OCR GCSE Computing Unit A451: Computer Systems and Programming

### Section 2.1.2: Computing Hardware

OCR recognises that the teaching of this qualification above will vary greatly from school to school and from teacher to teacher. With that in mind this lesson plan is offered as a possible approach but will be subject to modifications by the individual teacher.

Lesson length is assumed to be **one hour**.

### Learning Objectives for the Lesson

|  |  |
| --- | --- |
| Objective 1 | Understand the role of the processor in fetching and executing instructions |
| Objective 2 | Understand the concept of machine code and assembly language instructions |

### Recap of Previous Experience and Prior Knowledge

No prior knowledge expected, but it is useful for the pupils to already know what a CPU is.

### Content

|  |  |
| --- | --- |
| **Time** | **Content** |
| 15 minutes | Introduction & Presentation – Whole class   * Load Little Man Computer simulation. Show a CPU (pass it around) and explain that we will study what happens inside the CPU. We can’t see in it, so we have a simulation. * Run Little Man Computer simulation on projector with given example program and talk the pupils through the simulation. |
| 10 minutes | Individual work... students try to understand the example program.  Give out the cut out sheets and get them to run the program and order the descriptions of the instructions according to what they see. When they have finished, give them sheet 1 to record their findings. |
| 5 minutes | Plenary: Check completion and understanding, and consolidate by doing sheet 2 together as a class. |
| 5 minutes | Get students to write their own little man programs. Give them sheet 3 to work on. If they have finished, they should do the extension sheet.  They will also need the reference sheet to do the second exercise on sheet 3 or the extension.  Circulate to help and correct exercises as they work. |
| 5 minutes | Correct exercises and check understanding. Recap. |

The Little Man Computer – Cut out

Photocopy onto card

Cut this table out into one block

|  |  |
| --- | --- |
| Address | Instruction |
| 00 | INP |
| 01 | STA 99 |
| 02 | INP |
| 03 | ADD 99 |
| 04 | OUT |
| 05 | HLT |

Cut the instructions out into individual strips

|  |
| --- |
| Input a number and put it in the calculator |
| Store the number in the calculator in memory slot 99 |
| Input a number and put it in the calculator |
| Add the number in memory slot 99 to the number in the calculator |
| Output the number which is now in the calculator |
| Halt |

Pupils should match the explanation with the instruction. And use this to fill in Sheet 1.

The Little Man Computer – Sheet 1

#### Programming the Little Man Computer

#### 1 The example program

When you load the LMC there is already a program in the computer. The program is written out in the table below in machine code. By executing the program and using the list of instructions, work out what the program does.

|  |  |  |
| --- | --- | --- |
| **Address** | **Instruction** | **What it does:** |
| 00 | 901 |  |
| 01 | 399 |  |
| 02 | 901 |  |
| 03 | 199 |  |
| 04 | 902 |  |
| 05 | 000 |  |

The Little Man Computer – Reference

The little man’s instruction set: These are all the instructions the little man can execute.

|  |  |  |
| --- | --- | --- |
| Instruction | Mnemonic | MachineCode |
| Load | LDA | 5xx |
| Store | STA | 3xx |
| Add | ADD | 1xx |
| Subtract | SUB | 2xx |
| Input | INP | 901 |
| Output | OUT | 902 |
| End | HLT | 000 |
| Branch if zero | BRZ | 7xx |
| Branch if zero or positive | BRP | 8xx |
| Branch always | BRA | 6xx |
| Data storage | DAT |  |

xx refers to a Mailbox number (Memory Address)

The Little Man Computer – Extension

#### 1 Add 3 numbers

Write a program to add 3 numbers

Note down any initial data:

|  |  |  |
| --- | --- | --- |
| Address | Value | Comment |
|  |  |  |
|  |  |  |
|  |  |  |

And also the program

|  |  |  |
| --- | --- | --- |
| Address | Instruction | What it does |
| 00 |  |  |
| 01 |  |  |
| 02 |  |  |
| 03 |  |  |
| 04 |  |  |
| 05 |  |  |
| 06 |  |  |
| 07 |  |  |
| 08 |  |  |
| 09 |  |  |
| 10 |  |  |

#### 2 Addition & Subtraction

Write a program that correctly calculates   
x + y + z – a – b (Ex. 1 + 2 + 3 – 4 – 5 = -3)

Data:

|  |  |  |
| --- | --- | --- |
| Address | Value | Comment |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Program:

|  |  |  |
| --- | --- | --- |
| Address | Instruction | What it does |
| 00 |  |  |
| 01 |  |  |
| 02 |  |  |
| 03 |  |  |
| 04 |  |  |
| 05 |  |  |
| 06 |  |  |
| 07 |  |  |
| 08 |  |  |
| 09 |  |  |
| 10 |  |  |