Imperial College London

A Pointless Talk

Phil Ramsden

Imperial College London

A Pointless Talk

Imperial College London

A Pointless Talk

If you don't know the show...

Four pairs of contestants, four rounds.

One pair eliminated in each of the first three rounds.

In the fourth round, the remaining pair compete for the Jackpot.

Imperial College London

"Everyone gets two chances to get to the Pointless final"

“Everyone gets two chances to get to the Pointless final”

If you weren’t on the last show…

… **and** you don’t get to the final on this show…

… you’re invited back next show to have another go.

“Everyone gets two chances to get to the Pointless final”

If you *were* on the last show…

… **or** you *do* get to the final on this show…

… you’re not invited back.

Imperial College London

First show

Lily and **Tia** (first time pair)

Elliot and **Lucas** (first time pair)

Georgia and **Louis** (first time pair)

Gabriel and **Sam** (first time pair)

Number of returning pairs: 0

Imperial College London

First show

Lily and **Tia** (first time pair)

Elliot and **Lucas** (first time pair)

Georgia and **Louis** (first time pair)

Gabriel and **Sam** (first time pair)

Imperial College London

Second show

Elliot and **Lucas** (returning pair)

Max and **Holly** (first time pair)

Lily and **Tia** (returning pair)

Gabriel and **Sam** (returning pair)

Number of returning pairs: 3

Second show

Elliot and **Lucas** (returning pair)

Max and **Holly** (first time pair)

Lily and **Tia** (returning pair)

Gabriel and **Sam** (returning pair)

Imperial College London

Third show

Max and **Holly** (returning pair)

Logan and **Henry** (first time pair)

George and **Hannah** (first time pair)

Shannon and **Abigail** (first time pair)

Number of returning pairs: 1

Third show

Max and **Holly** (returning pair)

Logan and **Henry** (first time pair)

George and **Hannah** (first time pair)

Shannon and **Abigail** (first time pair)

Fourth show

Shannon and **Abigail** (returning pair)

George and **Hannah** (returning pair)

Harry and **Tom** (first time pair)

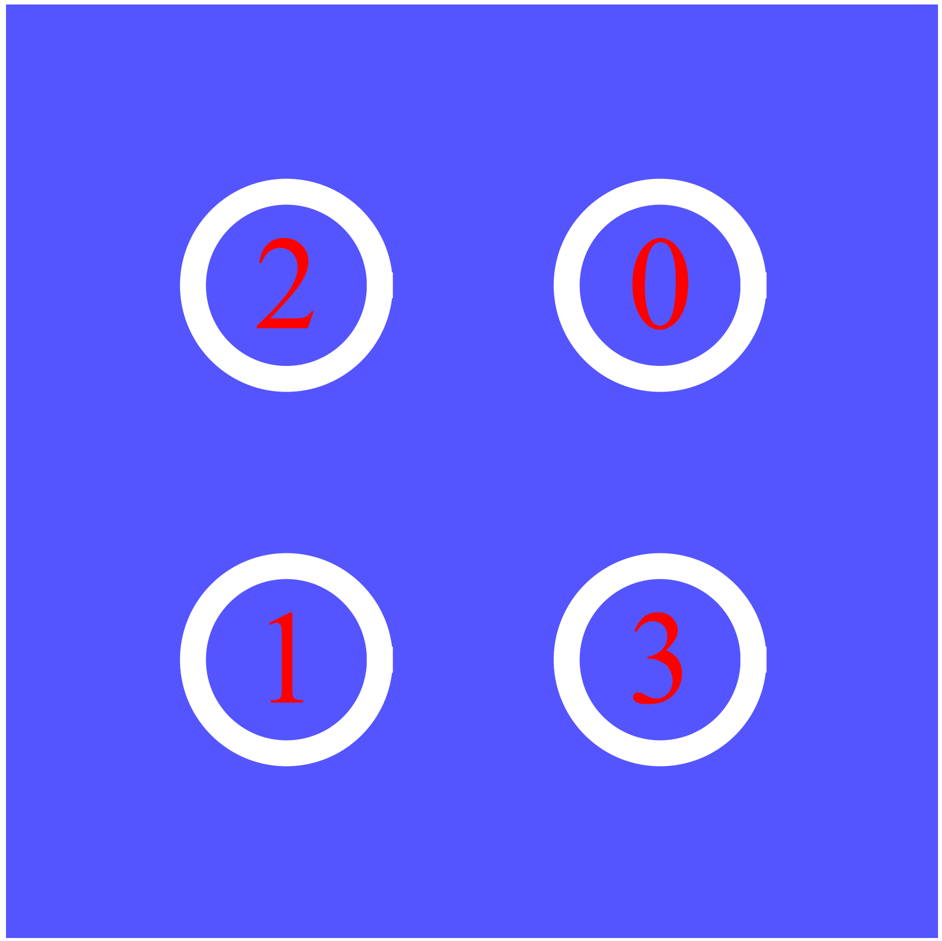
Isabel and **Adam** (first time pair)

Number of returning pairs: 2

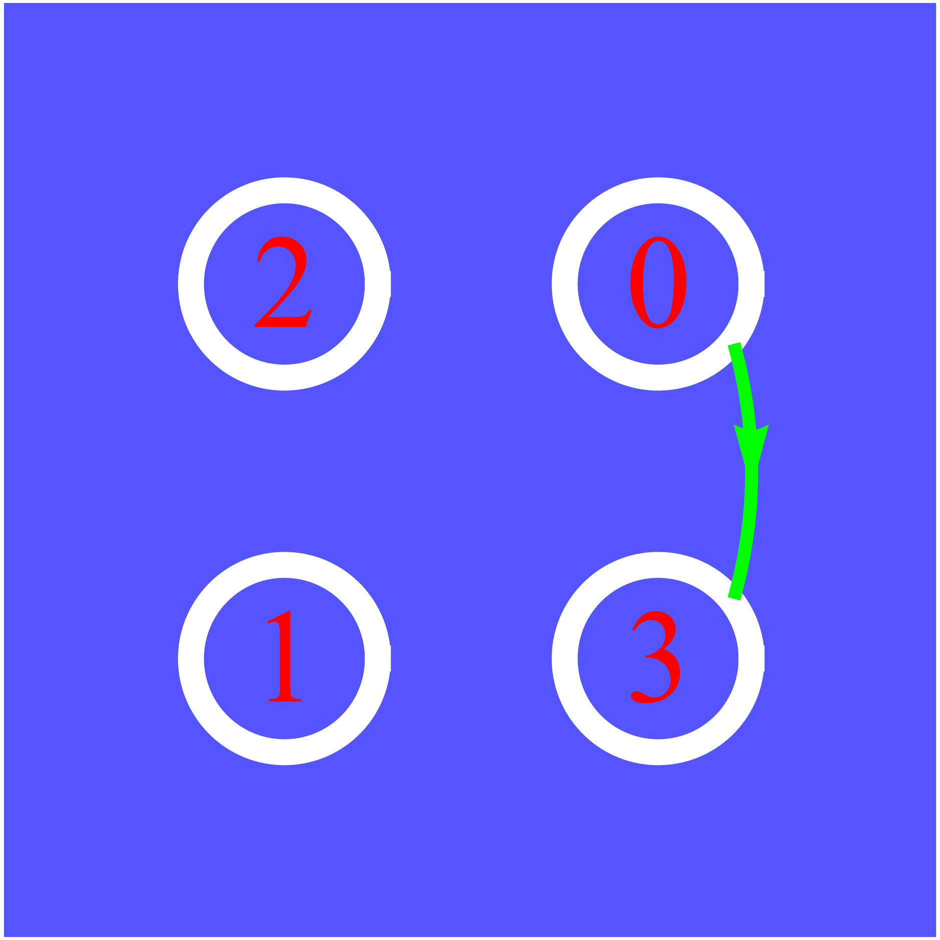
Number of returning pairs each show

0, 3, 1, 2, …

Number of returning pairs each show

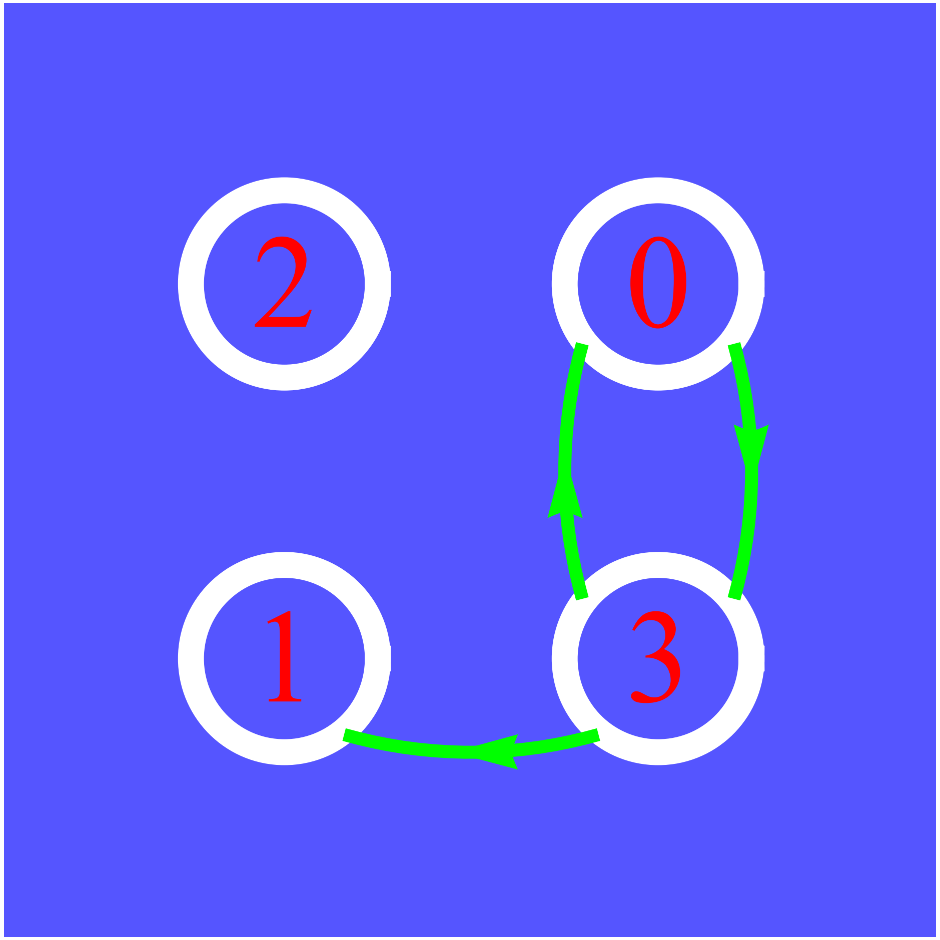


Number of returning pairs each show

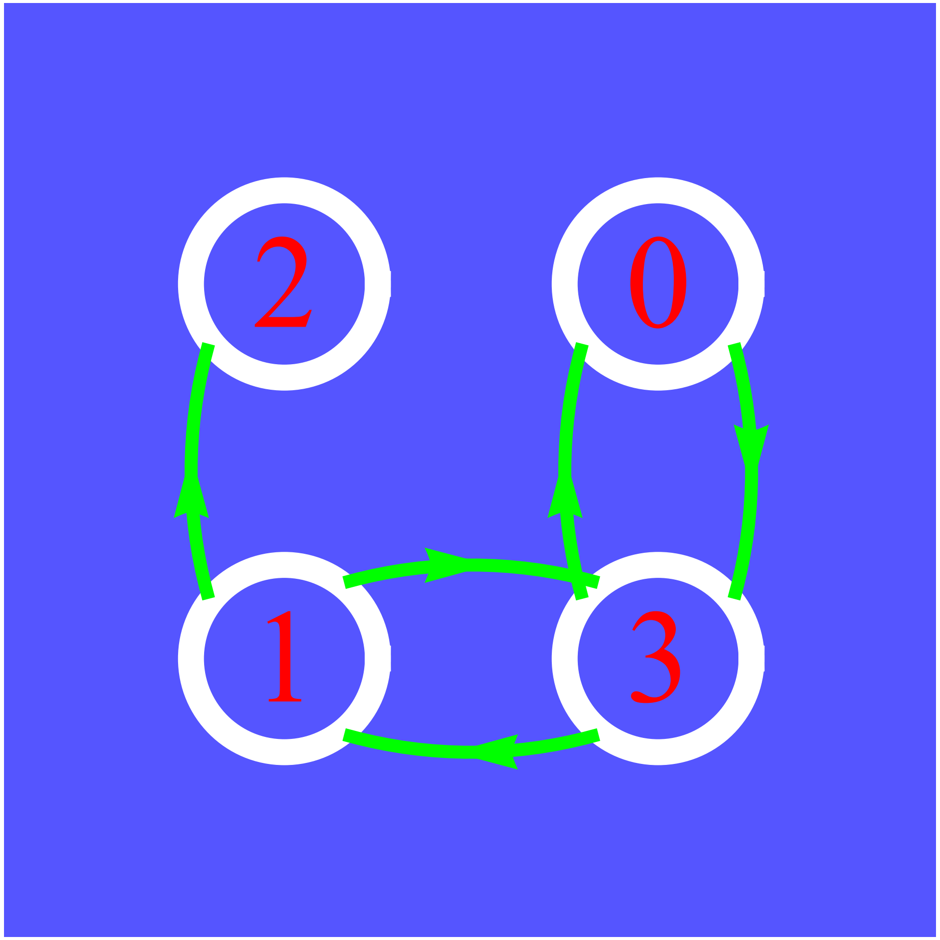


Imperial College London

Number of returning pairs each show

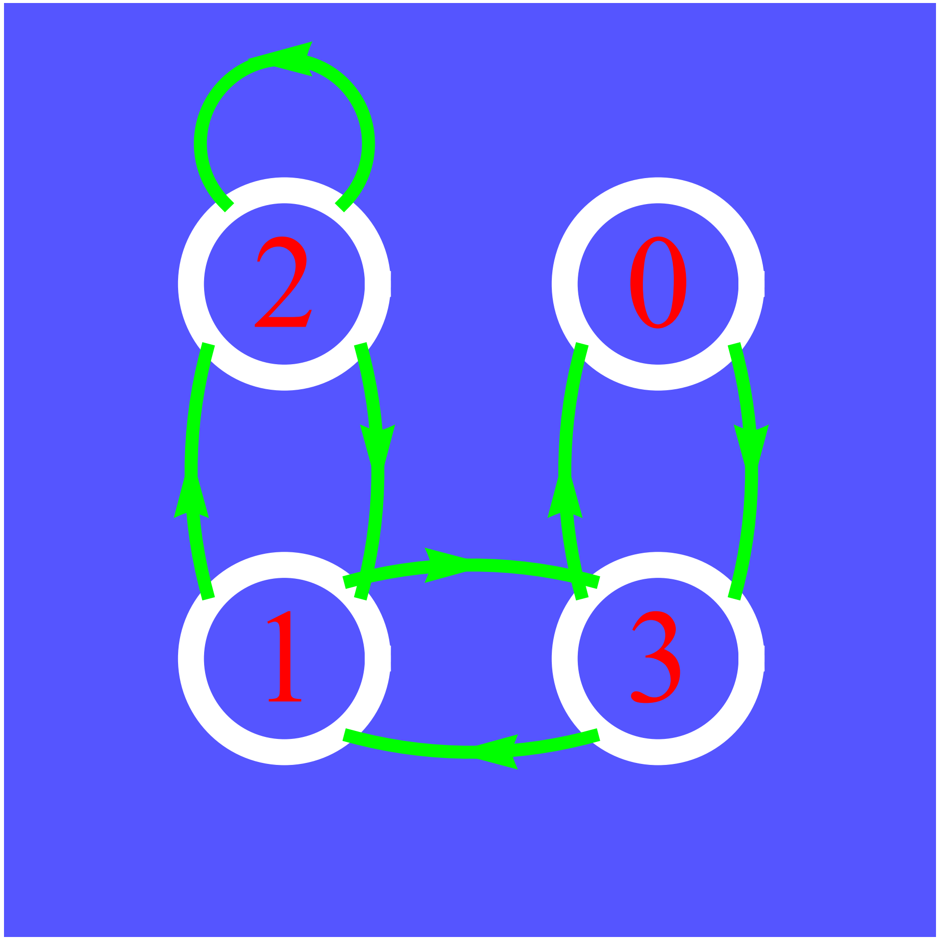


Number of returning pairs each show

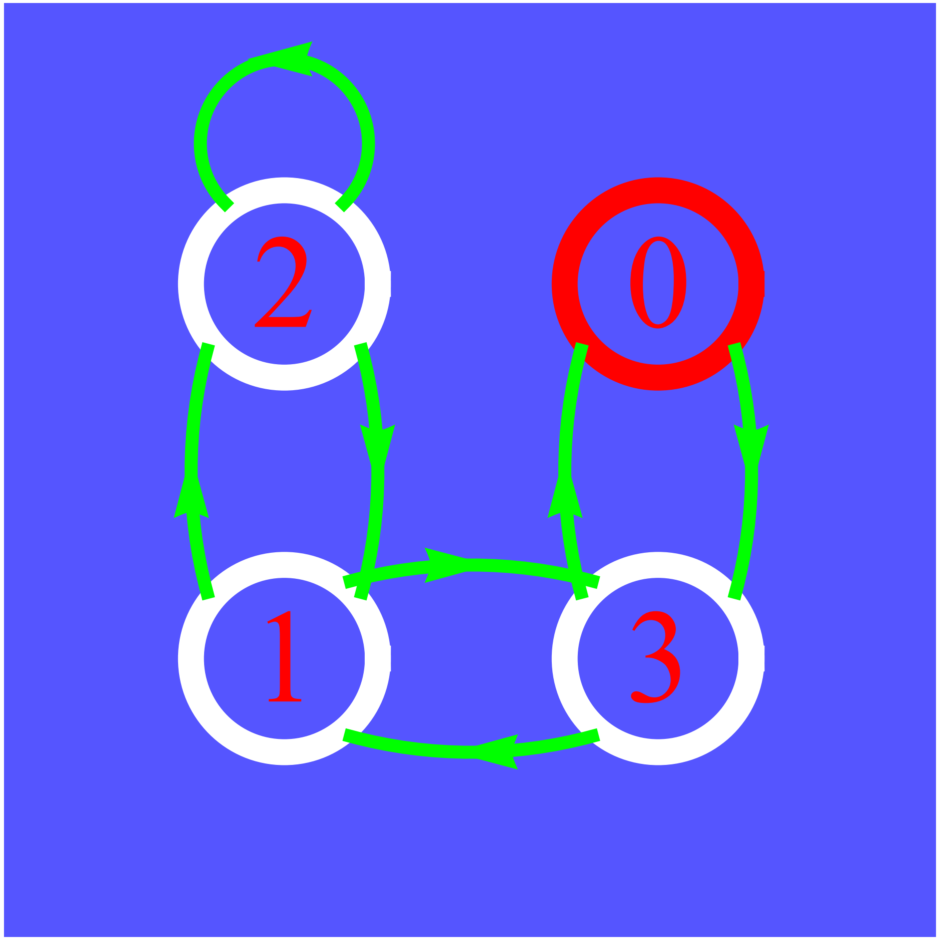


Imperial College London

Number of returning pairs each show

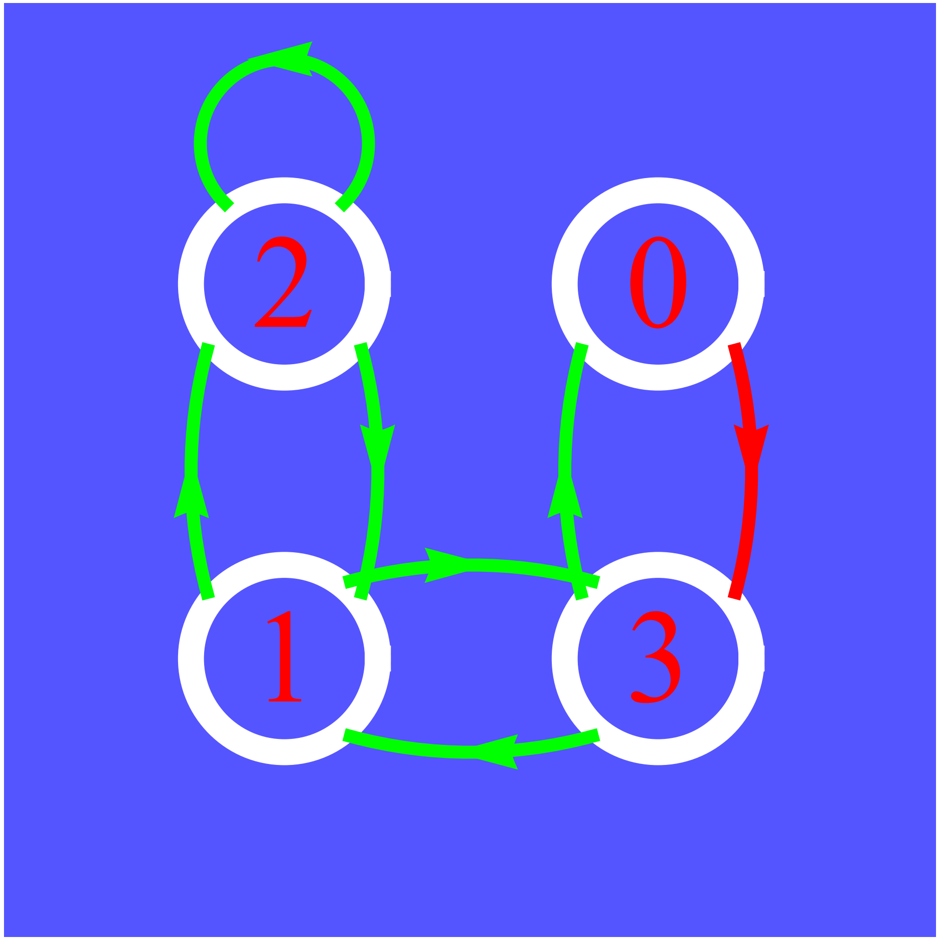


Number of returning pairs each show



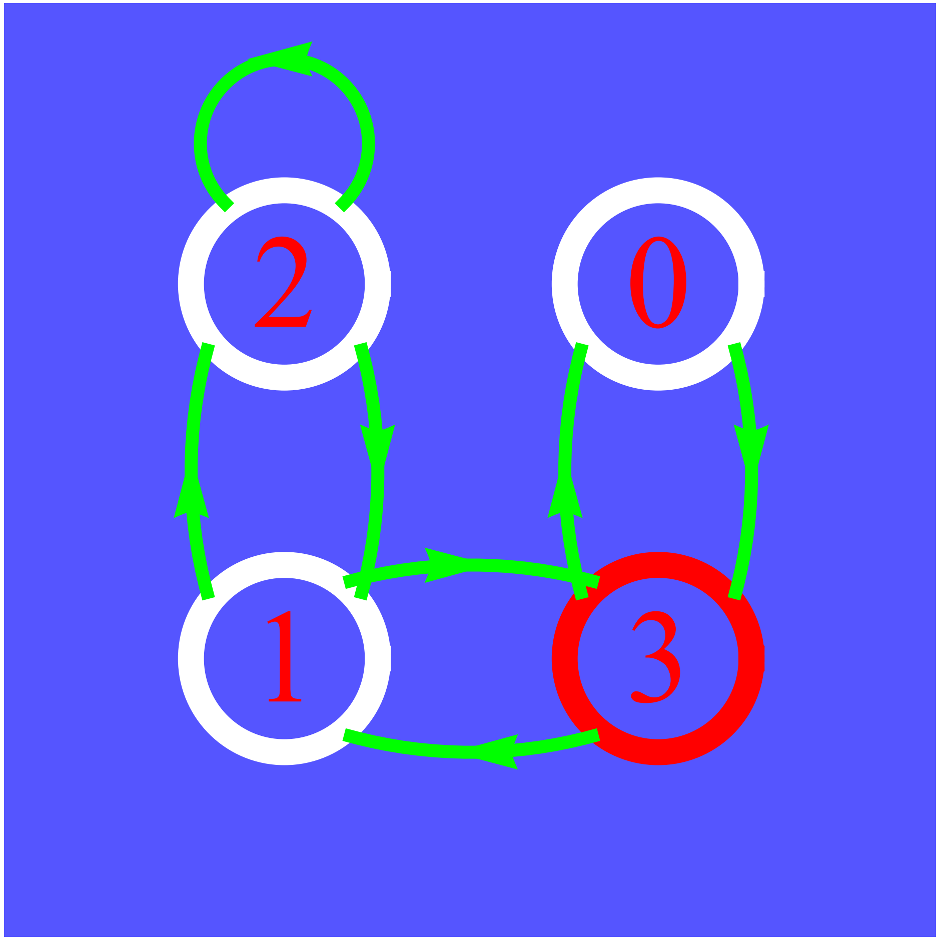
Imperial College
London

Number of returning pairs each show

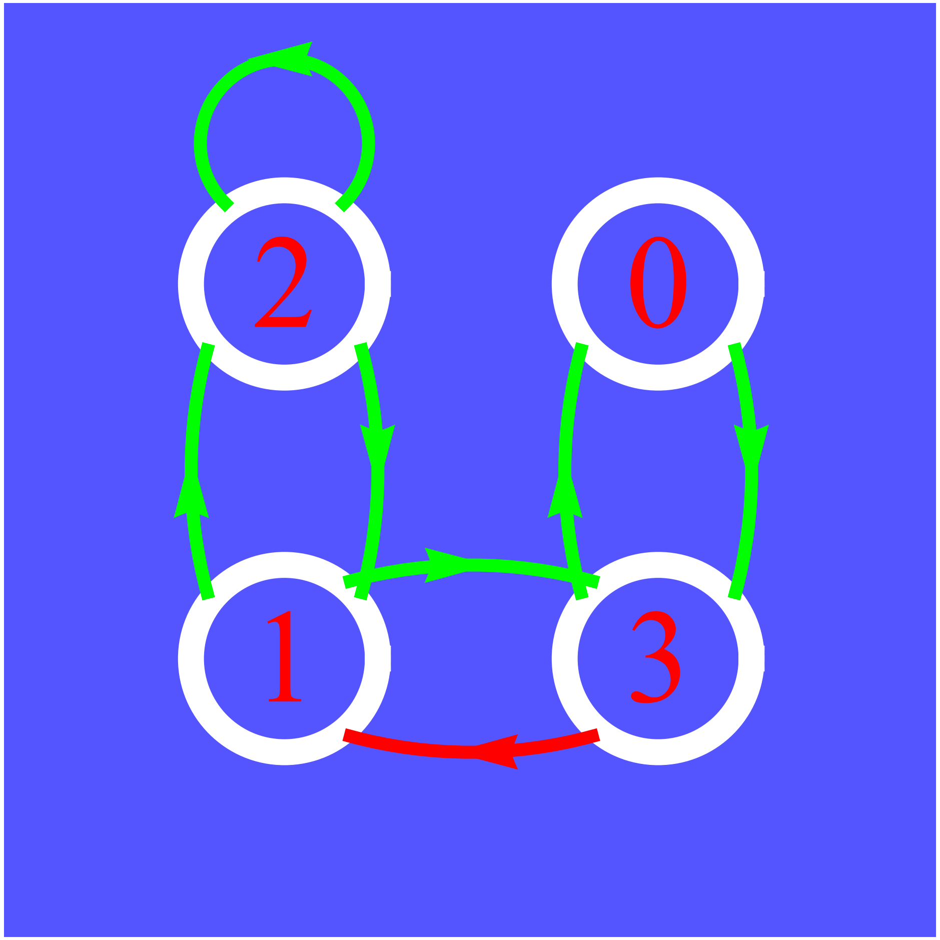


Imperial College London

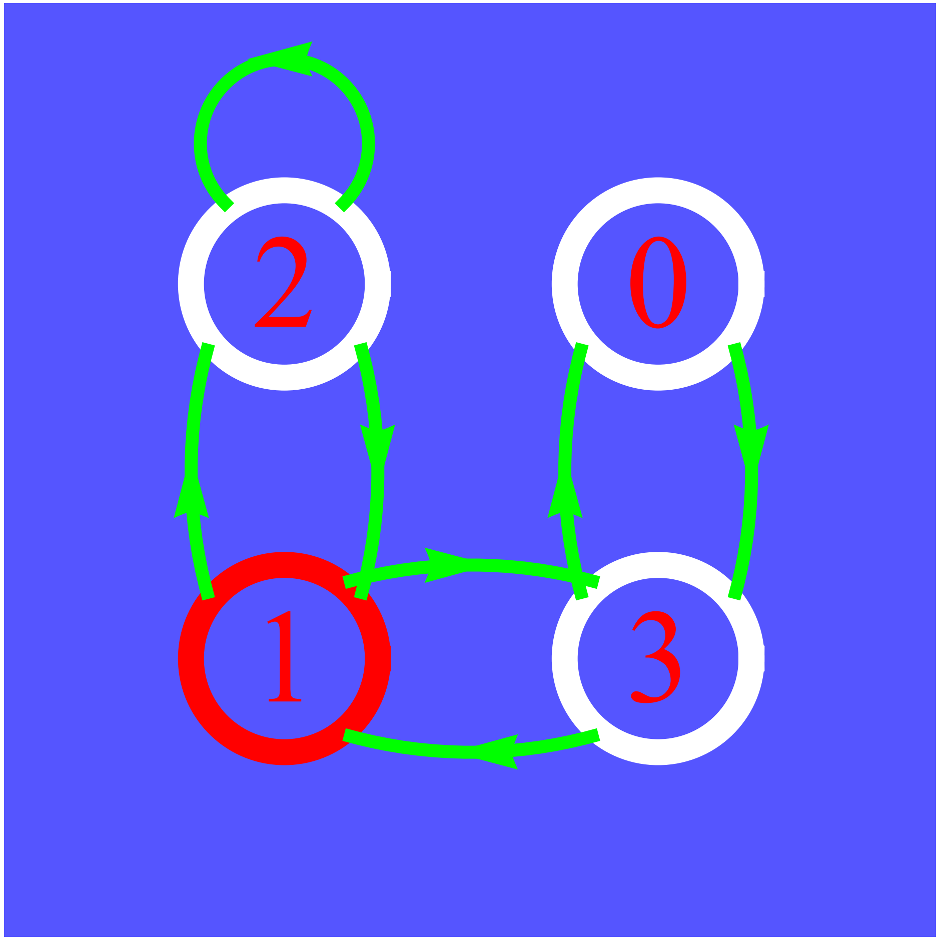
Number of returning pairs each show



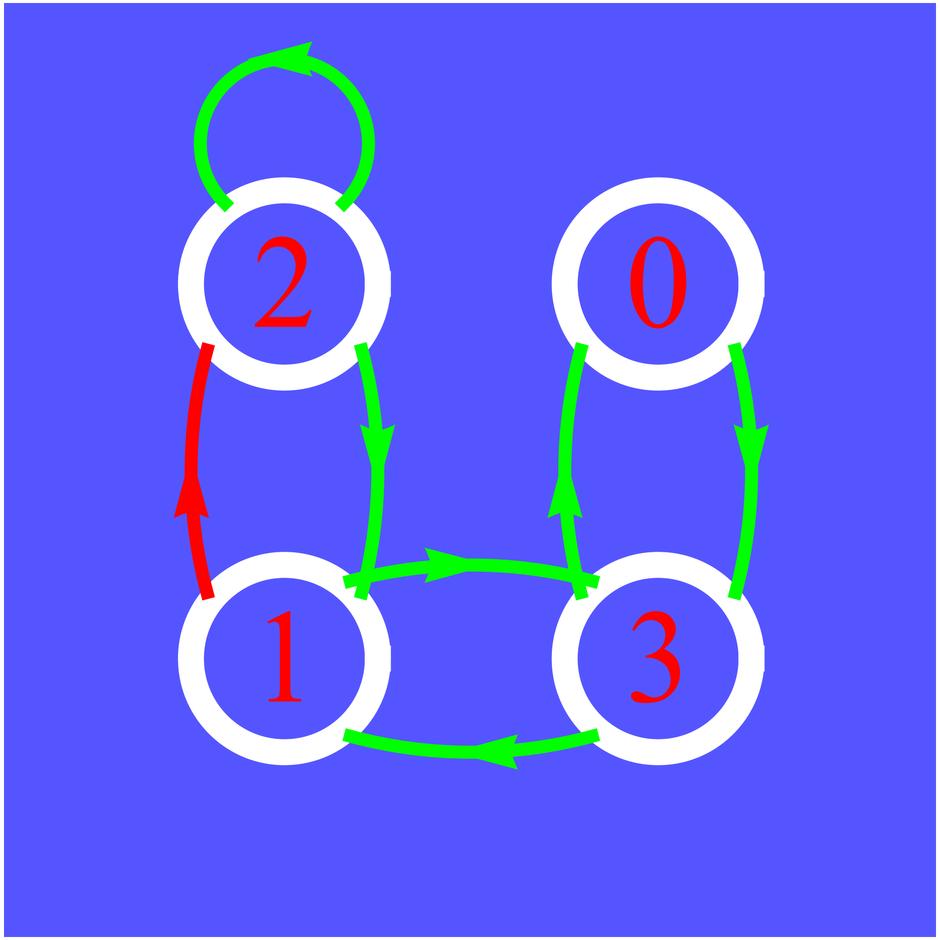
Number of returning pairs each show



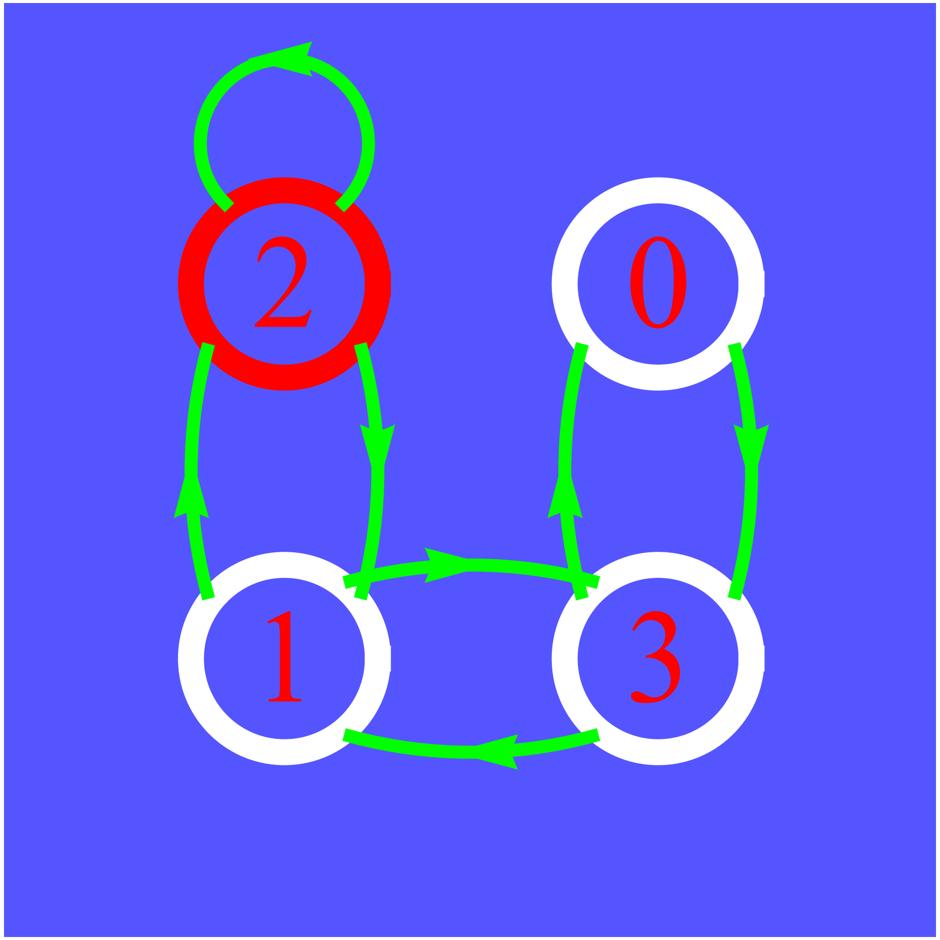
Number of returning pairs each show



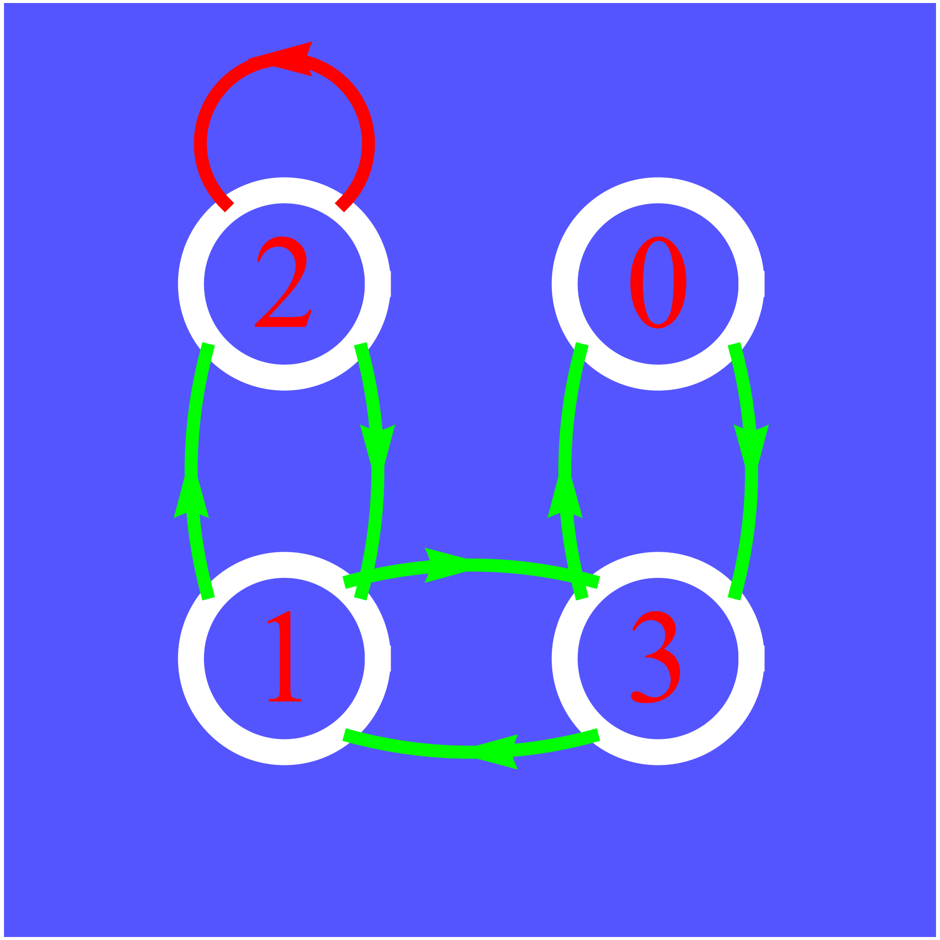
Number of returning pairs each show



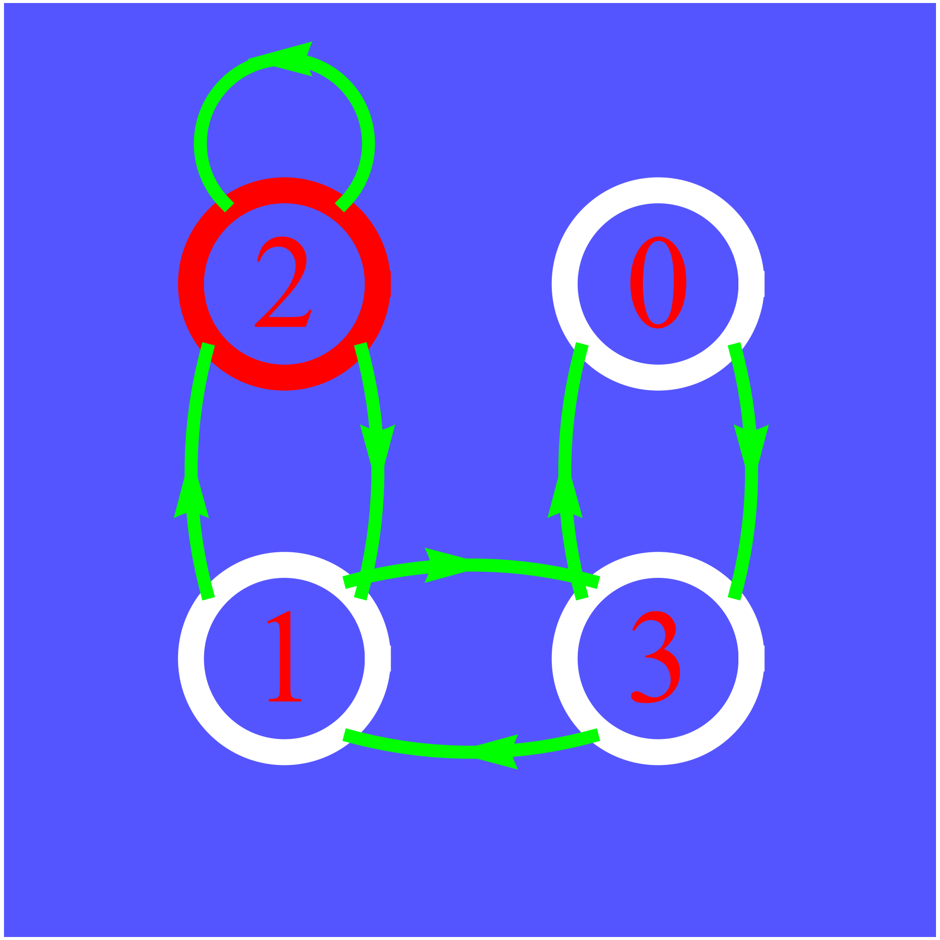
Number of returning pairs each show



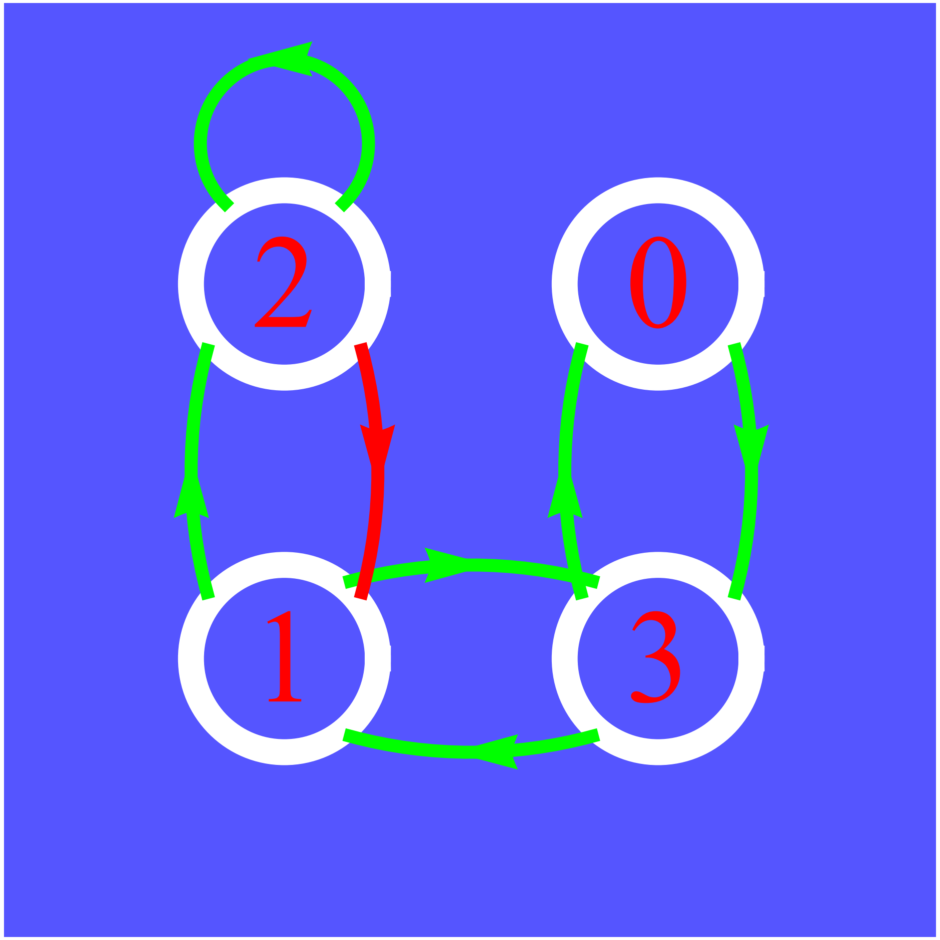
Number of returning pairs each show



Number of returning pairs each show

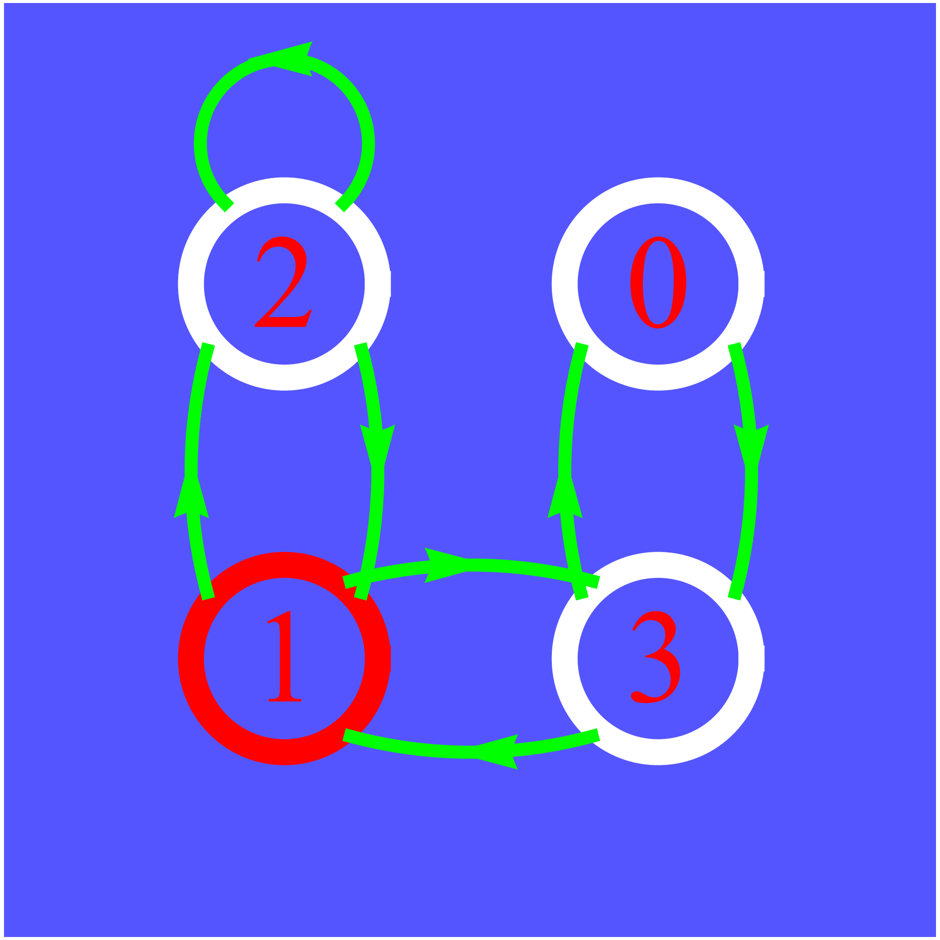


Number of returning pairs each show



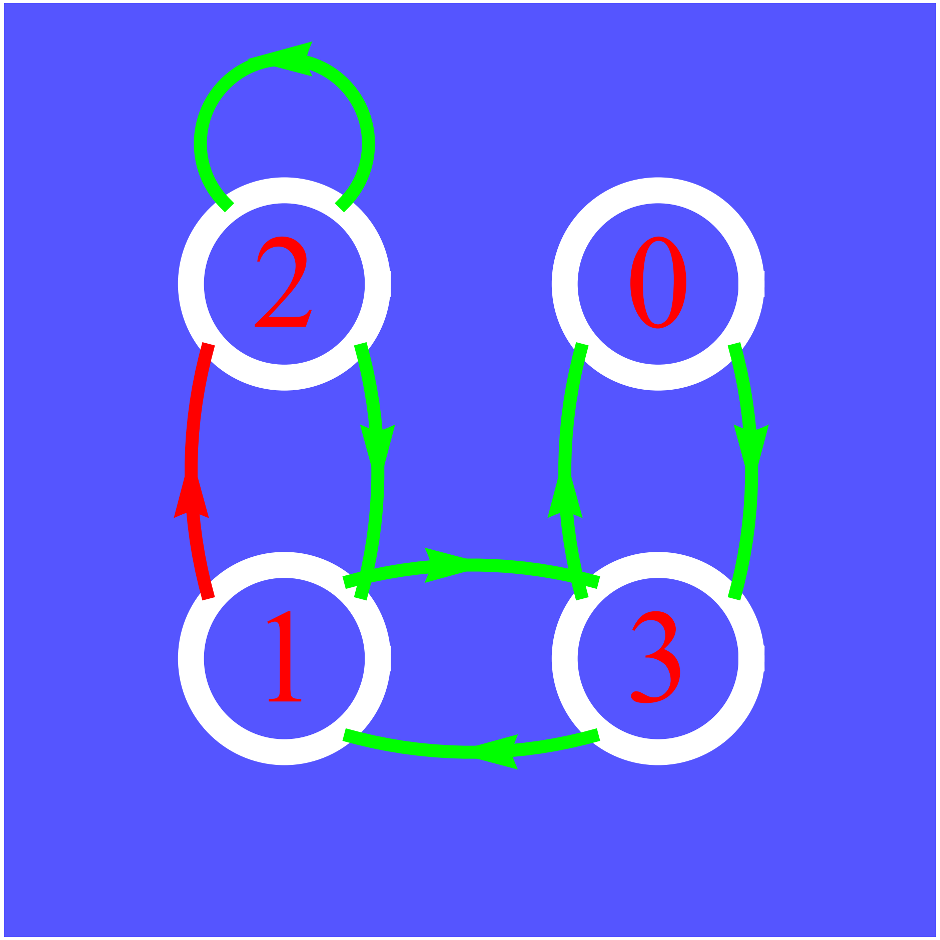
Imperial College London

Number of returning pairs each show

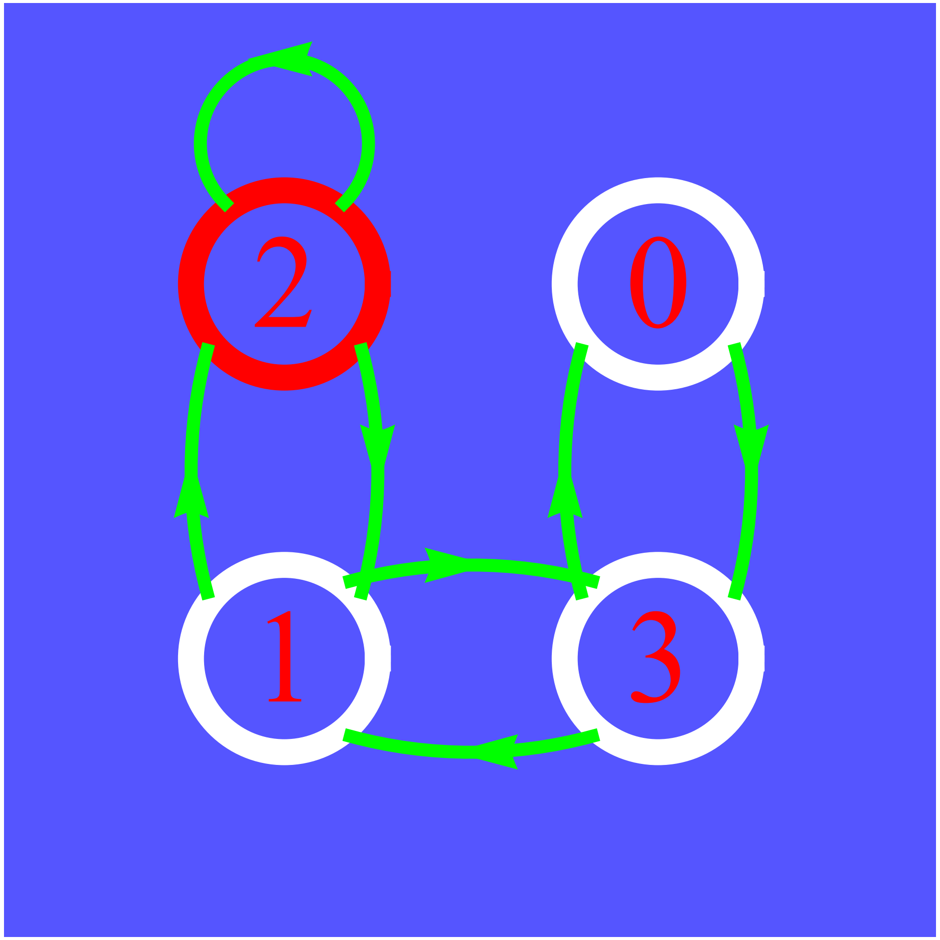


Imperial College London

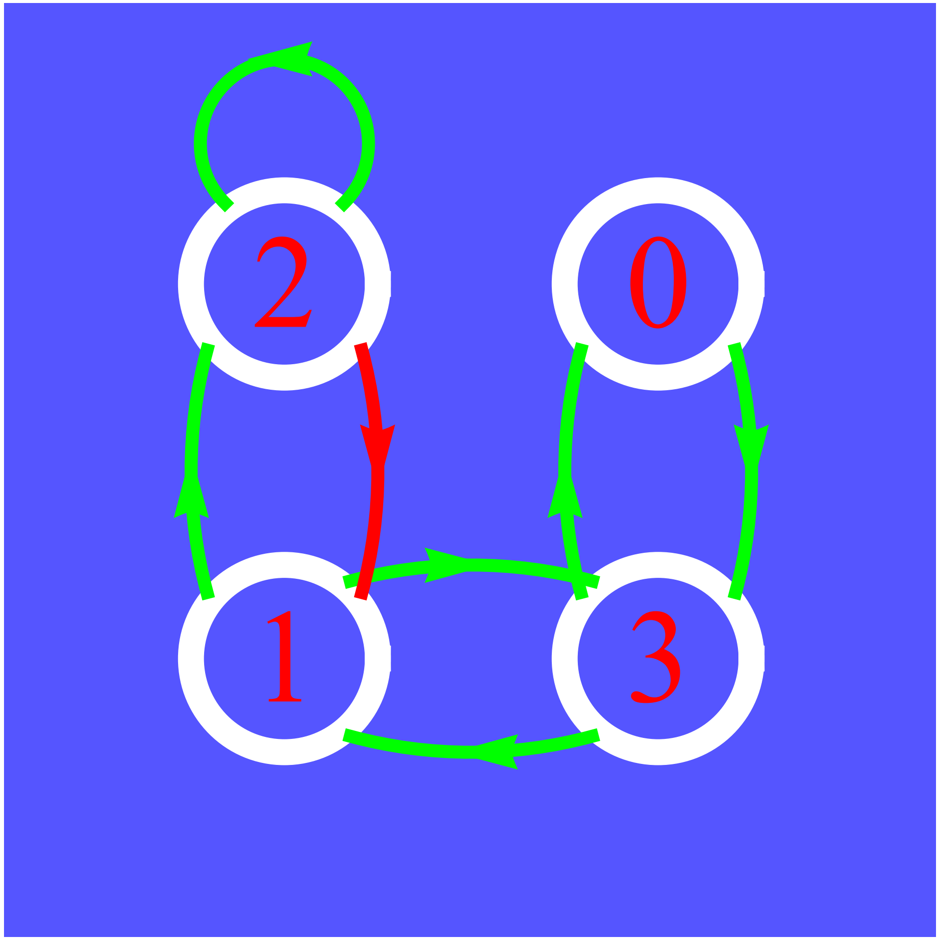
Number of returning pairs each show



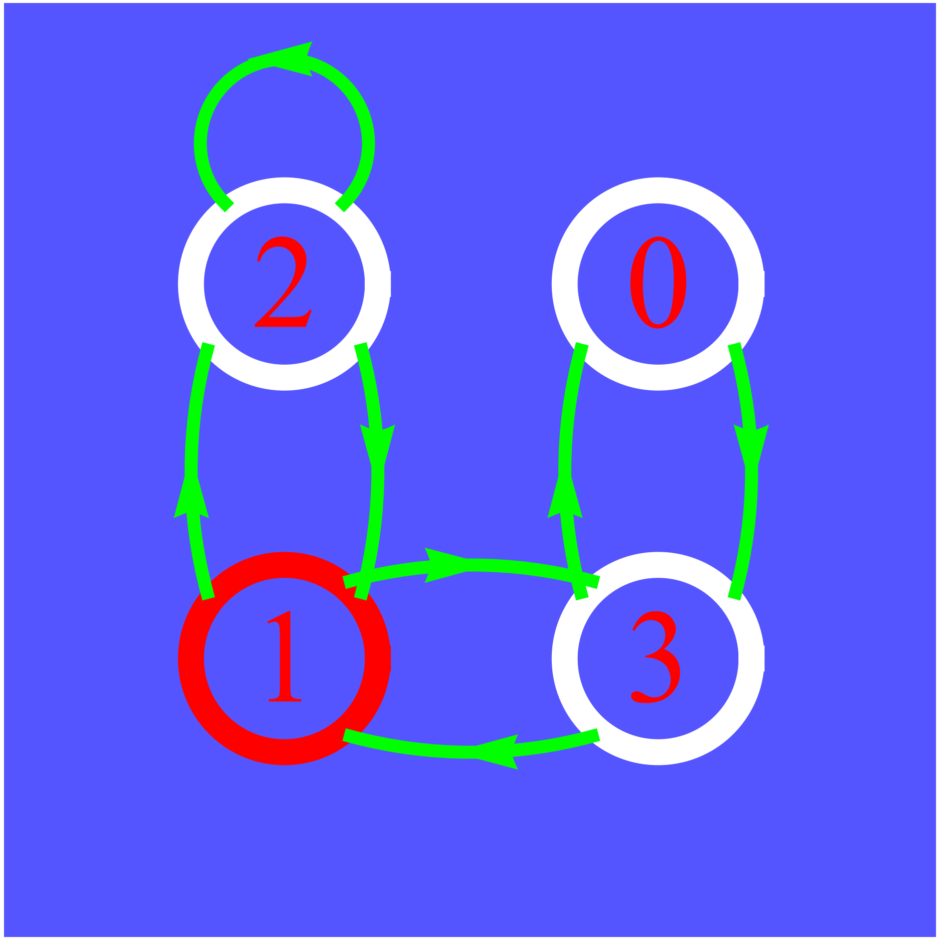
Number of returning pairs each show



Number of returning pairs each show

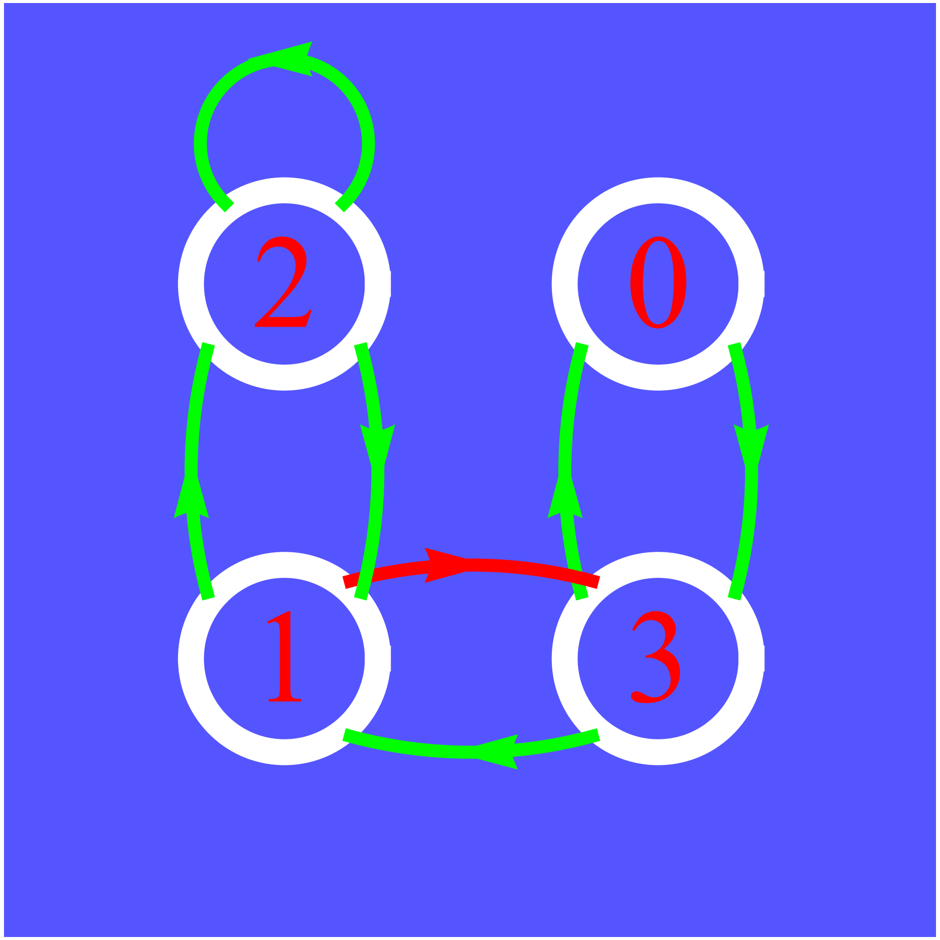


Number of returning pairs each show

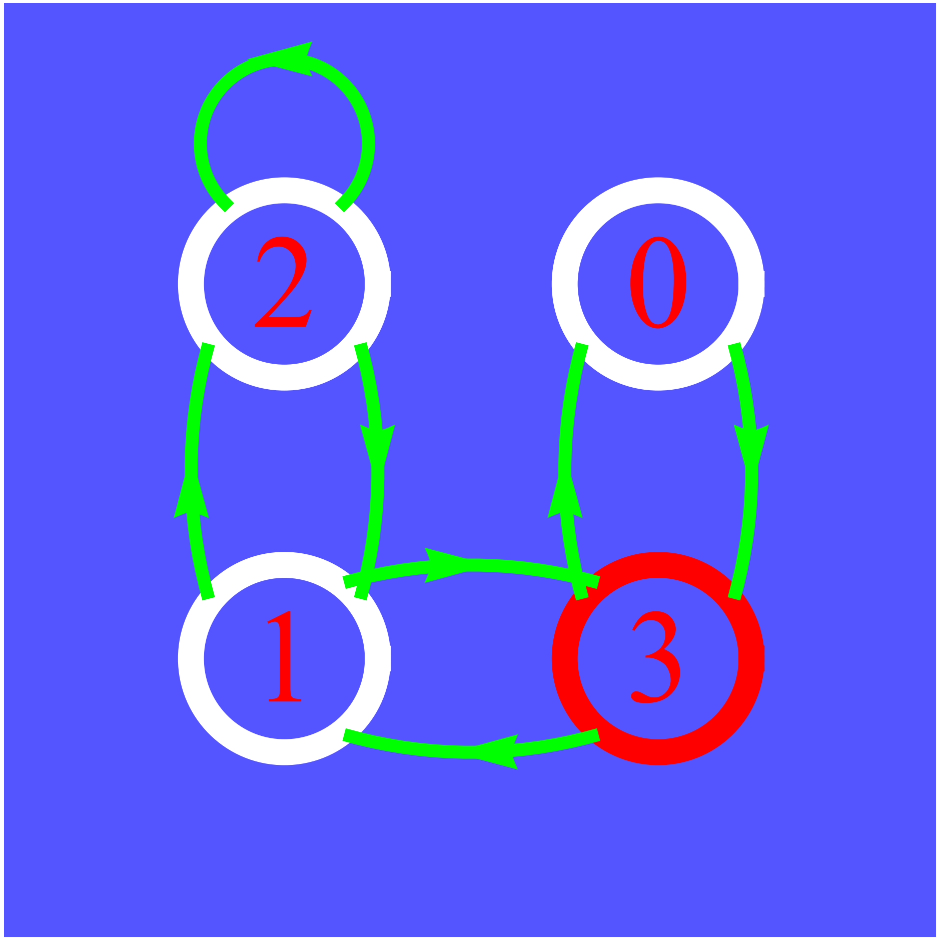


Imperial College London

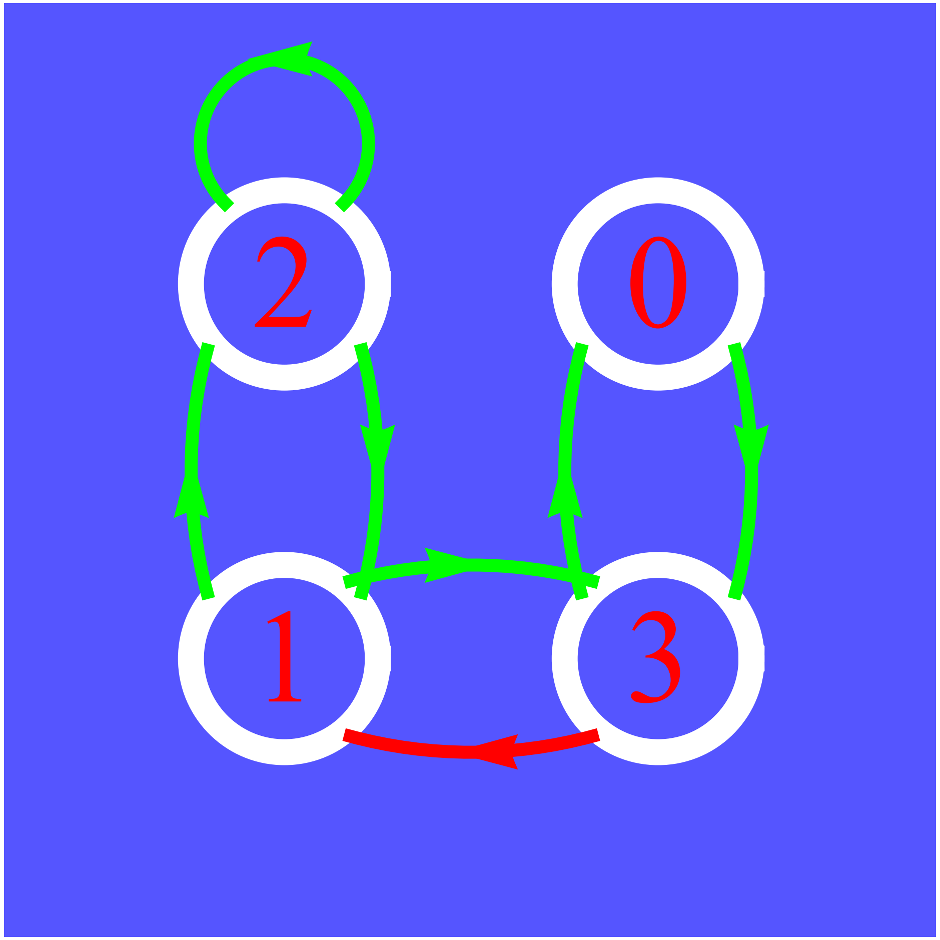
Number of returning pairs each show



Number of returning pairs each show

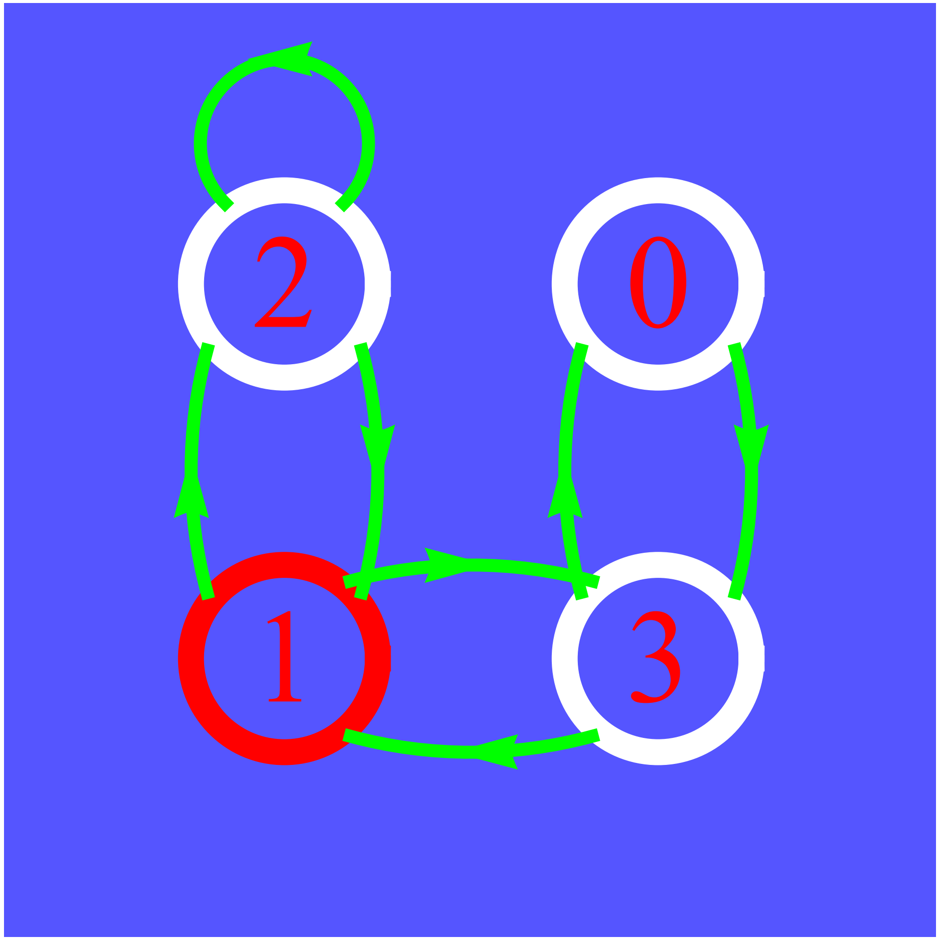


Number of returning pairs each show



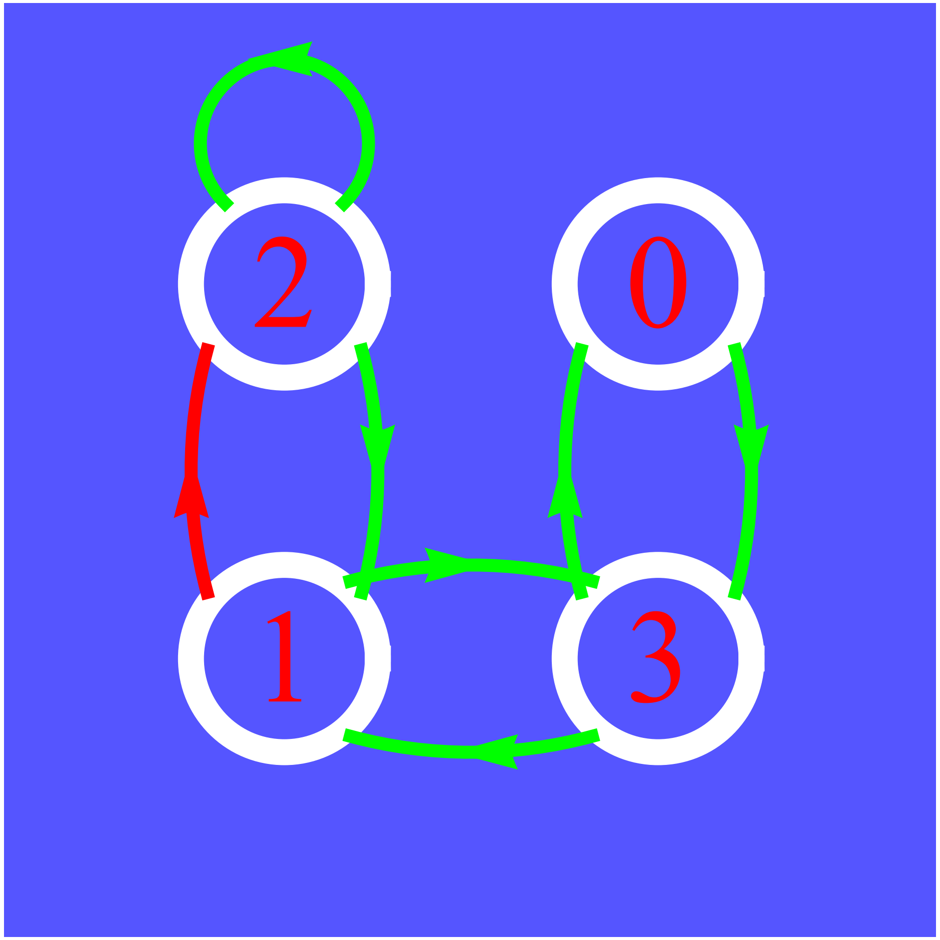
Imperial College London

Number of returning pairs each show



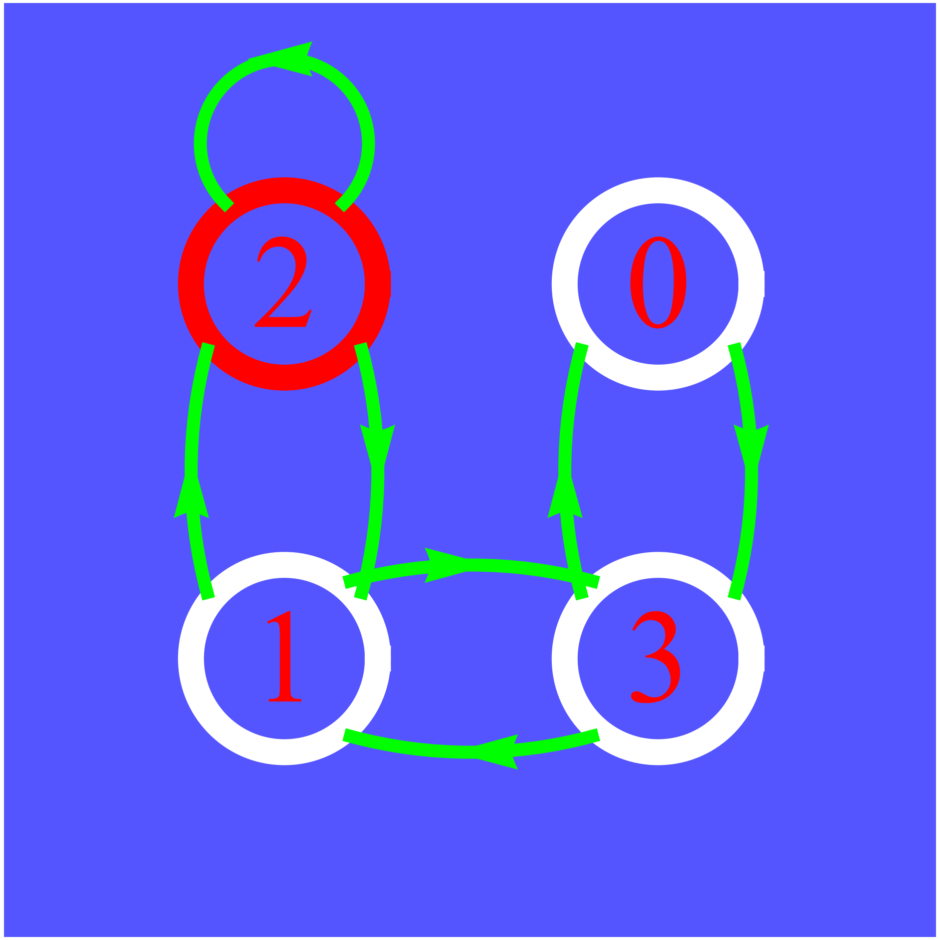
Imperial College
London

Number of returning pairs each show

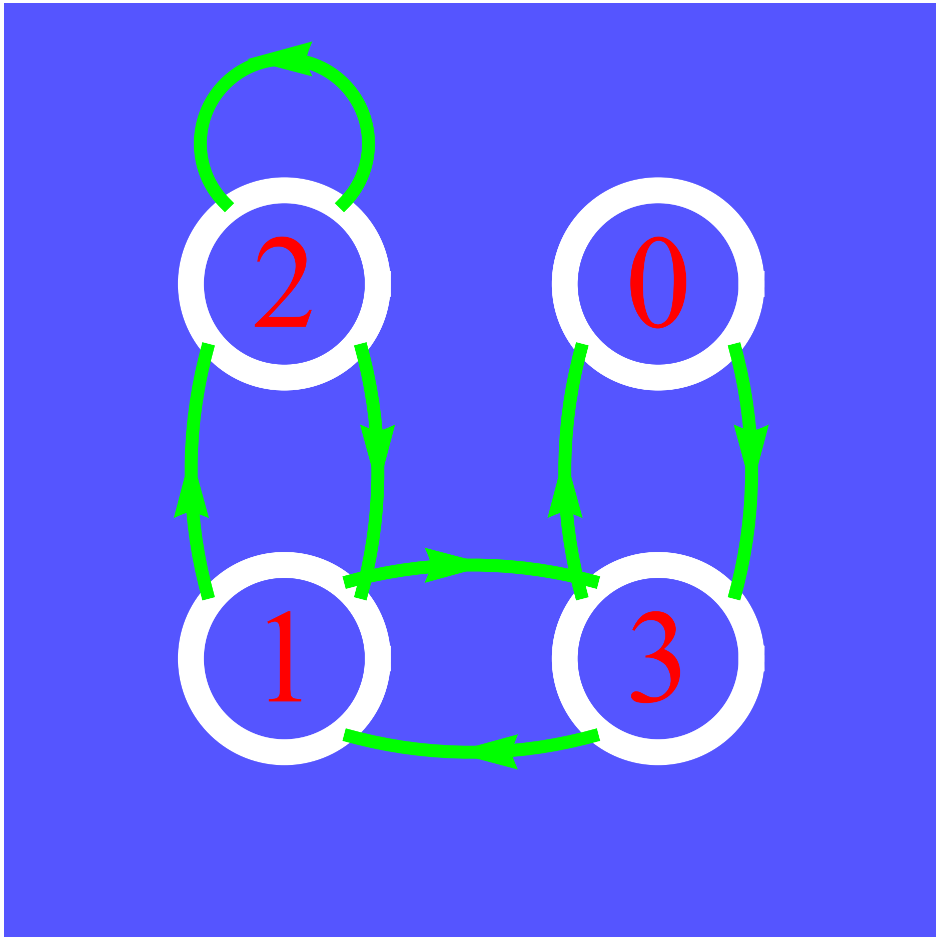


Imperial College London

Number of returning pairs each show



Number of returning pairs each show

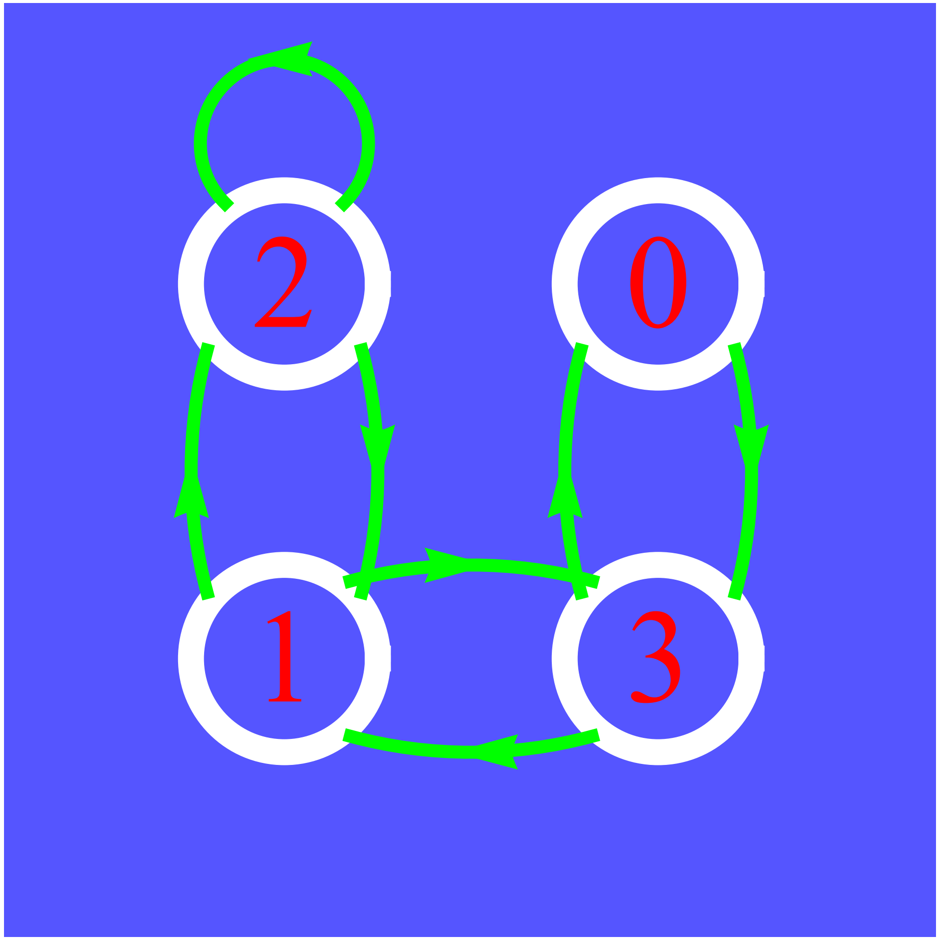


Number of returning pairs each show

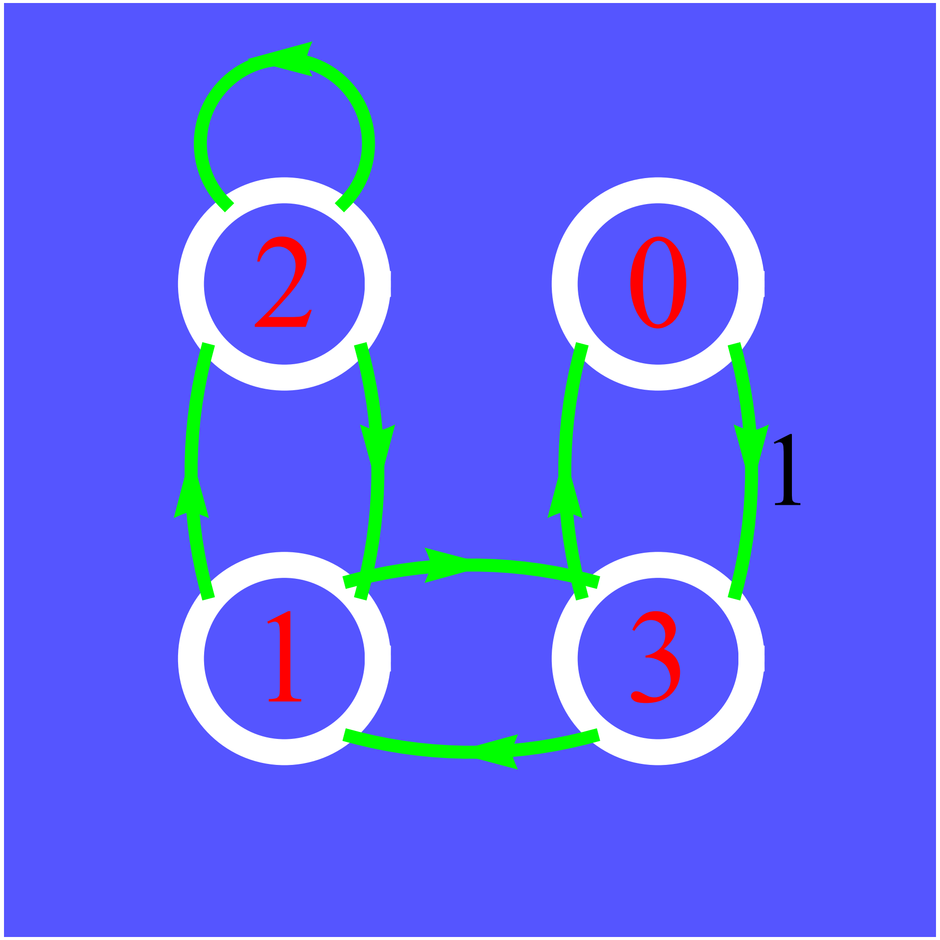
Let’s assume who gets to the final is entirely random…

Imperial College London

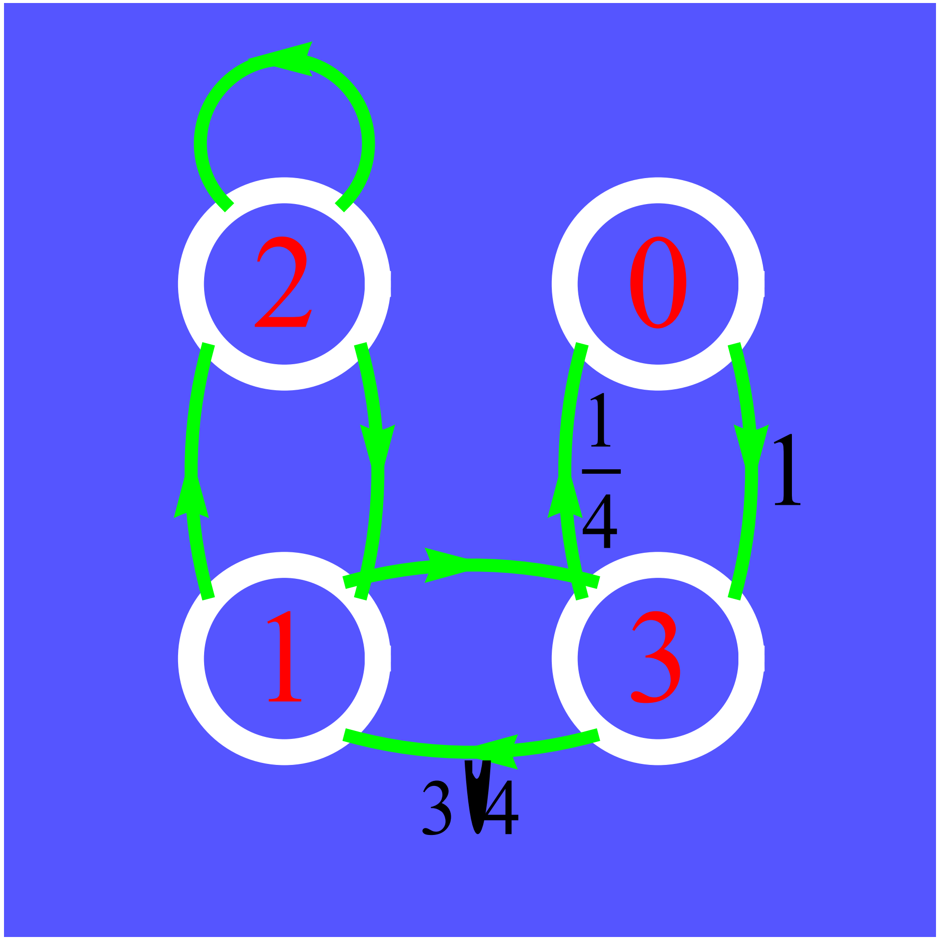
Number of returning pairs each show



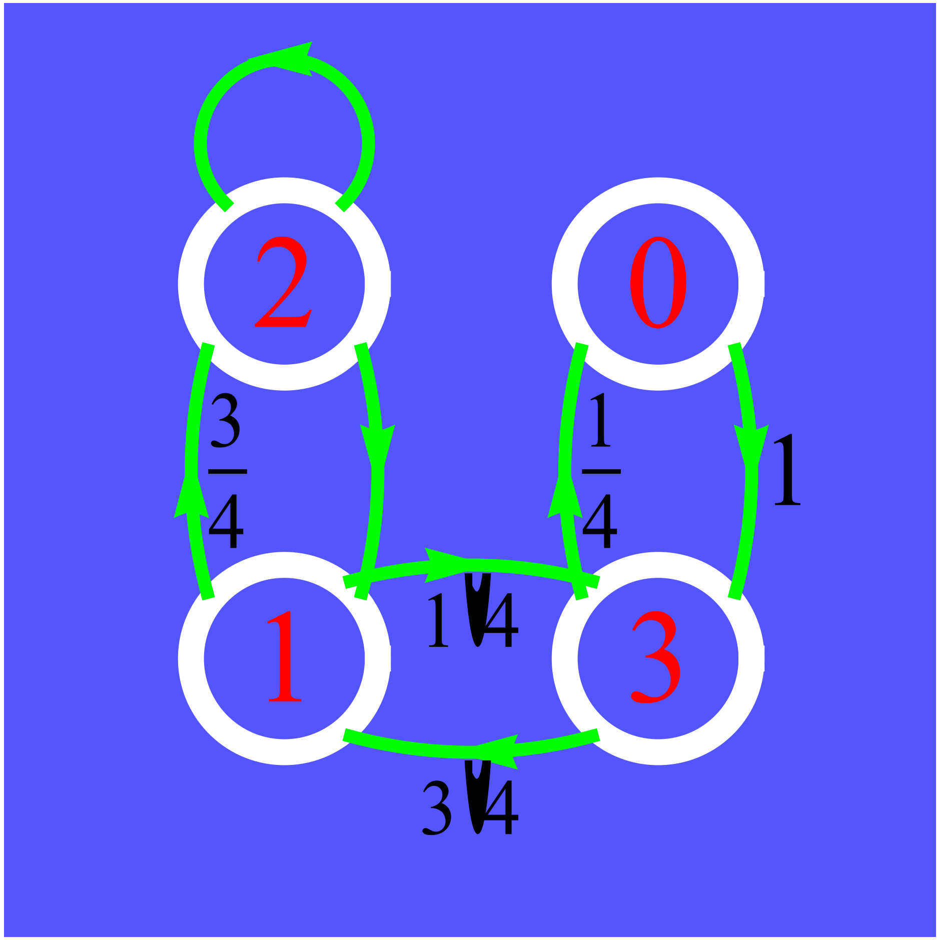
Number of returning pairs each show



Number of returning pairs each show

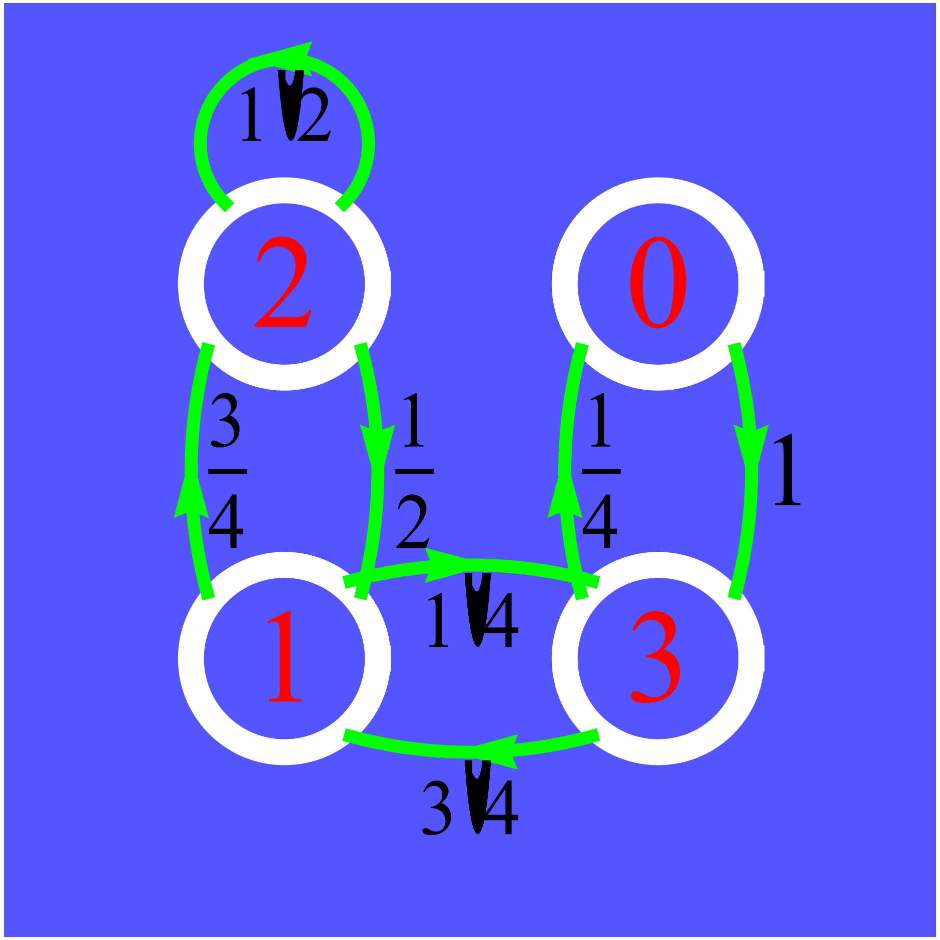


Number of returning pairs each show



Imperial College
London

Number of returning pairs each show



Imperial College London

Number of returning pairs each show

		Next Show			
		0	1	2	3
This Show	0	0	0	0	1
	1	0	0	$\frac{3}{4}$	$\frac{1}{4}$
	2	0	$\frac{1}{2}$	$\frac{1}{2}$	0
	3	$\frac{1}{4}$	$\frac{3}{4}$	0	0

Imperial College London

Number of returning pairs each show

A Markov chain!

Probabilities

	0	1	2	3
Show 1	1	0	0	0
Show 2				
Show 3				
Show 4				
Show 5				
Show 6				
Show 7				

Probabilities

	0	1	2	3
Show 1	1	0	0	0
Show 2	0	0	0	1
Show 3				
Show 4				
Show 5				
Show 6				
Show 7				

Imperial College London

Probabilities

	0	1	2	3
Show 1	1	0	0	0
Show 2	0	0	0	1
Show 3	$\frac{1}{4}$	$\frac{3}{4}$	0	0
Show 4				
Show 5				
Show 6				
Show 7				

Imperial College London

Probabilities

	0	1	2	3
Show 1	1	0	0	0
Show 2	0	0	0	1
Show 3	$\frac{1}{4}$	$\frac{3}{4}$	0	0
Show 4	0	0	$\frac{9}{16}$	$\frac{7}{16}$
Show 5				
Show 6				
Show 7				

Imperial College London

Probabilities

	0	1	2	3
Show 1	1	0	0	0
Show 2	0	0	0	1
Show 3	$\frac{1}{4}$	$\frac{3}{4}$	0	0
Show 4	0	0	$\frac{9}{16}$	$\frac{7}{16}$
Show 5	$\frac{7}{64}$	$\frac{39}{64}$	$\frac{18}{64}$	0
Show 6				
Show 7				

Imperial College London

Probabilities

	0	1	2	3
Show 1	1	0	0	0
Show 2	0	0	0	1
Show 3	$\frac{1}{4}$	$\frac{3}{4}$	0	0
Show 4	0	0	$\frac{9}{16}$	$\frac{7}{16}$
Show 5	$\frac{7}{64}$	$\frac{39}{64}$	$\frac{18}{64}$	0
Show 6	0	$\frac{36}{256}$	$\frac{153}{256}$	$\frac{67}{256}$
Show 7				

Imperial College London

Probabilities

	0	1	2	3
Show 1	1	0	0	0
Show 2	0	0	0	1
Show 3	$\frac{1}{4}$	$\frac{3}{4}$	0	0
Show 4	0	0	$\frac{9}{16}$	$\frac{7}{16}$
Show 5	$\frac{7}{64}$	$\frac{39}{64}$	$\frac{18}{64}$	0
Show 6	0	$\frac{36}{256}$	$\frac{153}{256}$	$\frac{67}{256}$
Show 7	$\frac{67}{1024}$	$\frac{507}{1024}$	$\frac{414}{1024}$	$\frac{36}{1024}$

Long-term Probabilities

	0	1	2	3
Show ◎	$\frac{1}{35}$	$\frac{12}{35}$	$\frac{18}{35}$	$\frac{4}{35}$

But...

Are our assumptions correct?

Is the pair that gets to the final random?

If not, what difference would it make?

Imperial College London

Pure trial of strength

Each pair has a certain **strength**.

- Randomly assigned
- Never mind what distribution (uniform will do)

The strongest pair always gets to the final.

(Assign each pair a random real number, and make the highest-ranked pair get to the final every time.)

Then brute-force simulate it.

‘Strength plus noise

Each pair has a certain **strength**.

The strongest pair is most likely to get to the final, but there’s still a random element.

Assign each pair a strength, normally distributed with standard deviation σ_1 …

… and then add **noise**, normally distributed with standard deviation σ_2 .

The pair with highest strength-plus-noise gets to the final.

Then brute-force simulate it.

Strength plus noise

$\sigma_1/\sigma_2 \ll 1$

Noise outweighs strength.

Approximated by the Markov chain.

Strength plus noise

$\sigma_1 / \sigma_2 \gg 1$

Strength outweighs noise.

Approximated by the “best pair” model.

One million shows

Markov chain

- (didn't bother simulating, just used calculated probabilities)

Strength plus noise

$\sigma_1 / \sigma_2 = 1$.

Pure trial of strength

Imperial College London

One million shows

What do we expect, as regards the long term probabilities of the four states?

In what ways will the "pure luck" and "pure strength" ones differ?

How much will they differ?

Imperial College London

One million shows