

Advanced Programming in the UNIX Environment

Week 04, Segment 4: Directory Size

**Department of Computer Science
Stevens Institute of Technology**

Jan Schaumann

`jschauma@stevens.edu`

`https://stevens.netmeister.org/631/`

```
apue$ ls -l
total 1
prw-r--r--  1 jschauma  wheel      0 Sep 23 00:40 fifo
-rw-r--r--  1 jschauma  wheel      4 Sep 23 00:39 file
srwxr-xr-x  1 jschauma  wheel      0 Sep 23 00:41 socket
crw-rw-rw-  1 root          wheel    22, 1 Aug 10 22:51 stdout
lrwxr-xr-x  1 jschauma  wheel      9 Sep 23 00:44 symlink -> /wherever
brw-r----- 1 root          operator  0, 3 Aug 10 22:51 wd0
apue$ cat file
foo
apue$
```

```
apue$ cd /
apue$ sudo newfs -b 4096 /dev/rwd1a
apue$ sudo mount /dev/wd1a /mnt
apue$ sudo chown jschauma /mnt
apue$ cd /mnt
apue$ df .
```

Filesystem	512-blocks	Used	Avail	%Cap	Mounted on
/dev/wd1a	96207	1	91396	0%	/mnt

```
apue$
```

```
apue$ cd /
apue$ sudo newfs -b 4096 /dev/rwd1a
apue$ sudo mount /dev/wd1a /mnt
apue$ sudo chown jschauma /mnt
apue$ cd /mnt
apue$ df .
Filesystem      512-blocks      Used        Avail %Cap Mounted on
/dev/wd1a        96207            1        91396    0% /mnt
apue$ mkdir dir
apue$ df .
Filesystem      512-blocks      Used        Avail %Cap Mounted on
/dev/wd1a        96207            2        91395    0% /mnt
apue$
```

```
apue$ cd /
apue$ sudo newfs -b 4096 /dev/rwd1a
apue$ sudo mount /dev/wd1a /mnt
apue$ sudo chown jschauma /mnt
```

```
apue$ cd /mnt
```

```
apue$ df .
```

Filesystem	512-blocks	Used	Avail	%Cap	Mounted on
/dev/wd1a	96207	1	91396	0%	/mnt

```
apue$ mkdir dir
```

```
apue$ df .
```

Filesystem	512-blocks	Used	Avail	%Cap	Mounted on
/dev/wd1a	96207	2	91395	0%	/mnt

```
apue$ ls -lai
```

```
total 6
```

2	drwxr-xr-x	3	jschauma	wheel	512	Sep 22 17:57	.
2	drwxr-xr-x	21	root	wheel	512	Aug 10 22:54	..
4832	drwxr-xr-x	2	jschauma	wheel	512	Sep 22 17:57	dir

```
apue$
```

```
apue$ cd /
apue$ sudo newfs -b 4096 /dev/rwd1a
apue$ sudo mount /dev/wd1a /mnt
apue$ sudo chown jschauma /mnt
```

```
apue$ cd /mnt
```

```
apue$ df .
```

Filesystem	512-blocks	Used	Avail	%Cap	Mounted on
/dev/wd1a	96207	1	91396	0%	/mnt

```
apue$ mkdir dir
```

```
apue$ df .
```

Filesystem	512-blocks	Used	Avail	%Cap	Mounted on
/dev/wd1a	96207	2	91395	0%	/mnt

```
apue$ ls -lai
```

```
total 6
```

2	drwxr-xr-x	3	jschauma	wheel	512	Sep 22	17:57	.
2	drwxr-xr-x	21	root	wheel	512	Aug 10	22:54	..
4832	drwxr-xr-x	2	jschauma	wheel	512	Sep 22	17:57	dir

```
apue$
```

```
apue$ cd /
apue$ sudo newfs -b 4096 /dev/rwd1a
apue$ sudo mount /dev/wd1a /mnt
apue$ sudo chown jschauma /mnt
apue$ cd /mnt
```

```
apue$ df .
Filesystem      512-blocks      Used        Avail %Cap Mounted on
/dev/wd1a        96207            1          91396    0% /mnt
```

```
apue$ mkdir dir
```

```
apue$ df .
Filesystem      512-blocks      Used        Avail %Cap Mounted on
/dev/wd1a        96207            2          91395    0% /mnt
```

```
apue$ ls -lai
```

```
total 6
  2 drwxr-xr-x   3 jschauma  wheel  512  Sep 22 17:57 .
  2 drwxr-xr-x  21 root        wheel  512  Aug 10 22:54 ..
4832 drwxr-xr-x   2 jschauma  wheel  512  Sep 22 17:57 dir
```

```
apue$ ls -lid /.
```

```
2 drwxr-xr-x  21 root  wheel  512  Aug 10 22:54 /.
```

```
2 drwxr-xr-x  21 root  wheel  512  Aug 10 22:54 /..
```

```
apue$
```

```
apue$ cd dir
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 17:57 .
```

```
apue$
```



```
apue$ cd dir
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 17:57 .
```

```
apue$ touch 3
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 17:59 .
```

```
apue$
```

```
apue$ cd dir
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 17:57 .
apue$ touch 3
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 17:59 .
apue$ touch 4
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 18:00 .
apue$
```

```
apue$ jot 40 3 | xargs touch
```

```
apue$ ls
```

```
10 12 14 16 18 20 22 24 26 28 3 31 33 35 37 39 40 42 6 8
```

```
11 13 15 17 19 21 23 25 27 29 30 32 34 36 38 4 41 5 7 9
```

```
apue$ ls -a | wc -l
```

```
42
```

```
apue$
```

```
apue$ jot 40 3 | xargs touch
```

```
apue$ ls
```

```
10 12 14 16 18 20 22 24 26 28 3 31 33 35 37 39 40 42 6 8
```

```
11 13 15 17 19 21 23 25 27 29 30 32 34 36 38 4 41 5 7 9
```

```
apue$ ls -a | wc -l
```

```
42
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 18:01 .
```

```
apue$
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 18:01 .
apue$ dd if=/dev/zero of=3 bs=1024 count=1024
1024+0 records in
1024+0 records out
1048576 bytes transferred in 0.007 secs (149796571 bytes/sec)
apue$ du -h 3
1.0M    3
apue$
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 18:01 .
apue$ dd if=/dev/zero of=3 bs=1024 count=1024
1024+0 records in
1024+0 records out
1048576 bytes transferred in 0.007 secs (149796571 bytes/sec)
apue$ du -h 3
1.0M    3
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 18:01 .
apue$
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 18:01 .
apue$ ls -a | wc -l
      42
apue$ touch 43
apue$
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel   512 Sep 22 18:01 .
apue$ ls -a | wc -l
      42
apue$ touch 43
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  1024 Sep 22 18:04 .
apue$
```



```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel   512 Sep 22 18:01 .
```

```
apue$ ls -a | wc -l
      42
```

```
apue$ touch 43
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  1024 Sep 22 18:04 .
```

```
apue$ jot 42 43 | xargs touch
```

```
apue$ ls
```

```
10 14 18 22 26 3  33 37 40 44 48 51 55 59 62 66 7  73 77 80 84
11 15 19 23 27 30 34 38 41 45 49 52 56 6  63 67 70 74 78 81 9
12 16 20 24 28 31 35 39 42 46 5  53 57 60 64 68 71 75 79 82
13 17 21 25 29 32 36 4  43 47 50 54 58 61 65 69 72 76 8  83
```

```
apue$ ls -a | wc -l
      84
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  1024 Sep 22 18:05 .
```

```
apue$
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel   512 Sep 22 18:01 .
```

```
apue$ ls -a | wc -l
      42
```

```
apue$ touch 43
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  1024 Sep 22 18:04 .
```

```
apue$ jot 42 43 | xargs touch
```

```
apue$ ls
```

```
10 14 18 22 26 3  33 37 40 44 48 51 55 59 62 66 7  73 77 80 84
11 15 19 23 27 30 34 38 41 45 49 52 56 6  63 67 70 74 78 81 9
12 16 20 24 28 31 35 39 42 46 5  53 57 60 64 68 71 75 79 82
13 17 21 25 29 32 36 4  43 47 50 54 58 61 65 69 72 76 8  83
```

```
apue$ ls -a | wc -l
      84
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  1024 Sep 22 18:05 .
```

```
apue$ touch 85
```

```
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ echo $(( 512 / 42 ))
```

```
12
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ rm 85
```

```
apue$
```

```
apue$ echo $(( 512 / 42 ))
```

```
12
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ rm 85
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$
```

```
apue$ echo $(( 512 / 42 ))
```

```
12
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ rm 85
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ rm [4-9]*
```

```
apue$ ls -a | wc -l
```

```
33
```

```
apue$
```

```
apue$ echo $(( 512 / 42 ))
```

```
12
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ rm 85
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ rm [4-9]*
```

```
apue$ ls -a | wc -l
```

```
33
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:07 .
```

```
apue$
```

```
apue$ echo $(( 512 / 42 ))
```

```
12
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ rm 85
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:06 .
```

```
apue$ rm [4-9]*
```

```
apue$ ls -a | wc -l
```

```
33
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:07 .
```

```
apue$ pwd
```

```
/mnt/dir
```

```
apue$ rm *
```

```
apue$ ls -ld
```

```
drwxr-xr-x  2 jschauma  wheel  1536 Sep 22 18:08 .
```

```
apue$
```

```
apue$ cd ..
apue$ rm -fr dir
apue$ mkdir dir
apue$ cd dir
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 18:08 .
apue$
```



```
apue$ cd ..
apue$ rm -fr dir
apue$ mkdir dir
apue$ cd dir
apue$ ls -ld
drwxr-xr-x  2 jschauma  wheel  512 Sep 22 18:08 .
apue$ touch $( yes a | head -1024 | tr -d '\n' )
```



```
apue$ cd /  
apue$ sudo umount /mnt  
apue$ sudo newfs -b 4096 /dev/rwd1a  
apue$ sudo mount /dev/wd1a /mnt  
apue$ sudo chown jschauma /mnt
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma  wheel  512 Sep 22 02:56 .
     2 drwxr-xr-x  3 jschauma  wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 third-file
apue$
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma  wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma  wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....%|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....|
00000060  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
```

```
*
00000200
```

```
apue$
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma  wheel  512 Sep 22 02:56 .
   2 drwxr-xr-x  3 jschauma  wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
00000000 c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010 0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%|
00000020 66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....|
00000030 6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040 c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050 6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....|
```

```
*
00000200
apue$ echo "ibase=16; 25C0" | bc
```

```
9664
```



```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma  wheel  512 Sep 22 02:56 .
     2 drwxr-xr-x  3 jschauma  wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01  2e 00 00 00 02 00 00 00  |.%.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00  c1 25 00 00 10 00 08 04  |.....%.%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00  c2 25 00 00 18 00 08 0f  |file.....%.%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66  69 6c 65 6e 61 6d 65 00  |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a  74 68 69 72 64 2d 66 69  |.%.%.%.%.third-fi|
00000050  6c 65 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |le.....%.%.%.%.%.|.
*
```

```
00000200
apue$ echo "ibase=16; 25C0" | bc
```

```
9664
```



```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

padding

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file%.|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le%.|
```

*

```
00000200
```

```
apue$ echo "ibase=16; FF" | bc
```

```
255
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
  2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.%.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |%.%.%.%.%.%.%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file%.%.%.%.%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename|.
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.%.%.%.third-fi|.
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le%.%.%.%.%.%.%.%.%.|.
*
```

```
00000200
apue$ echo "ibase=16; 02" | bc
```

2


```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
    2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
```

00000000	c0 25 00 00 0c 00 04 01	2e 00 00 00	02 00 00 00	.%.
00000010	0c 00 04 02 2e 2e 00 00	c1 25 00 00	10 00 08 04	...%.
00000020	66 69 6c 65 00 00 00 00	c2 25 00 00	18 00 08 0f	file...%.
00000030	6c 6f 6e 67 65 72 2d 66	69 6c 65 6e	61 6d 65 00	longer-filename.
00000040	c3 25 00 00 c0 01 08 0a	74 68 69 72	64 2d 66 69	.%.third-fi
00000050	6c 65 00 00 00 00 00 00	00 00 00 00	00 00 00 00	le...

```
*
00000200
```

```
apue$ echo "ibase=16; 0C" | bc
```

```
12
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
     2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....|
```

```
*
00000200
apue$ echo "ibase=16; 0C" | bc
```

```

apue$ cd dir
apue$ touch file longer-filename third-file
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma  wheel  512 Sep 22 02:56 .
    2 drwxr-xr-x  3 jschauma  wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 third-file
apue$ hexdump -C .
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....%.%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename|.
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.%.%.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....%.%.%.%.|.
*
00000200
apue$ echo "ibase=16; 02" | bc
2

```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
```

```

9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file

```

```
apue$ hexdump -C .
```

```

00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%.%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....%.%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.%.|.
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.%.%.%.third-fi|.
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....%.%.%.%.%.|.

```

```
*
00000200
```

```
apue$ echo "ibase=16; 25C1" | bc
```

```
9665
```



```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file%.|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le%.|
```

```
*
00000200
```

```
apue$ echo "ibase=16; 10" | bc
16
```

```

apue$ cd dir
apue$ touch file longer-filename third-file
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma  wheel  512 Sep 22 02:56 .
     2 drwxr-xr-x  3 jschauma  wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 third-file
apue$ hexdump -C .
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....|
*
00000200
apue$ echo "ibase=16; 25C1" | bc
9665

```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.%.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%.%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....%.%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.%.%.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....%.%.%.%.%.|.
*
```

```
00000200
```

```
apue$ echo "ibase=16; 25C0" | bc
```

```
9664
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
     2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
apue$ hexdump -C .
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |%.%.%.%.%.%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file%.%.%.%.%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.%.%.%.%.%.%.%.%.|.
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le%.%.%.%.%.%.%.%.%.|.
*
00000200
apue$ echo "ibase=16; 25C2" | bc
9666
```



```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
     2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....|
```

*

```
00000200
```

```
apue$ echo "ibase=16; 18" | bc
```

```
24
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
```

```

9664 drwxr-xr-x  2 jschauma  wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma  wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 third-file

```

```
apue$ hexdump -C .
```

```

00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....%.%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename|.
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.%.%.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....%.%.%.%.|.

```

```
*
00000200
```

```
apue$ echo "ibase=16; 18" | bc
```

```
24
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file...%|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le...|
```

```
*
00000200
```

```
apue$ echo "ibase=16; 0F" | bc
```

```
15
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
00000000  c0 25 00 00 0c 00 04 01  2e 00 00 00 02 00 00 00  |.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00  c1 25 00 00 10 00 08 04  |.....%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00  c2 25 00 00 18 00 08 0f  |file.....%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66  69 6c 65 6e 61 6d 65 00  |longer-filename.|
00000040  c3 25 00 00  c0 01 08 0a  74 68 69 72 64 2d 66 69  |.%.%.%.%.third-fi|
00000050  6c 65 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |le.....%.%.%.%.|.
*
```

```
00000200
apue$ echo "ibase=16; 25C3" | bc
```

9667


```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma  wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma  wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma  wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....%|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....|
```

```
*
00000200
```

```
apue$ echo "ibase=16; 01C0" | bc
```

```
448
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....|
*
```

```
00000200
apue$ echo "ibase=16; 0A" | bc
```

```
10
```

```
apue$ cd dir
apue$ touch file longer-filename third-file
```

```
apue$ ls -lai
```

```
total 2
9664 drwxr-xr-x  2 jschauma wheel  512 Sep 22 02:56 .
      2 drwxr-xr-x  3 jschauma wheel  512 Sep 22 02:55 ..
9665 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 file
9666 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 longer-filename
9667 -rw-r--r--  1 jschauma wheel    0 Sep 22 02:56 third-file
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.%.%.%.%.%.%.%.%.|.
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |.....%.%.%.%.%.|.
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file.....%.%.%.%.|.
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.%.%.%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....%.%.%.%.%.|.
*
```

```
00000200
```



```
apue$ echo "ibase=16; 01C0" | bc
```

```
448
```

```
apue$ rm longer-filename
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01  2e 00 00 00 02 00 00 00  |.%. . . . . . . . . . . . . . . .|
00000010  0c 00 04 02 2e 2e 00 00  c1 25 00 00 28 00 08 04  |. . . . . . . . % . . ( . . . |
00000020  66 69 6c 65 00 00 00 00  c2 25 00 00 18 00 08 0f  |file . . . . % . . . . . . .|
00000030  6c 6f 6e 67 65 72 2d 66  69 6c 65 6e 61 6d 65 00  |longer-filename .|
00000040  c3 25 00 00 c0 01 08 0a  74 68 69 72 64 2d 66 69  |.%. . . . . third-fi|
00000050  6c 65 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |le . . . . . . . . . . . . .|
00000060  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |. . . . . . . . . . . . . . . .|
```

```
*
00000200
```



```
apue$ rm longer-filename
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |...%..(..|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file...%...|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%....third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le...|
00000060  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
*
00000200
```

```
apue$ rm longer-filename
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |...%..(..|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file...%...|
00000030  6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%....third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le...|
00000060  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
*
00000200
```

```
apue$ rm longer-filename
```

```
apue$ hexdump -C .
```

```
00000000 c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010 0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |...%..(..|
00000020 66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 0f |file...%...|
00000030 6c 6f 6e 67 65 72 2d 66 69 6c 65 6e 61 6d 65 00 |longer-filename.|
00000040 c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%....third-fi|
00000050 6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le...|
00000060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
```

```
*
```

```
00000200
```

```
apue$ echo "ibase=16; 28" | bc
```

```
40
```

```
apue$ echo hello > shorty
```

```
apue$ hexdump -C .
```

```
00000000 c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010 0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%.|
00000020 66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file%.|
00000030 73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040 c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050 6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le|.|
00000060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ||.|
```

```
*
```

```
00000200
```

```
apue$ echo "ibase=16; 10" | bc
```

```
16
```

```
apue$ echo hello > shorty
```

```
apue$ hexdump -C .
```

```
00000000 c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010 0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%.|
00000020 66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file%.|
00000030 73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040 c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |%.third-fi|
00000050 6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le|.|
00000060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ||.|
```

```
*
```

```
00000200
```

```
apue$ echo "ibase=16; 18" | bc
```

```
24
```

```
apue$ echo hello > shorty
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%.|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file%.|
00000030  73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040  c3 25 00 00 c0 01 08 0a 74 68 69 72 64 2d 66 69 |%.third-fi|
00000050  6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le|.|
00000060  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ||.|
```

```
*
```

```
00000200
```

```
apue$ echo "ibase=16; 18" | bc
```

```
24
```



```

apue$ rm shorty
apue$ hexdump -C .
00000000 c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010 0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |.....%..(..|
00000020 66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file.....%|
00000030 73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040 c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%.|
00000050 6c 65 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |le.....|
00000060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
*
00000200
apue$ echo "ibase=16; 28" | bc
40

```

```
apue$ rm shorty
```

```
apue$ touch a-significantly-longer-name
```

```
apue$ hexdump -C .
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |.....%..(..|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file.....%|
00000030  73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%......third-fi|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le...%......a-si|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 00 00 00 00 00 00 00 00 |er-name.....|
00000080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
```

```
*
```

```
00000200
```



```

apue$ rm shorty
apue$ touch a-significantly-longer-name
apue$ hexdump -C <.
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |.....%..(..|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file.....%|
00000030  73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%......third-fi|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le...%......a-si|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 00 00 00 00 00 00 00 00 |er-name.....|
00000080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
*
00000200
apue$ echo "ibase=16; 28" | bc
40

```

```

apue$ rm shorty
apue$ touch a-significantly-longer-name
apue$ hexdump -C <.
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |.....%..(..|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file.....%|
00000030  73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le.....a-si|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 00 00 00 00 00 00 00 00 |er-name.....|
00000080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
*
00000200
apue$ echo "ibase=16; 14" | bc
20

```

```
apue$ rm shorty
apue$ touch a-significantly-longer-name
apue$ hexdump -C <.
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |.....%..(..|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file.....%|
00000030  73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%.third-fi|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le...%.a-si|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 00 00 00 00 00 00 00 00 |er-name.....|
00000080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
*
00000200  →
```

```
apue$ rm shorty
```

```
apue$ touch a-significantly-longer-name
```

```
apue$ hexdump -C <.
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |.....%..(..|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file.....%|
00000030  73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilename.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%......third-fi|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le...%......a-si|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 00 00 00 00 00 00 00 00 |er-name.....|
00000080  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
```

```
*
```

```
00000200
```

```
apue$ echo "ibase=16; 25C2" | bc
9666
```



```
apue$ touch $(yes a | head -255 | tr -d '\n')
```

```
apue$ touch $(yes b | head -255 | tr -d '\n')
```

```
apue$ hexdump -C <.
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 28 00 08 04 |.....%..(..|
00000020  66 69 6c 65 00 00 00 00 c2 25 00 00 18 00 08 06 |file.....%|
00000030  73 68 6f 72 74 79 00 00 69 6c 65 6e 61 6d 65 00 |shorty..ilene.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%.|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le...%.|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 c4 25 00 00 88 01 08 ff |er-name.....|
00000080  61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 |aaaaaaaaaaaaaaaa|
*
00000170  61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 00 |aaaaaaaaaaaaaaaa.|
00000180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
*
00000200  c5 25 00 00 00 02 08 ff 62 62 62 62 62 62 62 62 |.K.....bbbbbbb|
00000210  62 62 62 62 62 62 62 62 62 62 62 62 62 62 62 62 |bbbbbbbbbbbbbbbb|
*
00000300  62 62 62 62 62 62 62 00 00 00 00 00 00 00 00 00 |bbbbbbb.....|
00000310  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |.....|
*
00000400
```

```
apue$ rm aaa*
apue$ touch ccc ddd eee
apue$ hexdump -C <.
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%..(..|
00000020  66 69 6c 65 00 00 00 00 c4 25 00 00 0c 00 08 03 |file...%...|
00000030  63 63 63 00 c5 25 00 00 0c 00 08 03 64 64 64 00 |ccc..%....ddd.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |%.|...third-fi|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le...%....a-si|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 c4 25 00 00 88 01 08 03 |er-name...|
00000080  65 65 65 00 61 61 61 61 61 61 61 61 61 61 61 61 |eee.aaaaaaaaaaa|
*
00000170  61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 00 |aaaaaaaaaaaaaaa.|
00000180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
*
00000200  c5 25 00 00 00 02 08 ff 62 62 62 62 62 62 62 62 |.K...bbbbbbb|
00000210  62 62 62 62 62 62 62 62 62 62 62 62 62 62 62 62 |bbbbbbbbbbbbbbb|
*
00000300  62 62 62 62 62 62 62 00 00 00 00 00 00 00 00 00 |bbbbbbb...|
00000310  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
*
00000400
```

```
apue$ rm aaa*
apue$ touch ccc ddd eee
apue$ hexdump -C <.
```

```
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%..(..|
00000020  66 69 6c 65 00 00 00 00 c4 25 00 00 0c 00 08 03 |file...%...|
00000030  63 63 63 00 c5 25 00 00 0c 00 08 03 64 64 64 00 |ccc...%....ddd.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%....third-fi|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le...%....a-si|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 c4 25 00 00 88 01 08 03 |er-name...|
00000080  65 65 65 00 61 61 61 61 61 61 61 61 61 61 61 61 |eee.aaaaaaaaaaa|
```

```
*
00000170  61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 00 |aaaaaaaaaaaaaaa.|
00000180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
```

```
*
00000200  c5 25 00 00 00 02 08 ff 62 62 62 62 62 62 62 62 |.K...bbbbbbb|
00000210  62 62 62 62 62 62 62 62 62 62 62 62 62 62 62 62 |bbbbbbbbbbbbbbb|
```

```
*
00000300  62 62 62 62 62 62 62 00 00 00 00 00 00 00 00 00 |bbbbbbb...|
00000310  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
```

```
*
00000400
```



```
apue$ rm aaa*
apue$ touch ccc ddd eee
apue$ hexdump -C <.
```

```
00000000  c0 25 00 00 0c 00 04 01  2e 00 00 00 02 00 00 00  |.%.|
00000010  0c 00 04 02 2e 2e 00 00  c1 25 00 00 10 00 08 04  |.....%..(..|
00000020  66 69 6c 65 00 00 00 00  c4 25 00 00 0c 00 08 03  |file.....%.....|
00000030  63 63 63 00 c5 25 00 00  0c 00 08 03 64 64 64 00  |ccc..%.....ddd.|
00000040  c3 25 00 00 14 00 08 0a  74 68 69 72 64 2d 66 69  |.%.|
00000050  6c 65 00 00 c2 25 00 00  ac 01 08 1b 61 2d 73 69  |le..%.....a-si|
00000060  67 6e 69 66 69 63 61 6e  74 6c 79 2d 6c 6f 6e 67  |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00  c4 25 00 00 88 01 08 03  |er-name.....|
00000080  65 65 65 00 61 61 61 61  61 61 61 61 61 61 61 61  |eee.aaaaaaaaaaa|
*
00000170  61 61 61 61 61 61 61 61  61 61 61 61 61 61 61 00  |aaaaaaaaaaaaaaa.|
00000180  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |.....|
*
00000200  c5 25 00 00 00 02 08 ff  62 62 62 62 62 62 62 62  |.K.....bbbbbbb|
00000210  62 62 62 62 62 62 62 62  62 62 62 62 62 62 62 62  |bbbbbbbbbbbbbbb|
*
00000300  62 62 62 62 62 62 62 00  00 00 00 00 00 00 00 00  |bbbbbbb.....|
00000310  00 00 00 00 00 00 00 00  00 00 00 00 00 00 00 00  |.....|
*
00000400
```

```
apue$ rm aaa*
apue$ touch ccc ddd eee
apue$ hexdump -C <.
00000000  c0 25 00 00 0c 00 04 01 2e 00 00 00 02 00 00 00 |.%.|
00000010  0c 00 04 02 2e 2e 00 00 c1 25 00 00 10 00 08 04 |...%..(..|
00000020  66 69 6c 65 00 00 00 00 c4 25 00 00 0c 00 08 03 |file...%...|
00000030  63 63 63 00 c5 25 00 00 0c 00 08 03 64 64 64 00 |ccc...%....ddd.|
00000040  c3 25 00 00 14 00 08 0a 74 68 69 72 64 2d 66 69 |.%....third-fi|
00000050  6c 65 00 00 c2 25 00 00 ac 01 08 1b 61 2d 73 69 |le...%....a-si|
00000060  67 6e 69 66 69 63 61 6e 74 6c 79 2d 6c 6f 6e 67 |gnificantly-long|
00000070  65 72 2d 6e 61 6d 65 00 c4 25 00 00 88 01 08 03 |er-name...|
00000080  65 65 65 00 61 61 61 61 61 61 61 61 61 61 61 61 |eee.aaaaaaaaaaa|
*
00000170  61 61 61 61 61 61 61 61 61 61 61 61 61 61 61 00 |aaaaaaaaaaaaaaa.|
00000180  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
*
00000200  c5 25 00 00 00 02 08 ff 62 62 62 62 62 62 62 62 |.K...bbbbbbb|
00000210  62 62 62 62 62 62 62 62 62 62 62 62 62 62 62 62 |bbbbbbbbbbbbbbb|
*
00000300  62 62 62 62 62 62 62 00 00 00 00 00 00 00 00 00 |bbbbbbb...|
00000310  00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 |...|
*
00000400
```

Directory Size

On a traditional Unix File System (UFS / FFS):

- a directory consists of a number of blocks, often chosen so they can be written to disk in an atomic operations, *i.e.*, 512 byte blocks
- the size of the directory is independent of the sizes of the files therein
- the size of the directory is dependent on the *length* of the *filenames* it contains
- directories may *increase* in size, but do not *decrease* in size

Other file systems may behave differently - try it out for yourself!

- NetBSD /tmp - tmpfs
- macOS - HFS+
- Linux - NFS / ext4