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A LEVEL

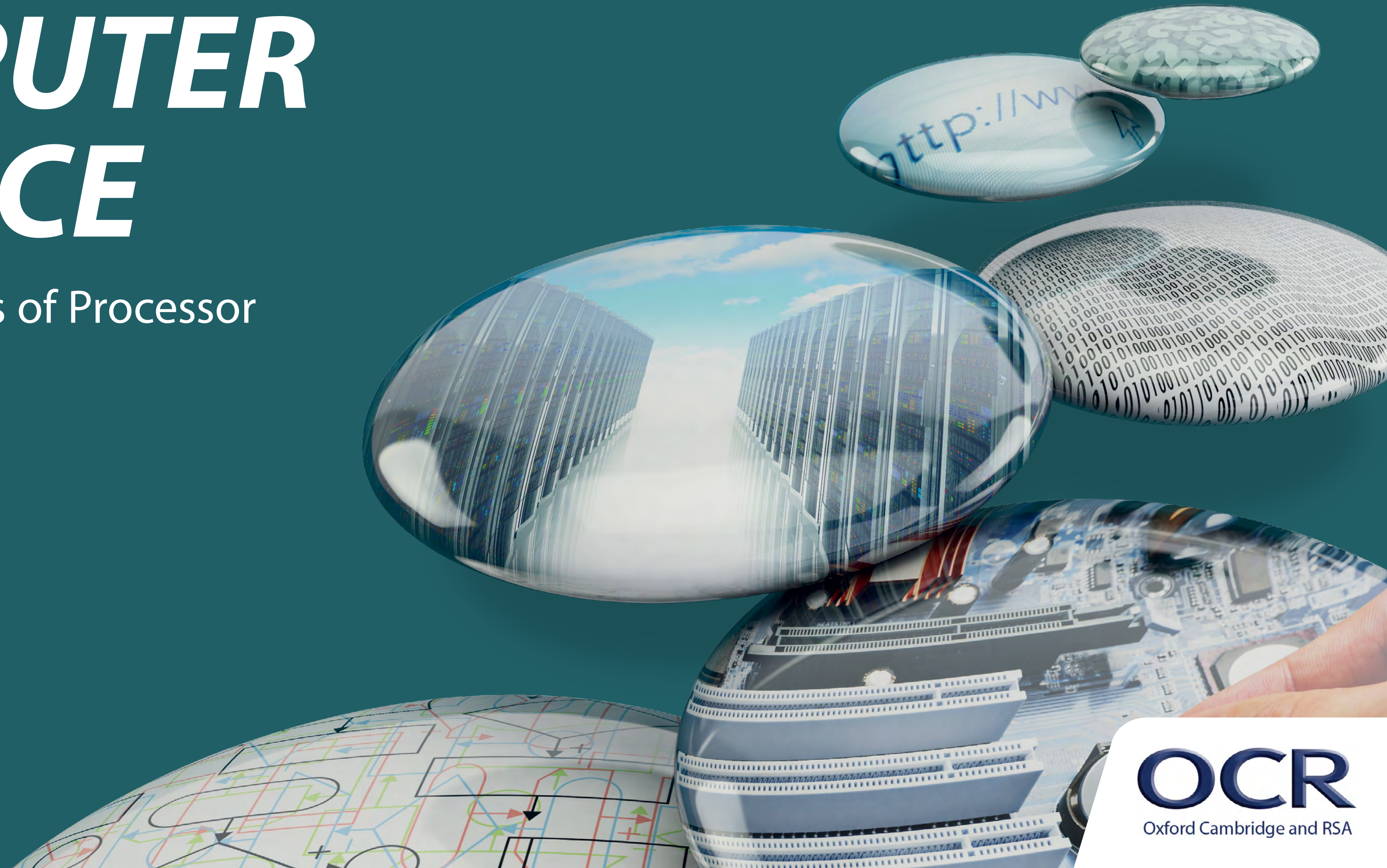
Delivery Guide

H446

COMPUTER SCIENCE

Theme: 1.1.2 Types of Processor

June 2015



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CONTENTS

Introduction

Delivery guides are designed to represent a body of knowledge about teaching a particular topic and contain:

- Content: a clear outline of the content covered by the delivery guide;
- Thinking Conceptually: expert guidance on the key concepts involved, common difficulties students may have, approaches to teaching that can help students understand these concepts and how this topic links conceptually to other areas of the subject;
- Thinking Contextually: a range of suggested teaching activities using a variety of themes so that different activities can be selected that best suit particular classes, learning styles or teaching approaches.

If you have any feedback on this Delivery Guide or suggestions for other resources you would like OCR to develop, please email resources.feedback@ocr.org.uk.

KEY

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Click here	Click to view external resources
AS Level only	AS Level content only

Curriculum Content

a) The differences between and uses of CISC and RISC processors.

b) GPUs and their uses (including those not related to graphics).

c) Multicore and parallel systems.

Thinking Conceptually

RISC/CISC	Resources
This topic introduces students to two standard CPU designs, RISC and CISC. Since we program in high level languages and the CPU functions in machine code, a compiler is required to convert the code into assembly language. This is then assembled into machine code. Students could start off by defining the keywords and then listing and categorising programming languages in high/low level languages. A list can be found here: http://www.tecoed.co.uk/learn-to-code.html To learn about the function of the processor, this website gives a detailed overview and examples of how the two processors operate. http://www.engineersgarage.com/articles/risc-and-cisc-architecture?page=5 If the school has access to Raspberry Pi, students could install and use the RISC-based operation system available at: https://www.riscosopen.org/content/sales/risc-os-pi Once students have learnt the differences between RISC and CISC processors they could test their understanding by comparing a number of products that contain CPUs, from a range such as mobile phone, tablet, dishwasher, laptop, and notebook. They could consider whether a RISC/CISC is used and justify why.	Click here Click here Click here

GPUs	Resources
A common misconception that students will have about GPUs (Graphics Processing Units, commonly referred to as graphics cards) is that they are used to process graphics in computer games. They may well be aware of the specifications required for particular games and quality levels which determine a graphics card requirement. However GPUs are processors which can be used for a range of tasks other than processing computer game graphics. GPUs are used to display high quality video content such as HDMI or Blu-Ray on a screen. Video editing also requires many calculations, especially where edits or effects have been made. The decoding and encoding of videos is also carried out by the GPU. More recently, bitcoin mining has used GPU; a video here explains what bitcoin is: https://www.youtube.com/watch?v=Um63OQz3bjo These sites explain how to utilise the processing power of your GPU as a bitcoin miner: http://www.coindesk.com/information/how-to-set-up-a-miner/ http://guiminer.org/ Market-leading graphics card manufacturers are now using the GPU alongside the CPU to create 'parallel computing'. Check out NVIDIAS CUDA. http://blogs.nvidia.com/blog/2012/09/10/what-is-cuda-2/ https://developer.nvidia.com/how-to-cuda-python	Click here Click here Click here Click here Click here

Thinking Conceptually

Parallel computing	Resources
As software becomes more complex and demanding it increases the number of instructions required for processing, and this takes time. Completing two or more tasks at the same time or sharing the processing between processors can reduce the overall time of completion and performance. Students could consider how long it would take to paint the classroom, individually and as a group. What other tasks are there?	
Multicore processors and parallel computing enables several processors to share the same task or carry out several tasks simultaneously such as conduct a virus scan and edit a graphic. https://computing.llnl.gov/tutorials/parallel_comp/#Whatis	Click here
This video gives a detailed overview of a Hybrid CPU/GPU parallel processor, making reference back to the role of the GPU in processing tasks. https://www.youtube.com/watch?v=Xliq7LUX7uo	Click here
The video shows how new processor developments combine the GPU/CPU processing power, utilising each processor for the most appropriate task and thus optimising the overall performance.	

<table>
<tr><th>Activities</th><th></th></tr>
<tr><td>Activity 1
Students are given a random selection of statement cards from Learner Resource 1 and they are required to sort them into the CISC and RISC groups. This could be done individually or the students could each be given a statement and then arrange themselves into two groups.
Students should justify their choice for example, “I think this is RISC because RISC uses….. and the statement states that …..”</td><td>Learner Resource 1</td></tr>
</table>

Activities

Activity 2

Part 1: Serial processing

1) This activity shows the difference between serial and parallel processing of instructions.
2) Select one student – for larger classes create groups of five and then select one student from each group.
3) The selected student is given a piece of paper and a pen and has to write down a sentence or a statement: this could be a song lyric, quote or saying. Letting students choose usually motivates them.
4) Time how long it takes them to write down the same statement 12 times, record these times on the board.
    - Students should discuss the issues with this method, advantages/disadvantages, suitability.

Part 2: Parallel but with issues?

1) All the students in the group are given a piece of paper.
2) As a group they are required to write down a statement collectively 12 times.
3) Give the groups a new statement and time how long it takes to write it down 12 times as a group.
4) Students should discuss the issues with this method, advantages and disadvantages, suitability. Did it work, who wrote what and why?
5) Highlight that with the group task or multiprocessor you require an organiser, a processor that is responsible for organising/deciding who does what.

Part 3: Parallel processing

1) One of the students is the organiser CPU, who will tell the other students what to do.
2) As a group they are required to write down a statement collectively 12 times.
3) Give the groups a new statement and time how long it takes to write it down 12 times as a group.
4) Again, students should discuss the issues with this method, advantages and disadvantages, suitability. Did it work, who wrote what and why?

Thinking Contextually

Activities
Activity 3
Research task
• Compare and contrast two GPU specifications; these can be obtained from a reseller or a manufacturer's website.
• Students should analysis the suitability of the GPU for a range of tasks other than playing video games.
• This could include: video editing and rendering, bitcoin mining, data visualisation.
• Explain how the GPU is used.
• Identify the benefits.
• Evaluate the impact on the overall performance of the computer system.

Learner Resource 1 Activity 1 cards

See page 8

Less work for the compiler to do
Every operation takes place in one clock cycle
Longer code requiring more RAM
Further away from high level languages
More complex hardware
Compiler has to do more work
Reduced Instruction Set Computer
Some instructions take multiple clock cycles to complete
Closer to High Level Language
Smaller code requiring less RAM
Complex Instruction Set Computer
Simple hardware

Teacher Answers Activity 1

See page 8

RISC

- Reduced Instruction Set Computer
- Simple hardware
- Further away from high level languages
- Longer code requiring more RAM
- Compiler has to do more work
- Every operation takes place in one clock cycle

CISC

- Complex Instruction Set Computer
- More complex hardware
- Closer to High Level Language
- Less work for the compiler to do
- Smaller code requiring less RAM
- Some instructions take multiple clock cycles to complete

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