Tutorial 1: Introduction to Computer Systems

1. What are the **FOUR (4)** key components of a computer information system? How these components are connected to support computer operation? Give an example for each of them.

2. Differentiate between a volatile memory and a non-volatile memory.

3. Briefly discuss the interaction between the computer users and computer hardware.

4. Compare and contrast between an application software and a system software. Provide **THREE (3)** examples for each of them.

5. It is said that bus topology is the most reliable network topology that implemented in most of the computer network architecture. Do you agree? Justify your answer.

6. You are newly appointed as an IT specialist to brief the business stream students during a school visit. During the briefing, you describe the Information Processing Cycle (IPC) model. Support your answer with appropriate diagram and example.

7. Suppose you would like to implement a network system in your hostel with 8 hostel mates. Which type of network architecture is most appropriate? Justify you answer with the factors that would influence your decision.

Tutorial 2: Digital Logic and Numeric Data Representation

1. Perform the following conversions. You are required to show your working steps clearly.

   a.) Convert $3D7_{16}$ to binary, octal and decimal respectively

   b.) Convert 1100010100100001_2 to octal, decimal and hexadecimal respectively

   c.) Convert 7098_{10} to binary, octal and hexadecimal respectively

   d.) Convert 13612_8 to binary, decimal and hexadecimal respectively

   e.) Convert 210102_3 to decimal

2. Perform the following computations. You are required to show your working steps clearly.

   a.) $1011_2 + 1111_2$

   b.) $715_8 – 57_8$

   c.) C521H x 3DH

3. Given the following computation, perform the operation if it is logical. If it is illogical, state the reason.

   a.) $101101101_2 + 10011011_2 + 10010011_2$

   b.) $1FF9_{16} + AC_{16}$

   c.) $7702_8 – 577_8$

   d.) $2A6_{12} - 2A_{12}$

4. Perform the following computations. Show your working steps clearly.

   a) 1101_2 x 1011_2 x 11_2

   b) 3175_5 x 4_5

Tutorial 3: Floating Point Representation

1. Given the binary integer 11001100_2, convert it into the following data formats respectively

   a.) Signed decimal value

   b.) Unsigned decimal value

   c.) ASCII data format

2. Given **A = 36H**, **B = 9AH** and **C = BBH**, perform the unrelated operations respectively.

   a.) A • B

   b.) B + C'

   c.) A + B ⊕ C

   d.) (A • B)' + B ⊕ C

3. Perform the following operations.

   a.) Convert 25.625_{10} to base 16

   b.) Convert $BC.75_{16}$ into base 8

   c.) $73.25_8 + 77.77_8$

   d.) $25A_{12} - 3AB_{12}$

4. Assume numbers are represented in 8-bits two's complement representation. Show the calculation of the following and then verify your answer by showing the answer in signed decimal value.

   a.) $24_{10} - 15_{10}$

   b.) $70_{10} - 30_{10}$

      i. Perform the operation above.

      ii. Verify your answer by showing your answer in signed decimal value.

      iii. Comment on the validity of you answer.

      iv. Does overflow or/and carry occur? How do you detect whether overflow or/and carry occur?

5. Convert the following decimal numbers to the SEEMMMMM format by applying excess-40. Assume that "0" is used to represent positive sign and "5" is used to represent negative sign. The implied decimal point is at the beginning of the mantissa.

   a.) 0.0034057_{10}

b.) -1.4117_{10}

6. Given the following decimal numbers.

$$(+\ 1.7250_{10})$$
$$(-\ 0.22375_{10})$$

a.) Assuming that excess-50 floating point format is applied. A "9" is used to represent a negative sign while a "0" is used to represent a positive sign. Convert these two numbers into SEEMMMMM format.

b.) Find the difference of these two numbers. Present your answer in sign-magnitude notation.

c.) Multiply these two numbers. Present your answer in sign-magnitude notation.

7. The floating-point decimal numbers below are stored in the form of SEEMMMMM, where the exponent is stored in excess-35 with the implied decimal point at the beginning of the mantissa. A "2" in the sign position is to indicate a negative number and a "6" in the sign position is to indicate a positive number.

63334108
23610564

a.) Add these two numbers. Show the result in both SEEMMMMM notation and scientific notation.

b.) Multiply these two numbers. Show the result in SEEMMMMM notation and scientific notation.

8. Assuming that a base 2, 8-bit, excess-127 exponent is applied and the implied binary point is at the right of the first mantissa Convert the decimal number -20.0625_{10} into IEEE 754 single-precision floating-point format. You are required to show your steps clearly.

9. Given the binary floating-point number represented in in IEEE754 single precision notation as follows.

$$11000\ 00111001100000000000000000_2$$

Assuming that excess-127 is applied, convert the binary floating-point number into sign-magnitude notation. *(You are required to show your working steps clearly.)*

Tutorial 4: Addressing Data in Memory and Segments

1. In the context of computer architecture, how many bits can be stored in a paragraph?

2. Distinguish between a Random-Access Memory (RAM) and a register in term of their capacity, data storage and reference methods.

3. Given the following data items, draw a diagram of a block of consecutive memory with 8 bit for each memory location to indicate how the following data item could be stored in memory.

   a.) A 1-byte item named VAR1 containing "**A**"

   b.) A 2-byte item named VAR2 containing **2018**

   c.) A 4-byte item named VAR3 containing "**BACS**", **1024H**

   d.) A 8-byte item named VAR4 containing **983**

4. Given a diagram as shown below, calculate the absolute address for the next instruction to be executed. (You are required to show your working steps clearly.)

SI: $2AA5_{16}$	DS:2789_{16}
IP: 1705_{16}	CS:2788_{16}
SP: 2006_{16}	SS:2787_{16}

5. Given the absolute address at 25A34H and SP register containing the value of DAC4H, calculate the segment address for stack segment.

6. Differentiate between carry flag and overflow flag. Complete the following table.

Flag	Carry	Overflow
Definition		
Detect in signed or unsigned number?		
How to detect?		
Example		

7. Identify which register is used for the following purposes:

   a.) Used for error checking when there is a possibility that data might be altered or corrupted.

   b.) Used for determining the frequency of **LOOP** operations

   c.) Used to hold the address of current word being processed in the stack segment

   d.) Used as an index to extend addressing

8. Briefly explain each of the followings:

   a.) CS register

   b.) Code segment

   c.) Instruction pointer register

   Draw a diagram to illustrate their relationship.

9. Perform the following calculations and show your answers in hexadecimal format. Draw a diagram for each of them to indicate how the respective answer would store in the AX register and memory respectively. You are required to show your working steps clearly.

   a.) $73_8 + 25_8$

   b.) $1111_2 \times 111_2 \times 11_2$

Tutorial 5: Computer Architecture and Memory Management

1. Assuming that LMC model is applied. Suppose that the following instructions are found at the given location in memory:

   Program counter: 20
   Value in memory location 20: 560 (LOAD)
   Value in memory location 21: 161 (ADD)
   Value in memory location 22: 360 (STORE)
   :
   Value in memory location 60: 422
   Value in memory location 61: 008

   Show the changes of contents in IR, PC, MAR, MDR and A during the execution of Instruction 20, 21 and 22.

2. Examine and show the changes of contents in IR, PC, MAR, MDR and A during the execution of Instruction 76 and Instruction 77.

   Program counter: 75
   Value in memory location 75: 590 (LOAD)
   Value in memory location 76: 190 (MUL)
   Value in memory location 77: 391 (STORE)
   :
   Value in memory location 90: 23_{16}
   Value in memory location 91: 5_{16}

3. Briefly describe **THREE (3)** differences of point-to-point bus and multipoint bus. Complete the table below.

Bus architectures	Point to point bus	Multipoint bus
Connection between sender & receiver		
Types of buses		
Data sent		
Diagram		

4. Jason has a computer with 8GB of memory. One day while he is using his computer for his assignment, he found that a total of 5GB of the memory is cached as indicated in the Performance Tab of the Task Manager as shown in Figure 1 below.

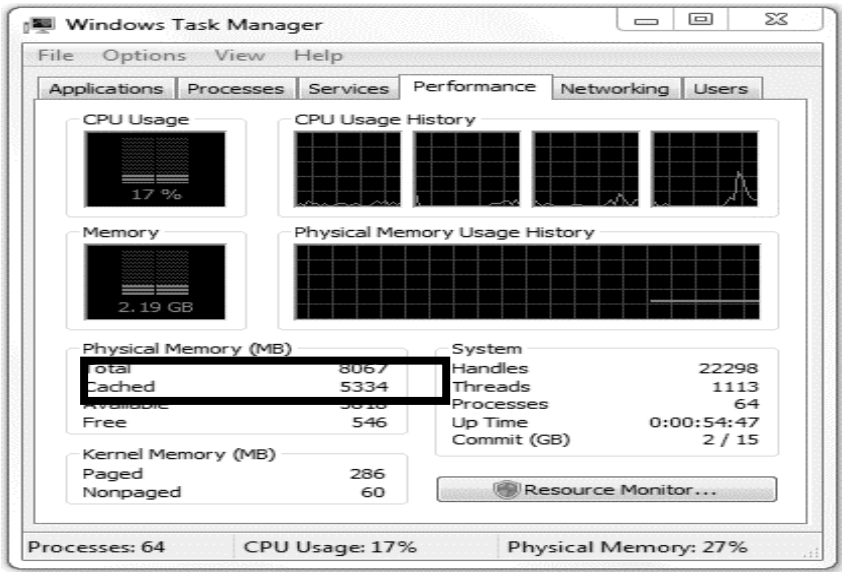

Figure 1

a.) What is cache memory?

b.) How does a cache memory work?

c.) What could be the impact after a cache miss occur?

5. How does memory interleaving works?

6. Draw a table to describe the **THREE (3)** key dynamic memory partition schemes.

7. Given that the memory is partition as P1 through P5 with the partition size of 370KB, 256KB, 120KB, 50KB and 400KB and the jobs labelled as J1 through J4 with job size of 75KB, 125KB, 398KB and 225KB respectively.

   a.) Show the jobs are allocated in memory partition when the following memory allocation algorithms is applied respectively.

      i) First fit algorithm

      ii) Best fit algorithm

      iii) Worst fit algorithm

   b.) Which memory allocation algorithm makes the best use of memory space? Justify your answer.

Tutorial 6: Assembly Language Fundamental – Part 1

1. Define the following numeric values in data item named val1 through val4.

   a.) A 1-byte item containing the hexadecimal equivalent to decimal 77

   b.) A 2-byte item containing the hexadecimal equivalent to decimal 65535

   c.) A 4-byte item containing the hexadecimal value of FFFFh

2. For each of the following statement, state whether or not the instruction is valid. If valid, state the result. If invalid, state the reason.

Data item	Valid / invalid?	Justification / Result
i) `ITEM1 DB "A", "B"`		
ii) `2ITEM DB 2AH`		
iii) `$ITEM DB "$"`		
iv) `NAME DB "TEST"`		
v) `INC DB "2015","$"`		

3. Use the following variable definitions for the remaining part of Q3.

```
.DATA
   ITEM1 DB  42H, 25, "A", "$"
   ITEM2 DB  2AH
   ITEM3 DD  CAH
   ITEM4 DB  2 DUP (3 DUP ("*"), 01H), "A"
```

   a.) Draw a diagram of a consecutive memory to depict how the above data items were stored in memory. Assuming that the starting offset address in the data segment is 0000H and an 8-bit size memory storage is used per memory location.

   b.) For each of the following statement, state whether or not the instruction is valid. If valid, state the result. It invalid, state the reason.

Instruction	Valid / invalid?	Justification / Result
i) `MOV AX, ITEM1`		
ii) `ADD ITEM2, ITEM1`		
iii) `SUB ITEM1, 5`		
iv) `XCHG ITEM3, 5`		
v) `INC ITEM3`		

4. Determine the value for overflow flag, sign flag, zero flag and carry flag after each f the following instruction has executed. Complete the table below for your answer.

Instruction	Working	OF	SF	ZF	CF
i) `MOV AX, 1095H`					
ii) `ADD AH, 2AH`					
iii) `SUB AL, 95H`					
iv) `MOV BL, 5`					
v) `MUL BL`					

Tutorial 7: Assembly Language Fundamental – Part 1I

1. Given the following program, identify **TEN (10)** errors and make the necessary correction. What is the output from the program?

```
1   .MODAL SMALL
2   .STACK 100
3   .DATA
4   .CODE
5   .MAIN PROC
6           MOV AX,@DATA
7           MOV DX,AX
8   ;-------------------------------------------------------------------
9   PRINT
10      MOV AH,02H
11      MOV AL,01H
12      INT 21
13    LOP PRINT
14
15    MOV AX,4Co0H
16    INT 21H
17
18  MAIN END
19  END MAIN
```

2. Given the following information.

```
.DATA
     ITEM1   DB   3,6,9,12,15,18,21
```

   a.) Write the instructions to add successively each byte defined in **`ITEM1`** to the **`AL`** register, using direct-offset addressing and **SIX (6) `ADD`** instructions.

   b.) Modify your code to use indirect-offset addressing using **`LOOP`** operator.

   c.) Output the result.

3. Given the sample output information

   Sample output:

```
Enter a character (in uppercase): A
The lowercase of the character is: a
```

   a) Write an assembly language program to convert the uppercase character to lowercase, by adding 20H to the user input.

   b) Modify the program, convert a lowercase letter to uppercase letter using XOR instruction.

4. Write an assembly language program to output all 256 **`ASCII`** characters from the **`ASCII`** table. (Hint: Use **`LOOP`** instruction.)

Tutorial 8: I/O Facilities

1. Differentiate between two key I/O handling techniques namely direct memory access and programmed I/O.

2. Considering the interrupt that occurs at the completion of video transfer from digital camera to memory.

   a.) "Who" is interrupting "whom"?

   b.) Why is the interrupt used in this case?

   c.) Describe the steps that take place after the interrupt occurs.

3. What is polling used for? What are the disadvantages of polling? What is a better way to perform the same job?

4. Explain why programmed I/O does not work very well when the I/O device is a hard disk or a graphics display?

5. A graphic card is an example of an I/O controller. I/O controllers have two interfaces. What are the TWO interfaces of a graphic card connected to? What is their core function respectively?

6. Given the following information, draw timeline to depict how CPU handle multiple interrupts.

Process	Arrival Time (ns)	CPU / Processing Time (ns)	Priority
Program A	0	5	4
Interrupt B	2	3	2
Interrupt C	3	2	1
Interrupt D	5	4	3

   Which process spent the longest waiting time? Comment on your answer.

7. The direct memory access would be useless if the computer did not have interrupt capability. Do you agree? Why or why not?

Tutorial 9: Operating Systems

1. Define operating system. Give **TWO (2)** examples of operating systems for desktop computer and **TWO (2)** examples of operating system for mobile devices.

2. List and explain **THREE (3)** key function of an operating system. Give example(s) to support your answer.

3. Based on the scenario given below, suggest the most appropriate type of operating system to support the operation respectively. Then justify each of your answer.

   a.) A clerk is assigned to print the bills and mail these bills to the customers on a monthly basis.

   b.) A multi-function laser printer which offers the features such as print, scan, fax, email, smart-card reader, connection to digital camera and so on.

   c.) Windows 8 that makes it possible to run the same application on both a low power tablet or kiosk and a high-end desktop or laptop.

   d.) Fuzzy logic system used by automatic rice cooker helps to ensure the rice is properly cooked with a variety of customized cooking options.

   e.) Information kiosk in shopping center that inform the visitors about interesting offers and allow the visitors to search for the shops by criteria such as shop name, shop category, floor plan for the shopping center with optimal guidance to the shops.

Tutorial 10: Processor Management

1. What are the major items found in a process control block?

2. During the process execution operation, the process changes state. The state of a process is defined by the current activity of that process. With the aid of a diagram, explain how a process may switch among the following different states.

3. How does context switch work? Give **TWO (2)** advantages and **TWO (2)** disadvantages of context switch.

4. List **THREE (3)** guidelines to good process scheduling policies.

5. In the context of processor management, differentiate between a preemptive policy and a non-preemptive scheduling policy.

6. Complete the table below.

Policy	Algorithm	Based on	Pros	Cons
Non-preemptive	Shortest Job First (SJN)		Job available at same time	Interactive system
Preemptive	Shortest remaining time (SRT)	Shortest remaining CPU cycle		Interactive system
	Round robin (RR)	Quantum	Equally share CPU	More overhead
Non-preemptive		Arrival time	Batch system	Interactive system
Non-preemptive	Priority scheduling (PS)	Priority	Preferential system	
Waiting Time =				
Turnaround time =				

7. Consider the following set of processes in Table 1.

Process	Arrival Time	CPU Cycle	Priority
A	0	3	5 (Lowest priority)
B	2	4	2
C	3	2	4
D	5	2	1 (Highest priority)
E	8	5	3

Table 1

You are required to draw a *timeline Gantt chart* for each of the following algorithms. Then, calculate the *Average Waiting Time* and *Average Turnaround Time* for each of the algorithms. (Ignore context switching time and natural wait). The given the CPU scheduling algorithms are:-

a.) First Come First Serve scheduling (FCFS)

b.) Shortest Job First (SJF)

c.) Priority Scheduling (PS)

d.) Shortest Remaining Time scheduling (SRT)

e.) Round Robin scheduling (RR) (Assuming the quantum given is 3 time slices.)

8. Consider the following set of processes in Table 2.

Process	Arrival Time	CPU Cycle	Priority assigned
A	8	7	3
B	7	4	5 (lowest priority)
C	5	5	1 (highest priority)
D	2	3	2
E	0	6	4

Table 2

Draw a *timeline Gantt chart*, calculate the *Average Waiting Time* and *Average Turnaround Time* for each of the following algorithms.

a.) First Come First Serve scheduling (FCFS)

b.) Shortest Job First (SJF)

c.) Priority Scheduling (PS)

d.) Shortest Remaining Time scheduling (SRT)

e.) Round Robin scheduling (RR) (Assuming the quantum given is 2 time slices.)

Tutorial 11: Virtual Memory

1. Explain demand paging memory allocation technique. List out advantage and disadvantage of this technique.

2. Given that the main memory is composed of **THREE (3)** empty page frames for public use and that a program requests pages in the following order:

   1, 7, 9, 7, 2, 7, 0, 7, 9, 2, 0, 1, 7, 0, 2, 9, 3, 1, 5, 1

3. Conduct a page trace analysis indicating page faults and then compute the numbers of page faults that will in each following algorithm:

   a.) FIFO algorithm

   b.) LRU algorithm

4. Suppose a page size of 500 bytes is used in a demand paging system. A particular process has FOUR (4) page frames allocated to it and they are initially empty. Given the following sequence of virtual addresses:

   105 580 2730 3401 1550 1800 385 12220 11700 1888 1750 1150 1112 123 1250 2760 990

   Conduct a page trace analysis indicating page faults and then compute the numbers of page faults using the following page replacement policies respectively.

   a.) FIFO algorithm

   b.) LRU algorithm

5. Virtual Memory is implemented through demand paging and segmentation schemes. Compared between virtual memory with paging and virtual memory with segmentation.

6. List **THREE (3)** advantages and **THREE (3)** disadvantages of Virtual Memory.