PDST
Professional Development Service for Teachers | An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí

An Roinn Oideachais agus Scileanna
Department of Education and Skills

National Workshop 5

LEAVING CERTIFICATE
COMPUTER SCIENCE

Schedule

Session 1	Introduction Computers and Society II
11.00 – 11.30	Tea/Coffee
Session 2	Creating an Inclusive Classroom: SEN for Computer Science
13.00 – 14.00	Lunch
Session 3	Resource Development Curriculum Planning Q&A

CPD Schedule for 2021/22

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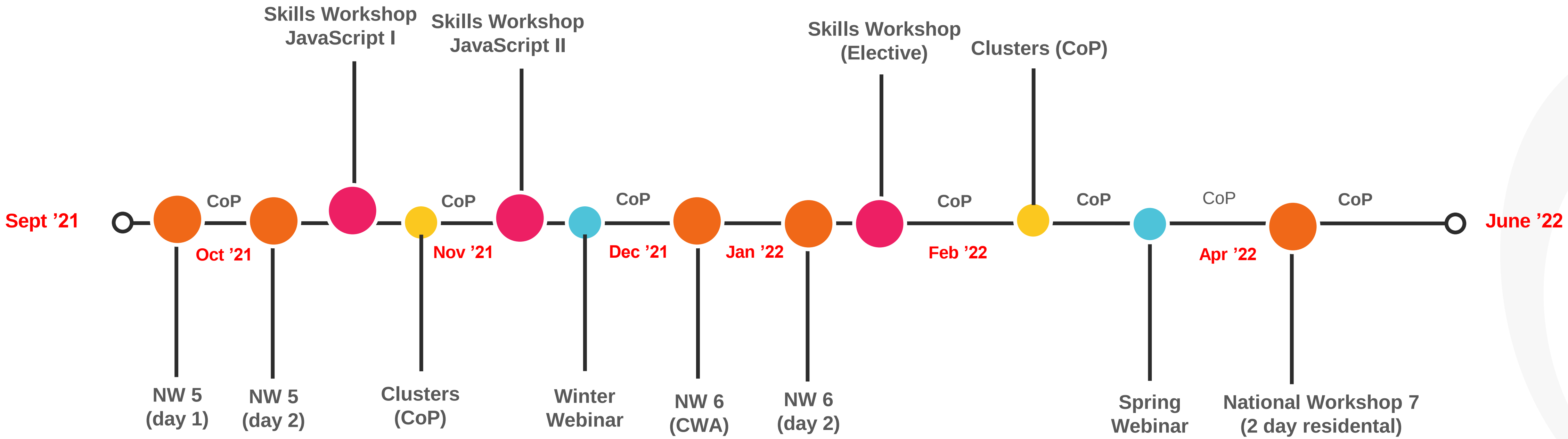


Timeline – Round 2 – 6th Year

Day 2 of NW5 Tuesday 5th October (cohorts 1&2) and Wednesday 6th October (cohorts 3&4)

Key Messages for National Workshop 5 (NW5)

There are many ways to use the LCCS specification.

LCCS can be effectively mediated through the use of a constructivist pedagogical orientation which will incorporate participatory and inquiry-based learning activities (whole-class, group, pair or individual).

The Turing Machine stands as the modern definition of computability.

ALTs

ALTs provide an opportunity to teach theoretical aspects of LCCS.

Digital technologies can be used to enhance collaboration, learning and reflection.

LCCS is suitable for all! This includes students with SEN and of all ability levels.

Session 1

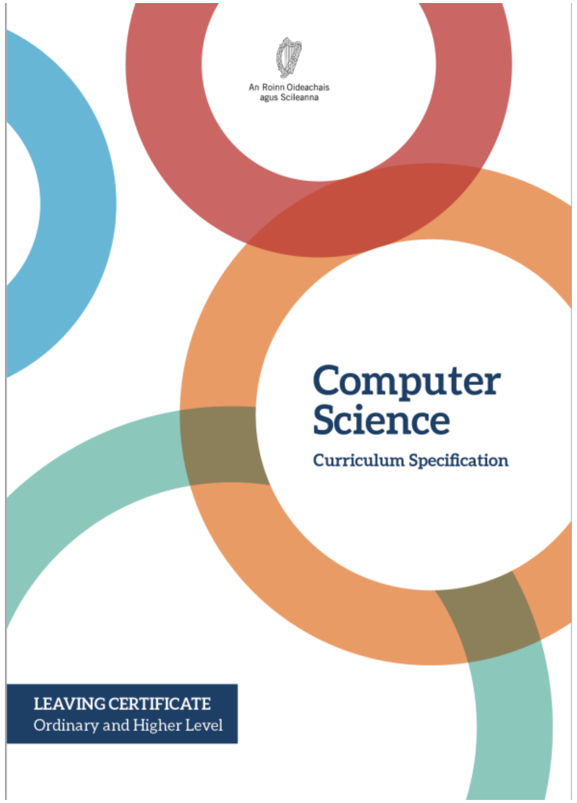
Computers and Society II

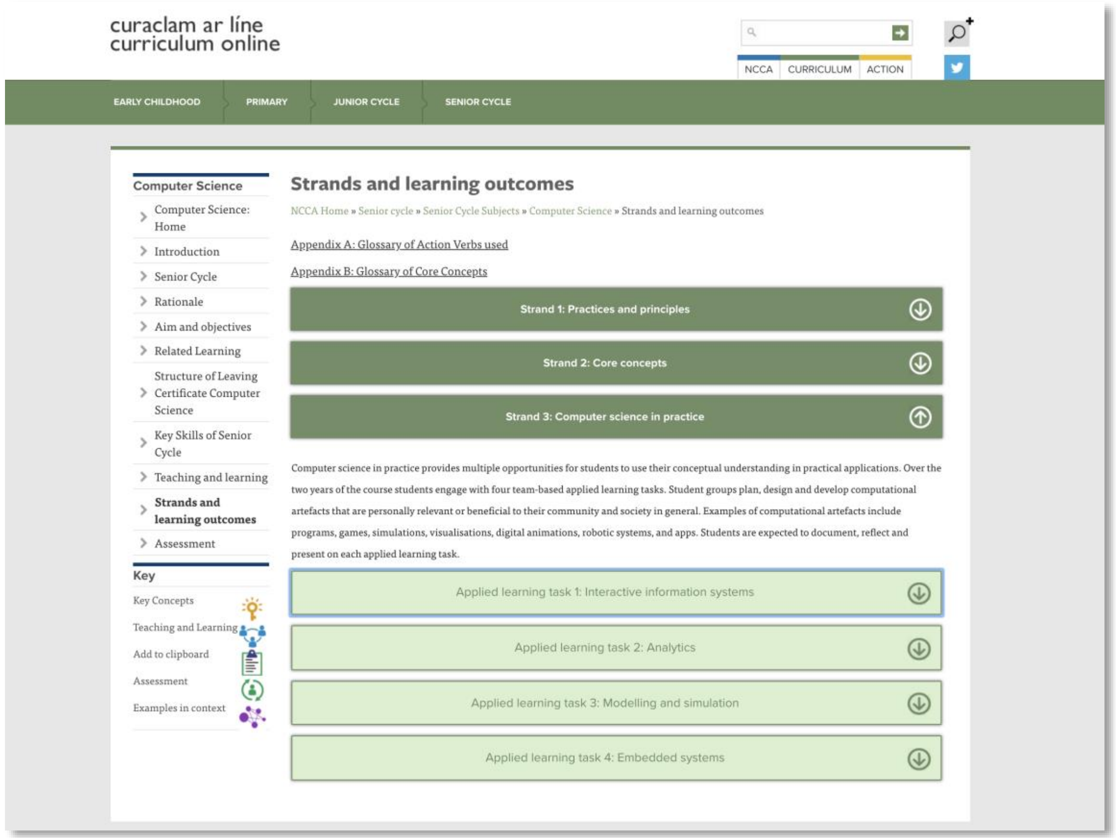
By the end of this session

Participants will be enabled to:

- reflect on what the specification says about Computers and Society
- listen to other teachers as they share their own classroom experiences
- further their pedagogic content knowledge of Computers and Society
- understand the significance of Turing Machines and how they operate
- participate in an activity to execute a Turing Machine

LCCS Curriculum Specification





https://www.curriculumonline.ie

What does the specification say?

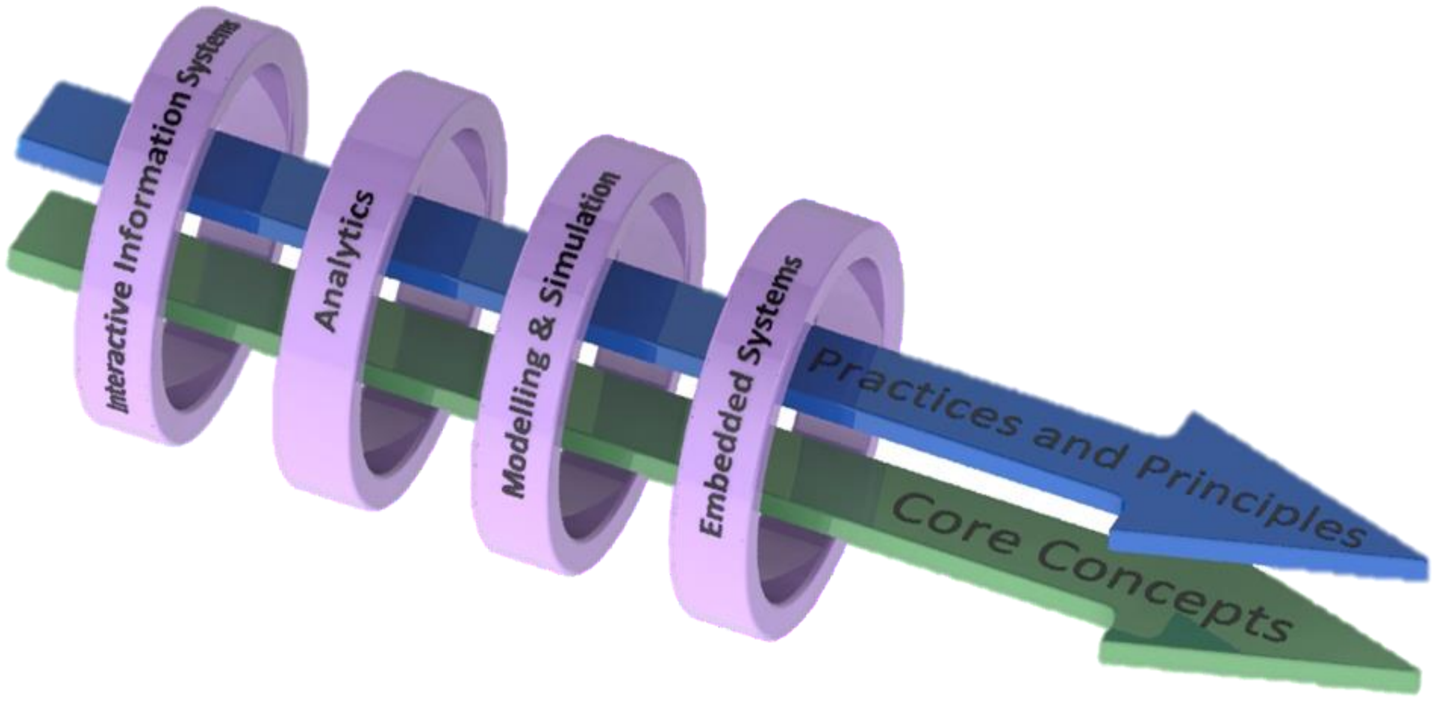
Two of the objectives (page 6) of LCCS are to enable students to:

- appreciate the ethical and social implications relating to the use of computing technology and information and identify the impact of technology on personal life and society
- understand how information technology has changed over time and the effects these changes may have on education, the workforce and society

Strand 1: Practices and principles	Strand 2: Core concepts	Strand 3: Computer science in practice
‣ Computers and society ‣ Computational thinking ‣ Design and development	‣ Abstraction ‣ Algorithms ‣ Computer systems ‣ Data ‣ Evaluation/Testing	‣ Applied learning task 1 - Interactive information systems ‣ Applied learning task 2 - Analytics ‣ Applied learning task 3 - Modelling and simulation ‣ Applied learning task 4 - Embedded systems

What does the specification say?

“Computer science is the study of computers and algorithmic processes. Leaving Certificate Computer Science includes how programming and computational thinking can be applied to the solution of problems, and **how computing technology impacts the world around us**.” [LCCS Spec. Page 2, paragraph 1]



Computers and Society - LCCS Learning Outcomes

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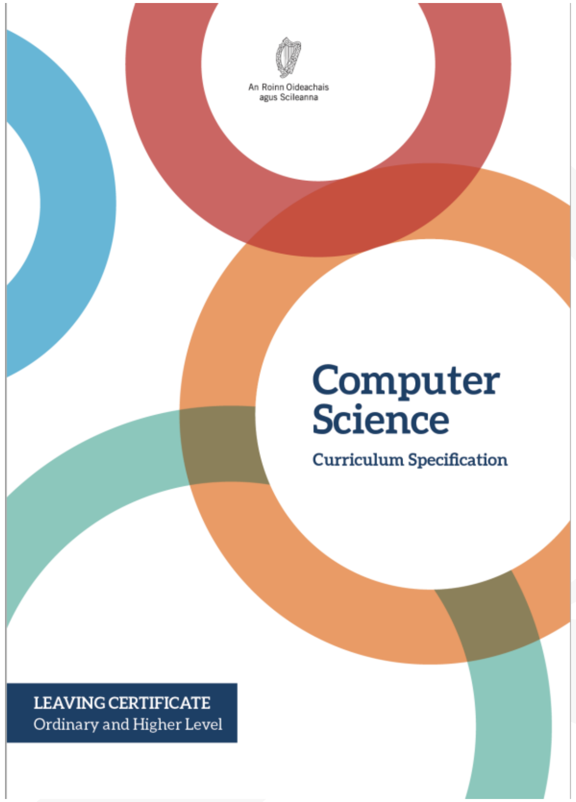
S1: Computers and society	
Social and ethical considerations of computing technologies	1.11 discuss the complex relationship between computing technologies and society including issues of ethics 1.12 compare the positive and negative impacts of computing on culture and society
Turing machines	
The Internet	1.13 identify important computing developments that have taken place in the last 100 years and consider emerging trends that could shape future computing technologies
Machine learning Artificial intelligence	1.14 explain when and what machine learning and AI algorithms might be used in certain contexts
	1.15 consider the quality of the user experience when interacting with computers and list the principles of universal design, including the role of a user interface and the factors that contribute to its usability
User-centred design	**1.16 compare two different user interfaces and identify different design decisions that shape the user experience**
	1.17 describe the role that adaptive technology can play in the lives of people with special needs
	1.18 recognise the diverse roles and careers that use computing technologies



Group Activity / Breakout #1

Switch video / sound ON

Check in: re-introduce yourselves

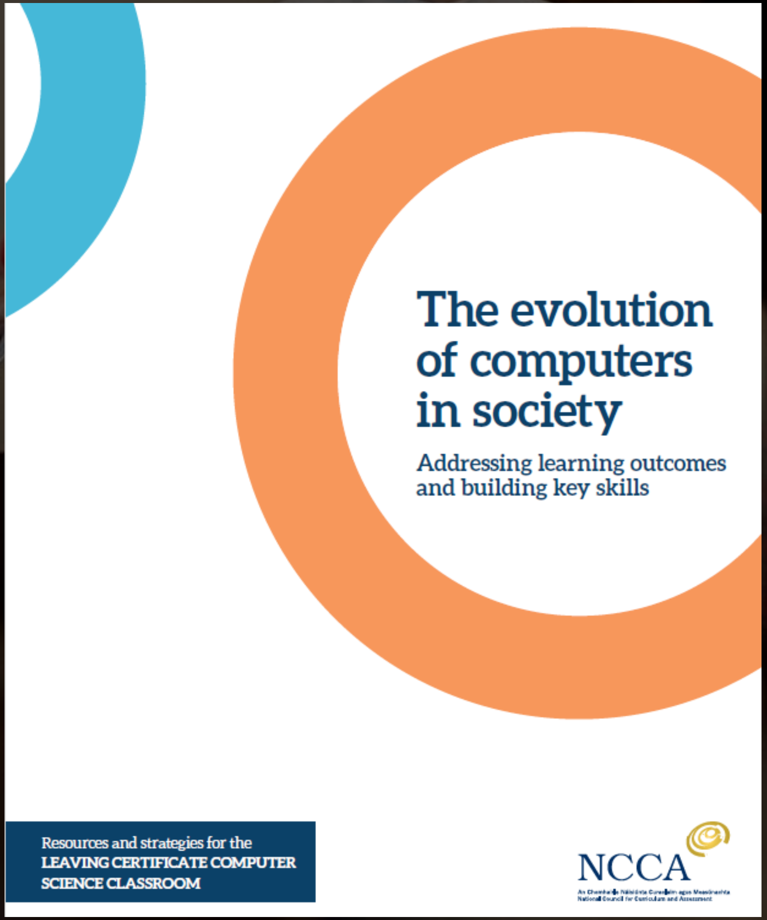
Focus on Computers and Society …

… how might you mediate this section of the course with your students in and out of the classroom?

Breakout Time

NCCA – The Evolution of Computers in Society

This booklet provides a chronologically structured series of detailed resources and learning plans aimed at supporting LCCS teachers as they explore the topic of Computers and Society with their students.



https://curriculumonline.ie/getmedia/a5e0d88d-e0f1-43bc-ab68-349b5660fbce/NCCA-The-Evolution-of-Computers-in-Society-LC-SC.pdf

Stimulate a Debate Strategy

Four step process:

1. Engage with Stimulus material (e.g. video/text)
2. Provide prompt questions to provoke discussion and elicit opinion
3. Divide into research groups and explore topic from key standpoints
4. Choose a teaching/facilitation methodology (Pg 63+)

Stimulate a Debate Examples

- Page 19. Positive and negative impact of military innovations
- Page 29. How CS is changing our world
- Page 34. How should society respond to AI?
- Page 51. Data/Privacy
- Page 56. Cloud Computing

Philosophical Inquiry

The Four Thinking C's

Most people participating	Reflecting about the stimulus	Thinking "What if..?"	Finding the big ideas	Giving evidence
Building on each other's ideas	Respecting each speaker	Thinking "So then..?"	Picking out the little details	Questioning assumptions and evidence
Disagreeing without being disagreeable	Taking an interest in other views	Seeing connections	Defining meanings	Finding criteria
Encouraging atmosphere	Open to changing ideas	Finding examples	Drawing distinctions	Judging reasons
Collaborative	**Caring**	**Creative**	**Critical**	

Philosophical Inquiry (full fat inquiry)

1. Warm up
2. Stimulus
3. Private reflections (thinking time)
4. Question creation
5. Question airing
6. Question choosing
7. First thoughts
8. Building (middle words)
9. Last words (without response)
10. Review and evaluation process/content

Philosophical Inquiry

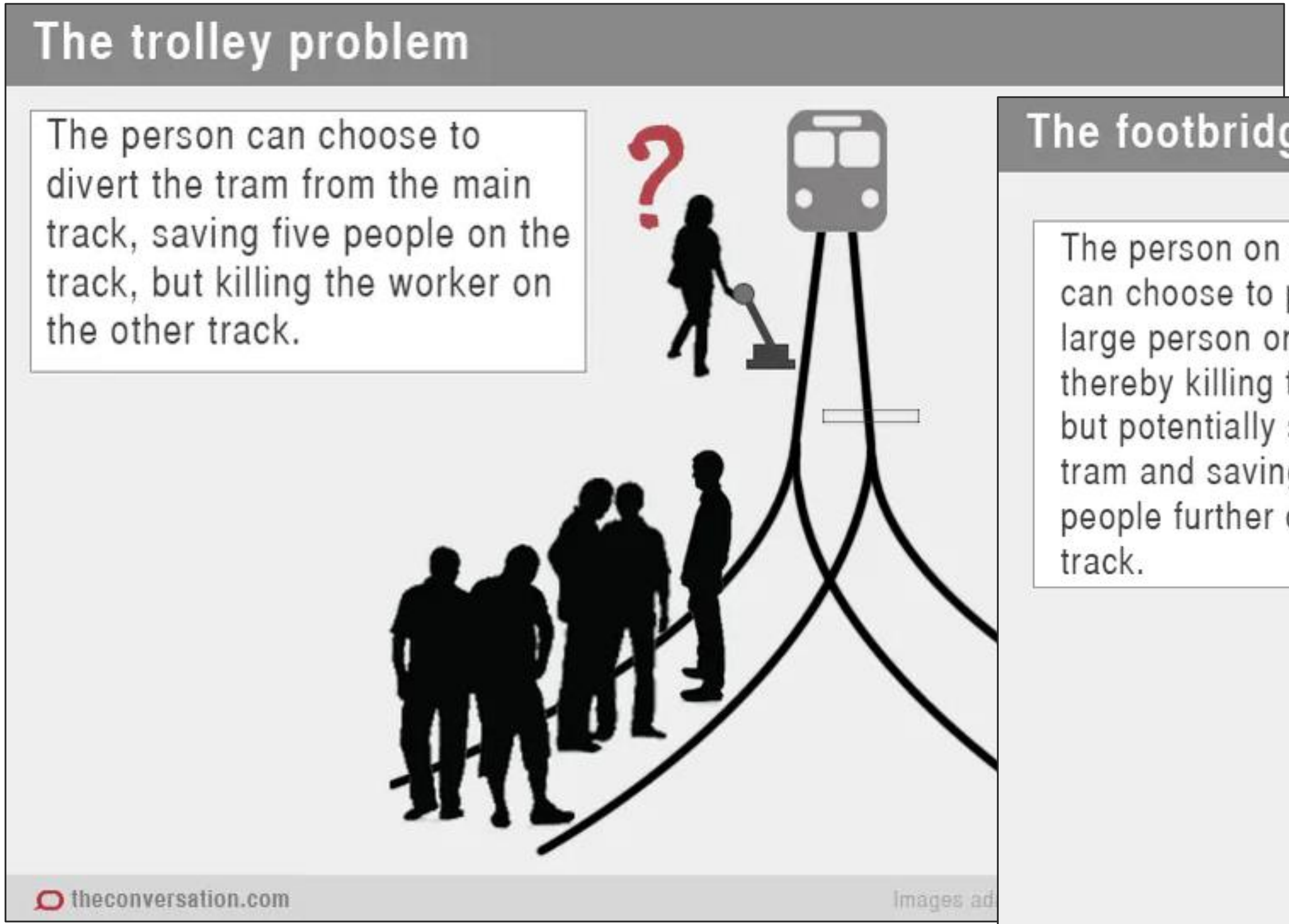
Initially developed by Matthew Lipman and Ann Margaret Sharp almost 50 years ago

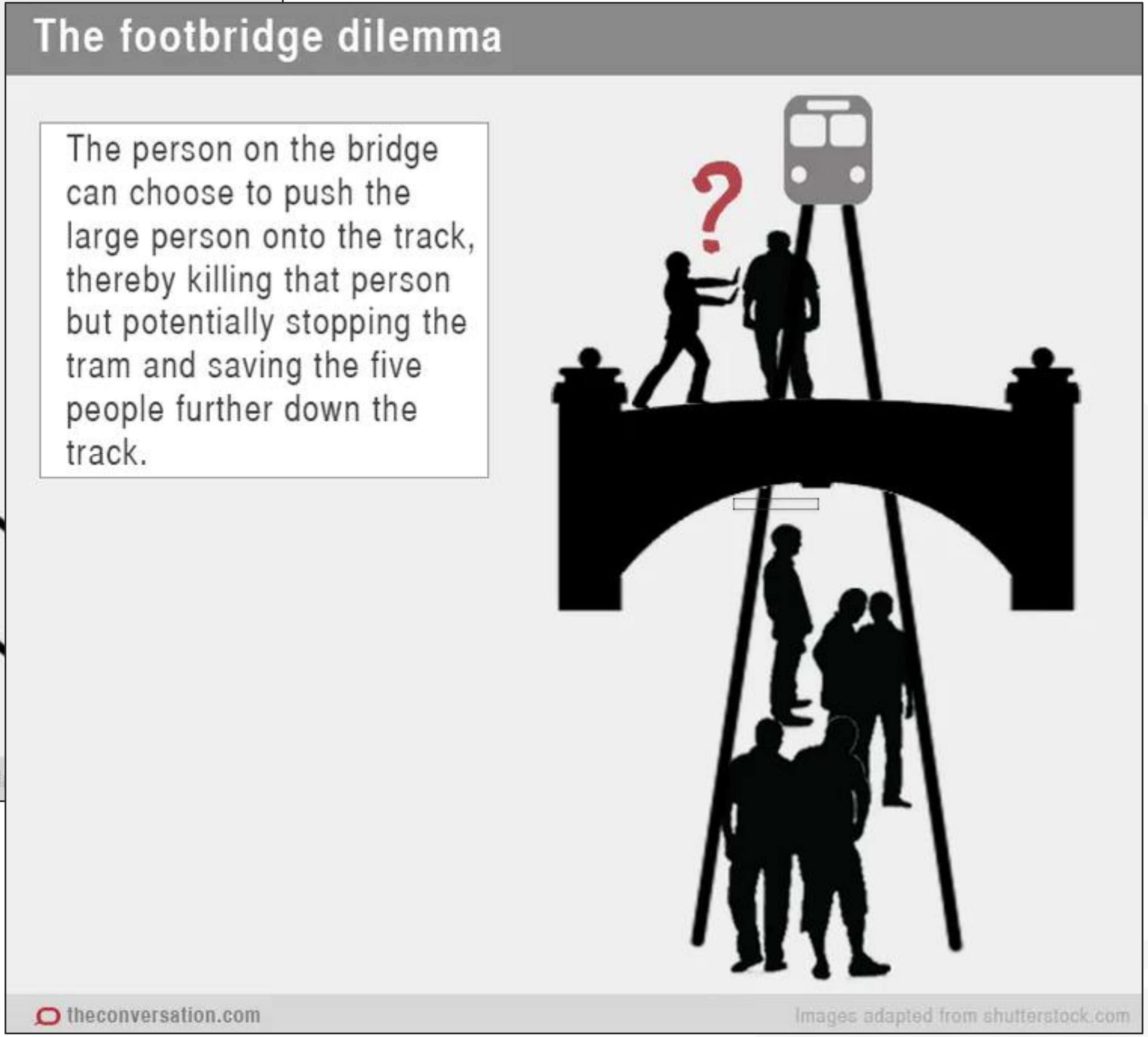
Agree/Disgree Line…What if?

Q: Could you be friends with a robot?

Q: What if the robot could display emotion? Would you change your mind?

Q: What if the robot thought it was a person?





Source: https://theconversation.com/the-trolley-dilemma-would-you-kill-one-person-to-save-five-57111

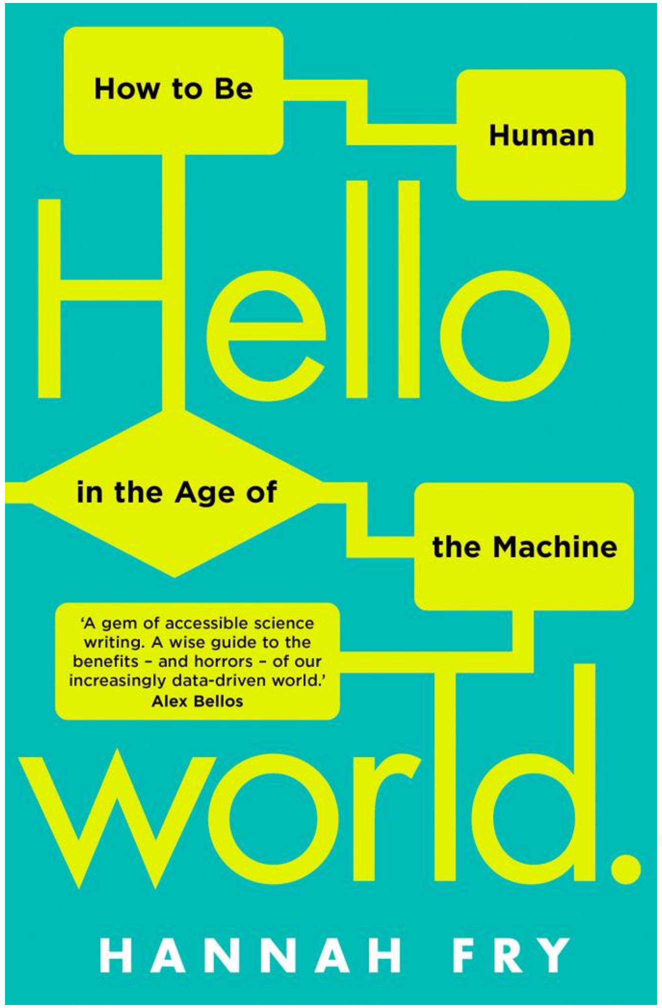
Agree/Disagree Line

"People have a right to a private life."

Philosophical Inquiry - stimulus

https://www.youtube.com/watch?v=Onm6Sb3Pb2Y

Resources: Computers and Society



1. Power
2. Data
3. Justice
4. Medicine
5. Cars
6. Crime
7. Art
8. Conclusion

Resources: Hello World Magazine

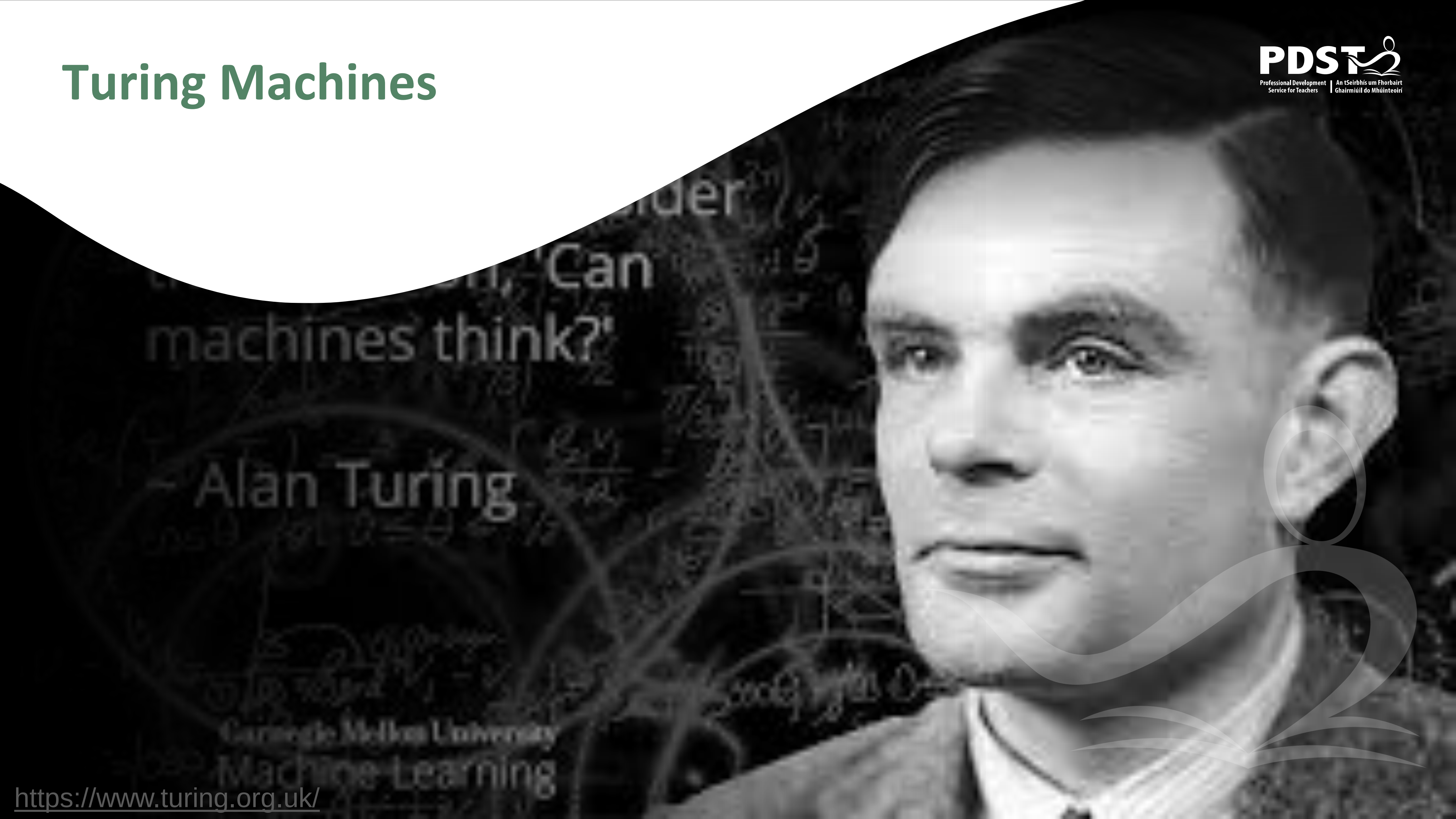
https://helloworld.raspberrypi.org/

5 minute stretch break

We now turn our attention to focus on a fundamental question of Computer Science:

What is computable?

Turing Machines



https://www.turing.org.uk/

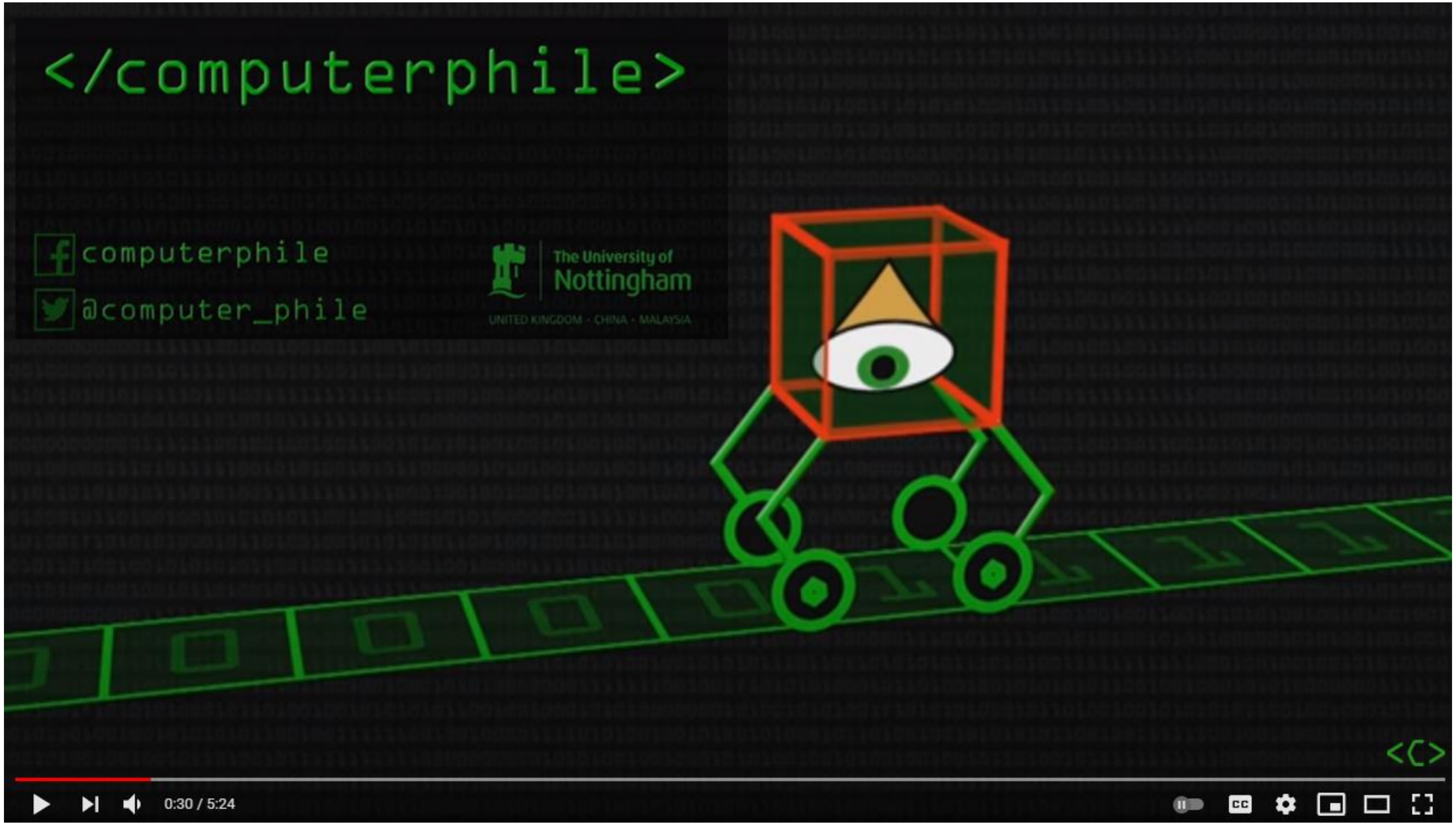
Turing Machines - Introduction

The Turing Machine (TM) was invented in 1936 by Alan Turing.

It is a basic abstract symbol manipulating device that can be used to simulate the logic of any computer that could possibly be constructed.

Although it was not actually constructed by Turing, its theory yielded many insights.

Turing Machines



Turing Machines Explained – Computerphile https://www.youtube.com/watch?v=dNRDvLACg5Q

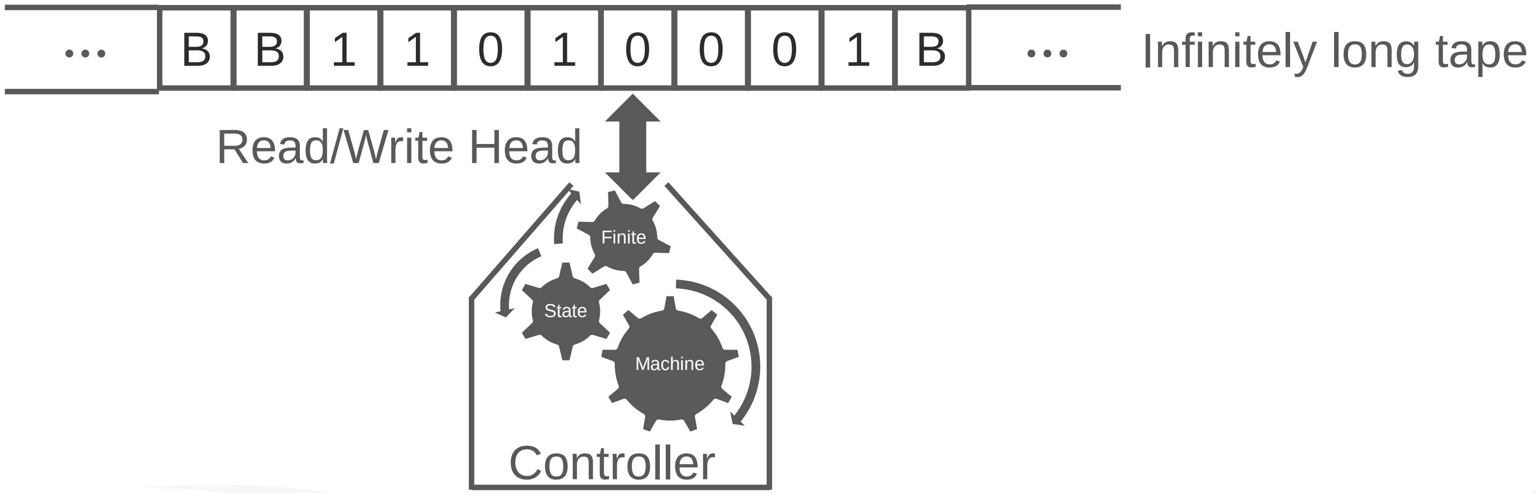
Turing Machines - Introduction

A Turing Machine consist of three components as follows:

1. **An infinitely long tape made up of individual cells. Each cell can contain a single character – typically 1, 0, or B (blank)**

2. **A read/write head pointed at an individual cell**

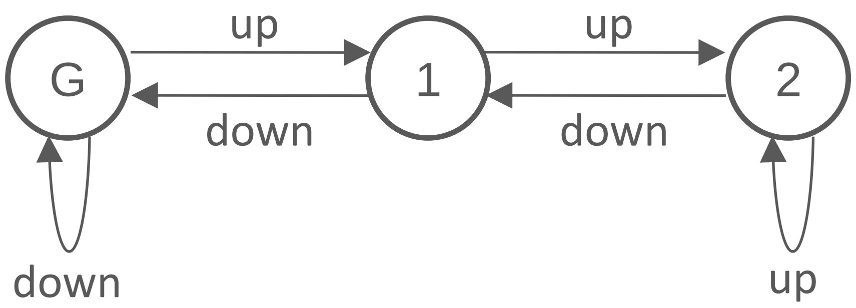
3. **A controller (aka finite-state machine) which instructs the read/write head what to do**



A schematic representation of a Turing Machine

Finite State Machines (FSMs)

The illustration below is of an elevator represented as a finite-state machine



- Circles represent states (in this case floors)
- Arrows between circles represent transitions between states
- The labels on each transition represents the button press event

What happens when we are on the ground floor and press the **UP** button?
What happens when we are on the ground floor and press the **DOWN** button?

Turing Machines - Operation

Initially the tape is inscribed with a sequence of characters – called the input

For example:

…	1	0	1	0	0	1	…

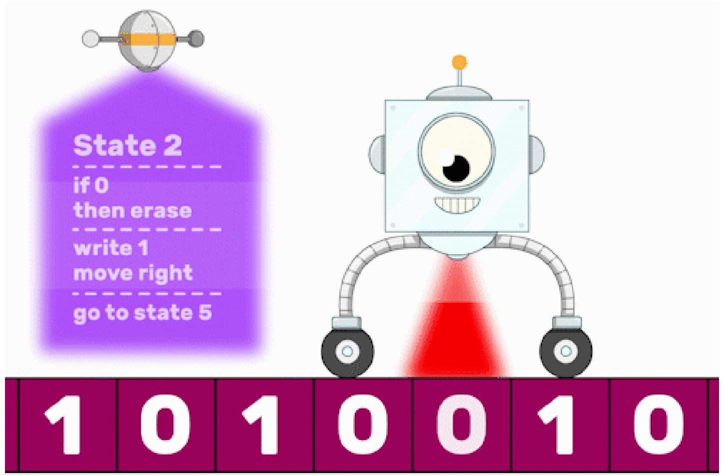
The operation of the Turing Machine is controlled by the finite-state machine (controller).

The operation takes place as a sequence of steps known as transitions

The controller decides for a given (input character, state) pair, the (output character, state) pair - know as a transition.

Each transition involves:

- Reading
- Writing
- Moving
- Updating

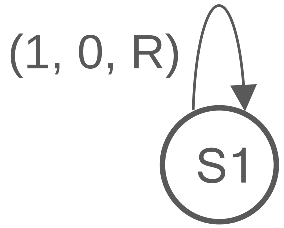


Turing Machines - Operation

Transitions can be expressed using:

state transition tables **OR** **state transition diagrams**

Current State	Read (input)	Write (output)	Direction to move r/w head	Next State
S1	1	0	Right	S1

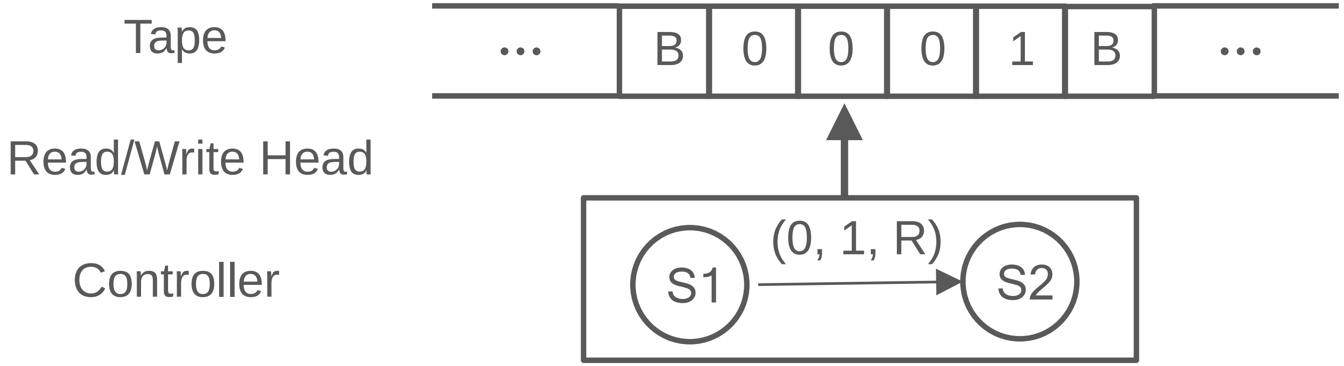


The above state transition table and diagram shows a single transition which says:

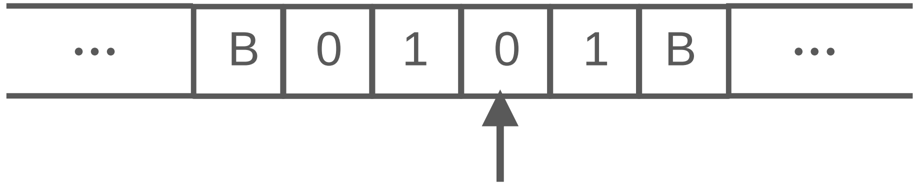
When in state S1 <u>and</u> the symbol being read is a one, write a zero, move right and remain in state S1

Turing Machines - Operation

The illustration below depicts a TM which defines a transition from state S1 to S2 when the current symbol being read in a zero.



After the transition has been completed the symbol zero has been replaced with a 1, the read/write head has been moved right and the new state is set to S2



The result of the computation (output) is the sequence of characters left on the tape if and when the Turing Machine halts.

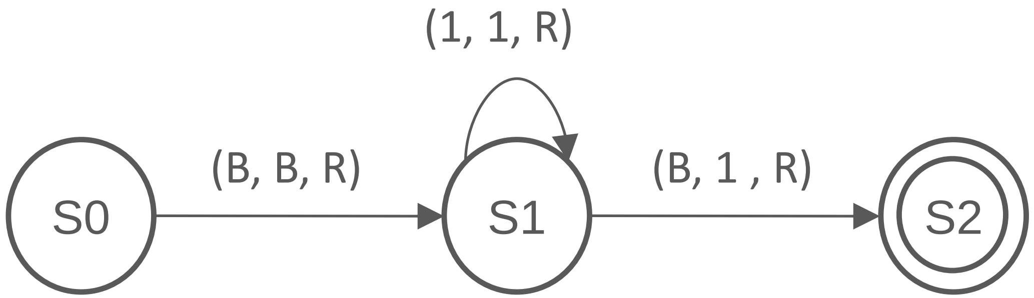
Turing Machines – States

At any given time, a TM is said to be in a particular state. States are usually denoted by the letter S followed by a number e.g. S2 is taken to mean state two.

S0 is conventionally used to denote the initial state. This is the state the TM is in before it starts to operate.

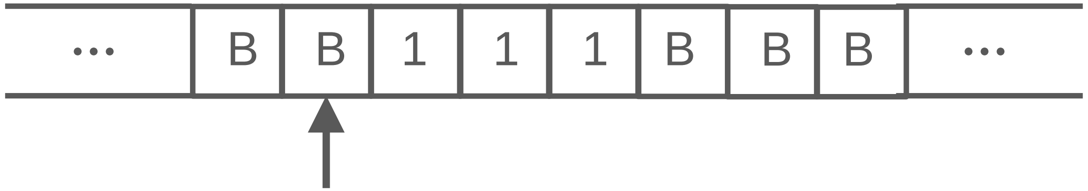
A double circle is used to denote the final or *halting state*. This is the state the TM is in when it finishes.

For example,

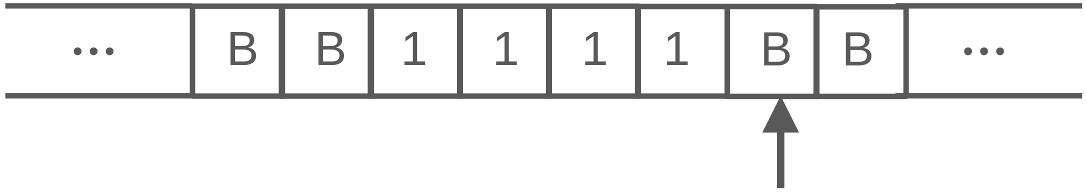


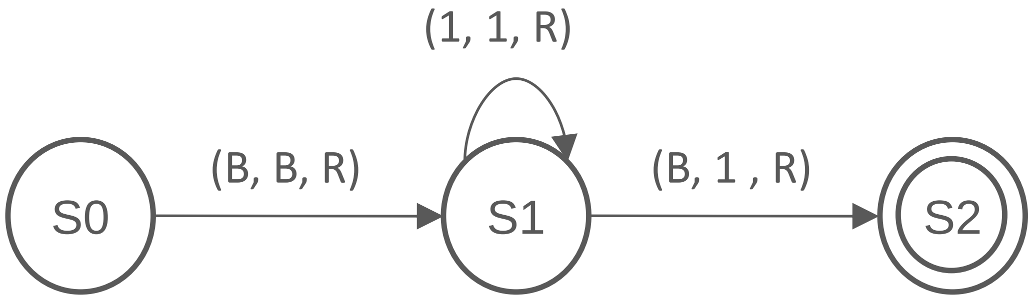
Turing Machines – Example (unary increment)

Test input: 111 (3)



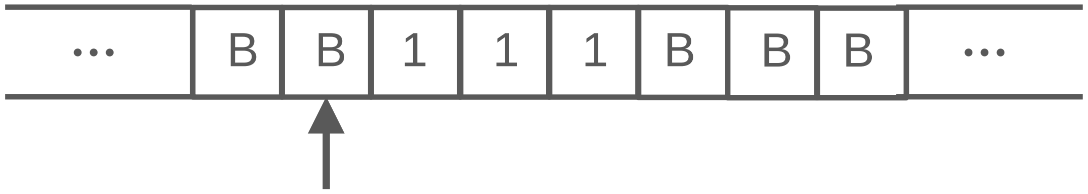
Required output: 1111 (4)



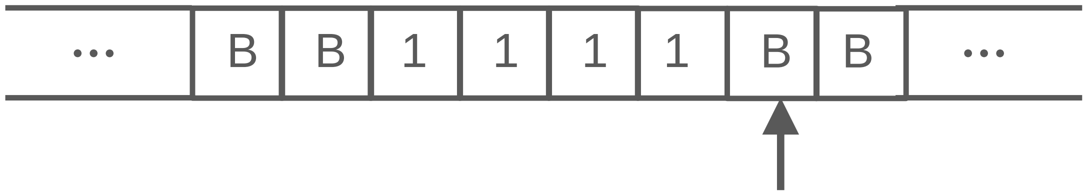


Turing Machines – Example (unary increment)

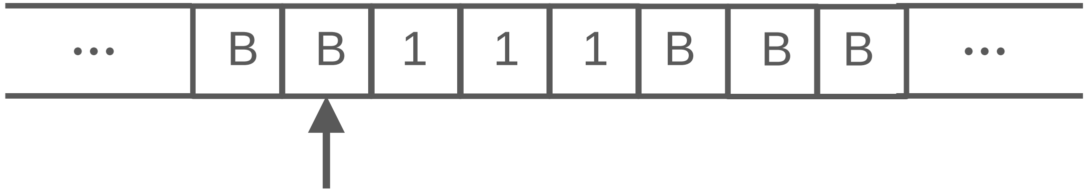
Test input: 111 (3)

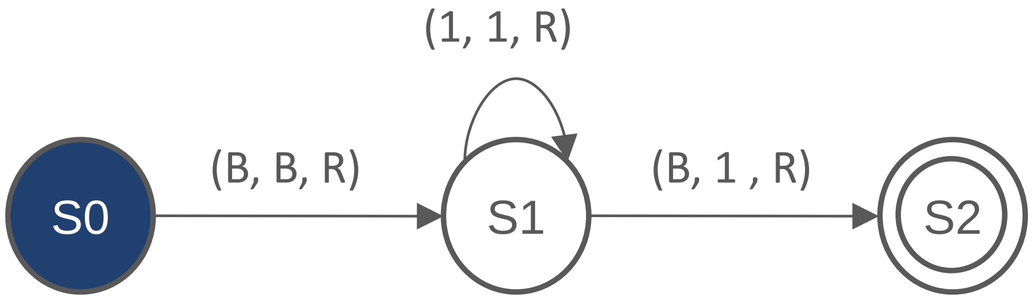


Required output: 1111 (4)



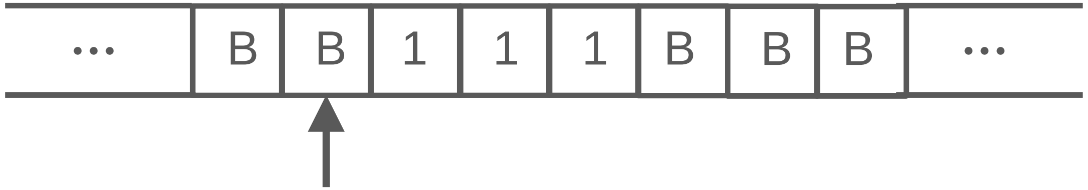
State: S0



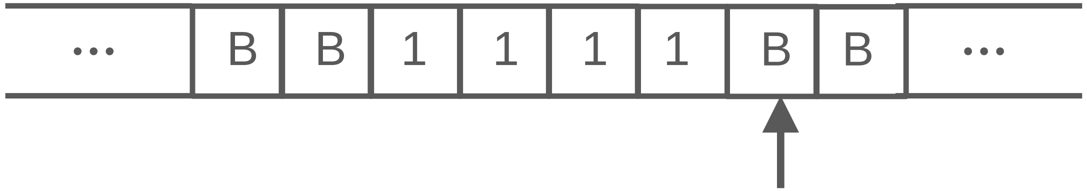


Turing Machines – Example (unary increment)

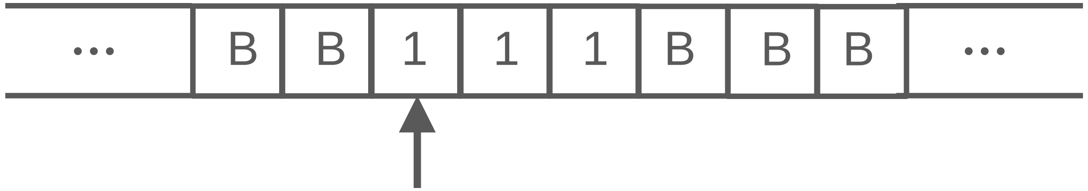
Test input: 111 (3)

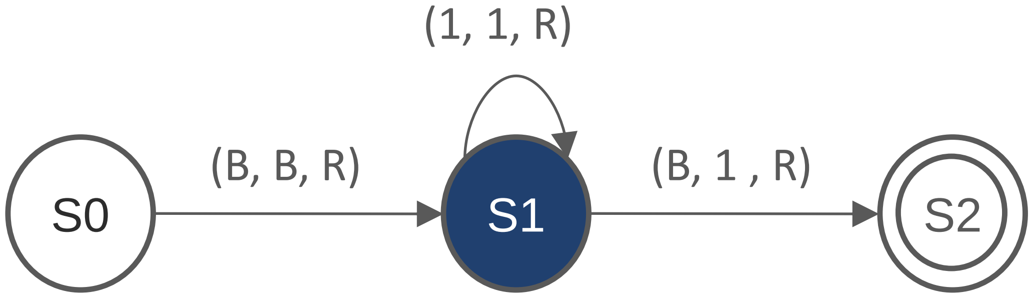


Required output: 1111 (4)



State: S1



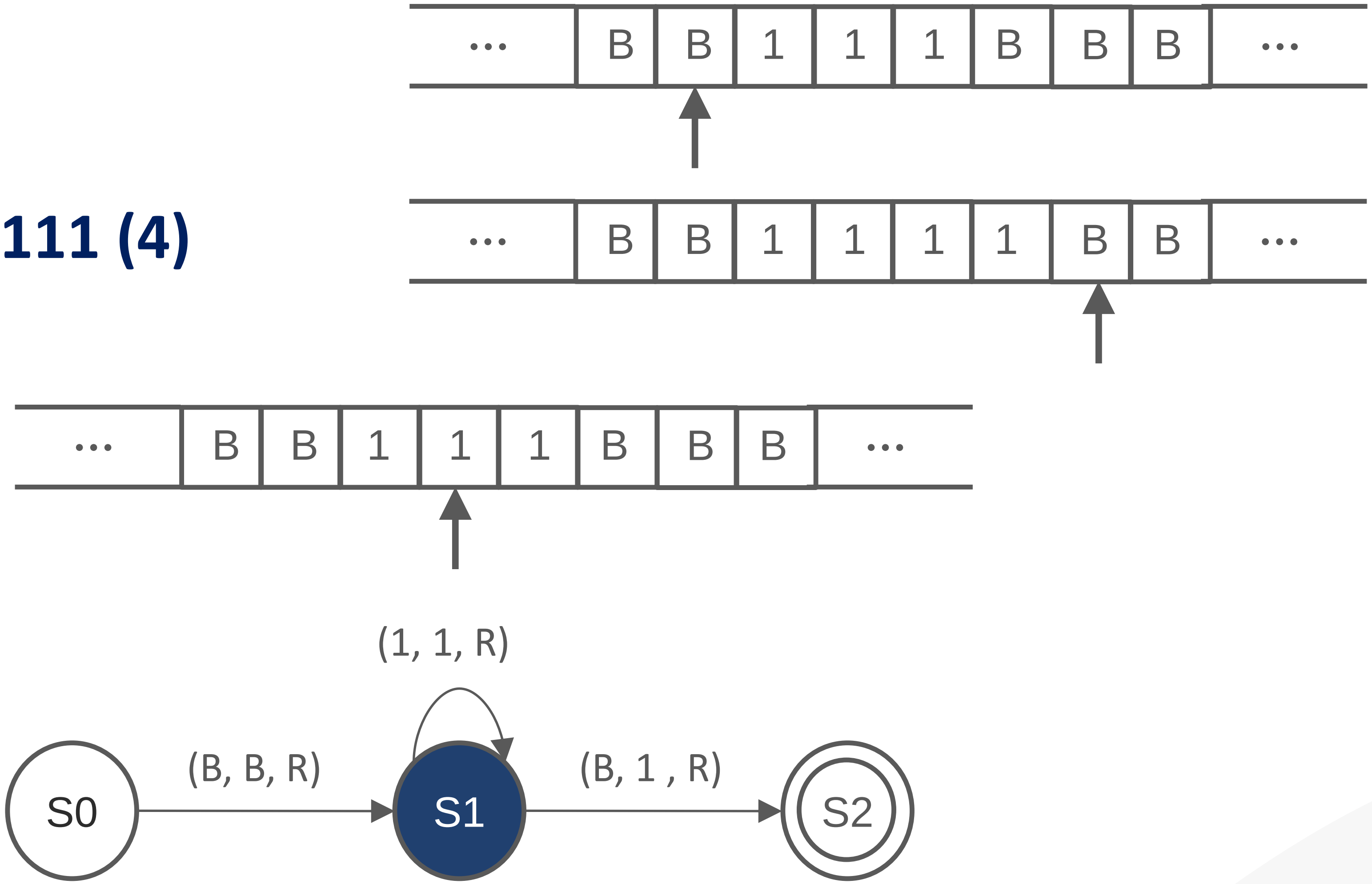


Turing Machines – Example (unary increment)

Test input: 111 (3)

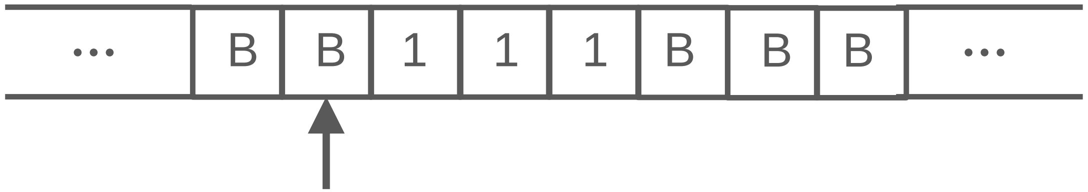
Required output: 1111 (4)

State: S1

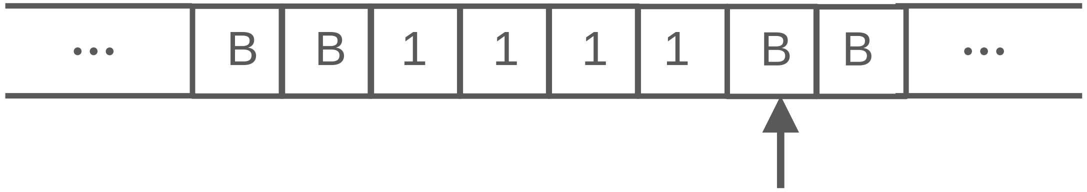


Turing Machines – Example (unary increment)

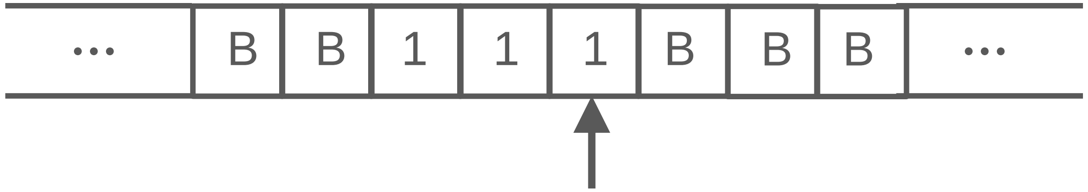
Test input: 111 (3)

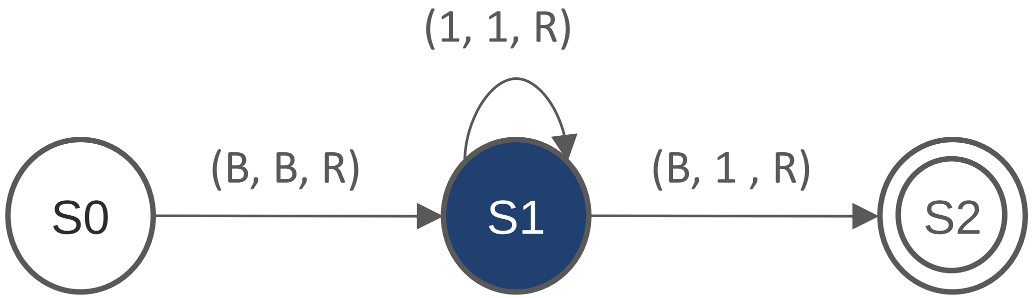


Required output: 1111 (4)



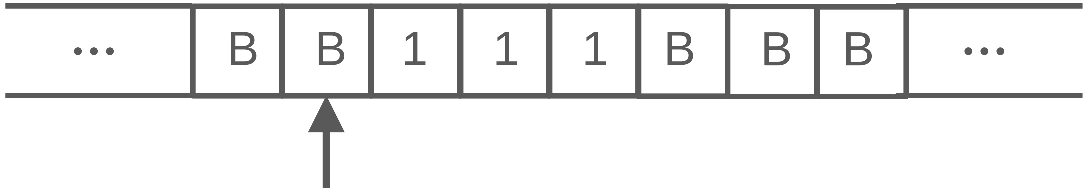
State: S1



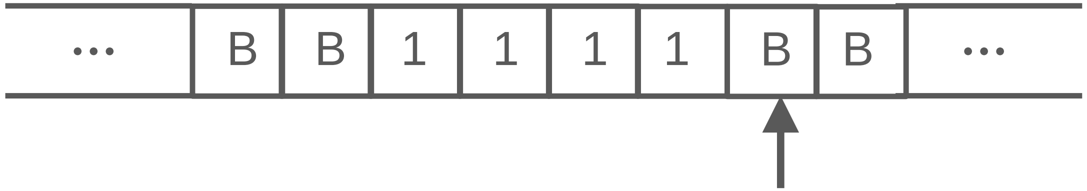


Turing Machines – Example (unary increment)

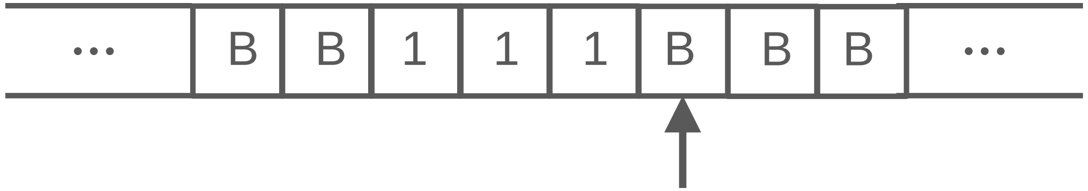
Test input: 111 (3)

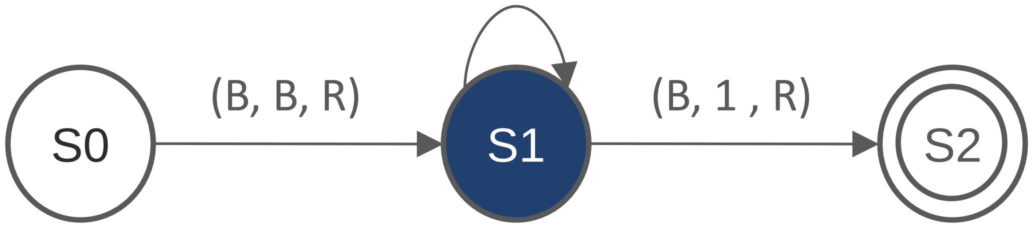


Required output: 1111 (4)



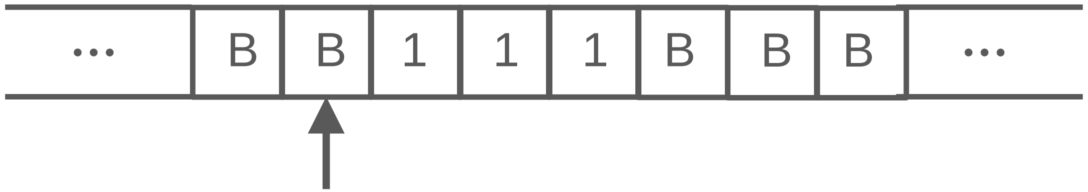
State: S1



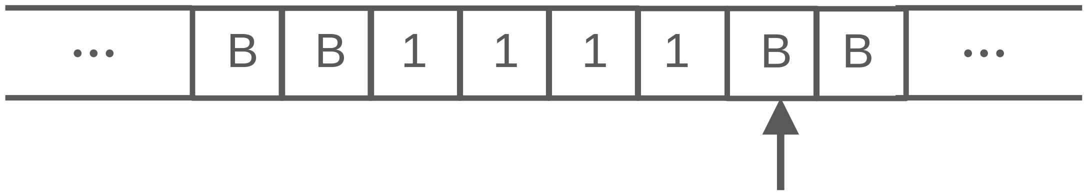


Turing Machines – Example (unary increment)

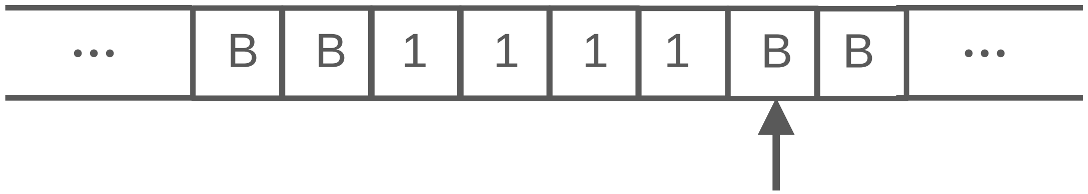
Test input: 111 (3)

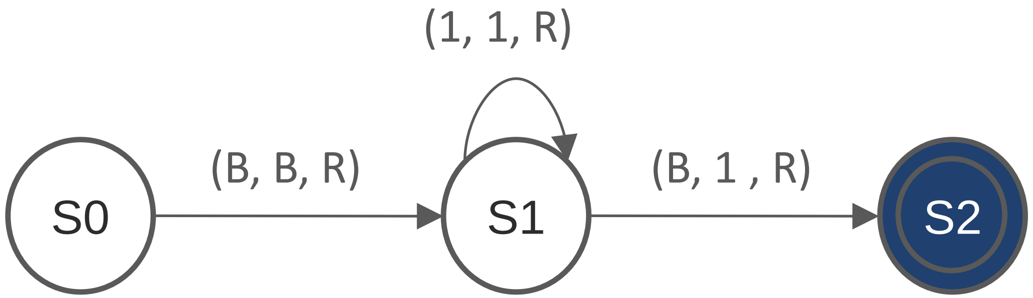


Required output: 1111 (4)



State: S2





Turing Machines – Significance

Earlier we asked the question:
How do we define computability?

Now we can provide the answer:
A task is computable if it can be carried out by a Turing Machine

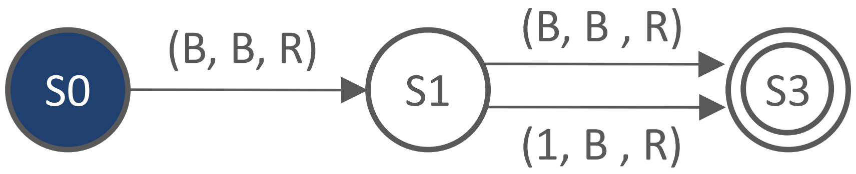
Turing Machine Activity

Groups will trace through the operation of three different Turing Machines

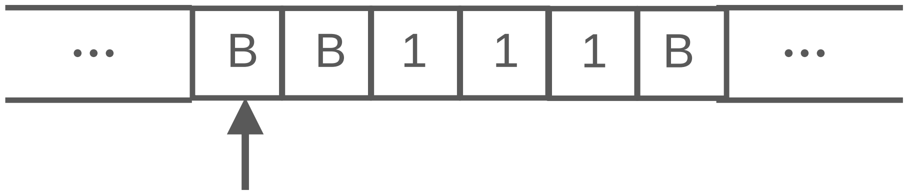
Think
Pair
Share
Square

Turing Machines – Activity – Problem #1

Initial State: S0

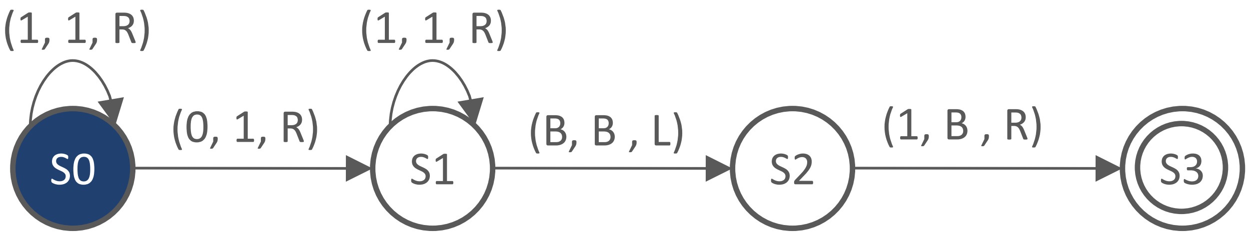


Test input: BB111B

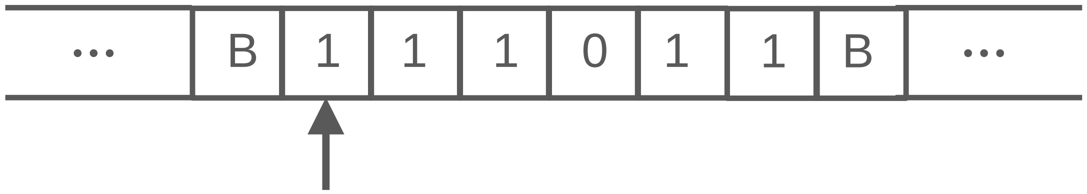


Turing Machines – Activity – Problem #2

Initial State: S0

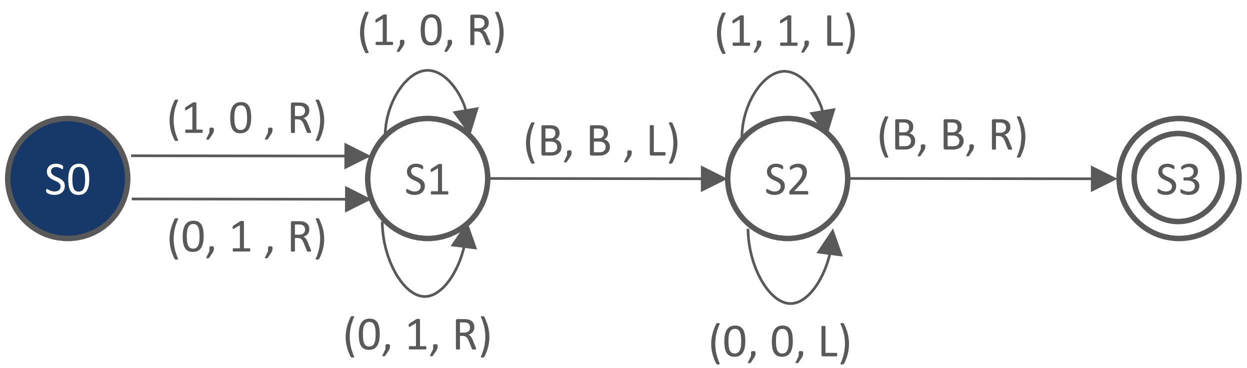


Test input: 111011

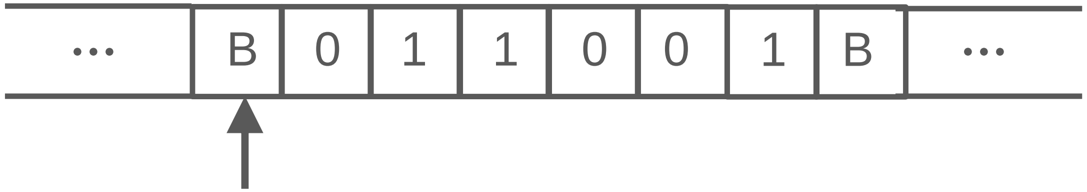


Turing Machines – Activity – Problem #3

Initial State: S0



Test input: B011001B



Turing Machines – Activity Handout

Initial Input

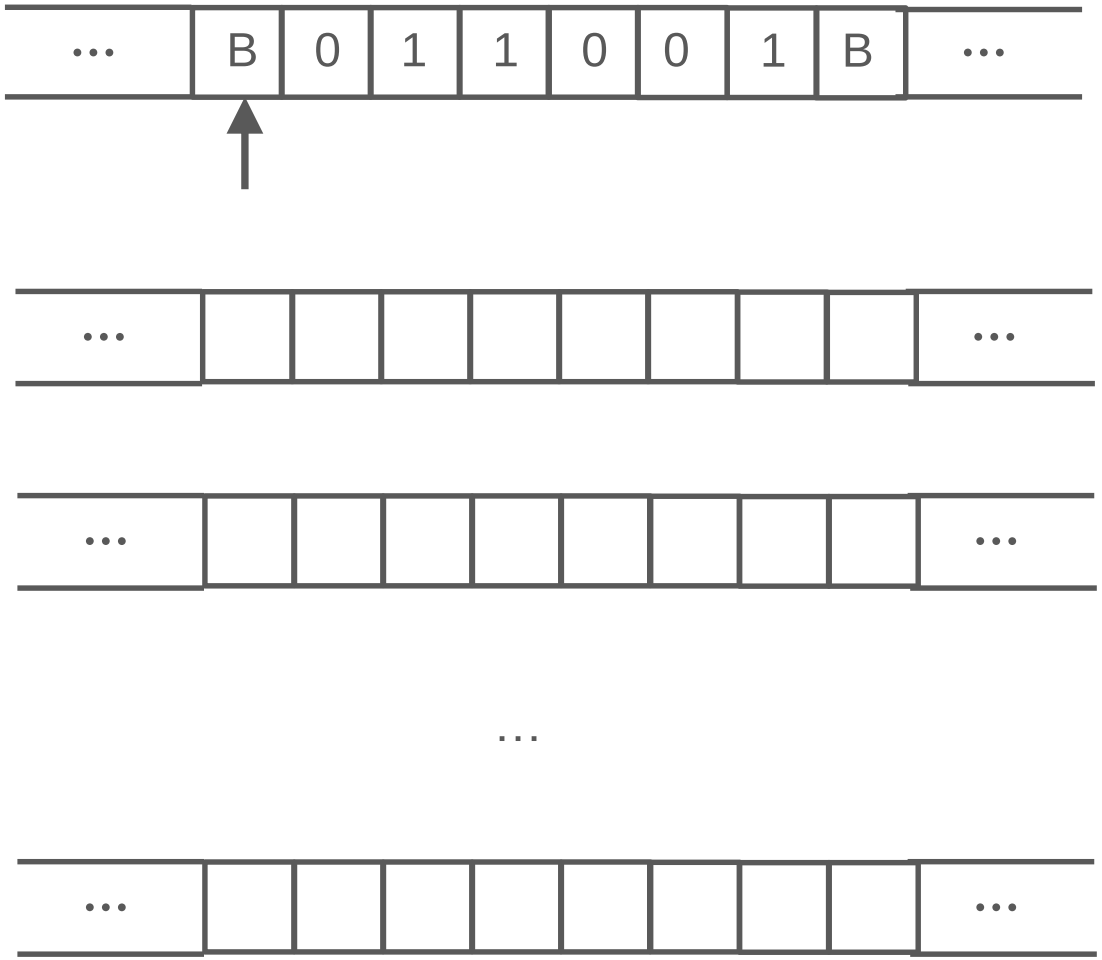
Initial State: S0

After Step 1:
Next State:

After Step 2:
Next State:

…

Final Output



Tea/Coffee

An Roinn Oideachais
Department of Education