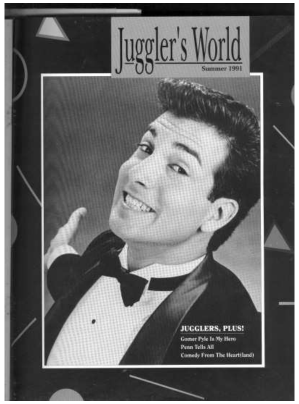

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A Notation for Juggling Tricks. A LOT of Juggling Tricks.

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From time to time, jugglers come up with new patterns that look interesting, and are relatively easy to do once you get the idea. But often they're hard to explain or describe. There is a way. In this article, a notation will be presented that not only simplifies the description of tricks, but also, because of its mathematical basis, permits an analysis that generates literally an infinite number of tricks.

Readers familiar with a letter by Charlie Simpson, (JW, Winter 86, p. 31) will find little new here as far as the notation is concerned. One difference, though, is that instead of using our notation merely to compile a library of tricks, it can be used to generate all possible tricks within certain constraints. To give credit where it is due, the notation as presented here was independently (and previously) invented by Paul Klimek, with whom we have had helpful discussions.

The notation applies to one juggler with two hands, throwing alternately left-right-left-right in a steady pattern. However, it is easily generalized beyond these constraints to passing patterns with any number of hands, to multiplex patterns where more than one object is thrown or caught at a time, and to in-sync patterns where the hands throw together or in a syncopated rhythm. We welcome those interested to pursue other applications.

The notation here applies to throw heights relative to one another. It is blind to the identity of the objects, applying equally to balls, clubs, rings, or whatever. For the time being, we'll call them balls. It is also blind to 'tricks'' like backcrosses, Mills' mess, under-the-leg throws or other such things where the throw height (actually the away-from-hand time) is the same as it would have been in the normal cascade.

In other words, these examples aren't tricks in the sense that something is changing from the notation's point of view - they are all just the ordinary cascade. However, tricks such as the shower, the half shower, the chase (three balls in a five pattern) and an infinite number of similar yet distinct tricks exist that can be done without the juggler making any kind of funny throws - just by varying the throw heights between consecutive throws.

In this notation, a trick is represented by a string of numbers. Each number in the string corresponds to one throw, e.g. a string of five numbers represents five consecutive throws. Since the hands are understood in this article to throw alternately, the first, third, fifth, etc. numbers in the string apply to one hand, the rest apply to the other.

The value of the number dictates how high the throw is. It is numerically equal to the number of balls that would be juggled if every throw were that value. For example, a 3 is the kind of throw made every time in a three cascade, a rather low throw across from one hand to the other. A 4 is a somewhat higher throw (higher because the handspeed is understood to be fixed at the three ball speed) that goes to the same hand that threw it. A 5 is a rather high throw that crosses, a 6 is a very high throw that lands in the hand that threw it, etc.

Figures one and two show the odd throws and the even throws up to 10 on the same scale, which is for a six foot tall juggler making 2.5 throws per second out of each hand, and assuming that catches in one hand are exactly coincident with releases made from the other hand. (We feel these are typical or representative values.) These figures can be used to compare against other "juggletoons."

One other thing: the average of all the throw-height numbers in a trick is the same as the number of balls being juggled-which is obvious if all the throws have the same value, but is true in general. (More later.)

Perhaps an analogy would help here. You might think of a hunt-and-peck typist who strictly alternates typing with his left and right index fingers every character. A "string of characters" - a sentence - can be thought of as a notation for how his fingers move. Lots of q's, a's, and z's and he's going to the left all the time, for example. Every other character will be typed by one hand only. Also, note that the spaces are characters so they must be typed. We'll come back to this later too.

Let's consider the basic three ball cascade. Each throw is the same kind as every other. Certainly some go from right-to-Ieft and others go the other way, but they are mirror images, not really different kinds of throws. In this notation, each throw would be called a 3. It does not mean that the throws go up three feet, or that they take three seconds to return, but rather that a total of three throws can be made (including the given one) before the ball is back in a hand, ready to be thrown again. A three ball cascade would be denoted a 3 3 3 3 3... etc. We can simply say it's the 3 pattern, since that's what you repeat to do it. For every throw, you throw a 3. We say this trick has a word length of one, because it's repeat unit is one character long, "3." There is a way to graphically represent this.

In this picture the progress of time is depicted as a downward motion through the diagram, and the two columns of dots represent the throws made 'by each of the two hands - the left one for the left hand and the right for the right hand. Individual dots represent individual throws, and the alternating aspect of the throws is taken care of by shifting one column half a dot spacing down with respect to the other, so that the path that connects them zig-zags symmetrically as it goes down. (It's similar to Simpson's notation.)

A ball represented by the solid circle is thrown from one of the dots and lands on another below it. How do you find which dot it lands on? Count the dots! A 3 lands on the third dot below it on the zig-zag path, and a 6 lands on the sixth dot below the starting position. (For example, our 6 is Simpson's "5-beat throw," just add one to his number to get ours.) ..

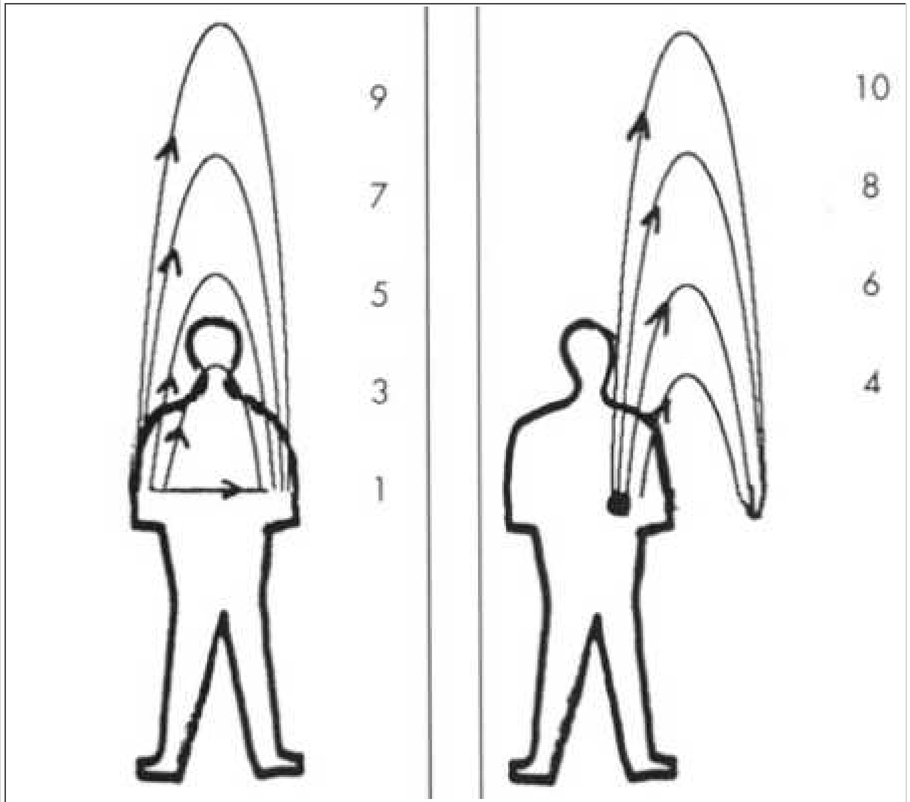

Figure 1- *(left) The odd throws cross sides. The 1 throw is handed directly from hand to hand.*
Figure 2- *(right) The even throws land in the same hand that threw them. A tossed 2 would go up only two inches.*

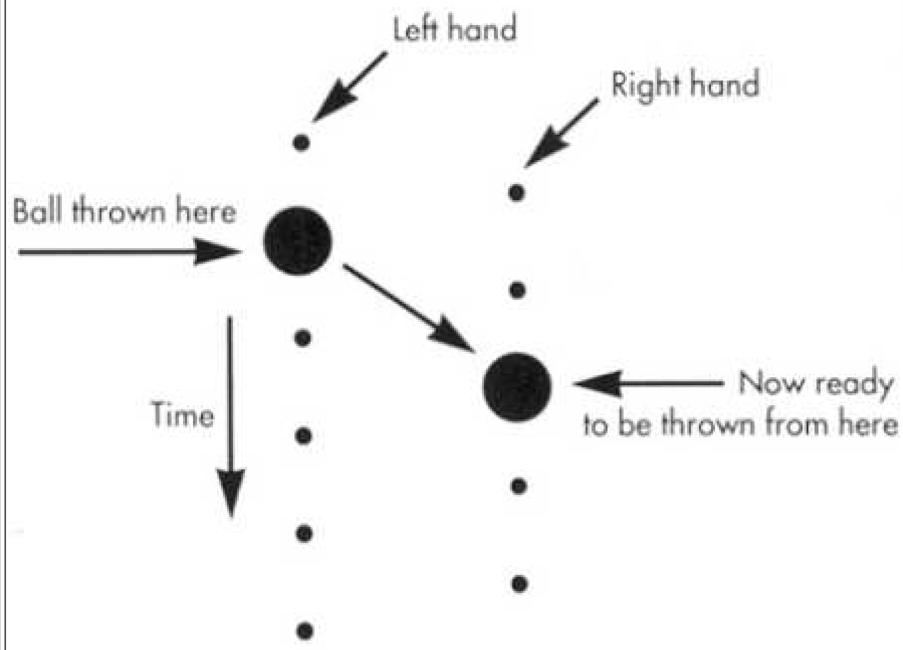

***Figure** 3---The diagram notation. This ball got a 3.*