1. Explain the difference between the **CPU** and **I/O** cycles that make up a program.

**I/O** cycles handle input that precedes the CPU cycle and the output that comes after. **CPU** cyclesdeals with the direct calculations with the given inputs from the initial I/O cycle. Given the nature of simplicity of input and output, CPU cycles take much longer than I/O.

1. Can a process run during an **I/O** cycle?

No because it requires either an interrupt or finish the CPU process.

1. Explain how the **Process Control Block** (PCB) is used to manage a process within the system.

A PCB is given to each new process and is updated as the job progress from beginning to end. The PCB tracks process status, process state and its’ unique process ID. Additionally, accounting information is available to keep track of resource use for financial purposes.

1. What are the three (3) states of the **Process Scheduler**?

* **Waiting State:** A job cannot be continued until some type of resource is allocated.
* **Ready State:** This state indicates that a job is available to keep on processing.
* **Running State:** The job is currently being processed.

1. List all of the paths a process can take between the three (3) states of the **Process Scheduler**.

* **RUNNING can go back to the READY** state if an **Interruption** of some sort is detected.
* **RUNNING can initiate WAITING** status if an **I/O request is involved.**
* **WAITING can return to READY** status if an **I/O request was satisfied.** (Ready to keep processing)

1. What are some advantages and disadvantages of using a single I/O interrupt queue?

Advantages: Processor doesn’t have to wait on I/O to complete.

Disadvantages: It is only a single I/O, you can only complete one process at a time.

1. What are some advantages and disadvantages of using multiple I/O interrupt queues?

Advantages: Improves performance, can do one read and one write at the same time

Disadvantages: More expensive to run, can strain hardware.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Job** | A | B | C | D | E | F |
| **Arrival Time** | 0 | 2 | 4 | 6 | 8 | 10 |
| **CPU Cycles** | 8 | 1 | 5 | 2 | 4 | 3 |

1. Refer to the table above to answer the following questions.  
   1. What is the average turnaround time for the First-Come, First-Served (FCFS) process scheduling algorithm?

* Job A Turnaround Time: 8 – 0 = *8*
* Job B Turnaround Time: 9 – 2 = *7*
* Job C Turnaround Time: 14 – 4 = *10*
* Job D Turnaround Time: 16 – 6 = *10*
* Job E Turnaround Time: 20 – 8 = *12*
* Job F Turnaround Time: 23 – 10 = 13

Sum of turnarounds: 60 / Total number of jobs: 6 = **10 Average Turnaround**

* 1. What is the average turnaround time for the Shortest Job Next (SJN) process scheduling algorithm?
* Job A Turnaround Time: 8 – 0 = *8*
* Job B Turnaround Time: 9 – 2 = 7
* Job C Turnaround Time: 23 – 4 = 19
* Job D Turnaround Time: 11 - 6 = 5
* Job E Turnaround Time: 18 – 8 = 10
* Job F Turnaround Time: 14 – 10 = 4

Sum of turnarounds: 53 / Total of jobs: 6 = **8.83 Average Turnaround**

* 1. What is the average turnaround time for the Shortest Remaining Time (SRT) process scheduling algorithm?
* Job A Turnaround Time: 23 – 0 = 23
* Job B Turnaround Time: 3 – 2 = 1
* Job C Turnaround Time: 11 – 4 = 7
* Job D Turnaround Time: 8 – 6 = 2
* Job E Turnaround Time: 18 – 8 = 10
* Job F Turnaround Time: 14 – 10 = 4

Sum of turnarounds: 47 / Total of jobs: 6 = **7.83 Average Turnaround**

* 1. What is the average turnaround time for the Round Robin process scheduling algorithm with a time quantum of 2?

Sum of turnarounds: 47 / Total of jobs: 6 = **11 Average Turnaround**

* 1. Does changing the time quantum to 3 increase or decrease the average turnaround time for the Round Robin process scheduling algorithm?

Sum or turnarounds: 65 / Total of jobs: 6 = **10.83 Average Turnaround**

1. In general, which process scheduling algorithm produces the smallest average turnaround time?

The **Shortest Remaining Time Algorithm** produces the smallest average.

1. Explain the advantages and disadvantages of a non-pre-emptive process scheduling algorithm.

**Advantages:** Low overhead, less cost.

**Disadvantages:** Users would not have a fast response on an interactive system and cannot estimate CPU use in advance. It also can cause important processes to be blocked off by unimportant ones.

1. Explain the advantages and disadvantages of a pre-emptive process scheduling algorithm.

**Advantages:** Gives users a smooth experience as no one job has a monopoly over resources, flexible, immediate CPU access to most processes.

**Disadvantages:** Can be detrimental if important data is being modified.