An online platform for teaching upper secondary school computer science

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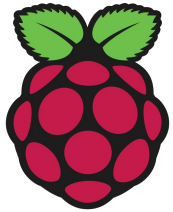
Raspberry Pi Computing Education Research Centre



Raspberry Pi

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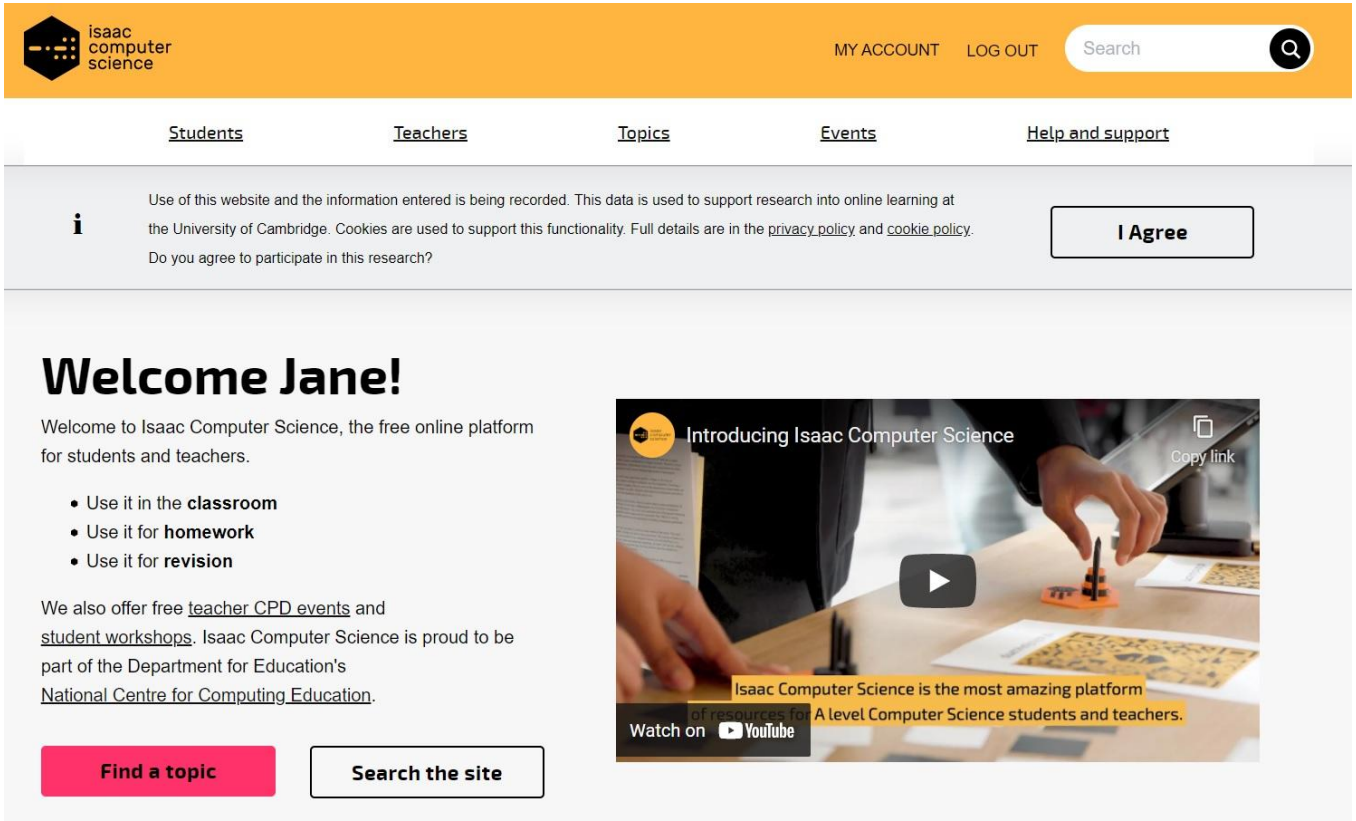
Tools Design



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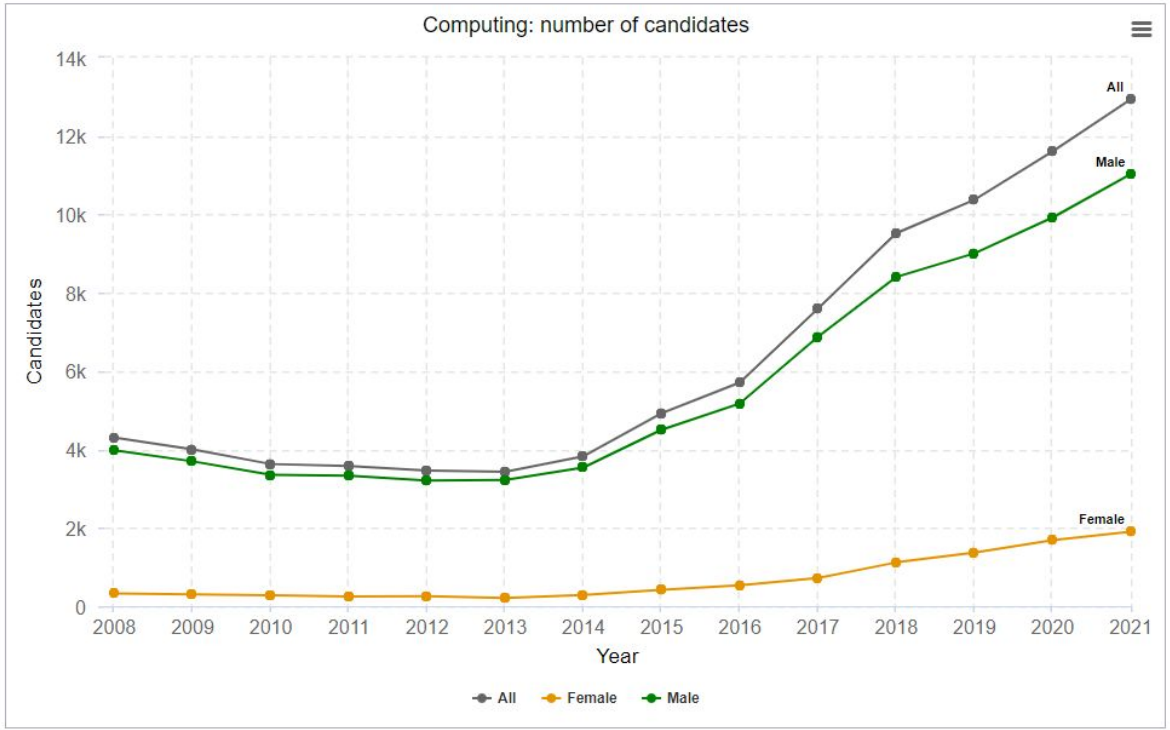
Why Isaac CS?



Department for Education. 2020. A level and other 16 to 18 results in England.
(DfE,2020)

There is a shortage of appropriately qualified computing teachers in secondary schools. Recruitment targets for computing teachers have consistently not been met.
(The Royal Society, 2019)

"The discipline is completely new to me. It's like a linguist having to teach a different language but with no resources or preparation time." Head of ICT and Computer Science, Secondary School
(Pye Tait Consulting, 2017)

Literature

Lack of robust evidence and conflicting views on effectiveness of online learning platforms
(Barbour, 2019, Education Endowment Fund, 2019, OECD, 2020)

Reasons for augmenting classroom activities are given

- Broadening access
- Facilitating small group and 1:1 teaching
- Serving diverse needs
- More opportunity for practice
- Adding variety and enhancing engagement
- Supporting learning of complex abstract ideas

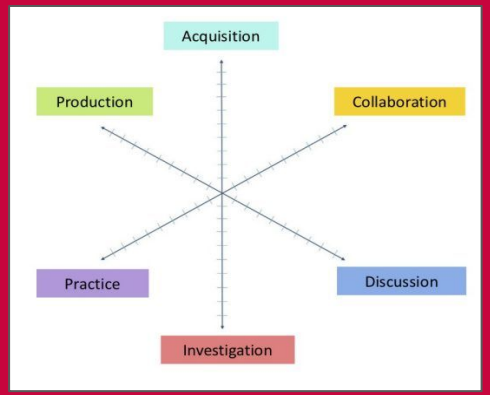
(Means, Bakia & Murphy 2014)

Functionality to support online teaching of computer science is suggested

- General pedagogy tools e.g. collaboration
- Augmented learning e.g. student differentiation
- Computer science adaptations e.g. IDE
- Algorithm & program visualisation

(Rößling et al., 2008)

Process such as Arena Blended Connected are popular for designing online learning activities balancing Laurillard's (2012) Learning Types



(Young & Perovic, 2016)

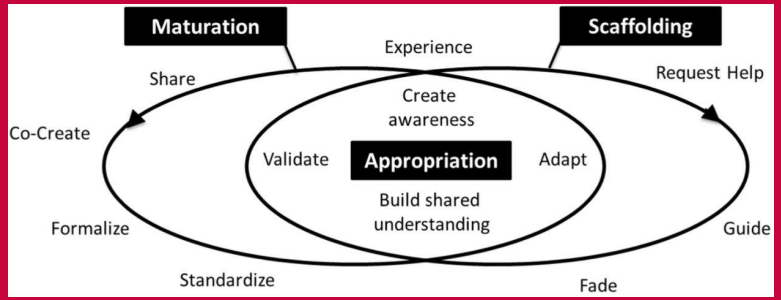
Literature

Pedagogy to support online teaching of CS to high school students suggests

- No one pedagogy fits all
- Multiple pedagogy should be considered
- Automatic feedback on programming
- Visualisations of algorithms
- Representation of concepts in animations
- Offline physical activities

(Anohah, 2016)

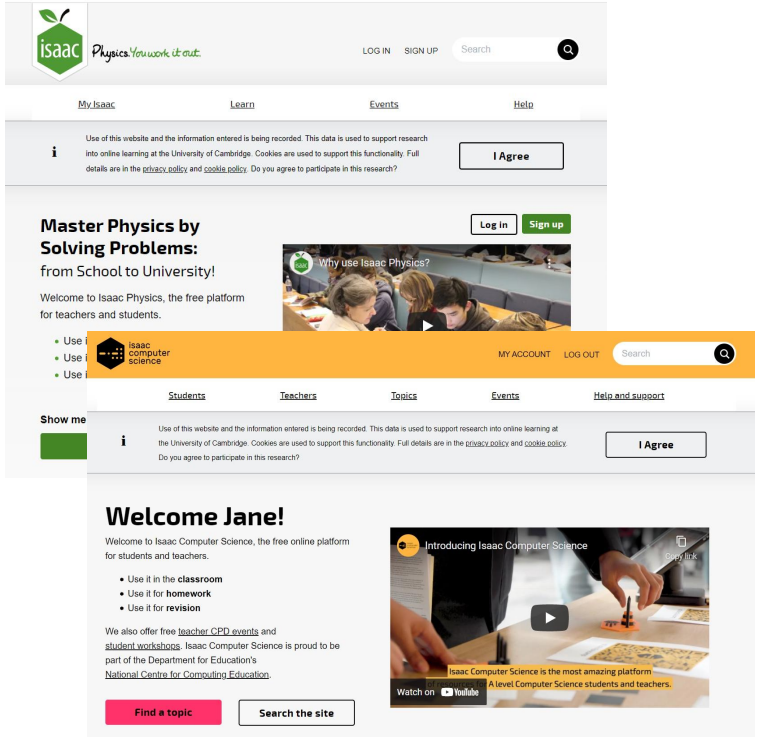
Models to support educators to appropriate new tools and working practices are available e.g Knowledge Appropriation Model



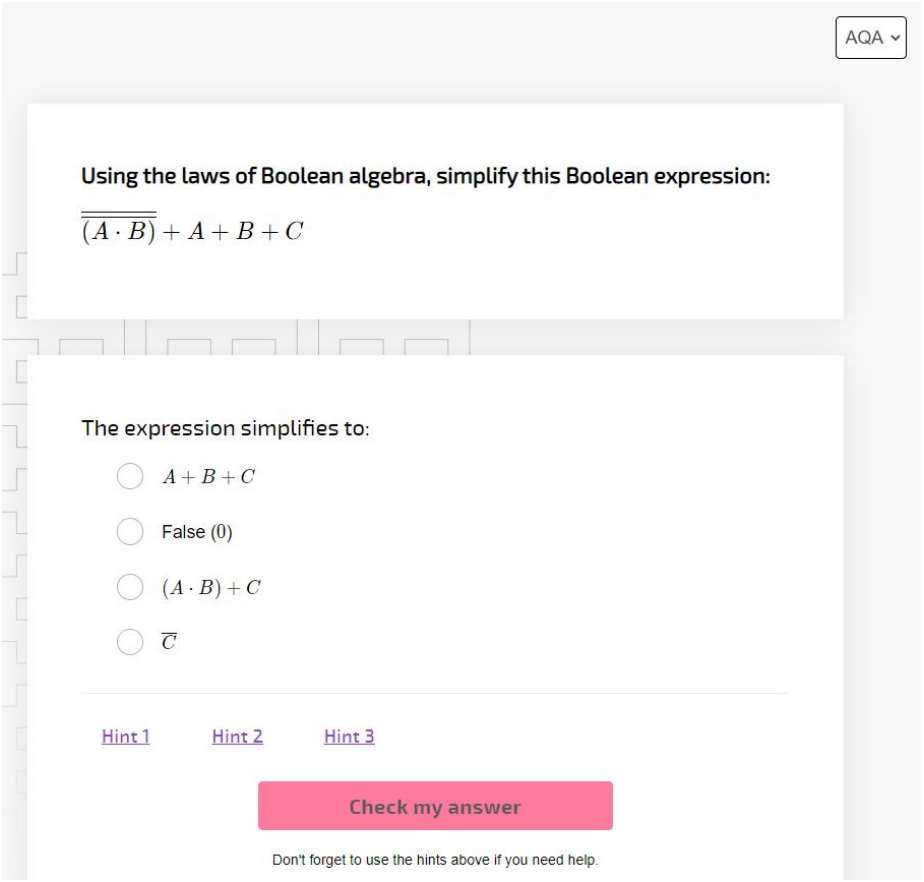
(Ley et. al, 2020)

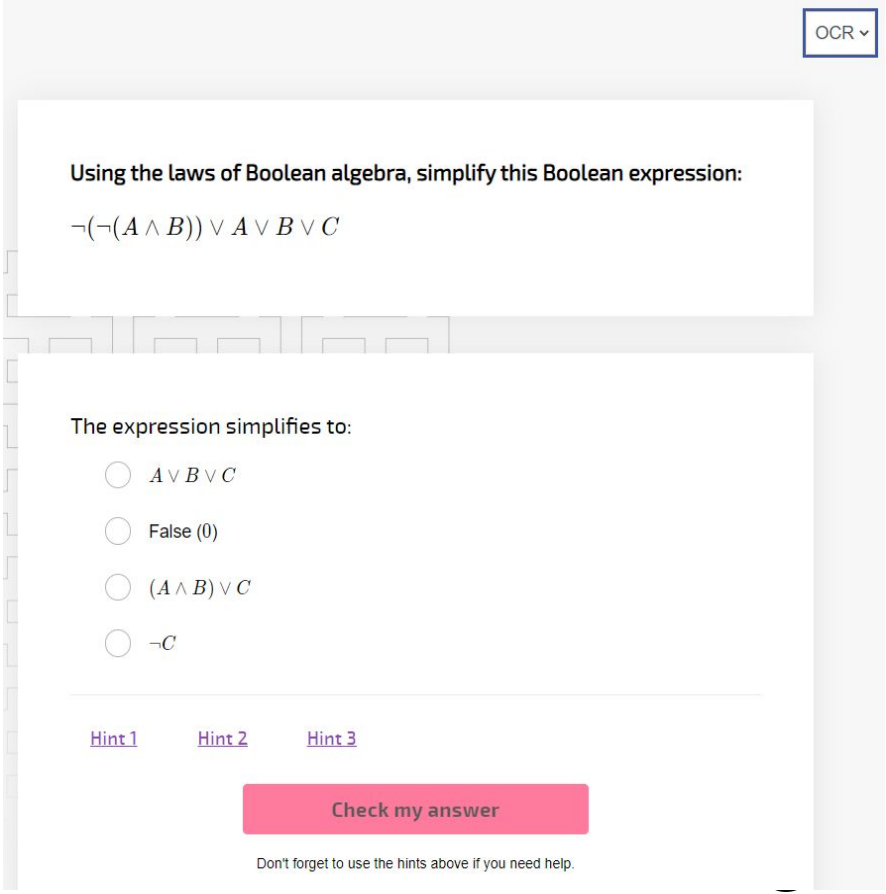
Main Features of Isaac CS

- Free
- For teachers and their students
- Builds on Isaac Physics
- Web-based
- Content filled - centrally created material
- Suggested teaching order but teachers are expected to integrate into blended teaching and learning
- Full CS A-level (16-18 upper secondary) curriculum
- Awarding board specific display of content and questions
- Question design features
    - Multiple tries
    - Hints
    - Tailored feedback (including explanation videos)
- Question types for CS
    - Parsons problems
    - Boolean algebra editor
    - Text matching
    - Multiple choice questions (MCQ)
- Teacher professional development and student events



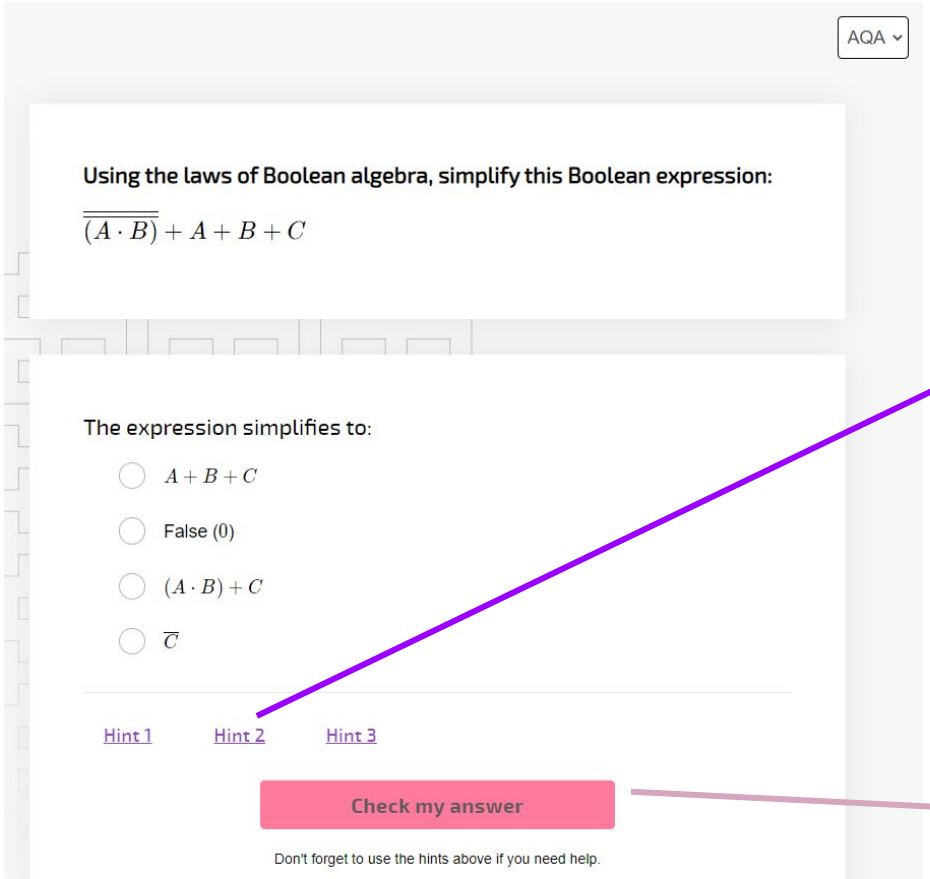
Awarding Body Specific

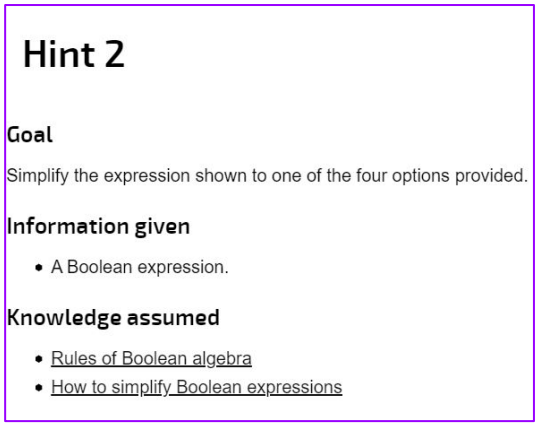




https://isaaccomputerscience.org/questions/sys_bool_07

Hints, Tailored Feedback





https://isaaccomputerscience.org/questions/sys_bool_07

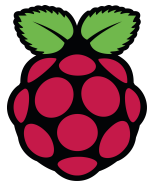
Testing and Evaluation

Functionality testing
- Prototyping
- Automated tests
- Regression testing

Pedagogy testing
- Hard to test
- Answer reviews

Content testing
- New content quality assurance process
  - Internal and external reviews
  - Pilot with teachers
- Annual review
- User issues are ticketed and resolved

Platform evaluation
- Advisory group
- Teacher and student surveys
- Platform usage

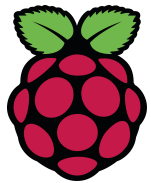


Platform Pedagogy Matrix

Functionality		Pedagogy: Instructional Approaches (Anderson & Dron, 2011) – Cognitive Behaviourism	Constructivism		Constructivism (socio constructivism)	*Assessment* – *Student*	*Assessment* – *Teacher*
		Learning types (Laurillard, 2012) – Acquisition	Practice	Investigation, Production	Discussion, Collaboration		
Functionality of online CS resources (Rossling et al. 2008)	**General Pedagogy tool**	Accessing content pages e.g. text & video material				Progress page Summary of questions attempts	Markbook page Summary of student data
	Augmented (including Computer Aided Assessment (Carter, 2003))	Student's Awarding Body specific content displayed	Questions with common answer types • multiple-tries • episode-related hints • tailored feedback			Questions • auto marked • tailored feedback	
	Computer Science Learning Management Specific	Boolean Algebra notation	Questions with CS specific answer types • parsons problems • Boolean • text-matching				
Functionality of offline resources			Answer workbook questions – a subset of online questions			Self assess	Marks workbook

Lessons learned

1. Not all functionality is easy to apply or the same cost: questions involving natural language processing are difficult to set up and explanation videos are expensive to create and replace.
2. Student practice through answering questions can be augmented by multiple tries, self-selected hints and tailored feedback
3. To ensure that teachers and students use an online platform, careful and sustained effort is needed through marketing, teacher professional development, student events etc.
4. What upper secondary CS content looks like is not yet agreed but teachers are looking for content that fits their requirements.



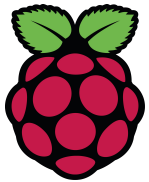
Next steps

Pedagogy matrix
- Theoretical foundation
- Produce examples
- Compare tools and patterns of pedagogy

Question types
- Student preference
- Multiple try rate and usefulness
- Desirable difficulty

Teachers and Isaac CS
- Impact on
  - Subject knowledge
  - Knowledge of alternate conceptions
  - Self-efficacy
  - Community of practice
- Use in class
  - Blending with other tools
  - Unplugged activities
  - Learning types (collaboration, production, discussion, investigation)
  - 1:1 groups, differentiation etc

Students and Isaac CS
- Impact on
  - Subject knowledge
  - Knowledge of alternate conceptions
  - Self-efficacy
  - Community of practice



Questions and Answers

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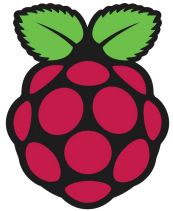

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Next slides are for Q&A

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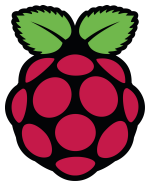

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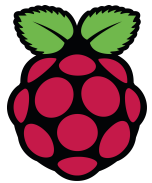


For Q&A

Awarding Body Specific Content and Activities

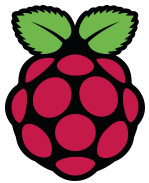
A digital circuit can include many types of logic gate. However, these gates combine the fundamental functions of Boolean logic: AND, OR, and NOT. This means that when you are asked to use Boolean algebra, you need only consider the operators $\wedge$, $\vee$, and $\neg$.

OCR

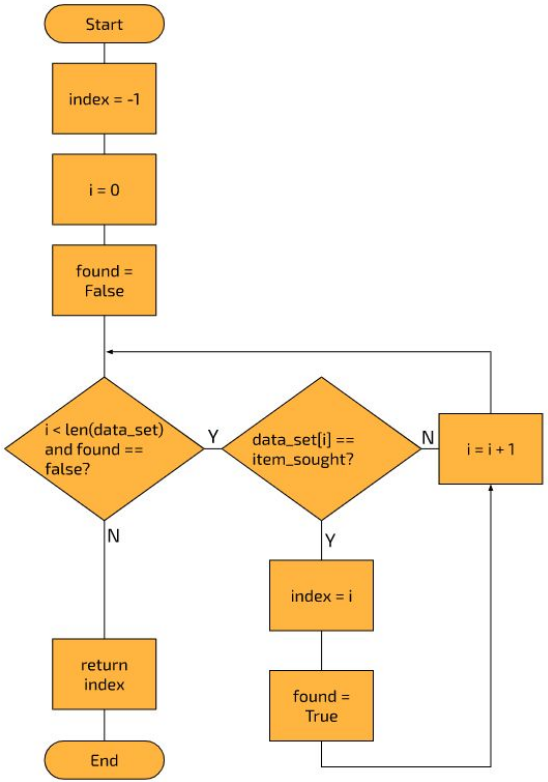
A digital circuit can include many types of logic gate. However, these gates combine the fundamental functions of Boolean logic: AND, OR, and NOT. This means that when you are asked to use Boolean algebra, you need only consider the operators $\cdot$, $+$, and .

AQA

https://isaaccomputerscience.org/concepts/sys_bool_boolean_algebra



Parsons problems



Available items

```
FUNCTION linear_search(data_set, item_sought)
index = i
RETURN index
ENDIF
i = 0
index = -1
ENDFUNCTION
found = False
i = i + 1
IF data_set[i] == item_sought THEN
```

Your answer

Drag items across to build your answer

https://isaaccomputerscience.org/questions/prog_pas_06_v2

Text matching

Laura has planned to go hiking in Snowdonia. She wants to take photos and videos of her trip with her digital camera and then show them to her friends, but her camera is running out of space.

Which **type of storage** is the most suitable in this case?

Type your answer here.

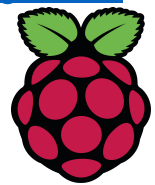
Hint 1 Hint 2

Check my answer

Don't forget to use the hints above if you need help.

https://docs.moodle.org/dev/The_OU_PMatch_algorithm

https://isaaccomputerscience.org/questions/gcse_sys_04



For Q&A

Wrap Around Support

Teacher CPD

Algorithm Complexity and Computational Thinking

When:
Tue, 31 Aug 2021
10:00 — 17:00

Location: Online

View details

Teacher CPD

Assembly Language

When:
Thu, 23 Sept 2021
14:00 — 17:00

Location: Online

View details

Student Booster

Functional Programming with Haskell

When:
Wed, 22 Sept 2021
15:45 — 17:15

Location: Online

View details

Student Booster

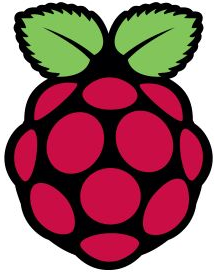
Boolean Algebra

When:
Tue, 28 Sept 2021
15:30 — 17:00

Location: Online

View details

https://isaaccomputerscience.org/



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