A+ will be down for a version upgrade on Tuesday 03.01.2023 at 9-12.

This course has already ended.

Process description and control exercises

Exercise 1

⚠ The deadline for the assignment has passed (Sunday, 9 October 2022, 23:59).

Fault Tolerance, Process Description, and Control questionnaire

1. Review questions. Please consult Chapter 3 from "Operating Systems - Internals and Design Principles" by William Stallings

Question 1   1 / 1

What is an instruction trace?

○ a listing of the instruction opcodes that execute for a process

● **a listing of the sequence of instructions that execute for a process**

○ a listing of the sequence of instructions that form the entire compiled code of a process

✔ Correct!

Question 2   1 / 1

What does it mean to preempt a process?

☑ **Preemption is defined to be the reclaiming of a resource from a process before the process has finished using it.**

☐ The OS has preempted a process, if the OS learns that the event upon which another process has been waiting has occurred.

☑ **The OS interrupts the running process and dispatches another process.**

✔ Correct!

Question 3   1 / 1

Which are characteristics of a suspended process?

☑ **The process is not immediately available for execution.**

☐ The process is always waiting on an event.

☑ **The process was placed in a suspended state by an agent.**

☑ **The process is not in main memory.**

✔ Correct!

Question 4   1 / 1

For what types of entities does the OS maintain tables of information for management purposes?

☑ **memory tables**

☐ user tables

☑ **I/O tables**

☐ IP address tables

✔ Correct!

Question 5   1 / 1

What are the elements of a process image?

☐ the CPU registers

☑ **the user stack**

☑ **the private address space of the process**

☐ a list of system calls

✔ Correct!

Question 6   1 / 1

What are the steps performed by an OS to create a new process?

○ The OS stops the currently running process, builds the data structures used to manage the new process, and allocates address space in main memory to the process.

○ The OS removes unused processes, stops the currently running process, builds the data structures used to manage the process, and allocates address space in main memory to the process.

◉ **The OS builds the data structures used to manage the process, and allocates address space in main memory to the process.**

✔ Correct!

Question 7   1 / 1

Select the most complete definition of an interrupt:

◉ **A signal from a hardware device and is independent of the currently running process, such as the completion of an I/O operation.**

○ A signal from a hardware device.

○ A signal from both software and hardware components of a system that is handled by special code.

✔ Correct!

Question 8 1 / 1

Which are valid examples of interrupts?

☑ **software interrupts, hardware interrupts**

☑ **I/O interrupts, timer interrupts**

☐ weekly interrupts, pixel interrupts

✔ Correct!

Submit

Exercise 2

⚠ The deadline for the assignment has passed (Sunday, 9 October 2022, 23:59).

Fault Tolerance, Process Description, and Control

Please make sure that you only enter valid (as in the examples), non-empty inputs for the following exercises. Please try to work on problems outside of A+ first (e.g. a text editor) and only copy the answers in. Do not press Enter by mistake, as that will submit your answers prematurely. Contact TAs in case of any problems.

1. Priority scheduling

A system adopts a priority-based preemptive scheduling where a process arrives with an initial priority number. The system will always schedule the process with the highest priority (LOWER priority number = HIGHER priority). If multiple processes have the same priority, the one that arrived sooner will be scheduled (e.g. P1 will be scheduled over P2). Every time a process is running uninterrupted for 5ms, the system will increment its priority number by 1 - making the scheduling "fairer" by trying to unblock processes. The dispatcher takes 2 ms for a process switch, where no process is being executed during the switch. We also assume processing can always resume from where it stopped when a process is re-scheduled.

In a recorded time span, the system has 3 processes: P1, P2, P3. As shown in the following table:

Process ID	Initial Priority	Arrival time(ms)	CPU time required to finish(ms)
P1	1	0	15
P2	2	5	8
P3	1	10	4

<u>Hint:</u> This exercise is much easier if you draw a timing diagram - to visualize what is happening at every 1 ms.

a) 2 points

What is the turnaround time (in ms) for process P1?

Answer is an integer

b) 2 points

What is the turnaround time (in ms) for process P2?

Answer is an integer

c) 1 point

What is the turnaround time (in ms) for process P3?

Answer is an integer

2. Process trace

Suppose that three interleaved processes are running in a system having start addresses 4050, 3200, 6700. The system's dispatcher has a starting address of 200 and the dispatcher cycle has 2 instructions. The system uses a Round-Robin scheduler where the dispatcher is invoked after 4 instructions OR for an interrupt OR when a process finishes.

The traces of the processes and the dispatcher are as follows:

Process P1	Process P2	Process P3	Dispatcher
4050	3200	6700	200
4051	3201	6701	201
4052	3202	6702	
4053		6703	
4054		6704	
4055		6705	
I/O		6706	
		6707	

a) 5 points

What is the trace of instructions being executed until all 3 processes complete?

Write out the answer in the field below as a list of space-separated addresses. E.g:

```
4050 4051 3020 3021 3033 200 203
```

3. Mean time between failure and annual failure rate

Mean time between failure (MTBF) is the predicted mean time between inherent failures of a (repairable) mechanical or electronic system.

Values can vary significantly, especially for systems with moving parts, like disk drives. It depends on the quality of the particular production batch, which is far from constant. It is hard for manufacturers to detect quality problems and there are too many variables: machinery tuning, clean room impurities, material quality etc.

Moreover, the appearance of failures does not follow a uniform distribution. Often, failure rate is high for new equipment (early mortality) and at the end of equipment's life. This forms a bathtub curve.

Manufacturers often provide impressive MTBF values - e.g. 10^6-h run time (about 114 years) for disk drives is standard.

a) 3 points

Let's say that a disk drive has an MTBF of 34 years. What is the AFR (https://en.wikipedia.org/wiki/Annualized_failure_rate) in failures/year?

Answer is an integer obtained after multiplying the 3 decimal precision float by 1000. E.g. for 0.999 enter 999, for 12.672 enter 12672

b) 2 points

Imagine a large server system that contains 200 of these disk drives. What would the AFR of that system be?

Answer is an integer obtained after multiplying the 1 decimal precision float by 10. E.g. for 0.9 enter 9, for 0.2 enter 2

4. Mean time between failure and repair

Mean time to repair (MTTR) is the average time it takes to repair a system (this includes repair + testing). A system can only be repaired after it has failed!

Mean time between failure (MTBF) is the predicted mean time between inherent failures of a (repairable) mechanical or electronic system.

A computer has a MTBF (mean time between failure) = 34 hr and a MTTR (mean time to repair) = 2.5 hr.

a) 2 points

What is the availability of the system?

Hint: Availability measures the probability that a system is not failed or undergoing a repair action when it needs to be used

Answer is an integer obtained after multiplying the 4 decimal precision float by 10000. E.g. for 0.9999 enter 9999, for 12.6722 enter 126722

b) 3 points

If the MTTR is reduced to 1.5 hr, what MTBF can be tolerated without decreasing the availability of the computer?

Use the answer you got in part a. Answer is an integer obtained after multiplying the 4 decimal precision float by 10000. E.g. for 0.9999 enter 9999, for 12.6722 enter 126722

Submit