CS.4310 HW1

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Q1. Conduct a research and give the top five most popular operating systems of the world. Justify your answer and explain why they are the most popular

Answer - The five most popular operating systems are Windows, MacOS, Android, iOS, and Linux. This is by account of their respective market share and users which is 72.2% for Windows, 14.7% for MacOS, and 4.45% for Linux regarding desktop applications. For mobile applications, Android makes up about 70.9% and iOS is 28.4% of market share. Colloquially, we can see the widespread adoption of these operating systems in our everyday lives and looking at the world around us. The majority of our phones, desktops, and interfaces run one of these five OSes.

Q2. Which of the following instructions should be allowed only in kernel mode?
(a) Disable all interrupts.
(b) Change the time-of-day clock.
(c) Read the time-of-day clock.
(d) Clear the memory.

Answer – A) Disable all interrupts

Q3. Consider a computer system that has cache memory, main memory (RAM) and disk, and the operating system uses virtual memory. It takes 2 nsec to access a word from the cache, 10 nsec to access a word from the RAM, and 20 ms to access a word from the disk. If the cache hit rate is 90% and main memory hit rate (after a cache miss) is 98%, what is the average time to access a word

Answer:

Cache access time = 2 ns

RAM access time = 10 ns

Disk access time = 20 ms or 20,000,000 ns

90% of the time it's a cache hit and the access time is 2ns

10% of the time, it's a cache miss so we must access the RAM. If it's a RAM hit, the access time is 10ns for 98% of the time. Else, if the RAM miss for 2% of the time, we have to access the disk which would take 10 + 20,000,000 = 20,000,010 ns

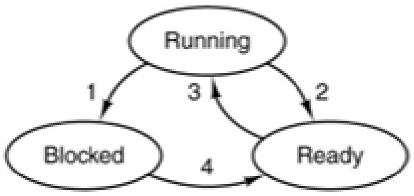
Avg time = Cache hit time*P + Cache miss time*P

Cache hit time * P(cache hit) = 2*0.9 = 1.8 ns

Cache miss time * P(cache miss) = (P(RAM hit) * RAM access time + P(RAM miss) * (RAM access time + disk access time)) * 0.1 = (0.98 * 10 + 0.02 * 20,000,010) * 0.1 = 40,001 ns

Avg access time = 1.8 + 40,001 = 40,002.8 ns

Q4.



In the figure, three process states are shown. In theory, with three states, there could be six transitions, two out of each state. However, only four transitions are shown. Are there any circumstances in which either or both of the missing transitions might occur?

Answer:

For processes to go from blocked to running, it's possible if the CPU runs idle and the block time expires, allowing the process to return to running. For processes to go from ready to blocked, it's impossible because ready processes can't be blocked since only running processes can be blocked.

Q5. What is the biggest advantage of implementing thread in kernel space? What is the biggest advantage?

Answer:

The biggest advantage for threads in kernel space is that they share resources, are light-weighted relative to process creation, supported by the OS, and can achieve true parallelism. However, the cost of context switching is heavy because the kernel must manage the thread table versus user-level threads where kernel doesn't have to intervene. Also, kernel threads can cause race conditions and other synchronization problems, so it increases complexity.

Q6. Five batch jobs A through E, arrive at a computer center at almost the same time. They have estimated running times of 7, 6, 3, 5, and 9 minutes. Their(externally determined) priorities are 3, 2, 1, 5, and 4, respectively, with 5 being the highest priority. For each of the following scheduling algorithms, determine the mean process turn- around time. Ignore process switching overhead.

Answer:

(a) Round robin (with time slice of2 minute)

Cycle	**Job**	**Time Used (min)**	**Remaining Time (min)**
1st	A	2	5
	B	2	4
	C	2	1
	D	2	3
	E	2	7
2nd	A	2	3
	B	2	2
	C	1	0 (completed at time 11)
	D	2	1
	E	2	5
3rd	A	2	1
	B	2	0 (completed at time 17)
	D	1	0 (completed at time 18)
	E	2	3
4th	A	1	0 (completed at time 19)
	E	2	1
5th	E	1	0 (completed at time 22)

Mean TAT = (11 + 17 + 18 + 19 + 22) / 5 = 17.4 mins

(b) Priority scheduling.

Job	Time Need (min)	Turnaround Time (min)
D	5	5
E	9	14
A	7	21
B	6	27
C	3	30

Mean TAT = (5 + 14 + 21 + 27 + 30) / 5 = 19.4 mins

(c) First-come, first served (running order A, B, C, D, E)

Job	Time Need (min)	Turnaround Time (min)
A	7	7
B	6	13
C	3	16
D	5	21
E	9	30

Mean TAT = (7+13+16+21+30) / 5 = 17.4 mins

(d) Shortest job first

Job	Time Need (min)	Turnaround Time (min)
C	3	3
D	5	8
B	6	14
A	7	21
E	9	30

Mean TAT = (3+8+14+21+30) / 5 = 15.2 mins

Q7.

(a) A RAID can fail if two or more of its drives crash within a short time interval. Suppose that the probability of one drive crashing in a given hour C. What is the probability of a k-drive RAID failing in a given hour?

Answer:

P (k-drive failing in given hour) = 1 – (P(no drive failed) + P (exactly one drive failed))

$= 1 - ((1\text{-}C)^{k} + k*C(1\text{-}C)^{1\text{-}k})$

(b) A RAID can fail if three or more of its drives crash within a short time interval. Suppose that the probability of one drive crashing in a given hour is C. What is the probability of a k-drive RAID failing in a given hour?

P (k-drive failing in given hour) = 1 – (P(no drive failed) + P (exactly one drive failed) + P (exactly two drive failed))

$= 1 - ((1\text{-}C)^{k} + k*C(1\text{-}C)^{1\text{-}k} + k(k\text{-}1)*C^{2}(1\text{-}C)^{k\text{-}2})$

Q8. Disk requests come into the disk driver for cylinders 25, 40, 7, 32, 22, 5 and 15, in that order. A seek takes 20 msec per cylinder moved. How much seek time is needed for

Answer:

(a) First-come, first served

Start Cylinder	Destination Cylinder	Seek time (ms)
17	25	160
25	40	300
40	7	660
7	32	500
32	22	200
22	5	340
5	15	200
Total Seek Time		2360

(b) Shortest Seek First (SSF)

Start Cylinder	Destination Cylinder	Seek time
17	15	40
15	22	140
22	25	60
25	32	140
32	40	160
40	7	660
7	5	40
Total Seek Time		1240

(c) Elevator algorithm (initially moving upward). In all cases, the arm is initially at cylinder 17

Start Cylinder	Destination Cylinder	Seek time
17	22	100
22	25	60
25	32	140
32	40	160
40	15	500
15	7	160
7	5	40
Total Seek Time		1160