PiXL Gateway: Progression – Computer Science

Year 12-13 Computer Science

Contents:

I. Computer Science Vocabulary

COMPUTER SCIENCE:

Currently, within the Computer Science section of the app, we have the following unit:
• Problem-solving, Programming and Algorithms.

Problem-solving, Programming and Algorithms Keywords and Definitions

Word	Definition
abstraction	Abstraction is the process of removing unnecessary details from a problem.
aggregation	Aggregation is a type of association between classes where there is a weak relationship between the classes.
algorithm	An algorithm is a set of steps that, when followed, will carry out a specific task.
append	Append means to add something to the end of a written document; in computer science this is often a text file.
attribute	An attribute is a quality or feature that is an inherent part of something.
automation	Automation is the method of designing and implementing a model or system that automatically controls a process, with the intention of reducing human input.
branching	Branching is when a program is instructed to execute a different set of instructions than it would if it continued to execute instructions sequentially.
class	The word class, in computer science, means a blueprint or template for an object.
complexity	The word complexity, in computer science, refers to the how fast or slow an algorithm performs.
component	A component is a part of a larger whole.
computation	Computation is the act of following a set of steps that incorporate maths and/or logic to arrive at a desired solution.
concurrently	Concurrently means when more than one thing happens or is done at the same time.
condition	A condition, in computer science, is a feature of a programming language where different computations or actions are performed depending on whether a boolean condition equated to true or false.
constant	A constant is a stored value that, unlike a variable, cannot change while the program is running.
constructor	A constructor, in computer science, is a special method of a class that is used to initialise an object of that type.
decomposition	Decomposition is breaking a problem down into smaller parts that are individually easier to solve.
encapsulation	The word encapsulation, in computer science, refers to combining elements to create a new entity.
execute	Execute is when a computer program (and instructions contained within it) are run.
exponent	An exponent is a quantity representing the power to which some other quantity is raised.
function	A function is a subroutine that returns a value to the routine it was called from.

global variable	A global variable can be accessed from any routine in the program.
heuristic	The word heuristic, in computer science, means approaching a problem by looking to implement a solution that may not be optimal or perfect.
inheritance	The word inheritance, in computer science, refers to when a sub class receives its attributes and methods from a parent or super class.
input	Input is when data is passed into a system.
instantiation	Instantiation is when a new object/an instance of a class is created.
interface	The word Interface, in the programming unit of computer science, means a set of methods that unrelated classes may implement.
intractable	Intractable refers to a problem that does not have a polynomial time solution.
iteration	Iteration is when a series of commands are repeated until a condition is met.
local variable	A local variable can only be accessed in the subroutine in which it was created; when the subroutine finishes executing the variable is destroyed.
method	The word method, in computer science, is the term for a behaviour that an object of a class can display.
modular	The word modular, in computer science, refers to dividing a computer program into separate sub programs.
output	Output is when data is passed out of a system.
polymorphism	Polymorphism is the ability for an attribute, method or function to take on multiple forms.
private	The word private, in computer science, refers to methods and attributes that can only be accessed by code from within that class.
procedure	A procedure is a section of code that can be called from elsewhere in the program but does not return a value.
protected	The word protected, in computer science, refers to a method or attribute of a class that has restricted but not private access.
public	The word public, in computer science, refers to methods and attributes that can be accessed by code from anywhere in the program.
recursion	Recursion is when a subroutine that is defined in terms of itself is executed.
sequence	A sequence is a series of tasks or events carried out one after the other.
tractable	A tractable problem is one that has a polynomial time solution.
traverse	Traverse refers to the act of moving over, along or through something.
variable	A variable is a name given to a memory location where data is stored during the execution of a program.

II.   The PiXL Unlock Template

PiXL Unlock

Read It

Define It

Digging Deeper:

Draw It

Deconstruct It

Link It

Use It
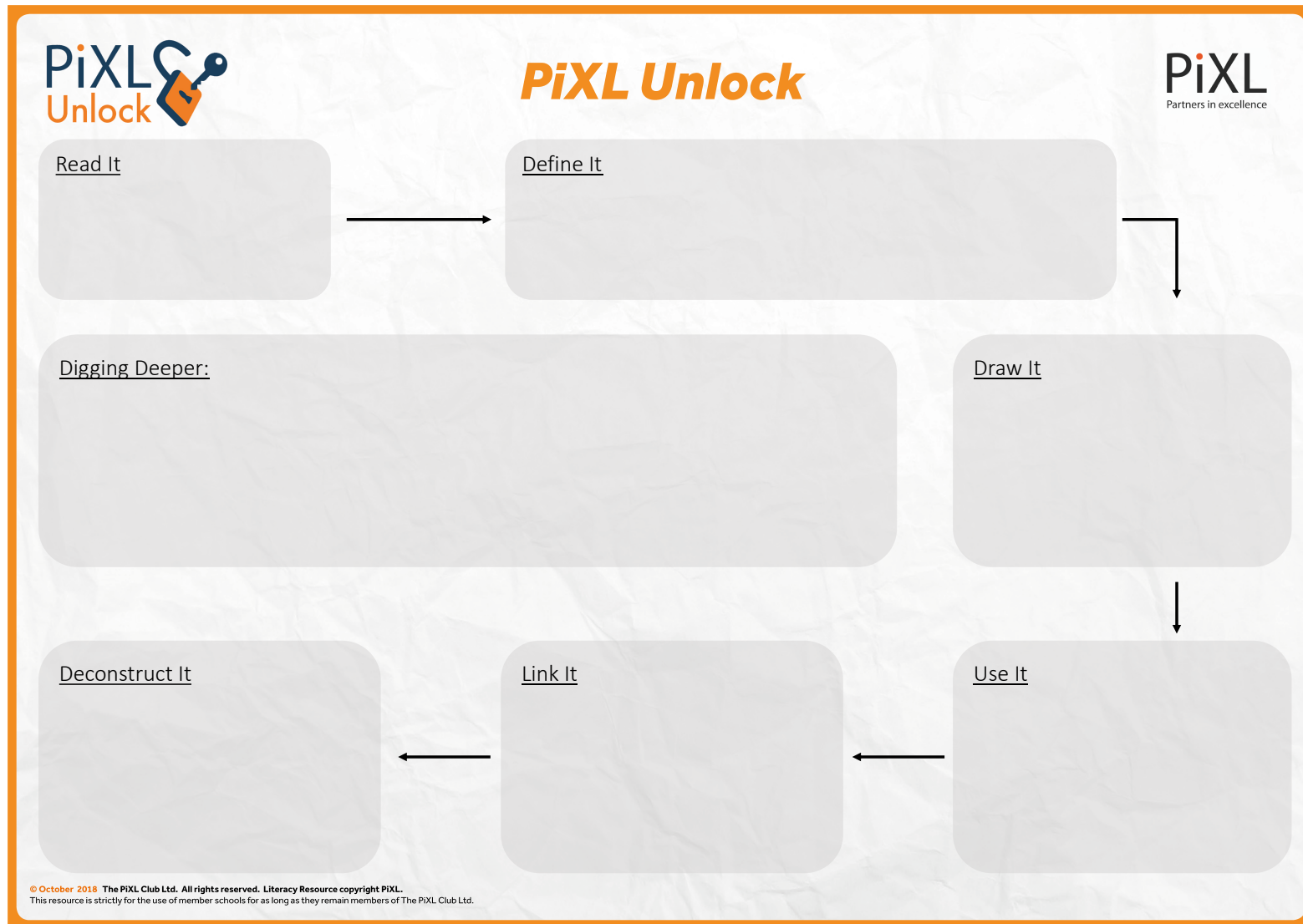
III.   Summer Reading list

The following are good reads for developing computing thinking and problem-solving skills, without delving into the A Level content too much. They are fun and engaging and help to develop the right mindset for A Level computer science. The python texts are provided as good free resources for students who are new to programming.

	Einstein's Riddle Jeremy Stangroom Bloomsbury Publishing (18 May 2009) ISBN-10: 1408801493 ISBN-13: 978-1408801499	Contains the world's most famous logic puzzle
	Algorithmic Puzzles Anany Levtin, Maria Levtin Oxford University Press, USA (14 Oct. 2011) ISBN-10: 0199740445 ISBN-13: 978-0199740444	A collection of puzzles designed to test and develop your algorithmic thinking and problem-solving strategies. The book is well organised, with a discussion of each problem solving strategy and then several puzzles to practice.
	The GCHQ Puzzle Book GCHQ Michael Joseph (20 Oct. 2016) ISBN-10: 0718185544 ISBN-13: 978-0718185541	A proper work-out for the brain!
	Think Python Learning with Python 3 Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers Oct. 2012 http://openbookproject.net/thinkcs/python/english3e/index.html	One of the best free books on learning to program using python. The emphasis is on understanding why we write code and solve problems in a particular way, which is useful for A-level students. The book is well organised, with plenty of exercises in each chapter, plus a glossary of key words. Up to Ch14 is AS level, and the rest of the book covers A level standard code, including the key data structures and algorithms. Note that the same resource is available for other languages, namely *Think Java* and *Think C*
	Invent with Python Albert Sweigart http://inventwithpython.com/	A nice way to start python, this site has a collection of introductory books on writing code, also all free. Each chapter has a game (or similar to make) and includes the full code, plus a step-by-step walkthrough of how to make it. It is a good exercise to read code before you write it, so making some of these games is useful.
	The British Informatics Olympiad https://www.olympiad.org.uk/problems.html	Lots of hard coding challenges. Like the maths challenge, only for programming. The Mayan Calendar is a good starting point.

IV.   Links to TED Talks/Articles/Documentaries/Books/Journals

The links below are to TED talks on a number of current Computer Science topics. There is deliberately some cross-over in topics to allow students to compare sources and get different perspectives on the same ideas.

The TED talks include transcripts if students wish to access the text, in multiple languages.

https://www.ted.com/talks/nadine_hachach_haram_how_augmented_reality_could_change_the_future_of_surgery/

Note that this talk includes graphic images of surgery and some viewer discretion is advised. The transcript is available if students wish to read the content, which is not graphic in its description.

https://www.ted.com/talks/jeremy_howard_the_wonderful_and_terrifying_implications_of_computers_that_can_learn

A broad discussion on machine learning.

https://www.ted.com/talks/james_patten_the_best_computer_interface_maybe_your_hands

A more hardware-oriented talk.

https://www.ted.com/talks/keren_elazari_hackers_the_internet_s_immune_system

Possibly good for an ethics discussion, as it discusses the benefits and consequences of hacking.

https://www.ted.com/talks/joseph_redmon_how_a_computer_learns_to_recognize_objects_instantly

https://www.ted.com/talks/fei_fei_li_how_we_re_teaching_computers_to_understand_pictures

These two talks approach the same topic, which may be useful for developing skills comparing sources.

https://www.ted.com/talks/oscar_schwartz_can_a_computer_write_poetry

A different view on computer intelligence and learning.

V.   Knowledge Organiser Template

VI.   Thinking Hard Revisit Template

Name of Topic: _____

Name: _____

Class: _____

Take a section of the text and do the following:

1)   Prioritise: Underline the three most important sentences here. Rank 1-3, briefly explain number 1. Cross out the least important sentence
2)   Reduce: Reduce the key information into 12 words
3)   Transform: Transform this information into 4 pictures or images (no words allowed)
4)   Categorise: Sort this information into three categories. Highlight and think of a suitable title for each category.
5)   Extend: Write down three questions you'd like to ask an expert in this subject.

VII. A Model of the Thinking Hard Revisit document

Name of Topic: Augmented Reality
https://www.ted.com/talks/nadine_hachach_haram_how_augmented_reality_could_change_the_future_of_surgery/

Name: A. Student

Take a section of the text and do the following:

1) Prioritise: Underline the three most important sentences here. Rank 1-3, briefly explain number 1. Cross out the least important sentence
   1. It allows two people to virtually interact in a way that mimics how they would collaborate in person – def. of AR and why it changes how we work.
   2. all you needed was a phone, a tablet, or a computer, an internet connection, a confident colleague on the ground and one magic ingredient: an augmented reality collaboration software
   3. ~~the idea that a surgeon doesn't actually have to be standing at the patient's bedside to deliver care, that he could be looking at a screen and instructing a robot through a computer. We call this remote surgery.~~

2) Reduce: Reduce the key information into 12 words

   Collaborate, AR, remote, interact, phone, Internet, personal, learning, access, time, money, travel

3) Transform: Transform this information into 4 pictures or images (no words allowed)
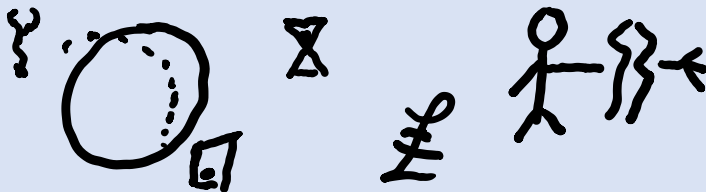
4) Categorise: Sort this information into three categories. Highlight and think of a suitable title for each category.
   Technology: phone, Internet, AR

   Interaction: collaborate, interact, personal, learning, remote

   Benefits: remote, learning, access, time, money, travel

5) Extend: Write down three questions you'd like to ask an expert in this subject.
   What are the limitations/barriers to using AR technology?

   In what other fields is AR also being used?

   How widespread is this technology?

VIII.   Cornell Notes Template

Name	Date

Topic	Subject

Main Ideas	Notes

Summary

IX.   A Model of the Cornell Notes document

Name A. Student.	Date 21/4/19

Topic Augmented Reality and Surgery	Subject Computer Science

Main Ideas	Notes
	From Nadine Hachach-Haram, TEDWomen 2017
	https://www.ted.com/talks/nadine_hachach_haram_how_augmented_reality_could_change_the_future_of_surgery/
Connectivity	Tech breaks boundaries and connects people.
Huge numbers of people lack access to simple surgeries	5bn people without access; In Sierra Leone 1:600,000 surgeon:people; In U.S. need +100,000 surgeons by 2030
Remote surgery	Surgeon to robot via screen, from distance. But robots are $1m
Augmented Reality Collaboration S/W	Expert surgeon uses phone to interact with operation remotely, guiding local doctor
AR mimics collaboration in person	Show, illustrate, guide, demonstrate, gesture. Learning via direct experience
Benefits to patients	Reduces travel time and costs. Improves access. Dr in California supporting Dr in Lima. 30% more ops, fewer complications, eventually team performs ops independently. Use in hard to reach places, e.g. conflict zone.
Remaining issues	Requires Internet.

Summary

AR and everyday devices allow skills to be shared remotely across a wide area. Significant benefits to people, e.g. patients needing access to surgeons.

Q: where else could this Tech be used?

© The PiXL Club Ltd. May 2019