The Math of Jenga

Jenga rules

- Players take turns taking a block
- Players cant take from the top most completed level
- Player who makes the tower topple loses

Assumptions

- 2 players
- Player r perfect
- Tower falls when only side block is remaining
- Tower falls when lone middle block is removed

2 layers

3 choices what block to take

3 choices where to place block

$$3 \times 3 = 9$$

~~9 move options~~

3 options

N position – Next player to move win 

P position – Previous player to move to win 

3 layers

~~$6 blocks \times 3 spots = 18 \ options$~~

~~$6 blocks \times 1 \ type \ of \ spot = 6 \ options$~~

~~$4 \ types \ of \ blocks \times 1 \ type \ of \ spot = 4 \ options$~~

$2 \ types \ of \ blocks \times 1 \ type \ of \ spot = 2 \ options$

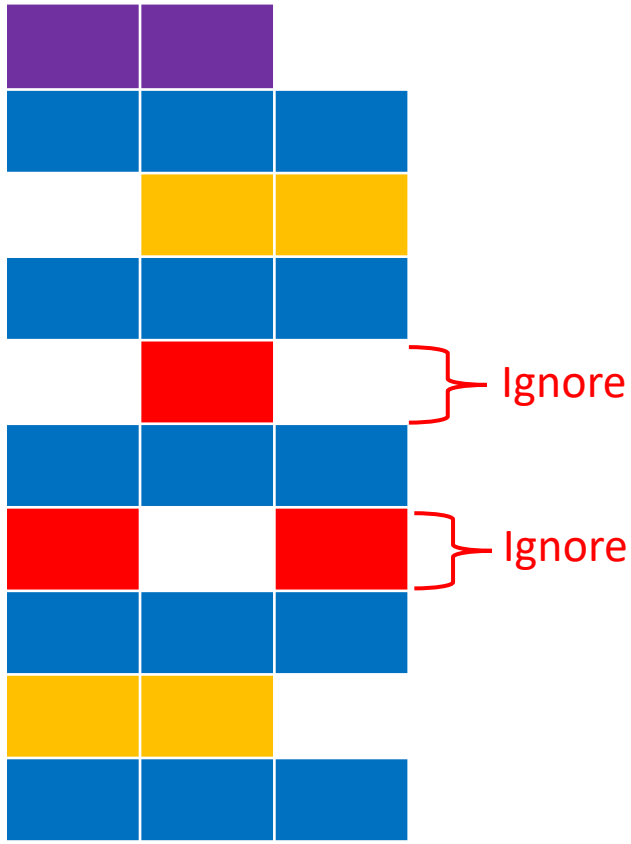
3 level jenga is a P position

i.e 2nd player always wins

assigning ordered pairs

keep track of:

1) full levels – player can take middle or side
2) half levels – players can only take side block
3) how many blocks on top



$$\left\{5+\frac{2}{3}\,,2\right\}$$

5 full levels

2 half levels

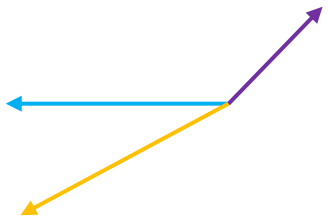
2 blocks on yop

Analyzing change in ordered pairs

removing middle block from full: Net change $\left(-\frac{2}{3}, 0\right)$

removing side block from half: Net change $\left(+\frac{1}{3}, -1\right)$

removing side block from full: Net change $\left(-\frac{2}{3}, +1\right)$



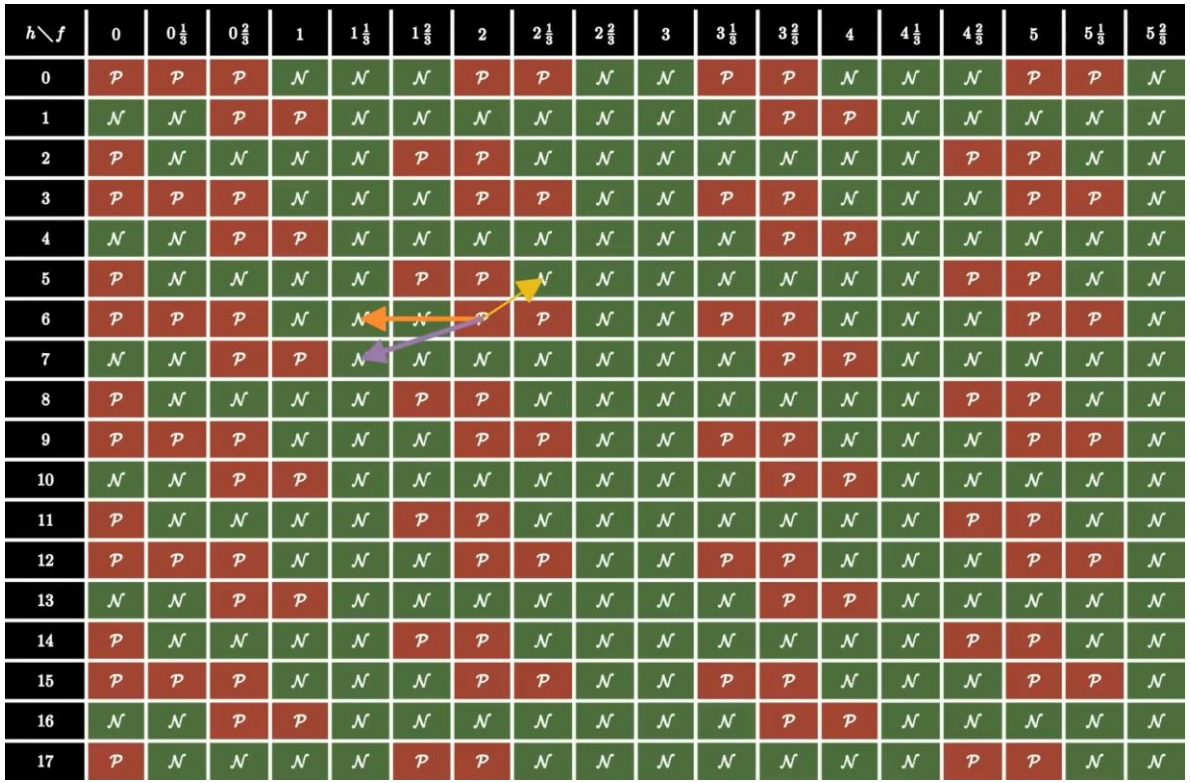
$$\left(-\frac{2}{3},0\right),\left(+\frac{1}{3},-1\right),\left(-\frac{2}{3},+1\right)$$

	0	$0\frac{1}{3}$	$0\frac{2}{3}$	1	$1\frac{1}{3}$	$1\frac{2}{3}$	2	$2\frac{1}{3}$	$2\frac{2}{3}$
0	P	P	P	N	N	N	P	P	N
1	N	N	P	P	N	N	N	N	N
2	P	N	N	N	N	P	P	N	N
3	P	P	P	N	N	N	P	P	N
4	N	N	P	P	N	N	N	N	N
5	P	N	N	N	N	P	P	N	N

	0	$0\frac{1}{3}$	$0\frac{2}{3}$	1	$1\frac{1}{3}$
0	P	P	P		
1					
2					
3					

	0	$0\frac{1}{3}$	$0\frac{2}{3}$	1	$1\frac{1}{3}$
0	P	P	P		
1	N				
2					
3					

	0	$0\frac{1}{3}$	$0\frac{2}{3}$	1	$1\frac{1}{3}$
0	P	P	P	N	N
1	N				
2	P				
3					



$h \backslash f$	0	$0\frac{1}{3}$	$0\frac{2}{3}$	1	$1\frac{1}{3}$	$1\frac{2}{3}$	2	$2\frac{1}{3}$	$2\frac{2}{3}$	3	$3\frac{1}{3}$	$3\frac{2}{3}$	4	$4\frac{1}{3}$	$4\frac{2}{3}$	5	$5\frac{1}{3}$	$5\frac{2}{3}$
0	P	P	P	N	N	N	P	P	N	N	P	P	N	N	N	P	P	N
1	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N	N	N	N
2	P	N	N	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N
3	P	P	P	N	N	N	P	P	N	N	P	P	N	N	N	P	P	N
4	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N	N	N	N
5	P	N	N	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N
6	P	P	P	N	N	N	P	P	N	N	P	P	N	N	N	P	P	N
7	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N	N	N	N
8	P	N	N	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N
9	P	P	P	N	N	N	P	P	N	N	P	P	N	N	N	P	P	N
10	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N	N	N	N
11	P	N	N	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N
12	P	P	P	N	N	N	P	P	N	N	P	P	N	N	N	P	P	N
13	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N	N	N	N
14	P	N	N	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N
15	P	P	P	N	N	N	P	P	N	N	P	P	N	N	N	P	P	N
16	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N	N	N	N
17	P	N	N	N	N	P	P	N	N	N	N	N	N	N	P	P	N	N

1) Start out on an N
2) Find vector that keeps the opponent on P
3) Do the corresponding move to that vector
4) Repeat until opponent has no moves