4, a)Run your test program several times. Which fields in the prinfo structure change? Which ones do not? Discuss why different fields might change with different frequency.

A:

```
w4118@w4118:~$ adb shell /data/misc/prinfo       w4118@w4118:~$ adb shell /data/misc/prinfo       w4118@w4118:~$ adb shell /data/misc/prinfo
swapper,0,0,0,1,0,0                               swapper,0,0,0,1,0,0                               swapper,0,0,0,1,0,0
   init,1,1,0,31,2,0                                 init,1,1,0,31,2,0                                 init,1,1,0,31,2,0
      ueventd,31,1,1,0,43,0                             ueventd,31,1,1,0,43,0                             ueventd,31,1,1,0,43,0
      healthd,43,1,1,0,44,0                             healthd,43,1,1,0,44,0                             healthd,43,1,1,0,44,0
      servicemanager,44,1,1,0,45,1000                   servicemanager,44,1,1,0,45,1000                   servicemanager,44,1,1,0,45,1000
      vold,45,1,1,0,47,0                                vold,45,1,1,0,47,0                                vold,45,1,1,0,47,0
      netd,47,1,1,0,48,0                                netd,47,1,1,0,48,0                                netd,47,1,1,0,48,0
      debuggerd,48,1,1,0,49,0                           debuggerd,48,1,1,0,49,0                           debuggerd,48,1,1,0,49,0
      rild,49,1,1,0,50,1001                             rild,49,1,1,0,50,1001                             rild,49,1,1,0,50,1001
      surfaceflinger,50,1,1,0,51,1000                   surfaceflinger,50,1,1,0,51,1000                   surfaceflinger,50,1,1,0,51,1000
      zygote,51,1,1,359,52,0                            zygote,51,1,1,359,52,0                            zygote,51,1,1,359,52,0
         system_server,359,1,51,0,440,1000                system_server,359,1,51,0,440,1000                system_server,359,1,51,0,440,1000
         ndroid.systemui,440,1,51,0,546,10007             ndroid.systemui,440,1,51,0,546,10007             ndroid.systemui,440,1,51,0,546,10007
         d.process.acore,546,1,51,0,575,10002             d.process.acore,546,1,51,0,575,10002             d.process.acore,546,1,51,0,575,10002
         putmethod.latin,575,1,51,0,593,10029             putmethod.latin,575,1,51,0,593,10029             putmethod.latin,575,1,51,0,593,10029
         m.android.phone,593,1,51,0,605,1001              m.android.phone,593,1,51,0,605,1001              m.android.phone,593,1,51,0,605,1001
         ndroid.settings,605,1,51,0,638,1000              ndroid.settings,605,1,51,0,638,1000              ndroid.settings,605,1,51,0,638,1000
         ndroid.exchange,638,1,51,0,687,10025             ndroid.exchange,638,1,51,0,687,10025             ndroid.exchange,638,1,51,0,687,10025
         m.android.email,687,1,51,0,692,10024            m.android.email,687,1,51,0,692,10024            m.android.email,687,1,51,0,692,10024
         m.android.music,692,1,51,0,739,10032            m.android.music,692,1,51,0,739,10032            m.android.music,692,1,51,0,739,10032
         ndroid.launcher,739,1,51,0,757,10008            ndroid.launcher,739,1,51,0,757,10008            ndroid.launcher,739,1,51,0,757,10008
         d.process.media,757,1,51,0,886,10005            d.process.media,757,1,51,0,886,10005            d.process.media,757,1,51,0,886,10005
         droid.deskclock,886,1,51,0,922,10020           droid.deskclock,886,1,51,0,922,10020            droid.deskclock,886,1,51,0,922,10020
         ndroid.calendar,922,1,51,0,941,10016           ndroid.calendar,922,1,51,0,941,10016            ndroid.calendar,922,1,51,0,941,10016
         viders.calendar,941,1,51,0,957,10001           viders.calendar,941,1,51,0,957,10001            viders.calendar,941,1,51,0,957,10001
         .android.dialer,957,1,51,0,997,10004           .android.dialer,957,1,51,0,997,10004            .android.dialer,957,1,51,0,997,10004
         com.android.mms,997,1,51,0,0,10009             com.android.mms,997,1,51,0,0,10009              com.android.mms,997,1,51,0,0,10009
      drmserver,52,1,1,0,53,1019                        drmserver,52,1,1,0,53,1019                       drmserver,52,1,1,0,53,1019
      mediaserver,53,1,1,0,54,1013                      mediaserver,53,1,1,0,54,1013                     mediaserver,53,1,1,0,54,1013
      installd,54,1,1,0,55,1012                         installd,54,1,1,0,55,1012                        installd,54,1,1,0,55,1012
      keystore,55,1,1,0,56,1017                         keystore,55,1,1,0,56,1017                        keystore,55,1,1,0,56,1017
      qemud,56,1,1,0,59,0                               qemud,56,1,1,0,59,0                              qemud,56,1,1,0,59,0
      sh,59,1,1,0,60,2000                               sh,59,1,1,0,60,2000                              sh,59,1,1,0,60,2000
      adbd,60,1,1,1144,0,0                              adbd,60,1,1,1149,0,0                             adbd,60,1,1,1151,0,0
         prinfo,1144,0,60,0,0,0                            prinfo,1149,0,60,0,0,0                           prinfo,1151,0,60,0,0,0
   kthreadd,2,1,0,3,0,0                              kthreadd,2,1,0,3,0,0                              kthreadd,2,1,0,3,0,0
      ksoftirqd/0,3,1,2,0,5,0                           ksoftirqd/0,3,1,2,0,5,0                          ksoftirqd/0,3,1,2,0,5,0
      kworker/u:0,5,1,2,0,6,0                           kworker/u:0,5,1,2,0,6,0                          kworker/u:0,5,1,2,0,6,0
      khelper,6,1,2,0,7,0                               khelper,6,1,2,0,7,0                              khelper,6,1,2,0,7,0
      sync_supers,7,1,2,0,8,0                           sync_supers,7,1,2,0,8,0                          sync_supers,7,1,2,0,8,0
      bdi-default,8,1,2,0,9,0                           bdi-default,8,1,2,0,9,0                          bdi-default,8,1,2,0,9,0
      kblockd,9,1,2,0,10,0                              kblockd,9,1,2,0,10,0                             kblockd,9,1,2,0,10,0
      rpciod,10,1,2,0,11,0                              rpciod,10,1,2,0,11,0                             rpciod,10,1,2,0,11,0
      kworker/0:1,11,1,2,0,12,0                         kworker/0:1,11,1,2,0,12,0                        kworker/0:1,11,1,2,0,12,0
      kswapd0,12,1,2,0,13,0                             kswapd0,12,1,2,0,13,0                            kswapd0,12,1,2,0,13,0
      fsnotify_mark,13,1,2,0,14,0                       fsnotify_mark,13,1,2,0,14,0                      fsnotify_mark,13,1,2,0,14,0
      crypto,14,1,2,0,25,0                              crypto,14,1,2,0,25,0                             crypto,14,1,2,0,25,0
      mtdblock0,25,1,2,0,26,0                           mtdblock0,25,1,2,0,26,0                          mtdblock0,25,1,2,0,26,0
      mtdblock1,26,1,2,0,27,0                           mtdblock1,26,1,2,0,27,0                          mtdblock1,26,1,2,0,27,0
      mtdblock2,27,1,2,0,28,0                           mtdblock2,27,1,2,0,28,0                          mtdblock2,27,1,2,0,28,0
      binder,28,1,2,0,29,0                              binder,28,1,2,0,29,0                             binder,28,1,2,0,29,0
      deferwq,29,1,2,0,30,0                             deferwq,29,1,2,0,30,0                            deferwq,29,1,2,0,30,0
      kworker/u:1,30,1,2,0,33,0                         kworker/u:1,30,1,2,0,33,0                        kworker/u:1,30,1,2,0,33,0
      jbd2/mtdblock0-,33,1,2,0,34,0                     jbd2/mtdblock0-,33,1,2,0,34,0                    jbd2/mtdblock0-,33,1,2,0,34,0
      ext4-dio-unwrit,34,1,2,0,40,0                     ext4-dio-unwrit,34,1,2,0,40,0                    ext4-dio-unwrit,34,1,2,0,40,0
      jbd2/mtdblock1-,40,1,2,0,41,0                     jbd2/mtdblock1-,40,1,2,0,41,0                    jbd2/mtdblock1-,40,1,2,0,41,0
      ext4-dio-unwrit,41,1,2,0,81,0                     ext4-dio-unwrit,41,1,2,0,81,0                    ext4-dio-unwrit,41,1,2,0,81,0
      kworker/0:2,81,1,2,0,0,0                          kworker/0:2,81,1,2,0,1147,0                      kworker/0:2,81,1,2,0,1147,0
                                                        _flush-31:1,1147,1,2,0,0,0                        flush-31:1,1147,1,2,0,0,0
```

The pid "prinfo" change each run. Because every time we use adb shell to create new instance of prinfo, the new pid will be re-assigned to prinfo. And the prinfo is actually the child process of adbd. So both child pid of adbd and pid of prinfo itself change.

And it is expected

4, b)Start the mobile web browser in the emulator, and re-run your test program. How many processes are started? What is/are the parent process(es) of the new process(es)? Close the browser (press the "Home" button). How many processes were destroyed? Discuss your findings.

A: When we start the web browser, the android.browser process is created. It's child process of zygote. When close the browser(I mean go to app manage of Android to stop the browser), the android.browser will be destroyed. If we tap the Home button instead, the android.browser still exists. It may go to background mode, and later might be killed by android if resources are limited.

4, c)Notice that on the Android platform there is a process named zygote. Investigate this process and any children processes:
i)What is the purpose of this process?

Zygote is a daemon whose goal is to launch Apps, do the function similiar to fork(). Zygote is is the parent of all App processes in android.

ii)Where is the zygote binary? If you can't find it, how might you explain its presence in your list of processes?

There's no independent zygote binary but zygote is started by /system/bin/app_process -Xzygote.
After kernel is loaded, init.rc is parsed and native services are started. With this, the /system/bin/app_process is run.
We can find some comments in app_process source(frameworks/base/cmds/app_process/app_main.cpp):
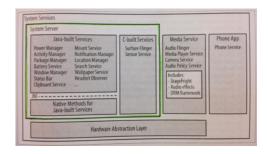   // --zygote : Start in zygote mode
    // --start-system-server : Start the system server.
    // --application : Start in application (stand alone, non zygote) mode.
    // --nice-name : The nice name for this process.
    //
    // For non zygote starts, these arguments will be followed by
    // the main class name. All remaining arguments are passed to
    // the main method of this class.
    //
    // For zygote starts, all remaining arguments are passed to the zygote.
    // main function.

This eventually calls AndroidRuntime.start() function, passing it the parameters com.android.internal.os.ZygoteInit and start-system-server. ZygoteInit.main() first registers the zygote socket (the zygote process listens to a socket for incoming commands, and on receiving new command, spawns a new process as requested). It initializes a lot of classes system-wide resources like drawables, xmls, etc. Then it calls startSystemServer() which forks a new process for com.android.server.SystemServer. Forking of system server is a special case, because in all other cases, zygote process opens a socket /dev/socket/zygote to listen for requests for starting applications.

iii)Discuss some reasons why an embedded system might choose to use a process like the zygote.
A:
1, To save time start other applications. Once Zygote starts, it preloads all necessary Java classes and resources, starts System Server, initialize all the different System Services and the Activity Manager.

For System Service, we refer to the picture above. They are shared resources for other Apps. So when launch app, there's no need to start services again.

2, For the design pattern of android, zygote is to start Dalvik VM each time App launches. This is different from the way linux do. So it's necessary to take zygote the responsibility to manage all App processes.

3, Save memory. As we know, Android runs on Linux. The Linux Kernel implements a strategy call Copy On Write (COW). In the case of Android those libraries are not writable. This means that all process forked from Zygote are using the exact same copy of the system classes and resources. No matter how many applications are started the increase in memory usage will be a lot smaller.