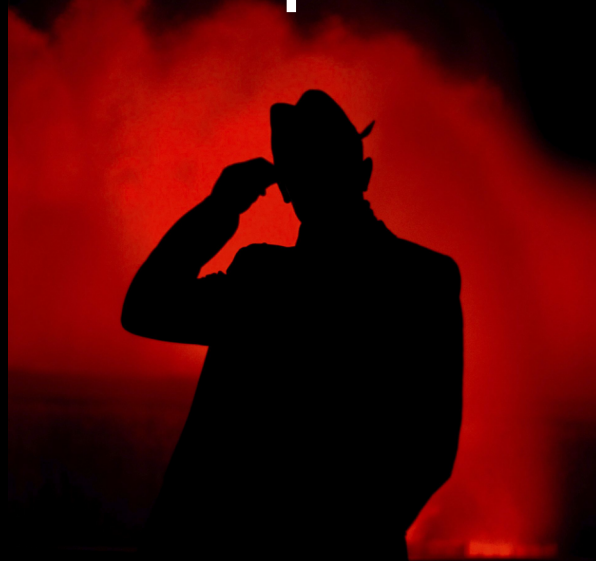


Introducing Computing and Computational Thinking without Computers



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EPSRC

Engineering and Physical Sciences
Research Council

www.cs4fn.org

Supported by Google



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What is computational thinking?

- I think the interesting parts are:
 - algorithmic thinking
 - logical thinking
 - rigorous argument and proof
 - translating solutions between domains
 - computational modeling
 - abstraction
 - understanding people



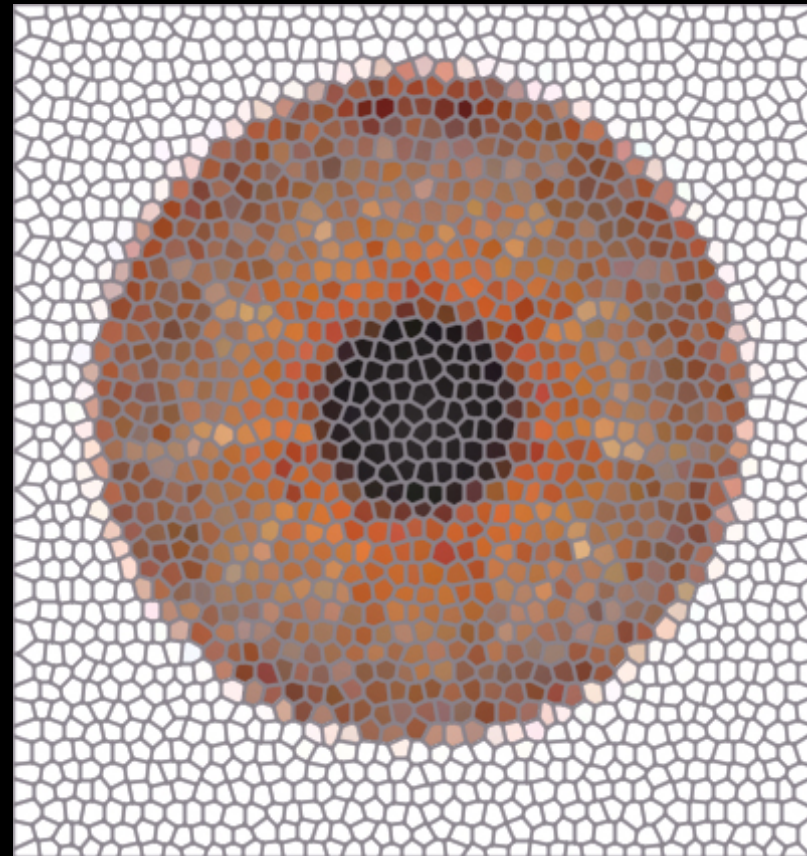
Weaving CT in...

- cs4fn uses oddball and real-world links to tell computing stories in a fun, memorable way
 - We weave computational thinking messages into our stories ...
 - ...both in print and in our unplugged activities
 - That in itself is an example of computational thinking
-
- Now for a lightning example (or two) ...



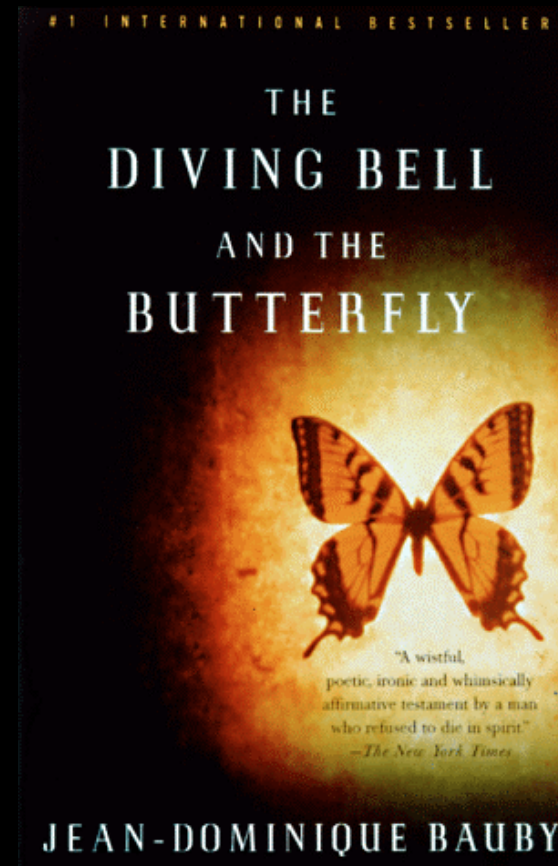
Locked-in Syndrome

- A person with locked-in syndrome is totally paralyzed except perhaps being able to move an eyelid.
- They can see, hear and think but they cannot communicate back.
- **Their intelligent mind is trapped inside a useless body.**



Could you write a book if you had locked-in syndrome?

- Jean-Dominique Bauby did...
 - “one of the greatest books of the century”.
- Describing his life with locked-in syndrome.
- How did he do it?
- How might he have done it if he'd known some computational thinking?



Winning at 20-Questions

- Do you ask questions like
 - Is it Jessica Ennis?
 - Is it Will Smith?
 - Is it Gandhi?
 - Is it Adele?
- That would on average take billions of questions
 - you have only 20!
- Instead you try to ask halving questions...
 - Are they female?
- Linear Search? or
- Divide and conquer?



Does everyone agree we
would have improved things
for Bauby?

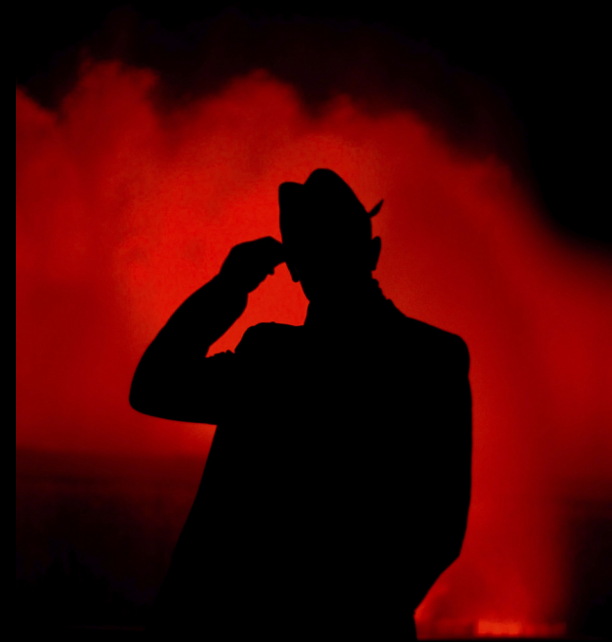
Did we get it right?

- Did we count the right thing?
- What if blinking is hard work for him?
 - We should have found out first.
- Have we made his life better or worse?

**Computing is about understanding
people too.**

Computational Thinking Lessons

- Algorithmic thinking
 - including efficiency
- Translating solutions between domains
- Understanding people



I have a piece of paper that is
more intelligent than anyone
in this room!

I am X... and I go first...

Move 1: Go in a corner.

Move 2:

IF the other player did not go there

THEN go in the opposite corner to your move 1.

ELSE go in a free corner.

...



Als beat humans at their own game

1997, IBM's **Deep Blue**
Supercomputer beat
reigning World Chess
Champion, Garry
Kasparov



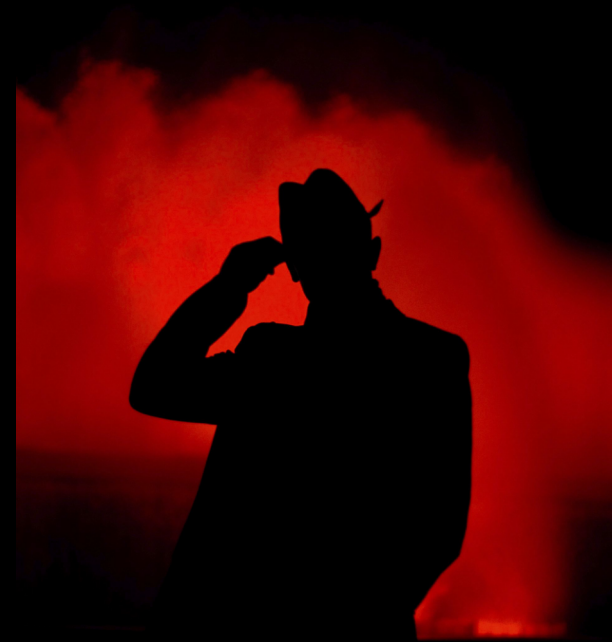
...Following rules,
...brute force searching

**"I'm not afraid to admit
that I'm afraid,"**

- Kasparov

Computational Thinking Lessons

- Algorithmic thinking
- Logical Thinking
- Abstraction





Are you psychic?

Ponder break

How on earth
do they do
that?



It's just an algorithm

1. Put two sets of 5 cards together in the same order
2. Cut the cards several times
3. Deal out the top 5 into a pile
4. Place the rest on to the table in a second pile
5. Set a counter n to be 4 and REPEAT the following until n is 1
 1. Ask a volunteer to pick a number k between 0 to n
 2. Move k cards to the bottom of the first pile
 3. Move $n - k$ cards to the bottom of the second pile
 4. Put the top card of each pile as a pair to the side
 5. Subtract 1 from the counter n
6. Reveal that all cards match

How do you know a trick always works



- Self-working tricks are just algorithms
- Programmers and magicians have to think in the same way
 - creating new tricks,
 - creating new programs
- Want to be sure following the steps works in ALL situations
 - testing ... proof ...

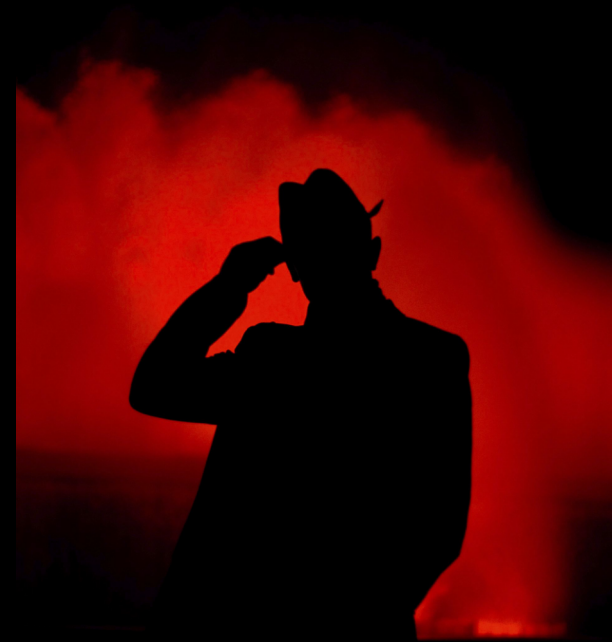
Computing is about understanding people

- Computer Science needs:
 - algorithms and interaction design.
- Magic needs:
 - secret methods and presentations.
- Without good presentation based on an understanding of people even a brilliant trick/algorithm may not 'work'!



Computational Thinking Lessons

- Algorithmic thinking
- Logical Thinking
- Rigorous argument and proof
- Translating solutions between domains
- Understanding people
- Abstraction



Another word game: 'spit not so'

SPIT

NOT

SO

FAT

FOP

AS

IF

IN

PAN

Tough to play? - Why?

What's your game?

- I've been playing noughts and crosses ...how about you?
- The human brain is better at spotting visual patterns than remembering things
 - Recognition not recall
- Used in the design of computer interfaces

NOT

IN

PAN

SO

SPIT

AS

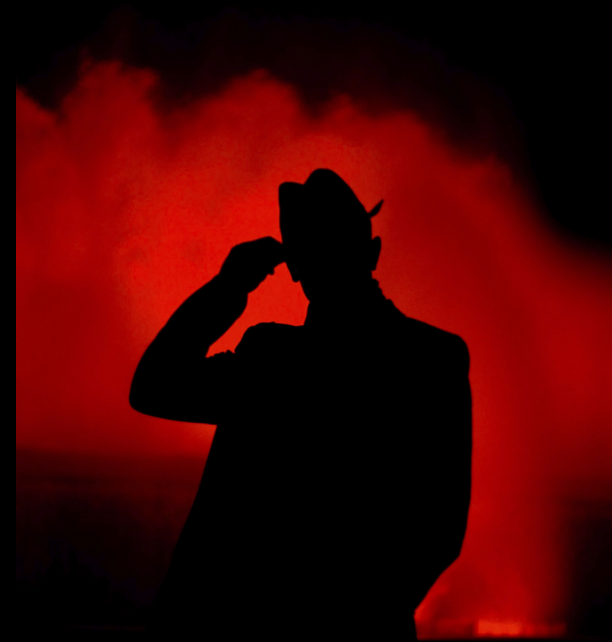
FOP

IF

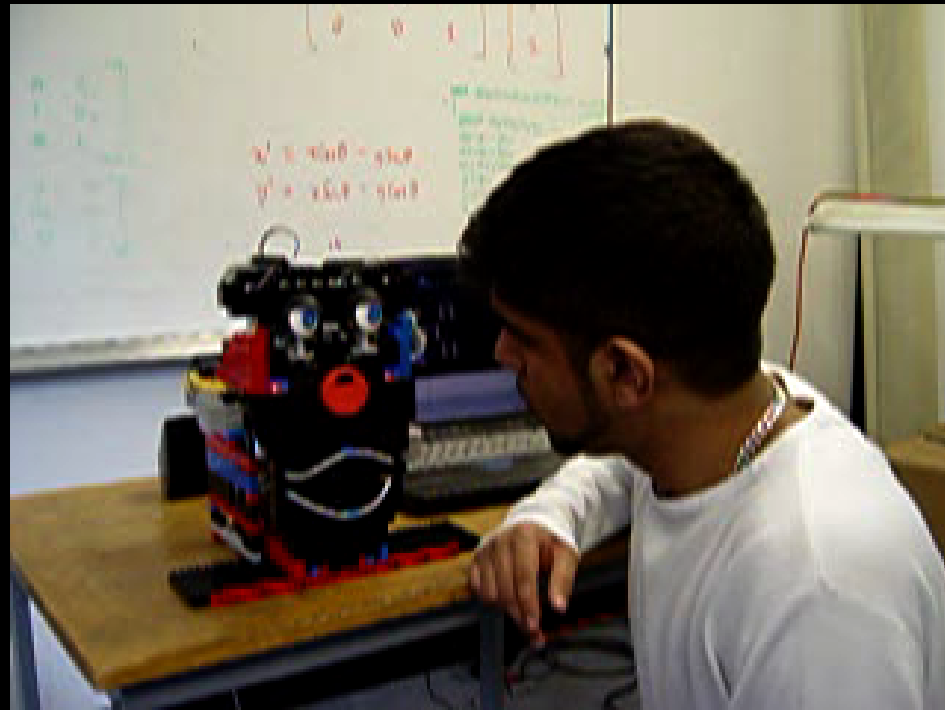
FAT

Computational Thinking Lessons

- Algorithmic thinking
- Logical Thinking
- Abstraction
- Understanding people



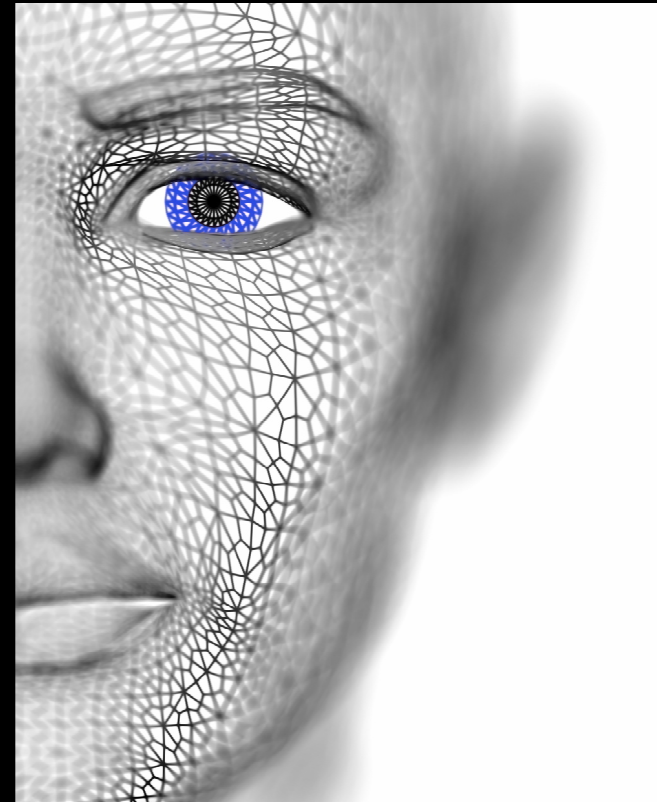
Let's program an emotional robot



Let's not bother with Lego...

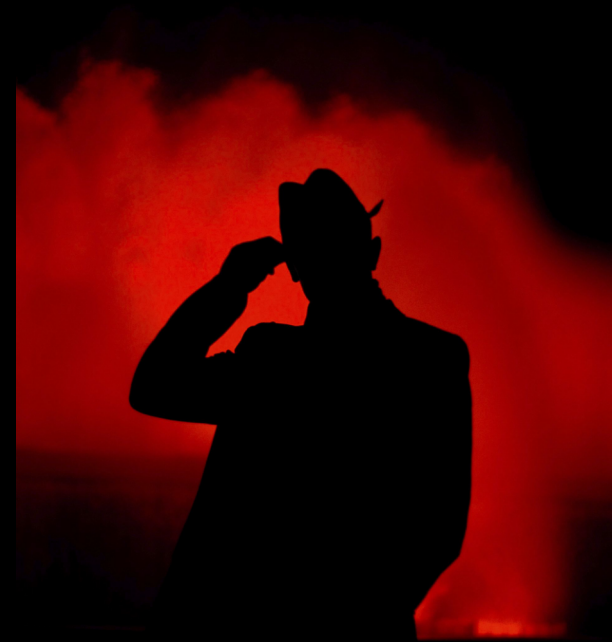
Objects: Programming an eyebrow

If NICE SOUND
 then DOWN
If NASTY SOUND
 then DOWN
If SUDDEN SOUND
 then UP



Computational Thinking Lessons

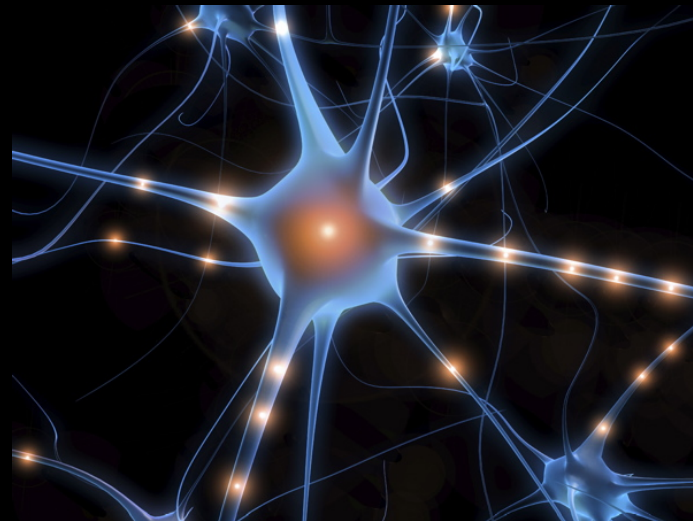
- Algorithmic thinking
- Abstraction



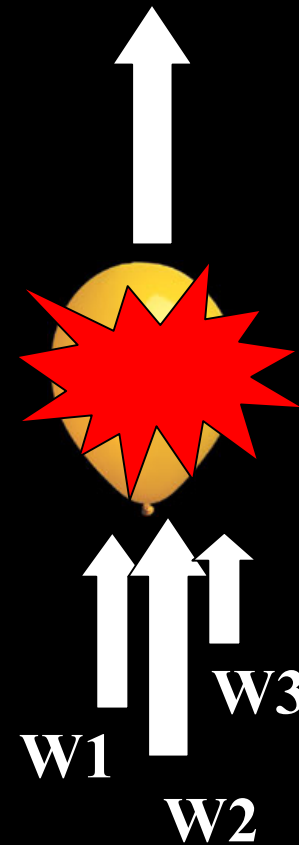
So what's in our head?



- Billions of interconnected nerve cells called neurons
- Very simple computing units, working together

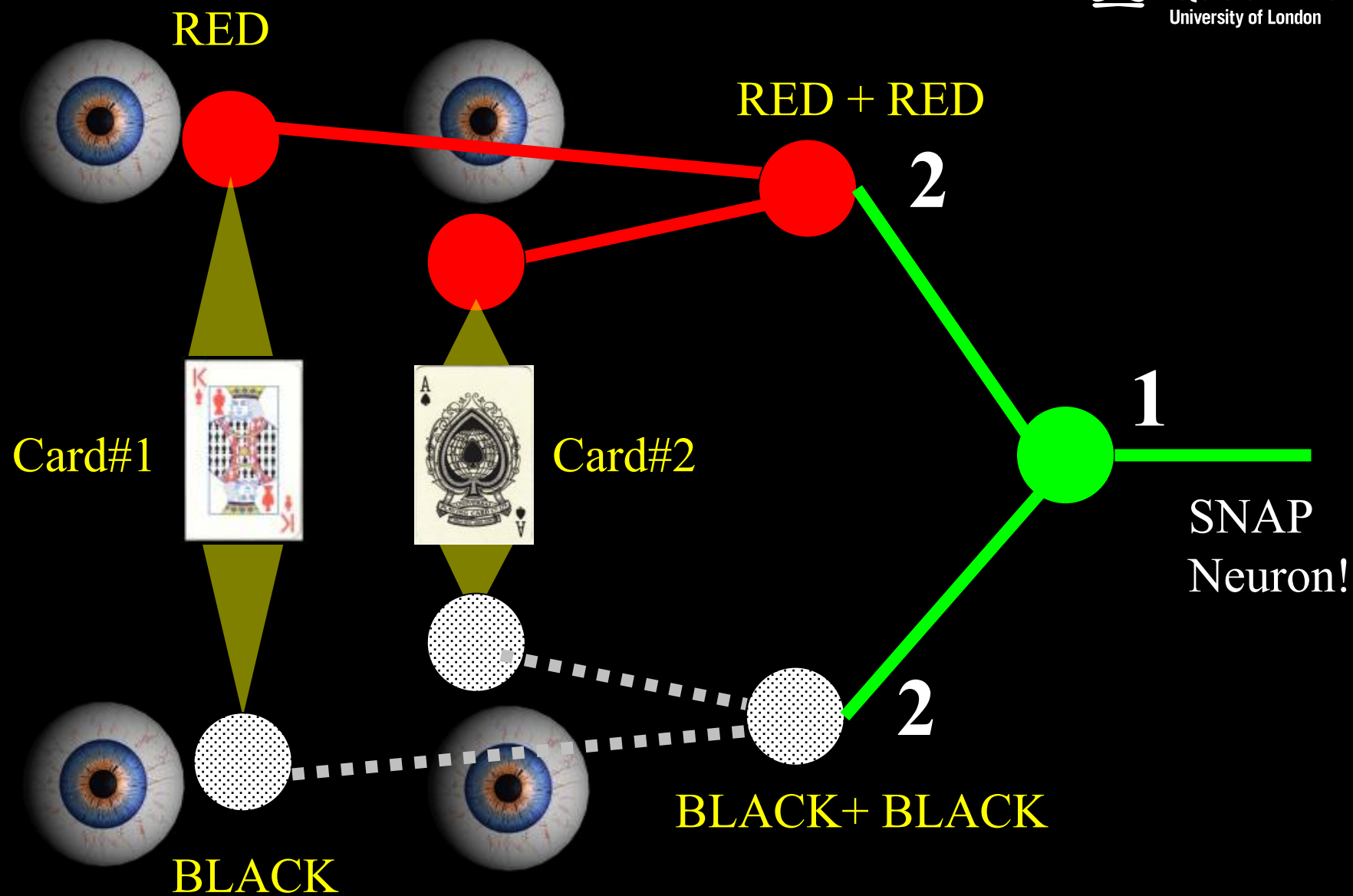


A simple model of a neuron

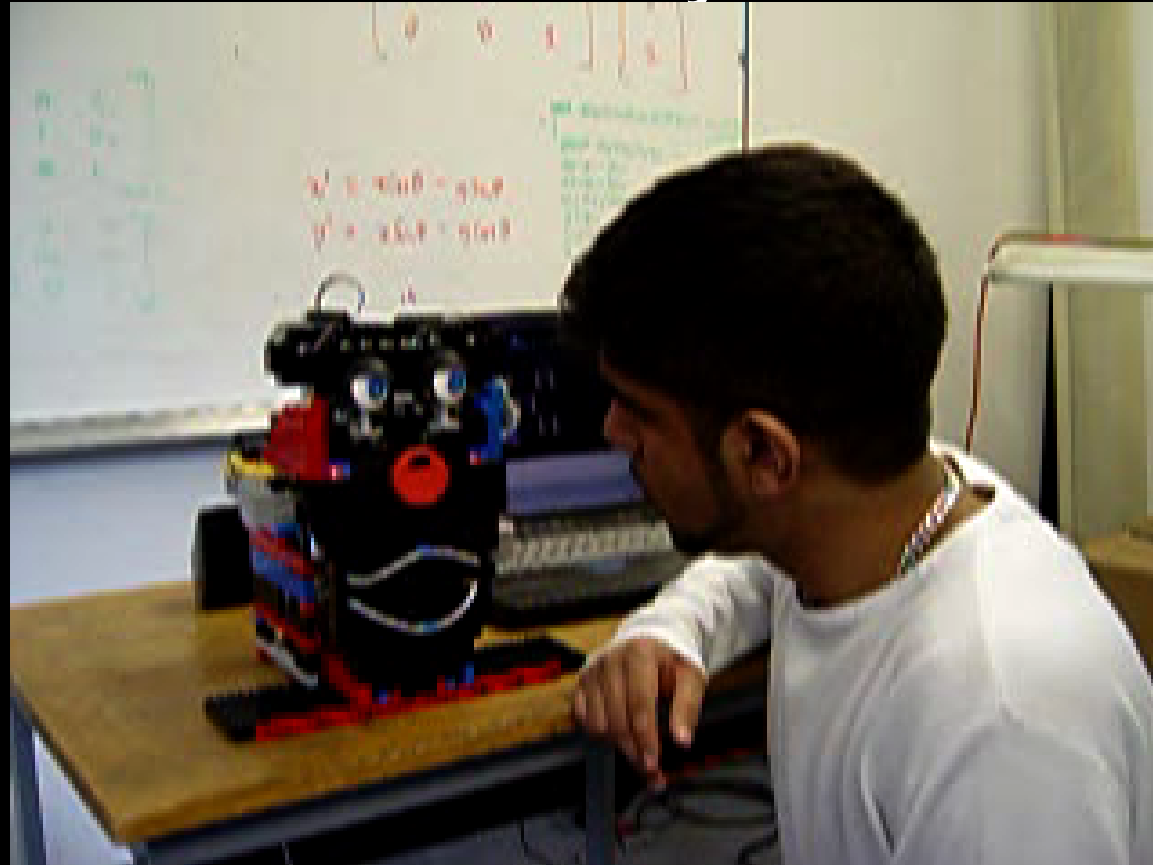


- But what does a neuron 'understand'?

Let's build a bit of a brain
to play snap!

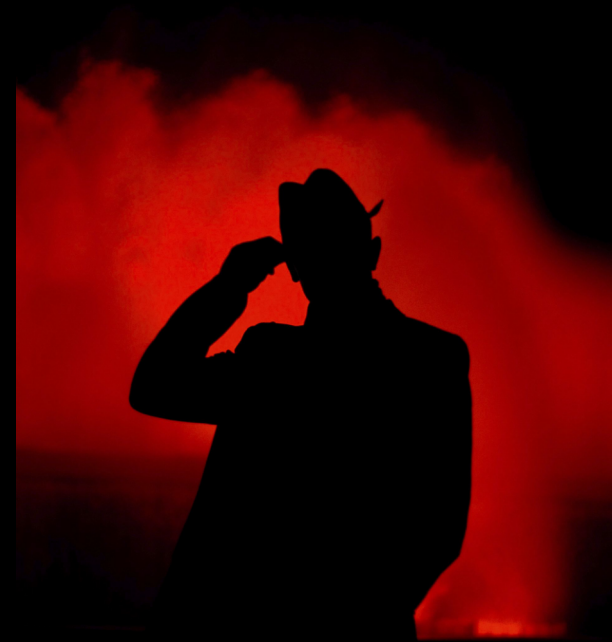


That's how this robot's brain actually works



Computational Thinking Lessons

- Algorithmic thinking
- Computational modeling
- Translating solutions
- Understanding people





The Four Aces

Ponder break

How on earth
do they do
that?



Medical device design?

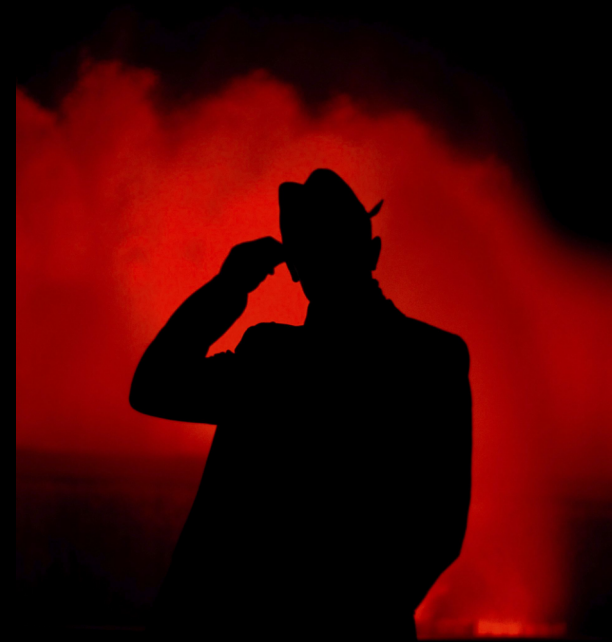


Just because
something is on the
screen ...doesn't
mean the nurse will
see it
- even if he's looking

If it is important,
then as a computer scientist you must
design the interaction so they do!

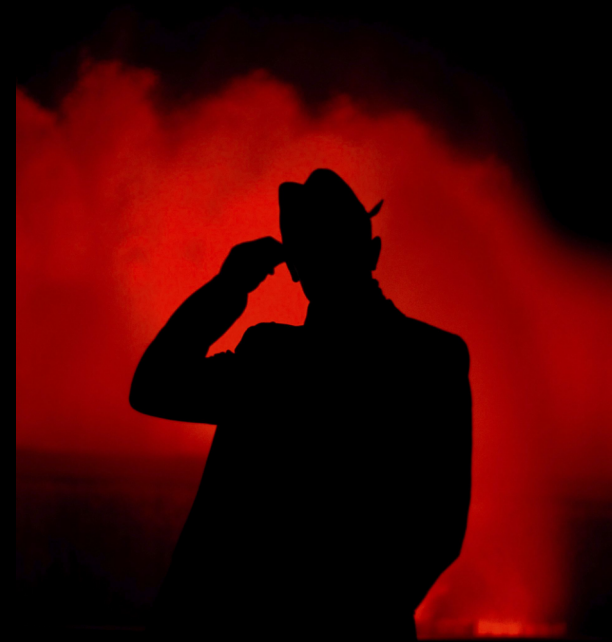
Computational Thinking Lessons

- Translating solutions
- Understanding people



Make Computational Thinking Computational Fun

- Unplugged activities are a great way to teach computing but also to introduce Computational Thinking
- Cs4fn and Unplugged are computational thinking in action!



Thank you!

- More activities at:
www.cs4fn.org/teachers/
- More computational thinking throughout the cs4fn website:
www.cs4fn.org



