Problem Set 1 - Spring 2024

Due at the end of Unit 1: _____

Name: _____

The problem sets ask questions about the important concepts of the reading and lecture materials. Each question should be answered in 1-4 paragraphs (no more 150 words).

We are looking for answers in your own words, NOT copies of the explanation given online, in the book, or in lecture material. Please explain your answers as if we are sitting together at a table discussing computer science concepts.

1. (10 pt) What are the three high level features that are provided by an Operating System? (describe each feature)

2. (5 pt) Why does an Operating System need protection from user code?

3. (5 pt) What are the four major components of an Operating System? (describe each)

4. (5 pt) How does a user application access system code within the Operating System? (list the steps, describe how CPU knows what code is running)

5. (10 pt) Describe the differences between multi-programming and multi-tasking?

6. (5 pt) What is a context switch? Describe the mechanism, the reasons for a switch, and what needs to be switched.

7. (5 pt) What are the three ways of communicating between processes or threads? (describe each feature)

8. (5 pt) How does RCP work? Why would you use this mechanism?

9. (10 pt) Compare and contrast creating a process (*via fork()*) and creating a thread for a process (*via pthread_create()*). Be sure to include the information copied and the information shared. Describe each term, discuss what is common between them, what is unique to each, and where you would use each of the concepts.

10. (10 pts) Describe the four major benefits of virtualization.

11. (5 pts) Describe why using a virtual machine is perfect for operating system development.

12. (10 pts) Is it always crucial to know that the message you have sent has arrived at its destination safely? If your answer is "yes," explain why. If your answer is "no," give appropriate examples.

13. (5 pt) Given the code below answer the following questions (explain your reasoning):

    a. Is the function thread safe?
    b. Is the function reentrant?

```
int temp;
void swap(int *y, int *z)
{
int local;

local = temp; temp = *y;
*y = *z;
*z = temp; temp = local;
}
```

14. (10 pt) Provide a timing chart for the processes listed below using multi-programming and another when using multi-tasking. The values are all in the number of ticks and you can assume no switching overhead. The multi-tasking timeline should assume a 20 tick time block. The IO column indicates when within the process an IO request is made and how long the wait for IO completion will take.

The table lists each process and its execution time, time of arrival, and the execution pattern with IO wait times. The process execution pattern for a process that runs for 10 ticks, pauses for IO for 20 ticks, and finishes executing its final 30 ticks would have a pattern *10 <20> 30* listed in the last column.

Process	Length	Arrival Time	Execution and IO wait times
P1	40	0	20 <30> 20
P2	20	10	none
P3	25	30	none