National University of Computer and Emerging Sciences

Chiniot-Faisalabad Campus

Operating Systems (CS2006)

Date: April 8th 2024

Course Instructor(s)

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Sessional-II Exam

Total Time (Hrs.): 1
Total Marks: 50
Total Questions: 9

Roll no _____ Section _____ Student Signature _____

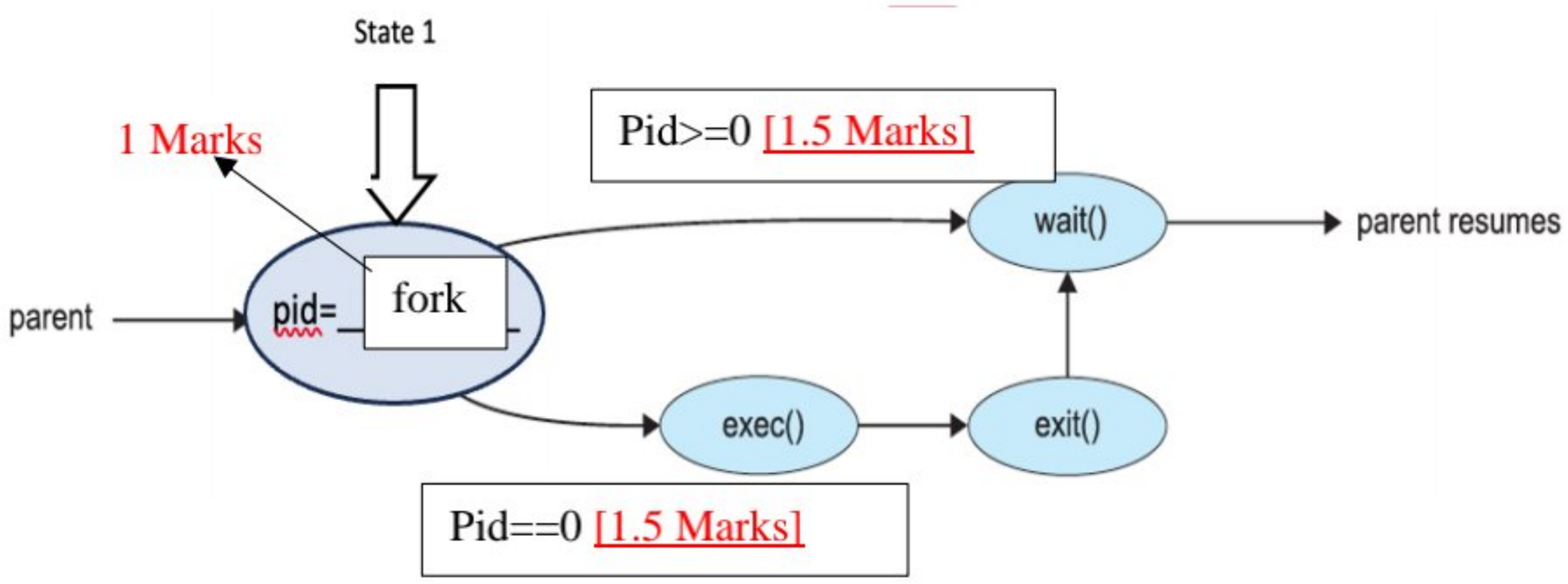
☐ *I hereby certify that the questions included in the question paper have not appeared in the exact form in the previous two years' examinations.*

Vetted by: _____ **Signature:** _____

Attempt all the questions.

C2: Implement solutions employing concepts of Processes and Threads

Q1: In the following diagram, the parent creates a process identifier (pid), mentioning the system call that initiates a child process.? Furthermore, mention at what condition the of the pid the state 1 moves to the wait () and exec ()? Note: conditions can be pid>0, pid==0, and pid <0.
[Marks =4]



Q2: Choose the correct answers [Marks = 6]

1. A process can be terminated due to _____
   a. normal exit
   b. fatal error
   c. killed by another process

1 mark for each right option 1 x 5 = 5
1 marks to attempt the question

2. What is the ready state of a process?
   a. when the process is scheduled to run after some execution
   b. when the process is unable to run until some task has been completed
   c. when the process is using the CPU

3. In Unix, which system call creates the new process?
   a. fork
   b. create
   c. new

Q3: What resources are used when a thread is created? How do they differ from those used when a process is created? [Marks = 3]

creating either a user or kernel thread involves allocating a small data structure to hold a t**hread ID, a program counter, a register set, stack and priority**,

[1.5 mark for Thread Resources]

creating a process involves allocating the large data structure called **as PCB(Process Control Block) which includes a memory map, list of open files, and environment variables**.

[1.5 Mark for Process Resources]

Q4: Write the purpose of Given functions in Threading using P_thread [Marks = 2]

Function	Purpose
Pthread_join	Wait for the termination of thread
Pthread_cancel	Send the cancellation request to the thread
Pthread_detach	Deallocate the resources of thread
Pthread_Self	Get the thread ID of current Thread.

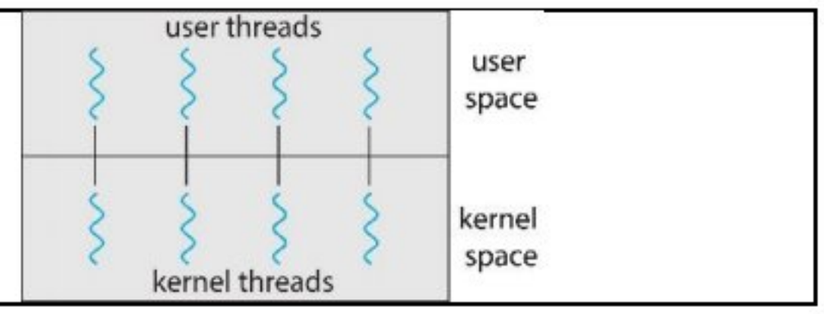
Q5: what is threading model? Explain its four types also draw the diagrams [Marks =5]

A relationship must exist between user threads and kernel threads. The relationship between the user and kernel thread is known as thread Model [1 marks]

1 Mark for each[0.5 definition + 0.5 Diagram]

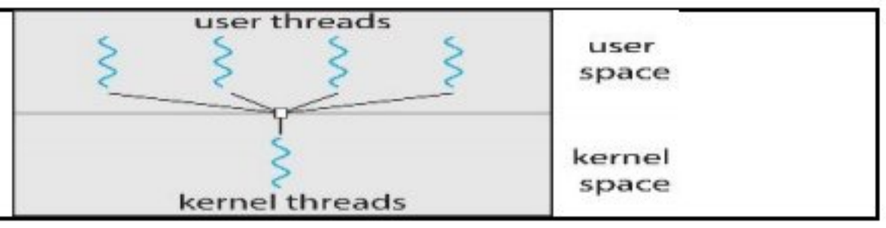
One to one Model:

Each user-level thread maps to kernel thread



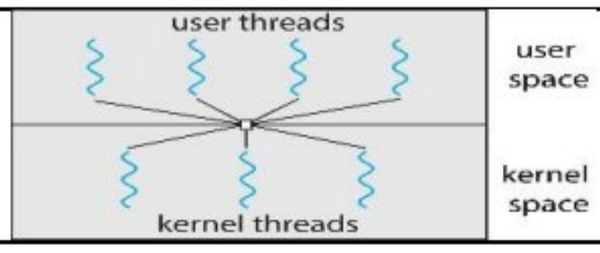
Many to One Model

Many user-level threads mapped to single kernel thread

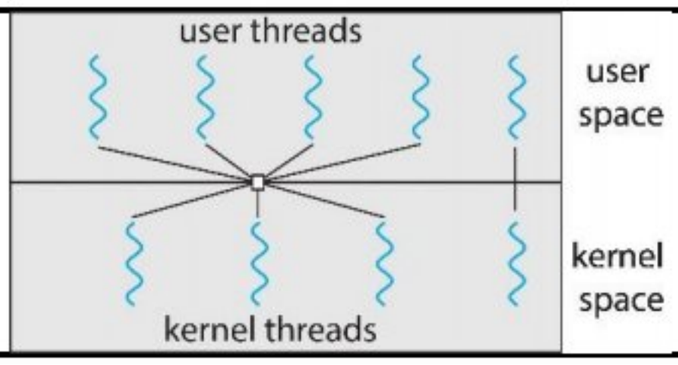


Many to Many Model

Allows many user level threads to be mapped to many kernel threads



Two Mode Model

• Similar to Many to Many , except that it allows a user thread to be bound to kernel thread	

C3: Evaluate the commonly used mechanisms for scheduling of tasks and implement synchronization mechanisms like Semaphores, TSL, etc.

Q6: Distinguish between PCS and SCS scheduling.
[marks =2]

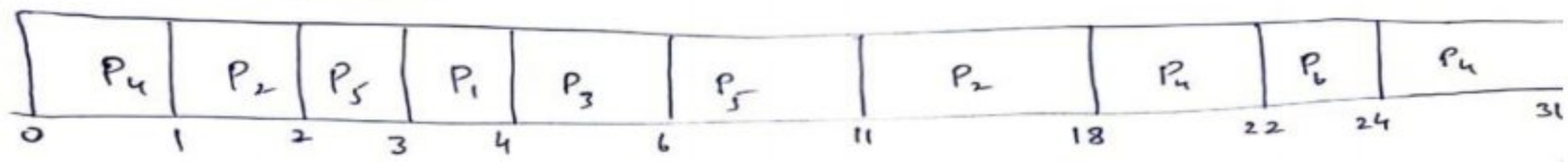
PCS scheduling is local to the process as competition for the CPU takes place among threads belonging to the same process.**[1 Marks]**
SCS is used when the operating system schedules kernel thread as competition for the CPU takes place among all threads in the system.**[1 Mark]**

Q7: Consider the set of 6 processes whose arrival time and burst time are given below answer and If the CPU scheduling policy is Shortest Job First (SJF) preemptive, calculate the following: **[Marks = 8]**

1. Show the scheduling order of the processes using a Gantt chart.
2. What is the turnaround time for each process?
3. What is the waiting time for each process?
4. What is the CPU utilization rate**?**

Process ID	Arrival Time	Brust Time
P1	3	1
P2	1	8
P3	4	2
P4	0	12
P5	2	6
P6	22	2

Gantt Chart:



P#	Arrival	Burst	Completion	Turnaround (Completion − Arrival)	Waiting (T.A.T − Burst)
P_1	3	1	4	4−3 = 1	1−1 = 0
P_2	1	8	18	18−1 = 17	17−8 = 9
P_3	4	2	6	6−4 = 2	2−2 = 0
P_4	0	12	31	31−0 = 31	31−12 = 19
P_5	2	6	11	11−2 = 9	9−6 = 3
P_6	22	2	24	24−22 = 2	2−2 = 0

$$\text{CPU Utilization Rate} = \frac{\text{CPU Time}}{\text{Total Time}} \times 100$$

$$= \frac{31}{31} \times 100$$

$$= 100\ \%$$

Q8: Consider the following scenario and apply round robin with time quantum=3 and complete the given table [Note: All Calculation must be done in required calculation portion given on Page 5] **[Marks = 10]**

Process	Arrival Time	CPU burst time	Turnaround Time	Waiting Time	Response Time
P0	**0**	**12**	**36-0 = 36**	**36-12 = 24**	**0-0 = 0**
P1	**2**	**9**	**30-2 = 28**	**28-9 = 19**	**3-2 = 1**
P2	**3**	**11**	**40-3 = 37**	**37 – 11 =26**	**6-3 = 3**
P3	**5**	**8**	**38 – 5 =33**	**33-8 = 25**	**12- 5 =7**

a. Compute average Turn Around Time

$$ATT = \frac{36 + 28 + 37 + 33}{4} = 33.5$$

b. Compute average Wait time.

$$AWT = \frac{24 + 19 + 26 + 25}{4} = 23.5$$

c. Compute average response time.

$$ART = \frac{0 + 1 + 3 + 7}{4} = 2.75$$

d. Compute throughput.

$$Throughput = \frac{4}{40} = 0.1$$

Q9: Consider the following scenario and predict the next CPU burst. [Note: Calculation must be done in required calculation portion given on page 5] [Marks =10]

T_0		8	10	6	4	3
S_{N+1}	10					

Q9

T_0		8	10	6	4	3
S_{N+1}	10	9	9.5	7.75	5.875	4.4375 3.4375

$S_{n+1} = (1-\alpha) S_n + \alpha T_n$

α value is not specified so check according to α value supply by Student. But it should be constant for whole procedure

let Suppose $\alpha = 1/2$

$S_{n+1} = (1-\alpha) S_n + \alpha T_n$

$= (1-\frac{1}{2}) 10 + \frac{1}{2} \times 8$

$= 5 + 4 = 9$

marks
2.5 pts

For next

$S_{n+1} = (1-\frac{1}{2}) \times 9 + \frac{1}{2} \times 10$

$= 4.5 + 5 = 9.5$

marks
2.5 pts

$S_{n+1} = (1-\frac{1}{2}) \times 9.5 + \frac{1}{2} \times 6$

$= 4.75 + 3 = 7.75$

2.5 pts

$S_{n+1} = (1-\frac{1}{2}) \times 7.75 + \frac{1}{2} \times 4$

$= 3.375 + 2 = 5.875$

2.5 pts

$S_{n+1} = (1-\frac{1}{2}) \times 5.875 + \frac{1}{2} \times 3$

$= 2.9375 + 1.5$

$= 4.4375$

2.5 pts

Required Calculations: