OPERATING SYSTEMS

Exercises

CHAPTER 1: BACKGROUND OF OPERATING SYSTEMS

1. List and briefly define the four main elements of a computer.

2. Define the two main categories of processor registers.

3. What is an interrupt?

4. What are the differences between a trap and an interrupt?
   Apakah perbezaan antara perangkap dan sampukan?

5. What is cache memory?

6. Explain the potential performance disadvantage of a microkernel operating system.

7. What is the basic form of communications between processes or threads in a microkernel operating system?

8. What is Operating System? Briefly explain three objectives of an operating system design.
   Apakah sistem pengoperasian? Terangkan secara ringkas tiga objektif reka bentuk sistem pengoperasian.

9. What is the kernel of an operating system? What are the general functions of the kernel?
   Apakah ia kernel bagi sebuah sistem pengoperasian? Apakah fungsi-fungsi am bagi kernel?

10. Give the difference between uniprogramming and multiprogramming.
    Berikan perbezaan di antara pengaturcaraan tunggal dan multipengaturcaraan.

11. Draw some figures that show the operation examples of uniprogramming and multiprogramming with three programs.
    Lukiskan beberapa gambar rajah yang menunjukkan operasi bagi contoh-contoh pengaturcaraan tunggal dan multipengaturcaraan dengan tiga atur cara.

12. Define symmetric multiprocessing (SMP).
    Takrifkan multi-proses simetrik.

13. State THREE of the characteristics of modern operating systems.
    Nyatakan ciri-ciri bagi sistem pengoperasian moden.

14. What is an operating system? Give two (2) examples of operating systems.
    Apakah sistem pengoperasian? Berikan dua (2) contoh sistem pengoperasian.

15. What is multiprogramming and what is the main advantage?
    Apakah multipengaturcaraan dan apakah kelebihan utamanya?

16. What are the differences between a trap and an interrupt?

17. What are booting and bootstrap program?
    Apakah maksud 'booting' dan atur cara 'bootstrap'?

18. What is the distinction between blocking and nonblocking with respect to messages?
    Apakah perbezaan antara menunggu dan tidak-menunggu bila berkaitan dengan mesej?

19. Briefly explain the benefits of a microkernel organization.
    Secara ringkas terangkan faedah organisasi 'microkernel'.

20. What is the purpose of interrupts? What are the differences between a trap and an interrupt? Can traps be generated intentionally by a user program? If so, for what purpose?

21. Direct memory access (DMA) is used for high-speed I/O devices in order to avoid increasing the CPU's execution load.
    a. How does the CPU interface with the device to coordinate the transfer?
    b. How does the CPU know when the memory operations are complete?
    c. The CPU is allowed to execute other programs while the DMA controller is transferring data. Does this process interfere with the execution of the user programs? If so, describe what forms of interference are caused.

22. Give two reasons why caches are useful. What problems do they solve? What problems do they cause? If a cache can be made as large as the device for which it is caching (for instance, a cache as large as a disk), why not make it that large and eliminate the device?

23. Define the essential properties of the following types of operating systems:

    a. Batch
    b. Interactive
    c. Time sharing
    d. Real time
    e. Network
    f. Parallel
    g. Distributed
    h. Clustered
    i. Handheld

24. List five services provided by an OS that are designed to make it more convenient for users to use the computer system. In what aces it would be impossible for user-level programs to provide these services? Explain.

CHAPTER 2: PROCESSES

1. What are the differences between multiprogramming and time-sharing?

2. Draw the complete five State Process Model.

3. What is a suspended process? Give and explain two (2) suspended states.

4. Draw the Process State Transition Diagram with one Suspend states.
   Lukiskan gambar rajah peralihan keadaan proses dengan satu keadaan Suspend.

5. Give TWO (2) examples of events that cause a state transition for a process from RUNNING to READY.
   Berikan DUA (2) contoh peristiwa yang menyebabkan pertukaran keadaan bagi proses daripada RUNNING kepada READY.

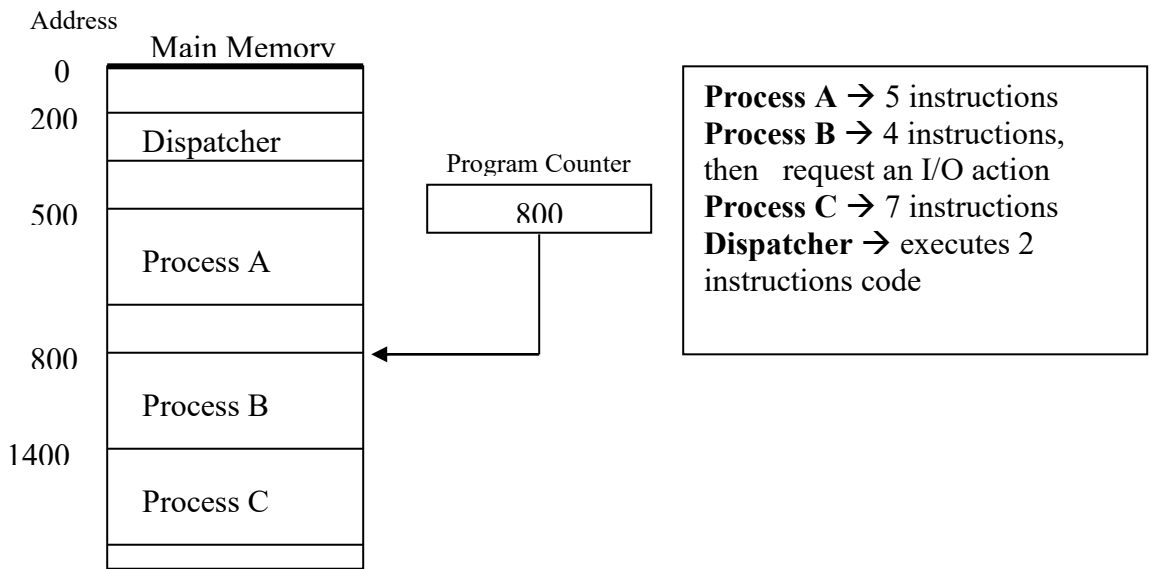
6. What is a process? Explain how operating system does to create a new process.
   Apakah ia satu proses. Jelaskan bagaimanakah yang dilakukan oleh sistem pengoperasian untuk mencipta suatu proses yang baru.

7. List three general categories of information in a process control block.
   Senaraikan tiga kategori-kategori am bagi maklumat yang terkandung dalam blok kawalan proses.

8. Give and explain five states of process model.
   Beri dan terangkan mengenai model lima keadaan proses.

9. What are the steps performed by an operating system to create a new process?
   Apakah langkah-langkah yang dilaksanakan oleh sistem pengoperasian untuk membentuk proses baru.

10. Based on the information below, do the trace of processes. Assume Operating System allows a process to execute for maximum three instruction cycles, after which it is interrupted. Start with process A.
    Berdasarkan maklumat di bawah, laksanakan pengesanan proses-proses. Andaikan sistem pengoperasian membenarkan proses melaksanakan tiga kitaran arahan, selepas itu ianya akan disampuk. Mulakan dengan proses A.



11. Give four types of relationship between thread and process implementation normally used with example of operating system using that method.
Berikan empat jenis perlaksanaan hubungan diantara bebenang dan prosses yang biasa digunakan beserta contoh sistem pengoperasi yang menggunakan kaedah tersebut.

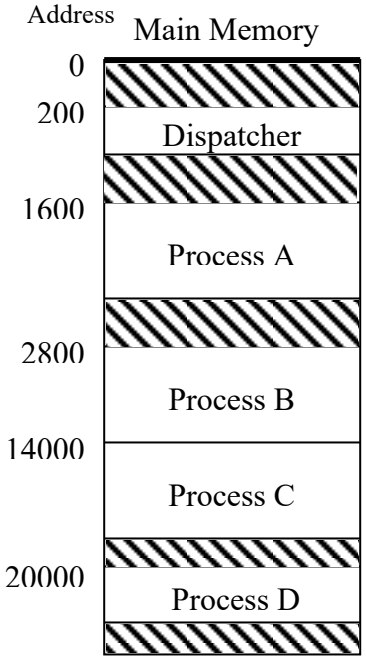
12. How is the execution context of a process used by the operating system.
(Bagaimanakah 'execution context' bagi sesuatu proses digunakan oleh sistem pengoperasian).

13. What is instruction trace?
(Apakah dia penjejak arahan?).

14. List four characteristics of a suspended process.
(Senaraikan empat ciri proses tergantung)

15. Process Control Block contains specific information stored in a data structure. Describe four (4) elements of the PCB that characterize the process
Blok Pengawalan Proses (PCB) mengandungi maklumat tertentu yang disimpan di dalam struktur data. Terangkan empat (4) elemen PCB yang memperincikan sesuatu proses.

16. Consider the execution of four processes, each of them loaded into main memory as shown below:



Process A → 6 instructions
Process B → 4 instructions, then request an I/O action
Process C → 6 instructions
Process D → 5 instructions
Dispatcher → executes 3 instructions code

Assume the operating system allows a process to continue execution for a maximum of 3 instruction cycles, after which it is interrupted.

Show the **combined trace** of the four processes using the information given above.

Threads

17. List reasons why a mode switch between threads may be cheaper than a mode switch between processes.

18. Give four general examples of the use of threads in a single-user multiprocessing system.

19. Consider a multiprocessor system and a multithreaded program written using many-to-many threading model. Let the number of user-level threads in the program be more than the number of processors in the system. Discuss the performance implications of the following scenarios:

    a. The number of kernel threads allocated to the program is less than the number of processors.

    b. The number of kernel threads allocated to the program is equal to the number of processors.

    c. The number of kernel threads allocated to the program is greater than the number of processors but less than the number of user-level threads.

    (SGG 4.6)

20. Give **TWO (2)** general examples of the use of threads in a single-user multiprocessing system.

21. Windows, Solaris, Linux, Mach, and OS/2 are the examples of operating systems that support multiple threads.
    Windows, Solaris, Linux, Mach, dan OS/2 adalah contoh-contoh sistem pengoperasian yang menyokong pelbagai bebenang.

    a. What is thread?
    Apakah bebenang?

    b. Explain the concept of multithreading.
    Jelaskan konsep multi-bebenang.

    c. Give TWO (2) benefits of using thread?
    Berikan DUA (2) faedah menggunakan bebenang?

22. What does a process do to start another process?

23. Distinguish between a process and a thread.

24. Why do we usually say that kernel level threads are better than user level threads?

25. A thread is sometimes called as a lightweight process. The table below refers to two of the relationships between threads and processes.

Bebenang juga dikenali sebagai pecahan proses atau proses ringan. Jadual di bawah merujuk kepada dua perhubungan antara bebenang dan proses.
Describe each of the relationships below.
Terangkan setiap perhubungan di bawah.

Threads : Process	**Description**
1 : 1	
1 : M	

26. List the benefits of threads over processes.
Senaraikan kelebihan bebenang berbanding proses.

27. Give the differences between user-level threads and kernel-level threads.
Berikan perbezaan di antara bebenang tahap-pengguna dan bebenang tahap-kernel.

28. Define multithreading.
Definisikan multi-bebenang.

CHAPTER 3: UNIPROCESSOR SCHEDULING

1. Answer the following questions, using the process scheduling table below:

Process Name	Arrival Time	Processing Time
A	4	5
B	7	4
C	1	5
D	0	2
E	3	3

Shows the execution pattern for one cycle and find out turnaround time and waiting time for each process, using the following scheduling policies:

Round Robin (quantum time (q) = 3)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Turnaround Time	Waiting Time
A																							
B																							
C																							
D																							
E																							

Non-preemptive SJF

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Turnaround Time	Waiting Time
A																							
B																							
C																							
D																							
E																							

Preemptive SJF

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Turnaround Time	Waiting Time
A																							
B																							
C																							
D																							
E																							

2. Answer the following question using the process scheduling table below.

Process Name	Arrival Time	Processing Time
A	2	3
B	0	6
C	4	1
D	3	2

Show the sequence of process execution for one cycle and find out the turnaround time and the average waiting time for each process, using the following scheduling policies:

i. Round Robin (quantum time (q) = 3)

ii. Shortest Process Next (SPN) / Non-preemptive SJF (Shortest Job First)

iii. Shortest Remaining Time (SRT) / Preemptive SJF (Shortest Job First)

3. Consider the following set of processes, with the length of CPU burst given in milliseconds:
Teliti set proses-proses berikut, dengan panjang masa letusan-CPU diberi dalam milisaat.

Process *Proses*	Burst time *Masa Letusan*	Priority *Keutamaan*
P1	10	3
P2	1	1
P3	2	5
P4	1	4
P5	5	2

The processes are assumed to have arrived in the order P1, P2, P3, P4 and P5, all at time 0.
Proses-proses tersebut dianggap tiba dalam turutan P1, P2, P3, P4 dan P5, semua pada masa 0.

   a. Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, non-preemptive priority (a smaller number implies a higher priority), and RR (quantum = 1).
   Lukiskan Carta Gantt yang menunjukkan perlaksanaan proses-proses ini menggunakan penskedulan FCFS, SJF, keutamaan bukan-pintasan (nombor keutamaan kecil mewakili keutamaan yang lebih tinggi), dan RR (kuantum = 1).

   b. What is the turnaround time of each process for each of the scheduling algorithms (in question a)?
   Berapakah masa pusing-balik bagi setiap proses bagi setiap algoritma penskedulan (dalam soalan a) yang digunakan?

   c. What is the waiting time of each process for each of the scheduling algorithms (in question a)?
   Berapakah masa menunggu bagi setiap proses bagi setiap algoritma penskedulan (dalam soalan a) yang digunakan?

   d. Which of the algorithms in question a results in the minimum average waiting time (over all processes)?
   Penskedulan manakah (dalam soalan a) yang menghasilkan purata masa menunggu yang paling pendek?

4. Give and explain two categories of decision mode in scheduling policies. Give an example of scheduling technique for each category.
Beri dan terangkan dua kategori mod keputusan di dalam polisi pengskedulan. Berikan satu contoh teknik pengskedulan bagi setiap kategori.

5. What is turnaround time?
Apakah itu masa pusing balik?

6. Why do we care if a process scheduler is fair?

7. The SJF process scheduling algorithm is optimum, so why do we not use it as it was described initially?

8. Since FCFS process scheduling is so fair, what is the problem with it?

9. Give and explain four (4) situations when the CPU scheduling decisions may take place.

10. Explain the five (5) scheduling criteria, and how they can be optimized.

11. What is dispatch latency?

CHAPTER 4: SYNCHRONIZATION

1. List four design issues for which the concept of concurrency is relevant.

2. List the requirements for mutual exclusion.

3. What operations can be performed on a semaphore?

4. What is a monitor?

5. What is the distinction between *blocking* and *nonblocking* with respect to messages?

6. Define race condition in the concurrency context. Give an example of a race condition.
   Takrifkan suasana perlumbaan dalam konteks keserentakan. Berikan satu contoh suasana perlumbaan.

7. Define the following control problems which are associated with competing processes for resources:
   Takrifkan masalah-masalah kawalan berikut yang dikaitkan dengan persaingan proses-proses terhadap sumber-sumber:
   i. Mutual exclusion
   ii. Deadlock
   iii. Starvation

8. What is the producer / consumer problem?
   Apakah ia masalah pengeluar / pengguna?

9. List the requirements for mutual exclusion.
   Senaraikan keperluan-keperluan untuk 'mutual exclusion'.

10. Concurrency arises in three different context. State these context.
    (Persetujuan muncul dalam tiga konteks yang berbeza. Nyatakan semua konteks tersebut)

11. Interrupt disabling is one of the hardware support approaches used to satisfy mutual exclusion requirements. However, this approach contributes into two major difficulties. State the difficulties of "interrupt disabling" approach.
    "Interrupt disabling" adalah salah satu daripada pendekatan perkakasan sokongan yang digunakan untuk memenuhi keperluan "mutual exclusion". Akan tetapi, pendekatan ini menyumbang kepada dua kerumitan. Nyatakan kerumitan pendekatan "interrupt disabling".

12. What is semaphore? Explain how it is used in synchronizing concurrent processes.
    Apakah itu semafor? Terangkan bagaimana ia digunakan dalam pensinkronian proses serentak.

13. A solution to the critical section problem must satisfy three requirements:
    Satu penyelesaian kepada masalah seksyen genting mestilah memenuhi tiga syarat:
    - Mutual exclusion (*pengasingan atas persetujuan*)
    - Progress (*kemajuan*)
    - Bounded waiting (*penantian terhad*)

    Explain these requirements. (*Terangkan syarat-syarat ini*.)

14. Define the following terms related to concurrency:
    Takrifkan istilah-istilah berikut yang berkaitan dengan keserentakan:
    iv. Critical section (*bahagian kritikal*)
    v. Mutual exclusion (*pengasingan atas persetujuan*)
    vi. Race condition (*keadaan perlumbaan*)

CHAPTER 5: SYNCHRONIZATION & DEADLOCK

15. Consider the matrix tables below and answer the following questions:

Claim matrix C

	R_1	R_2	R_3
P_0	4	4	3
P_1	7	2	1
P_2	5	4	2
P_3	5	0	2
P_4	4	3	3

Allocation matrix A

	R_1	R_2	R_3
P_0	0	0	2
P_1	2	0	0
P_2	2	1	1
P_3	3	0	2
P_4	0	0	2

Available vector V

R_1	R_2	R_3
3	3	2

Answer the following questions using the banker's algorithm.

a) What is the content of the matrix Need?

b) Is the system in a safe state? If yes, what is the amount of each resource? Show all your steps.

16. Consider the matrix tables below and answer the following questions:

Request matrix Q

	R_1	R_2	R_3	R_4
P_0	1	1	0	0
P_1	2	0	0	1
P_2	1	0	1	0
P_3	3	0	3	0
P_4	2	4	1	1

Allocation matrix A

	R_1	R_2	R_3	R_4
P_0	0	1	2	0
P_1	0	0	1	0
P_2	2	0	0	1
P_3	1	1	1	1
P_4	0	1	2	2

Available vector V

R_1	R_2	R_3	R_4
2	1	0	0

Apply the steps of **deadlock detection** to the data above.

17. Consider the matrix below and answer the following questions:
Pertimbangkan matriks di bawah dan jawab soalan yang berikutnya:

Process	Claim Matrix, C		
	R1	R2	R3
A	9	10	11
B	6	7	8
C	3	4	5
D	0	1	2

Process	Allocation Matrix, A		
	R1	R2	R3
A	3	4	3
B	2	3	2
C	1	2	1
D	0	1	0

Process	Need Matrix C - A		
	R1	R2	R3
A	6	6	8
B	4	4	6
C	2	2	4
D	0	0	2

R1	R2	R3
11	11	11

Resource vector, R

R1	R2	R3
5	1	5

Available vector, V

a) Using Banker's algorithm, complete the following table by stating the process that would be executed in order and the available vector after each process runs to completion.

Menggunakan algoritma Banker, lengkapkan jadual berikut dengan menyatakan proses yang akan dilaksanakan mengikut turutan dan vektor "available" selepas setiap proses selesai perlaksanaannya.

Process to be executed (in order)		Available vector, V		
		R1	R2	R3
1st process:				
2nd process:				
3rd process:				
4th process:				

b) Referring to your answer in (a), is any deadlock detected? Why?
Merujuk kepada jawapan anda di (a), adakah kebuntuan dikesan? Kenapa?

18. Consider the matrix tables below and answer the following questions:
Pertimbangkan rajah matrik di bawah dan jawab soalan-soalan berikut:

Request matrix Q

	R_1	R_2	R_3	R_4
P_0	1	0	1	0
P_1	2	0	0	1
P_2	1	1	0	0
P_3	2	4	1	3
P_4	3	0	3	0

Allocation matrix A

	R_1	R_2	R_3	R_4
P_0	0	1	2	0
P_1	0	0	1	0
P_2	2	0	0	1
P_3	0	1	2	2
P_4	1	1	1	1

Available vector V

R_1	R_2	R_3	R_4
4	2	0	0

Apply the steps of **deadlock detection** to the data above.
Jalankan langkah-langkah pengesanan kebuntuan kepada data di atas.

19. Define deadlock. Is it possible to have a deadlock involving only one single process? Explain your answer.
Takrifkan kebuntuan. Adakah berkemungkinan untuk mendapatkan kebuntuan yang melibatkan hanya satu proses tunggal? Jelaskan jawapan kamu.

20. What is deadlock avoidance? Give two approaches of deadlock avoidance.
Apakah ia pengelakan kebuntuan? Berikan dua pendekatan kepada pengelakan kebuntuan.

21. Consider the matrix tables below and answer the following questions:
Pertimbangkan rajah matrik di bawah dan jawab soalan-soalan berikut:

Request matrix Q

	R_1	R_2	R_3	R_4
P_0	1	4	1	2
P_1	2	0	0	1
P_2	1	1	2	0
P_3	2	2	1	0
P_4	1	5	0	4

Allocation matrix A

	R_1	R_2	R_3	R_4
P_0	0	1	2	0
P_1	0	0	1	0
P_2	2	1	0	0
P_3	0	1	2	2
P_4	1	1	1	0

Available vector V

R_1	R_2	R_3	R_4
5	2	1	1

Apply the steps of **deadlock detection** to the data above.
Jalankan langkah-langkah pengesanan kebuntuan kepada data di atas.

22. There are three general approaches in dealing with deadlock, give and explain the approaches.
Terdapat tiga pendekatan untuk menangani kebuntuan, beri dan terangkan pendekatan tersebut.

23. List all four conditions when hold together can create a deadlock situation.
Senaraikan kesemua empat keadaan yang mana secara bersama boleh menyebabkan satu situasi kebuntuan.

24. Consider the matrix tables below and answer the following questions:
Pertimbangkan jadual-jadual matrik di bawah dan jawab soalan-soalan berikut:

Claim matrix C

	R_1	R_2	R_3
P_1	4	3	3
P_2	5	2	1
P_3	4	3	2

Allocation matrix A

	R_1	R_2	R_3
P_1	1	0	2
P_2	2	0	0
P_3	2	1	2

Need (C-A)

	R_1	R_2	R_3
P_1	3	3	1
P_2	3	2	1
P_3	2	2	0

Available vector V

R_1	R_2	R_3
2	3	2

Using Banker's algorithm, identify whether the system in safe state or not.

25. Consider the matrix tables below:
Pertimbangkan jadual-jadual matrik di bawah:

Request matrix Q

	R_1	R_2	R_3
P_1	2	0	2
P_2	2	1	1
P_3	1	1	0
P_4	0	2	4

Allocation matrix A

	R_1	R_2	R_3
P_1	0	0	1
P_2	2	0	1
P_3	0	1	1
P_4	0	1	1

Available vector V

R_1	R_2	R_3
2	1	0

Apply the steps of deadlock detection algorithm to the data above.
Gunakan langkah-langkah algoritma pengesahan kebuntuan terhadap data di atas.

26. Draw the resource allocation graph for the following scenario:
System has three processes P1, P2, P3 and has three resources R1, R2, R3 (each of different types.)

Event	Action
1	P1 requests and is allocated R1
2	P1 requests and is allocated R2
3	P2 requests R1
4	P3 requests and is allocated R3
5	P1 releases R1, which is allocated to P2
6	P3 requests R2
7	P1 releases R2, which is allocated to P3

27. Consider a system consisting of four processes and a single resource. The current state of the claim and allocation matrices are:

C

3
2
9
7

A

1
1
3
2

What is the minimum number of units of the resource needed to be available for this state to be safe?

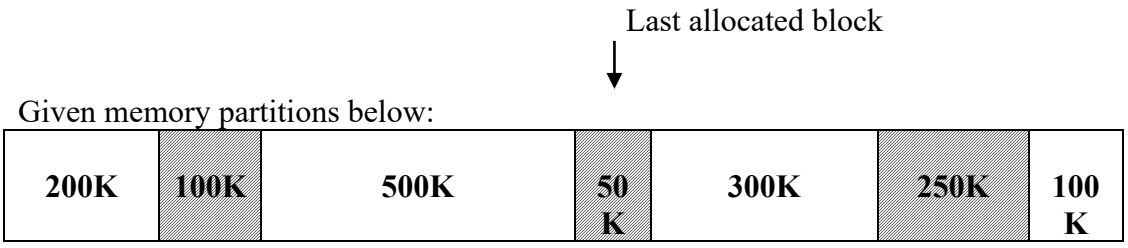
28. A resource allocation graph is a directed graph showing the states of resources and processes in a system. Based on the information given below, build the resource allocation graph and the corresponding wait-for graph.
Graf peruntukan sumber adalah graf terarah yang menunjukkan keadaan sumber-sumber dan proses-proses sesuatu sistem. Berdasarkan maklumat di bawah, bina graf peruntukan sumber dan juga graf tunggu yang setara.

(Process) P = {P1, P2, P3}, (Resource) R={R1, R2, R3}
(Edges) E = {P1→R1, P1→R2, P3→R3, R1→P3, R2→P2, R3→P2}

a) Graf peruntukan sumber *(Resource allocation graph):*
b) Graf tunggu *(Wait-for graph):*
c) Based on the graph drawn, is the system in a deadlock state? Explain your answer.
Berdasarkan graf yang dilukis, adakah sistem berada di dalam keadaan kebuntuan? Terangkan jawapan anda.

CHAPTER 6: MEMORY MANAGEMENT

1. Given memory partitions below:

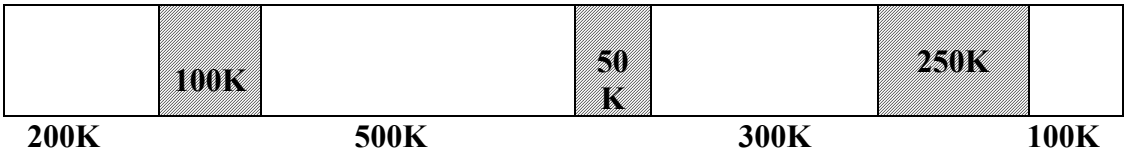


The shaded areas are allocated blocks; the white areas are free blocks.

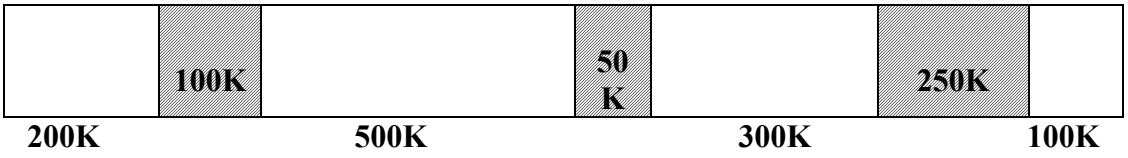
Using the following placement algorithms, show the partition allocated for the processes of size 110K, 150K, 300K and 200K (loaded in that order):

a) First-fit
b) Best-fit
c) Next-fit

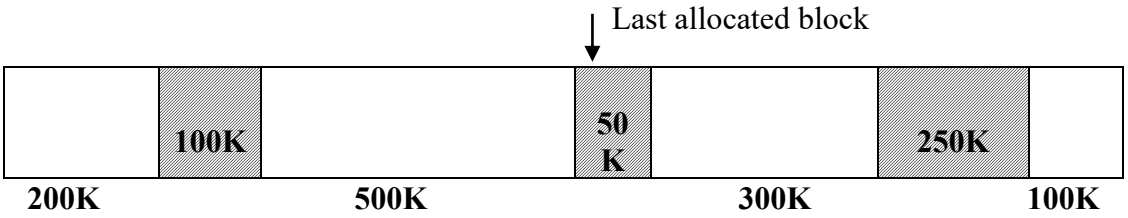
First fit:



Best fit:



Next fit:



2. Consider the following segment table:

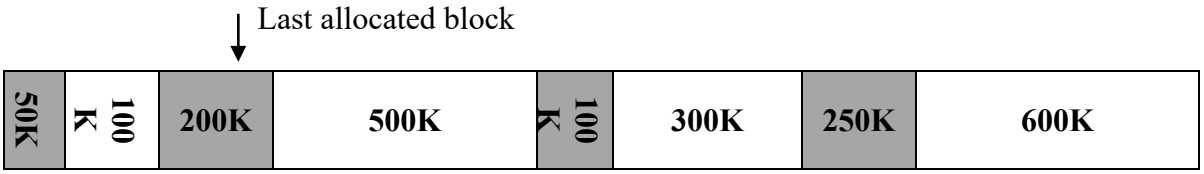
Segment	*Base*	*Length*
0	660	248
1	1752	422
2	222	198
3	996	604

What are the physical addresses for the following logical addresses or indicate if a segment fault occurs?

i) (0, 198)

ii) (1, 530)
iii) (3, 444)
iv) (0, 222)
v) (2, 156)

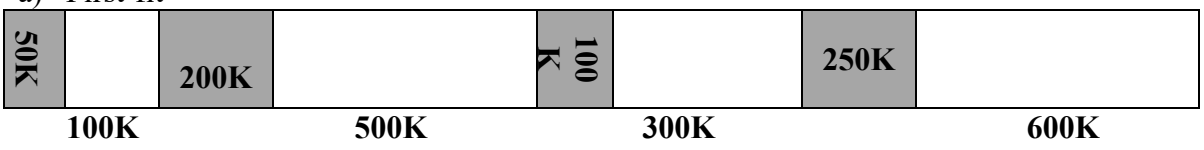
3. Dynamic partitioning scheme is being used, and the following is the main memory configuration is given:



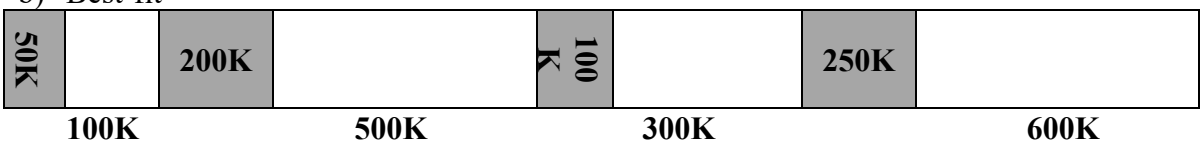
The shaded areas are allocated blocks; the white areas are free blocks.

Using the following placement algorithms, show the partition allocated for the processes of size 119K, 455K, 212K and 145K (loaded in that order):

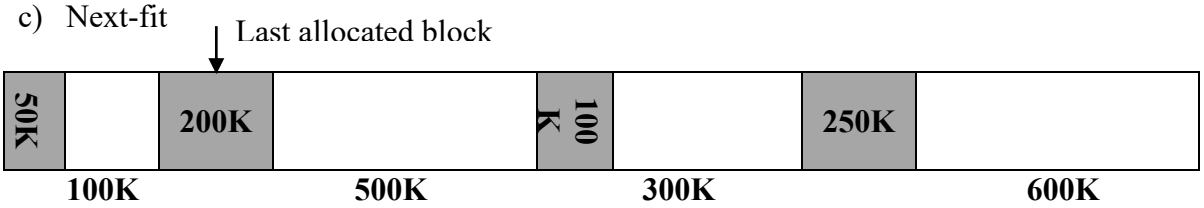
a) First-fit



b) Best-fit



c) Next-fit

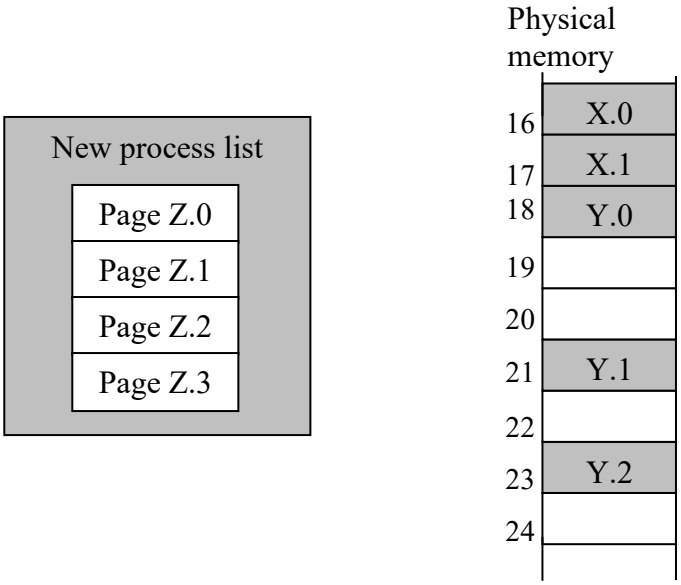


4. Consider the following page table. The page size is 8 bytes each.

Page	*Frame*
0	6
1	2
2	0
3	3
4	5

What are the physical addresses for the following logical addresses?
i) (1, 5)
ii) (2, 0)
iii) (0, 6)
iv) (3, 8)

5. Solve the paging problem based on the information given below: pages of processes X and Y have already occupied several frames in main memory, while a new process Z is to be loaded in.



a) Show the frame (in the physical memory) that is allocated to each page of the new process.

b) Draw the appropriate page-table for each process.

6. Consider the following segment table:

Segment	Base	Length
0	996	248
1	2180	422
2	222	198
3	660	204
4	1752	96

a) Illustrate using diagram the places of all segments in main memory.

b) What are the physical addresses for the following logical addresses?
   i) (0, 178)
   ii) (1, 256)
   iii) (2, 130)
   iv) (3, 244)
   v) (4, 73)

7. Consider a simple paging system which uses 16 bits addressing scheme. The page size is 1K each. Given a process page table as follows,

0	000101
1	000111
2	001001
3	001011
4	001100

Process Page Table

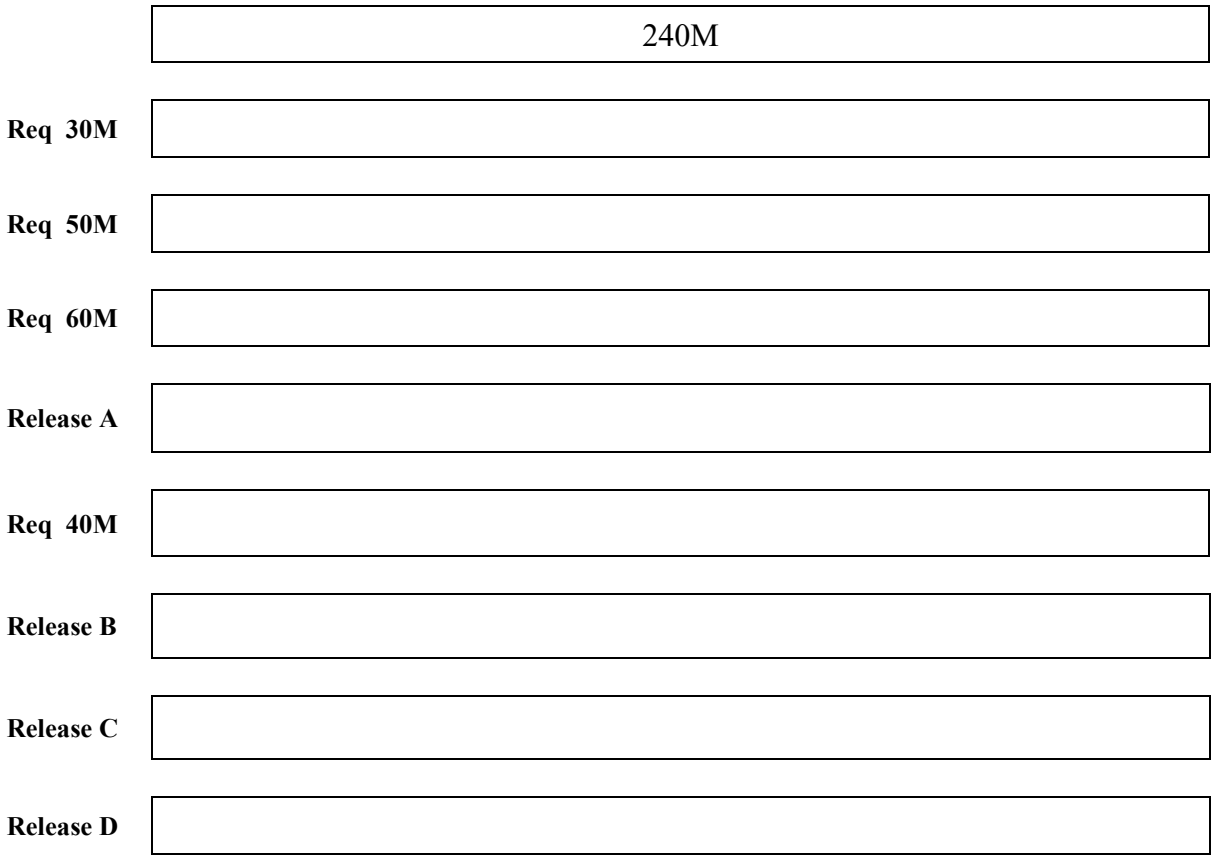
Determine the physical address of the following logical address for this scheme.
a) 0001000001111110
b) 0000111111111111

8. Consider a simple segment system which uses 16 bits addressing scheme. The segment size is 1K each. Given a process segment table as follows,

Segment	Length	Base
0	11110 11111	0000000010100000
1	11100 11111	0000000001111000
2	11111 00000	0000000010011010
3	10000 00000	0000000010010000
4	11111 11111	0000000010101000

Determine the physical address of the following logical address for this scheme.
a) 0000010111100000
b) 0001001110001111

9. If a memory size is 240MB. By using the buddy partitioning scheme, shade the memory insertion for the memory space request as follows: 30MB, 50MB, 60MB, Release A, Request 40MB, Release B, Release C and Release D.
Saiz satu ingatan adalah 240MB. Dengan menggunakan skema 'buddy partitioning', tunjukkan lakaran kemasukan ruangan ingatan bagi permintaan ruangan ingatan seperti berikut: 30MB, 50MB, 60MB, pemulangan A, permintaan 40MB, pemulangan B, pemulangan C dan pemulangan D.



10. Describe a mechanism for enforcing memory protection in order to prevent a program from modifying the memory associated with other programs.

11. What is the main difference between a page and a frame?

12. Why does fix partitioning suffer from internal fragmentation whereas dynamic partitioning suffers from external fragmentation? When is compaction needed?

13. What is the difference between a physical address and a logical address?

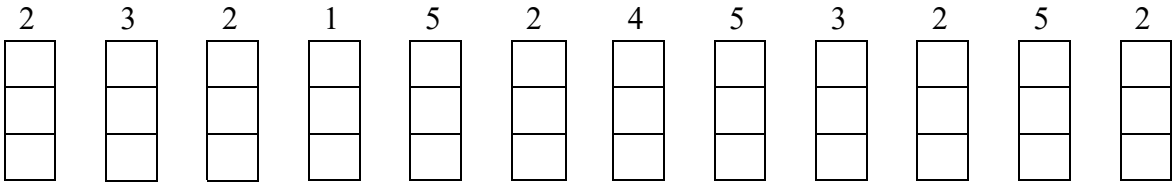
14. What is the difference between page, frame and segment in memory management?

15. In memory management, block of data loaded into memory partitioning can cause a condition called fragmentation. Define fragmentation and explain briefly types of fragmentation that exists.

VIRTUAL MEMORY

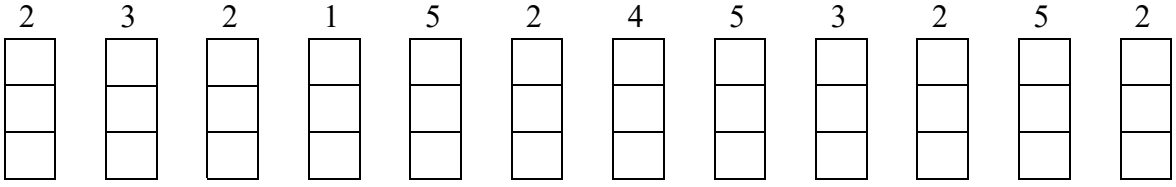
16. Consider the following page-reference string: **2, 3, 2, 1, 5, 2, 4, 5, 3, 2, 5, 2**
If the number of frames is three, fill in the frames figure below for each page replacement that would occur. Identify how many page faults that would occur for each of the following page replacement algorithms:

    i. First-In-First-Out (FIFO) replacement algorithm



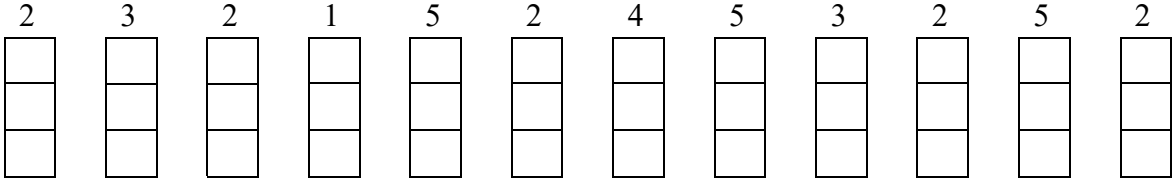
Page faults = _____

    ii. Least-Recently-Used (LRU) replacement algorithm



Page faults = _____

    iii. Optimal replacement algorithm

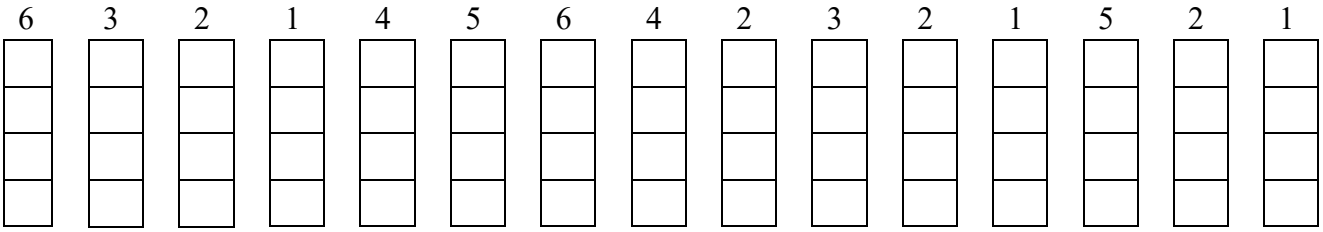


Page faults = _____

17. Redo the above question using:
    a. 5 frames
    b. 6 frames

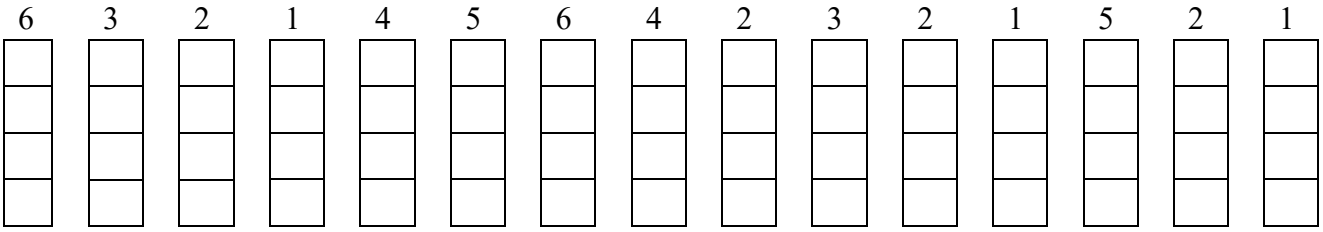
18. Consider the following page-reference string: **6, 3, 2, 1, 4, 5, 6, 4, 2, 3, 2, 1, 5, 2, 1**
    If the number of frames is four, fill in the frames figure below for each page replacement that would occur. Identify how many page faults that would occur for each of the following page replacement algorithms:

    i. First-In-First-Out (FIFO) replacement algorithm



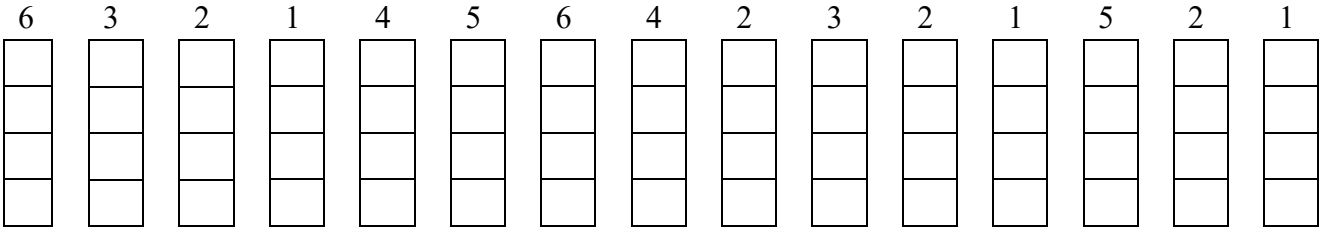
    Page faults = __ _ __

    ii. Least-Recently-Used (LRU) replacement algorithm



    Page faults = _____

    iii. Optimal replacement algorithm

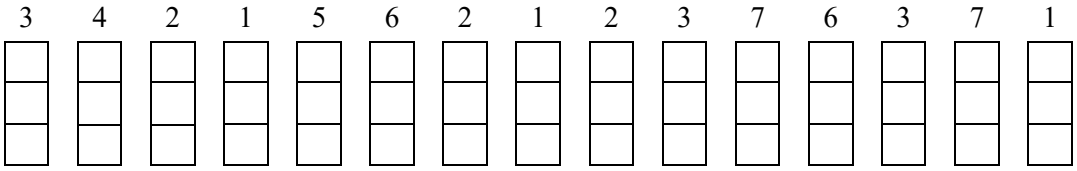


    Page faults = _____

19. Redo the above question using:
    a. 5 frames
    b. 3 frames

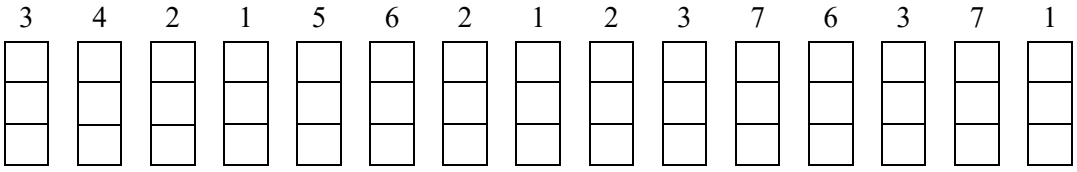
20. Consider the following page-reference string: **3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 7, 1**
If the number of frames is three, fill in the frames figure below for each page replacement that would occur. Identify how many page faults that would occur for each of the following page replacement algorithms:

i. First-In-First-Out (FIFO) replacement algorithm



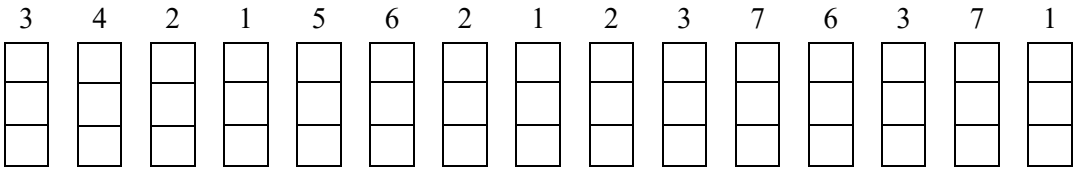
Page faults = _____

ii. Least-Recently-Used (LRU) replacement algorithm



Page faults = _____

iii. Optimal replacement algorithm



Page faults = _____

21. Describe the term ‘replacement policy’ within an operating system.

22. What is the difference between simple paging and virtual memory paging?

23. When does a page fault occur? Describe what the operating system does to handle a page fault.

24. What is thrashing and how can an operating system take steps to avoid it?

CHAPTER 7: INPUT/OUTPUT (I/O) MANAGEMENT

1. I/O devices can be roughly grouped into three categories. List these categories and given examples for each category.

2. There are great differences across I/O devices. Briefly explain the key differences.

3. What is Direct Memory Access (DMA)?

4. The kernel I/O subsystem provides services related to I/O. List and explain these services.

5. What is the distinction between blocking and nonblocking I/O?

6. List and briefly define three techniques for performing I/O.

7. What is the difference between logical I/O and device I/O?

8. What is the difference between block-oriented devices and stream-oriented devices? Give a few examples of each.

9. How can we improve the performance of our computer system, with regard to I/O management? Give the five strategies.

10. Why do you expect improved performance using a double buffer rather than a single buffer for I/O?

11. What are the various kinds of performance overheads associated with servicing an interrupt?

12. Describe three circumstances under which blocking I/O should be used. Describe three circumstances under which nonblocking I/O should be used. Why not just implement nonblocking I/O and have processes busy-wait until their device is ready?

CHAPTER 8: DISK SCHEDULING

1. Consider one disk with 200 cylinders, numbered 0 to 199. Assume the current position of head is at cylinder 66. The request queue is given as follows:

   55, 32, 6, 99, 58, 71, 86, 153, 11, 179, 42.

Answer questions a) through c) for each of the following disk-scheduling algorithms:
First Come First Served (FCFS) – (example answer is given)
Shortest Seek Time First (SSTF)
SCAN – in the direction of increasing track number
C-SCAN – in the direction of increasing track number
LOOK – in the direction of increasing track number
C-LOOK – in the direction of increasing track number

a) Show the current position of head based on the disk arm movement to satisfy the above requests, i.e. the sequence of requests serviced.

b) Count the total distance (in cylinders) of the disk arm movement to satisfy the requests.

c) Decide the best algorithm for the given case above. Why?

Example answers:

First Come First Served (FCFS)
a) 66, 55, 32, 6, 99, 58, 71, 86, 153, 11, 179, 42
b) 11 + 23 + 26 + 93 + 41 + 13 + 15 + 67 + 142 + 168 + 137 = 736

2. Consider one disk with 2000 cylinders, numbered 0 to 1999. Assume the current position of head is at cylinder 143. The request queue is given as follows:
Pertimbangkan satu cakera dengan 2000 silinder, bernombor 0 hingga 1999. Andaikan kedudukan semasa kepala adalah pada silinder 143. Giliran permintaan diberi seperti berikut:
103, 80, 1400, 813, 1714, 748, 1409, 1100, 1666, 90

For each of the following disk-scheduling algorithms,
Bagi setiap algorithma penjadualan cakera berikut,

i. Shortest Seek Time First (SSTF)

ii. LOOK (variation of SCAN) – in the direction of increasing track number
(dalam arah nombor trek menaik)

iii. C-LOOK (variation of C-SCAN) – in the direction of increasing track number

a) show the current position of head based on the disk arm movement to satisfy the above requests, i.e. the sequence of requests serviced.
tunjukkan kedudukan semasa kepala berdasarkan pergerakan lengan cakera untuk memenuhi permintaan di atas, iaitu jujukan permintaan yang dipenuhi.

b) count the total distance (in cylinders) of the disk arm movement to satisfy the requests. *kirakan jumlah jarak (dalam silinder) bagi pergerakan lengan cakera untuk memenuhi permintaan tersebut.*

SSTF	
Track accessed	Distance
Total distance	=

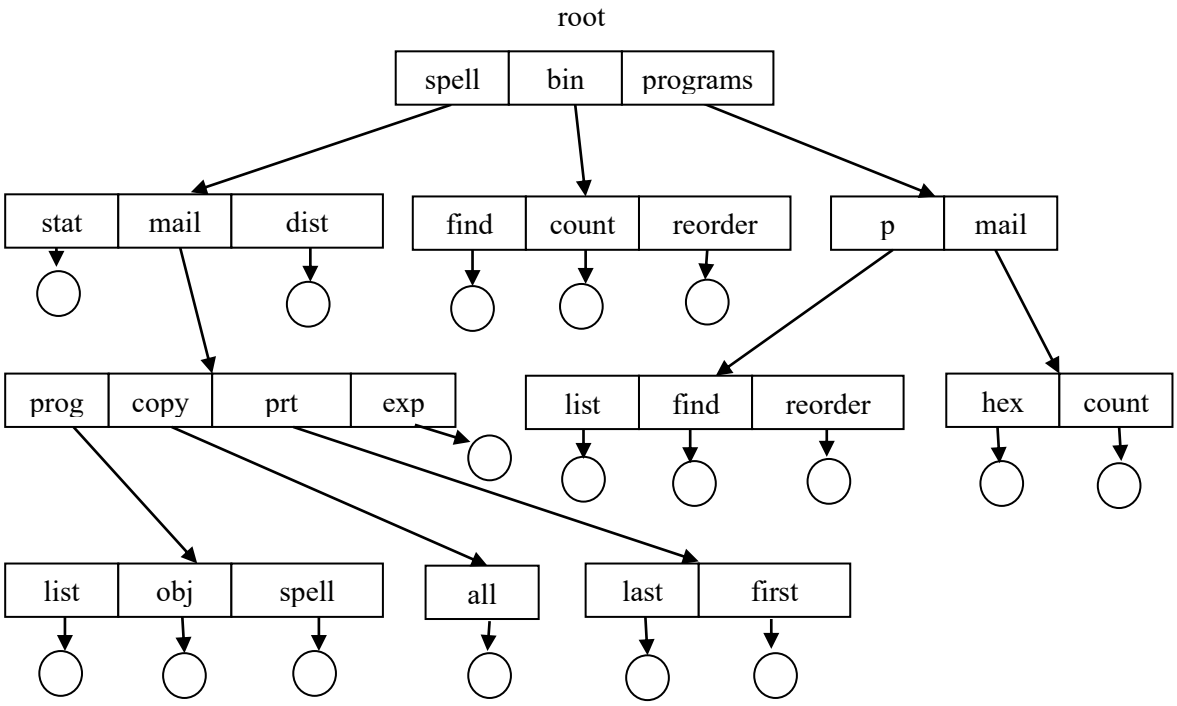
LOOK	
Track accessed	Distance
Total distance	=

C-LOOK	
Track accessed	Distance
Total distance	=

3. Access time has two major components: seek time and rotational latency/delay. Explain each of them.

CHAPTER 9: FILE MANAGEMENT

1. Consider the following directory structure:



Nyatakan (*Specify*):

a. nama laluan mutlak bagi merujuk fail 'all'.
absolute path name to refer the file 'all'.

_____

b. nama laluan relatif bagi merujuk fail 'all', jika direktori semasa ialah 'mail'.
relative path name to refer the file 'all', if the current directory is 'mail'.

_____

2. Assuming there are 16 blocks on a disk. Given the table below, show the storage location of **assign1.asm** file using the indexed allocation with variable length portions method.

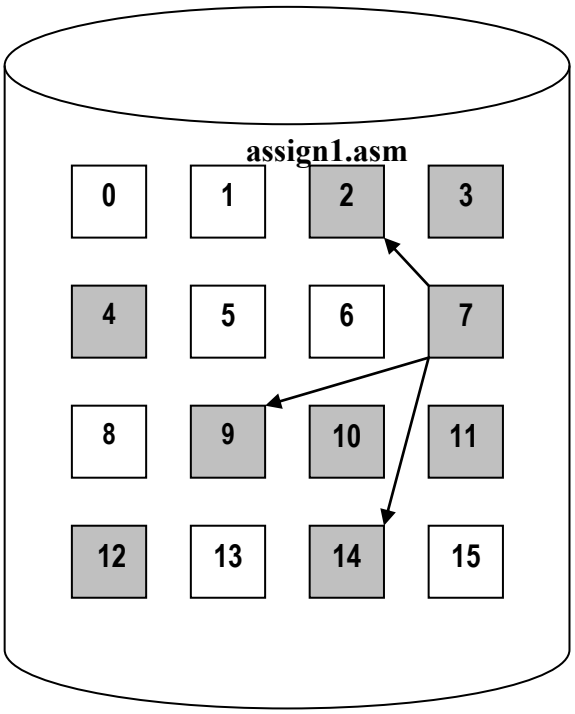
File Allocation Table

File Name	Index Block
assign1.asm	7

Start Block	Length
2	3
14	1
9	4

Use pointers (arrows) and shade the blocks involved.

File Allocation



3. Give two objectives of the file management system.

4. Give two types of file organizations and explain each of them.

5. List and explain SIX (6) basic file operations.

6. Give and explain TWO (2) file access methods. How do they differ from each other?

7. File organization is the logical structuring of records as how they are accessed. Files are organized to suit certain criteria. Give five (5) criteria for file organization.

8. There are three methods of record blocking. Briefly explain each of them.