Institue de Mathématique et
Informatique
Licence Math L1
Module : Electronique, composants des systèmes

TD 3

Chapter 4. Microprocessor

Exercice 1: Microprocessor tasks

After pressing Enter, BIOS loads operating system and a program into RAM in which instructions are arranged at increasing addresses in memory. Data provided by input devices passes through chipset (from southbridge to northbridge) and are loaded in RAM too. Reorder the following sentences to describe how a microprocessor work.

1. Accumulator (working register) stores an operand in the beginning of an arithmetic operation
2. or it stores the result at the end of the operation (arithmetic or logical)
3. The CU places this first instruction address value on address bus in order to read correspondent instruction in RAM.
4. After a time access to RAM, the convenient instruction is available on data bus.
5. If the instruction requires operand, the control unit calls it from RAM.
6. Thus, the operand comes through data bus and stored in buffer register
7. Instruction register (IR) stores instruction currently being processed
8. The CU sends a signal to ALU to request execution of the instruction and the stage register is updated with flags (status indicators).
9. Logic control block or sequencer, depending on clock signal, it produces internal and external synchronization signals (through Command bus)
10. Program Counter (PC) (register) is initialized with the first instruction address of program.
11. Instruction decoder decodes instruction using internal commands
12. The CU memorizes next instruction address in Program Counter (PC)

Exercice 02: Microprocessor performance

A microprocessor has a clock frequency $f = 1.8\ GHz$ and it executes a program contained five (5) types of instructions:

Instruction Type (i)	**Number of Executed Instruction type i** C_i	**Number of Cycle Per Instruction type i** CPI_i
Entire operation	150000	1
Memory transfert	45000	2
Floating operation	55000	2
Control	2000	2
Display	500	15

2.1. How many cycles will this program take to execute ?
2.2. How long will it take to complete execution ?

2.3. Calculate CPI (Cycle Per Instruction) of this program, defined as the ratio between the number of cycles required for its execution and the number of instructions.

Exercice 03: Clock frequency and performances

A program runs in 10 seconds on machine A, which has frecquency $f_A = 100\,MHz$. We are trying to build a machine B, which will run this program in 6 seconds. Assuming that an increasing of clock frequency is possible, but this increase requires machine B to use 1.2 times more clock cycles than machine A for this program. What clock frequency f_B we have to give to machine B?

Exercice 04: Performances comparaison

The table 1 shows CPI_i for three types of instruction A, B and C.

Instruction type	CPI_i
A	1
B	2
C	3

Table 1

In addition, we have tow code sequences as it is shown in table 2 below.

	Number of instruction by type instruction i		
Code sequence	A	B	C
1	2	1	1
2	4	1	1

Table 2

4.1. Which code sequence executes more instructions?
4.2. What is the fastest?
4.3. Can we predict the larger CPI. Give CPI for each code sequence to verify your answer.

Exercice 05: Buffer memoty importance

A microprocessor executes a program composed of N instructions. Each instruction requires on average 8 cycles to execute. In addition, each instruction makes on average 3 memory accesses. We have two possibles cases:
1. In the first case, the buffer memory is used, so, there is no waiting for information reading. How many correspondent cycles does this program need to run?

2. In the second case, the buffer memory is not efficient, so, all instructions and data are read from RAM. Knowing that it is required 6 cycles for each access memory, how many cycles does this program need to be executed?