**Exercise 1**

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**Problem 1.** (15 points)Answer the following questions:  
  
1) Explain the goals of an operating system.

The main goals of operating system are

1. making the computer convenient to use.

2. using the hardware in an efficient manner: manage the computer correctly.

2) What are the characteristics of a virtual machine.  
  
The characteristics of VM are

1. It takes the layered approach to its logical conclusion, and treats hardware and OS kernel like they were all hardware.

2. It provides an interface identical to the underlying bare hardware

3. OS creates the illusion of multiple processes, each executing on its own processor with its own (virtual) memory.

4. To create the virtual machines, resources of the physical computer are shared.

3) What are the main differences between OS for personal computers and OS for mainframe computers?

The main differences between OS for personal computers and mainframe computers are below.

1. Normally personal computers are running common OS like Windows or Linux, but mainframe computers are running Unique OS for each company or developers.

2. Generally, there is only one OS running in personal computer. In other hands, sometimes mainframe computer can run unique OS and another OS at the same time.

**Problem 2.**  (20 points)Answer the following questions:

1) What are the main differences between process management and memory management?

The main differences are

1. What the management handling.

2. The layer each management working.

First, process management handling the system process. It manages the operations of process like assigning resources or creation, deletion, suspension and resumption of each process. On the other hand, memory management handling the assignments of memory. It manages where the data stored or allocation and release of memory.

Second, those managements are different in working layer. Process management is working at process operations, in other words, it's operating jobs of computer. On the other hand, memory management is working at memory operations, in other words, it's operating one of the resources of computer. Memory management is in lower layer of Process management.

2) What are the main differences between memory management and file management?

Memory management handling the assignments of memory. It manages where the data stored or allocation and release of memory. On the other hand, file system management handling aggregate data: the layer or relation between each set of data.

3) For the following services provided by an operating system, explain how each service provides convenience to users.

* Program execution:

When user try to execute some programs, the system load the program on main memory and make it possible to execute it. And also, operating system make it possible to end its execution, either normally or abnormally.

* Input/Output operations:

When executing program requests I/O including input/output for file or I/O machine, operating system provide a means to do I/O because users usually can't control I/O devices directly.

* File-system manipulation:

Normally, programs need to read and write files and directories, and they also need to create and delete them by name, search for given file, and list file information. Operating system provides convenience by operating permission and file ownership.

* Communication between processes:

Operating system implement a communication to another process through a computer network when some processes needs to exchange information with process executing on different computer systems.

* Error detection:

Operating system is aware of possible errors happening on CPU, memory hardware, I/O devices, user program and so on constantly, and it take the appropriate action to ensure correct and consistent computing.

* Resource allocation:

When there are multiple multiple jobs running at the same time, operating system manage many different types of resources.

* Accounting:

Operating system keep track of which users use how much and what kinds of computer resources, and contribute to reconfiguration of the system to improve computing services.

**Problem 3.** (20 points)

Study how some OS commands work by inputting them in your terminal command line, and find answers to the following questions.   
(Please copy-paste terminal screen contents together with answers).

1. What does the command "w" do?

It display who is logged in and what they are doing.

<terminal screen contents>

std6dc39{s1240234}45: w

13:29 up 6 days, 6:34, 2 users, load averages: 1.90 1.74 1.80

USER TTY FROM LOGIN@ IDLE WHAT

s1240234 console - 13:08 20 -

s1240234 s000 - 13:23 - w

1. Is it possible to determine user's name by it?

Yes. Actually, there is my user name “s1240234” as the column of USER.

1. What is the amount of total memory and the amount of free memory in the system? Which command can give this information?

By using “top” command, I can see the information like below.

Processes: 277 total, 2 running, 1 stuck, 274 sleeping, 1024 threads 14:43:43

Load Avg: 1.37, 1.36, 1.34 CPU usage: 2.21% user, 1.22% sys, 96.56% idle SharedLibs: 167M resident, 43M data, 15M linkedit.

MemRegions: 62934 total, 2883M resident, 79M private, 697M shared. PhysMem: 8069M used (1628M wired), 119M unused.

VM: 753G vsize, 627M framework vsize, 35997(0) swapins, 87628(0) swapouts.

Networks: packets: 8002222/9643M in, 5082162/3474M out. Disks: 1092258/8167M read, 809047/17G written.

PID COMMAND %CPU TIME #TH #WQ #PORT MEM PURG CMPRS PGRP PPID STATE BOOSTS %CPU\_ME %CPU\_OTHRS

34728 top 1.7 00:00.61 1/1 0 20 3248K+ 0B 0B 34728 32078 running \*0[1] 0.00000 0.00000

34718 MTLCompilerS 0.0 00:00.05 2 2 23 8712K 0B 0B 34718 1 sleeping 0[2] 0.00000 0.00000

...

By checking the data “PhysMem”, I can see the amount of physical memory size. In this case, 8069MB used and 119MB unused. Also, I can see the amount of Virtual Memory size in “VM” In this case, total size of Virtual Memory is 753GB.

1. What is the size of the root file-system, and how much space (in percent) is occupied? Which command should be used for it?

By executing the command “df -h”, I can see the size of file-system like below.

Filesystem Size Used Avail Capacity iused ifree %iused Mounted on

/dev/disk1s2 72Gi 44Gi 27Gi 62% 1187662 4293779617 0% /

devfs 190Ki 190Ki 0Bi 100% 659 0 100% /dev

/dev/disk0s2 140Gi 5.3Gi 134Gi 4% 2377 4294964902 0% /private/var/netboot

...

stdfsv1:/vol/vol10/istc/istc 356Gi 313Gi 43Gi 89% 8212188 13038842 39% /home/professor/istc

stdfsv1:/vol/vol4/home8 250Gi 109Gi 141Gi 44% 1590924 20782710 7% /Network/Servers/stdfsv1/vol/vol4/home8

osxfsv172:/vol/vol1/log 250Gi 41Gi 209Gi 17% 1051871 8691683 11% /LogCollect/ArchiveSV

Then I can check the file-system size on root. In this case, size of root file-system is 72GB, and 62 percent of the space is occupied(44GB been used).

1. How many processes are there in the system? (Zero)

By executing the command below,

ps -a

I can know what processes are in the system like

PID TTY TIME CMD

1148 ttys000 0:00.03 -csh

2225 ttys000 0:00.03 ssh std6dc36

32077 ttys001 0:00.02 login -pf s1240234

32078 ttys001 0:00.05 -csh

33677 ttys001 0:00.00 ps -a

32086 ttys002 0:00.01 login -pf s1240234

32088 ttys002 0:00.01 -csh

To count the process, I do

ps -a | wc -l

Then I get the number “9”, but this number including the command line and item line, so I get the number of system “7” by canceling them.

There are 7 processes now in the system.

1. What network protocols are activated on your machine?

By executing the command: netstat -s

Network protocols in my machine are “tcp”, “udp”, “icmp”, “igmp”, “ipsec”, “arp”, “mptcp”, “ip6”, “icmp6”, “ipsec6”, “rip6”, “pfkey”, “kevt”, “kctl” and “xbkidle”

**Problem 4.** (20 points)

What do the following commands do and what their names stand for?

1. awk

It does pattern-directed scanning and processing language. It process the data file by row.

And the name stands for the developers name: Aho, Weinberger, Kernighan.

1. grep  
   It search the files by common patterns. It search the matched row by file or standard input using regular expressions.

And the name comes from the expression “**g**lobally search a **r**egular **e**xpression and **p**rint”

1. cat  
   It display the file or contents of standard input directly.

And the name comes from the expression “catenate” or “concatenate”.

1. troff

It format texts or documents for printing on typesetting device.

And the name comes form “typesetter roff” This “roff” is also command stands for “to run off a document, “ so for “troff” the name stands for “typesetter run off a document”

1. biff

It notify the arrival of mail and display who it is from.

And the name comes from the name of a dog the developer of this command had.

You can find answers at the UNIX Reference Desks (search the Internet!)

**Problem 5.** (10 points)

You have a text file. How can you select those lines which contain two specified strings of characters?

To select those lines, I execute the command below.

Command: grep [string 1] [file name] | grep [string 2]

For example, suppose the name of the text file is “sample.txt”, and two specified strings are “operating” and “system”, then the command is like ' grep “operating” sample.txt | grep “system” '

**Problem 6.** (15 points)

How can an executing program determine its own pathname? (If it is a difficult task for you, please, try to find an answer at the UNIX Reference Desk)

To determine its own pathname, the program refer to the content of “argv[0]” If the content begin with '/', the program can know the absolute pathname by this argv[0]. But if it doesn't begin with '/', the program make reference to environment variable PATH and search the content contains an executable file the name matches the argv[0] content, then the program get its own pathname.