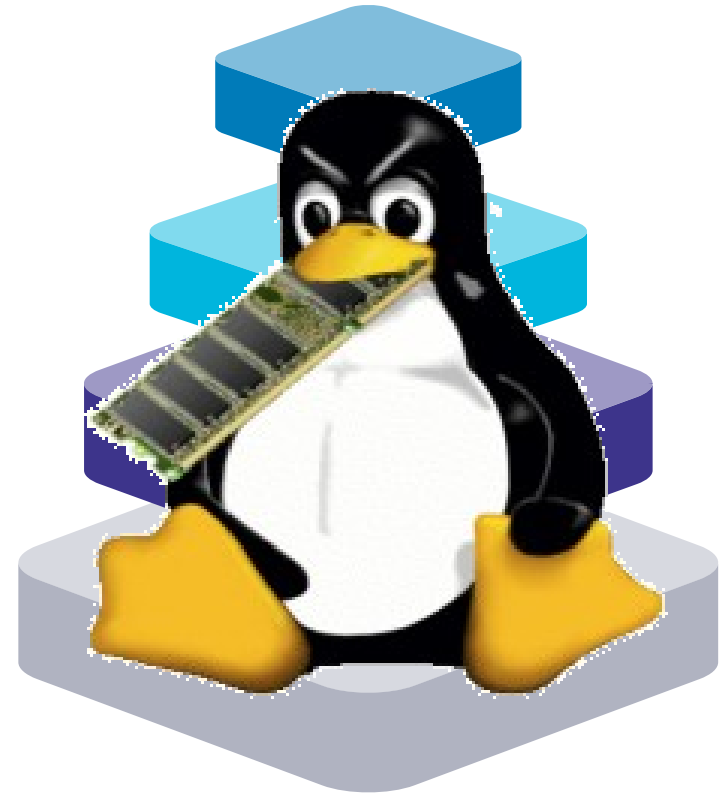# Memory and Linux

Ramon Dominguez
July 17, 2024

Content
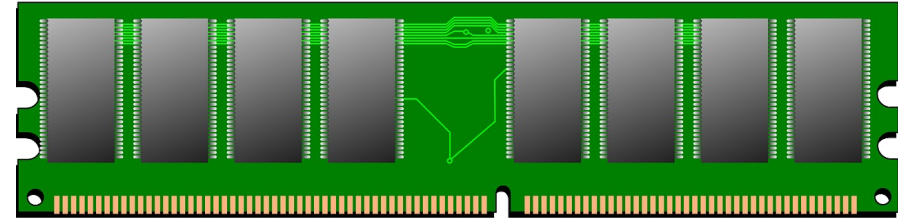
Physical and Virtual Memory

The Kernel and Memory

Graphical User Interface (GUI) Usage

Memory Management (terminal)

Physical Memory

- RAM installed and the Hard drive partition dedicated for Swap.

Do not consider the internal CPU L2 and L3 cache as memory.

Virtual/Logical Memory

- Exist in the MMU tables and it "MAPS" the physical memory (RAM). Inside the cashe.

- It prevents memory override.

- Pages are in 4k and re-direct to the physical address.

- The MMU also handles memory swap locations.

Programs in Proc

Web Browser

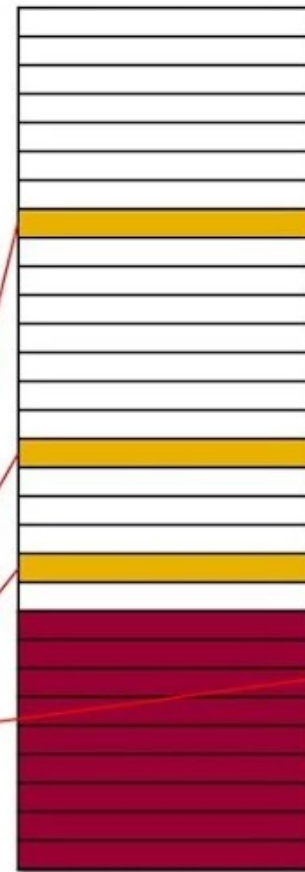**Word Processor**

Game

Spreadsheet

Operating System
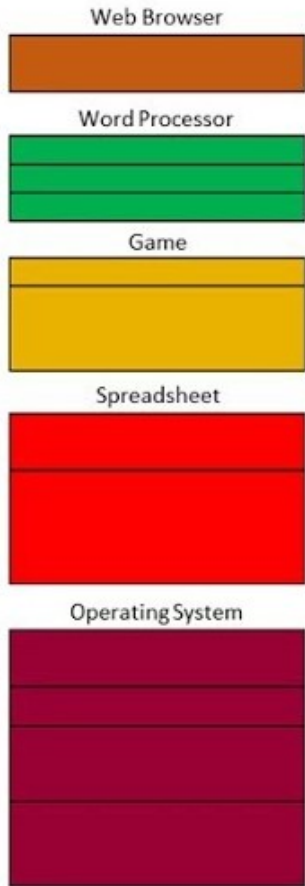
Virtual memory

Page Table
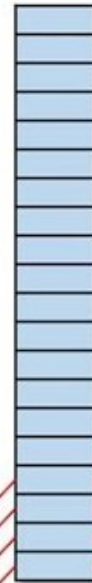
Physical Memory

Swap file on hard drive
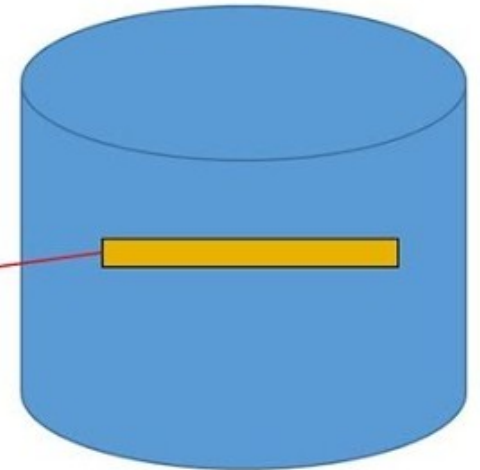
Virtual Memory

- Virtual memory comes from the pageing tables in the CPU.
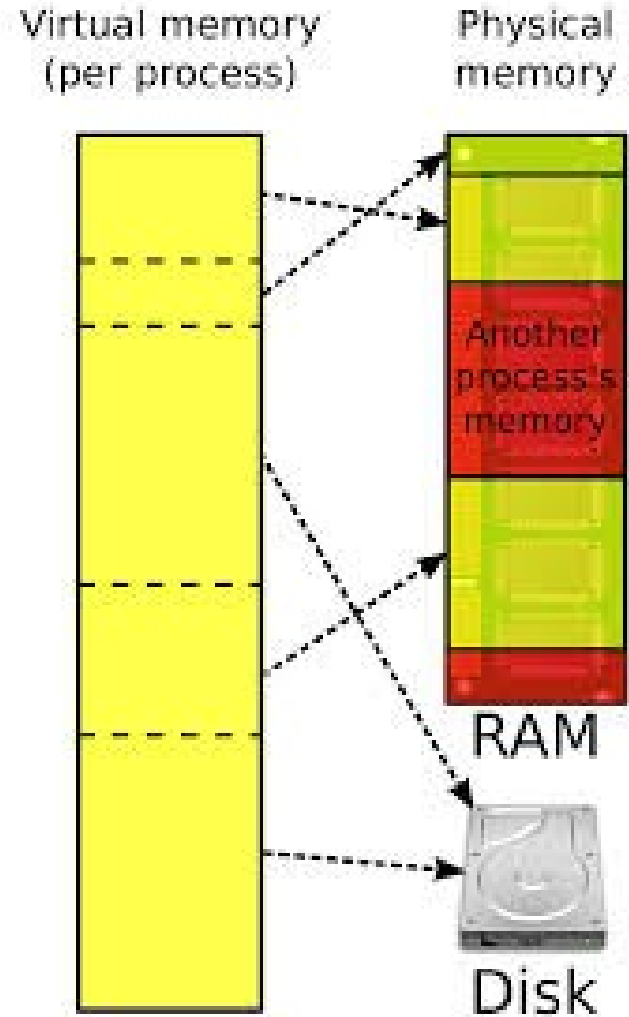
Kernel to Ram

700 – 900 usual Kernel size
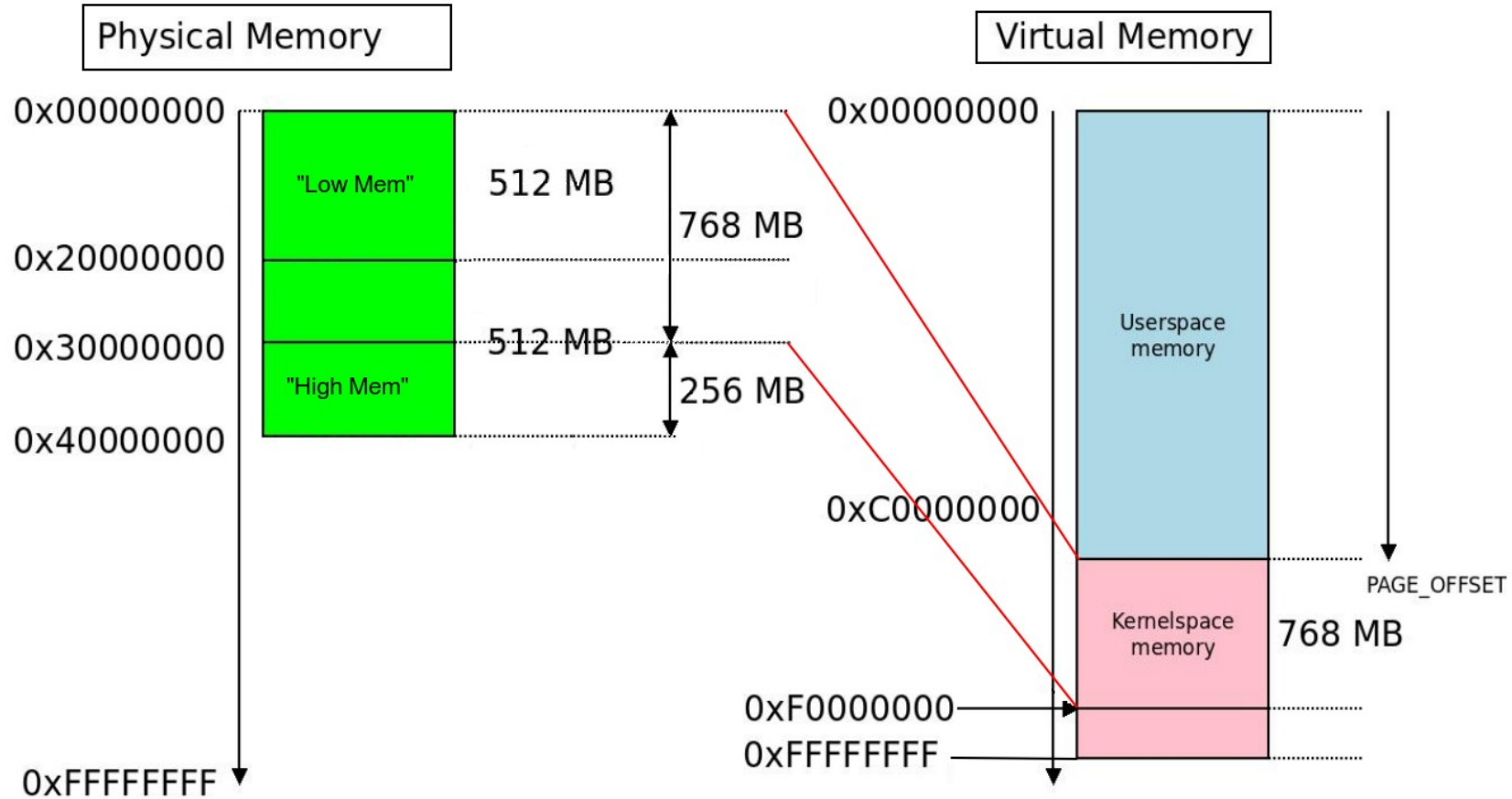
Swap

- Swap memory dictated in OLI systems.

- Try to keep it under 10% in new systems.

sysctl vm.swappiness

What is SWAP Memory ?

Physical memory

2GB

Swap Memory Partition

Hard Drive

496 GB

4 GB
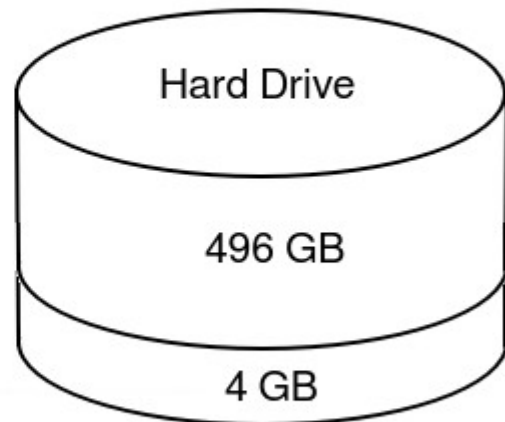
IF (RAM < 2GB)
    SWAP= RAM * 2GB
ELSE
    SWAP= RAM + 2GB

With 2GB of RAM
your Swap will be 4GB

Swap

- The MMU will move a program that has NOT been active for a while.

- Virtually reference and mapped for latter use.
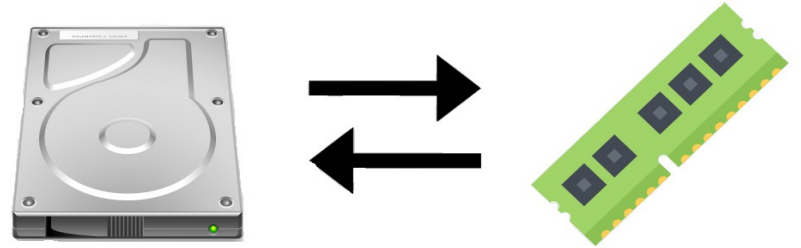
RAM not mapped is RAM not used (free)

SWAP is the slowest memory available.

GUI Usage

- Generalized table with GUI Usage.
- Minimums.

Desktops: Memory Consumption

Desktop	Memory (MB)
MATE	260
LXQT	306
DDE	345
Xfce	395
KDE Plasma	398
GNOME	405
Budgie	405
Cinnamon	514
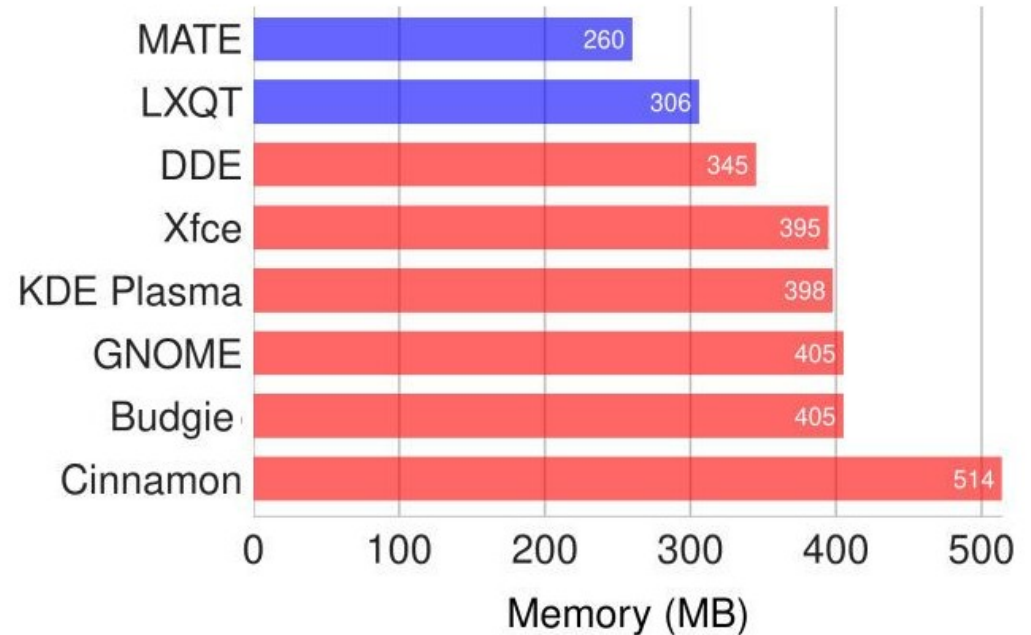
Memory (MB)

GUI Usage

- Light versions will average 150-210MB

- While a Heavy version will use up to 600MB

RAM usage

KDE	585
GNOME	573
Cinnamon	494
MATE	213
XFCE	211
LXDE	198

Startup time

KDE	58
GNOME	35
Cinnamon	33
XFCE	30
MATE	24
LXDE	22
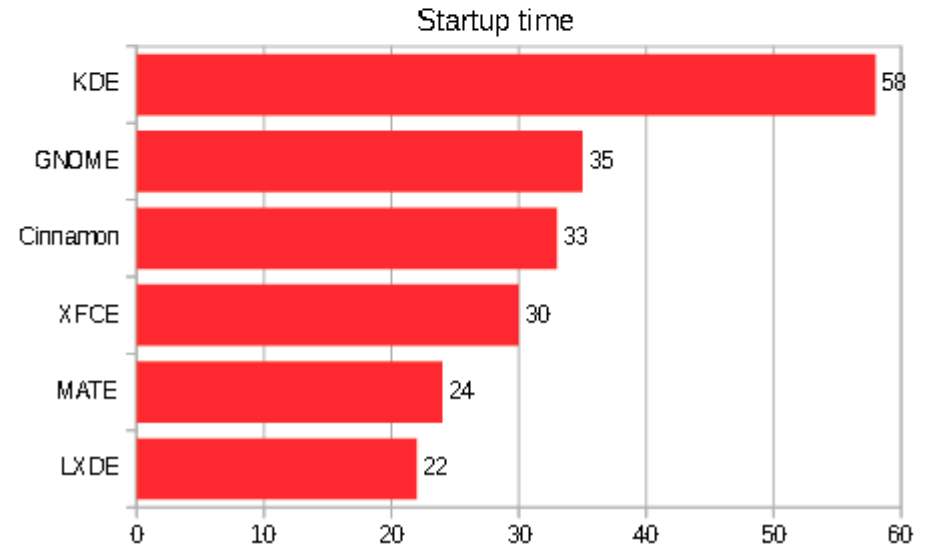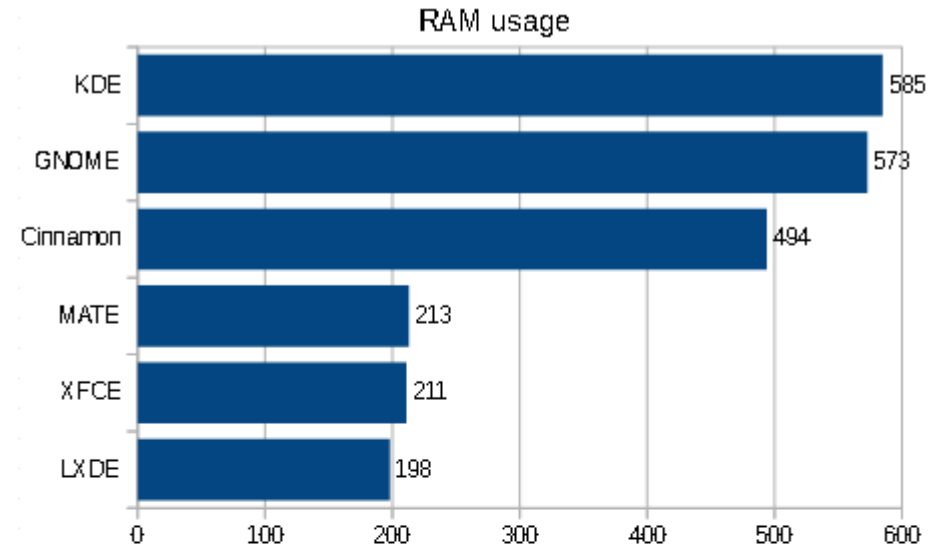
Memory management

- There are many tools to manage your memory requirements, we will only cover the basics:
  - ~$ FREE
  - ~$ TOP
  - ~$ VMSTAT
  -

FREE

```
File  Edit  View  Search  Terminal  Help
tutor@debian:~$ free --mega
              total        used        free      shared  buff/cache   available
Mem:          33753        1952       30164          96        1636       29969
Swap:          1023           0        1023
tutor@debian:~$ free -h
              total        used        free      shared  buff/cache   available
Mem:           31Gi        1.8Gi        28Gi        91Mi        1.5Gi        27Gi
Swap:         975Mi          0B       975Mi
tutor@debian:~$ ▯
```

The *free* command displays:
  ◆ Total amount of free and used physical memory
  ◆ Total amount of swap memory in the system
  ◆ Buffers and caches used by the kernel

  ◆ --mega (megabytes), -h (human readable), -t (total)

TOP

```
 File  Edit  View  Search  Terminal  Help
top - 10:38:53 up  4:11,  1 user,  load average: 0.69, 0.53, 0.46
Tasks: 242 total,   1 running, 241 sleeping,   0 stopped,   0 zombie
%Cpu(s):  4.8 us,  1.6 sy,  0.0 ni, 91.7 id,  1.4 wa,  0.0 hi,  0.5 si,  0.0 st
MiB Mem :  32189.9 total,  27948.2 free,   2418.1 used,   1823.7 buff/cache
MiB Swap:    976.0 total,    976.0 free,      0.0 used.  27761.1 avail Mem

  PID USER      PR  NI    VIRT    RES    SHR S  %CPU  %MEM     TIME+ COMMAND
 4757 tutor     20   0  451052 270352 126788 S  10.3   0.8   7:20.31 soffice.bin
 1046 tutor     20   0  340832 101264  77492 S   9.0   0.3   9:05.68 Xorg
 8994 tutor     20   0  838244 181188  98560 S   8.6   0.5   3:28.12 Isolated Web Co
 1164 tutor     20   0 1149836 166876  90992 S   6.6   0.5   6:27.91 gnome-shell
 1204 tutor      9 -11 2296912  24972  19288 S   5.6   0.1   2:36.73 pulseaudio
 8998 tutor     20   0  949192 196512 102692 S   4.0   0.6   1:09.64 Isolated Web Co
 8781 tutor     20   0 2100312 366848 174040 S   3.0   1.1   1:36.85 firefox-esr
 9246 tutor     20   0  841764 133872  96144 S   1.7   0.4   0:27.60 Isolated Web Co
 4420 tutor     20   0  116704  38696  27464 S   1.3   0.1   0:02.86 gnome-terminal-
    1 root      20   0   35424   8960   7300 S   0.7   0.0   0:18.67 systemd
  479 root      20   0       0      0      0 I   0.3   0.0   0:03.58 rtsx_usb_ms_1
 1682 tutor     20   0 2160188 723964 169376 S   0.3   2.2  13:58.65 chromium
```

The *top* command,

provides a dynamic, real-time view of a running system. Included in that system summary is the ability to check memory usage on a per-process basis.

~$ top -o %MEM (will prioritize on percentage used)

vmstat -s

```
File   Edit   View   Search   Terminal   Help
tutor@debian:~$ vmstat -s
      32962508 K total memory
       1968036 K used memory
       2488140 K active memory
        822436 K inactive memory
      29374704 K free memory
         92548 K buffer memory
       1527220 K swap cache
        999420 K total swap
             0 K used swap
        999420 K free swap
        453986 non-nice user cpu ticks
          1014 nice user cpu ticks
        160486 system cpu ticks
      13045689 idle cpu ticks
```

Reports virtual memory and total memory usage.

vmstat -s (single column), -a (active)

vmstat 1 (will give you information in one second intervals)

vm.swappiness

```
File  Edit  View  Search  Terminal  Help
tutor@debian:~$ cat /proc/sys/vm/swappiness
60
tutor@debian:~$ []
```

- If you want to change the percentage of swap file you are running.

- Run this command:

`~# sudo sysctl vm.swappiness=10`

~# sudo /proc/meminfo

This reads a virtual file that contains the real-time dynamic information

f you want to get fancy:

egrep –color 'Mem|Cache|Swap' /proc/meminfo.

```
File   Edit   View   Search   Terminal   Help
MemTotal:          32962508 kB
MemFree:           28985860 kB
MemAvailable:      28844060 kB
Buffers:              95768 kB
Cached:             1486648 kB
SwapCached:               0 kB
Active:             2842324 kB
Inactive:            841624 kB
Active(anon):       2103592 kB
Inactive(anon):       99848 kB
Active(file):        738732 kB
Inactive(file):      741776 kB
Unevictable:             96 kB
Mlocked:                 96 kB
HighTotal:         32484908 kB
HighFree:          28819012 kB
```

Sudo less */proc*/meminfo (allow you to scroll)

~# sudo dmidecode

```
File   Edit   View   Search   Terminal   Help
Handle 0x003B, DMI type 16, 23 bytes
Physical Memory Array
        Location: System Board Or Motherboard
        Use: System Memory
        Error Correction Type: None
        Maximum Capacity: 64 GB
        Error Information Handle: Not Provided
        Number Of Devices: 4

Handle 0x003C, DMI type 17, 40 bytes
Memory Device
        Array Handle: 0x003B
        Error Information Handle: Not Provided
        Total Width: Unknown
        Data Width: Unknown
        Size: No Module Installed
        Form Factor: Unknown
        Set: None
        Locator: ChannelA-DIMM0
        Bank Locator: BANK 0
```

- Is a long list of all items in the computer including the Physical Memory array (RAM banks)

Clearing PageCache

To clear the **PageCache** only, you can use the following command, which will specifically clear the PageCache, helping to free up memory resources.

```
~# sudo sync;echo 1> proc/sys/vm/drop_caches
```

`;echo 1` – Clears only the page cache.
`;echo 2` – Clears dentries and inodes.
`;echo 3` – Clears page cache, dentries, and inodes.

Questions

- conclusion
  - Research the programs your using and give your self some more RAM that what is needed.
  - Monitor your programs RAM consumption and kill any unwanted use of resources.
  - Be careful when clearing your cache.