, 9467925, 9558672, 9562758, 9564756, 9564855, 9567726, 9567825, 9592458, 9594456, 9594852, 9662757, 9662955, 9692457, 9692952, 9727278, 9729258, 9742695, 9742794, 9752685, 9752784, 9782295, 9792294, 9925278, 9962727, 9962925, 9992427, 9992922, a445595, a455585, a475295, a529592, a558572, a559562, a742595, a752585, a772295

8 clubs: a599a49, a696979, a699949, a796978, a796a77, a799948, a799a47, a79a596, a894979, a895978, a895a77, a899929, aa595a7, aa69597, aa79497, aa79992

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6 clubs: 8274777, 8574675, 8574774, 8584575, 9264777, 9447792, 9457485, 9457782, 9525858, 9564675, 9564774, 9584475, 9584772, 9589425, 9594672, 9625857, 9625956, 9722958, 9724857, 9724956, 9727827, 9727926, 9729294, 9758274, 9759264, 9925827, 9925926, 9942792, 9952485, 9952782, 9962295, 9992292, a455747, a455945, a552749, a555746, a555845, a564575, a569525, a574475, a574772, a579425, a579722, a594572, a599522, a752747, a752945

8 clubs: a496999, a596899, a6799a5, a796897, a796996, a7a6797, a7a6995, a892999, a895897, a895996, a8a5797, a8a5995, aa49599, aa59589, aa5a579, aa79299

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6 clubs: 7575666, 7747566, 7777266, 8256777, 8556675, 8556774, 8647575, 8677275, 9255867, 9445758, 9455667, 9525894, 9555666, 9555864, 9645756, 9645855, 9647772, 9667275, 9669255, 9695256, 9727296, 9742758, 9744756, 9744855, 9747726, 9747825, 9752667, 9752964, 9757266, 9758256, 9792258, 9794256, 9797226, 9925296,

9944772, 9945726, 9945825, 9949722, 9955266, 9964275, 9969225, 9994272, 9995226, 9999222, a425597, a455567, a522599, a525596, a552569, a555566, a556475, a556772, a559445, a559742, a722597, a752567

8 clubs: 9797888, 9969788, 9995888, 9999488, a478999, a578899, a778897, a778996, a829999, a858979, a8597a7, a859969, a8599a5, a869797, a869995, a899497, a899992, aa56979, aa59949, aa72999, aa75897, aa75996, aaa5597

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4 clubs: 5525524, 7522552

6 clubs: 7567566, 7746675, 7746756, 7747746, 8456757, 8457567, 8457747, 8556756, 8557566, 8557746, 8557845, 8558556, 8627577, 8852757, 9245778, 9457467, 9458457, 9525678, 9527478, 9527892, 9529458, 9557466, 9557862, 9558456, 9558852, 9625677, 9627477, 9629457, 9645675, 9645774, 9685275, 9695274, 9724677, 9729627, 9744675, 9744774, 9749625, 9749724, 9784275, 9789225, 9794274, 9922497, 9924477, 9924972, 9929427, 9929922, 9952467, 9952962, a524579, a525578, a529529, a625577, a645575, a675275, a724577, a729527, a744575, a749525, a756275, a759245, a774275, a779225, a855275

8 clubs: 9789788, 9968897, 9968978, 9969968, a678979, a679789, a679969, a699589, a69a579, a778978, a779788, a779968, a779a67, a77a778, a799588, a79a578, a849799, a859789, a85a779, a899299, aa74979, aa75978, aa75a77, aa79929

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7 clubs: 9595858, 9595894, 9695857, 9695956, 9792958, 9794857, 9794956, 9797827, 9797926, 9949792, 9959485, 9959782, 9969295, 9995827, 9995926, 9999292, a475797, a475995, a495597, a569595, a572799, a575796, a575895, a579495, a579792, a592599, a595596, a599592, a5a5595, a772797, a772995, a792597

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5 clubs: 7562555, 7572455, 7572752, 8552555, 9255275, 9552455, 9552752

7 clubs: 9585778, 9595678, 9685777, 9695677, 9749695, 9759685, 9784777, 9784975, 9789295, 9789727, 9794677, 9794974, 9925978, 9929497, 9958477, 9958972, 9959467, 9962797, 9962995, 9992497, 9992992, a574779, a575778, a579729, a594579, a595578, a599529, a675777, a675975, a695577, a749595, a759585, a75a575, a774777, a774975, a779295, a779727, a779925, a794577, a799527

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5 clubs: 6455555, 7445555, 7525556, 7525574, 7742555, 7772255, 9455255, 9752255

7 clubs: 8677777, 8857777, 9567778, 9667777, 9747778, 9747796, 9747895, 9757786, 9757867, 9757885, 9757966, 9758677, 9758857, 9758956, 9758974, 9759667, 9797278, 9797296, 9925897, 9945778, 9945796, 9945895, 9955786, 9955867, 9955885, 9955966, 9964777, 9964975, 9969727, 9969925, 9994477, 9994972, 9995278, 9995296, 9999427, 9999922, a529599, a556779, a558579, a559569, a559749, a729597, a756777, a756975, a758577, a759567, a759747, a759945, a855777, a855975, aa55577

9 clubs: a899999, aa79999

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6 clubs: 7575756, 7747575, 7777275, 8557575, 9255777, 9455757, 9555675, 9555756, 9555774, 9555855, 9557475, 9557772, 9559455, 9752757, 9752955, 9757275, 9759255, 9955275, a555575

8 clubs: 9797978, 9969797, 9995897, 9995978, 9995996, 9999497, 9999992, a579799, a599599, a779797, a779995, a799597

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5 clubs: 5555555

7 clubs: 7777777, 9757777, 9759757, 9955777, 9955975

9 clubs: 9999999