National University of Singapore
Dept of Electrical & Computer Engineering (ECE)

CG2028 Computer Organization

Tutorial 1: Microprocessor Concepts

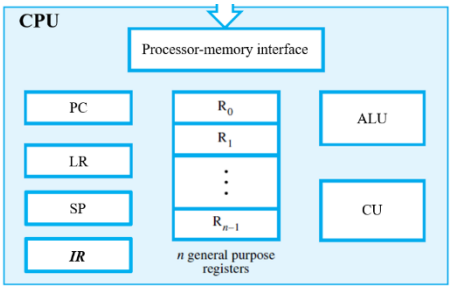
Note: "Add", "Load" and "Store" used in this tutorial are **generic** assembly language instructions.

1. Given a binary pattern in some memory location, is it possible to tell whether this pattern represents a *machine instruction* or a *number*?

2. List the *steps needed* to execute the machine instruction

Add R4, R2, R3

in terms of simple control commands and the information (i.e. instruction or data) transfers between the processor components and memory discussed in Lecture 1, as shown on the right. Assume that the address of the memory location containing this instruction is initially in register PC.



3. A program to add a number stored at location A to another number stored at location B on a RISC computer is given by:

```
Load   R2, A
Load   R3, B
Add    R4, R2, R3
```

Explain why the program cannot simply be written as:

Add R4, A, B

4. A program comprising several instructions is stored in the main memory at the locations shown below. In order to repeat the execution of the sequence of instructions (found in locations 0x00000100 to 0x0000010C) when a certain condition is satisfied, a conditional branch instruction (at 0x00000110) is used in the program.

What is the effect of the conditional branch instruction on the *content of the Program Counter (PC) register* in the processor when the condition is satisfied (i.e. the whole sequence of 4 instructions is to be repeated)?

Main Memory	
0x00000100	Load R2, A
0x00000104	Load R3, B
0x00000108	Add R4, R2, R3
0x0000010C	Store R4, C
0x00000110	Conditional branch
0x00000114	:

5. Regarding the *program counter (PC)*,

- The flow of an ARM assembly program can be altered by changing the content of the PC.
  [True / False]

- By default, the PC is incremented by 4 because the next instruction word is 4 bits away in Cortex-M4.
  [True / False]

END