FIT1047 Applied Session Week 1 Solution

NUMBER SYSTEMS AND CONVERSIONS

OBJECTIVES

- The purpose of this applied session is to get to know each other, to know our expectations from this subject and to practice conversions between different number systems.

INSTRUCTIONS

- Work in small groups for activities 4 and 5.

Activity 1: Introduction

Introduce yourself to the group. Tell the others a bit about your prior knowledge in this subject area, like:

- what kinds of computers you have worked with,
- whether you've ever looked inside a computer,
- any programming knowledge,
- whether you have done binary numbers in High School, etc.

Activity 2: Expectations from FIT1047

What are your expectations from this subject?

Explain the different topics covered: Computer Systems, Operating Systems, Networks & Security. Can you see how those topics are related to each other?

What challenges do you expect? Your TA will also share their expectations of challenges in this unit.

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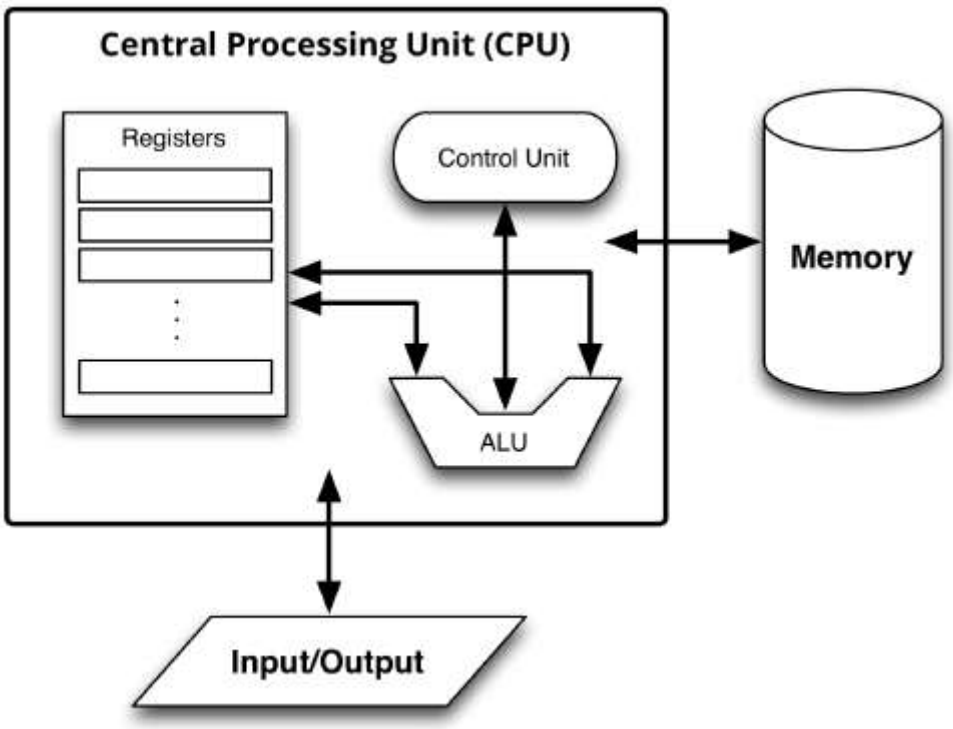
Activity 3: Explore a Computer System

Find some images online of

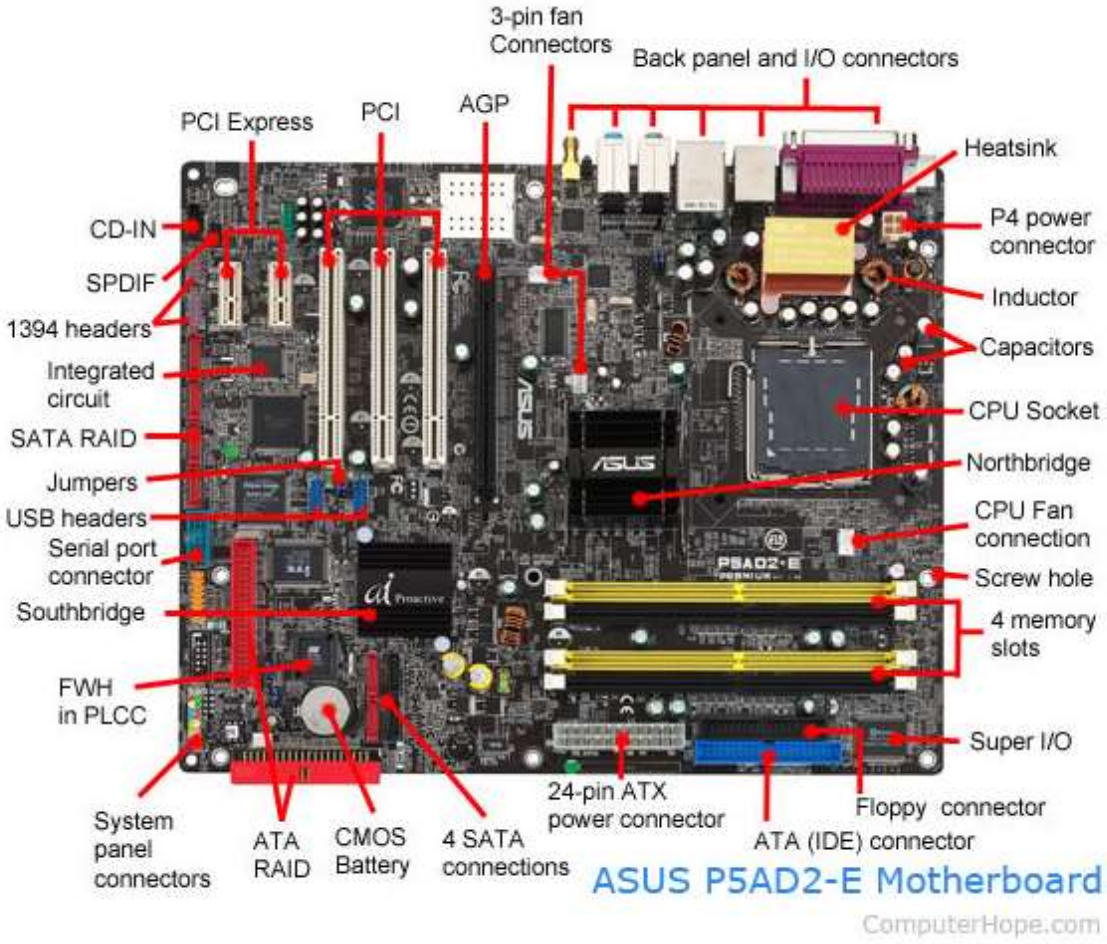
- a computer motherboard and identify all the locations for different important components like CPU, Memory, I/O devices;
- an integrated circuit and discuss the purpose of the pins on its outside;
- a memory chip and discuss what kind of data it stores.

Sample Solution:

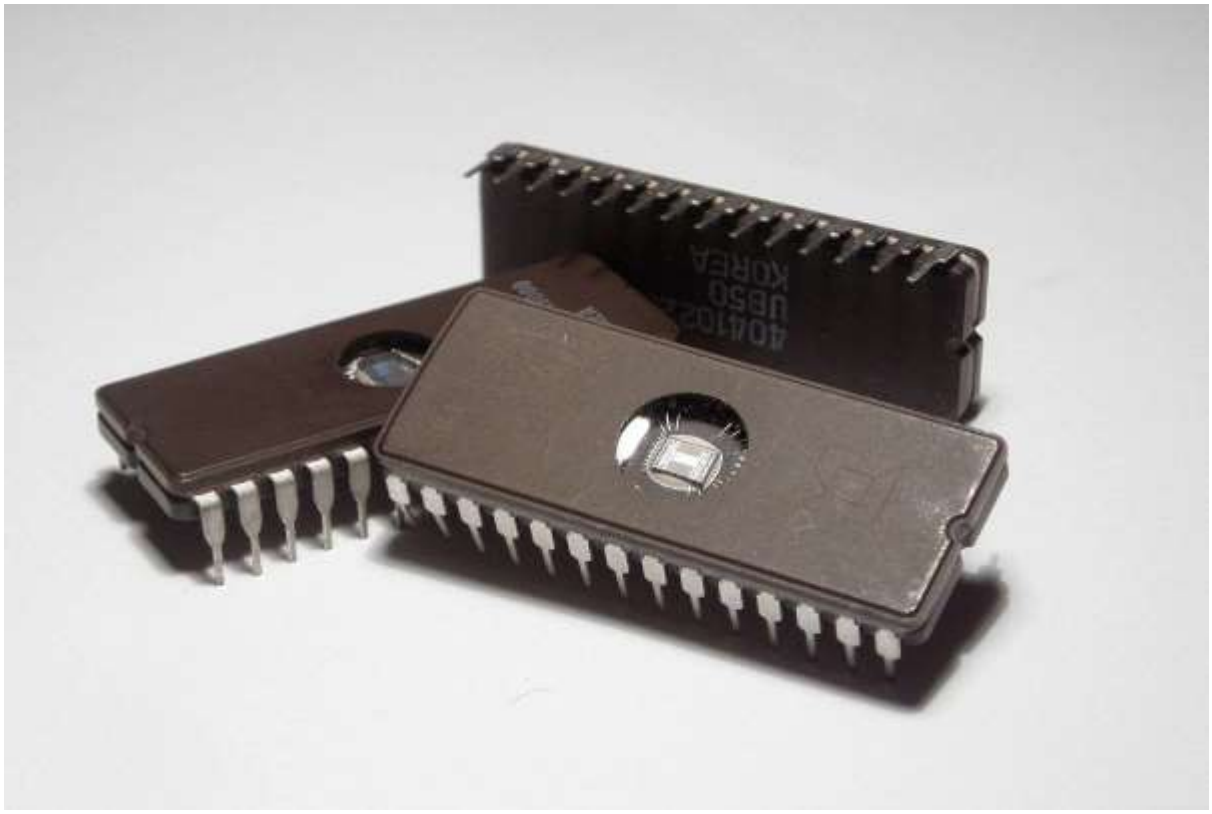


[Image: https://en.wikipedia.org/wiki/John_von_Neumann.]

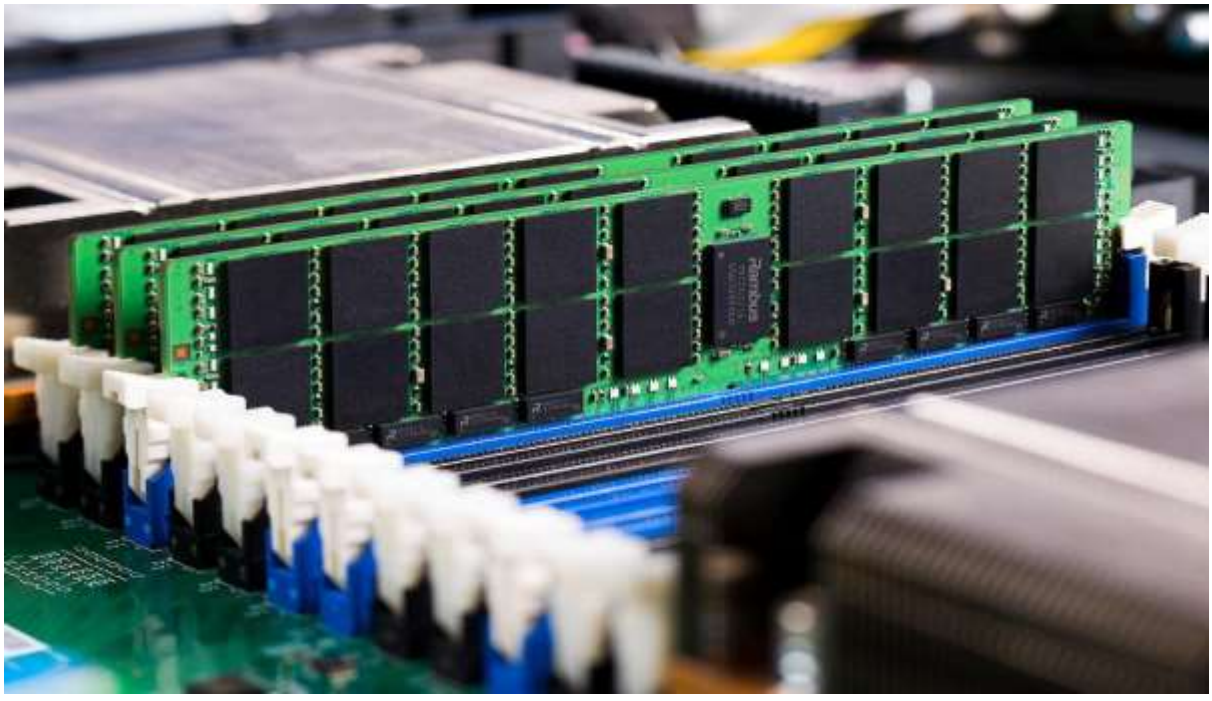
The Von Neumann architecture consists of a Central Processing Unit (CPU), the memory, and the input/output devices. Identify and discuss about some common parts of a usual PC or laptop that might relate to the von Neumann Model.



A computer motherboard [Image source: https://www.computerhope.com/issues/ch000504.htm]



An Integrated Circuit (IC) chip



VLSI or IC chips in memory cards.

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Activity 4: Bits, Bytes and Numbers

Task 4.1: Bit, Byte and Word
Construct a bit, a byte, and a word.

Sample Solution:

(i) A bit -> ‘0’ or ‘1’
(ii) Bytes and words are fundamental data types in computer architecture. A byte consists of 8 bits.

1	0	1	0	1	1	0	0

A Word consists of 8 Bits or 16 bits or 32 bits or 64 bits.

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Task 4.2: Build a Table of Number Systems

Build a table of Number Systems consisting of- Base 10, Base 8, Base 16 & Base 2 numbers. This table will contain 16 numbers only (decimal numbers 0-15). Represent Base-2 numbers using 4 bits.

Use appropriate notations to differentiate between different number systems:

(a) subscripts "10" for Decimal Numbers- 45_{10},
(b) subscripts "8" for Octal Numbers- 45_{8},
(c) subscripts "16" for Hexadecimal Numbers- 45_{16},
(d) subscripts "2" for Binary Numbers- 1010_{2}.

Sample Solution:

	Hexadecimal NS	Decimal NS	Octal NS	Binary NS
	[0 - 9, A - F]	[0-9]	[0-7]	[0-1]
	0_{16}	0_{10}	0_{8}	0000_{2}
	1_{16}	1_{10}	1_{8}	0001_{2}
	2_{16}	2_{10}	2_{8}	0010_{2}
	3_{16}	3_{10}	3_{8}	0011_{2}
	4_{16}	4_{10}	4_{8}	0100_{2}
	5_{16}	5_{10}	5_{8}	0101_{2}
	6_{16}	6_{10}	6_{8}	0110_{2}
	7_{16}	7_{10}	7_{8}	0111_{2}
	8_{16}	8_{10}	10_{8}	1000_{2}
	9_{16}	9_{10}	11_{8}	1001_{2}
	A_{16}	10_{10}	12_{8}	1010_{2}
	B_{16}	11_{10}	13_{8}	1011_{2}
	C_{16}	12_{10}	14_{8}	1100_{2}
	D_{16}	13_{10}	15_{8}	1101_{2}
	E_{16}	14_{10}	16_{8}	1110_{2}
	F_{16}	15_{10}	17_{8}	1111_{2}

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Activity 5: Number System Conversions

Task 5.1: Binary to Decimal and Decimal to Binary

(i) Convert the Decimal number **165_{10}** to a Binary number using Division & Remainder operations.

Sample Solution:

Base	Decimal	Remainder
2	165	
2	82	1
2	41	0
2	20	1
2	10	0
2	5	0
2	2	1
2	1	0
	0	1

$165_{10} = 10100101_2$

(ii) Convert the Binary number **11000101_2** to a Decimal number using step (or place) value and multiplication process.

Sample Solution:

		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
		128	64	32	16	8	4	2	1
		1	1	0	0	0	1	0	1

$= 1 \text{ X } 2^7 + 1 \text{ X } 2^6 + 0 \text{ X } 2^5 + 0 \text{ X } 2^4 + 0 \text{ X } 2^3 + 1 \text{ X } 2^2 + 0 \text{ X } 2^1 + 1 \text{ X } 2^0$

$= 128 + 64 + 0 + 0 + 0 + 4 + 2 + 1$

$= 197_{10}$

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Task 5.2: Binary to Hexadecimal and Hexadecimal to Binary

(i) Convert the Binary number **11101010_2** to a Hexadecimal number using the Number Systems table.

Sample Solution:

Arrange the binary number in groups of 4-bit (starting from the right). Convert each 4-bit binary number to its corresponding hexadecimal digit using the number system table that we have built before.

$1110\ 1010_2$ -> Hexadecimal Number

1110_2 -> E_{16}
1010_2 -> A_{16}

$1110\ 1010_2$ -> EA_{16}

(ii) Convert the Hexadecimal number **$FA01_{16}$** to a Binary number using the Number Systems table.

Sample Solution:

Convert each hexadecimal digit to its corresponding 4-bit binary number using the number system table.

$FA01_{16}$ -> Binary Number

F_{16} -> 1111_2
A_{16} -> 1010_2
0_{16} -> 0000_2
1_{16} -> 0001_2

$FA01_{16}$ -> $1111\ 1010\ 0000\ \ 0001_2$

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Task 5.3: Hexadecimal to Decimal and Decimal to Hexadecimal

(i) Convert the Hexadecimal number **$1AF_{16}$** to a decimal number using place value and multiplication operations.

Sample Solution:

							16^2	16^1	16^0
							256	16	1
							1	A	F
							1	10	15

$= 1 \text{ X } 16^2 + 10 \text{ X } 16^1 + 15 \text{ X } 16^0$

$= 256 + 160 + 15$

$= 431_{10}$

(ii) Convert the Decimal number **151_{10}** to a Hexadecimal number using division and remainder operations.

Sample Solution:

Base	Decimal	Remainder
16	151	
16	9	7
	0	9

$151_{10} = 97_{16}$