

Understanding Crossed-Arm Juggling Patterns

An Illustrated Guide

Greg Phillips greg.phillips@juggler.net

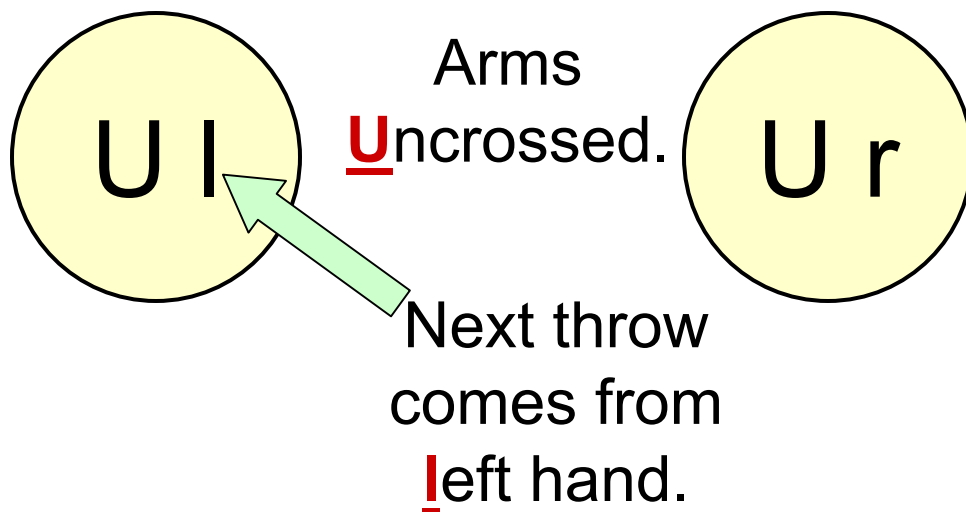
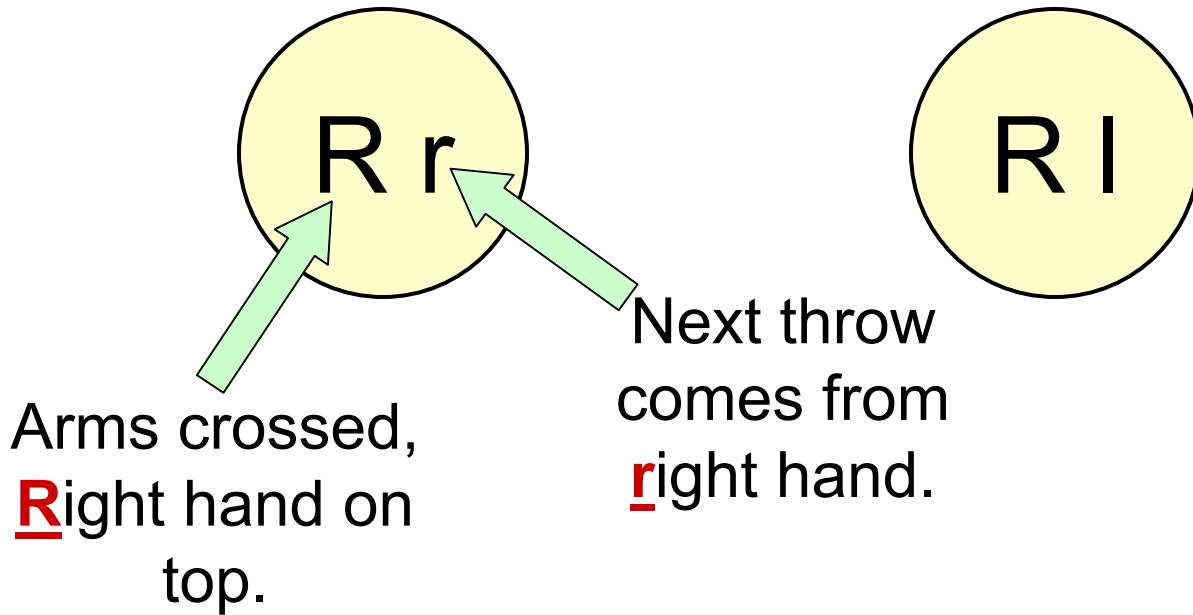
This guide uses a variant of Mike Day’s “Mills Mess State Transition Diagrams” (MMSTD) to illustrate some well-known (and not so well-known) crossed-arm juggling patterns.

The MMSTD is a modeling language that allows us to write down a concise description (model) of a crossed-arm juggling pattern that focuses on the essentials and leaves out unnecessary detail.

For crossed-arm patterns, the first essential piece of information is *the relative position of the arms when throws are made*. Are the arms crossed or uncrossed? If they’re crossed, which one is on top? And which hand throws next?

MMSTD answers these questions by identifying six possible *states*, which are illustrated on page 2.

Hand Positions (States)

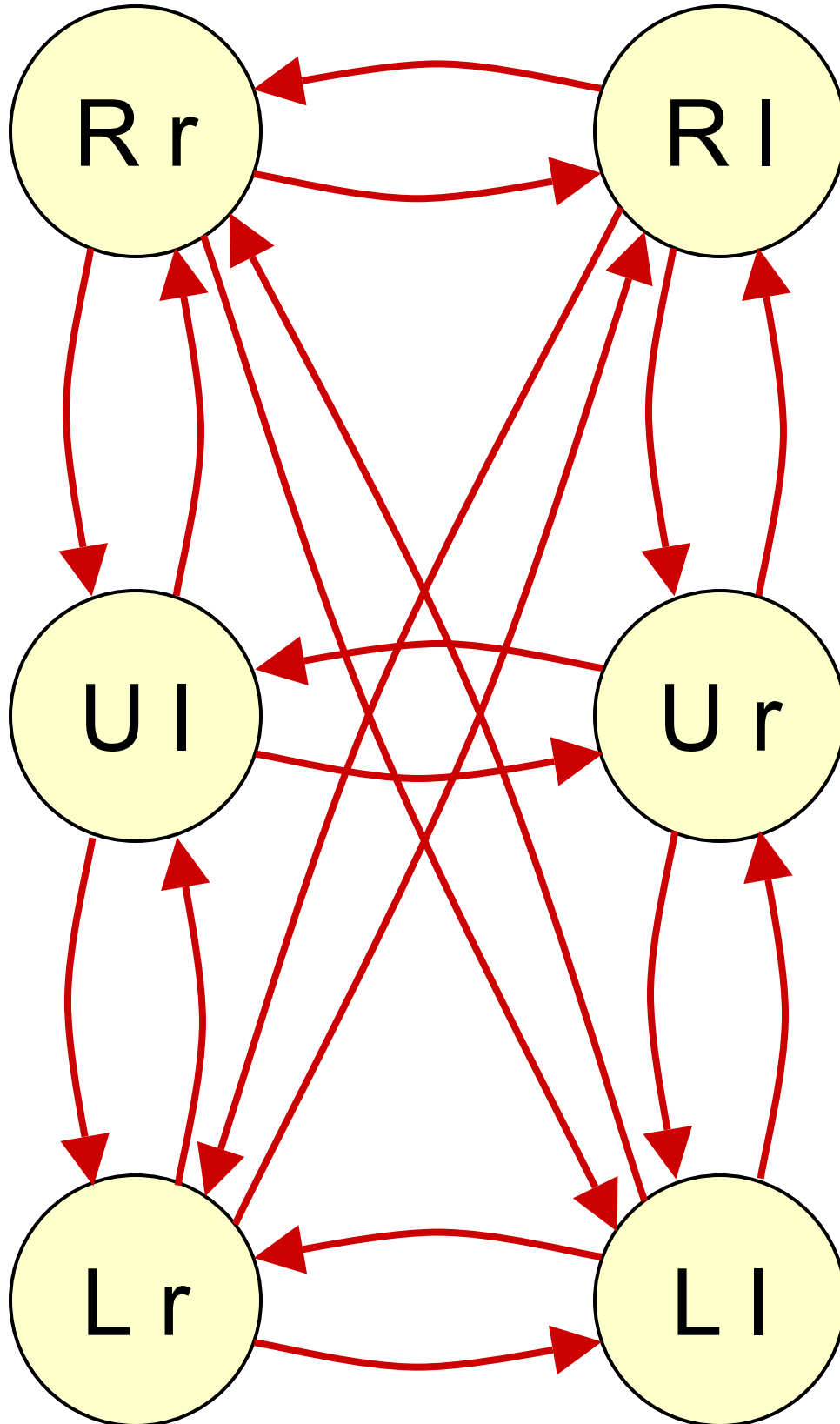


Each state on page 2 represents the position of the hands at the moment a throw is made. The next essential piece of information we need is *what the hands do after making a throw*. Do they stay in the same relative position? Or do they move to a new position? If so, which?

All the allowable hand movements, including no movement, are illustrated by the arrows on page 4. Note that *transitions* always take us from “left throwing next” to “right throwing next” and vice versa. So in *this particular variant* of the MMSTD we can only describe so-called *asynchronous* (L-R-L-R) patterns, but that’s good enough for today’s purposes.

If you happen to look at the description of MMSTD in Charlie Dancey’s *Encyclopedia of Ball Juggling* you’ll notice a couple of differences: Dancey distinguishes between cascade and reverse cascade throws by having different types of arrows, and he also doesn’t include the long arrows running from corner to corner of the diagram.

Throws and Movement (Transitions)



Now that we know about hand positions and how they change, the last thing we need to add is some information about the throws themselves. For this we will mostly use *asynchronous siteswap notation*. A quick summary:

- imagine a metronome marking a steady beat
- we throw on each and every beat
- we alternate left and right hand throws
- we write the siteswap representation of juggling pattern as a string of numbers, one number for each throw, where the number represents how many beats later that object must be back in the hand and ready to re-throw

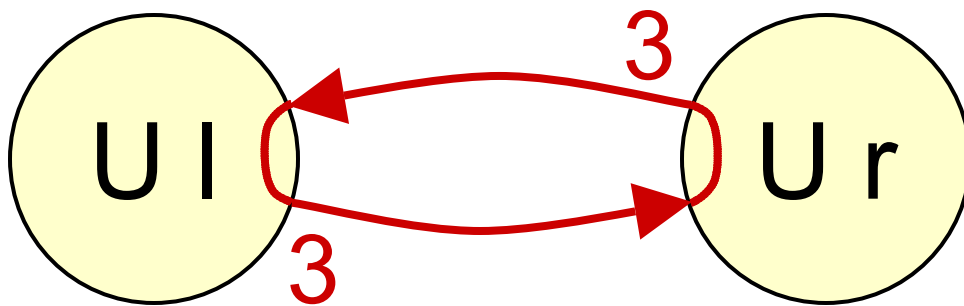
Using this definition we find that the siteswap for a three-ball cascade is just a series of threes (which we abbreviate as ‘3’); the siteswap for a four-ball fountain is 4, and so on. The siteswap for a three ball shower is 51 — the high throws are fives and the low crossing throws are ones.

For more thorough explanations see www.jugglingdb.com/articles/?id=29 or www.juggling.org/help/siteswap/

3-ball Cascade **3**



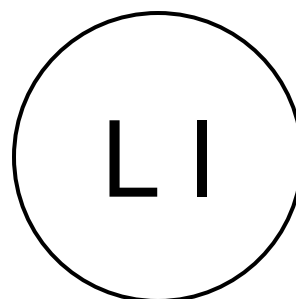
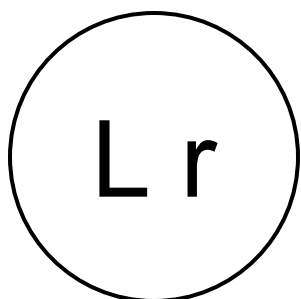
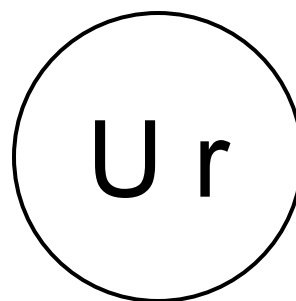
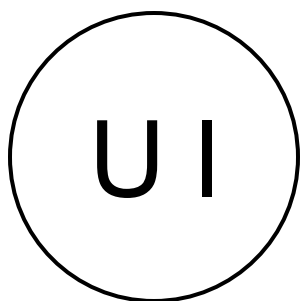
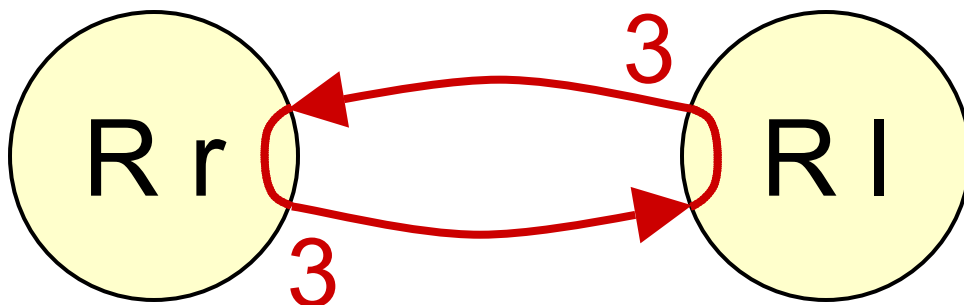
We add asynchronous siteswap numbers to the arrows to indicate the throw type.



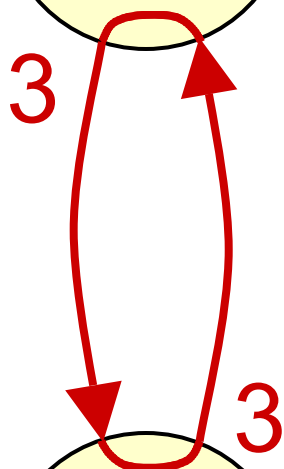
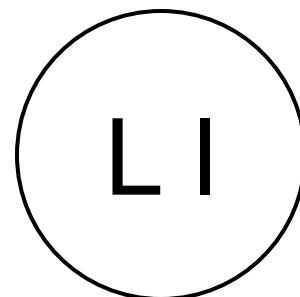
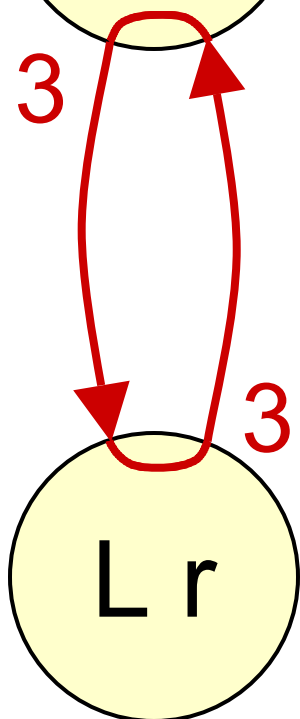
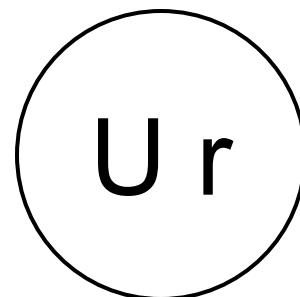
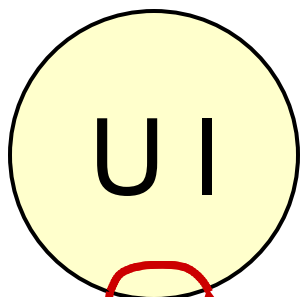
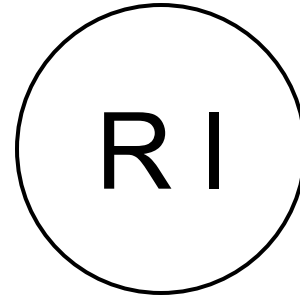
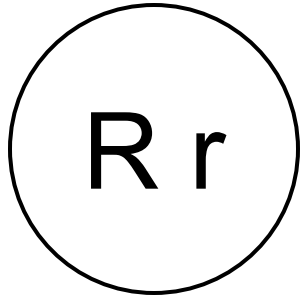
To get an n ball cascade or fountain for any number n , simply replace the 3's with n 's.



Hands-crossed 3-ball Cascade **3**

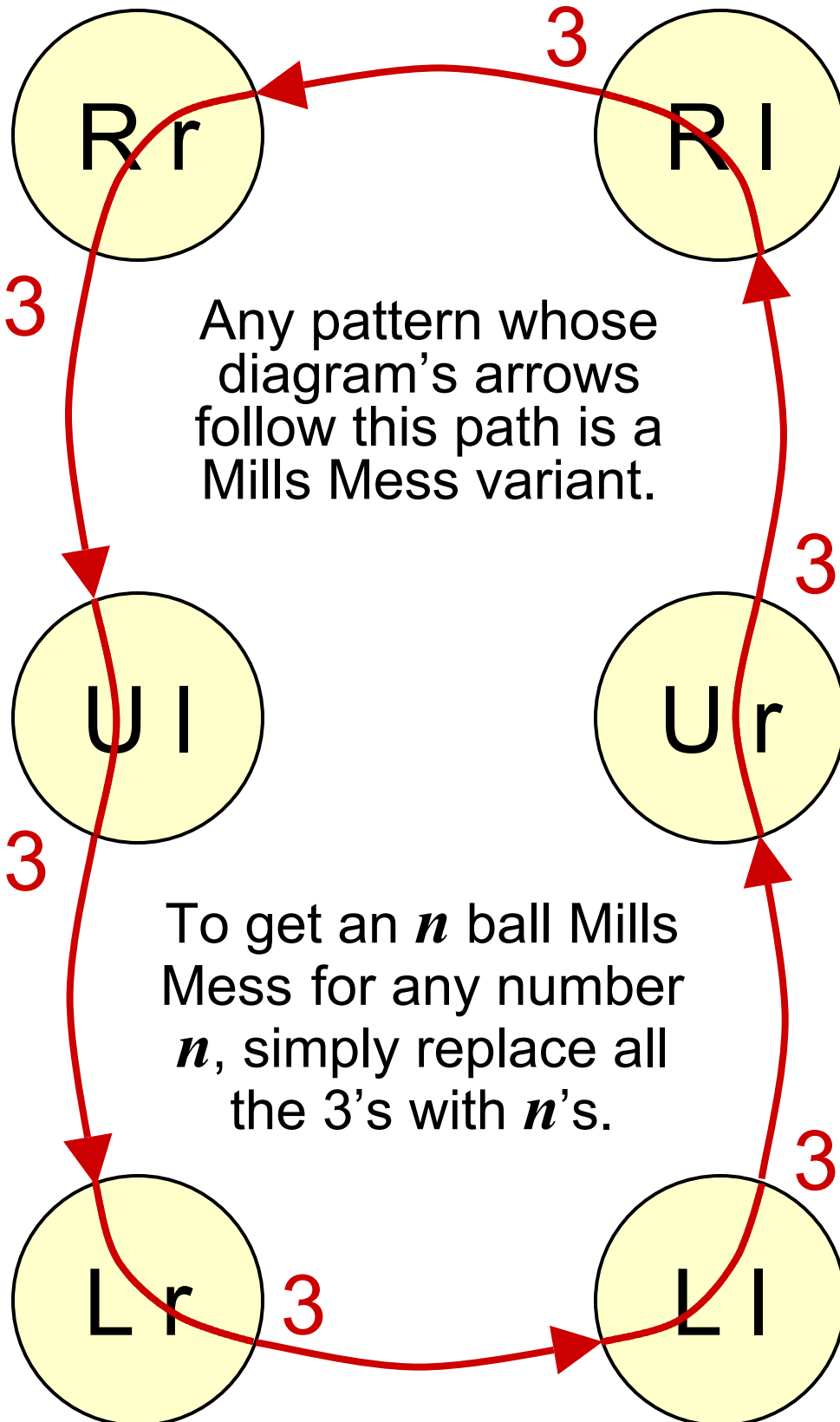


Windmill **3** (Left side)



Pop quiz: how do we
draw a right-side
Windmill?

Mills Mess 3

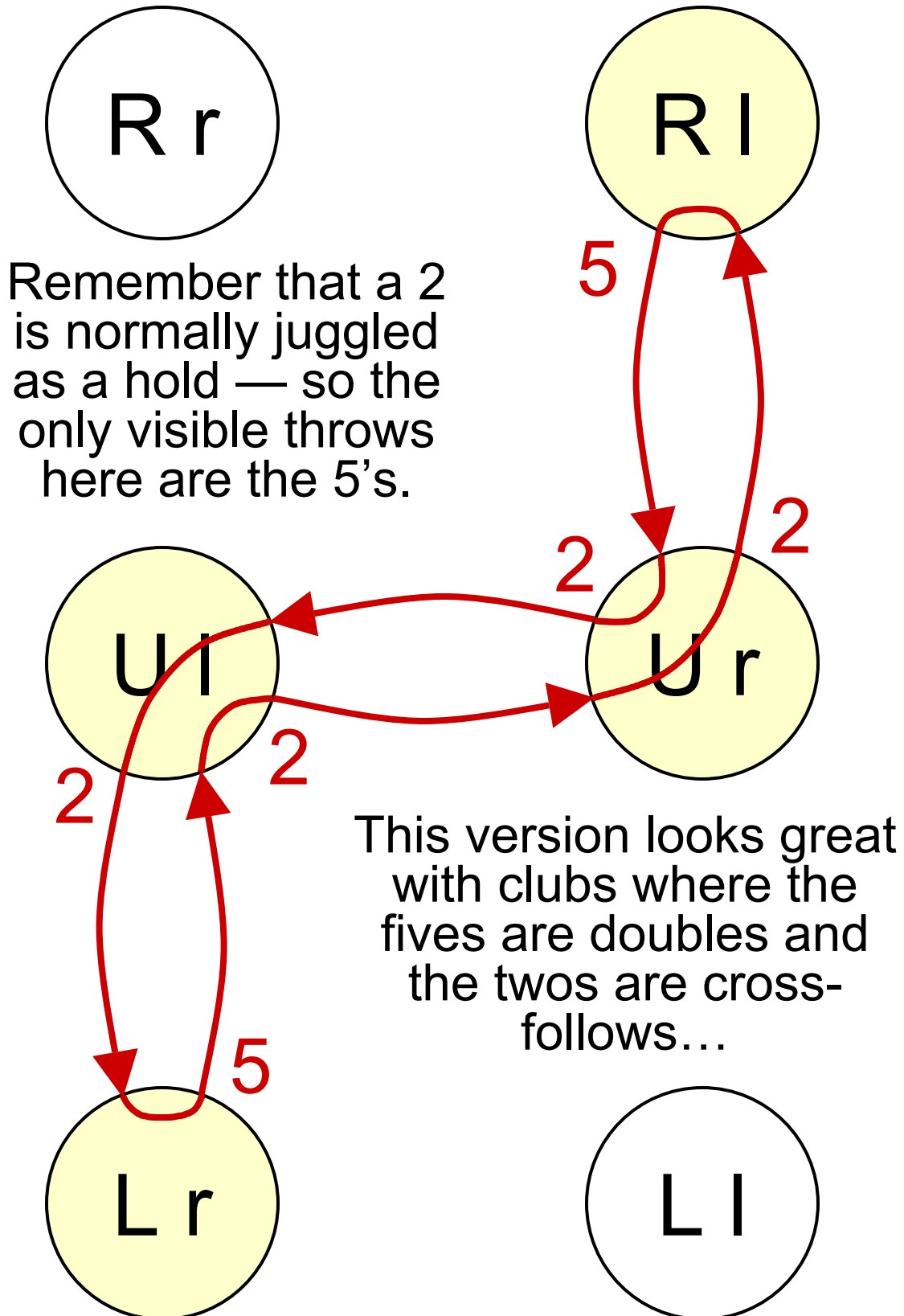


I mentioned earlier that the MMSTD notation was invented by Mike Day. Mike is also one of the co-inventors of siteswap notation, which was created independently by three different people at about the same time in 1985 — the other two were Paul Klimek and Bruce Tiemann (a.k.a. Boppo, who coined the term “siteswap”).

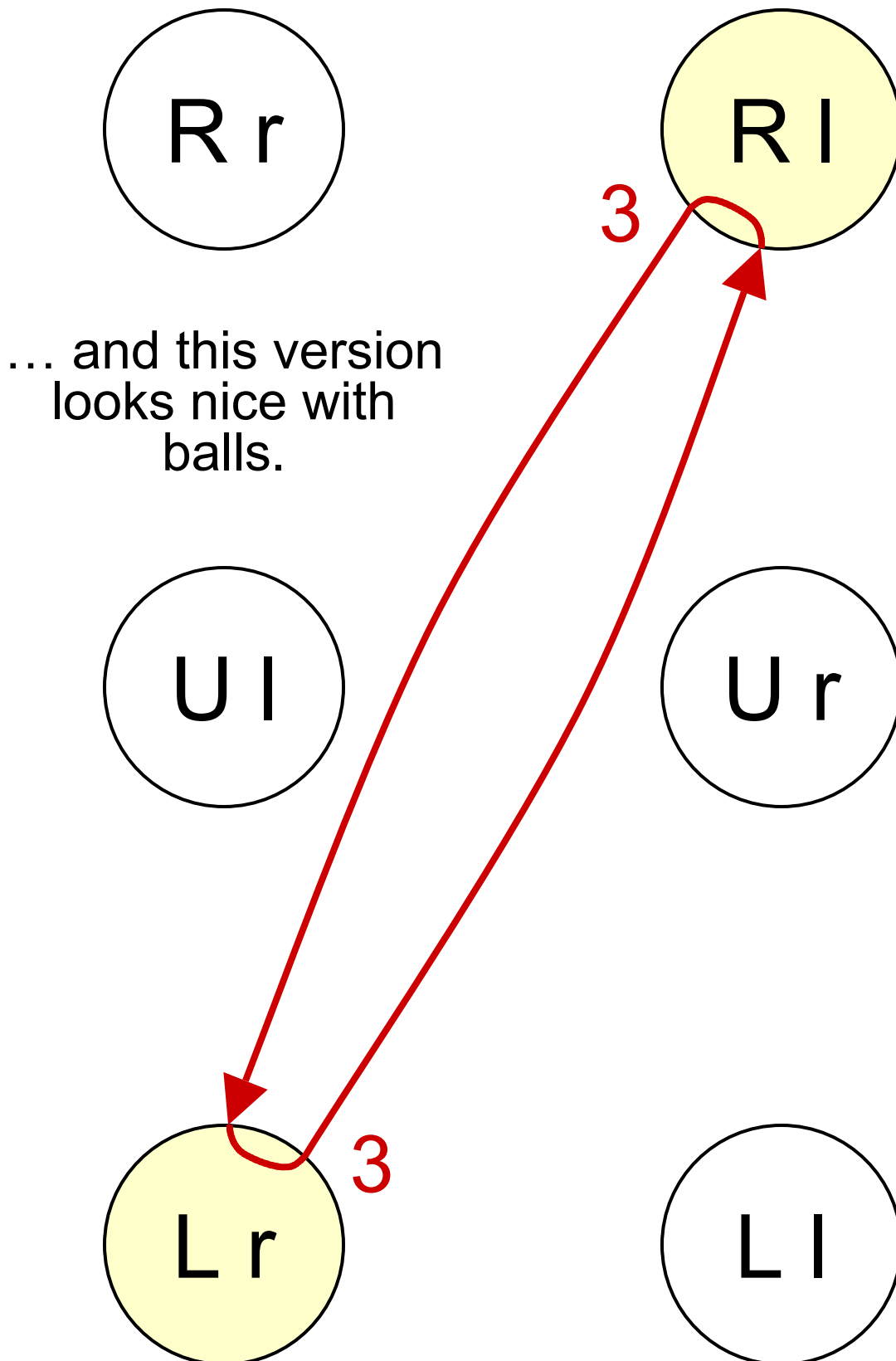
Mike Day is also the Mike in the Mike’s Mess juggling pattern, illustrated on page 9. He invented the pattern by playing around with the notation and seeing what came out; as you might imagine there are many more crossed-arm juggling patterns waiting to be discovered in the MMSTD.

Note that in siteswap notation a two can indicate a very quick “throw to the same hand” but it can also be “juggled” simply by holding onto the ball. The siteswap 522 is sometimes called the slow cascade. Mike’s Mess is a slow cascade with each throw made under the opposite arm.

Mike's Mess **522**

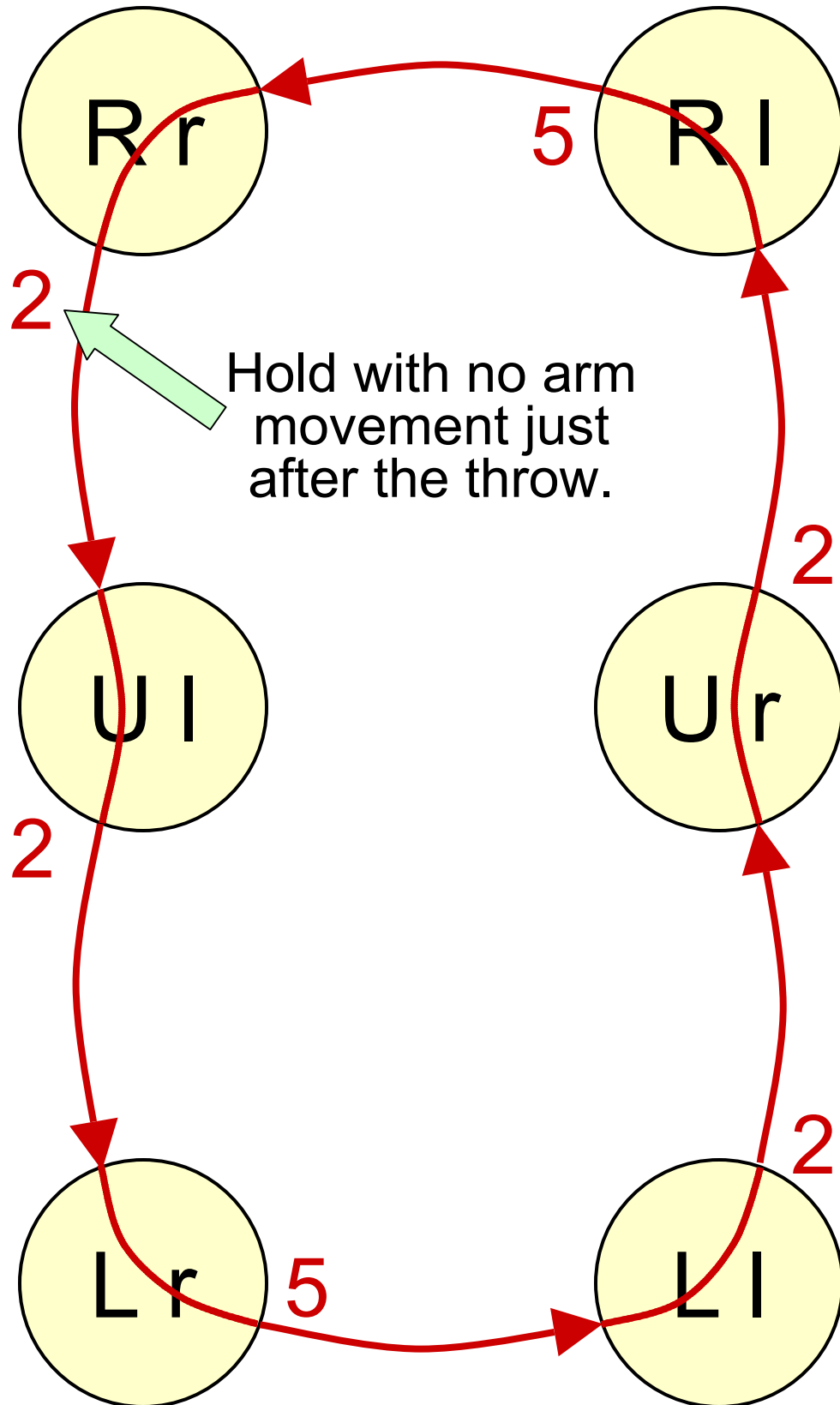


Fast and Low Mike's Mess **3**



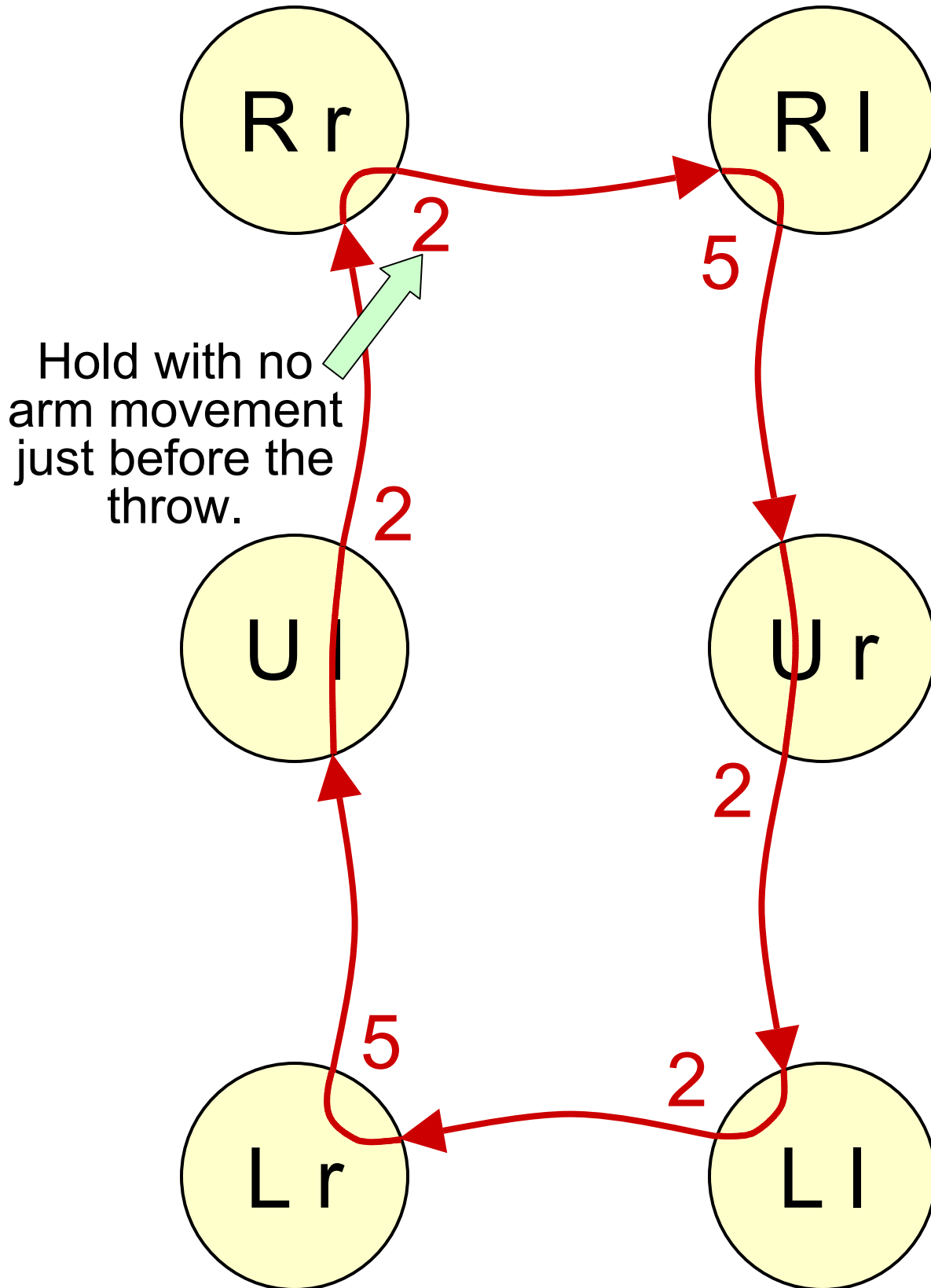
A Jerky

“Not Mike’s Mess” **522**



Another Jerky

“Not Mike’s Mess” **522**



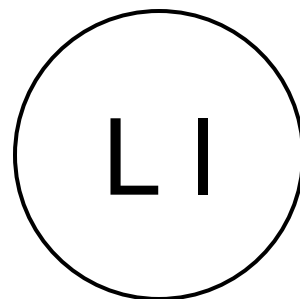
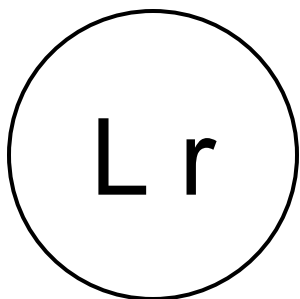
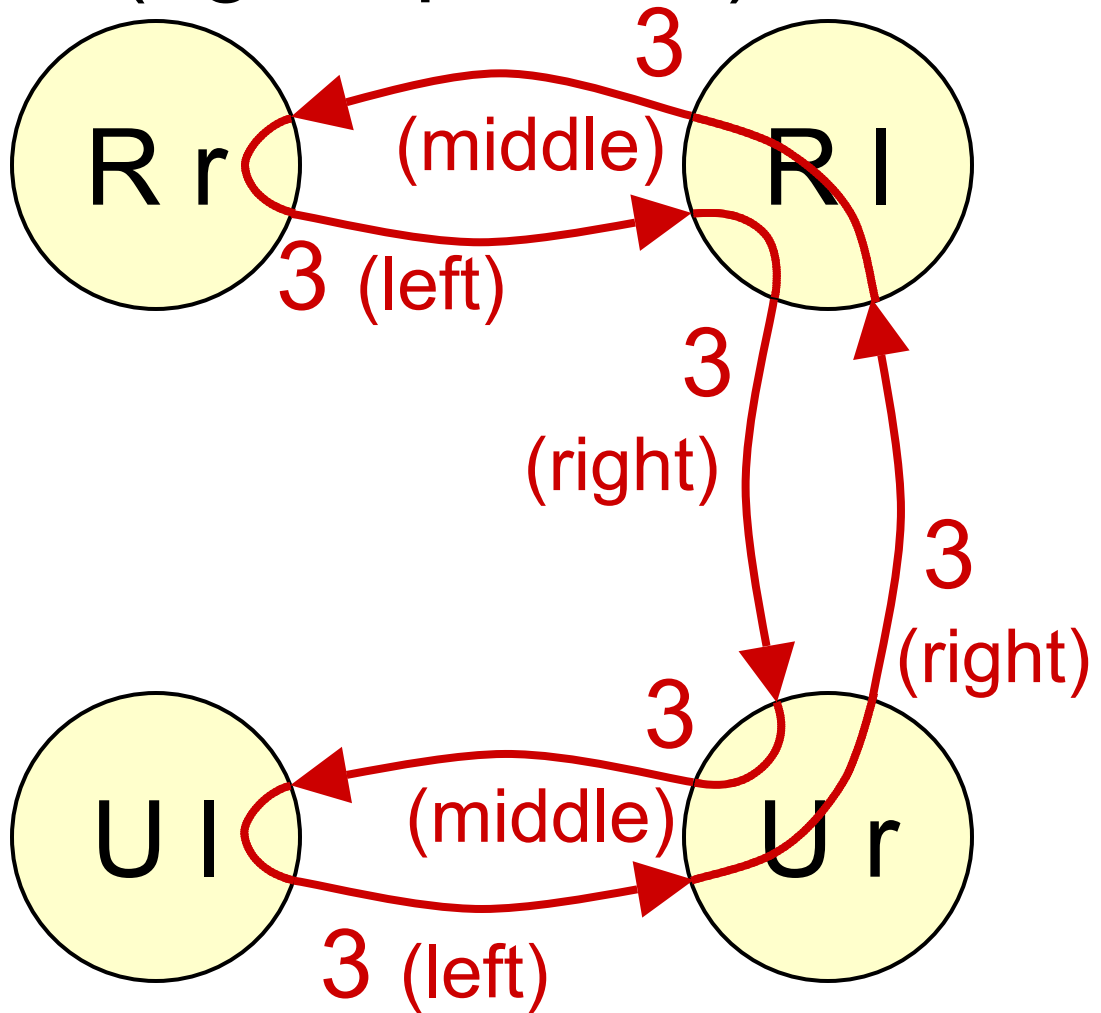
I had always been told that the Boston Mess was essentially “Mills Mess juggled in columns.” I more or less believed this explanation until the first time I drew the MMSTD for the Boston Mess, which you can see on page 16. It seems pretty clear to me that this isn’t Mills Mess at all since the diagrams look nothing alike.

If that was surprising, you can imagine my surprise when I realized that there are at least *six* distinct patterns that can reasonably be called the Boston Mess. These are illustrated on pages 16 through 21.

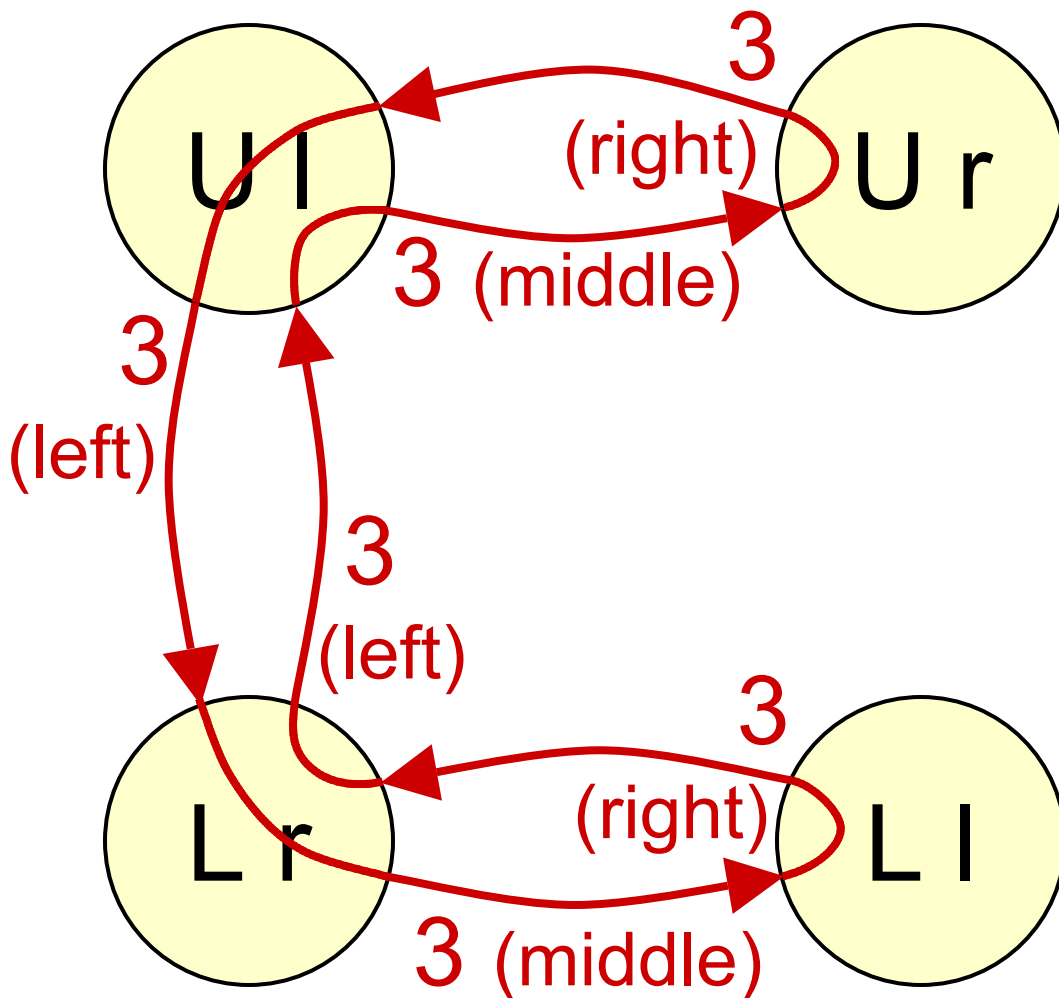
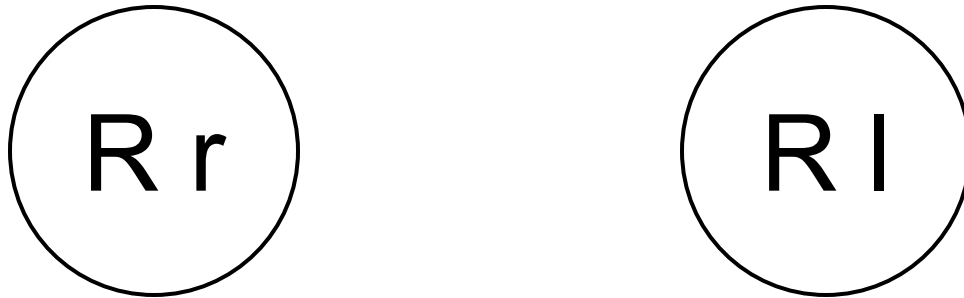
Three of the Boston Messes are juggled with the columns in left-right-middle (LRM) order and three are juggled RLM. Two have the right hand crossing over the left, two have the left over the right, and two alternate left over right with right over left. Each feels distinctly different and all six are fun to learn.

Boston Mess

(right up, LRM) **3**

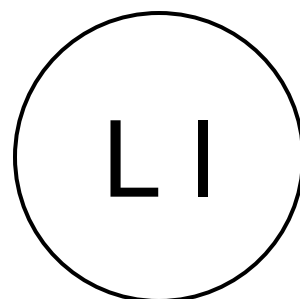
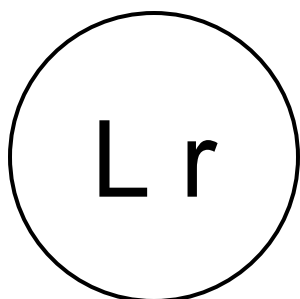
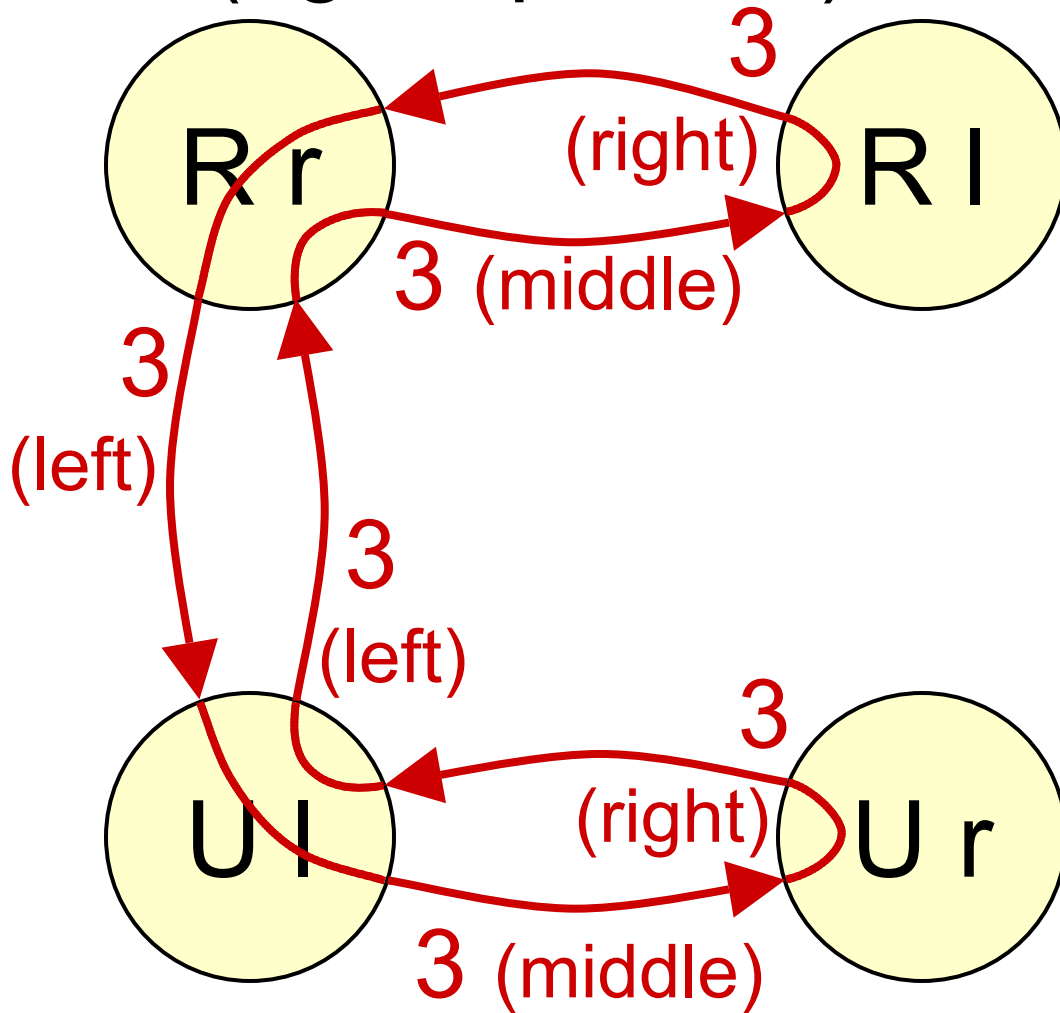


Boston Mess (left up, RLM) **3**

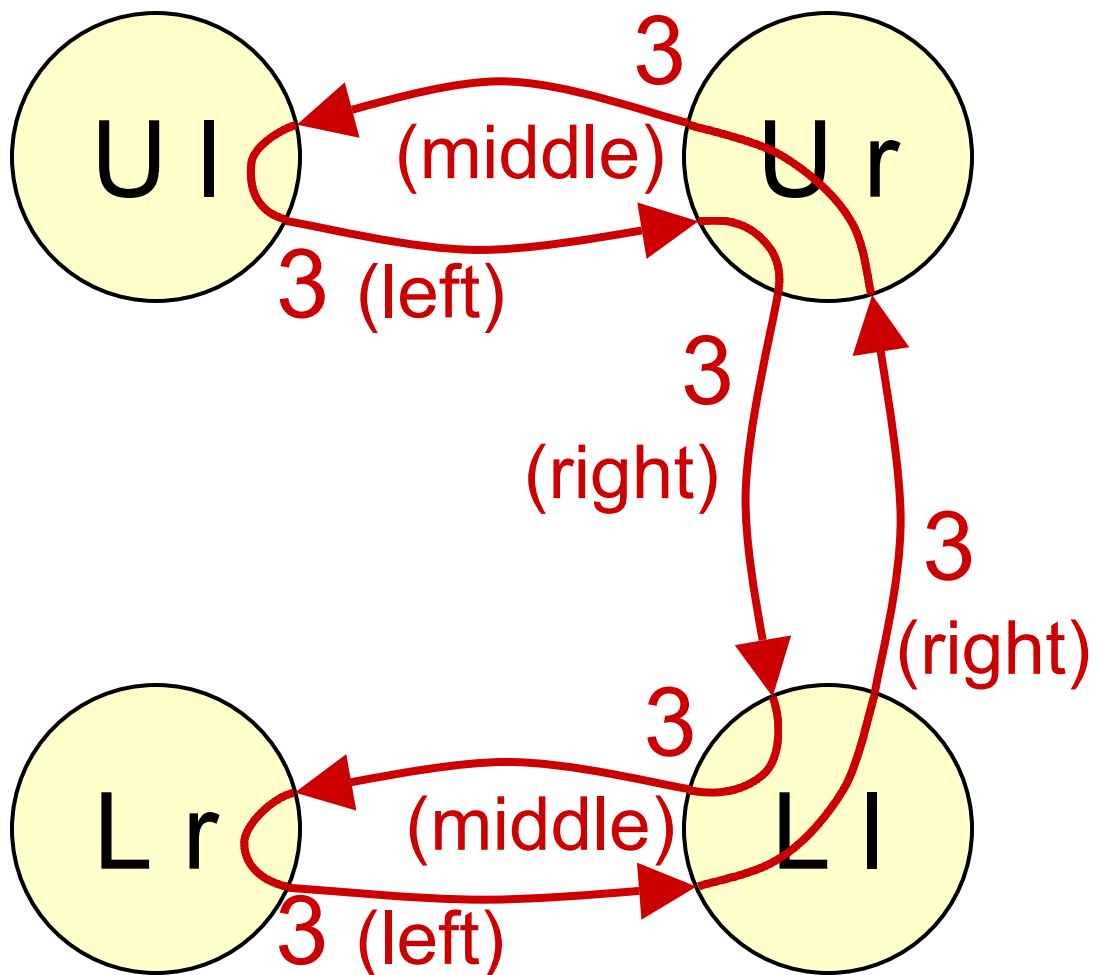


Boston Mess

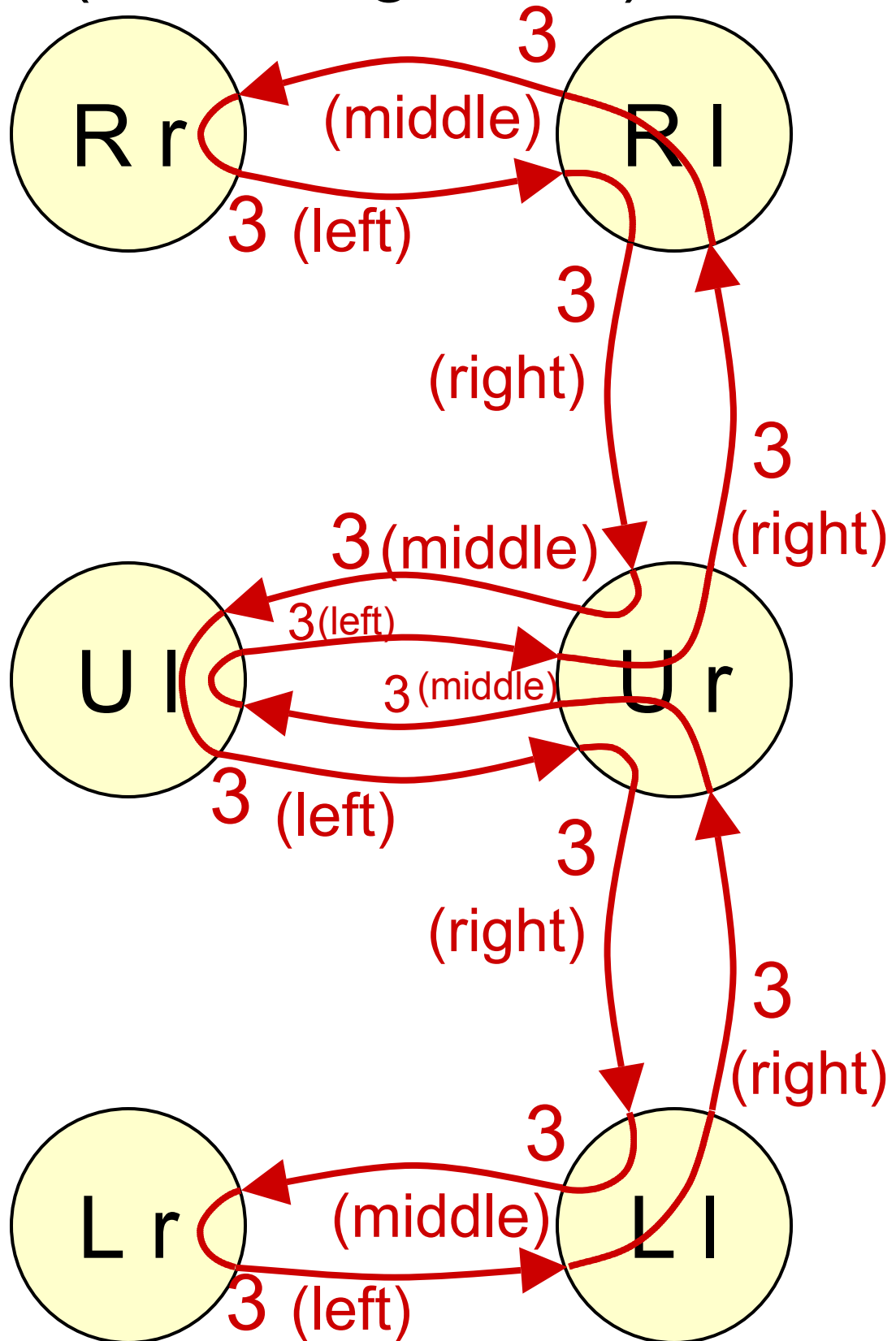
(right up, RLM) **3**



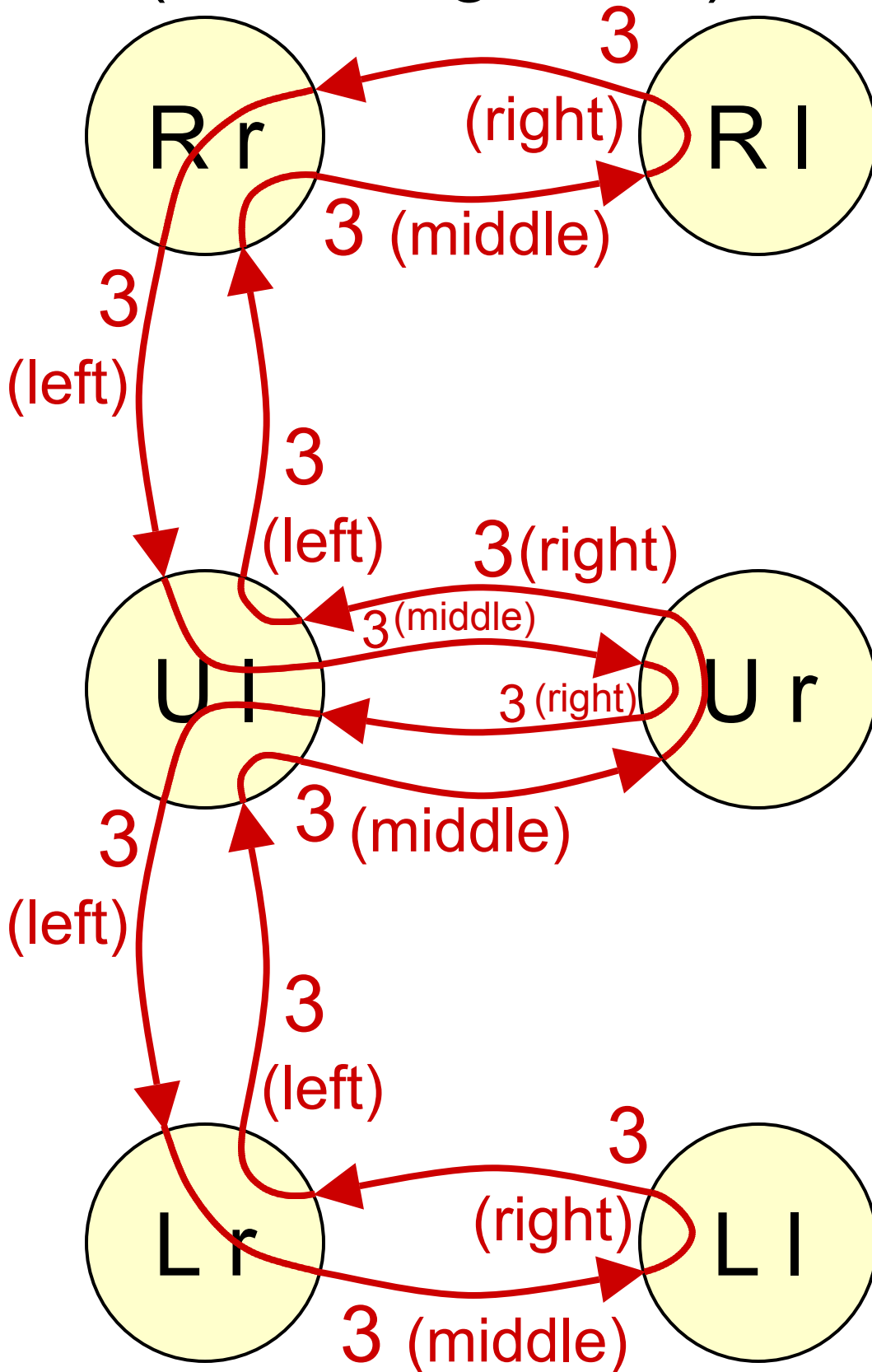
Boston Mess (left up, LRM) **3**



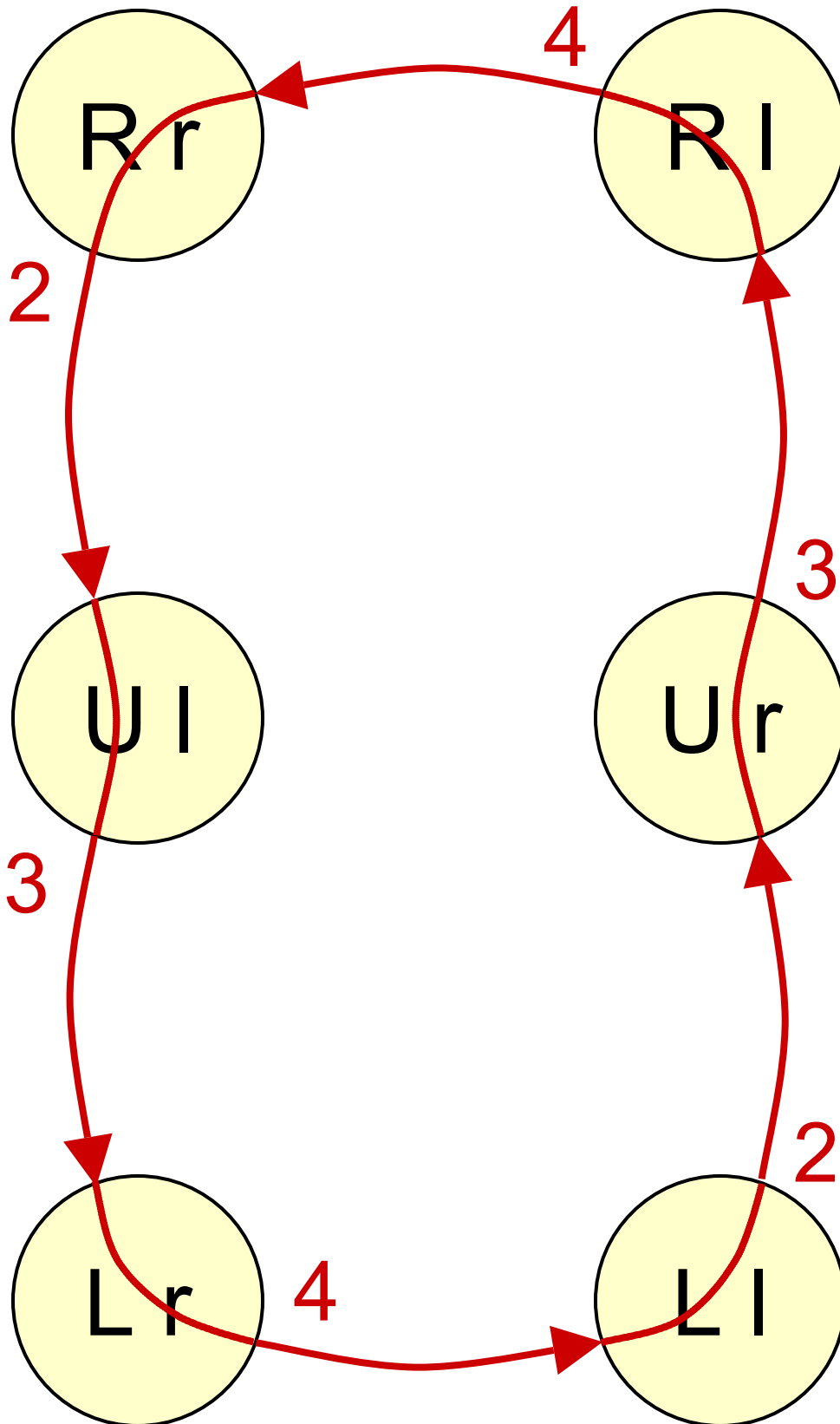
Boston Mess (switching, LRM) **3**



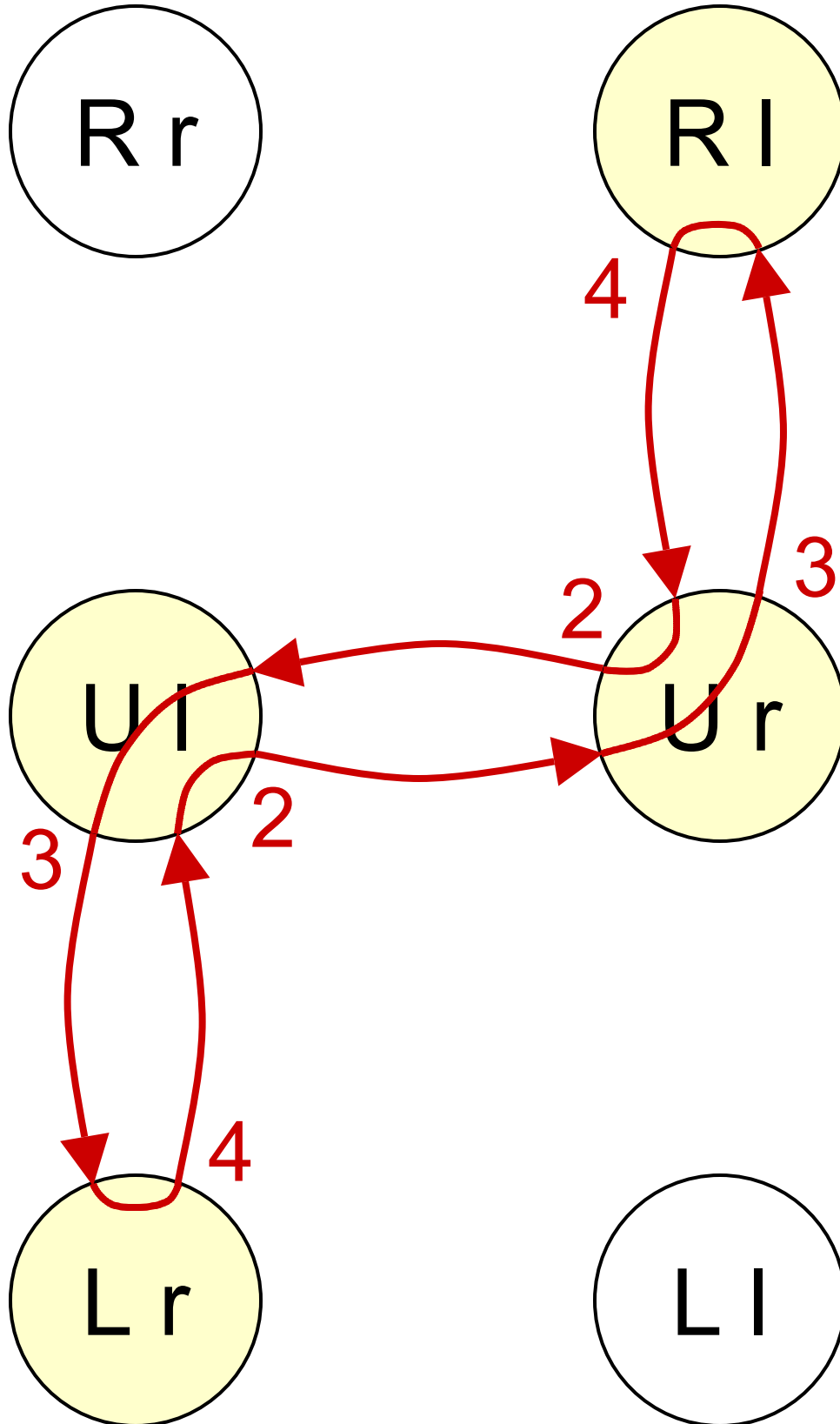
Boston Mess (switching, RLM) **3**



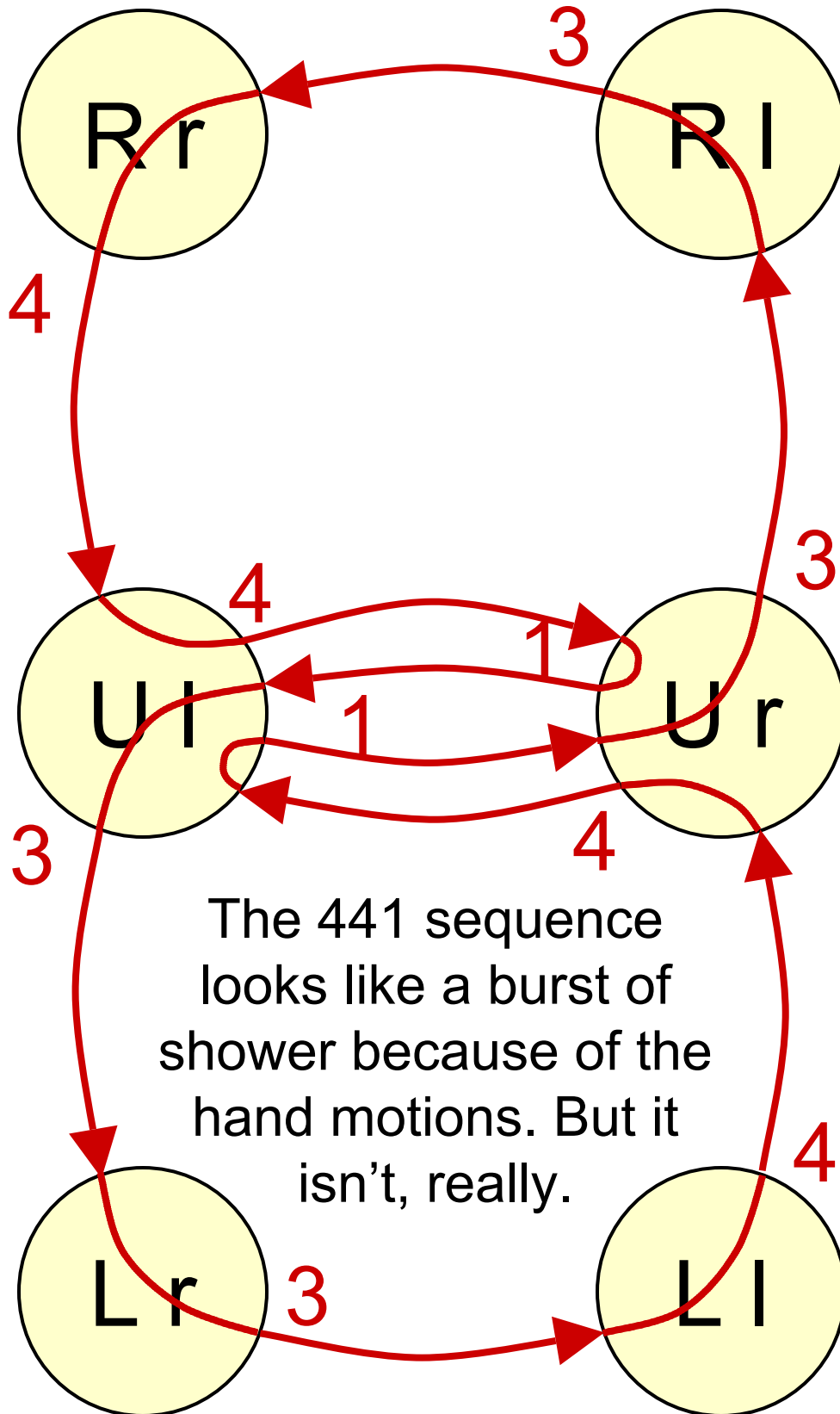
Burke's Barrage **423**



Windshield Wipers 423

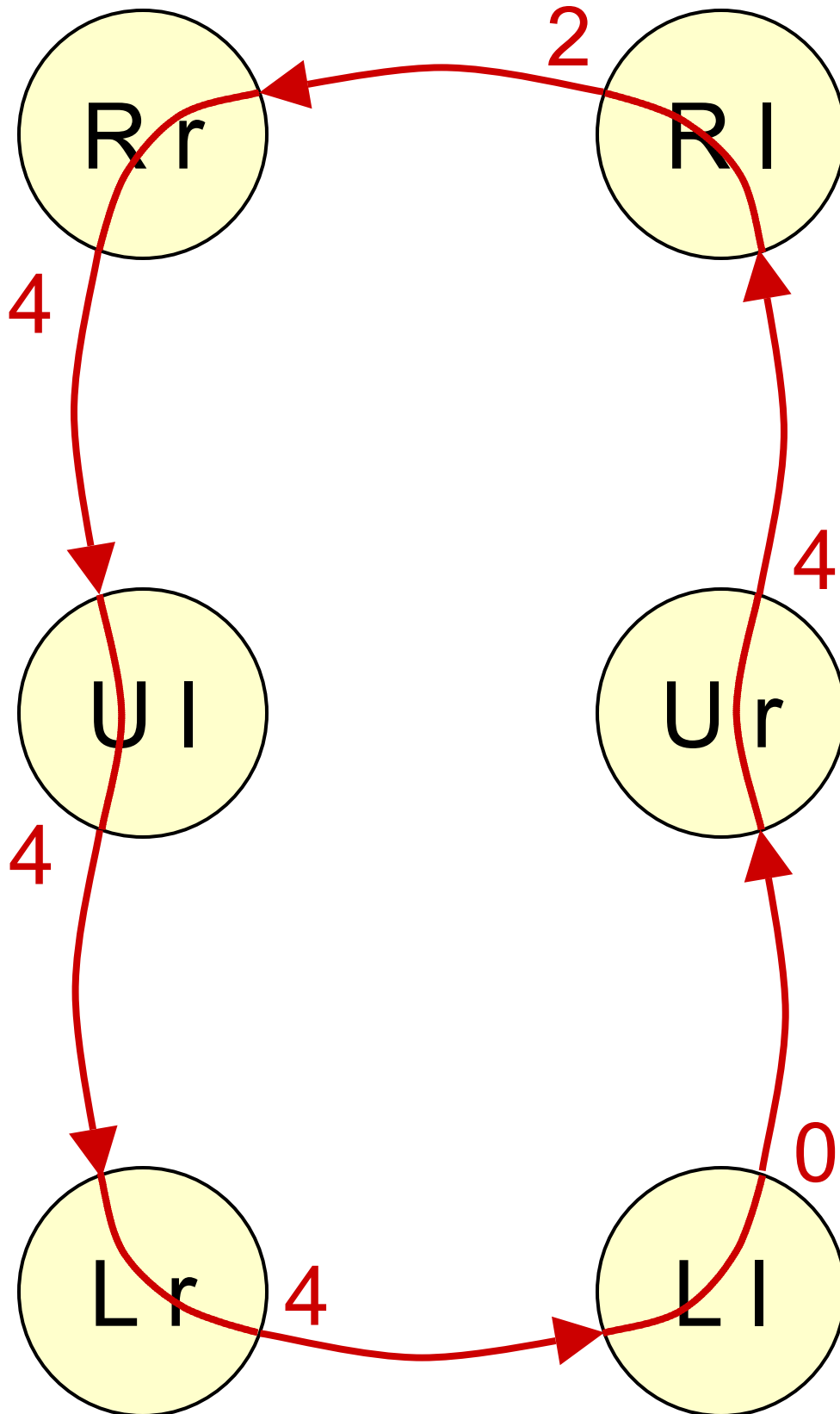


Mills Mess with a burst of “shower” **441333**

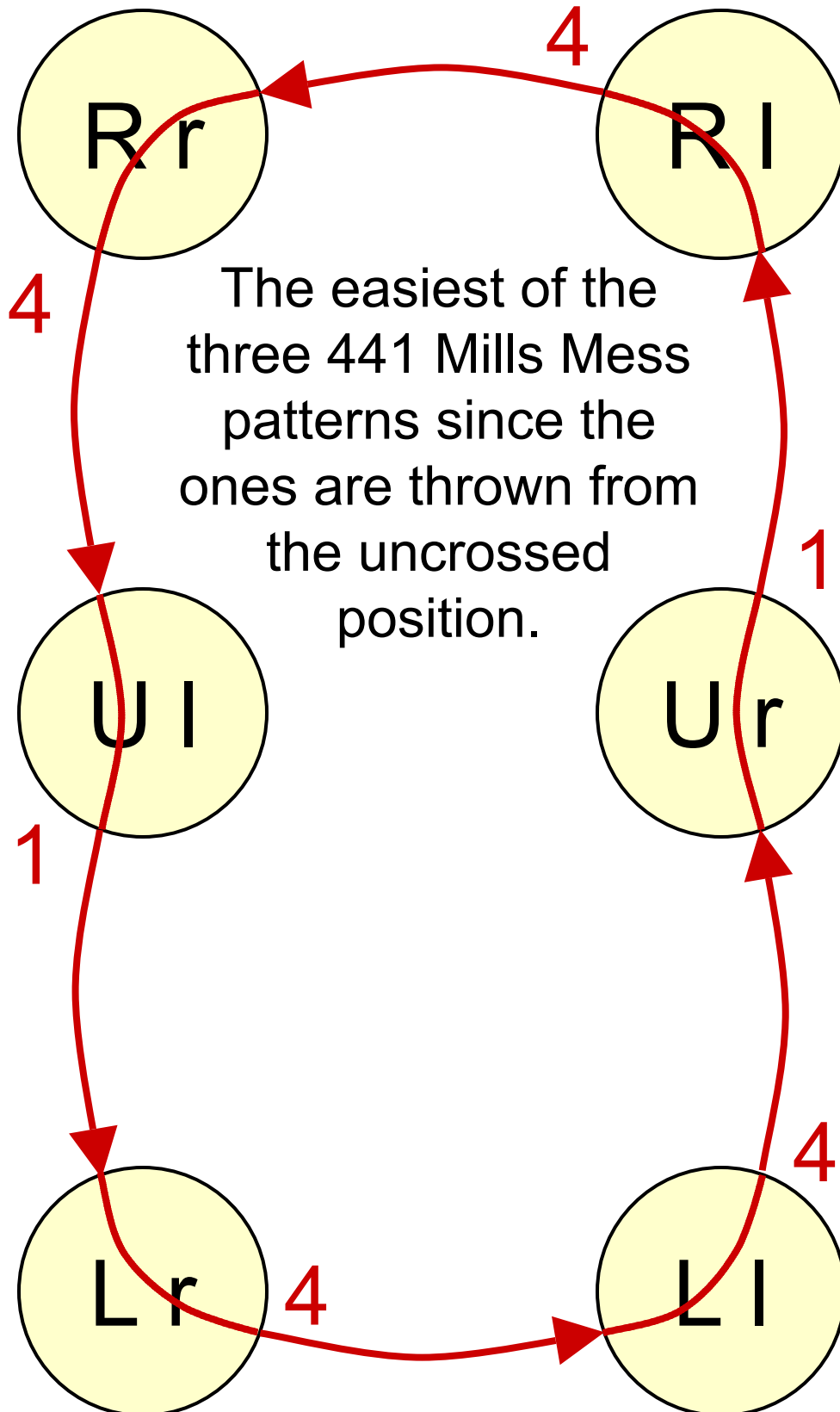


The Geyser

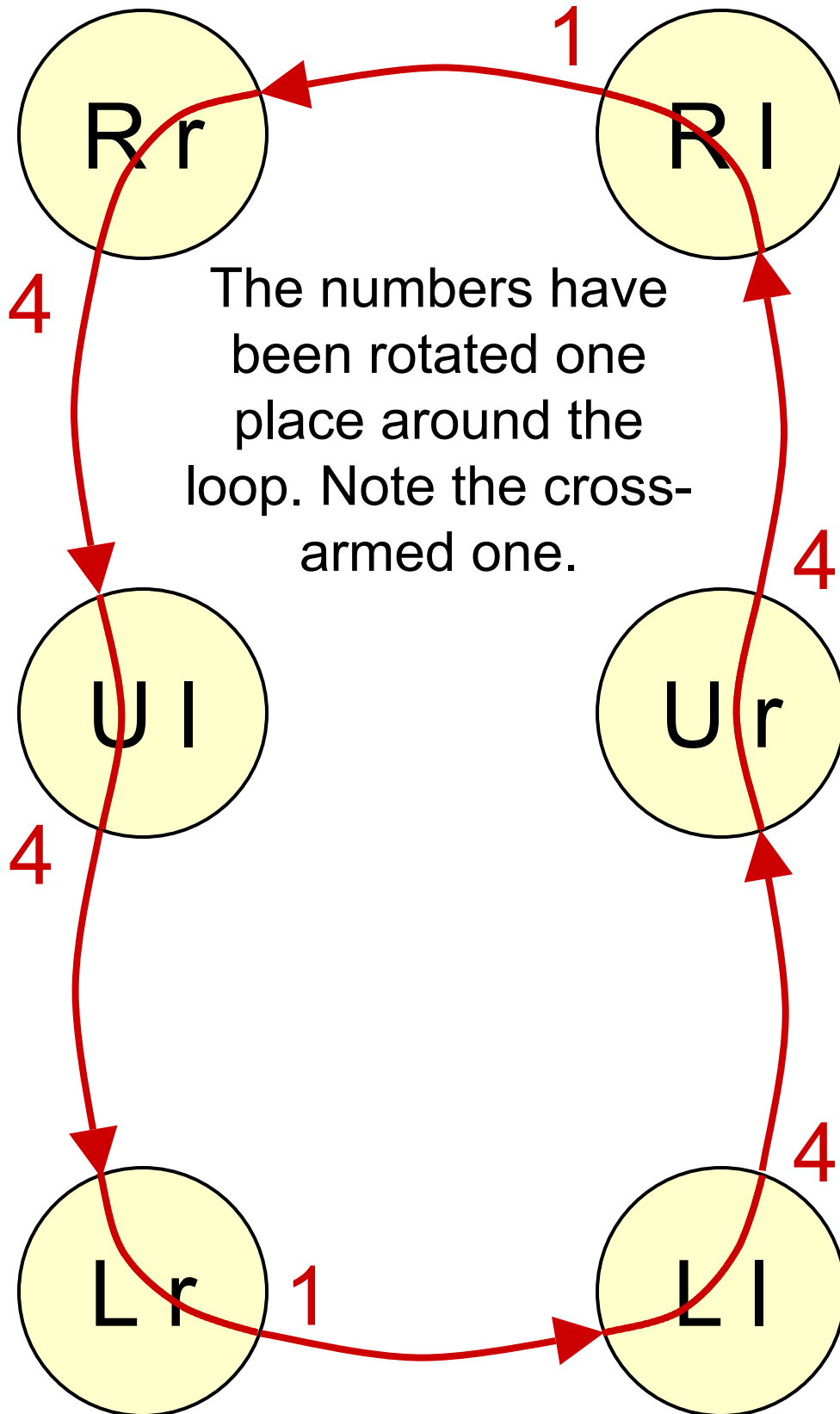
444042



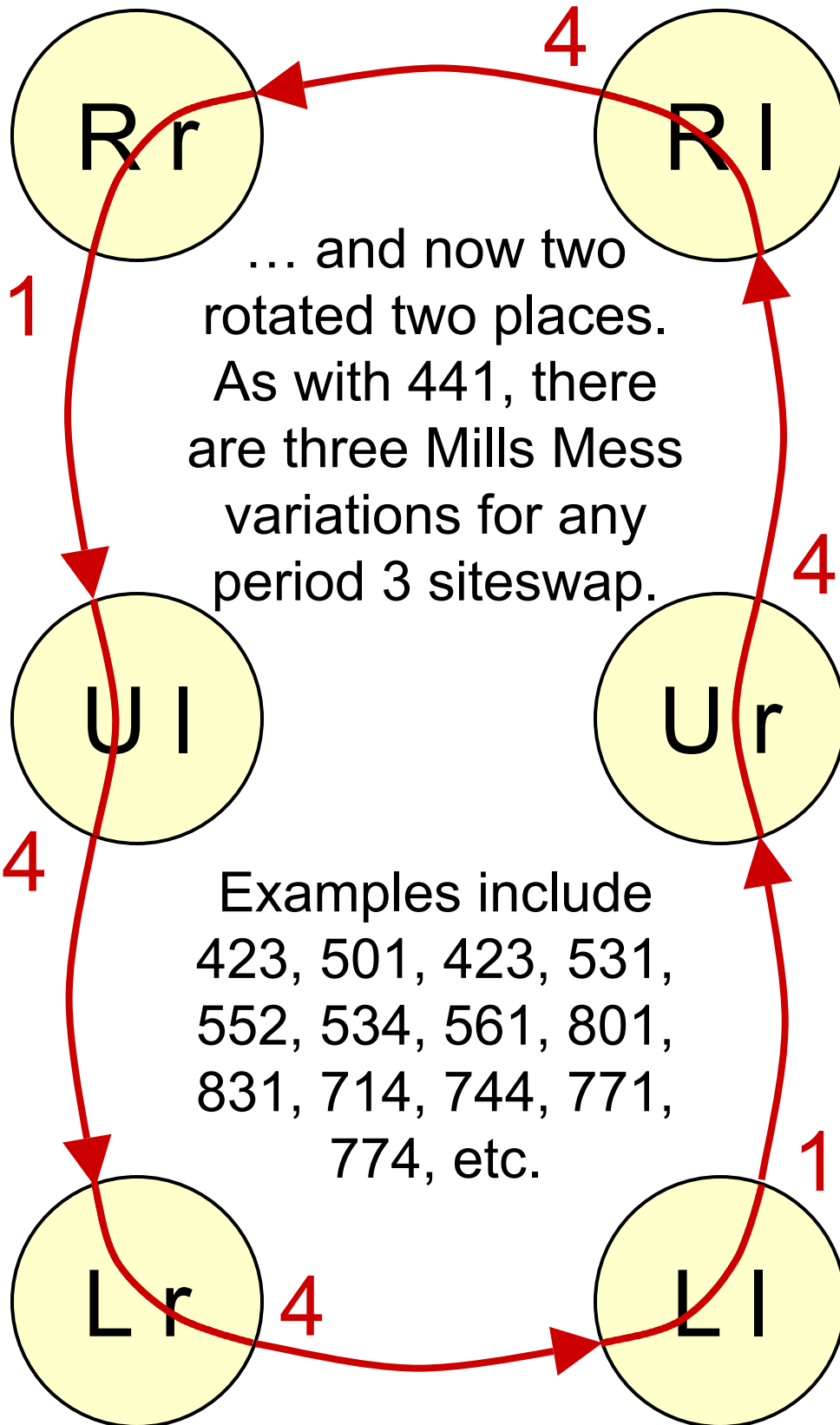
441 Mills Mess (a)



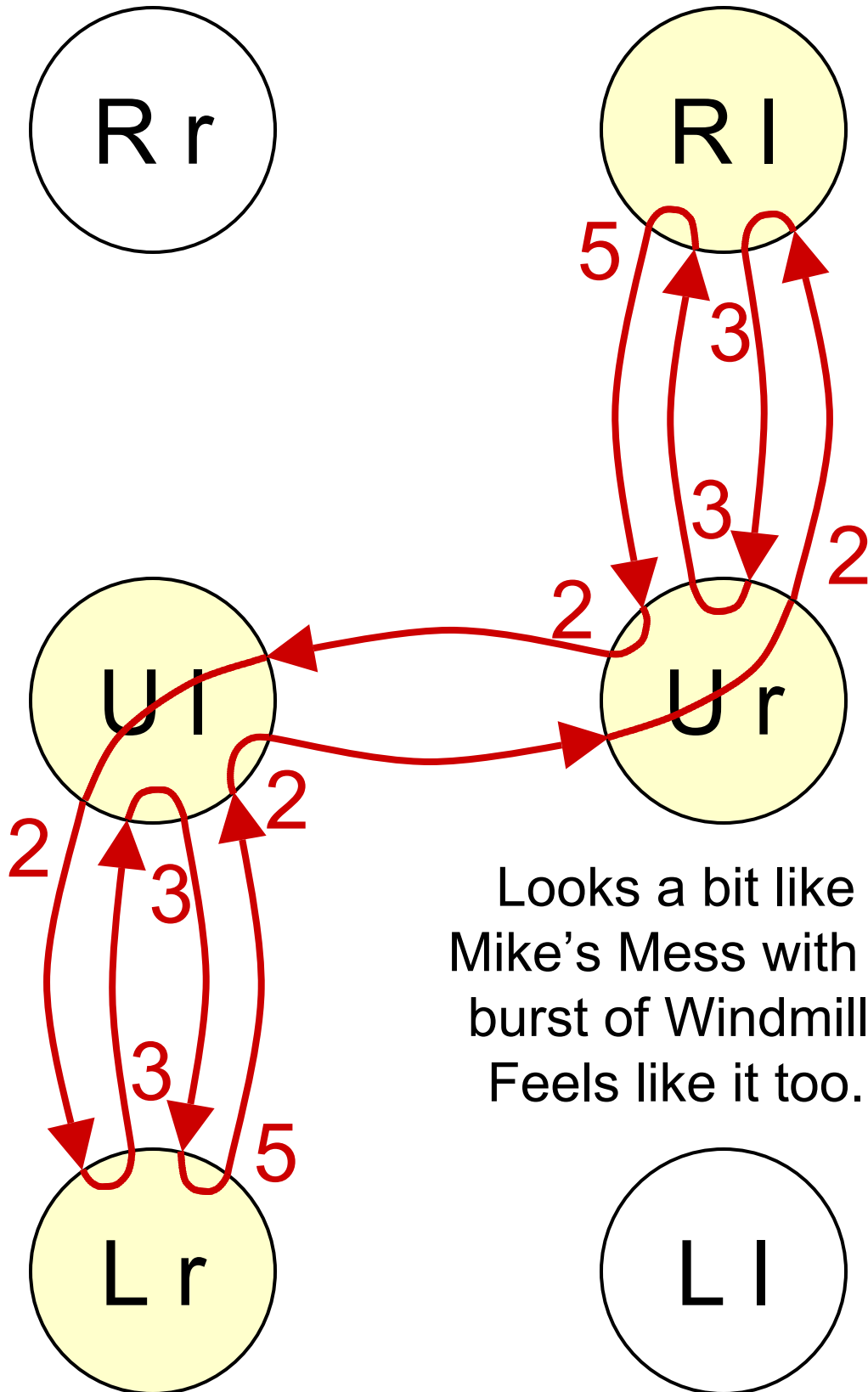
441 Mills Mess (b)



441 Mills Mess (c)



Rubenstein's Revenge **52233**

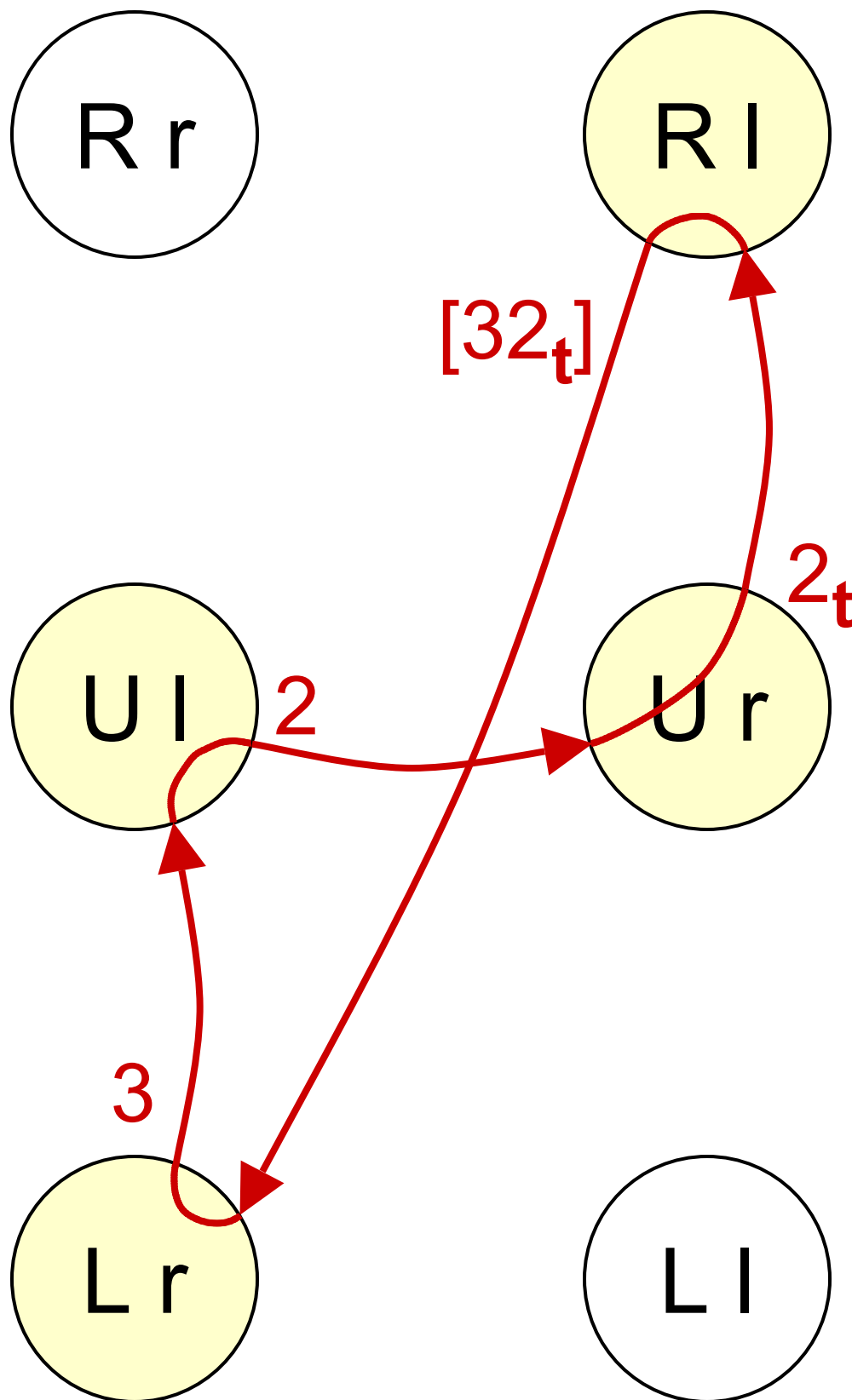


Looks a bit like
Mike's Mess with a
burst of Windmill.
Feels like it too.

These last few patterns involve throwing multiple objects at the same time from one hand. These *multiplex throws* are written in square brackets. [32] means a single throw, of two objects, where one will be re-thrown three beats later and the other re-thrown two beats later. In the patterns on the following pages all the multiplexed twos as well as some of non-multiplexed twos are thrown and then clawed; for clarity I've indicated thrown twos as "2_t".

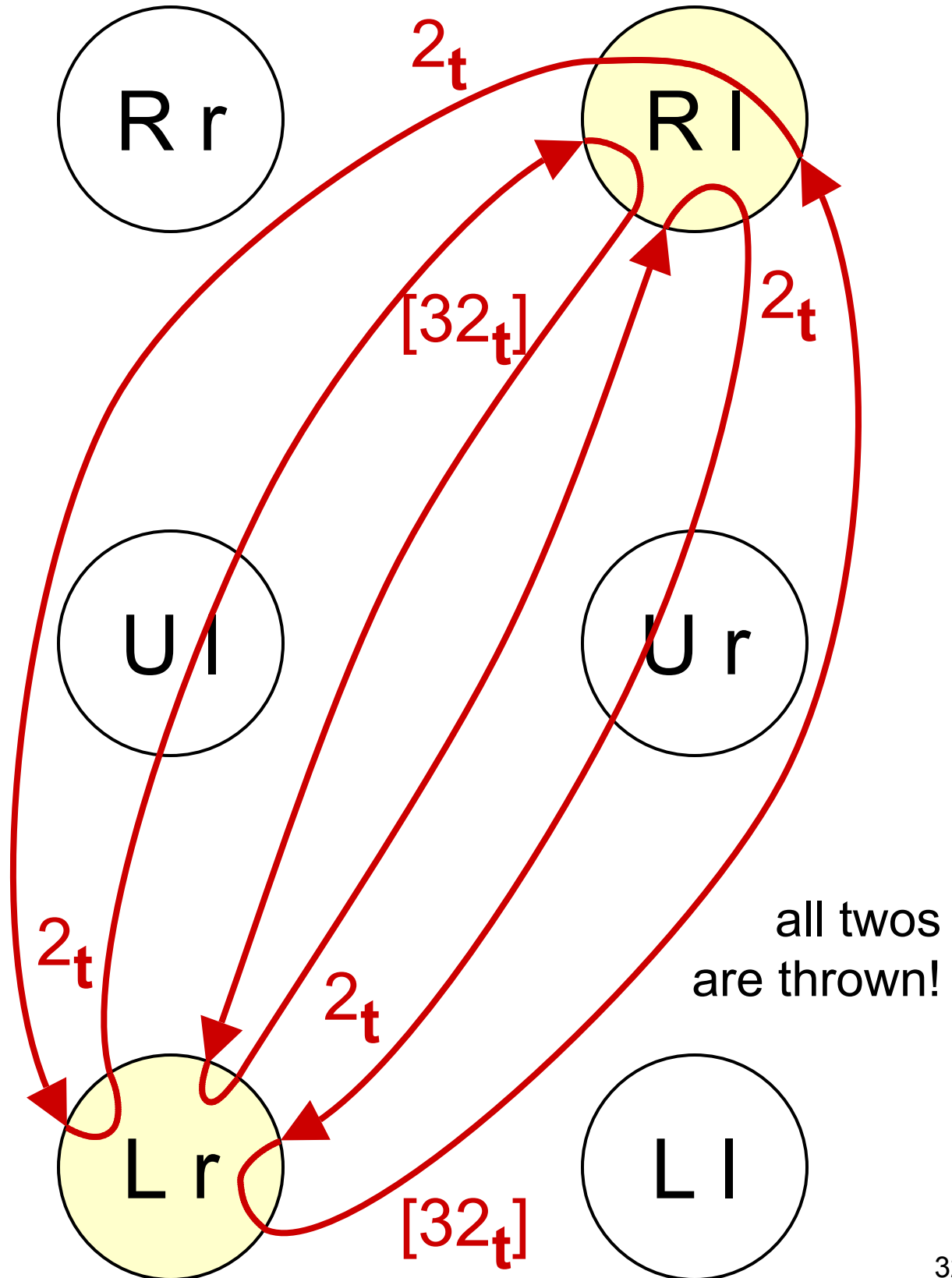
The original Georgian Shuffle was invented in 1991 by some bored jugglers waiting for a plane at the Moscow airport on their way to a juggling festival in Tblisi Georgia, USSR. The version on page 31 is a variation invented by Colin E. The 3-ball Singapore Shuffle was invented by Loh Koah Fong of Singapore in 1999 as a symmetric extension of Colin's Georgian Shuffle. In 2001 Koah Fong extended it to four balls, and a few weeks later I extended it to five. It seems obvious once you see the diagrams, but it wasn't at the time. The Kingston Shuffle is brand new!

Colin E.'s Georgian Shuffle Variation $[32_t]322_t$

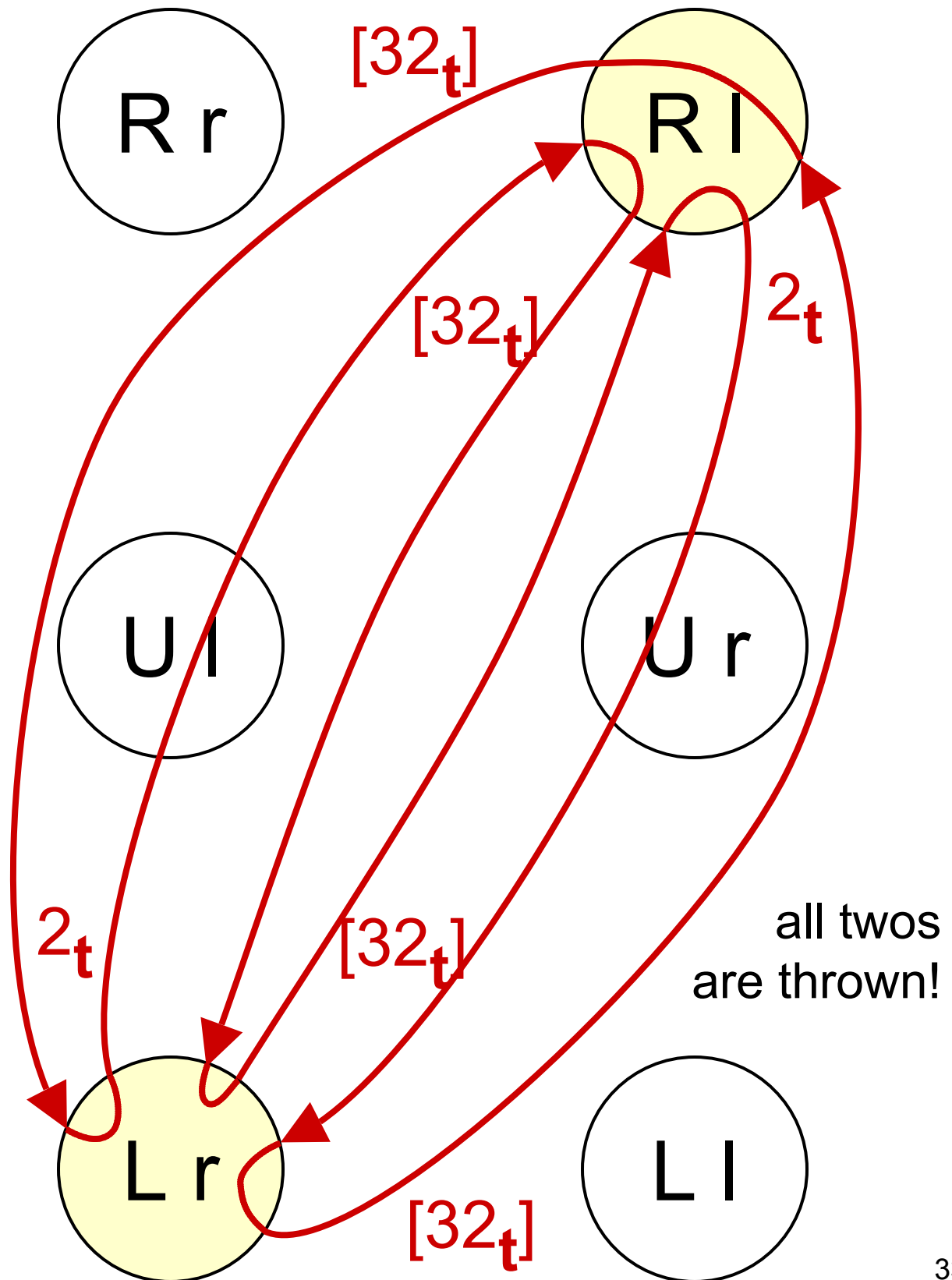


Singapore Shuffle

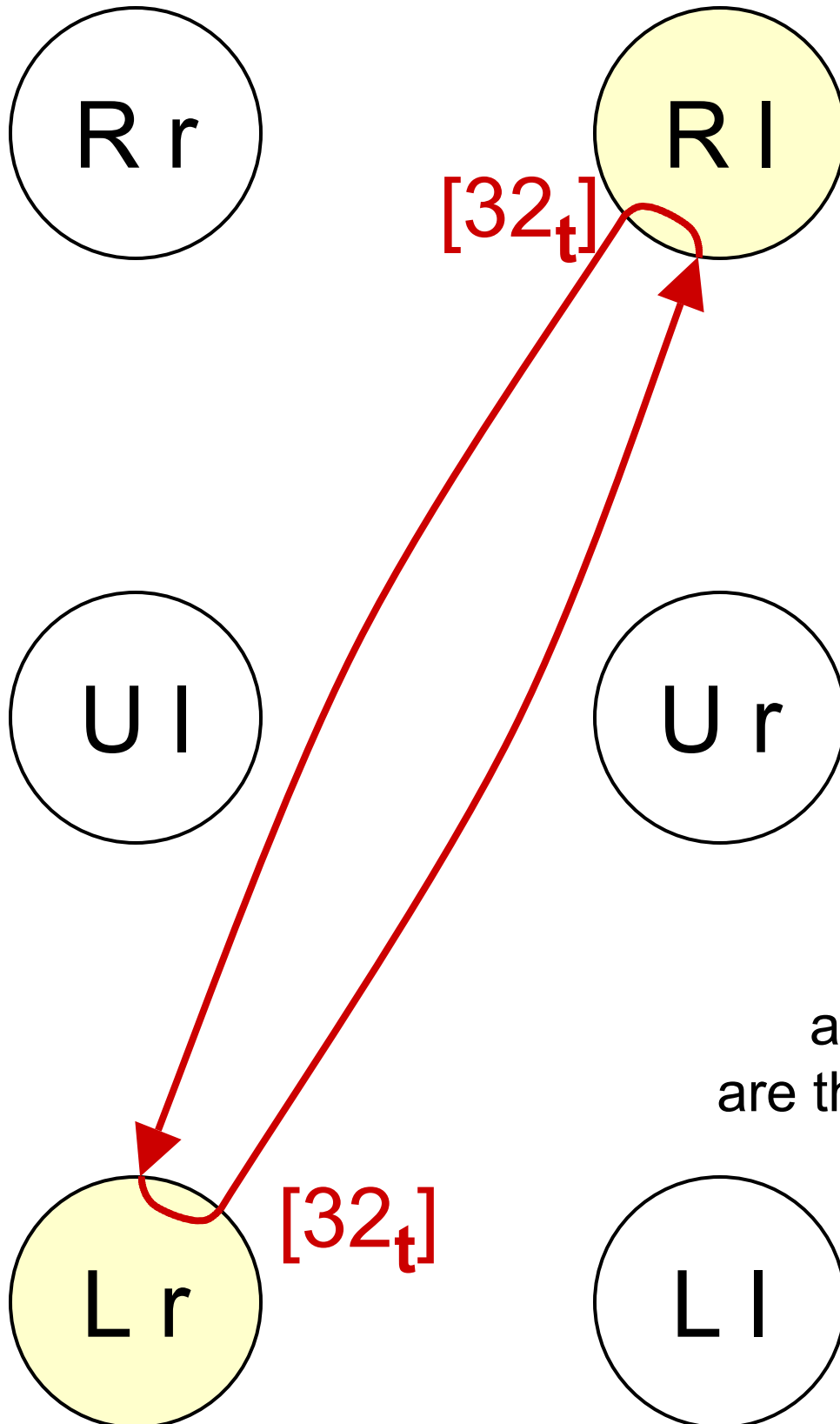
$[32_t]2_t2_t$



Four Ball Singapore Shuffle $[32_t][32_t]2_t$

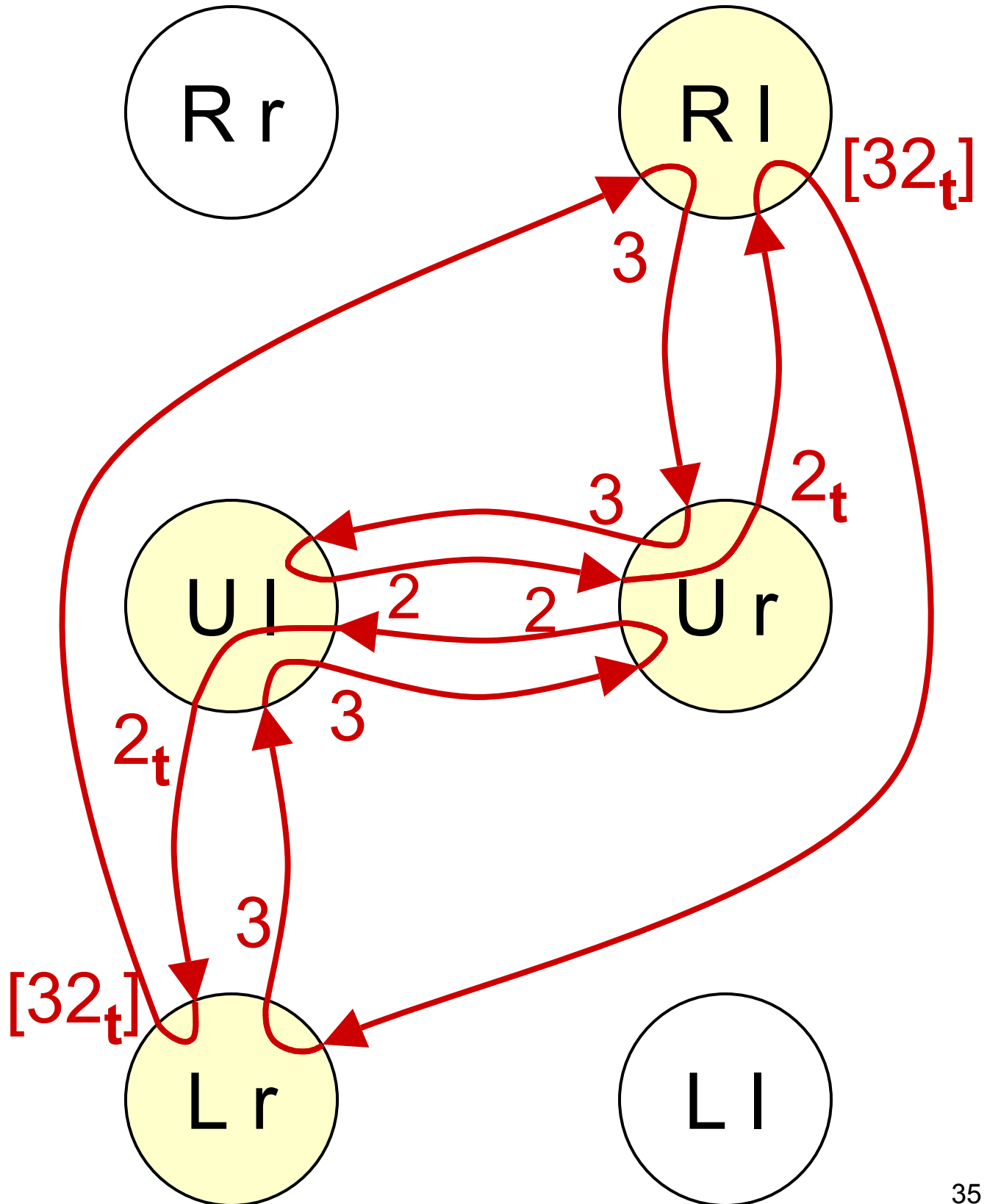


Five Ball Singapore Shuffle $[32_t]$



Kingston Shuffle

(by Greg Phillips) $[32_t]3322_t$



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