

The Australian Magician's Dream

The Magic of Search Algorithms



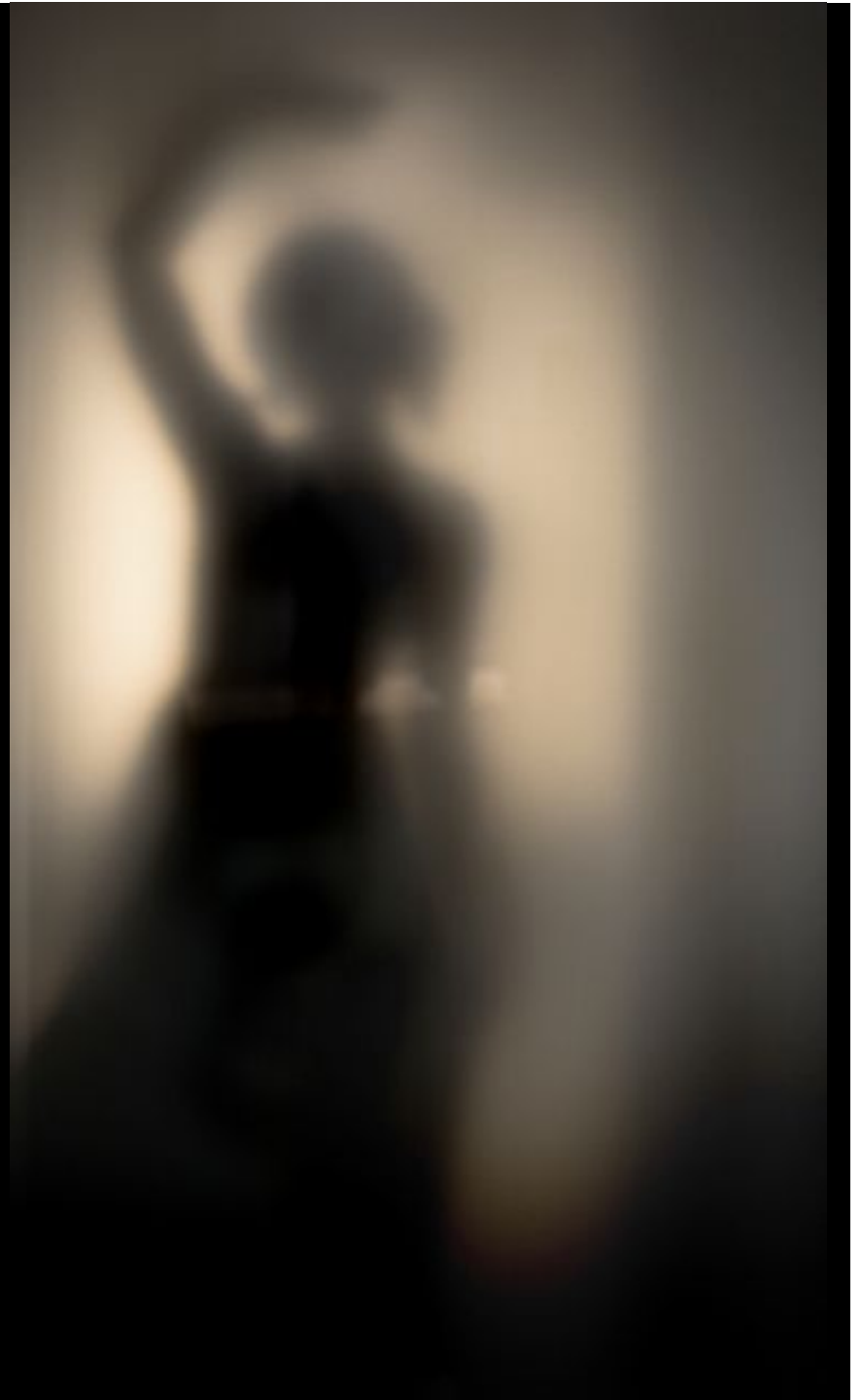
Paul Curzon

Queen Mary, University of London

On with the magic ...
Please keep the secrets

- I'm going to teach you how to do the tricks
- Some are actually in the shows of professional magicians
- If you do perform them later for friends don't break the magician's code
- Keep the secrets!
- If you do know then don't shout out let others puzzle it out first!

The Australian magician's dream



Ponder break

How on earth
do they do
that?



The computer science?

It is a self-working trick: an algorithm

1. Place the chosen card in position 16
2. Discard roughly the bottom half
3. Repeat 4 times:
Discard the first and then
every second card thereafter
4. Reveal the card is the one predicted.

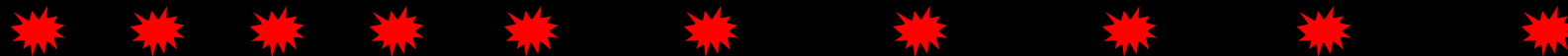
How can you be sure the trick always works?

- How long would it take to test all combinations of card starting positions and points cut is done?
- Instead use logical reasoning to cut down the number of options to test
 - The values of the other cards don't matter!
- Could we prove it works with no testing?

A diagrammatic proof

- Shows you will always be left with the 16th card
 - As long as there are between 16 and 32 cards in the pile

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, **16**, 17, 18, 19, 20, ...



2, 4, 6, 8, 10, 12, 14, **16**, 18, 20, ...



4, 8, 12, **16**, 20, ...



8, **16**



16

I set my force
card 16 from
the top

It is a real search algorithm

- It is not just that magic tricks are algorithms
- Real computer algorithms can be turned into magic tricks (and vice versa)
- This trick is actually a search algorithm
 - the algorithm was used by early computers to find data stored on punch cards
- Used to pull out a particular punch card based on numbers encoded in binary as holes and slots along the top of the card
 - A slot = 1
 - A hole = 0

We need some binary maths

16 in Binary is 10000

	16	8	4	2	1
x	1	0	0	0	0
=	16 +	0 +	0 +	0 +	0

5 in Binary is 00101

	16	8	4	2	1
x	0	0	1	0	1
=	0 +	0 +	4 +	0 +	1

0 means DISCARD the “down” pile

1 means KEEP the “down” pile

APPLY THIS RULE WITH PUNCH CARDS TO FIND ANY CARD

Searching for punch card 16

- Apply the rule below to a mixed up pile of punch cards.
 - Put the pin in each hole starting from the units hole, shaking out cards
 - 0 means DISCARD the “down” pile (the ones that drop out)
 - 1 means KEEP the “down” pile

16 in Binary is 10000

1 :	0	DISCARD the “down” pile
2 :	0	DISCARD the “down” pile
4 :	0	DISCARD the “down” pile
8 :	0	DISCARD the “down” pile
16 :	1	KEEP the “down” pile

You will be left holding punch card 16
Follow the binary for any number and you will find that card

The big picture?

Magic = secret method + presentation

Software = algorithm + interaction design

It's important that both the
algorithm and interaction design
are correct!

Summary

Programmers really are wizards!



- Programmers and magicians have to think in the same way
 - creating new tricks,
 - creating new programs
- It's all about computational thinking

Thank you!

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