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**CE521 - Real-time Systems and Programming**

**Homework Assignment #2**

**Due day: 2/20/2022**

**Student ID: 19590**

**Instruction:**

1. **Push the answer sheet to GitHub**
2. **Overdue homework submission could not be accepted.**
3. **Takes academic honesty and integrity seriously (Zero Tolerance of Cheating & Plagiarism)**
4. **Why do some systems store the operating system in firmware, while others store it on disk?**

The reason to use a firmware as storage for the operating system would be if the device cannot contain a disk or a disk is not compatible with the specific hardware. Firmware is a set of instructions programmed on a hardware device. It provides the necessary instructions for how the device communicates with other hardware and it is typically stored in non-volatile memory. changing the firmware of a device may rarely or never be done during its lifetime so in some cases if the firmware is damaged, the machine will be unusable.

Since some machines can never upgrade the firmware during its lifetime and in other cases it is very difficult to do so safely it is better to place only immutable code in the firmware. However, the kernel needs updates and changes so the only reason to use a firmware as storage for the operating system would be if the device cannot contain a disk or disk in not available for it.

1. **How could a system be designed to allow a choice of operating systems from which to boot? What would the bootstrap program need to do?**

Consider a system that would like to run both Windows 10 and two different distributions of Linux (e.g., Debian and RedHat). Each operating system will be stored on a disk. During the initial system boot-up, a special program will determine which operating system to boot into. This means the boot manager will run first during the system startup and rather than booting to an operating system, the boot manager will first run during system start-up. It is this boot manager that is responsible for determining which operating system one needs to boot into. Typically boot managers must be stored at certain locations of the hard disk to be recognized during system start-up (which is generally The BOOTMGR file which is both read-only and hidden and is in the root directory of the partition marked as Active in Disk Management). Boot managers often provide the user with a selection of systems to boot into; boot managers are also typically designed to boot into a default operating system (which is selected based on priority) if no choice is made by the user at the time of the system startup.

1. **The services and functions provided by an operating system can be divided into two main categories. Briefly describe the two categories and discuss how they differ.**

* **One category:** Services provided by an operating system is to enforce protection between different processes running concurrently in the system. Processes are allowed to access only those memory locations that are associated with their address spaces. Also, processes are not allowed to corrupt files associated with other users. A process is also not allowed to access devices directly without operating system intervention.
* **Another Category:** Services provided by an operating system is to provide new functionality that is not supported directly by the underlying hardware. Virtual memory and file systems are two such examples of new services provided by an operating system.

1. **What is the main advantage of the microkernel approach to system design? How do user programs and system services interact in microkernel architecture? What are the disadvantages of using the microkernel approach?**

**Advantage of the micro-kernel approach to system design:**

* Adding a new service does not require modifying the kernel
* It is more secure as more operations are done in user mode than in kernel mode
* A simpler kernel design and functionality typically results in a more reliable operating system.

User programs and system services interact in a micro-kernel architecture by using inter-process communication mechanisms such as messaging. These messages are conveyed by the operating system.

**Disadvantages of using the micro-kernel approach:**

* The overheads associated with inter process communication and the frequent use of the operating system’s messaging functions to enable the user process and the system service to interact with each other.

1. **Explain why Java programs running on Android systems do not use the standard Java API and virtual machine.**

The standard Java API and virtual machine are mainly designed for desktop as well as server systems. They are not that compatible with mobile devices. Because of this, Google has created a different API and virtual machine for mobile devices. This is known as the Dalvik virtual machine.

The Dalvik virtual machine is a key component of the Android runtime and is a part of JVM (Java Virtual Machine) developed specially for Android. The Dalvik virtual machine uses features that are quite important in Java such as memory management, multi-threading etc. The programs in Java are first converted into JVM and this is then interpreted into the DVM bytecode.