How to make changes in the Xinu code

Generally speaking, the recommended way to make a "modified" xinu is to do the work in a subdirectory of XIN4WIN/NEWSRC, like XIN4WIN/NEWSRC/targill, create the new files there, copy the xinu source files that you want to change there, and xinu.lib.

When making changes in xinu, any new data structures definitions such as typedefs, structs, #defines, as well as extern definitions should be contained in a .h file.

For instance look at q.h. it contains definitions of struct qentry, #define NQENT and extern definition of q[]. Similarly, proc.h has definitions of pentry, #define NPROC, extern of proctab and so on. There are never declarations of variables in .h files, only extern, because these files are included in more than one file, which would lead to multiple declarations of global variables.

   To incorporate the .h file in the program, it depends where the file is put. For instance, if the file "new.h" is put in the NEWSRC directory, then
#include <new.h>
will do the trick. The recommended practice is to put the new .h in the dedicated directory (e.g. XIN4WIN/NEWSRC/targill) and use the command:

#include "new.h"

   Students should not modify existing .h in xinu, because this will require re-compiling all existing .c files that include the modified .h file. For instance; if they add a field to pentry they will have to re-compile most of xinu.

   Typically, a solution to the second and other exercises consists of changing a few xinu files, particularly resched.c, ready.c, initilali.c and perhaps some new files.

   These files should be compiled via commands like

   tcc -I.. -c -DTURBOC initaili.c > errs

   tcc -I.. -c recshed.c > errs

   and so on. -DTURBOC is needed only for initaili.c, although it is of no harm to use it on all. It is possible to compile all of them at once:

   tcc -I.. -c -DTURBOC *.c > errs

  To check compilation and error messages run

   type errs

Notice the "-c" option. It instructs the compiler not to try to create an .exe file but only .obj files.

Existing xinu files should be replaced in xinu.lib like so:

tlib xinu.lib -+ resched.obj -+ initiiali.obj and so on.

A new file can be added to xinu.lib. the FIRST time the command should be

tlib xinu.lib + newfile.obj

Finally, the .exe will be created by a command such as this:

tcc -I.. ex9.c xinu.lib > errs

```
#define SYSCALL        int                 /* System call declaration    */
```

```
SYSCALL create(procaddr,ssize,priority,namep,nargs,args)
int (*procaddr)();              /* procedure address              */
word ssize;                     /* stack size in words            */
short priority;                 /* process priority > 0           */
char *namep;                    /* name (for debugging)           */
int nargs;                      /* number of args that follow     */
int args;                       /* arguments (treated like an array) */
```

```
SYSCALL resume(pid)
int pid;
```

```
SYSCALL screate(count)
        int     count;          /* initial count (>=0)            */
```

```
SYSCALL signal(sem)
register int    sem;
```

```
SYSCALL wait(sem)
register int    sem;
```

```
/* ex2.c - xmain, prA, prB */

#include <conf.h>
#include <kernel.h>

/*-------------------------------------------------------------------
 *  xmain  --  example of creating processes in PC-Xinu
 *-------------------------------------------------------------------
 */
xmain()
{
        int prA(), prB();

        resume( create(prA, INITSTK, INITPRIO, "proc 1", 0) );
        resume( create(prB, INITSTK, INITPRIO, "proc 2", 0) );
}

/*-------------------------------------------------------------------
 *  prA  --  repeatedly print 'A' without ever terminating
 *-------------------------------------------------------------------
 */
prA()
{
        while (1)
                putc(CONSOLE, 'A');
}

/*-------------------------------------------------------------------
 *  prB  --  repeatedly print 'B' without ever terminating
 *-------------------------------------------------------------------
 */
prB()
{
        while (1)
                putc(CONSOLE, 'B');
}
```

```
C:\XINU4WIN\NEWSRC\EXAMPLES>tcc -Ic:\xinu4win\newsrc ex2.c c:\xinu4win\newsrc\xi
nu.lib
Turbo C++ Version 3.00 Copyright (c) 1992 Borland International
:ex2.c
Warning ex2.c 16: Function should return a value in function xmain
Turbo Link  Version 5.0 Copyright (c) 1992 Borland International

Available memory 4114392

C:\XINU4WIN\NEWSRC\EXAMPLES>ex2.exe
Initializing . . .

PC-Xinu Version 6pc (1-Dec-87)
63880 real mem
21368 base addr
42512 avail mem

Hit any key to continue . . .
```

```
AAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBB
BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBB
BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBB
BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBB
BBBBBBBBBB

-- system halt --

PC-Xinu terminated with 6 processes active
Returning . . .


C:\users\eytan\XINU4WIN\NEWSRC\EXAMPLES>
```

```
/* ex3.c - xmain, prntr */

#include <conf.h>
#include <kernel.h>

/*------------------------------------------------------------------------
 *  xmain  --  example of 2 processes executing the same code concurrently
 *------------------------------------------------------------------------
 */
xmain()
{
        int prntr();

        resume( create(prntr, INITSTK, INITPRIO, "print A", 1, 'A') );
        resume( create(prntr, INITSTK, INITPRIO, "print B", 1, 'B') );
}

/*------------------------------------------------------------------------
 *  prntr  --  print a character indefinitely
 *------------------------------------------------------------------------
 */
prntr( ch )
int ch;
{
        while (1)
                putc(CONSOLE, ch);
}
```

```
C:\XINU4WIN\NEWSRC\EXAMPLES>tcc -Ic:\xinu4win\newsrc ex3.c c:\xinu4win\nb.
inu.lib
Turbo C++ Version 3.00 Copyright (c) 1992 Borland International
:ex3.c
Warning ex3.c 16: Function should return a value in function xmain
Turbo Link  Version 5.0 Copyright (c) 1992 Borland International

Available memory 4114392

C:\XINU4WIN\NEWSRC\EXAMPLES>ex3.exe
Initializing . . .

PC-Xinu Version 6pc (1-Dec-87)
63880 real mem
21372 base addr
42508 avail mem

Hit any key to continue . . .


_____


AAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBB
BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBB
BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBB
BBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBBB
BBBBBBBBBBBBBBAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAABB
BBBBBBBBBBBBBBBBBBBBBBBB

-- system halt --

PC-Xinu terminated with 6 processes active
Returning . . .


C:\XINU4WIN\NEWSRC\EXAMPLES>
```

```
/* ex41.c - xmain, produce, consume */

#include <conf.h>
#include <kernel.h>

int     n=0;                    /* external variables are shared by all processes */

/*------------------------------------------------------------------
 *  xmain  --   example of unsynchronized producer and consumer processes
 *------------------------------------------------------------------
 */
xmain()
{
        int     produce(), consume();

        resume( create(consume,INITSTK,INITPRIO,"cons",0) );
        resume( create(produce,INITSTK,INITPRIO,"prod",0) );
}

/*------------------------------------------------------------------
 *  produce  --   increment n 2000 times and exit
 *------------------------------------------------------------------
 */
produce()
{
        int     i;

        for (i=1; i<=2000; i++)
                n++;
}

/*------------------------------------------------------------------
 *  consume  --   print n 2000 times and exit
 *------------------------------------------------------------------
 */
consume()
{
        int     i;

        for (i=1; i<=2000; i++)
                printf("n is %d\n",n);
}
```

84

```
C:\XINU4WIN\NEWSRC\EXAMPLES>tcc -Ic:\xinu4win\newsrc ex41.c c:\xinu4win\newsrc\x
inu.lib
Turbo C++ Version 3.00 Copyright (c) 1992 Borland International
:ex41.c
Warning ex41.c 18: Function should return a value in function xmain
Warning ex41.c 30: Function should return a value in function produce
Warning ex41.c 42: Function should return a value in function consume
Turbo Link  Version 5.0 Copyright (c) 1992 Borland International

Available memory 4113352

C:\XINU4WIN\NEWSRC\EXAMPLES>ex41
Initializing . . .

PC-Xinu Version 6pc (1-Dec-87)
63888 real mem
21376 base addr
42512 avail mem

Hit any key to continue . . .
```

```
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
n is 2000
^@

-- system halt --

PC-Xinu terminated with 4 processes active
Returning . . .


C:\XINU4WIN\NEWSRC\EXAMPLES>
```

90

```
/* ex5.c - xmain, prod2, cons2 */

#include <conf.h>
#include <kernel.h>

int      n=0;                    /* external variables are shared by all processes */

/*-------------------------------------------------------------------------
 * xmain  --   producer and consumer processes synchronized with semaphores
 *-------------------------------------------------------------------------
 */
xmain()
{
        int      prod2(), cons2();
        int      produced, consumed;

        consumed = screate(0);
        produced = screate(1);
        resume(create(cons2,INITSTK,INITPRIO,"cons",2,consumed,produced));
        resume(create(prod2,INITSTK,INITPRIO,"prod",2,consumed,produced));
}

/*-------------------------------------------------------------------------
 * prod2  --   increment n 2000 times, waiting for it to be consumed
 *-------------------------------------------------------------------------
 */
prod2(consumed,produced)
int consumed,produced;
{
        int      i;

        for (i=1; i<=2000; i++) {
                wait(consumed);
                n++;
                signal(produced);
        }
}

/*-------------------------------------------------------------------------
 * cons2  --   print n 2000 times, waiting for it to be produced
 *-------------------------------------------------------------------------
 */
cons2(consumed,produced)
int consumed,produced;
{
        int      i;

        for (i=1; i<=2000; i++) {
                wait(produced);
                printf("n is %d\n",n);
                signal(consumed);
        }
}
```

91

```
C:\XINU4WIN\NEWSRC\EXAMPLES>tcc -Ic:\xinu4win\newsrc ex5.c c:\xinu4win\newsrc\xi
nu.lib
Turbo C++ Version 3.00 Copyright (c) 1992 Borland International
:ex5.c
Warning ex5.c 21: Function should return a value in function xmain
Warning ex5.c 37: Function should return a value in function prod2
Warning ex5.c 53: Function should return a value in function cons2
Turbo Link  Version 5.0 Copyright (c) 1992 Borland International

C:\XINU4WIN\NEWSRC\EXAMPLES>ex5.exe
Initializing . . .

PC-Xinu Version 6pc (1-Dec-87)
63888 real mem
21376 base addr
42512 avail mem

Hit any key to continue . . .


_____


n is 1984
n is 1985
n is 1986
n is 1987
n is 1988
n is 1989
n is 1990
n is 1991
n is 1992
n is 1993
n is 1994
n is 1995
n is 1996
n is 1997
n is 1998
n is 1999
^@

-- system halt --

PC-Xinu terminated with 4 processes active
Returning . . .


C:\XINU4WIN\NEWSRC\EXAMPLES>
```

92

```c
/* ex5a.c - xmain, prod2, cons2 - busy wait -  wastes CPU time */

#include <conf.h>
#include <kernel.h>

int       n=0;       /* external variables are shared by all processes */
volatile int      produced, consumed;


/*-------------------------------------------------------------------
 * xmain   --   producer and consumer processes synchronized with messages
 *-------------------------------------------------------------------
 */
xmain()
{
        int       prod2(), cons2();

        produced = 1;
        consumed = 0;
        resume(create(cons2,INITSTK,INITPRIO,"cons",0));
        resume(create(prod2,INITSTK,INITPRIO,"prod",0));
} /* xmain */


/*-------------------------------------------------------------
 * prod2   --   increment n 2000 times, waiting for it to be consumed
 *-------------------------------------------------------------
 */
prod2()
{
        int       i, k;

        for (i=1; i<=2000; i++) {
                while(consumed == 0)
                        ;
                n++;
                produced = 1;
                consumed = 0;
        }/* for */
} /* prod2 */


/*-------------------------------------------------------------
 * cons2   --   print n 2000 times, waiting for it to be produced
 *-------------------------------------------------------------
 */
cons2()
{
        int       i;

        for (i=1; i<=2000; i++) {
                while(produced == 0)
                        ;
                printf("n is %d\n", n);
                consumed = 1;
                produced = 0;
        } /* for */
} /* cons2 */
```

93

```
C:\XINU4WIN\NEWSRC\EXAMPLES>tcc -Ic:\xinu4win\newsrc ex5a.c c:\xinu4win\new
src\xinu.lib
Turbo C++ Version 3.00 Copyright (c) 1992 Borland International
:ex5.c
Warning ex5.c 21: Function should return a value in function xmain
Warning ex5.c 37: Function should return a value in function prod2
Warning ex5.c 53: Function should return a value in function cons2
Turbo Link  Version 5.0 Copyright (c) 1992 Borland International

C:\XINU4WIN\NEWSRC\EXAMPLES>ex5a.exe
Initializing . . .

PC-Xinu Version 6pc (1-Dec-87)
63888 real mem
21376 base addr
42512 avail mem

Hit any key to continue . . .
```

```
n is 1984
n is 1985
n is 1986
n is 1987
n is 1988
n is 1989
n is 1990
n is 1991
n is 1992
n is 1993
n is 1994
n is 1995
n is 1996
n is 1997
n is 1998
n is 1999
^@

-- system halt --

PC-Xinu terminated with 4 processes active
Returning . . .


C:\XINU4WIN\NEWSRC\EXAMPLES>
```

94

```
/* ex7a.c - xmain, prod2, cons2 */

#include <conf.h>
#include <kernel.h>

int      n=0;      /* external variables are shared by all processes */
int      produced, consumed;


/*----------------------------------------------------------------
 *  xmain  --  producer and consumer processes synchronized with messages
 *----------------------------------------------------------------
 */
xmain()
{
        int      prod2(), cons2();

        consumed =
                create(cons2,INITSTK,INITPRIO,"cons",0);
        produced =
                create(prod2,INITSTK,INITPRIO,"prod",0);
        resume(consumed);
        resume(produced);
}

/*----------------------------------------------------------------
 *  prod2  --  increment n 2000 times, waiting for it to be consumed
 *----------------------------------------------------------------
 */
prod2()
{
        int      i, k;

        for (i=1; i<=2000; i++) {
                n++;
                send(consumed, n);
                k = receive();
        }
}

/*----------------------------------------------------------------
 *  cons2  --  print n 2000 times, waiting for it to be produced
 *----------------------------------------------------------------
 */
cons2()
{
        int      i, msg;

        for (i=1; i<=2000; i++) {
                msg = receive();
                printf("n is %d\n", msg);
                send(produced, 1);
        }
}
```

95

```
C:\XINU4WIN\NEWSRC\EXAMPLES>tcc -Ic:\xinu4win\newsrc ex7a.c c:\xinu4win\ne
wsrc\xinu.lib
Turbo C++ Version 3.00 Copyright (c) 1992 Borland International
:ex7a.c
Warning ex7a.c 24: Function should return a value in function xmain
Warning ex7a.c 39: Function should return a value in function prod2
Warning ex7a.c 39: 'k' is assigned a value that is never used in function
prod2
Warning ex7a.c 54: Function should return a value in function cons2
Turbo Link  Version 5.0 Copyright (c) 1992 Borland International

Available memory 4117208

C:\XINU4WIN\NEWSRC\EXAMPLES>ex7a.exe
Initializing . . .
Disk read error 80H reading drive 0

PC-Xinu Version 6pc (1-Dec-87)
63892 real mem
21380 base addr
42512 avail mem

Hit any key to continue . . .

_____

n is 1985
n is 1986
n is 1987
n is 1988
n is 1989
n is 1990
n is 1991
n is 1992
n is 1993
n is 1994
n is 1995
n is 1996
n is 1997
n is 1998
n is 1999
n is 2000
^@

-- system halt --

PC-Xinu terminated with 3 processes active
Returning . . .


C:\XINU4W98\NEWSRC\EXAMPLES>
```

96