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

This course has already ended.

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System operation exercises

Exercise 1

⚠ The deadline for the assignment has passed (Saturday, 1 October 2022, 22:00).

System operation questionnaire

1. General questions. *(Hint: Answers to these question you will find in Chapter 2 of "Computer Organization and Design - The hardware/software interface", David Patterson, John Hennessy. You can also Google for some of the answers.)*

Question 1 **1 / 1**

In terms of CPU architectures, choose ALL that are correct:

- [ ] x86 can natively run x86-64 programs
- [x] **x86-64 can natively run x86 programs**
- [ ] ARM can natively run x86 programs
- [ ] x86 can natively run ARM programs

✔ Correct!

Question 2 **1 / 1**

In their CPU, typical smartphones use:

- (•) **ARM**
- ( ) x86
- ( ) x86-64
- ( ) AMD64
- ( ) Intel 64

- ○ PowerPC

✔ Correct!

Question 3 **1 / 1**

What is the difference between x86-64, AMD64 and Intel 64?

- ○ They are competing architectures designed by three different companies
- ◉ **They are essentially the same architecture with a different marketing name and minor differences**

✔ Correct!

Question 4 **1 / 1**

What are THREE objectives of an OS design?:

- ☑ **Convenience: An operating system makes a computer more convenient to use**
- ☐ Economics: An operating system generates maximum revenue for its creator
- ☑ **Ability to evolve: An operating system should be constructed in such a way as to permit the effective development, testing, and introduction of new system functions without interfering with service**
- ☑ **Efficiency: An operating system allows the computer system resources to be used in an efficient manner**
- ☐ Transparency: An operating system should be open-source, so as to allow anyone to update the source code, apply patches, and distribute updated versions to users

✔ Correct!

Question 5 **1 / 1**

What is the kernel of an OS?:

- ○ The portion of the operating system that first initializes RAM as soon as the computer boots up
- ○ The portion of the operating system that is responsible for user applications
- ◉ **The portion of the operating system that includes the most heavily used portions of software, runs in a privileged mode, and responds to calls from processes and interrupts**

✔ Correct!

Question 6 **1 / 1**

What is multiprogramming?:

- ◉ **A mode of operation that provides for the interleaved execution of two or more computer programs by a single processor**
- ○ A style of programming where more than one programming languages are used to build a complete application

- ○ An operating system feature that allows for multiple kernels to be loaded and swapped on-demand

✔ Correct!

Question 7 **1 / 1**

What is a process?:

- ○ A segment of a thread, which is controlled and scheduled by the operating system
- ◉ **A program in execution, which is controlled and scheduled by the operating system**
- ○ A program that only runs in the background and is solely responsible for setting up hardware peripherals

✔ Correct!

2. Data centers and cloud services *(Hint: When answering the following questions, you may find this paper very helpful https://dl.acm.org/doi/fullHtml/10.1145/1721654.1721672)*

Question 8 **1 / 1**

Choose ALL that are correct:

- ☐ Online content management systems, such as WordPress, can be seen as an IaaS (Infrastructure as a Service), because they offer the infrastructure to create anything from a simple blog to a full eCommerce website.
- ☐ One of the main advantages of SaaS (from user perspective) is that the user gains full control over the provided software.
- ☑ **One of the main advantages of SaaS (from user perspective) is the ease of use.**
- ☐ A typical PaaS allows the user to fully control and customize the underlying operating system. This can be useful, for example, when the user requires a specific version of the OS or needs to install custom software and drivers.
- ☑ **A typical PaaS allows the available computational resources, along with the usage costs, to be (manually or automatically) scaled based on the current needs.**
- ☑ **Cloud service servers typically have hardware that supports virtualization. For example, CPU virtualization allows multiple users to simultaneously use the same CPU in isolation without having any knowledge about the other users.**

✔ Correct!

Question 9 **1 / 1**

Choose ALL that are correct:

- ☑ **SaaS allows the user to use the software provided by the service.**
- ☑ **PaaS allows the user to deploy their own software on a scalable platform provided by the service. This software typically has to be supported by the underlying software stack.**
- ☑ **IaaS allows the user to deploy their own software stack on the virtual machines provided by the service.**

- [ ] IaaS allows the user to specify server hardware, such as CPUs, GPUs and storage devices that are then purchased, installed and managed by the service provider. This equipment is installed directly on-site of the buildings owned by the user.

✔ Correct!

Question 10 **1 / 1**

Choose ALL that are correct (check https://blog.scaleway.com/understanding-network-latency/):

- [ ] It is theoretically impossible to achieve a latency (round-trip-time) of 50 ms from Otaniemi to a cloud service located near New York, North America.
- [x] **It is reasonable to expect a latency (round-trip-time) of <100 ms from Otaniemi to a cloud service located in Europe.**
- [x] **Minimizing latency is one of the reasons cloud providers have multiple data centers geographically scattered around multiple countries.**
- [ ] You should always choose a cloud service provider which provides the smallest latency. Latency is the most important aspect when using cloud services.

✔ Correct!

Submit

Exercise 2

⚠ The deadline for the assignment has passed (Saturday, 1 October 2022, 22:00).

Processor Utilization and Task Scheduling

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. Multiprogramming scheduling

Suppose we have three jobs in a multiprogramming computer system: JOB1, JOB2, JOB3.

1. JOB1 requires 6s of CPU time
2. JOB2 requires 4s of CPU time
3. JOB3 requires 2s of CPU time

We define the following quantities for system utilization:

1. Turnaround time = actual time to complete a job
2. Throughput = average number of jobs completed per time period T

3. Processor utilization = percentage of time that the processor is active (not waiting)

The multiprogramming system follows a simple round-robin scheduling (processes are scheduled in the order of their number, e.g. JOB1 is first). Each process gets 2s of CPU time turn-wise in a circular manner.

a) 2 points

What is the turnaround time for JOB1?

Answer is an integer (in seconds)

b) 3 points

What is the throughput for the system?

Answer is in float (per second)

c) 2 points

What is the processor utilization percentage?

Answer is an integer (percentage)

2. Uniprogramming scheduling

Suppose we have two jobs in a uniprogramming computer system: JOB1, JOB2.

1. JOB1 requires 2s of disk time, followed by 4s of CPU time, followed by 2s of I/O time
2. JOB2 requires 0s of disk time, followed by 8s of CPU time, followed by 8s of I/O time

We define the following quantities for system utilization:

1. Turnaround time = actual time to complete a job
2. Throughput = average number of jobs completed per time period T
3. Processor utilization = percentage of time that the processor is active (not waiting)

We assume the processor is NOT utilized for any disk or I/O tasks.

a) 2 points

What is the turnaround time for JOB2?

Answer is an integer (in seconds)

b) 3 points

What is the throughput for the system?

Answer is a floating point number (3 decimal places)

c) 2 points

What is the processor utilization percentage?

Answer is an integer (percentage)

3. CPU and DMA

With DMA, the CPU first initiates the transfer, then it does other operations while the transfer is in progress, and it finally receives an interrupt from the DMA controller when the operation is done. DMA module (https://en.wikipedia.org/wiki/Direct_memory_access) is transferring characters to main memory from an external device transmitting at 10800 bits per second (bps). Each character is 8 bits wide. The processor can fetch instructions at the rate of 1 million instructions per second. Assume that: a) the CPU is only fetching instructions, b) each fetch takes one cycle, c) interrupt handling does not consume CPU cycles.

a) 4 points

By how much will the processor be slowed down due to the DMA related activity (initiate transfer and handle interrupt)? In other words, what is the percentage of CPU cycles "stolen" by the DMA operations?

Answer is a int obtained after multiplying the two decimals precision (in percentage) float by 100. For example, for 0.99% enter 99 and for 12.67% enter 1267.

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