

Time and Timers

- The time *Epoch*
- The Current Time
- Sleeping and Waiting
- Timers

- Reading: R&R, Ch 9
-

Current Time

UNIX' Time Zero: 00.00 (midnight), January 1, 1970.

```
#include <time.h>

time_t time(time_t * tloc);
/* returns time (in seconds) since epoch */
```

This sets up a UNIX version of Y2K:

- If `time_t` is long, then overflow happens in Year 2038.
- IF `time_t` is unsigned long, then overflow happens in Year 2106.
- If `time_t` is long long, then overflow happens in Year $292 \cdot 10^9$.

```
#include <sys/time.h>

struct timeval {
    time_t tv_sec; /* second since epoch */
    time_t tv_usec; /* microseconds */
}

int gettimeofday(struct timeval * tp, NULL);
/* stores time since epoch in tp */
```

Timing an Activity

```
#include <stdio.h>
#include <sys/time.h>

void activity_to_time(void);

int main(void) {
    long        timedif;
    struct timeval tpstart, tpend;

    gettimeofday(&tpstart, NULL);

    activity_to_time(void);

    gettimeofday(&tpend, NULL);

    timedif = 1000000L * (tpend.tv_sec - tpstart.tv_sec) +
              (tpend.tv_usec - tpstart.tv_usec);

    printf("The function took %ld msec\n", timedif);
}
```

Sleeping and Waiting

```
#include <time.h>

unsigned sleep(unsigned seconds);
/* sleeps for "seconds",
   returns "unslept" time if interrupted */
```

```
#include <unistd.h>

int usleep(useconds_t microseconds);
/* returns -1 if error or interrupted */
```

```
#include <time.h>

int nanosleep(const struct timespec * rqtp,
              const struct timespec * rmtp);
/* sleeps for amount of time specified in "rqtp",
   stores "unslept" time in "rmtp" if interrupted */
```

How long does `usleep` actually sleep?

```
#include ...
#define COUNT 100
#define DTIME 1000
int main(void) {

    struct timeval tpstart;
    struct timeval tpend;

    printf(">>> %d iterations of usleep(%d)...", COUNT, DTIME);
    gettimeofday(&tpstart, NULL);
    for(int i = 0; i < COUNT; i++) {
        usleep(DTIME);
    }
    gettimeofday(&tpend, NULL);
    printf("done");
    long timedif = MILLISECOND * (tpend.tv_sec - tpstart.tv_sec)
        + tpend.tv_usec - tpstart.tv_usec;

    printf(": Time: %ld msec\n", timedif);
}
```

Sleep Resolution: Mac OS X

```
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 122610 msec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 120996 msec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 116964 msec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 131199 msec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 134771 msec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 118535 msec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 111832 msec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 118744 msec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 118983 msec
```

Sleep Resolution: Solaris

```
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > g++ sleeptest.C
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1993492 muscec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1999026 muscec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1994520 muscec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1996332 muscec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1996228 muscec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1992549 muscec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 2011751 muscec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1991755 muscec
```

Sleep Resolution: Linux

```
bettati@linux [~/My Documents/Classes/313/mini case studies] > g++ sleeptest.C
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1998109 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1998160 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1990182 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1999947 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1999914 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1994023 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1995898 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 2004510 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1996401 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1995852 muscec
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1997722 muscec
```

Detailed Sleep Resolution

```
#include ...
#define COUNT 100
#define DTIME 1000
int main(void) {

    struct timeval tpstart, tpend, tpold, tpnew;

    printf(">> %d iterations of usleep(%d)...", COUNT, DTIME);
    gettimeofday(&tpstart, NULL);
    tpold = tpstart;
    for(int i = 0; i < COUNT; i++) {
        usleep(DTIME);
        gettimeofday(&tpnew, NULL);
        printf("timediff = %ld\n", tvaldiff(tpold, tpnew));
        tpold = tpnew;
    }
    gettimeofday(&tpend, NULL);
    printf("done");
    long timedif = tvaldiff(tpstart, tpend);

    printf(": Time: %ld musec\n", timedif);
}
```

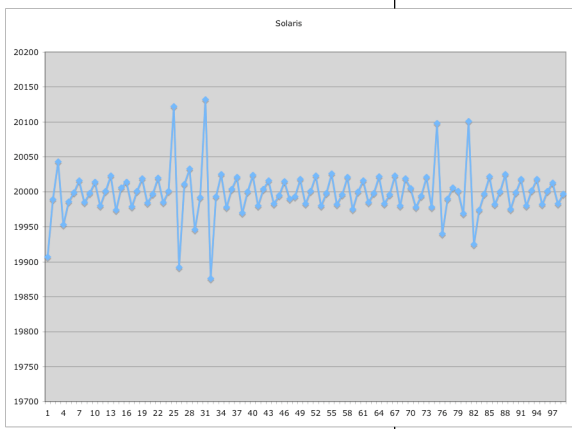
Detailed Sleep Resolution: Linux

```
bettati@linux [~/My Documents/Classes/313/mini case studies] > g++ sleeptest2.C
bettati@linux [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...timediff = 15453
timediff = 19998
timediff = 20038
timediff = 19965
timediff = 19998
timediff = 20001
timediff = 20001
timediff = 19999
. . .
timediff = 20006
timediff = 19996
timediff = 20001
timediff = 19999
timediff = 20001
timediff = 20000
timediff = 19993
timediff = 20011
done: Time: 1995525 musec
```

Detailed Sleep Resolution: Solaris

```

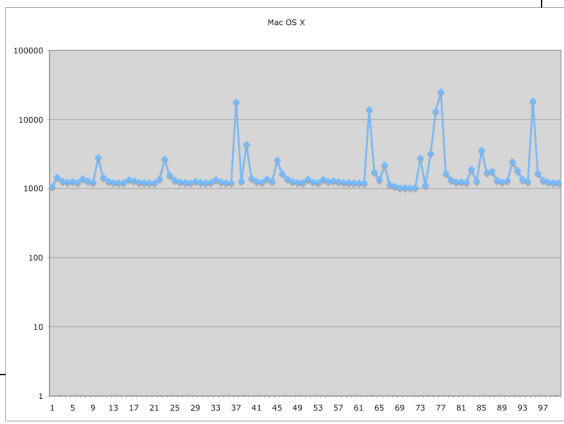
bettati@cs-sun03 [~/case studies] > g++ sleeptest2.C
bettati@cs-sun03 [~/case studies] > a.out
>> 100 iterations of usleep(1000)...timediff = 12517
timediff = 19907
timediff = 19989
timediff = 19997
timediff = 20022
timediff = 19982
. . .
timediff = 20025
timediff = 19975
timediff = 19999
timediff = 20018
timediff = 19980
timediff = 20002
timediff = 20018
timediff = 19982
timediff = 20001
timediff = 20013
timediff = 19983
timediff = 19997
done: Time: 1992449 musec
    
```



Detailed Sleep Resolution: Mac OS X

```

riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % g++ sleeptest2.C
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>> 100 iterations of usleep(1000)...timediff = 1071
timediff = 1471
timediff = 1282
timediff = 1238
timediff = 1273
timediff = 2766
. . .
timediff = 13192
timediff = 2460
timediff = 1826
timediff = 1353
timediff = 1265
timediff = 18541
timediff = 1683
timediff = 1331
timediff = 1251
timediff = 1227
timediff = 1221
done: Time: 228348 musec
    
```



Simple Timer Interrupt Handling

```
#include <sys/time.h>

int setitimer(int which, const struct itimerval * value,
              struct itimerval * ovalue);
```

```
ITIMER_REAL
ITIMER_VIRTUAL
ITIMER_PROF
```

```
struct itimerval {
    struct timeval it_value; /* time until next expiration */
    struct timeval it_interval; /* value to reload into the timer */
}
```
