

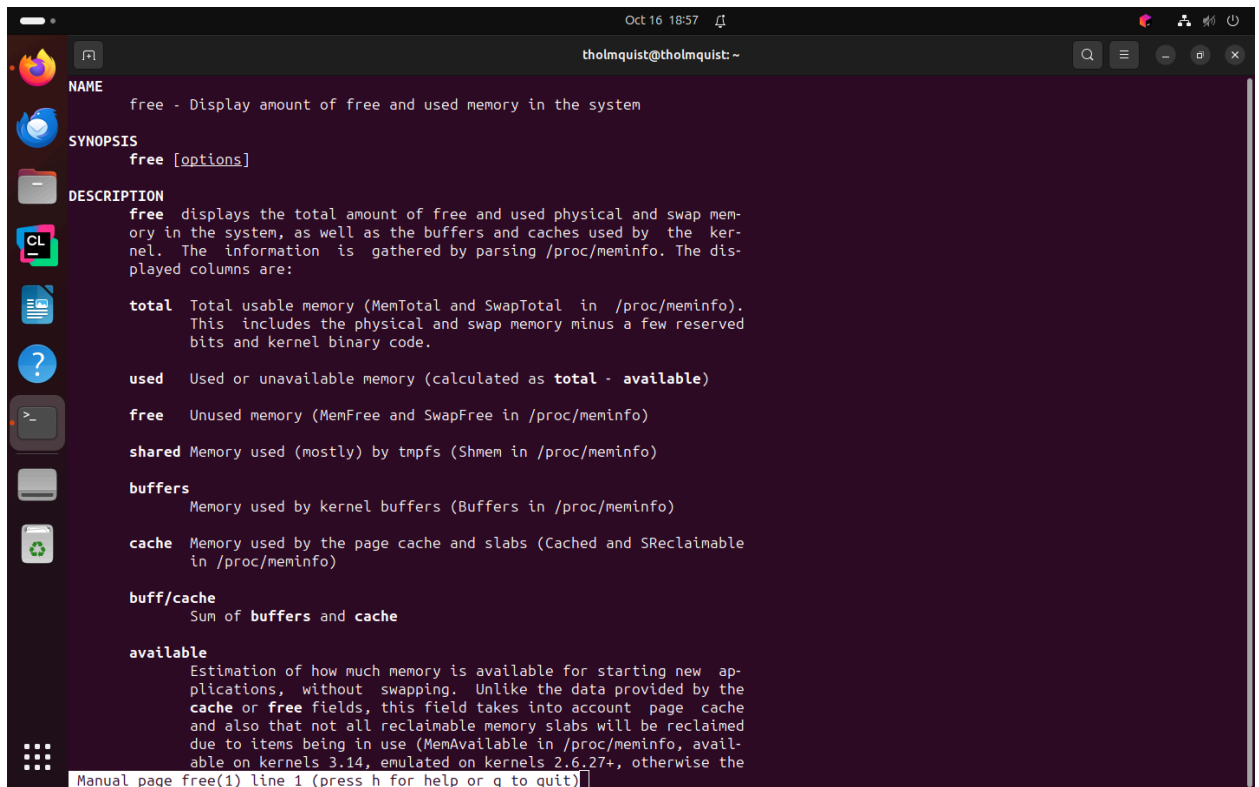
# Ch.13 Coding Homework

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gcc (Ubuntu 13.2.0-4ubuntu3) 13.2.0

gcc -o mem\_user memory-user.c

1.



Oct 16 18:57 tholmquist@tholmquist:~

**NAME**  
free - Display amount of free and used memory in the system

**SYNOPSIS**  
free [options]

**DESCRIPTION**  
free displays the total amount of free and used physical and swap memory in the system, as well as the buffers and caches used by the kernel. The information is gathered by parsing /proc/meminfo. The displayed columns are:

**total** Total usable memory (MemTotal and SwapTotal in /proc/meminfo). This includes the physical and swap memory minus a few reserved bits and kernel binary code.

**used** Used or unavailable memory (calculated as **total** - **available**)

**free** Unused memory (MemFree and SwapFree in /proc/meminfo)

**shared** Memory used (mostly) by tmpfs (Shmem in /proc/meminfo)

**buffers** Memory used by kernel buffers (Buffers in /proc/meminfo)

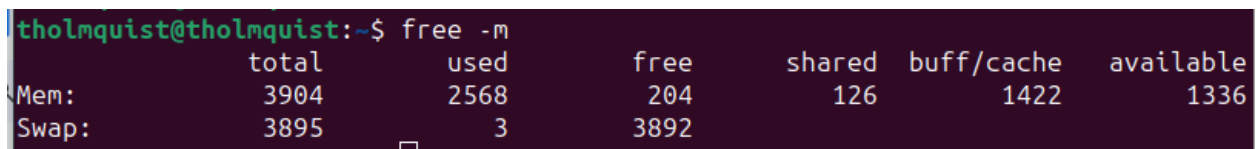
**cache** Memory used by the page cache and slabs (Cached and SReclaimable in /proc/meminfo)

**buff/cache** Sum of **buffers** and **cache**

**available** Estimation of how much memory is available for starting new applications, without swapping. Unlike the data provided by the **cache** or **free** fields, this field takes into account page cache and also that not all reclaimable memory slabs will be reclaimed due to items being in use (MemAvailable in /proc/meminfo, available on kernels 3.14, emulated on kernels 2.6.27+, otherwise the

Manual page free(1) line 1 (press h for help or q to quit)

2.



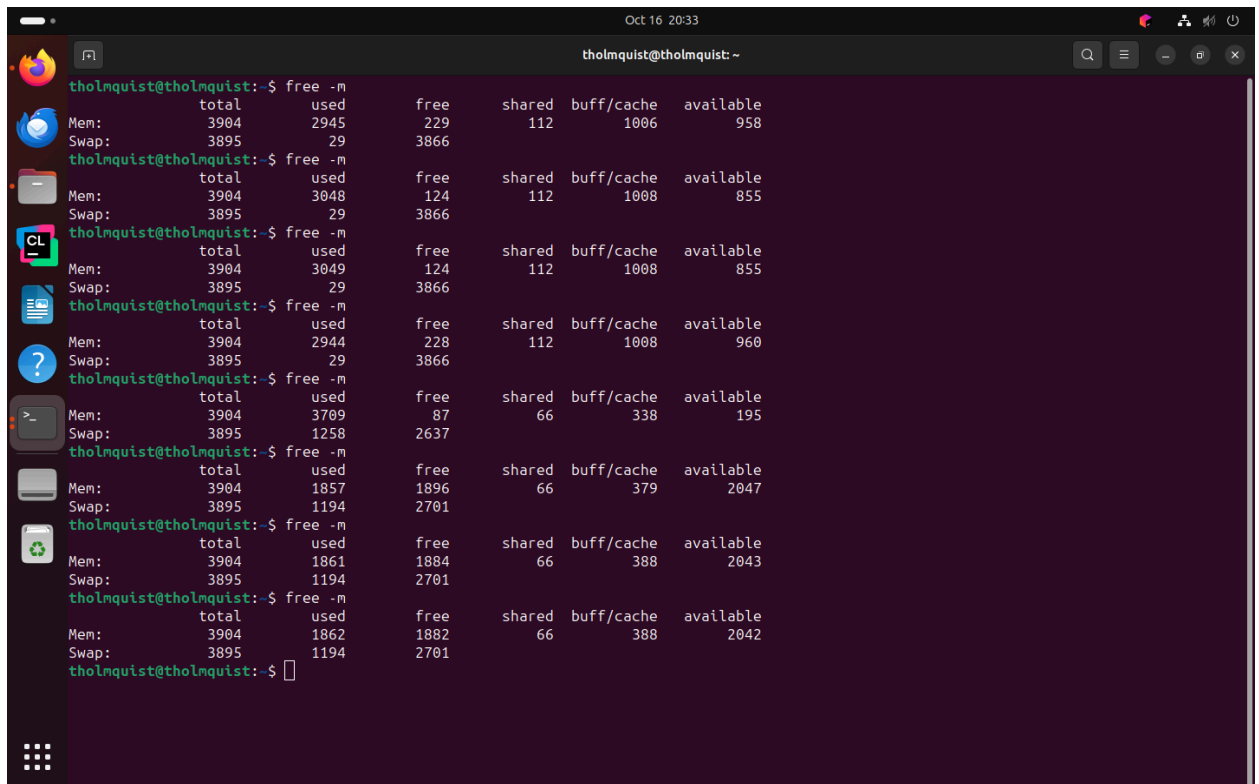
```
tholmquist@tholmquist:~$ free -m
```

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 2568 | 204  | 126    | 1422       | 1336      |
| Swap: | 3895  | 3    | 3892 |        |            |           |

I have 3904 megabytes in my system, 204 mb are free and I would have figured there would be more free according to my intuition.

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4.

A terminal window titled 'tholmquist@tholmquist: ~' showing the output of the 'free -m' command multiple times. The output displays memory usage statistics in megabytes, including total, used, free, shared, buff/cache, and available memory. The statistics change across the runs, showing an increase in used memory and a decrease in free memory as the program runs.

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 2945 | 229  | 112    | 1006       | 958       |
| Swap: | 3895  | 29   | 3866 |        |            |           |

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 3048 | 124  | 112    | 1008       | 855       |
| Swap: | 3895  | 29   | 3866 |        |            |           |

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 3049 | 124  | 112    | 1008       | 855       |
| Swap: | 3895  | 29   | 3866 |        |            |           |

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 2944 | 228  | 112    | 1008       | 960       |
| Swap: | 3895  | 29   | 3866 |        |            |           |

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 3709 | 87   | 66     | 338        | 195       |
| Swap: | 3895  | 1258 | 2637 |        |            |           |

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 1857 | 1896 | 66     | 379        | 2047      |
| Swap: | 3895  | 1194 | 2701 |        |            |           |

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 1861 | 1884 | 66     | 388        | 2043      |
| Swap: | 3895  | 1194 | 2701 |        |            |           |

|       | total | used | free | shared | buff/cache | available |
|-------|-------|------|------|--------|------------|-----------|
| Mem:  | 3904  | 1862 | 1882 | 66     | 388        | 2042      |
| Swap: | 3895  | 1194 | 2701 |        |            |           |

When running the program memory-user the amount of memory being used increases dramatically as the number input into the program increases and the amount of memory that is free decreases dramatically as the number gets larger. As you can see from the runs above the first run of free is when the program is not being run. The second and third are when the program is being run with an input of 100. Then the fifth is with an input of 10000 and as you can see the amount of free memory is all the way down to 87 mebibytes and the amount of memory being used is 3709 mebibytes which is much more than the 1857 being used after canceling the program.

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```

tholmquist@tholmquist: ~/Downloads/OS_ch13_hw
0000e603fe2eb000 20 rw--- 0000000000000000 000:00000 [ anon ]
0000e603fe2f0000 4 r-x-- 0000000000000000 007:00008 bindtextdomain.so
0000e603fe2f1000 64 ---- 0000000000001000 007:00008 bindtextdomain.so
0000e603fe301000 4 r---- 0000000000001000 007:00008 bindtextdomain.so
0000e603fe302000 4 rw--- 0000000000002000 007:00008 bindtextdomain.so
0000e603fe303000 4 r--s- 0000000000000000 0fc:00000 4b2eda6bb976bda485cb2176619421d5-le64.cache-7
0000e603fe304000 8 r--s- 0000000000000000 0fc:00000 6afa1bb216ce958c1589e297e8008489-le64.cache-7
0000e603fe306000 4 r--s- 0000000000000000 0fc:00000 c277e94e32b20404286a1ddafa5a80f0-le64.cache-7
0000e603fe307000 4 r---- 0000000000000000 007:00002 LC_NUMERIC
0000e603fe308000 4 r---- 0000000000000000 007:00002 LC_TIME
0000e603fe309000 4 r---- 0000000000000000 007:00002 LC_COLLATE
0000e603fe30a000 4 r---- 0000000000000000 007:00002 LC_MONETARY
0000e603fe30b000 4 r---- 0000000000000000 007:00002 SYS_LC_MESSAGES
0000e603fe30c000 4 r---- 0000000000000000 007:00002 LC_PAPER
0000e603fe30d000 4 r---- 0000000000000000 007:00002 LC_NAME
0000e603fe30e000 4 r---- 0000000000000000 007:00002 LC_ADDRESS
0000e603fe30f000 4 r---- 0000000000000000 007:00002 LC_TELEPHONE
0000e603fe310000 40 r---- 0000000000000000 007:00006 libmozsandbox.so
0000e603fe31a000 60 ---- 000000000000a000 007:00006 libmozsandbox.so
0000e603fe329000 108 r-x-- 0000000000009000 007:00006 libmozsandbox.so
0000e603fe344000 60 ---- 0000000000003400 007:00006 libmozsandbox.so
0000e603fe353000 8 r---- 0000000000002300 007:00006 libmozsandbox.so
0000e603fe355000 60 ---- 0000000000004500 007:00006 libmozsandbox.so
0000e603fe364000 4 rw--- 0000000000002400 007:00006 libmozsandbox.so
0000e603fe365000 28 r--s- 0000000000000000 007:00002 gconv-modules.cache
0000e603fe36c000 20 rw--- 0000000000000000 000:00000 [ anon ]
0000e603fe371000 172 r-x-- 0000000000000000 007:00002 ld-linux-aarch64.so.1
0000e603fe39c000 4 r---- 0000000000000000 007:00002 LC_MEASUREMENT
0000e603fe39d000 4 r---- 0000000000000000 007:00002 LC_IDENTIFICATION
0000e603fe39e000 40 rw--- 0000000000000000 000:00000 [ anon ]
0000e603fe3a8000 8 r---- 0000000000000000 000:00000 [ anon ]
0000e603fe3aa000 4 r-x-- 0000000000000000 000:00000 [ anon ]
0000e603fe3ab000 8 r---- 0000000000002a00 007:00002 ld-linux-aarch64.so.1
0000e603fe3ad000 8 rw--- 0000000000002c00 007:00002 ld-linux-aarch64.so.1
0000e603fe3d4000 452 r--s- 0000000000000000 000:00001 memfd:mozilla-ipc (deleted)
0000ffffd3379000 208 rw--- 0000000000000000 000:00000 [ stack ]
0000ffffd33ad000 8 rw--- 0000000000000000 000:00000 [ anon ]
mapped: 2744476K writeable/private: 289348K shared: 3060K
tholmquist@tholmquist:~/Downloads/OS_ch13_hw$

```

Many different entities make up an address space on top of the code, heap and stack. We can also see here many anonymous pieces of memory with some library calls and other assortments of memory allocation outside of the three basic ones described.

8.

```

tholmquist@tholmquist:~$ sudo pmap 7523 -x
[sudo] password for tholmquist:
7523:  ./p3 100
Address      Kbytes      RSS      Dirty  Mode  Mapping
0000aee51a5a0000 4          4          0  r-x--  p3
0000aee51a5bf000 4          4          4  r----  p3
0000aee51a5c0000 4          4          4  rw---  p3
0000aee53349a000 132        4          4  rw---  [ anon ]
0000ea80e9aaf000 102404     102404     102404  rw---  [ anon ]
0000ea80efeb0000 1604       1152       0  r-x--  libc.so.6
0000ea80f0041000 112        0          0  ----  libc.so.6
0000ea80f005d000 12         12         12  r----  libc.so.6
0000ea80f0060000 8          8          8  rw---  libc.so.6
0000ea80f0062000 52         16         16  rw---  [ anon ]
0000ea80f007f000 152        152       0  r-x--  ld-linux-aarch64.so.1
0000ea80f00b8000 8          8          8  rw---  [ anon ]
0000ea80f00ba000 8          0          0  r----  [ anon ]
0000ea80f00bc000 4          4          0  r-x--  [ anon ]
0000ea80f00bd000 8          8          8  r---  ld-linux-aarch64.so.1
0000ea80f00bf000 8          8          8  rw---  ld-linux-aarch64.so.1
0000ffffc5528000 132        12         12  rw---  [ stack ]
-----
total kB      104656    103800    102488

```

```

tholmquist@tholmquist:~$ sudo pmap 7546 -x
7546:  ./p3 10000
Address            Kbytes      RSS      Dirty Mode  Mapping
0000c68b82650000      4         4         0 r-x-- p3
0000c68b8266f000      4         4         4 r---- p3
0000c68b82670000      4         4         4 rw--- p3
0000c68b9c781000     132         4         4 rw--- [ anon ]
0000eb222b5bf000  1851396  1851396  1851396 rw--- [ anon ]
0000eb229c5c0000    1604       1152         0 r-x-- libc.so.6
0000eb229c751000     112         0         0 ----- libc.so.6
0000eb229c76d000      12         12        12 r---- libc.so.6
0000eb229c770000       8         8         8 rw--- libc.so.6
0000eb229c772000      52         16        16 rw--- [ anon ]
0000eb229c782000     152        152         0 r-x-- ld-linux-aarch64.
0000eb229c7bb000       8         8         8 rw--- [ anon ]
0000eb229c7bd000       8         0         0 r---- [ anon ]
0000eb229c7bf000       4         4         0 r-x-- [ anon ]
0000eb229c7c0000       8         8         8 r---- ld-linux-aarch64.
0000eb229c7c2000       8         8         8 rw--- ld-linux-aarch64.
0000ffff8521000     132         12        12 rw--- [ stack ]
-----
total kB           1853648  1852792  1851480
tholmquist@tholmquist:~$ 

```

In the first screenshot I ran the program with an input of 100 mb and in the second screenshot an input of 10000 mb. As can be seen by the screenshots there is a block of memory being stored that is much larger in the second screenshot than the first while everything else remains showing the size of the heap increasing as more memory is requested for, which would match my expectations based off of what I have learned.