**Objectives**

1. Research information about software for a specific operating system (OS) environment. You will be assigned one of the operating systems form the list of: Windows, Mac OS, Linux. You will also be provided with a list of topics to investigate.
2. Organize your rough research information into a list of topics, sub-topics and facts. This process will involve identifying sub-topics, rearranging your rough research notes, and selecting (or highlighting) interesting facts.
3. Report a summary of your research in the form of a “concept map”. Use the PowerPoint template provided as a starting point. The concept map should only include the best and most interesting information from your organized research notes.

Your assigned operating system is:

* Windows
* Mac OS
* Linux
* iOS
* Android

A concept map can be created using the “Smart Ideas” application or PowerPoint or other applications.

**Level 1 – Rough Research**

Research information about the software for your assigned operating system (OS) environment.

* Guide your research according to the suggested topic list below
* Feel free to copy-and-paste as long as you keep track of your bibliographic references.
* Do not be too picky or concerned about formatting as you will organize this information later in step 2
* Select things that look interesting and don’t forget to include graphics images as well
* Upload your rough research notes to your repository when you are done.

**Topic A – Productivity, Entertainment & Other Software Applications**

Entertainment

On Android, there are a lot of applications that offer entertainment. As we all know, there is Netflix, Hulu, Youtube, and many other entertainment applications. On Google Play Store, there are approximately 2.2 million apps available on Google Play Store. Therefore, it is the largest app store, even beating Apple’s App store, being the second largest with 2 million apps. Over 125 apps have been downloaded approximately 100 million times and around 1788 aps have been downloaded at least 10 million times. The top grossing app is Clash of Clans with 29.5 million active users. The top 10 contribute for half the revenue. One of the top ten spends nearly $7000 a month on his CoC village.

<https://www.engineerbabu.com/blog/interesting-android-apps/>

Topic B – User Interface (Window Management & Input Devices)

Many input devices are available for Android Devices. Keyboards, track pad mouse, and many other items can be used with an Android device. These input devices help with many uses, such as typing, playing games, or just writing an essay or something. There are many input devices, but very less use keyboards or a mouse as a computer or laptop would be better.

Topic C – Memory Allocation, Management,& Devices

The Android Runtime, or ART, and Dalvik virtual machine use paging and memory-mapping to manage memory. Any memory an app modifies remains resident in RAM and cannot be paged out. The only way to release memory from an app is to release object references that the app holds.

Topic D – Process / Task Scheduling and Management (System Startup)

The system startup process contains 6 steps for the device to startup properly. The first step is Power On and System Startup. When the power button is pressed, the Boot ROM code starts executing from a pre-defined location, which is always hardwired in ROM. It loads the Bootloader into RAM and starts executing. Step 2 is Bootloader. The bootloader is a small program which runs before Android does, and is not part of the Android operating system. The bootloader is the place where manufacturer puts their locks and restrictions. The bootloader executes in two stages. In the first stage, it detects external RAM and loads a program which helps in the second stage. In the second stage, the bootloader setups the network, memory, and etc, which requires to run kernel. The bootloader is able to provide configuration parameters or inputs to the kernel for specific purposes. Step 3 is Kernel. The Android Kernel starts in a similar way as the Linux Kernel. As the Kernel launches, it starts to setup cache, protected memory, scheduling and loads drivers. When the kernel finishes system setup, it looks for “init” in the system files. Step 4 is the init process. Init is the very first process, or the grandfather of all process. The init has two responsibilities, which are to mount directories like /sys or /dev or /proc, and to run init.rc script. At this stage, you can finally see the Android logo on the screen. Step 5 is Zygote and Dalvik. In Android, the VM should run as quick as possible for an app. The Zygote enables code sharing across the Dalvik VM, achieving a lower memory footprint and minimal startup time. Zygote is a virtual machine process that starts at system boot. The Zygote loading process is in the following steps: it loads Zygote Init class, registerZygoteSocket(), preloadClasses(), and preloadResources(). At this time, you would also see the boot animation. Step 6 is the System Service. At this time, Zygote launches the system services. The Zygote forks a new process to launch the system services. Some Core services examples are as following: Starting power manage, creating the Activity Manager, starting telephony registry, starting package manager, and set activity manager service as system process. Other services include starting status bar service, starting hardware service, starting NetStat service, starting connectivity service, and starting notification manager.

Topic E – Software Security, Updates & System Tools

There are multiple apps which give security for Android devices. Some apps include Bitdefender, Avast Mobile Security, Norton Security and Antivirus, and Sophos Mobile Security. The latest update for Android is Pie, or version 9.0. There are system tools which are available for Android, such as services, which finds background running services and dump will retrieve all services or extract information from service, properties, which any app can access as they do not require root or any special permissions, Android ID, which allows you to change android unique ID permanently, and Android Hostname, which allows you to change hostname per session.

Topic F – File System & User Accounts

Android uses several partitions, which include boot, system, recovery, data, etc, to organize files and folders on the device. There are normally 6 partitions on an Android device, but it may differ according to the company it was made from. The 6 partitions are /boot, /system, /recovery, /data, /cache, and /misc. Android supports multiple users on a single Android device by separating user accounts and application data, For instance, parents may allow children to use the family tablet. This is useful as there may be many people using one single device and others may want to share the device. This allows people to save data on their account.

Topic G – Special Features of your OS

Some special features of the Android Operating System is Adaptive battery, which hibernates all apps not being used at the moment, App Timer, which sets a time limit on applications and after used for the specific time the app icon will gray out, Adaptive Brightness, which is an automatic brightness adjuster for different apps, Indoor Navigation via Wi-Fi RTT, which enables users to go into malls and get directions or any other directions for indoor places, and a Lockdown mode, which disables the fingerprint unlock and a pin is needed to unlock the phone.

Topic H – Limitations of your OS

Although Android devices are great and way better overall from Apple, there are some drawbacks and limitations of Android devices too. Overheating is a very common problem. When users do things which cause an excessive use of memory, their phone may overheat. For example, when users play games which have heavy graphics or do hardcore productivity tasks, their phone overheats. Android apps do tend to run in the background even when closed by user, causing battery power to lose even more. Some phones start to lose efficiency dramatically if dozens of apps are installed. Also, cache buildup can cause the phone’s operational speed and experience can reduce and cause severe lags.

**Level 2 – Organized Research**

Organize your rough research information to provide more stricture and meaning.

* Re-read your rough research to identify (highlight) important sub-topics and facts
* Rearrange (cut–and-paste) your rough research so that related sub topics and facts are next to each other.
* Your finished organization should look like the template provided below.
* Upload your rough research notes to your repository when you are done.

Suggested organization template:

* Topic A – Productivity, Entertainment & Other Software Applications
  + Entertainment Apps
    - Netflix, YouTube, Hulu, and many other entertainment apps exist on Android phones
    - Approximately 2.2 million apps exist on the Google Play Store
    - Over 125 apps have been downloaded approximately 100 million times
  + Top Glossing App
    - Top glossing app is Clash Of Clans
    - Has 29.5 million active users
    - Top 10 players contribute half the revenue
    - One of top 10 users spends $7000 a month on his COC village
* Topic B – User Interface (Window Management & Input Devices)
  + Input Devices
    - Keyboard, trackpad mouse, and other input devices
    - Many uses, such as playing video games or typing up something
    - Many input devices
    - Rarely anyone uses them because of the availability of laptops and computers
* Topic C – Memory Allocation, Management and Devices
  + Memory Allocation
    - ART (Android Runtime) and Dalvik virtual machine use paging and memory-mapping to manage memory
    - Any memory an app modifies remains resident in RAM and cannot be paged out
    - Only way to release memory from an app is to release object references that the app holds
* Topic D – Process/Task Scheduling and Management(System Startup)
  + Startup Process
    - System process contains 6 steps to start the device properly
    - First step is Power on and System Startup
    - Power Button is pressed and the Boot ROM code starts executing from a pre-defined location
    - Loads Bootloader into RAM and starts executing
    - Step 2 is Bootloader
    - Runs before Android does
    - Not part of Android operating System
    - The place where manufacturer puts their locks and restrictions
    - Bootloader has two stages
    - First stage is where it detects external RAM and loads program to help in second stage
    - The bootloader setups the network, memory, etc in stage 2
    - Requires to run kernel
    - Step 3 is Kernel
    - As it launches, it sets up cache, protected memory, scheduling and loads drivers
    - When finished, it looks for “init” in system files
    - Step 4 is the init process
    - Has two responsibilities
    - Mount directories, like /sys, /dev, or /proc
    - Run init rc script
    - Android logo pops up
    - Step 5 is Zygote and Dalvik
    - Zygote enables code sharing across Dalvik VM, which allows a lower memory footprint and minimal startup time
    - Boot Animation is also shown
    - Step 6 is System Service
    - Zygote launches services
    - Forks new process to launch services
* Topic E – Software Security, Updates & System Tools
  + Security Apps
    - Multiple apps provide security for devices
    - Examples are Bitdefender, Avast Mobile Security, Norton Security and Antivirus, and Sophos Mobile Security
  + Updates and System Tools
    - Latest update is Pie (Version 9)
    - System Tools are Android ID and Android Hostname
    - Android ID allows you to change your unique ID permanently
    - Android Hostname allows you to change hostname per session
* Topic F – File System & User Accounts
  + Partitions
    - Several partitions are used
    - 6 partitions are normal for Android devices
    - /boot, /system, /recovery, /data, /cache, and /misc are all of them
  + User Accounts
    - Android supports multiple users on a single device
    - Separates user accounts and application data
    - Useful for multiple people who use one device
* Topic G – Special Features of your OS
  + Adaptive Battery
    - Hibernates all apps not being used at the moment
  + App Timer
    - Sets a time limit on applications
    - After used for that specific time, it will gray out
  + Adaptive Brightness
    - Automatic brightness adjuster for different apps
  + Indoor Navigation via Wi-Fi RTT
    - Enables users to go into indoor places and get directions to the places
  + Lockdown Mode
    - Disables fingerprint unlock and only unlocks using the pin number
* Topic H – Limitations of your OS
  + Overheating
    - When the memory is used a lot, overheat may be caused
    - May be of heavy graphics or hardcore productivity tasks
  + Battery Power
    - In Versions 8.0 and before, apps do tend to run in the background
    - Causes loss of power
  + Efficiency
    - Some phones start to lose efficiency if dozens of apps installed
  + Cache buildup problems
    - Cache buildup causes the phone’s operational speed and experience can reduce and cause severe lags

**Level 3 – Concept Map**

Create a “concept map” as a final report of your organized research.

Use the PowerPoint template provided as a starting point.

You can use PowerPoint or another concept mapping tool of your choice.

Select the best and most interesting information from your organized research.

Summarize and edit your information to fit on the concept map.

Share your finished concept map with Mr. Nestor at p0079141@pdsb.net

A concept map can be created using the “Smart Ideas” application or PowerPoint or other applications. A concept map template can be downloaded from the “Topic A” folder on the class GitHub repository

