CS3360: Homework #1

Due on Friday, Feb, 3rd @11:55 pm (Canvas submission)

PLEASE READ: You may discuss this problem set with other students as long as you do not share/verify answers. However, you must also write the names of other students you discussed any problem with. You must write up your answers on your own showing your work. Each problem has a different weight. Please state any assumptions you are making in solving a given problem. Late assignments will not be accepted with prior arrangements. By submitting this assignment, you acknowledge that you have read the course syllabus and abiding by the copyright (e.g., no posting) and Honor Code (e.g., not using note-sharing sites such as Chegg, OneClass, CourseHero, etc.) requirements

Problem 1

Consider the following two alternatives in which keyboard interrupts can be handled.

Scenario 1: Each character typed causes an interrupt service routine to execute for 0.01 millisecond (to copy the character typed from the keyboard to memory). You can assume that a computer user is typing at an average rate of 200 characters per minute.

Scenario 2: Every 50 milliseconds an interrupt service routine executes for 0.1 milliseconds and copies any buffered data from the keyboard to memory. Answer the following questions:

Answer the following questions:

a) What percentage of the CPU's utilization would be used in handling interrupts in each scenario? [4pts]

   A- .0033% would be utilized to handle the interrupts

   B- .002% would be utilized to handle the interrupts

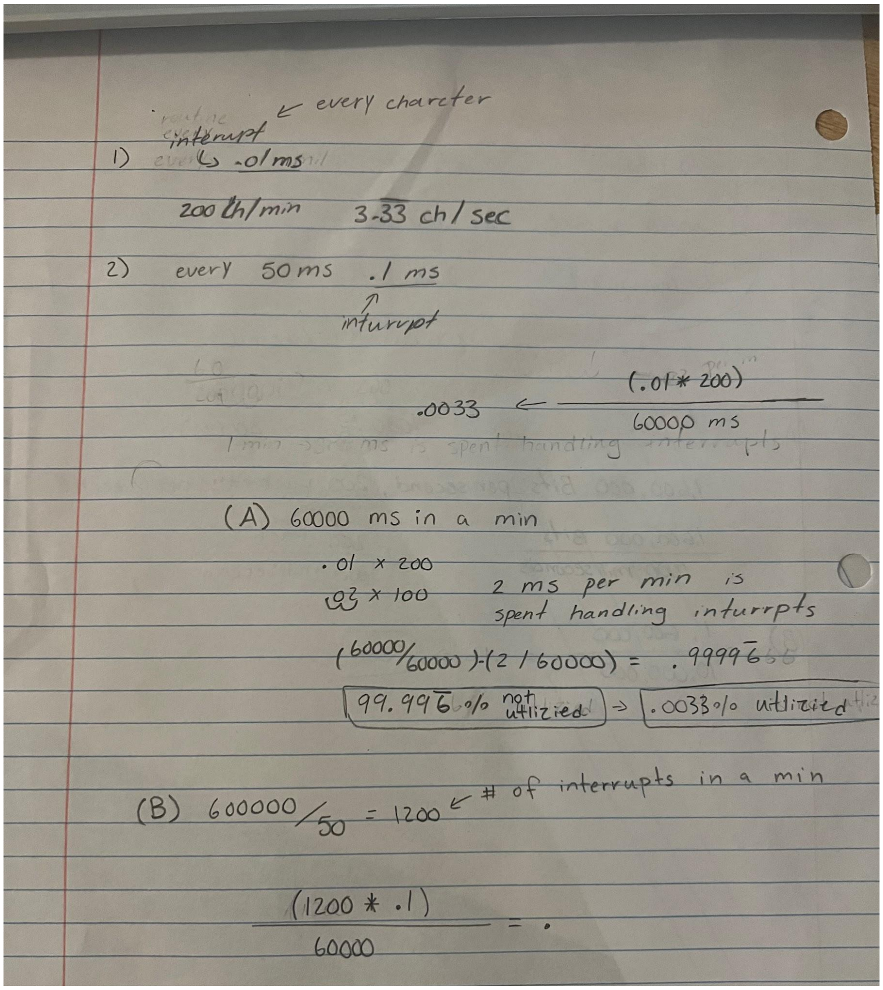
b) Give one advantage of scenario 1 over scenario 2. [2pts]

   Scenario 1 uses more CPU utilization but it is down for shorter periods of time So you have to wait for less while you are working

c) Give one advantage of scenario 2 over scenario 1. [2pts]

   Scenario 2 uses less CPU utilization so it allows the system to focus more on the typing

Work for problem 1



interrupt ← every charcter

1) ↳ .01 ms

200 ch/min $3.\overline{33}$ ch/sec

2) every 50 ms   .1 ms

↑ inturrupt

$.0033 \leftarrow \frac{(.01 * 200)}{60000 \text{ ms}}$

(A) 60000 ms in a min

.01 × 200

.02 × 100

2 ms per min is spent handling inturrpts

$(60000/60000) - (2/60000) = .999\overline{6}$

$\boxed{99.99\overline{6}\ \% \text{ not utilized}} \rightarrow \boxed{.0033\% \text{ utilized}}$

(B) $600000/50 = 1200$ ← # of interrupts in a min

$\frac{(1200 * .1)}{60000} = .$

Problem 2

A network card in a computer is connected to a switch with a link capable of delivering 10 Mbps (Megabits per second). The network card receives an average of 10 packets every 50 milliseconds from a streaming connection. Assume that each packet is 1000 Bytes. Answer the following questions

a) What is the average throughput achieved by the streaming connection? Assume no packets are dropped [2pts]

200 packets are delivered every second or 200 packets/1000 milliseconds
1,600,000 bits are also delivered every second within those packets

b) What is the average utilization of the network link?[2pt]

We are only moving 1,600,000 bits per second while the network link can move 10,000,000 bits per second so we are only utilizing (1,600,000/10,000,000) .16 of the network link or only 16%

Work for problem 2

send
↳ msg
10 mBS   10 pkts ever 50 ms

each packet has 1000 bytes
↓
1 byte = 8 Bites   8000 Bits

→ 10,000,000 Bits/second

(A)

$1000/50 \rightarrow 20(10)$

1,600,000 Bits per second, 200 packets per second

$\frac{1{,}600{,}000 \text{ Bits}}{1000 \text{ miliseconds}}$ $\frac{200 \text{ Packs}}{1000 \text{ miliseconds}}$

(B) $\frac{1{,}600{,}000}{10{,}000{,}000} = .16 \rightarrow \boxed{16\%}$

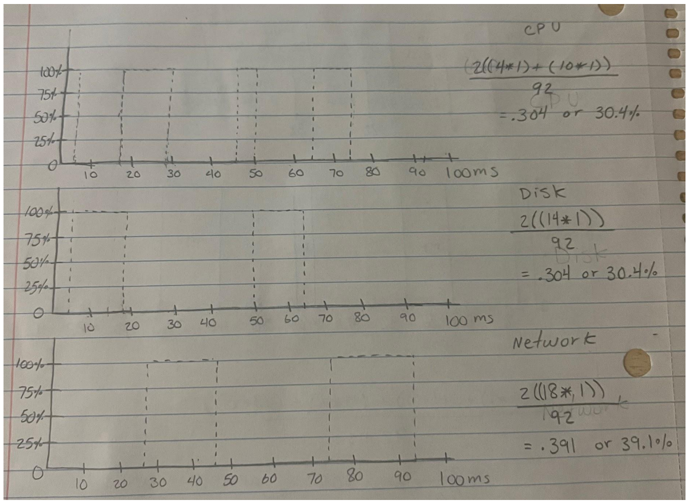
Problem 3

Consider a program that performs the following steps repeatedly:

1. Use the CPU for 4 milliseconds
2. Issue an I/O to disk for 14 milliseconds
3. Use the CPU for 10 milliseconds
4. Issue an I/O to the network for 18 milliseconds

Assume that each step depends on data obtained from the previous step (e.g. step 3 cannot start before step 2 is completed) Answer the following questions

a) Draw 3 time-line diagrams (time on the x-axis and utilization on the y-axis) that illustrate the utilization of the CPU, disk, an network over the execution of two iterations of the program above [3pts]



b) What are the average utilization of the CPU, disk, and network over these two iterations?[3pts]

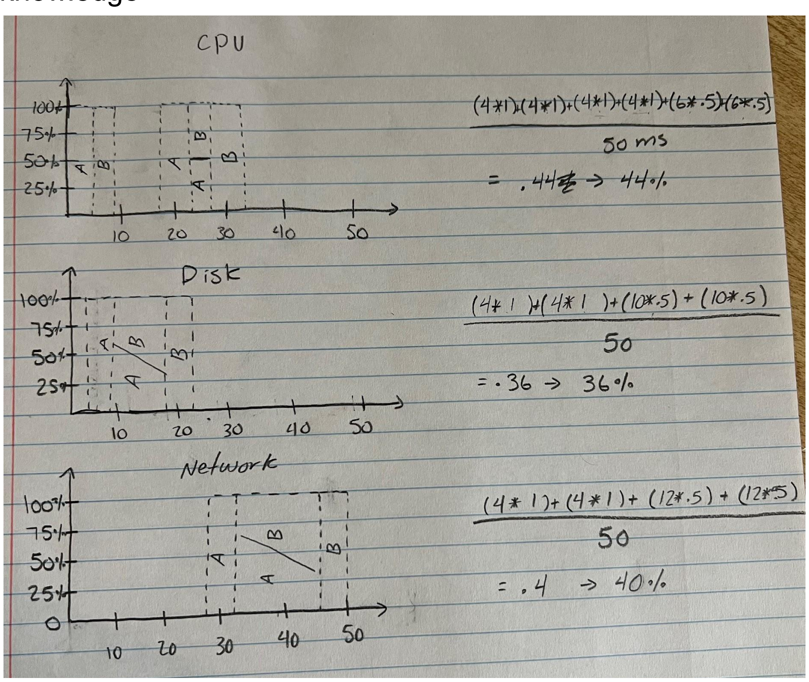
The utilization for CPU over 2 iterations is .304 or 30.4%

The utilization for Disk over 2 iterations is .304 or 30.4%

The utilization for Network over 2 iterations is .391 or 39.1%

c&d) Assume that there are two independent processes of the program above running in a multiprogramming system (i.e., when a process blocks for I/O another process and get the CPU) answer parts (a) and (b) for this case showing which part belong to which process. You can ignore the time spent in context switching [6pts]

Not quite sure if I did this one correctly but here is what I got using the best of my knowledge



Problem 4

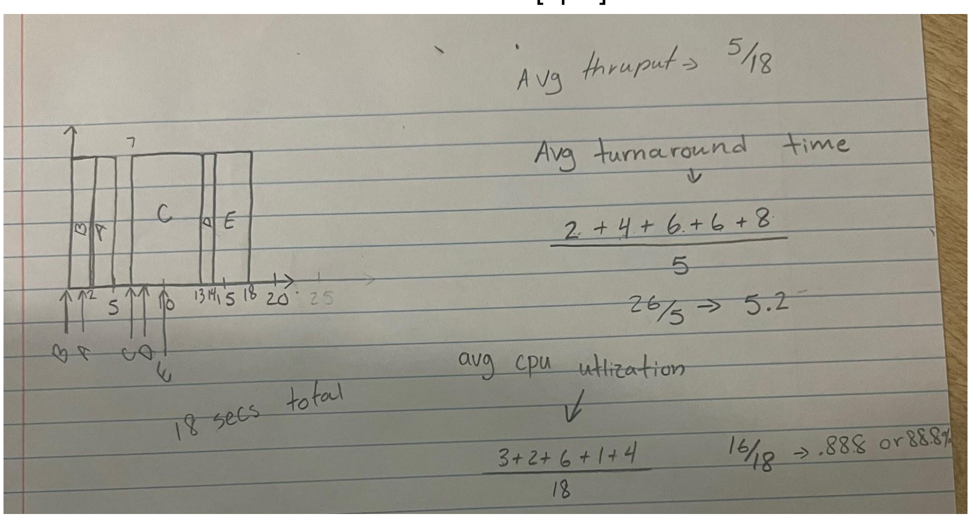
Consider 5 processes, A, B, C, D, and E, arriving at a system with a single CPU according to the table below. Each process has an arrival time and service time (time needed on the CPU). Assume the CPU services these processes in a first-in-first-out (FIFO) fashion. Also, assume that the CPU is used 100% of the time during the service time of any process

	Arrival Time	Duration (service time needed)
Process A	1	3sec
Process B	0	2sec
Process C	7	6sec
Process D	8	1sec
Process E	10	4sec

Answer the following Questions:

a) How long would it take until all the process are done?[2pts]
The process would all be done at 18 secs

b) Draw the utilization of the CPU over time.[2pts]



c) What is the average utilization of the CPU[2pts]
Average utilization for the CPU is .888 or 88.8%

d) What is the overall system throughput in processes done per second?[2pts]
The throughput was 5 tasks/18 secs = .278 tasks per second

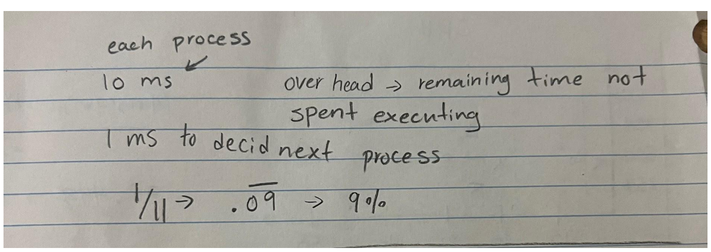
e) What is the average turnaround time for all the processes?[2pts]
The average turnaround time for the processes - 5.2
Found by taking the (finish time - arrival time) for all the processes adding those numbers together and dividing by the number of processes, 5 (26/5=5.2)

Problem 5

a) What is the overhead of context switching if a short-term schedular takes 1 millisecond to decide on the next process to execute on the CPU and it gives each process 10 milliseconds of execution time? Assume the CPU never goes idle. [2pts]
The process takes 10 ms and the deciding takins 1 ms the overhead will be 1/11 or .09 in a percent it would be 9%

b) Give two conditions upon which the context switch must occur in a multiprogramming system. [2pts]
Context switching will occur when the process has to switch from one process to another, one context may be that a process with a higher priority is being executed at the same time the context switching will occur another condition is if that process is already using that register while another process is trying to get access to it at this point the machine will have to stall of skip and come back when that register is available again

Work for number 5



Problem 6

Suppose that the Mean Time between failures (MTBF) of a single hard disk is 100,000 hours. Also, assume that disk failures are independent of each other. Answer the following questions:

a) What is the MTBF of a file system (i.e., a failure here is when any disk fails) composed of 20 disks? [2pts]
5,000 hours there are 20 disks total and the repair time is 100,000
(5000 = 100000/20)

b) What is the MTBF of a data center (i.e., a failure here is when any disk fails) composed of 20,000 disks? [2pts]

    5 hours there are 20,000 disks total, and the repair time is 100,000
    (5 = 100,000/20,000)

c) If your answer for part (b) is not acceptable for the operation of the data center, what can be done? [2pts]

    My answer for 2 is somewhat acceptable to be only down for 5 hours over a span of 20000 isn't bad at all

Work for problem 6

$$\frac{100{,}00\cancel{0}}{2\cancel{0}} = 5{,}000 \text{ hours}$$

$$\frac{10\cancel{0}{,}\cancel{000}}{2\cancel{0}{,}\cancel{000}} = \frac{10}{2} = 5 \text{ hours}$$

Problem 7

Consider two learning management systems (let's denote them by A and B). both systems go down for maintenance for 2 hours every month. System A goes down once per month for 2 hours, whereas system B goes down 6 times per month for 20 minutes each time. Answer the following questions:

a) What is the availability of system A?[2pts]

    99.72% availability both systems are only down for 2 hours out of the month

b) What is the availability of system B?[2pts]

    99.72% availability both systems are only down for 2 hours out of the month

c) What is the MTBF of system A?[2pts]

    718 hours (720 hours (in a 30-day month) - 2 hours for system down)

d) What is the MTBF of system B?[2pts]

    119.667 hours

Work for problem 7

2 hours per month

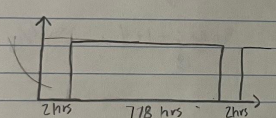
30 days

24 in each day

720 hours a month

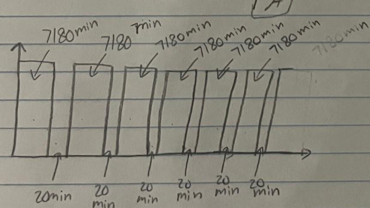
$(720/720) - (2/720) = .99722$

99.72 % avalibility ← Both systems



system A

$\frac{718 \text{ hours}}{1}$ = MTBF 718 hours for system A



43200 → mins in a 30 day month

43200 - 6(20)

$\frac{6(7180)}{6}$ → 7180/60

MTBF → 119.667 hours

for system B