Introduction to Programming

Digression - 2

Processes and Multiprogramming

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Processes

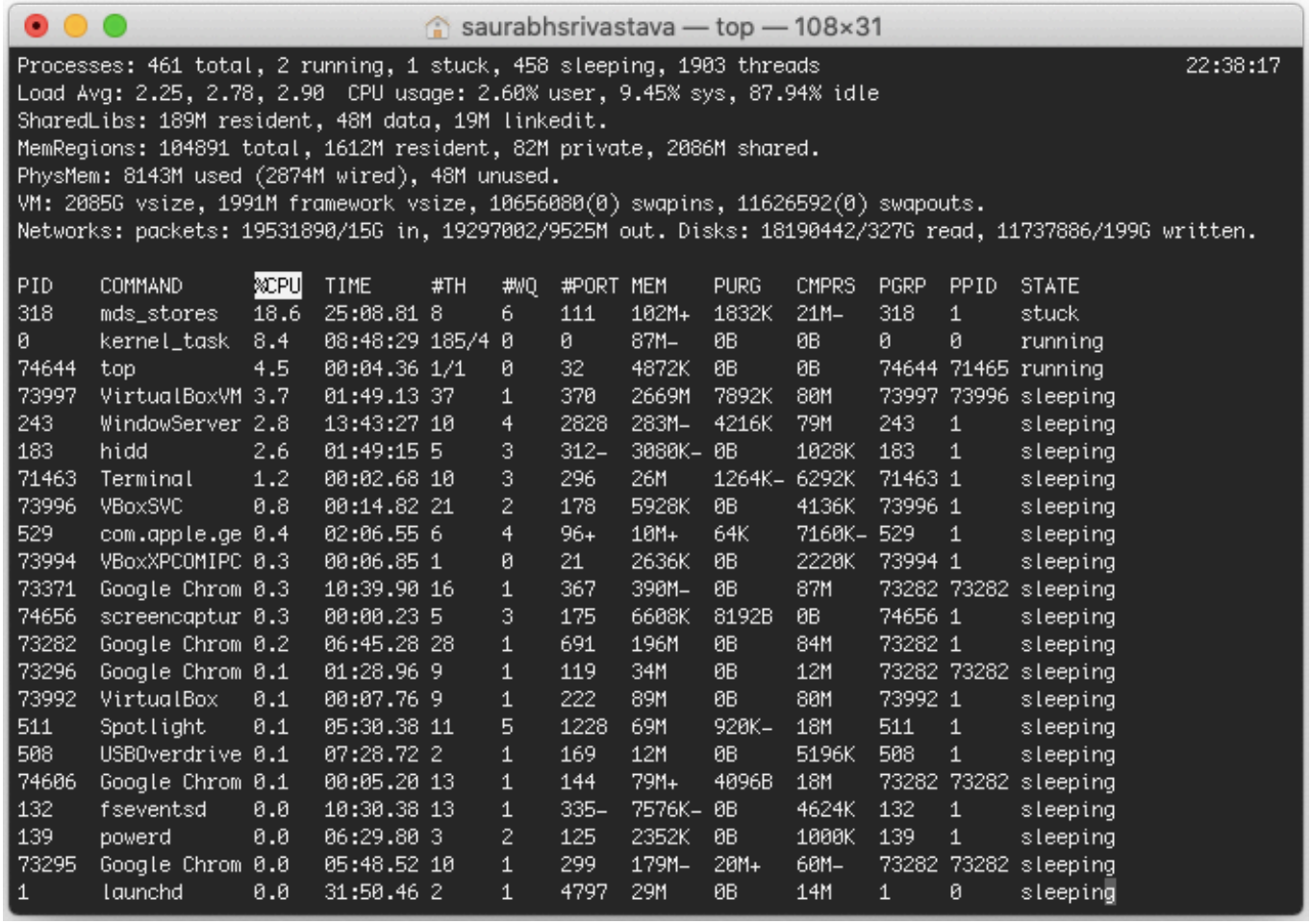
saurabhsrivastava — top — 108×31

```
Processes: 461 total, 2 running, 1 stuck, 458 sleeping, 1903 threads                 22:38:17
Load Avg: 2.25, 2.78, 2.90  CPU usage: 2.60% user, 9.45% sys, 87.94% idle
SharedLibs: 189M resident, 48M data, 19M linkedit.
MemRegions: 104891 total, 1612M resident, 82M private, 2086M shared.
PhysMem: 8143M used (2874M wired), 48M unused.
VM: 2085G vsize, 1991M framework vsize, 10656080(0) swapins, 11626592(0) swapouts.
Networks: packets: 19531890/15G in, 19297002/9525M out. Disks: 18190442/327G read, 11737886/199G written.

PID    COMMAND      %CPU  TIME     #TH   #WQ  #PORT MEM    PURG   CMPRS  PGRP  PPID  STATE
318    mds_stores   18.6  25:08.81 8     6    111   102M+  1832K  21M-   318   1     stuck
0      kernel_task  8.4   08:48:29 185/4 0    0     87M-   0B     0B     0     0     running
74644  top          4.5   00:04.36 1/1   0    32    4872K  0B     0B     74644 71465 running
73997  VirtualBoxVM 3.7   01:49.13 37    1    370   2669M  7892K  80M    73997 73996 sleeping
243    WindowServer 2.8   13:43:27 10    4    2828  283M-  4216K  79M    243   1     sleeping
183    hidd         2.6   01:49:15 5     3    312-  3080K- 0B     1028K  183   1     sleeping
71463  Terminal     1.2   00:02.68 10    3    296   26M    1264K- 6292K  71463 1     sleeping
73996  VBoxSVC      0.8   00:14.82 21    2    178   5928K  0B     4136K  73996 1     sleeping
529    com.apple.ge 0.4   02:06.55 6     4    96+   10M+   64K    7160K- 529   1     sleeping
73994  VBoxXPCOMIPC 0.3   00:06.85 1     0    21    2636K  0B     2220K  73994 1     sleeping
73371  Google Chrom 0.3   10:39.90 16    1    367   390M-  0B     87M    73282 73282 sleeping
74656  screencaptur 0.3   00:00.23 5     3    175   6608K  8192B  0B     74656 1     sleeping
73282  Google Chrom 0.2   06:45.28 28    1    691   196M   0B     84M    73282 1     sleeping
73296  Google Chrom 0.1   01:28.96 9     1    119   34M    0B     12M    73282 73282 sleeping
73992  VirtualBox   0.1   00:07.76 9     1    222   89M    0B     80M    73992 1     sleeping
511    Spotlight    0.1   05:30.38 11    5    1228  69M    920K-  18M    511   1     sleeping
508    USBOverdrive 0.1   07:28.72 2     1    169   12M    0B     5196K  508   1     sleeping
74606  Google Chrom 0.1   00:05.20 13    1    144   79M+   4096B  18M    73282 73282 sleeping
132    fseventsd    0.0   10:30.38 13    1    335-  7576K- 0B     4624K  132   1     sleeping
139    powerd       0.0   06:29.80 3     2    125   2352K  0B     1000K  139   1     sleeping
73295  Google Chrom 0.0   05:48.52 10    1    299   179M-  20M+   60M-   73282 73282 sleeping
1      launchd      0.0   31:50.46 2     1    4797  29M    0B     14M    1     0     sleeping
```

If you use a UNIX-based operating system, such as Linux or macOS, there is a good chance that you can issue `top` command on your terminal

Processes



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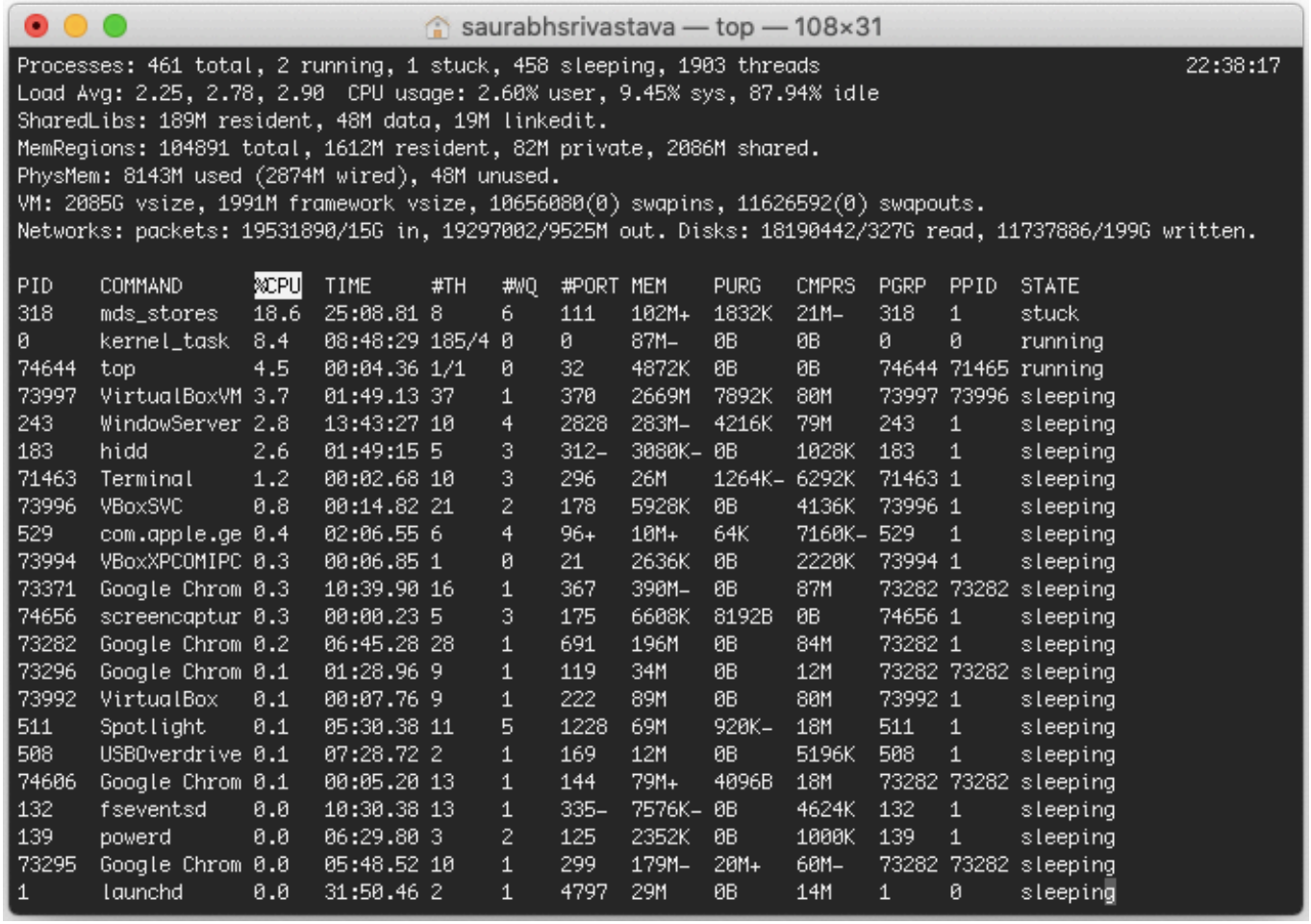

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`%CPU` and `MEM` are usually of interest, representing the average CPU usage and the amount of RAM your process is using

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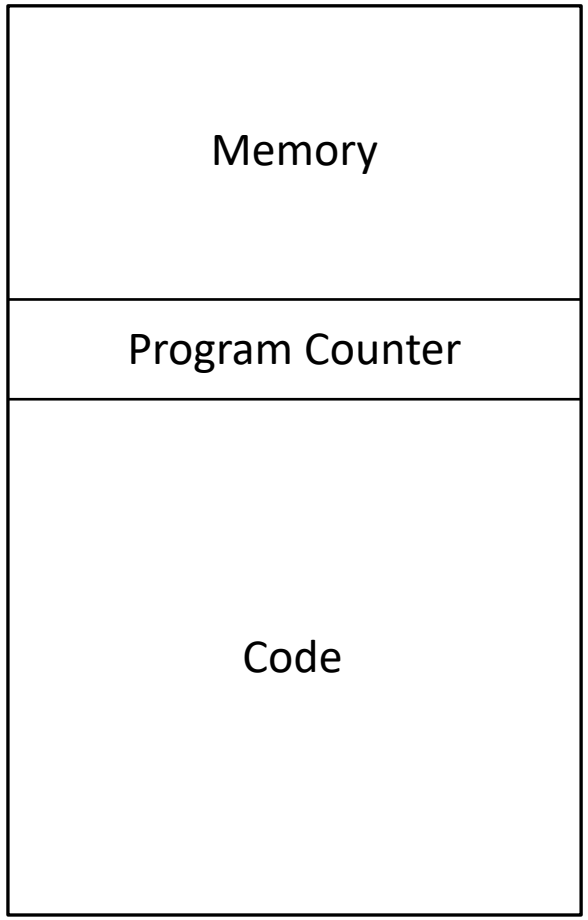
At any point of time, a process has a particular *state*

- A process is in the state *ready*, if it wishes to use the CPU, but doesn’t have it currently
- A process is in the state *running*, if it currently has the CPU for use
- A process is in the state *blocked*, if it does not require CPU due to some reason (e.g. a request for I/O)
- In addition, some categorisations also consider *new* and *terminated* as process states

Processes



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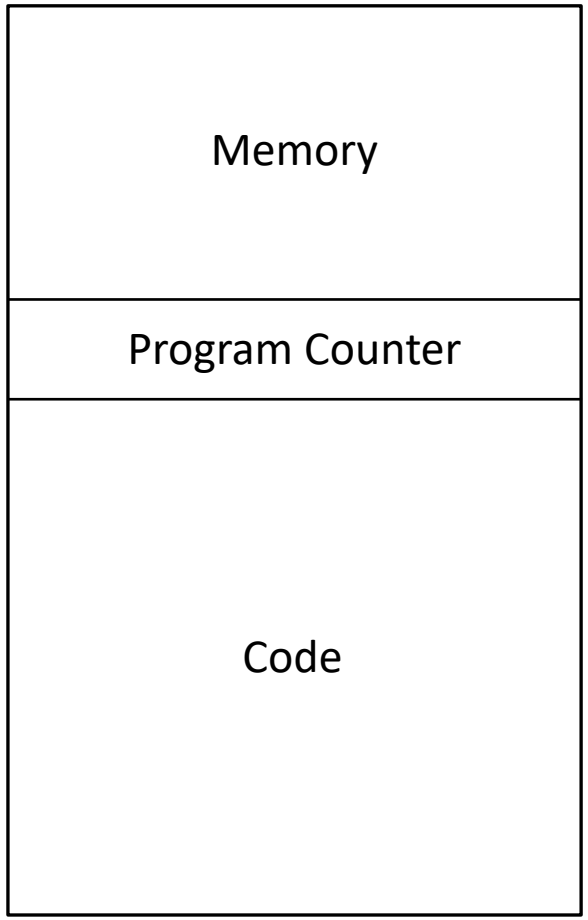

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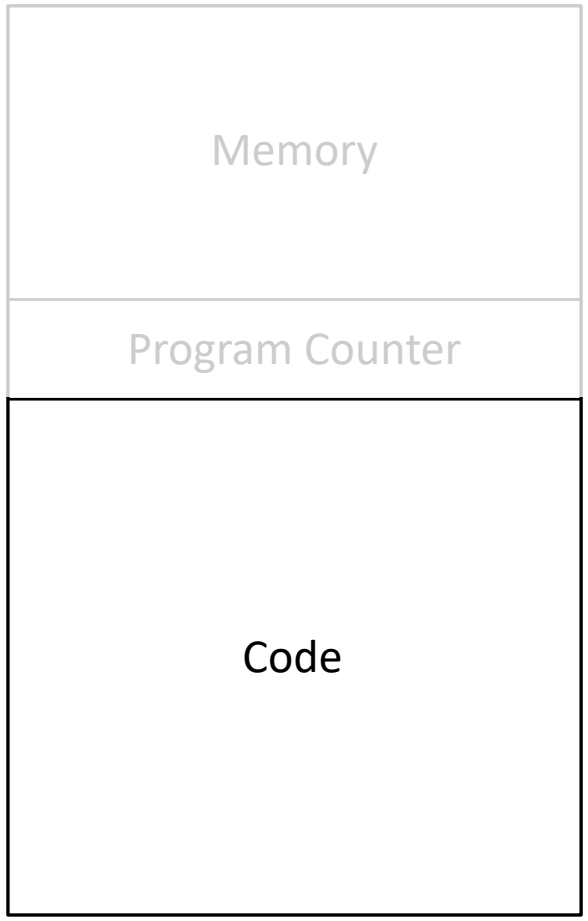

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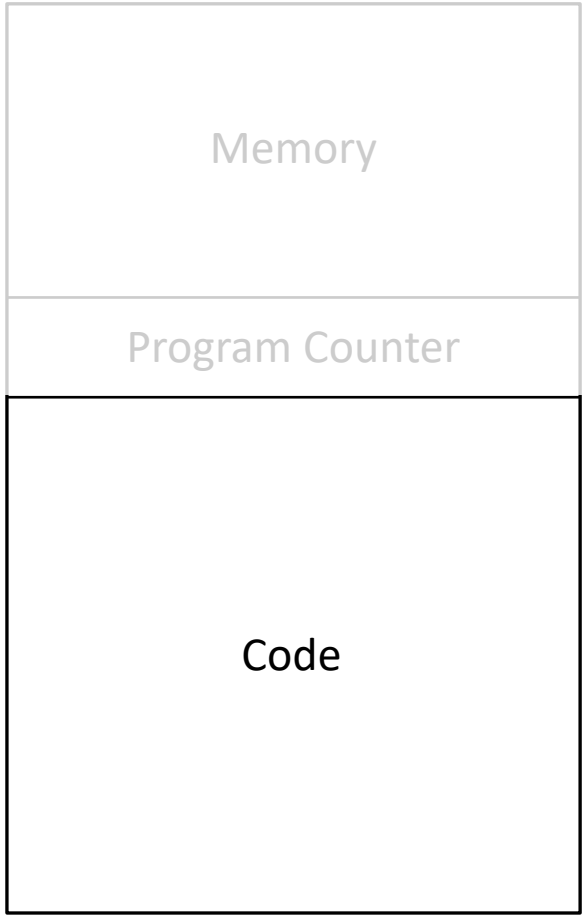

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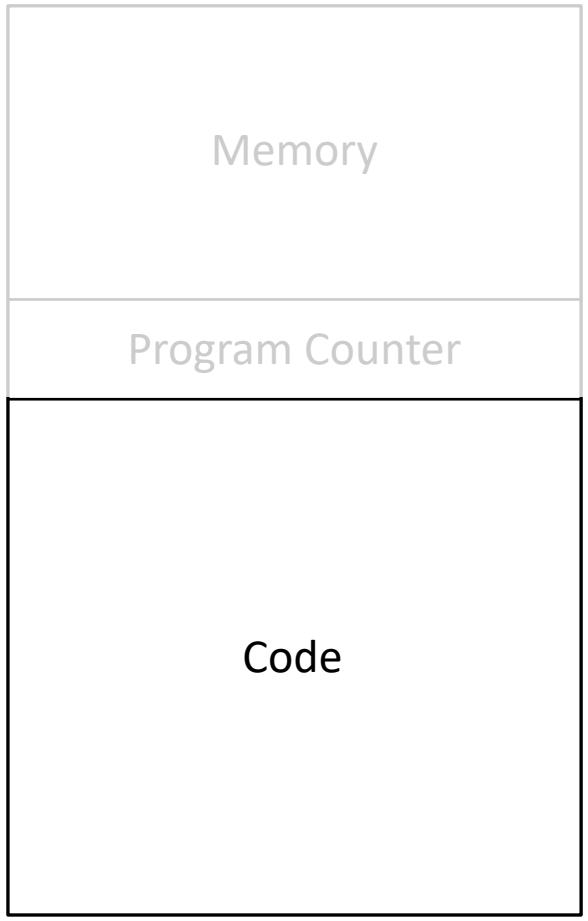
Processes

Similar to what we saw in Week 0



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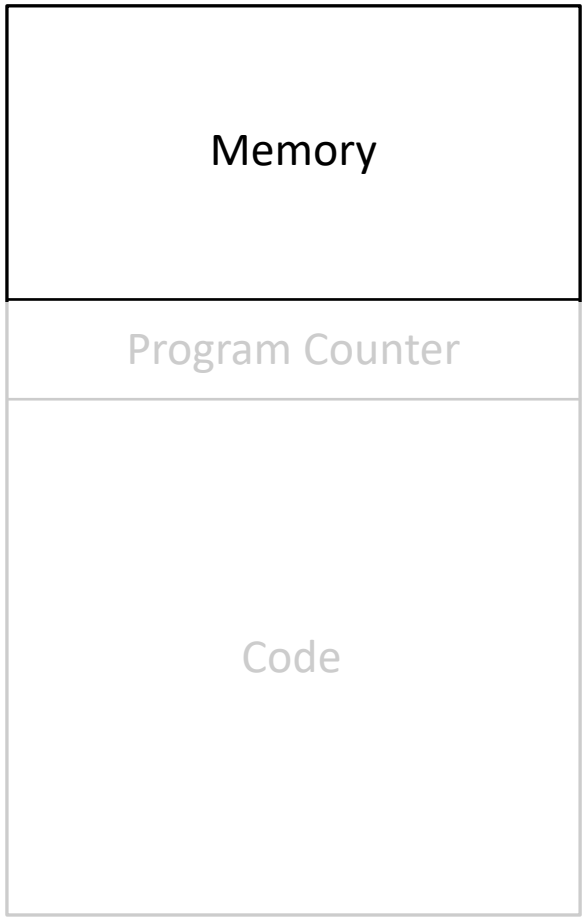

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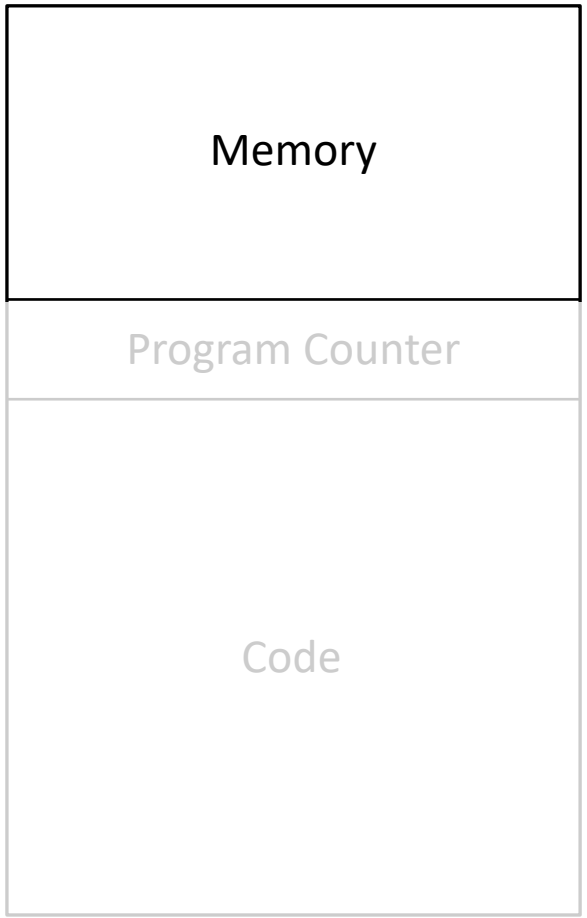

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There are different types of memory that a process has, but we don't need to know these details as of now

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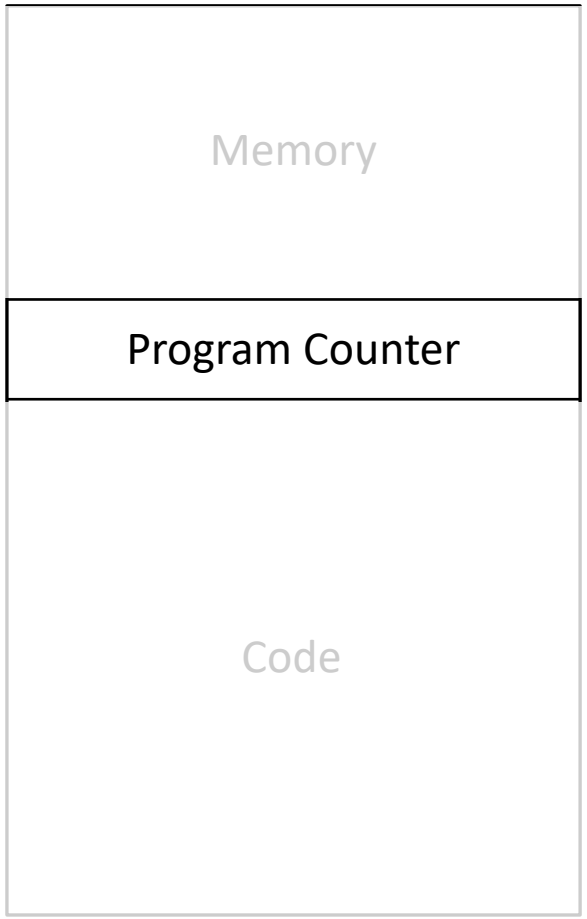

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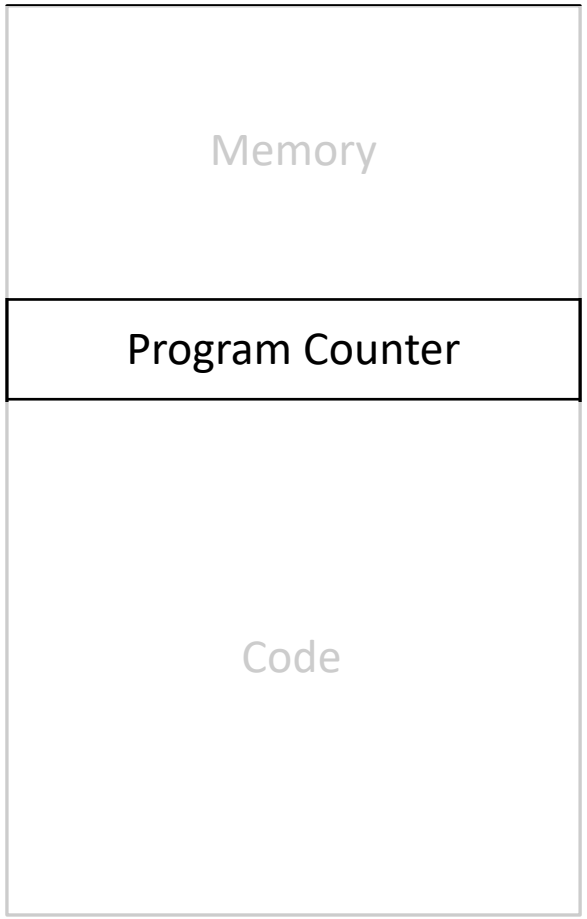
Processes

We did discuss the Program Counter in Week 0 !!



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The value of Program Counter is crucial, since it allows execution from where it was left last time

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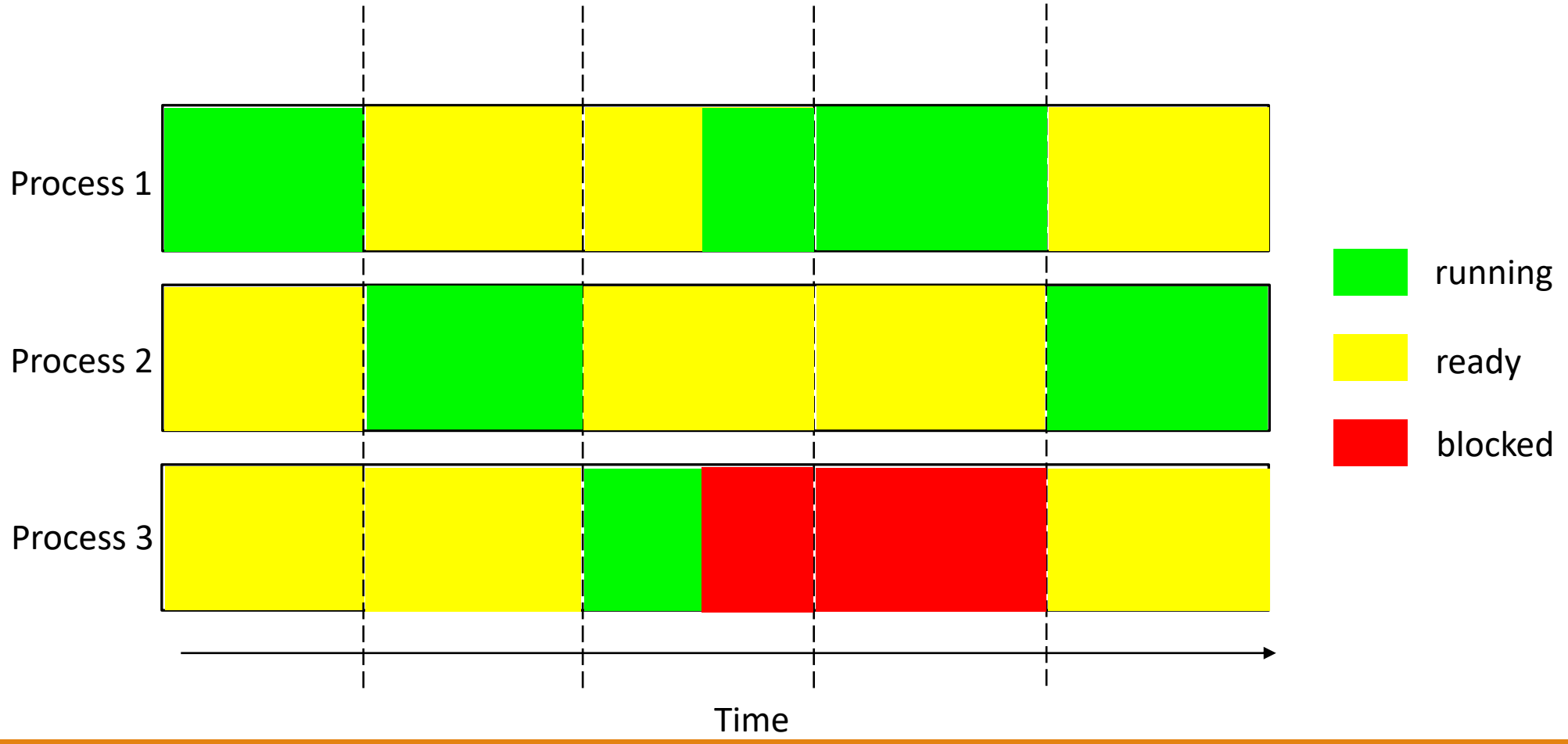

Additional Reading

Pratt TW, Zelkowitz MV, Gopal TV. Programming languages: design and implementation. Englewood Cliffs: Prentice-Hall; 1984.

- It is a fairly advanced book; try reading Section 10.1 in the book