ForNextDay(14)
Stephen Cole
3553803

Recursive Factorial x = 5

```
(gdb) run
Starting program: /home1/ugrads/scole4/Summer2020/cs2263/lecture/le

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$5 = (void *) 0x7fffffffe220
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$6 = (void *) 0x7fffffffe1f0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$7 = (void *) 0x7fffffffe1c0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$8 = (void *) 0x7fffffffe190
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$9 = (void *) 0x7fffffffe160
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$10 = (void *) 0x7fffffffe130
(gdb) c
Continuing.
120
[Inferior 1 (process 28291) exited normally]
```

memory: |0x7fffffffe130 - 0x7fffffffe220| = 0xF0 or 240

Iterative Factorial x = 5

```
(gdb) x/100x $sp
0x7fffffffe220: 0xffffe250      0x00007fff      0x00400578      0x0
0x7fffffffe230: 0xffffe338      0x00007fff      0x00400430      0x0
0x7fffffffe240: 0xffffe330      0x00007fff      0x00000000      0x0
0x7fffffffe250: 0x00000000      0x00000000      0xf7a303d5      0x0
0x7fffffffe260: 0x00000000      0x00000000      0xffffe338      0x0
0x7fffffffe270: 0x00000000      0x00000001      0x00400558      0x0
0x7fffffffe280: 0x00000000      0x00000000      0x4d561bd3      0x8
0x7fffffffe290: 0x00400430      0x00000000      0xffffe330      0x0
0x7fffffffe2a0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2b0: 0x89961bd3      0x7313ab81      0x4a4c1bd3      0x7
0x7fffffffe2c0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2d0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2e0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2f0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe300: 0x00400430      0x00000000      0xffffe330      0x0
0x7fffffffe310: 0x00000000      0x00000000      0x00400459      0x0
0x7fffffffe320: 0xffffe328      0x00007fff      0x0000001c      0x0
0x7fffffffe330: 0x00000001      0x00000000      0xffffe5a1      0x0
0x7fffffffe340: 0x00000000      0x00000000      0xffffe5df      0x0
0x7fffffffe350: 0xffffe5f0      0x00007fff      0xffffe5fc      0x0
0x7fffffffe360: 0xffffe60b      0x00007fff      0xffffe625      0x0
0x7fffffffe370: 0xffffe68b      0x00007fff      0xffffe6a7      0x0
0x7fffffffe380: 0xffffe6b7      0x00007fff      0xffffe6da      0x0
0x7fffffffe390: 0xffffe70f      0x00007fff      0xffffe722      0x0
0x7fffffffe3a0: 0xffffe736      0x00007fff      0xffffe74b      0x0
```

memory: |0x7fffffffe3a0 - 0x7fffffffe220| = 0x180 or 384

Recursive Factorial x = 10

```
(gdb) run
Starting program: /home1/ugrads/scole4/Summer2020/cs2263/lecture/lec

Breakpoint 1, 0x0000000000400521 in fac ()
Missing separate debuginfos, use: debuginfo-install glibc-2.17-260.e
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$1 = (void *) 0x7fffffffe1f0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$2 = (void *) 0x7fffffffe1c0
(gdb) c
Continuing.
```

```
Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$3 = (void *) 0x7fffffffe190
(gdb) print $sp
$4 = (void *) 0x7fffffffe190
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$5 = (void *) 0x7fffffffe160
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$6 = (void *) 0x7fffffffe130
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$7 = (void *) 0x7fffffffe100
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$8 = (void *) 0x7fffffffe0d0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$9 = (void *) 0x7fffffffe0a0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
```

memory: |0x7fffffffe040 - 0x7fffffffe1f0| = ox1B0 or 432

Iterative Factorial x = 10

```
(gdb) run
Starting program: /home1/ugrads/scole4/Summer2020/cs2263/lecture/le

Breakpoint 1, 0x0000000000400521 in fac2 ()
(gdb) x/100x $sp
0x7fffffffe220: 0xffffe250      0x00007fff      0x00400578      0x0
0x7fffffffe230: 0xffffe338      0x00007fff      0x00400430      0x0
0x7fffffffe240: 0xffffe330      0x00007fff      0x00000000      0x0
0x7fffffffe250: 0x00000000      0x00000000      0xf7a303d5      0x0
0x7fffffffe260: 0x00000000      0x00000000      0xffffe338      0x0
0x7fffffffe270: 0x00000000      0x00000001      0x00400558      0x0
0x7fffffffe280: 0x00000000      0x00000000      0x2fec30fb      0xf
0x7fffffffe290: 0x00400430      0x00000000      0xffffe330      0x0
0x7fffffffe2a0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2b0: 0xeb2c30fb      0x0412cf0a      0x28f630fb      0x0
0x7fffffffe2c0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2d0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2e0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2f0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe300: 0x00400430      0x00000000      0xffffe330      0x0
0x7fffffffe310: 0x00000000      0x00000000      0x00400459      0x0
0x7fffffffe320: 0xffffe328      0x00007fff      0x0000001c      0x0
0x7fffffffe330: 0x00000001      0x00000000      0xffffe5a1      0x0
0x7fffffffe340: 0x00000000      0x00000000      0xffffe5df      0x0
0x7fffffffe350: 0xffffe5f0      0x00007fff      0xffffe5fc      0x0
0x7fffffffe360: 0xffffe60b      0x00007fff      0xffffe625      0x0
0x7fffffffe370: 0xffffe68b      0x00007fff      0xffffe6a7      0x0
0x7fffffffe380: 0xffffe6b7      0x00007fff      0xffffe6da      0x0
0x7fffffffe390: 0xffffe70f      0x00007fff      0xffffe722      0x0
0x7fffffffe3a0: 0xffffe736      0x00007fff      0xffffe74b      0x0
(gdb)  print $sp
$1 = (void *) 0x7fffffffe220
```

memory: |0x7fffffffe3a0 - 0x7fffffffe220| = 0x180 or 384

Recursive Factorial x = 15

```
(gdb) run
Starting program: /home1/ugrads/scole4/Summer2020/cs2263/lecture/le

Breakpoint 1, 0x0000000000400521 in fac ()
Missing separate debuginfos, use: debuginfo-install glibc-2.17-260.
(gdb) print $sp
$1 = (void *) 0x7fffffffe220
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$2 = (void *) 0x7fffffffe1f0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$3 = (void *) 0x7fffffffe1c0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$4 = (void *) 0x7fffffffe190
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$5 = (void *) 0x7fffffffe160
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$6 = (void *) 0x7fffffffe130
(gdb) c
Continuing.
```

```
Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$7 = (void *) 0x7fffffffe010
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$8 = (void *) 0x7fffffffdfe0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$9 = (void *) 0x7fffffffdfb0
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$10 = (void *) 0x7fffffffdf80
(gdb) c
Continuing.

Breakpoint 1, 0x0000000000400521 in fac ()
(gdb) print $sp
$11 = (void *) 0x7fffffffdf50
(gdb) c
Continuing.
2004310016
[Inferior 1 (process 29341) exited normally]
```

memory: |0x7fffffffdf50 - 0x7fffffffe220| = 2D0 or 720

Iterative Factorial x = 15

```
Starting program: /home1/ugrads/scole4/Summer2020/cs2263/lecture/le

Breakpoint 1, 0x0000000000400521 in fac2 ()
(gdb) print $sp
$3 = (void *) 0x7fffffffe220
(gdb) x/100x $sp
0x7fffffffe220: 0xffffe250      0x00007fff      0x00400578      0x0
0x7fffffffe230: 0xffffe338      0x00007fff      0x00400430      0x0
0x7fffffffe240: 0xffffe330      0x00007fff      0x00000000      0x0
0x7fffffffe250: 0x00000000      0x00000000      0xf7a303d5      0x0
0x7fffffffe260: 0x00000000      0x00000000      0xffffe338      0x0
0x7fffffffe270: 0x00000000      0x00000001      0x00400558      0x0
0x7fffffffe280: 0x00000000      0x00000000      0x1c0ca628      0xb
0x7fffffffe290: 0x00400430      0x00000000      0xffffe330      0x0
0x7fffffffe2a0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2b0: 0xd8cca628      0x4bef6ba1      0x1b16a628      0x4
0x7fffffffe2c0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2d0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2e0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe2f0: 0x00000000      0x00000000      0x00000000      0x0
0x7fffffffe300: 0x00400430      0x00000000      0xffffe330      0x0
0x7fffffffe310: 0x00000000      0x00000000      0x00400459      0x0
0x7fffffffe320: 0xffffe328      0x00007fff      0x0000001c      0x0
0x7fffffffe330: 0x00000001      0x00000000      0xffffe5a1      0x0
0x7fffffffe340: 0x00000000      0x00000000      0xffffe5df      0x0
0x7fffffffe350: 0xffffe5f0      0x00007fff      0xffffe5fc      0x0
0x7fffffffe360: 0xffffe60b      0x00007fff      0xffffe625      0x0
0x7fffffffe370: 0xffffe68b      0x00007fff      0xffffe6a7      0x0
0x7fffffffe380: 0xffffe6b7      0x00007fff      0xffffe6da      0x0
0x7fffffffe390: 0xffffe70f      0x00007fff      0xffffe722      0x0
0x7fffffffe3a0: 0xffffe736      0x00007fff      0xffffe74b      0x0
(gdb) c
Continuing.
2004310016
[Inferior 1 (process 29687) exited with code 013]
```

memory: |0x7fffffffe3a0 - 0x7fffffffe220| = 0x180 or 384

I observed the recursive solution increasing in size as more stack frames are created. While the iterative solution grows within a single stack frame.