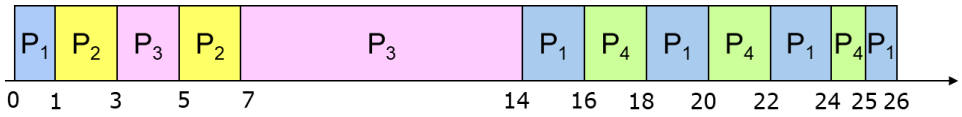
COSC 450 Operating System Midterm #1

3/28/2024

Name:_____.

1.



10.5 Average waiting time = ((13+2+2+2+1)+2+(1+2)+(13+2+2)+/4 =

16.5 Average Turnaround time = (26 +(7 – 1) +(14 -2) + (25 -3))/4 =

2.

- For 2KB: page number = 65350 / 2 x 2^{10} = 31 offset= (65350 – 31 x 2 x 2^{10}) = 1862
- For 4KB: page number= 65350 / 4 x 2^{10} = 15 offset = (65350 – 15 x 4 x 2^{10})= 3910

3.

a) $1 - p^n$

b)

n= (8 GB – 2 GB)/1GB = 6
p= 0.9 CPU utilization =1- $(0.9)^6$ = 0.468 about 46%

c)

n = (16 GB – 2GB) / 1GB = 14, p = 0.9 $1 – (0.9)^{14}$ = 0.771 about 77 %

4.

a) $2^{24} = 2^{14}$ KB = 16MB

b) $1 + 2^{20}$ page tables

c) there are 2^{20} page table and each has 2^{20} entries. # of pages = $2^{20} \times 2^{20} = 2^{40}$ pages

d) # of page frames = 8GB /16MB = $8 \times 2^{30} / 16 \times 2^{20} = 2^{33} / 2^{24} = 2^9$ page frames. The system needs reserve 9 bit for page frame number.

5.

In=false at the beginning

There are two processes P_0 and P_1.

- P_0 is scheduled and P_0 try to go to critical section.
- P_0 read In = false, then time out. P_0 status change from running state to ready state.
- P_1 is scheduled. P_1 try to enter the critical section.
- P1 read In =false and set In = ture then go to critical section.
- Sometimes later in the critical section, P_1 time out. P_1 status changes from running to ready state.
- P_0 rescheduled, and try to enter critical section. P_0 already read In =false before, P_0 set In = true again and enter the critical section.
- Now P_0 and P_1 are in critical section (violate mutual exclusion condition)

6.

a)

virtual address $29885/(2 \times 2^{10}) = 14.59$ in page #14 (map to page frame #245).
virtual page #14 begins with address $14 \times 2 \times 2^{10}$
page frame #245 begin with address $245 \times 2 \times 2^{10}$
physical address = $245 \times 2 \times 2^{10} + (29885 - 14 \times 2 \times 2^{10}) = 501{,}760 + 1{,}213 = 502{,}973$

b)

virtual address $12530/(2 \times 2^{10}) = 6.11$ in page #6 which is map to page frame #2
virtual page #6 begin with address $6 \times 2 \times 2^{10}$
page frame #2 begin with address $2 \times 2 \times 2^{10}$
physical address = $2 \times 2 \times 2^{10} + (12530 - 6 \times 2 \times 2^{10}) = 4{,}096 + 242 = 4338$

7.

a)

Sol) Possible maximum size of virtual space = $2^{32} = 2^{22} \times 2^{10} = 2^{22}$ **KB**

$\therefore$ Maximum # of pages per a process = virtual space / a page size = $2^{22}/4 = 2^{20}$ pages .

Since maximum number of pages is 2^{20} pages, there are 2^{20} possible entries in a page table.
Maximum size of page table per a process = number of pages $\times$ one entry size

= $2^{20} \times 64$ bits = $(2^{20} \times 64)/8$ Byte= $2^{20} \times 8$ byte= **8 MB**

b)

# of page frame = size of RAM / size of page = 32 GB / 4 KB = $32 \times 2^{30} / 4 \times 2^{10} = 2^{23}$ page frames $\therefore$ **23 bits for page frame number.**

8. Short answer questions

a) since second generation OS does not support multiprogramming.

b)

a. Protection between jobs
b. Job scheduling

c) - A situation where two or more processes are reading or writing some shared data and the final result depends on who runs precisely when, are called race condition.

d) Since context switch between processes need very expensive overhead.

e) aging

f) limited size of memory, big size processes.

g) smaller page size means bigger page table, bigger page size means internal fragmentation.

h)

(Sol) OS involved in creation of both. OS take care mutual exclusion and synchronization for message queue but not shared memory.

i) MMU

j)

a. Throughput – number of processes completed per time unit
b. Turnaround time – the interval from the time of submission to the time of completion of a process.

9.

1. Lets assume count is currently N, producer read check count == N and then time out before go to sleep.
2. Consumer remove one item from the buffer and reduce count to N-1. The consumer check count is N- 1, call wakeup() to wake up the producer. Since producer did not sleep yet, the signal will be lost.
3. Control back to producer, the producer already checked count =N, so go to sleep.

Control back to consumer, consumer will consume all items eventually, then go to sleep. Now, both consumer and producer sleep

10.

a) To avoid constantly storing the entire page table in memory, which would waste memory space.

b) Hashing idea can reduce the number of entries in a page table.

c)
Depends on memory size.
Number of entries in inverted page table = size of memory / size of a page frame.

11.

The TLB contains a subset of frequently accessed page table entries. When the CPU generates a logical address, the Memory Management Unit (MMU) first checks the TLB to obtain the page frame number. If the page number is found in the TLB (a 'hit'), the corresponding frame number is immediately available, and the MMU can map the physical address for memory access.

If the page number is not in the TLB, the system needs to search the page table to retrieve the page frame number for mapping the physical address. The result of this search is then added to the TLB for future reference.