

4.1 Components of the Von Neumann Model:

- (a) Memory: Storage of information (data/program)
- (b) Processing Unit: Computation/Processing of Information
- (c) Input: Means of getting information into the computer. e.g. keyboard, mouse
- (d) Output: Means of getting information out of the computer. e.g. printer, monitor
- (e) Control Unit: Makes sure that all the other parts perform their tasks correctly and at the correct time.

4.2 The communication between memory and processing unit consists of two registers: Memory Address Register (MAR) and Memory Data Register (MDR).

_ To read, the address of the location is put in MAR and the memory is enabled for a read.

The value is put in MDR by the memory.

_ To write, the address of the location is put MAR, the data is put in MDR and the Write Enable signal is asserted. The value in MDR is written to the location specified.

4.5 (a) Location 3 contains 0000 0000 0000 0000

Location 6 contains 1111 1110 1101 0011

(b) i. Two's Complement -

Location 0: 0001 1110 0100 0011 = 7747

Location 1: 1111 0000 0010 0101 = -4059

ii. ASCII - Location 4: 0000 0000 0110 0101 = 101 = 'e'

iii. Floating Point -

Locations 6 and 7: 0000 0110 1101 1001 1111 1110 1101 0011

Number represented is $1.10110011111111011010011 \times 2^{-114}$

iv. Unsigned -

Location 0: 0001 1110 0100 0011 = 7747

Location 1: 1111 0000 0010 0101 = 61477

(c) Instruction - Location 0: 0001 1110 0100 0011 = Add R7 R1 R3

(d) Memory Address - Location 5: 0000 0000 0000 0110 Refers to location 6. Value stored in location 6 is 1111 1110 1101 0011

4.6 The two components of an instruction are:

Opcode: Identifies what the instruction does.

Operands: Specifies the values on which the instruction operates.

4.8 a) 8-bits

b) 7-bits

c) Maximum number of unused bits = 3-bits

4.9 The second important operation performed during the FETCH phase is the loading of the address of the next instruction into the program counter.

4.11 The phases of the instruction cycle are:

- (a) Fetch: Get instruction from memory. Load address of next instruction in the Program Counter.
- (b) Decode: Find out what the instruction does.
- (c) Evaluate Address: Calculate address of the memory location that is needed to process the instruction.
- (d) Fetch Operands: Get the source operands (either from memory or register file).
- (e) Execute: Perform the execution of the instruction.
- (f) Store Result: Store the result of the execution to the specified destination.