VE482 - Homework 1

Introduction to Operating Systems

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Ex. 1 - Revisions

Stack and heap are two different ways regarding memory allocation. The stack is the memory set aside as scratch space for a thread of execution. The stack memory is allocated for variables when a function is called. And the heap is memory set aside for dynamic allocation during execution of instructions.

	stack	heap
Access time	faster	slower
Space size limit	smaller	larger
Allocation and free	done by compiler	done by programmer
Resize	not support	support
Cost	less	more

Ex. 2 - Personal research

1. When the computer is powered on, BIOS(Basic Input/Output System) is first launched and do series of actions to ensure the OS runs correctly. First, bootloader will be launched to run tasks including POST(Power On Self Test) and MBR(Master Boot Record) to run hardware tests, search for existing OS and initialize it. And then the control of hardwares will be handed over to the OS.
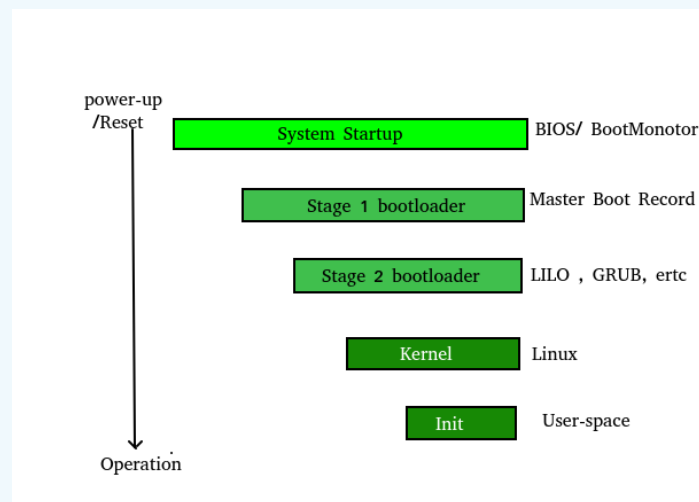
Figure 1: Boot Process

2. Hybrid kernel is a kernel architecture based on a combination of microkernel and monolithic kernel architecture used in computer operating systems. This kernel approach combines the speed and simpler design of monolithic kernel with the modularity and execution safety of microkernel.

   Exo kernel is a type of operating system developed at the MIT that seeks to provide application-level management of hardware resources. The exokernel architecture is designed to separate resource protection from management to facilitate application-specific customization.

Ex. 3 - Course application

1. a), c), d)

   In kernel mode, the executing code has complete and unrestricted access to the underlying hardware, which is reserved for the lowest-level and the most trusted functions of the OS, while in user mode, limited access is granted with protection and isolation. As a result, authority of "disable all interrupts", "set the time-of-day clock" and "change the memory map" are only allowed in kernel mode since the system might happen to be crashed beyond recovery if something got modified in user mode. However, "read the time-of-day clock" is allowed in user mode since it's read-only and won't modify the settings of OS.

2. 20ms, 25ms, 30ms or 35ms

   The time depends on how the operating system schedules them.

	P0(5ms)	P1(10ms)	P2(20ms)
20ms	CPU1	CPU1	CPU2
25ms	CPU1	CPU2	CPU1
30ms	CPU2	CPU1	CPU1
35ms	CPU1	CPU1	CPU1

Ex. 4 - Simple problem

1. How much video RAM is needed to support a 25 lines by 80 rows character monochrome text screen?
$$25 \times 80 = 2000 \, \text{bytes} = 1.953125 \, \text{KB}$$

2. How much for a 1024 x 768 pixel 24-bit color bitmap?

$$1024 \times 768 \times 24 = 18874368 \, \text{bit} = 2304 \, \text{KB}$$

3. Assuming the cost of this RAM in the 1980es was $5/KB what was the price of those two solutions?
$$5 \times 1.953125 = \$9.77$$

$$5 \times 2304 = \$11520$$

4. How much is it now?

Around $10 or less per GB for either DDR or DDR2 RAM.

Ex. 5 - Command lines on a Unix system

1. Create a new user:

```
1  useradd -m michael
```

2. List all the currently running processes:

```
1  ps -ael
```

3. Display the characteristics of the CPU and the available memory

```
1  cat /proc/cpuinfo
2  cat /proc/meminfo
```

4. Redirect some random output into two different files

```
1  head -n 666 /dev/random | tee 1.out > 2.out
```

5. Concatenate the two previous files

```
1  cat 1.out 2.out > 3.out
```

6. Read the content of the resulting file as hexdecimal values

```
1  hexdump 3.out
```

7. Use a single command to find all the files in /usr/src with the word semaphore in their name and containing the word ddekit_sem_down

```
1  find /usr/src -name '*semaphore*' | xargs grep -lw '
     ddekit_sem_down'
```