BACHELOR OF COMPUTER APPLICATIONS

SEMESTER 4

DCA2203

SYSTEM SOFTWARE

Unit 14

Memory Management in Android

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1. INTRODUCTION

The Android Operating System process management was covered in the previous unit along with android process management, threads management, threads, and inter-process communication.

Mobile phones are a very advanced smart devices to store huge amounts of data. Hence, its memory is constrained and limited with the memory size needed for efficiency and performance. In this unit, will study the memory management being performed in the android system and also will learn in what way the memory is used or shared by android system applications.

1.1 Learning Objectives:

After studying this unit, learners should be able to:

- *Discuss the memory that is used in the android system*
- *Justify the use of memory by each application*
- *Discuss the way memory management is done in the android system*

2. INTRODUCTION TO ANDROID MEMORY

Mobile devices have Android as a software stack that includes an operating system, middleware, and key applications. The Android Software Development Kit (SDK) provides the tools and Application Programming Interfaces (APIs) to develop applications on the Android platform using Java programming language.

Memory in handheld phone

Android system is a Linux-based OS with a 2.6.x kernel. It uses open-source C libraries as that of Linux OS. All the basic OS operations, like I/O, memory management, process management, networking, and so on, are handled by the Linux kernel.

All hand-held mobile phones consist of internal storage space. In this memory, applications, many files and data for applications are stored. The operating system manages and secures internal storage containing your private information. Its contents cannot be viewed when the phone is connected to a computer with an USB cable.

An application in a handheld phone uses two kinds of memory. They are(i) storage memory and (ii) RAM. Any files, settings, and other data that are in storage memory are used by applications. They also use RAM when they are running. RAM is designed for quick access to data and temporary storage.

the Phone also has internal USB storage or a removable SD card. The content of SD card memory as a file can be viewed and copied to and from the computer. Some applications are stored in this memory, rather than in internal memory, by default or as an option.

The operating system of your phone manages RAM usage by the program. . OS allows applications and their component processes and services to use RAM when needed. OS may cache the processes that have been used recently so that they can be accessed quickly when you restart it again. However, OS also erases the cache when the RAM is needed for new activities.

Applications and storage memory are directly and indirectly used in many ways when a phone is used. For example, you use a phone by:

- Installing or uninstalling applications in it.

- Downloading files in Browser, Gmail, and other applications.
- Creating files (for example, by taking pictures and shooting videos)
- Deleting downloaded files or files you created.
- Copying or deleting files from your USB storage or SD card through the computer.

Generally, people want the phone to be slim in size and memory. Therefore, when mobile devices need to manage the memory required by the active applications, it becomes a design limitation for mobile devices in terms of size.

Evolution of Android:

It began with a cupcake, then a donut, éclair. Each system was better than the other in many ways:

We can see the differences below:

1) Cupcake (v1.5)
   - Support for Widgets
   - Copy and paste features for web browser
   - Animated screen transitions
   - Auto rotation of the screen
2) Doughnut (v1.6)
   - First Android OS by Google after they bought it
   - Quick search box
   - Diverse screen size
   - Introduction of the android market.
3) Éclair (v2.1)
   - Google maps
   - Customisation of the home screen available
   - Search by speech available
4) Froyo (v2.2)
   - Voice actions
   - Portable hotspot
   - Introduced Devilik JIT compiler and V8JavaScript to improve the OS performance
5) Gingerbread (v2.3)

- Gamming APIs
- Launched Near Field Communication (NFC)
- Helps in battery management

6) Honeycomb (v3.0)
- Tablet-friendly design
- On-screen navigation control
- Quick settings feature

7) Ice Cream Sandwich (v4.0)
- Custom home screen
- Data usage control
- Android beam

8) 8)Jellybean (v4.1)
- Google is now available
- Interactive notice bar
- Account switching possible

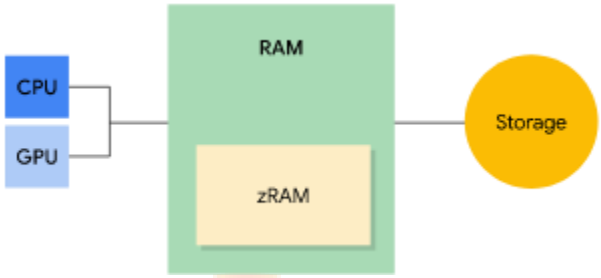
9) KitKat (v4.4)
- OK, Google is available
- Immersive and interactive design
- Availability of smart dealer

10) Lollipop (v5.0)
- Better material design
- Multi-screen available
- Notifications available on the lock screen

11) Marshmallow (v6.0)
- Assistance available without interruption
- Permissions needed
- Smart battery available

Types of memory:

RAM, zRAM, and storage are the three forms of memory found in Android smartphones. Take note that both the CPU and the GPU access the RAM.



The fastest type of memory is RAM; however, its capacity is typically constrained. Most RAM is often found in high-end gadgets.

A RAM partition designated as a swap space is called zRAM. When anything is put into zRAM, it is compressed, and when something is transferred out of zRAM, it is decompressed. As pages are transferred into or removed from zRAM, this area of RAM expands or contracts in size. Device manufacturers can specify the maximum size. .

The platform's object code, the file system, and other persistent data. are contained in the storage. The capacity of storage exceeds that of the other two forms of memory. Unlike previous Linux implementations, Android doesn't use storage as swap space since frequent writing can wear down this memory and reduce the lifespan of the storage media.

SELF ASSESSMENT QUESTIONS – 1

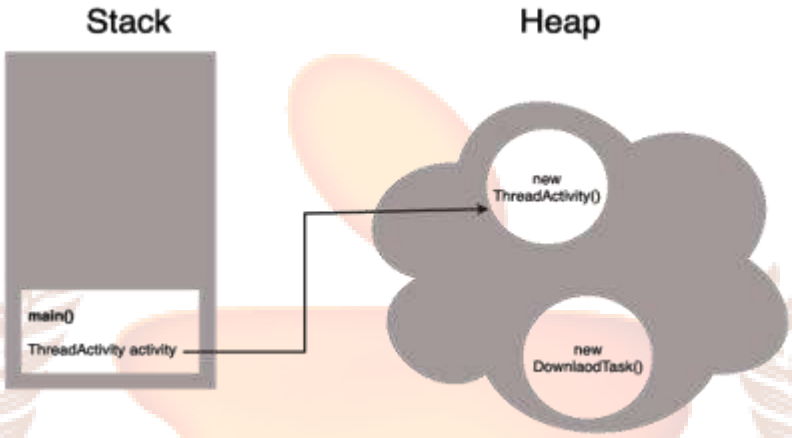
1. Which memory contents can be viewed and copied to and from when you connect your phone to a computer?
   a) internal USB storage or a removable SD card.
   b) RAM
   c) CD-ROM
   d) Hard disk
2. Applications use two kinds of memory in your phone. They are "_____"and "_____".
3. You use your phone to copy files or delete files from your USB storage or SD card through a computer. (True/False)

STACK:

A temporary static memory is a stack. The data item is released from memory once the process is finished.

HEAP:

Heap, a dynamic memory named after a single virtual memory, is used. The items are not released.



The object memory space is a heap. The local variable stack.

As a result, Heap produces objects. Each thread has its stack area.

Android is a multitasking system, so it allocates a memory capacity in the total memory to free up space for other processes.

The thread activity () function connects the stack & heap.

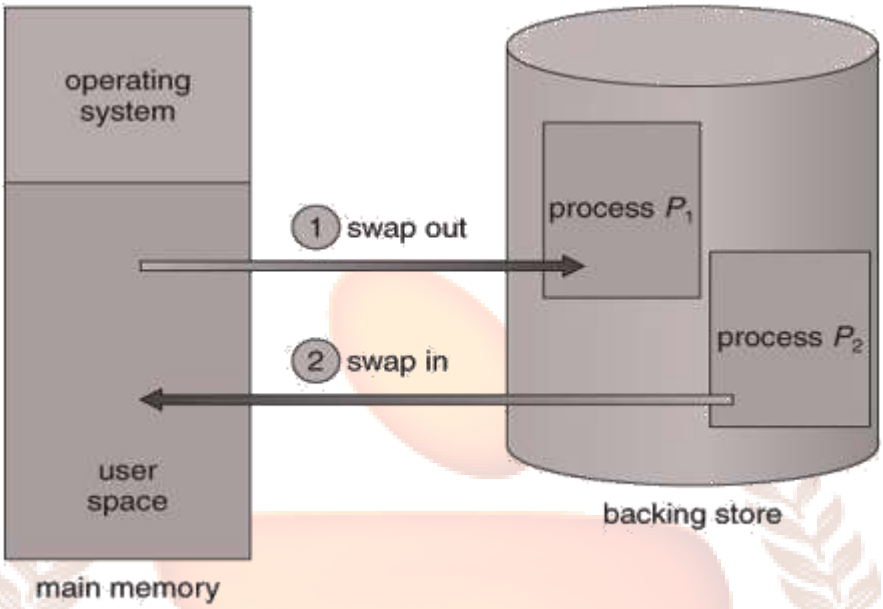
Let us understand about allocation and recovery of memory.

This has two processes:

- Memory Restriction: Heap size is capped to ensure the multitasking environment. .
- Once the heap limit is reached, an error is generated.

Application Switching:

- There is a cached process created each time we open and dismiss a single program.
- The same application can be opened again while using this cached process.



Let us learn the Swap in and swap our processes:

When a process swaps in, it goes from secondary storage (such as a hard drive) to main memory (RAM).

Swap out: Swapping out is moving a process from primary to secondary memory.

Swapping is the interchange of processes. Additionally, priority-based preemptive scheduling is used in process interchange.

a process with a higher priority enters the system, the memory management temporarily switches the lowest priority process to disc and executes the process with the highest priority in the main memory.

The lower priority process is switched back to memory and continues to operate after the highest priority process finishes. And the technique is known as switching.

3. USE OF MEMORY FOR EACH APPLICATION

Android is based on Linux Kernel.and these Linux kernels do most of the memory management jobs. . Linux kernel does the jobs such as page-based memory management and virtual address to physical address mapping. Android does not support virtual memory because it uses Dalvik Virtual Machine (DVM), unlike Java virtual machine.

Although Android is based on Linux Kernel, Android's process, and memory management are different from Linux OS. Android uses its own run time and virtual machine (Dalvik Virtual Machine) to manage application memory. Android run time also manages the process lifetimes. Android ensures that application response by stopping and killing processes associated with it and as necessary to free resources for higher-priority applications.

Android manages the opened applications that are running in the background. Android closes the applications only when more memory is required. However, sometimes there are too many processes running in the background to slow down the performance of Android. One can use an advanced task killer or task manager to handle this job to fix the problem.

Each Android application runs in a separate process within its own Dalvik instance, relinquishing all responsibility for memory and process management to the Android run time, which stops and kills processes as necessary to manage resources. Dalvik and the Android run time sit on top of a Linux kernel and handles low-level hardware interaction. It also handles drivers and memory management, while APIs provide access to all of the underlying services, features, and hardware.

SELF ASSESSMENT QUESTIONS – 2

4. Android uses its own run time and a virtual machine called "_____" to manage application memory.
5. Too many processes running in the background do not slow down the performance of Android. (True/False)

4. THE DALVIK VIRTUAL MACHINE

The Dalvik Virtual machine in unit 12 has already been understood. Let us revise it again briefly in this section. Android uses its customized Virtual Machine (VM) rather than a traditional Java virtual machine (VM) such as Java ME (Java Mobile Edition) to run Java applications. This VM is known as Dalvik VM and is a register-based virtual machine optimized to ensure that a device can run multiple instances efficiently on a single device. The Dalvik VM uses the underlying Linux kernel of the device to handle low-level functionality along with security, threading, process, and memory management.

The DALVIK virtual machine is optimized for low memory compared to other standard VMs like JVM or Parrot Virtual Machine. The Dalvik virtual machine uses less space. It uses its own bytes code, which is not a java byte code. It uses storage media as flash memory. All Android hardware and system service access is managed using Dalvik as a middle tier. VM is used to host application execution so developers have an abstraction layer without caring about a particular hardware implementation. The Dalvik VM executes Dalvik executable files, which are optimized to ensure minimal memory requirement. The. dex executables are created by transforming Java language compiled classes using the tools supplied within the SDK.

SELF ASSESSMENT QUESTIONS – 3

6. The Dalvik virtual machine uses less space and its own bytes code. (True/False)
7. Android hardware and system service access is managed using "_____" as a middle tier.

5. SUMMARY

Let us recapitulate the important concepts discussed in this unit:

- Applications use two kinds of memory in your phone: (i) storage and (ii) RAM.
- The operating system manages and allows applications and their component processes and services to use RAM when needed.
- Android uses its own run time and virtual machine (Dalvik Virtual Machine) to manage application memory.
- Dalvik and the Android run time sit on top of a Linux kernel that handles low-level hardware interaction, including drivers and memory management. At the same time, a set of APIs provides access to all of the underlying services, features, and hardware.
- The Dalvik VM uses the device's underlying Linux kernel to handle low-level functionality, including security, threading, and process and memory management.

6. GLOSSARY

- **Hard disks:** Store up to several gigabytes (billions of bytes) of information. Data are stored on their surfaces in concentric tracks
- **Main memory:** A non-moving storage device utilizing one of several types of electronic circuitry to store information.
- **RAM:** Chips that can be called for read/write memory location, usually 8 bits or 1 byte; data stored in them may be read, or new data may be written into any memory address on these chips.
- **Storage device:** A unit into which data or programs can be placed, retained, and retrieved
- **Storage memory:** Any files, settings, and other data used by mobile applications.
- **SD card:** type of memory removal card typically used in mobiles and other portable devices.

7. TERMINAL QUESTIONS

Short Answer Questions

1. What are the diverse types of memory in phones? List some of the usages of memory of the android system.
2. Explain how the memory are used for each application in Android system.

7.1 Answers

Self-Assessment Questions

1. (a)internal USB storage or a removable SD card.
2. storage memory, RAM
3. True
4. Dalvik Virtual Machine
5. False
6. True
7. Dalvik

Short Answer Questions

1. The memory in the phone can be in the form of internal storage, internal USB storage, or a removable SD card or RAM. (Refer to section 13.2 for more details)
2. Android manages the opened applications running in the background and closes any applications only when the system needs more memory.(Refer to section 13.2 for more details)

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