

Mathematical Enrichment Class

Professor Gary McGuire

*UCD School of Mathematics and
Statistics*



See www.irmo.ie for more details

- There are initial enrichment classes on Saturday 19,26 January and 2,9 February (2019).
- On Saturday 16 February there will be a selection test, at the end of which the best students will be invited for more intense training in view of participation in the Irish Maths Olympiad.
- This event (IrMO) will take place at a national level on Saturday 11 May 2019. The best six pupils at the Irish Maths Olympiad will represent the country at the International Maths Olympiad (IMO) which will take place in UK in July 2019.



- Suppose a hacker can try 1000 passwords in one second.
- Suppose there are 60 possibilities for each character in a password.
- How long will it take a hacker to check all passwords with two characters?
- With three characters?
- How about with eight characters?



A password with two characters ** has 60 choices for each *

So there are $60 \times 60 = 3600$ possible passwords.

3.6 seconds to try them all.

With three characters there are $60^3 = 216,000$

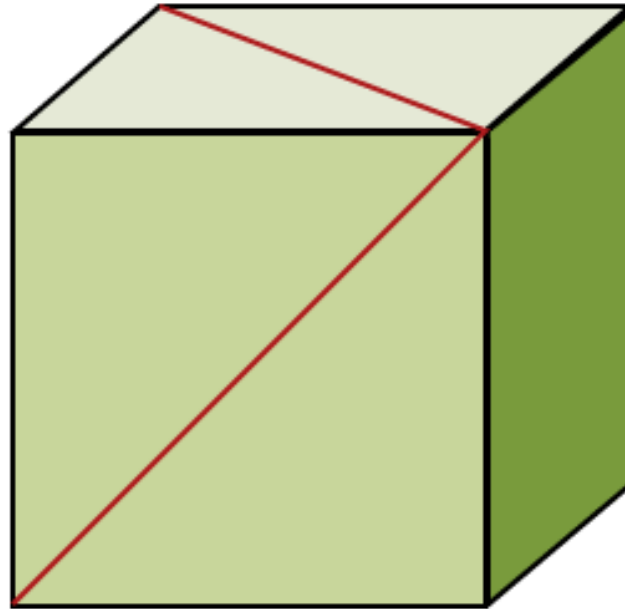
It would take 216 seconds, less than 4 minutes.

With eight characters there are 60^8 passwords.

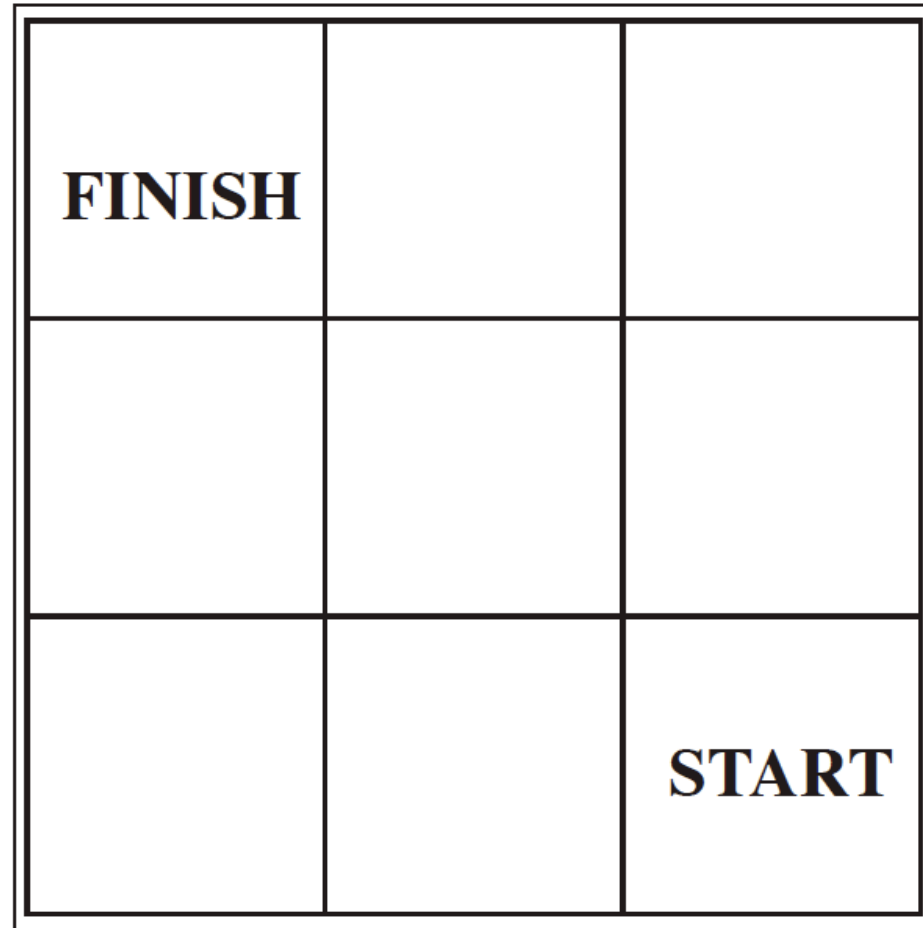
This is 167961600000000 which would take over 5,000 years!



What is the angle between the two red lines?



Heads go up, Tails go left. If you go off, you lose. What are the chances of winning?



A Hat Game

A group of N people are in a room. Each person is randomly given either a red hat or a blue hat.

Each person cannot see their own hat, but can see all other hats. Each person must guess the colour of their own hat. They all must guess at the same time. If they all guess correctly then they win a billion euro each. If anyone guesses incorrectly they win nothing. Before the hats are given out, the group may decide on a strategy. Once the hats are given out, no communication (of any kind) is allowed.



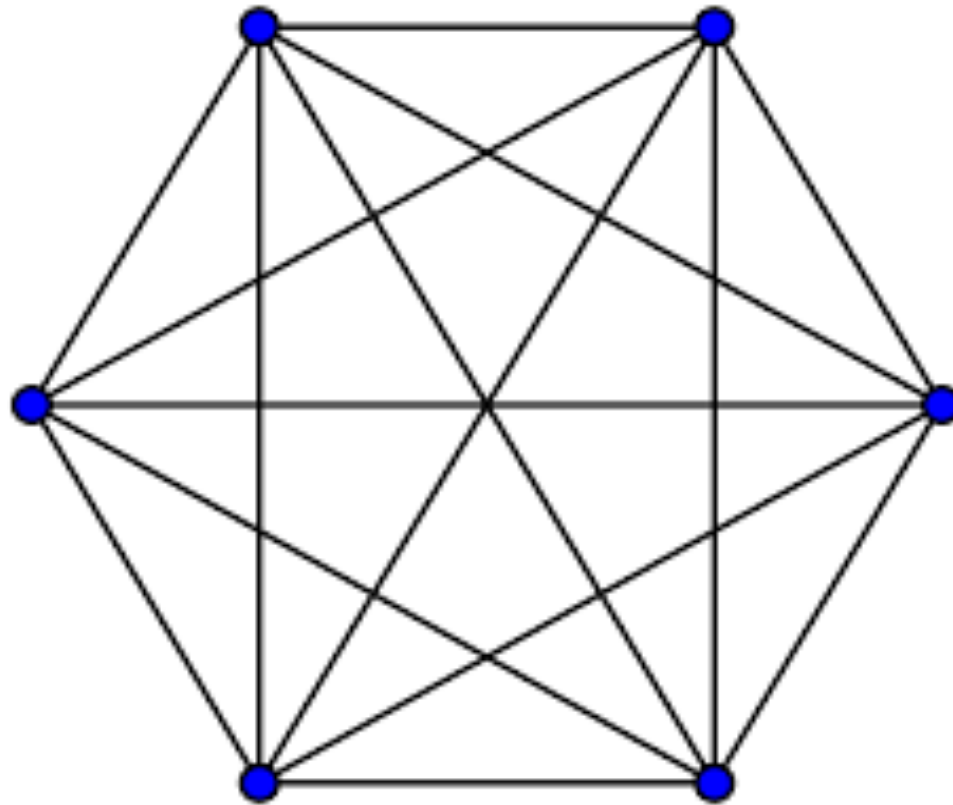
What would be the best strategy? What are the chances of that strategy working?

- 3 people in a room. Same scenario with the hats, except this time they may also pass. They win as long as nobody guesses incorrectly, and at least one person guesses correctly.
- What is the best strategy? What are its chances of working?

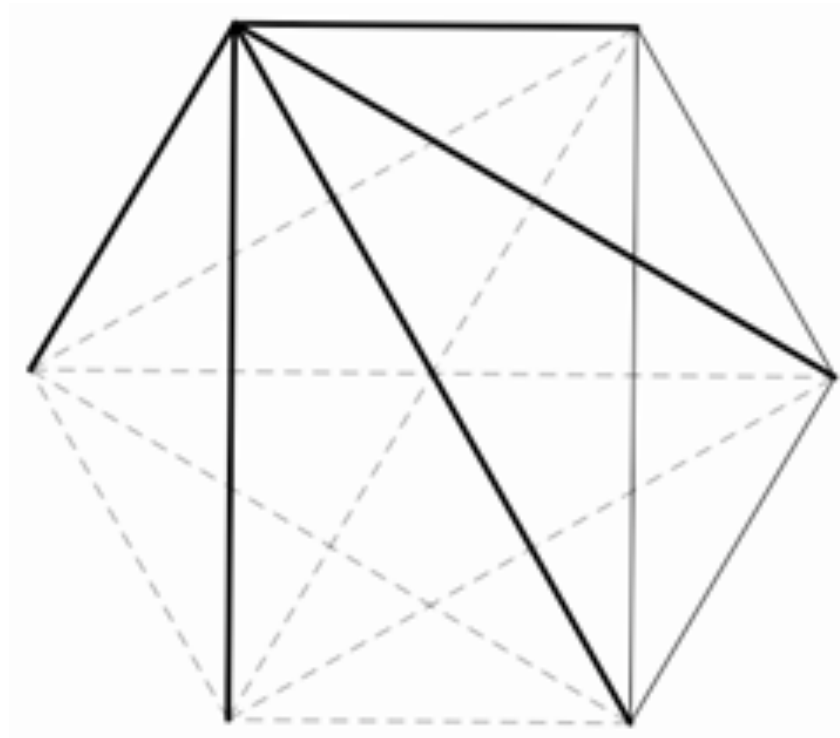


I colour a line red, you colour a line blue.
We take turns. If you make a triangle in your own colour, you lose.

Hexagon



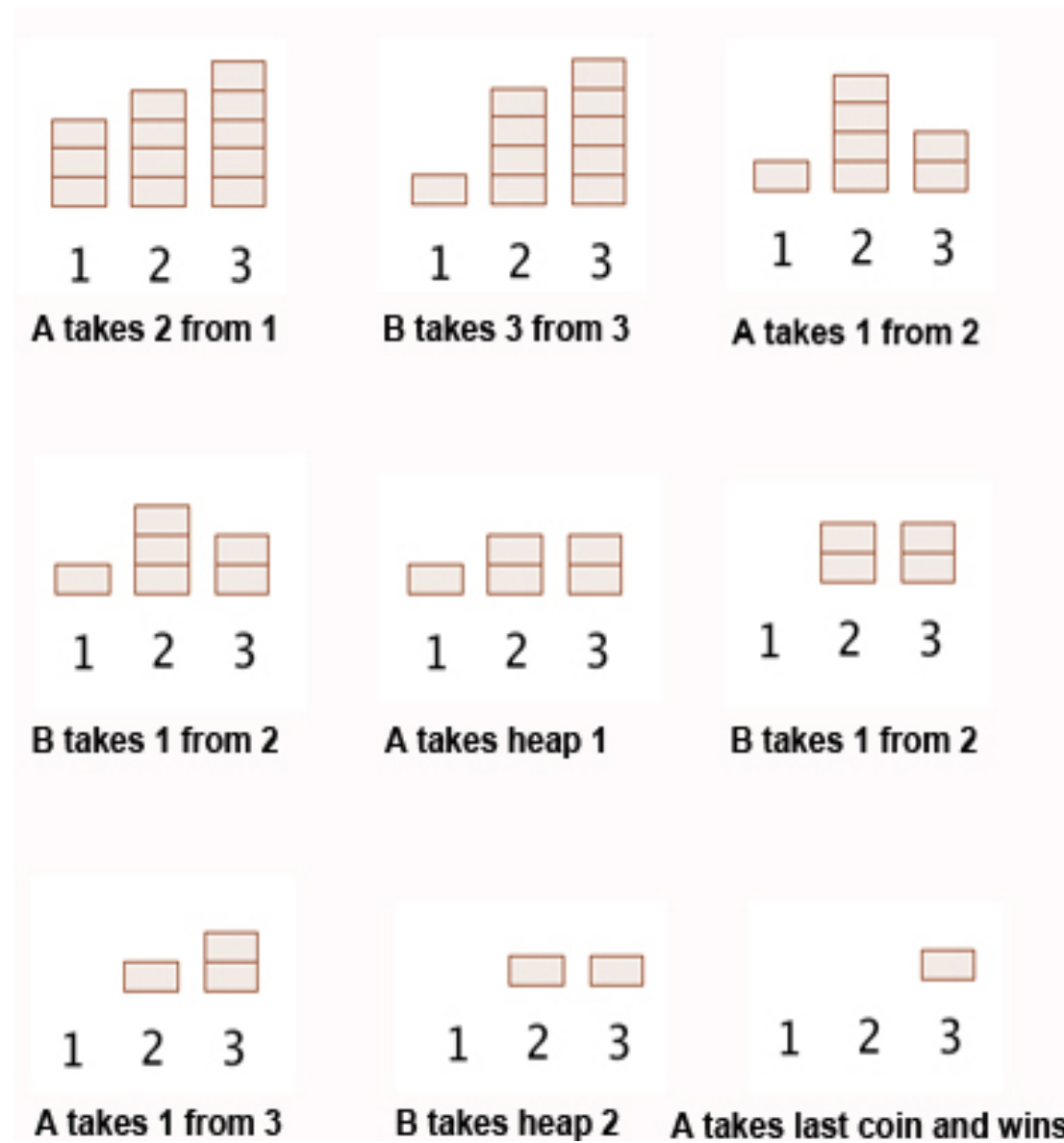
Why can this game not end in a draw?



Nim



Nim



Nim

- What is the best strategy for Nim?
(for first player, and for second player)
- What is the probability of this strategy working?



Nim

