Searching to Speak: Computational Thinking Unplugged

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Twitter @cs4fn

Computational thinking

- Computation is everywhere
- Computational thinking is about thinking skills
  - Algorithmic thinking
  - Abstraction
  - Generalisation
  - Logical thinking
  - Decomposition …
- Not just about computers!
  - Solutions for people
  - Understanding people

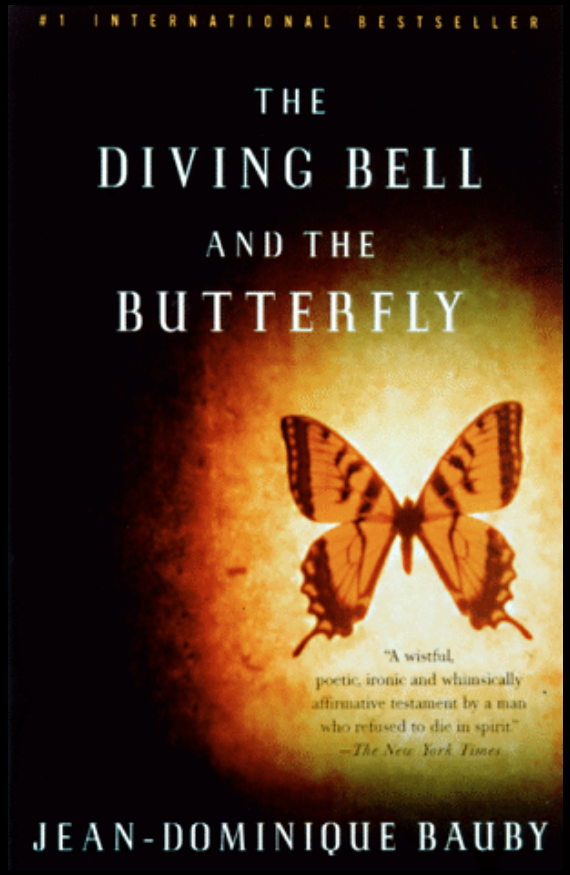
Locked-in Syndrome

- A person with locked-in syndrome is totally paralysed 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?
  - With a helper
  - No technology



How?

- The helper says:
  - “A B C … “
  - He blinks at the right letter.
- Try it…

Breakout Room Activity Communicating with blinks

We will now put you into small breakout groups

- Communicate something (eg your middle name) to each other using this method.
  - One person thinks of a word (eg your name)
  - The other runs through the alphabet A, B, …
  - The first blinks when at the next letter.
    - and so on
  - What are the problems?
  - How can this method be improved?

How well does it work?

- What problems need to be solved?
  - to make it really work
- Can it be improved?
- How fast is it?
  - How long would it take to write a book?

How fast is it?

- 20 Questions…

- It is very slow
- It takes on average 13 questions for *every* letter
- At worst it takes 26 questions

Computational thinking

Abstraction

- ignoring detail in switching from time to steps

Logical thinking

- reasoning about how long it takes

Computational thinking

Generalisation

- making connections and reusing algorithms from other problem domains

Decomposition

- thinking about parts separately of the whole

Computer Scientists do it better

- Any Computer Scientist knows it can be done in…

5 questions per letter at worst

How?

Let's play a game

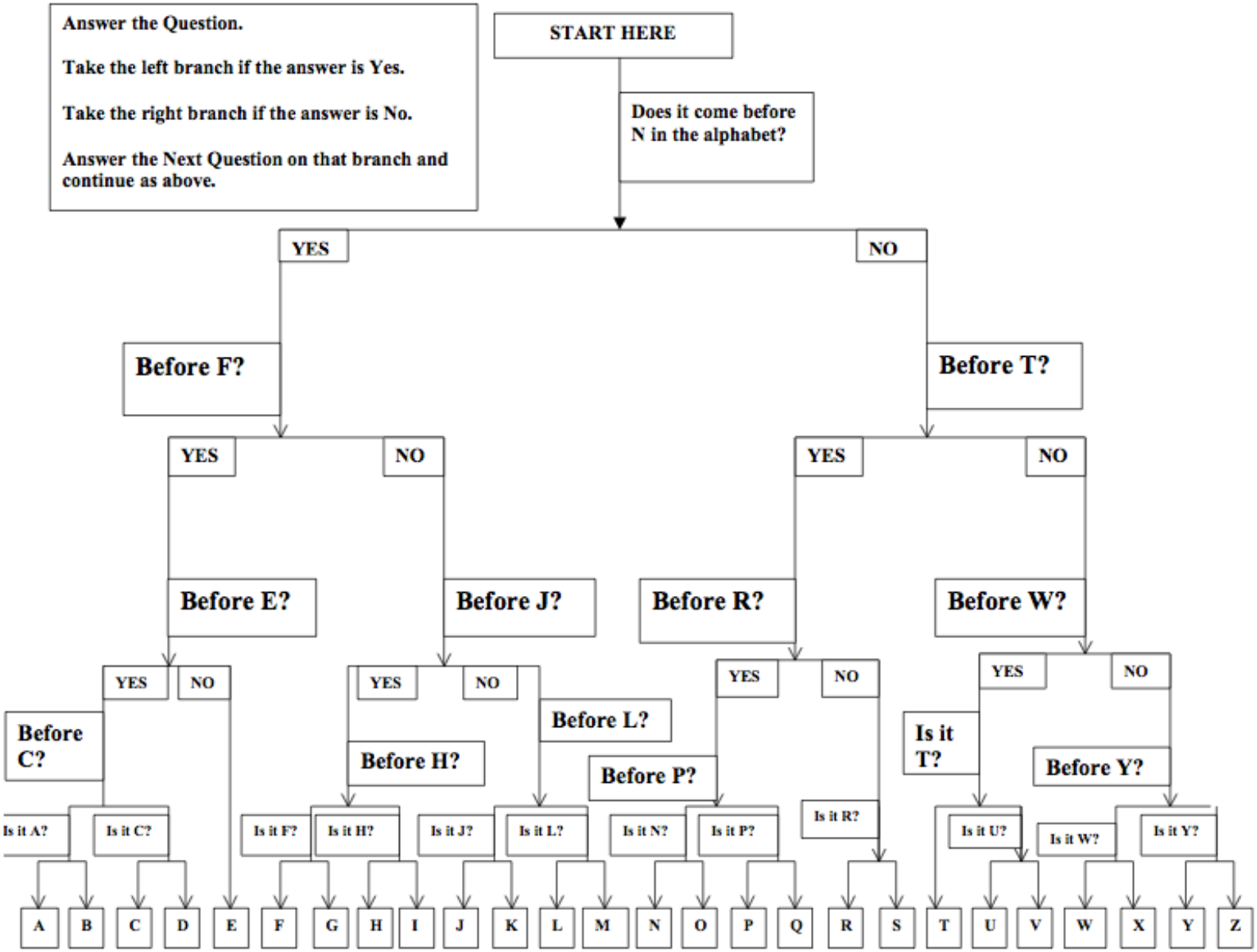
- 20 Questions…

- I think of a famous person.
- You have to guess who I am thinking of by asking questions.
- I can only answer yes or no.

Winning at 20-Questions

- Do you ask questions like
  - Is it Adele?
  - Is it Usain Bolt?
  - Is it Churchill?

- That takes millions of questions
  - you have only 20!
- Instead you try to ask halving questions…
  - Are they female?
- Apply that solution to Locked-in communication


Answer the Question.
Take the left branch if the answer is Yes.
Take the right branch if the answer is No.
Answer the Next Question on that branch and continue as above.
START HERE
Does it come before N in the alphabet?
YES
NO
Before F?
Before T?
YES
NO
YES
NO
Before E?
Before J?
Before R?
Before W?
YES
NO
YES
NO
YES
NO
YES
NO
Before C?
Before H?
Before L?
Before P?
Is it T?
Before Y?
Is it A?
Is it C?
Is it F?
Is it H?
Is it J?
Is it L?
Is it N?
Is it P?
Is it R?
Is it U?
Is it W?
Is it Y?
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z

Computational thinking

Generalisation

- transferring results from elsewhere

Decomposition

- divide and conquer

Algorithms first

- Now we have a better solution we can think about programming it…and using a particular technology to replace the human helper
- For example,
  - computer vision detecting blinks
  - brain implants or scalp electrodes to read thoughts

The first cyborg

- Prof Warwick of Reading University had a chip implanted in the nerves of his arm
  - A computer read the signals between his brain and hand…and sent them over the Internet.
  - The technology that helps the disabled could give "super-human powers".

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.

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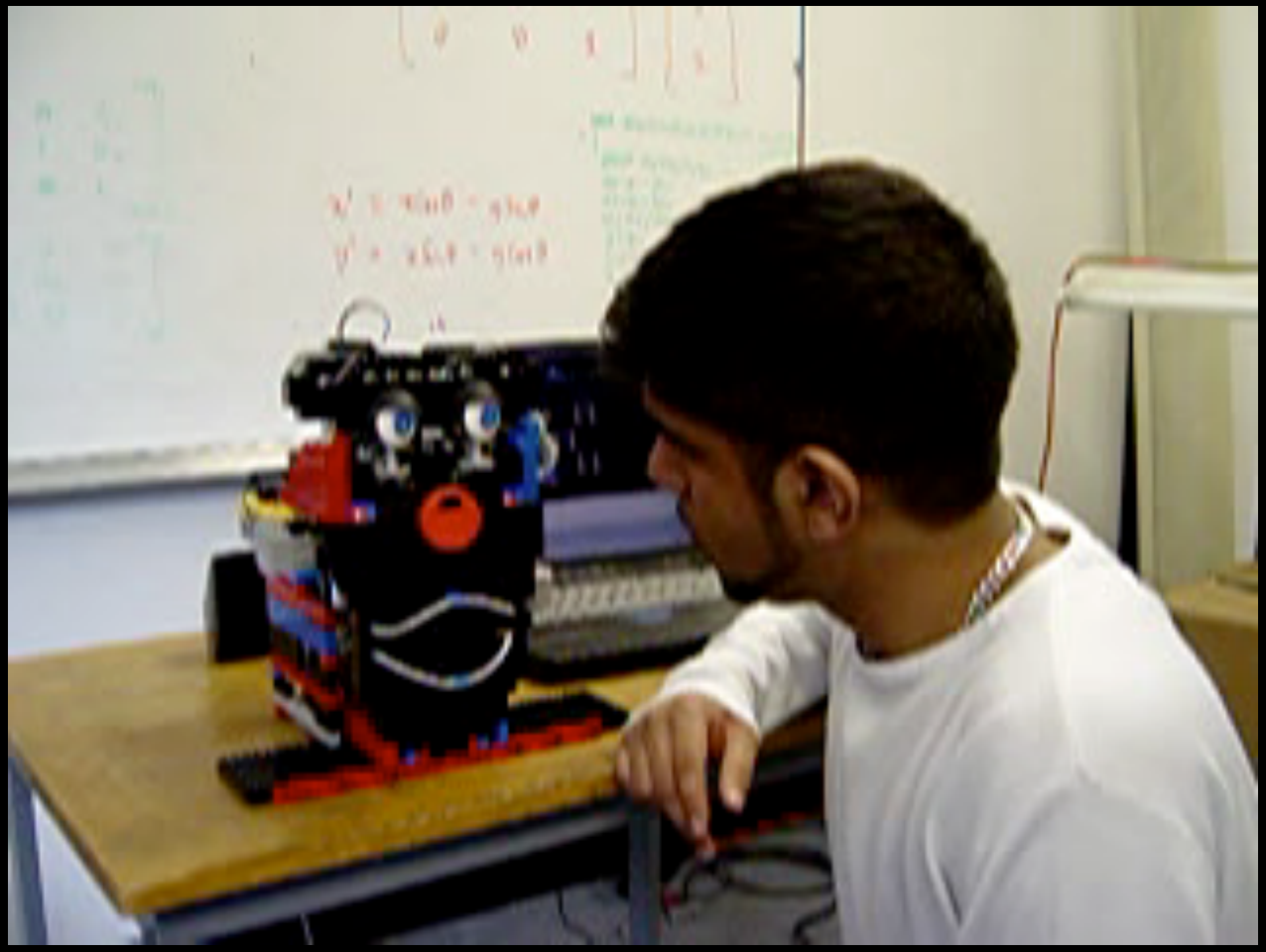
We communicate using more than words



Computational thinking

- MUST work out what the real problem is first…
  - understand the context
- Not just about computers!
  - Solutions for people
  - Understanding people

Activity: What is computational thinking about

Go to activity 3 in the Google Doc
http://bit.ly/SEARCHSPEAK

- Type there facts about computational thinking you can remember
  - eg what is each component about?

Computational thinking

- Computational thinking is about thinking skills around algorithms
  - Algorithmic thinking
  - Abstraction
  - Generalisation
  - Logical thinking
  - Decomposition
  - …
- Not just about computers!
  - Solutions for people
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Thank You

Please give feedback in the google doc

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