LEON STERLING

Coding v Computational Thinking

Professor Leon Sterling

STEAM Conference

Perth, August 31, 2018

SESSION OVERVIEW

- MY INTRODUCTION TO COMPUTING
- WHAT IS COMPUTATIONAL THINKING?
- WHAT IS CODING?
- ANALOGIES TO OTHER AREAS
- PLACE IN CURRICULUM
- QUESTIONS

Computational thinking

A problem-solving method that involves various techniques and strategies in order to solve problems that can be implemented by digital systems, such as organising data logically, breaking down problems into components, and the design and use of algorithms, patterns and models.

COMPUTATIONAL THINKING

Introduced by Jeanette Wing, Comm. ACM 2006 in a 3 page paper

'We do not acquire technical skills from the use of technology any more than engineering skills from using automobiles or aeronautical skills from flying'

What is more problematic is conflating the discipline with the skill. As discussed in (Webb et al., 2016), *"The distinction between computational thinking and programming is subtle; in principle computational thinking does not require programming at all, although in practice, representing a solution to a problem as a program provides a perfect way to evaluate the solution, as the computer will execute the instructions to the letter, forcing the student to refine their solution so that it is very precise."*

COMPUTATIONAL THINKING EXERCISE

SORT YOURSELF IN HEIGHT ORDER

SORT YOURSELF IN NUMBER ORDER

HOW DID YOU DO IT?

Secure | https://csunplugged.org/en/

CS UNPLUGGED

Topics Printables About

Search

Computer Science without a computer

CS Unplugged is a collection of free teaching material that teaches Computer Science through engaging games and puzzles that use cards, string, crayons and lots of running around.

Welcome to the new CS Unplugged!

This updated website has unit plans, lesson plans, teaching videos, curriculum integration activities, and programming exercises to plug in the Computer Science concepts they have just learnt unplugged.

The original activities are still available at classic.csunplugged.org.

Secure | https://www.amt.edu.au/informatics/cat/

Search

Australian Mathematics Trust

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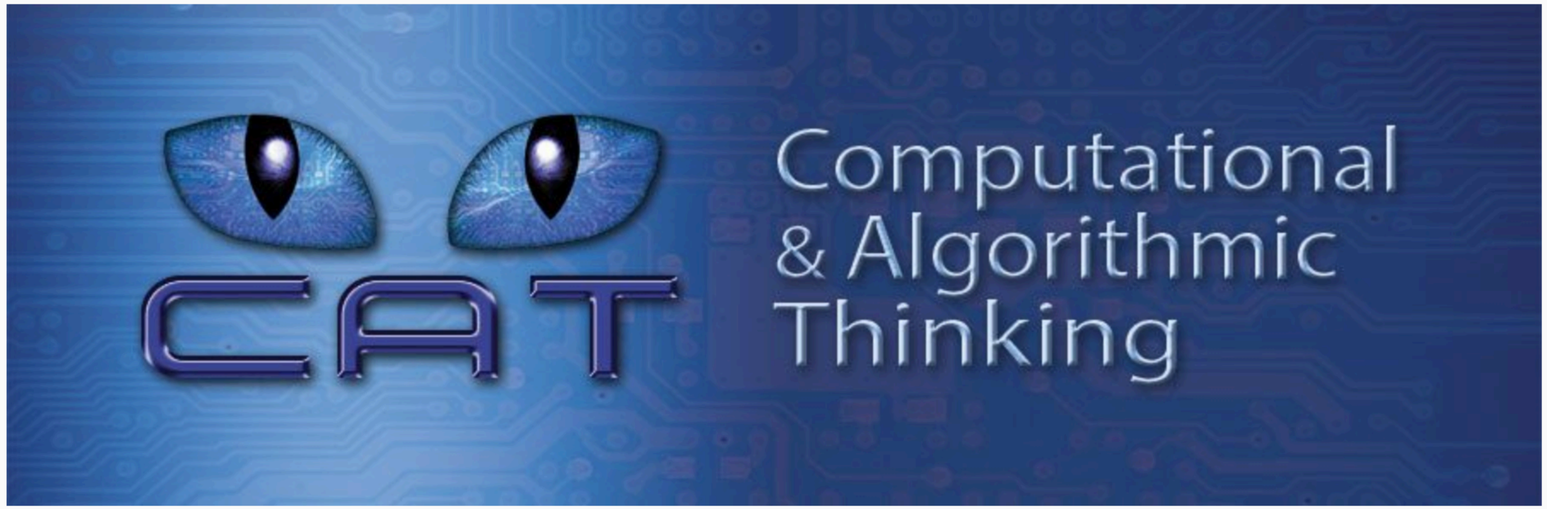


Computational and Algorithmic Thinking (CAT)

Tuesday 27 March 2018

Australian Informatics Olympiad (AIO)
23 August, 2018

Tools for the classroom

Download our CAT posters for your class today!

CODING

Sequencing, Choice, Repetition

TURING MACHINES

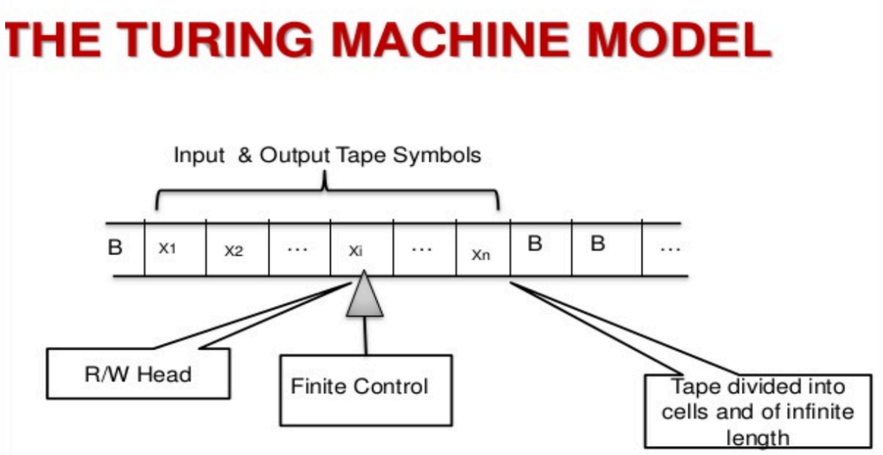
PROGRAMMING LANGUAGES robotics, etc

SCRATCH & BLOCKLY

PYTHON

JAVA, C, MATLAB, JAVASCRIPT, C#

TURING MACHINES



Alan Turing solved an open problem in 1937 about computable functions

Conceptually simple – can be shown to primary students

Practically useless

SCRATCH PROGRAMMING

Based in Logo from MIT in the 1970s,
Scratch has a wealth of anecdotal evidence to its effectiveness

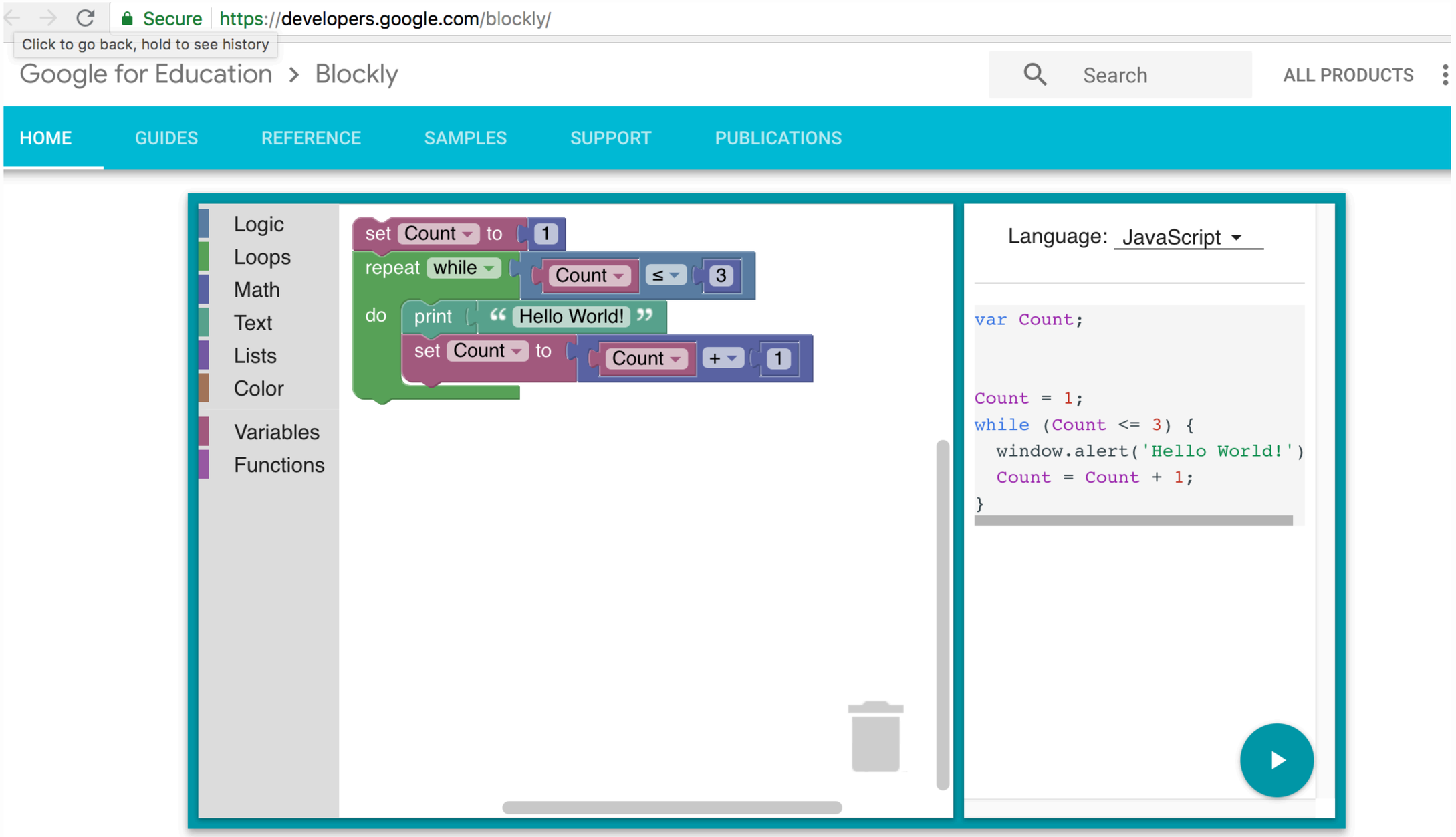
https://www.ted.com/talks/mitch_resnick_let_s_teach_kids_to_code?language=en

BLOCKLY PROGRAMMING

Supported by Google

Used in Hour of Code

Used in Australian Digital Technologies Challenges



The Blockly library adds an editor to your app that represents coding concepts as interlocking blocks. It outputs syntactically correct

Secure https://hourofcode.com/au/learn

Click to go back, hold to see history

All grades | Pre-reader | Grades 2-5 | Grades 6-8 | Grades 9+ | Beginner | Comfortable

Computers
Android
iPad/iPhone
Poor or no intern
No computers or

Topics

Science
Math
Social Studies
Language Arts
Art, Media, Music
Computer Scienc

Activity type

Self-led tutorial
Lesson plan

Length

One hour
One hour with fo
A few hours

Language

Blocks

Star Wars: Building a Galaxy with Code

Code.org

Grades 2+ | Blocks, JavaScript

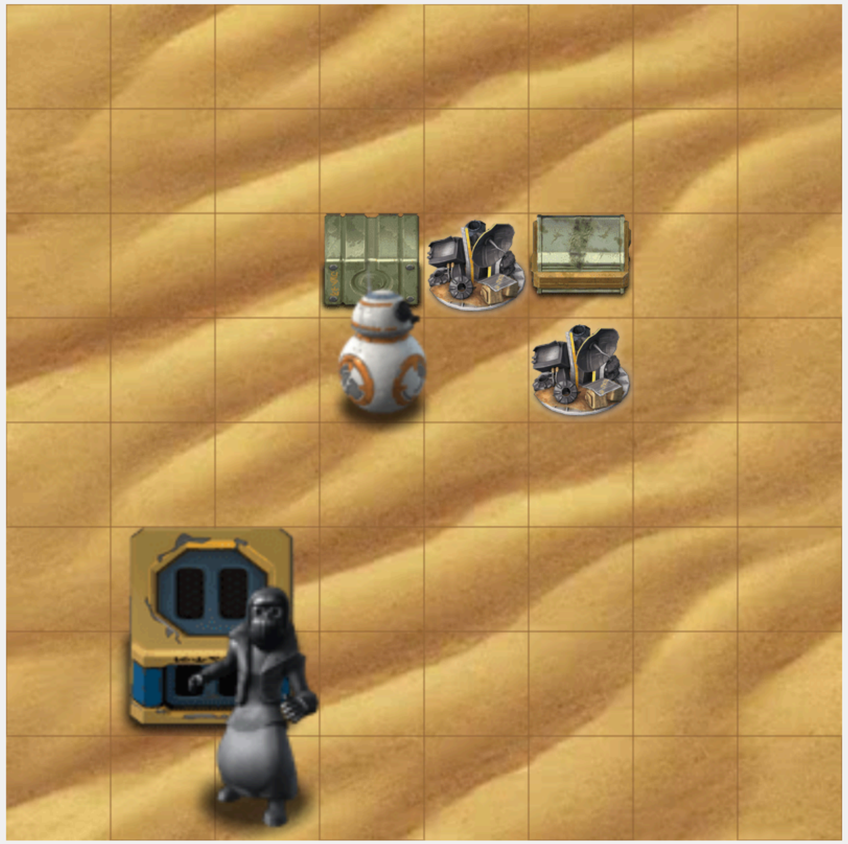
Learn to program droids, and create your own Star Wars game in a galaxy far, far away.

Start

More resources	**Teacher notes**
Short link	**https://hourofcode.com/star-wars**
Student experience	Beginner
Classroom technology	All modern browsers, Android tablet, iPad, Android phone, iPhone
Topics	Computer Science only
Activity type	Self-led tutorial

Secure https://studio.code.org/s/starwars/stage/1/puzzle/3

Star Wars: Building a Galaxy With Code 3 I've finished my Hour of Code Sign in



Run

"Go quickly, BB-8."

Toolbox

```
moveRight()
moveLeft()
moveUp()
moveDown()
```

Workspace: Start Over Show Te

```
1 moveRight();
2
```

Secure | https://groklearning.com/launch/

Author

- [ ] Australian Computing Academy
- [ ] Grok Learning

Competition

- [ ] Archived
- [ ] Current

Language

- [ ] Arduino
- [ ] BBC microbit
- [ ] Blockly
- [ ] CSS
- [ ] HTML
- [ ] JavaScript
- [ ] Python
- [ ] SQL
- [ ] Turtle

Level

- [ ] Junior
- [ ] Newbies

NCSS Challenge 2018

Ends September 2nd Learn more >

LIVE NOW

NCSS Challenge (Newbies) 2018

by Grok Learning

COMP WEEKS 5 POINTS 400

Perfect for young beginners learning to code visually. Competition starts on July 30th, 2018.

Newbies | School-aged only | Blockly

Details Start >

LIVE NOW

NCSS Challenge (Beginners Blockly) 2...

by Grok Learning

COMP WEEKS 5 POINTS 410

Perfect for beginners of all ages learning to code visually. Competition starts on July 30th, 2018

Beginners | School-aged only | Blockly

Details Start >

LIVE NOW

NCSS Challenge (Beginners) 2018

by Grok Learning

COMP WEEKS 5 POINTS 410

Perfect for beginners of all ages learning to code with text. Competition starts on July 30th, 2018.

Beginners | School-aged only | Python

Details Start >

LIVE NOW

NCSS Challenge (Intermediate) 2018

by Grok Learning

COMP WEEKS 5 POINTS 250

For experienced coders, to stretch further. Competition starts on July 30th, 2018.

Intermediate | School-aged only | Python

Details Start >

Problem | Solutions

According to the U.S. census data, in 1990, only 0.27% of surnames started with the letter Q and only 0.82% of surnames contained the letter Q. Write a program that asks the user for their surname and tells them how rare their surname is based on the letter Q.

If their surname starts with the letter Q, your program should print out `You have an extremely rare surname!` For example:

```
What is your surname? Quinn
You have an extremely rare surname!
```

Otherwise, if their surname contains a letter Q, your program should print out `You have a rare surname!` For example:

```
What is your surname? Rodriquez
You have a rare surname!
```

Otherwise, if their surname does not contain a letter Q, your program should print out `No Qs here.` For example:

```
What is your surname? Smith
No Qs here.
```

program.py

```
surname = input("What is your surname? ")
if(surname[0] == ('q') or surname[0] == ('Q')):
   print("You have an extremely rare surname!")
elif ("q" in surname or "Q" in surname):
  print("You have a rare surname!")
else:
  print("No Qs here.")
```

Submissions | Output

Autosaved 10 days ago Load

#2 Passed all tests! 10 days ago Load

- ✓ Testing the first example in the question.
- ✓ Testing the second example in the question.
- ✓ Testing the third example in the question.
- ✓ Testing another surname which starts with a Q.
- ✓ Testing another surname which contains a Q.
- ✓ Testing another surname which does not contain a Q.

CODING

Sequencing, Choice, Repetition

TURING MACHINES

PROGRAMMING LANGUAGES

SCRATCH & BLOCKLY

PYTHON

JAVA, C, MATLAB, JAVASCRIPT, C#

ANALOGIES To OTHER AREAS

01. Coding v Art

02. Coding v Music

03. Coding v Sport

PLACE IN CURRICULUM

01. MATHS – Computing is Applied Maths

02. SCIENCE – Astronomy is coding!

03. DESIGN

Digital Technologies Curriculum

COMPUTATIONAL THINKING
LEON STERLING 31/8/18

SUMMARY

01. Computational Thinking the aim rather than coding

02. Coding is an excellent way to appreciate what a computer does

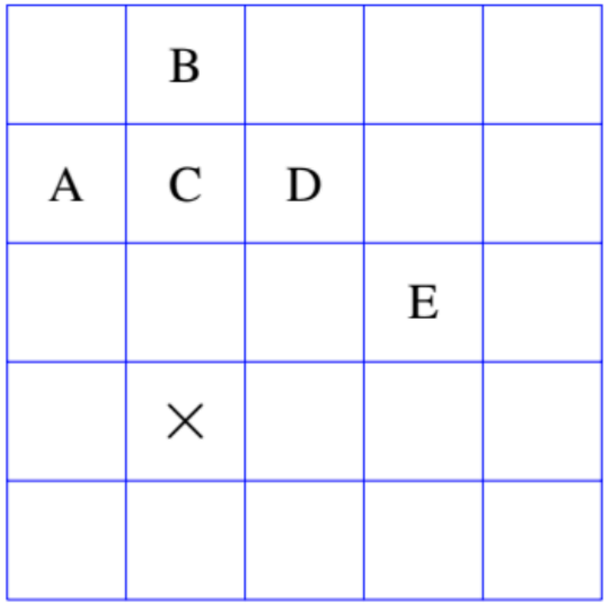
03. Plenty of resources available for both coding and computational thinking

FEEDBACK?

1. Chenni's Walk

For fun, Chenni steps around on a grid, moving one square with each step. She starts on the square marked with an $\times$ and takes nine steps according to the following sequence of arrows.

$\leftarrow \uparrow \rightarrow \uparrow \rightarrow \downarrow \downarrow \uparrow \uparrow$



On which square does she land?

(A) A (B) B (C) C (D) D (E) E

4. Front Seat Ride

John and Linda take a drive each morning with their father. Either John or Linda sits in the front seat of the car, with the other sitting in the back seat, according to the following rule.

- If it is ☼ (sunny), whoever sat in the front seat on the previous morning stays in the front seat.
- If it is ☁ (not sunny), whoever sat in the back seat on the previous morning moves to the front.

Suppose Linda last sat in the front seat. Over the next 11 days, the weather was

For how many days did John sit in the front seat?

(A) 0 (B) 4 (C) 6 (D) 7 (E) 10