CSCE 313 Introduction to Computer Systems

Instructor: Dr. Guofei Gu

http://courses.cse.tamu.edu/guofei/csce313

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.

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*10^9.

Timing an Activity

```c
#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 usec\n", timedif);
}
```
#include <time.h>

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

#include <unstd.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 */

---

## Sleeping and Waiting

### How long does `usleep` actually sleep?

```c
#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\n");
    long timedif = MILLION * (tpend.tv_sec - tpstart.tv_sec)
                   + tpend.tv_usec - tpstart.tv_usec;
    printf("%ld musec\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 musec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 120996 musec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 116964 musec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 131199 musec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 134771 musec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 118535 musec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 111832 musec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 118744 musec
riccardo@mac [~/MyDocuments/Classes/313/mini case studies] % a.out
>>> 100 iterations of usleep(1000)...doneTotal time: 118983 musec

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 musec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1999026 musec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1994520 musec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1996332 musec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1994520 musec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1992549 musec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 2011751 musec
bettati@cs-sun03 [~/My Documents/Classes/313/mini case studies] > a.out
>> 100 iterations of usleep(1000)...done: Time: 1991755 musec
Sleep Resolution: Linux

```c
#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\n");
    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 = 19999
ritemdiff = 20006
timediff = 19996
timediff = 20001
timediff = 19999
ritemdiff = 20001
timediff = 20000
timediff = 19993
timediff = 20011
done: Time: 1995525 usec

**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 usec
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(100) ... 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 = 1291
  timediff = 1227
  timediff = 1221
done: Time: 228348 usec

Simple Timer Interrupt Handling

#include <sys/time.h>

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

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