

Juggling : the highest form  
of manipulation

- I. Matt and volunteers demo patterns.
- II. Video of some of the greats.  
Rastelli, May, Fields, Franco, Gatto,  
Flying Karamazovs, Clockwork, Muschen
- III. What is juggling? Lots of stuff  
Props: balls, clubs, rings, hats, cigar boxes, ...  
Processes: balance, bounce, twirl, throw, spit, ...  
Variations: blind, endurance, passing, combat, ...  
Everyday: thumb spins, quarter on knuckles, ...
- IV <sup>History</sup>  
Goes back thousands of years  
Vaudeville  
IJA - founded in Pittsburgh 50 yrs ago
- V What's in a pattern?  
Laura Green's three ball vocabulary  
Siteswap notation
- VI Robots juggle, a little (more video)
- VII You can learn to juggle. Maybe an hour, maybe a day, but not today.
- VIII For additional info  
<http://www.juggling.org> (Juggling Info Service)  
Klutz - most book and toy stores, or  
(415) 424-0739

## V. What's in a pattern?

Robotists have ideas about how to represent motion. So do psychologists.

But the real experts are the jugglers

### A. Common usage

Jugglers have a vocabulary for discussing patterns

cascade

shower

fountain

shoulder throw

back throw

overs

reverse cascade

etc etc

See Laura Green's "Three Ball Tricks ..."

### B. More technical approaches

#### 1. Site swap notation

# THREE BALL TRICKS FOR BEGINNERS 1997

*The foundation of three ball tricks is two ball control*

## **I. TWO BALL SCALES: Mastery of these scales is elemental**

### **One Handed:**

- a. outside
- b. inside circles
- c. parallel columns
- d. vamping
- e. multiplex
- f. claws
- g. hand jives
- h. shoulder throws
- i. overhead
- j. body work

### **Two Handed:**

- a. vamping
- b. parallel columns
- c. showers
- d. high throws
- e. under throws
- f. claws
- g. boxes
- h. shuffles
- i. overhead
- j. shoulders

## **II. CASCADE**

- a. high
- b. wide
- c. low
- d. small
- e. reverse
- f. high reverse
- g. wide reverse
- h. small reverse

## **III. THROW OUT:**

- a. right
- b. left
- c. columns

## **IV. TAKE OUT:**

- a. right
- b. left
- c. top
- d. bottom
- e. middle

## **V. BACK OFFS:**

- a. right
- b. left
- c. shake your booty
- d. nose wiping
- e. head bangs
- f. eat it
- g. ear picking
- h. glasses poking
- i. random scratching
- j. Cray-yay-yazy!

## **VII. TRACKING:**

### **a. Parallel Columns:**

1. parallels
2. yo-yo
3. oy-oy
4. knock-knock
5. around the world

### **b. Outside Circles:**

1. behind track
2. speed circles
3. pass through

### **c. One Handed Vamping**

## **IX. TWO IN ONE:**

- a. right
- b. middle
- c. left
- d. weave
- e. M & M
- f. the hard way
- g. the easy way
- h. the stupid way

## **X. OVER THROW:**

- a. half shower
- b. full shower
- c. ping pong

## **IX. UNDER THROW**

- a. right
- b. left
- c. alternating
- d. chops made easy

## **XII. FAKES:**

- a. behind the back
- b. under the leg
- c. double back crosses
- d. off the knee
- e. off the foot
- f. Alberts
- g. Chinese Ping Pong

## **XIII. ADVANCED COMBINATIONS:**

- a. multi plex pick off
- b. Mills Mess
- c. Tilly's Mess
- d. The Box
- e. Illusions
- f. Waldo Slice & Dice
- g. Tax Man
- h. Statue of Liberty
- i. Three in One
- j. McDonalds
- k. Over the Head
- l. Above the Head Reverse
- m. Dr. J. Sky Hook

**NOTES:** Without automatic control of two balls three ball tricks are impossible and sloppy. Warm up, work with a key ball, have an attitude and make that fashion statement. Work on tricks that work for you. Practice, honey, and look raaaahvahlous!

*Laura Green The Juggling Queen*

## Site swap Notation

(Adapted from Allen Knutsen's article  
on the Juggling Info Service)

### Assume:

- hands alternate throws
- one ball per throw

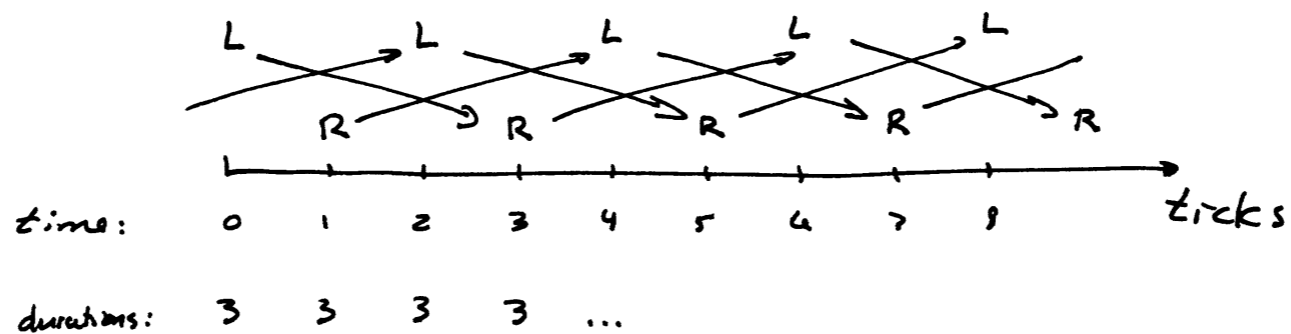
So there's a clock ticking — left right left right...

Define duration of a throw to # ticks  
until the next throw

A siteswap is sequence of durations

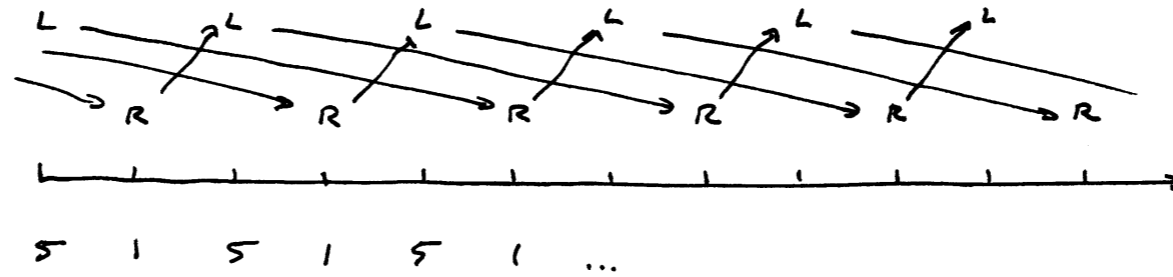
That's all! It doesn't capture every detail  
of a pattern, but it captures a lot.

Example 3 ball cascade — "3"

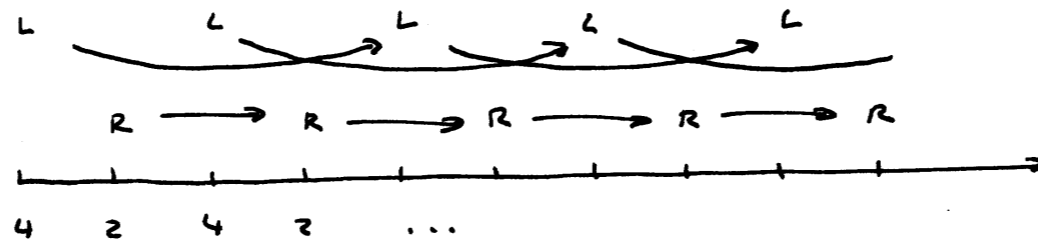


So the siteswap notation for a  
3-ball cascade would be "333..."  
but for periodic patterns just write "3"

Example 3 ball shower "51"

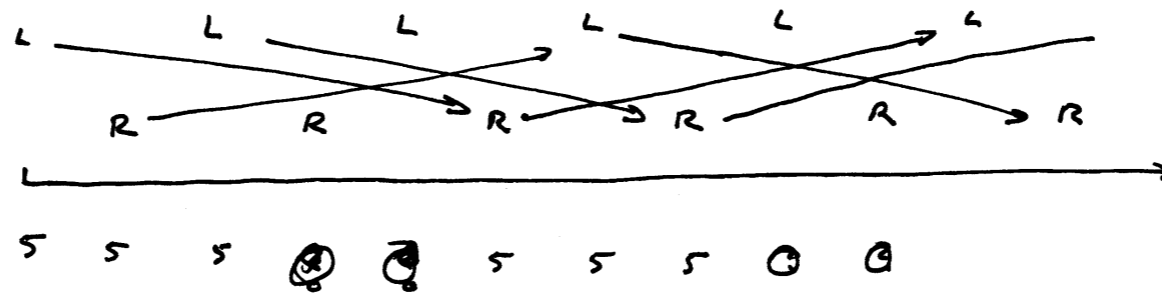


Example Two-in-one "42"



"2" means just hold the ball

Example Flash 3 out of 5 "55500"



If the hand doesn't have a ball — "0".

## Notice:

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- 1) even — throw to same hand  
odd — throw across
- 2) pattern length odd  $\rightarrow$  symmetric
- 3) pattern average = # balls!

How to determine if a given sequence is legal.

Just check no two balls land at once.

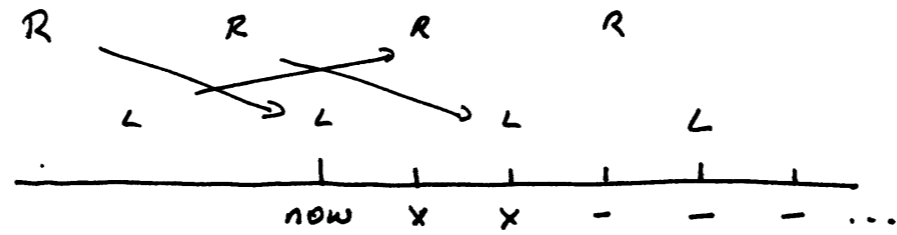
How to generate juggling patterns.

A state transition graph

You're about to throw a ball.  
What choices do you have?

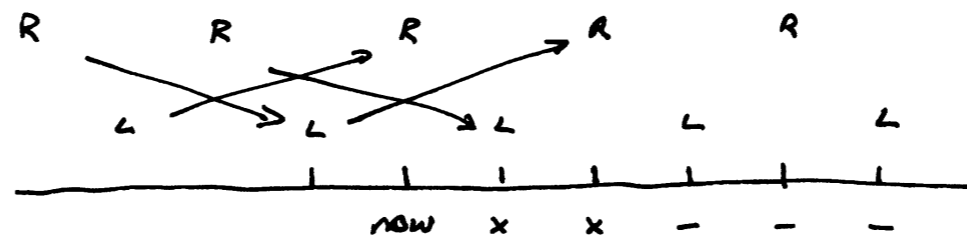
Each ball in the air represents a committed tick. You can throw to any uncommitted tick.

Example 3 ball cascade "3"



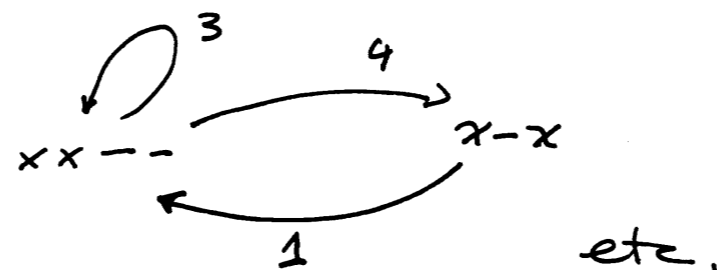
The next two ticks are committed.  
 Mark committed ticks "x"  
 Uncommitted "-"

One tick later, assuming you throw a 3

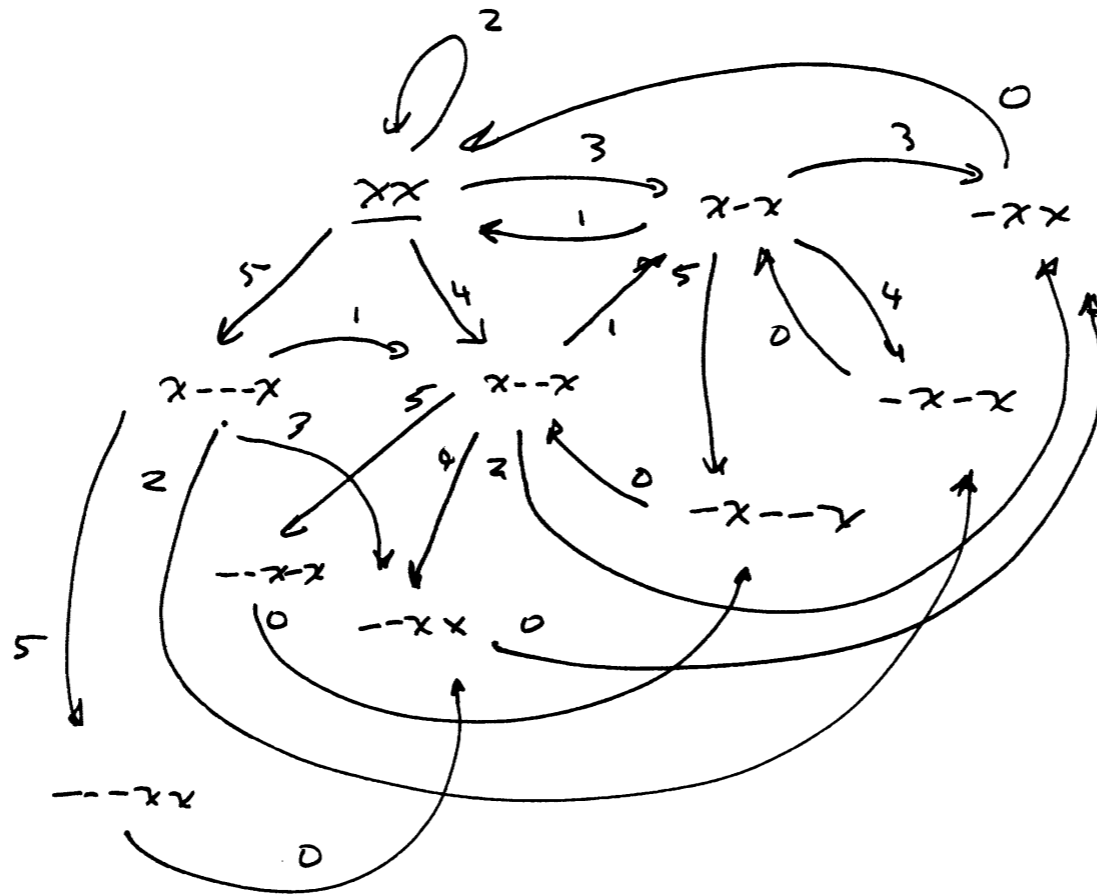


The state is the same — xx--

So state is a string xx-- etc denoting future commitments. State graph looks like



Complete graph for 2 balls  
 Maximum throw of 5:



Any closed path is a siteswap pattern.