Developing employability skills with Project Based Learning and Physical Computing

Arm School Program with support from CBSE

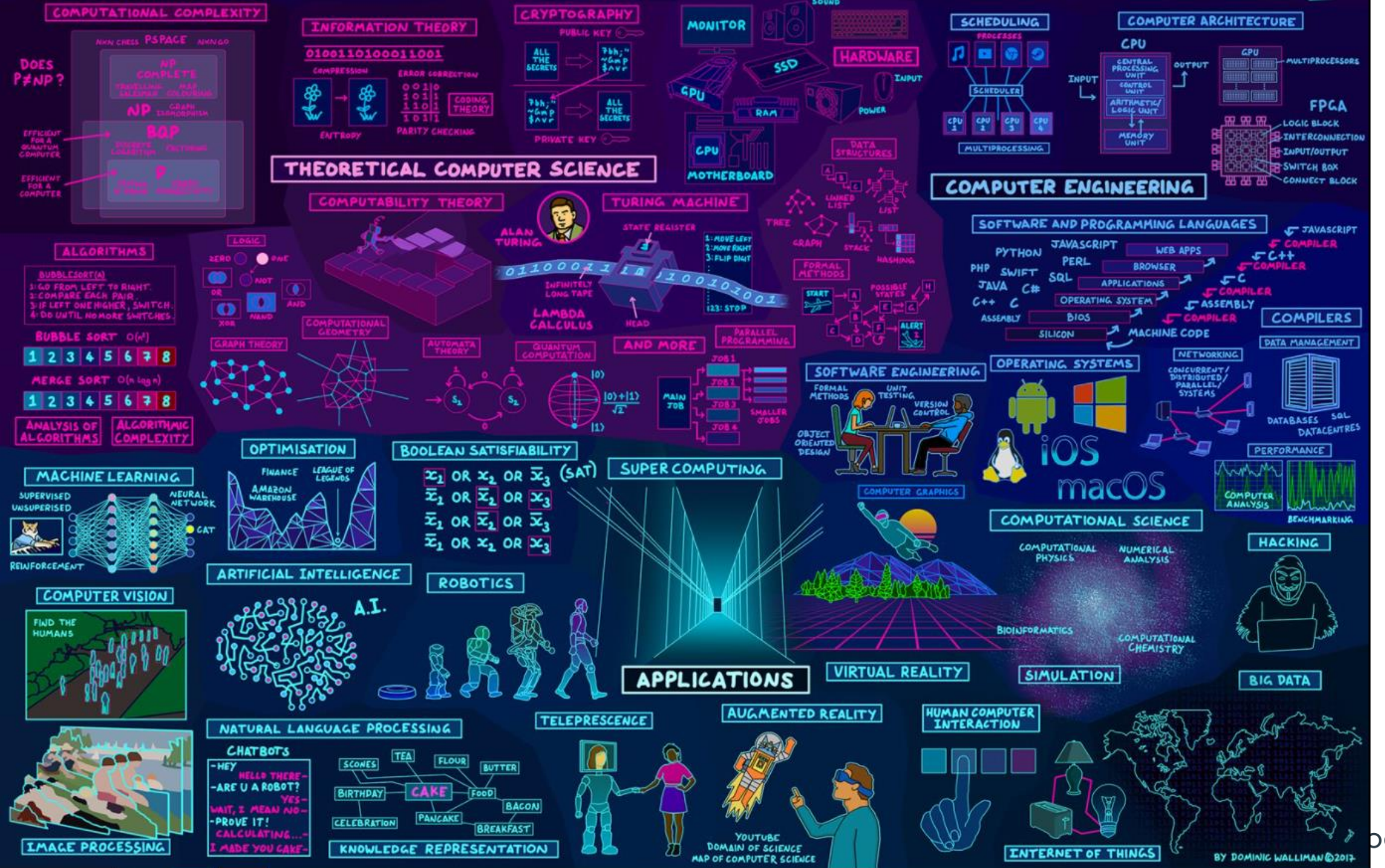
15th March, 2023

Learning outcomes:

- Understand what employability skills are
- Understand how to develop employability skills in learners through PBL
- Understand the various pedagogical techniques and practices used in PBL to develop employability skills
- Be able to confidently deliver a PBL lesson that focuses on developing employability skills in learners
- Understand how to build a culture of gracious professionalism in your classroom
- Understand how employability skills relate to equity, inclusion, differentiation and culturally responsive classrooms

Employability skills

- Good communication
- Motivation and initiative
- Resilience
- Problem solving
- Reliability/dependability
- Teamwork and collaboration
- Patience
- Adaptability
- Time management
- Gracious professionalism


THEORETICAL COMPUTER SCIENCE
COMPUTATIONAL COMPLEXITY
DOES P≠NP?
PSPACE
NP COMPLETE
NP
BQP
P
EFFICIENT FOR A QUANTUM COMPUTER
EFFICIENT FOR A COMPUTER
INFORMATION THEORY
01001101000011001
COMPRESSION
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ERROR CORRECTION
CODING THEORY
PARITY CHECKING
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PUBLIC KEY
ALL THE SECRETS
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PARALLEL PROGRAMMING
MAIN JOB
SMALLER JOBS
COMPUTER ENGINEERING
HARDWARE
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SOUND
INPUT
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POWER
CPU
MOTHERBOARD
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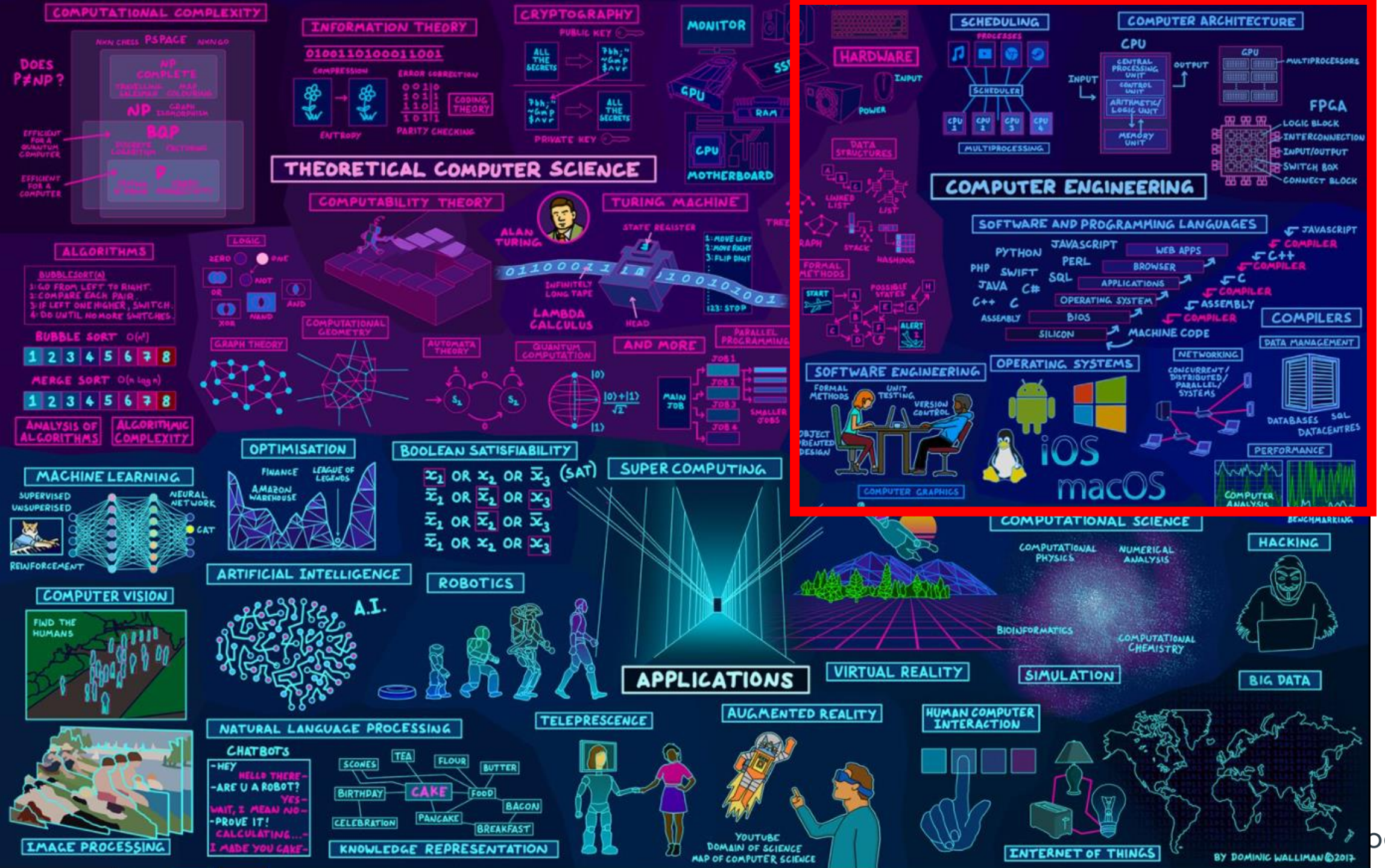
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Being digitally literate

- Use of devices and applications
- Handling, storing and interrogation of data and information
- Design, creation, and editing of content, systems and products
- Communication using technology
- Cyber Security
- Moral and ethical behaviour relating to technology

Python – the most popular language in 2023

- **TIOBE Index for February 2023**

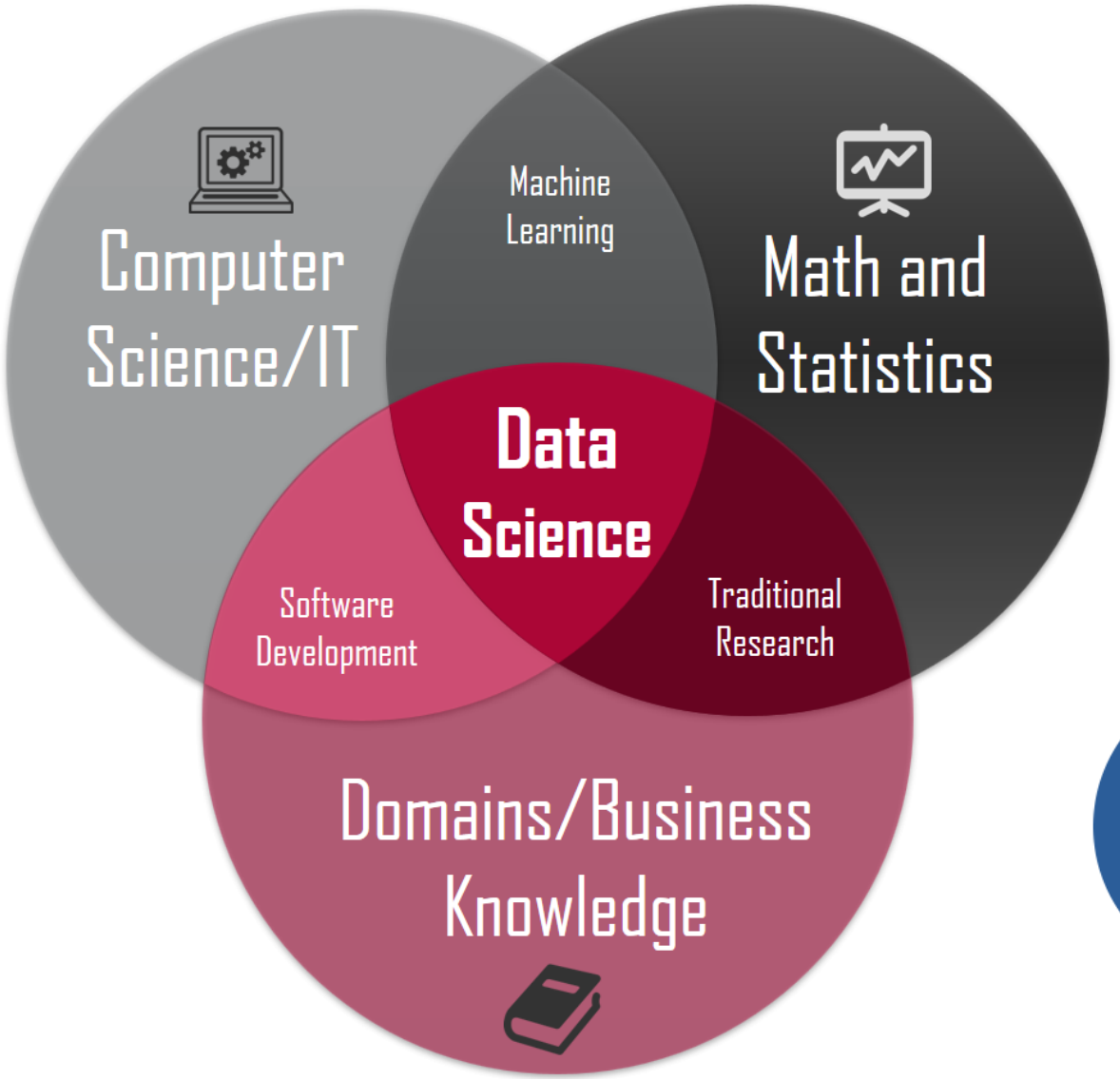
Feb 2023	Feb 2022	Change	Programming Language	Ratings	Change
1	1		Python	15.49%	+0.16%
2	2		C	15.39%	+1.31%
3	4	▲	C++	13.94%	+5.93%
4	3	▼	Java	13.21%	+1.07%
5	**5**		**C#**	**6.38%**	**+1.01%**

Python developers earn more!

- Python developers earn 2-3x more than JavaScript or PHP developers
- Even more in Data Science, ML, AI related jobs
- Can be used across many fields/industries

Recent job search in South Africa:

- Python dev - $80,000 - $200,000 pa (USD)
- Python+ SQL dev - $3,500 pcm salary (USD)



Data Science

- Machine Learning
- Statistics
- Artificial Intelligence
- Used widely in universities
- Automation in industry

What is IOT?

Internet of things

- Adding electronics to everything
- Electronics such as:
  - Sensors (cameras, temp, light, humidity etc.)
  - Microprocessors
  - Transmitters
  - Screens
  - GPS
  - RFID
- Everything can link to the internet/each other
- Anything electronic can be controlled
- Can stream data continuously

Cyber Security

- Networking
- The internet
- Protocols and standards
- Steganography
- Encryption
- Forensics
- Defensive design
- Penetration testing

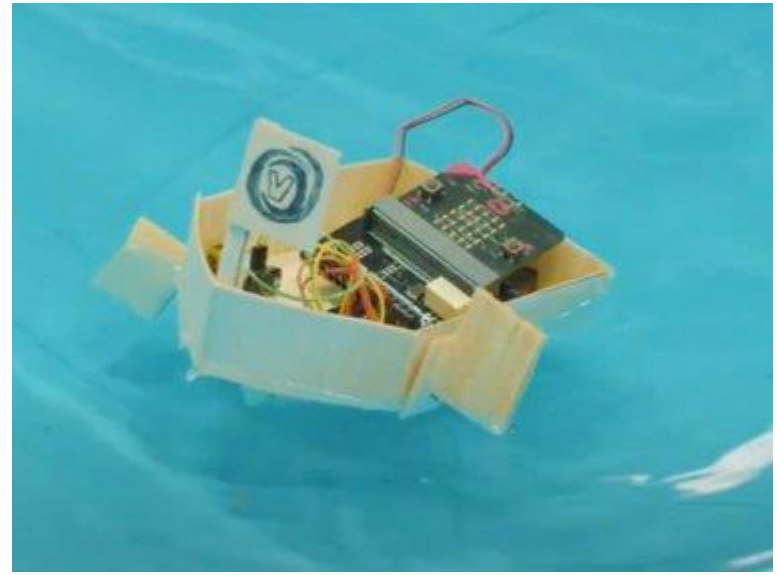
Python – interesting things to explore

- Python Standard Library - https://docs.python.org/3/library/
- Python Data Science Handbook - https://jakevdp.github.io/PythonDataScienceHandbook/
- Python challenge - http://www.pythonchallenge.com/
- Core Arm language

C/C++

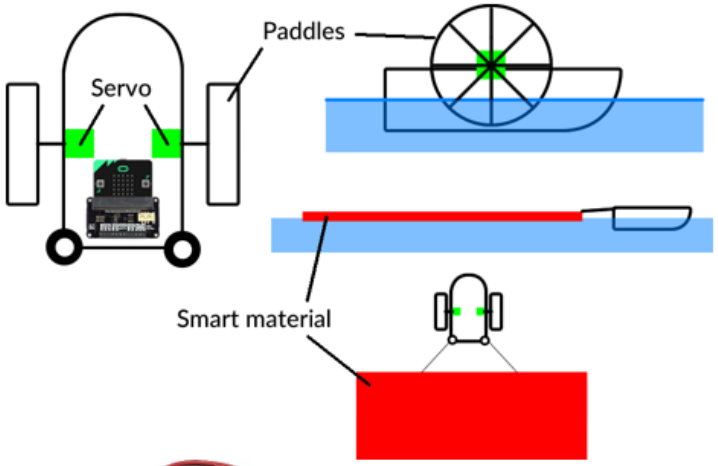
- W3Schools C– https://www.w3schools.com/c/index.php
- W3Schools C++ - https://www.w3schools.com/cpp/default.asp
- General purpose language
- Core Arm language

Oil spill cleaner-upper



Building the product

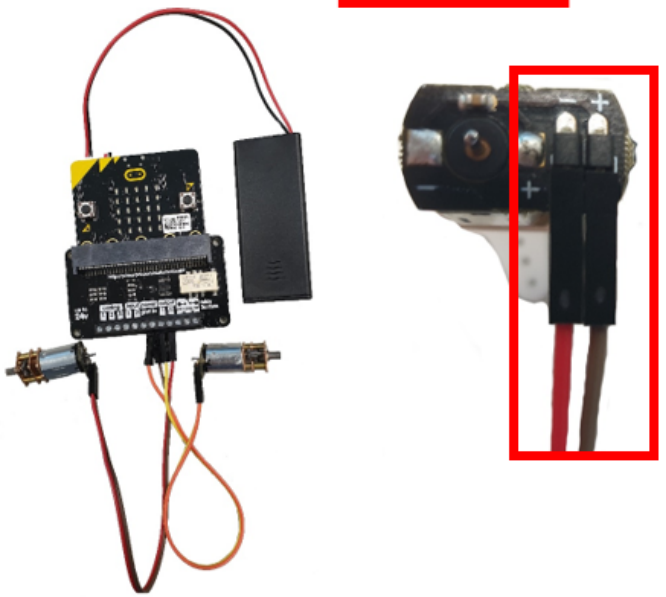
For this project we need to build a simple boat. You can use anything that is waterproof.



Kit required:

- A micro:bit
- Header wires
- Battery pack
- Boat building materials
- A foam sponge
- A mini screwdriver
- A servo driver board

There are many types of servo controller boards for micro:bit, in this example an 'automation bit' was used.



Here you can see how the servo motors are wired to the servo controller and micro:bit.

The + cable from **both** the servos need to go into the 3v opening on the servo control board.

The – cable needs to go into output 1 and 2 respectively.

Pay attention to which side you put them on. In this image:

Output 1 = Right
Output 2 = Left

You may have a third cable for the servo which is the ground (GND), attach this to the GND terminal on the board if you have this.

Success criteria:

- Build a floating oil spill cleaner upper boat drone that starts with a button press
- The product should be able to autonomously navigate over an area
- The product should be made to clean up an oil spill by dragging a 'smart material'

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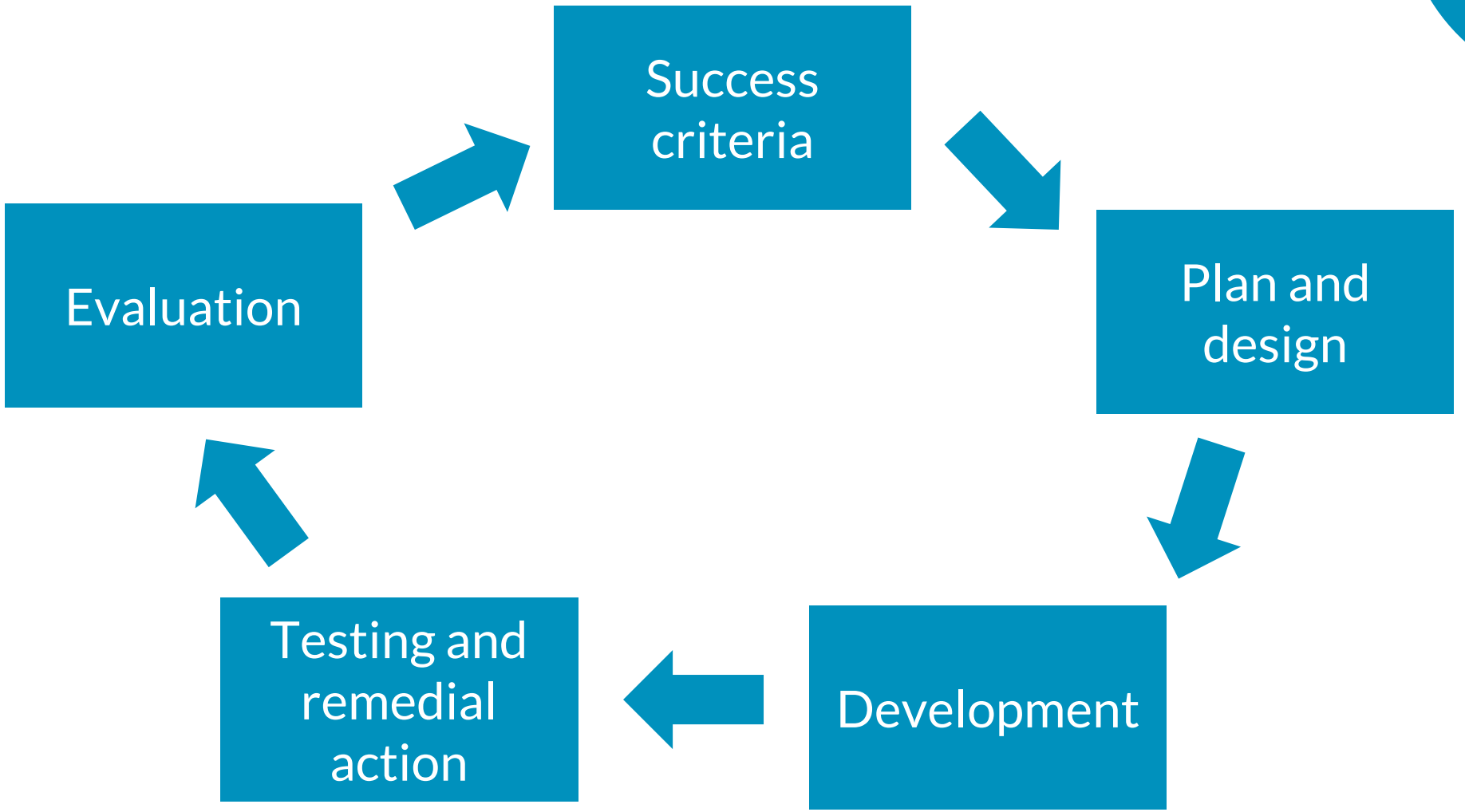
Iterative development cycle

Iterative development cycle



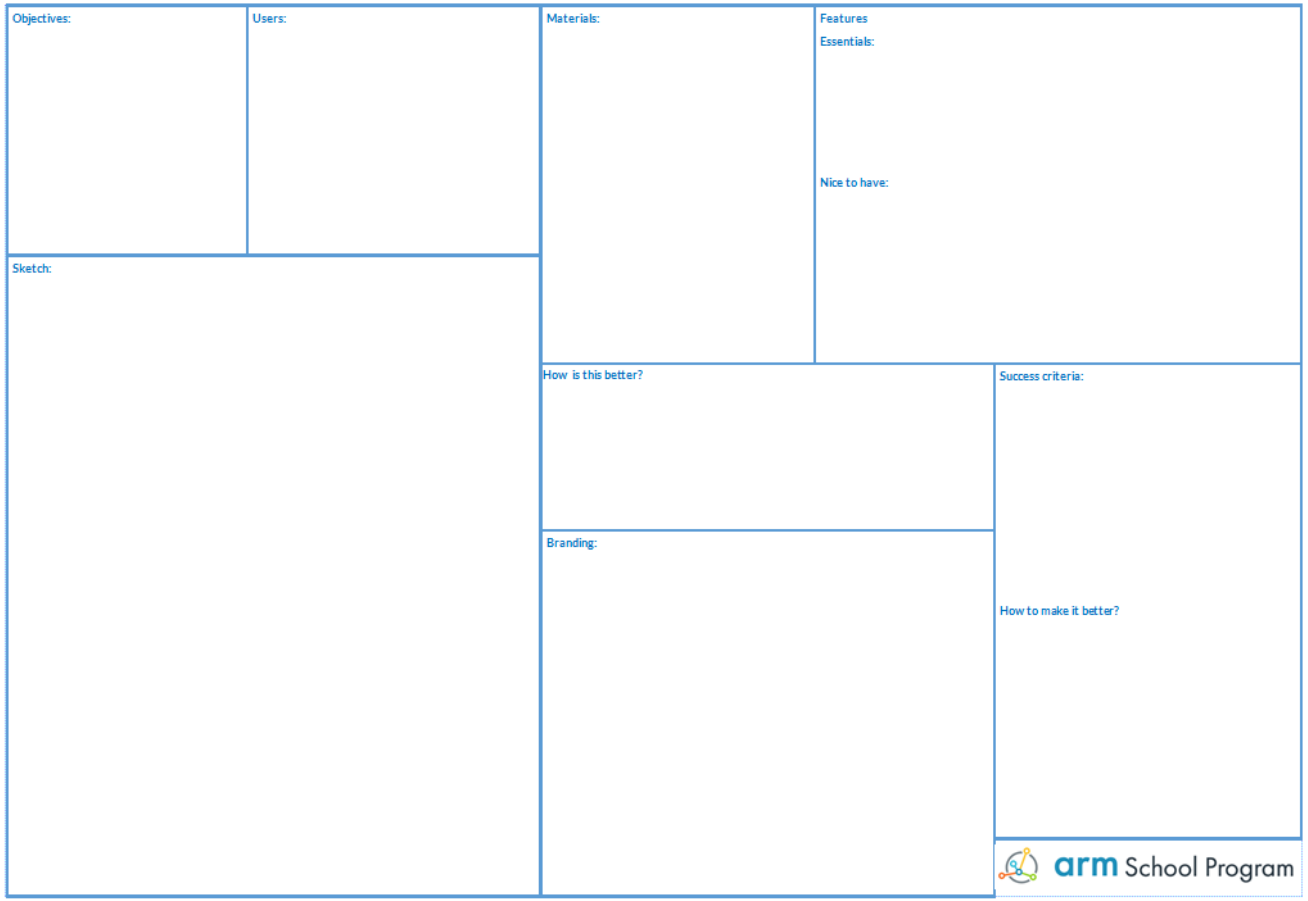
The Input Process Output (IPO) Model

- All computer systems take data into a system using ‘Inputs’, carry out processes on the inputs and then display the result of that processing using ‘Outputs’
- Using the **Input, Process, Output** worksheet try to identify what the outputs will be

Design thinking

Design first

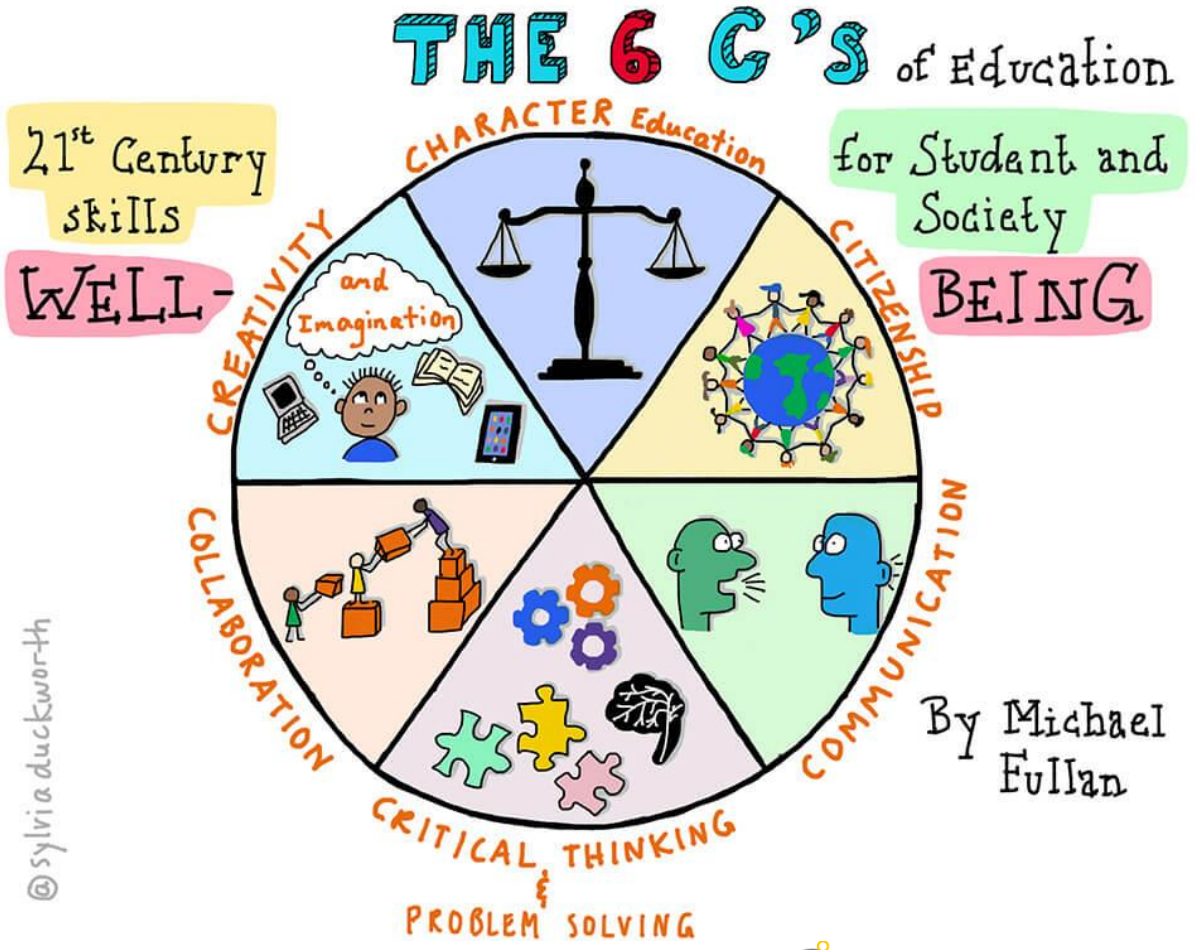
- Concept designs and rapid prototyping
- Iterating on designs
- Objectives
- Users
- Sketching
- Materials
- Features and prioritisation
- Analysis, why is this better?
- Brand
- What could be improved?



Soft skills

Soft skills (6Cs)

- Teamwork
- Collaboration
- Creative ideation
- Applied Computational thinking
- Communication
- Planning
- Iterative development
- Problem solving



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Careers in Computing

Developer/Engineer

- App/games developer
- Digital Product owner
- Robotics engineer
- Solutions architect
- Software engineer
- Complier engineer
- Technical writer
- Verification engineer
- SoC designer
- CPU architect

Cyber/IT/Web

- Cyber Intelligence officer
- Database admin
- IT project manager
- Network engineer
- Penetration tester
- Web dev
- Cyber analyst

Data Science/AI/ML

- Business analyst
- Data Scientist
- ML engineer

Things to explore

Linux	Python StdLib	Github/GIT	Electronics
CI/CD	SQL	OOP	Arduino
BASH	Jupyter	DevOps	IoT
Powershell	C/C++	Cyber	Rpi

Some of the jobs at Arm

Validation Engineering

Customer Support Engineering

SW Programmer

Product Marketing

Management

IT Engineering

Sales

Trade Shows Organisation

Communications

People Development

Design Engineering

Business Analyst

Some of the subjects our colleagues studied

Electronic Engineering

Computer Sciences

Psychology

Business

Languages

Mathematics

Physics

Communications

Design Engineering

Information Technology

Teaching with Physical Computing

A new series of PD courses from the Arm School Program

A course for teachers on Physical Computing and how to apply it through Project-Based Learning in the classroom.

Teaching with Physical Computing

Search for “Project-Based Learning” on edX.org

Course 1 Introduction to Project-Based Learning

Course 2 Practical application and classroom strategies for PBL

Course 3 Assessment of Project-Based Learning

Course 4 Soft skills, teamwork and the wider curriculum

Q & A

Nick Sample, Senior Manager, Arm School Program