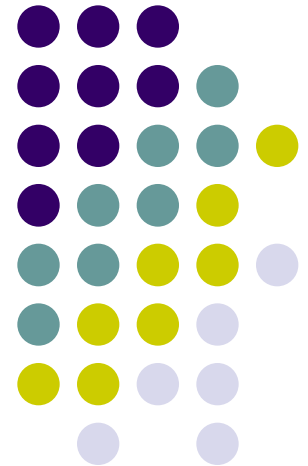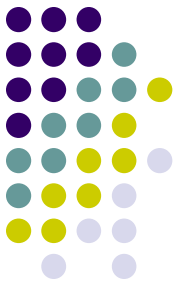# Advanced Operating System Software Project

Gwan-Hwan Hwang
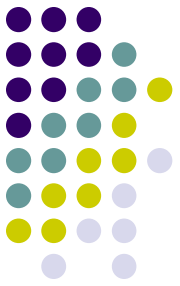
Dept. CSIE

National Taiwan Normal University

Goal of the project

- Let students practice programming for a multi-tasking software
- What can students learn from the implementation of this project?
  - Process management
  - Interprocess communication
    - Pipe
    - Message queue
  - Redirection of I/O
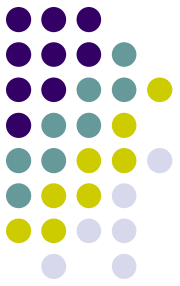 - Screen layout in curses package

Platform

- Unix operating system with standard System V system calls
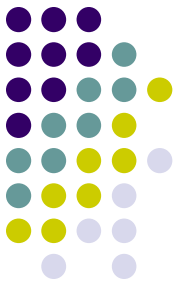
What to implement?

- A multi-window shell
  - Four windows for printing the executing results of the commands which are inputted by the user
    - W0, W1, W2, and W3
  - One window for the user to input his command
    - Command window

What to implement? (Cont'd)

W0

```
total 316
drwxrwxr-x  10 ghhwang faculty  4096 Nov 10 09:58 OS_course/
drwxr-xr-x   3 ghhwang faculty  4096 Oct  5 22:04 Programs/
drwx------   2 ghhwang faculty  4096 Sep 28 21:12 mail/
drwxr-xr-x   9 ghhwang faculty  4096 Jul 28 13:36 public_html/
-rw-r--r--   1 ghhwang faculty  1032 Oct 17  2003 sptnet32.INI
-rw-r--r--   1 ghhwang faculty 291840 Oct 17  2003 sptnet32.exe
drwxr-xr-x   2 ghhwang faculty  4096 Mar  3  2003 tmp/
ghhwang@www ~ $ ?ghhwang@www ~ $
```

W1

```
ghhwang@www ~ $ ps
  PID TTY       TIME CMD
14314 pts/2   00:00:00 bash
14489 pts/2   00:00:00 ps
ghhwang@www ~ $ who
root    tty1       Sep  6 08:08
u89405  pts/0      Nov 11 08:37 (140.122.65.54)
ghhwang pts/2      Nov 11 10:38 (61-216-119-89.dynamic.hinet.net)
zordius pts/1      Nov  8 21:06 (61-230-65-68.dynamic.hinet.net)
ghhwang@www ~ $
```
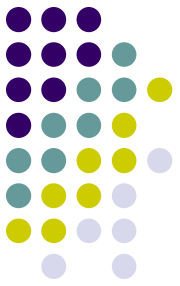
W2

```
man:x:13:15:man:/usr/man:/bin/false
postmaster:x:14:12:postmaster:/var/spool/mail:/bin/false
cron:x:16:16:cron:/var/spool/cron:/bin/false
ftp:x:21:21::/ftp/data:/bin/false
sshd:x:22:22:sshd:/dev/null:/bin/false
at:x:25:25:at:/var/spool/cron/atjobs:/bin/false
squid:x:31:31:Squid:/var/cache/squid:/bin/false
gdm:x:32:32:GDM:/var/lib/gdm:/bin/false
xfs:x:33:33:X Font Server:/etc/X11/fs:/bin/false
games:x:35:35:games:/usr/games:/bin/false
named:x:40:40:bind:/var/bind:/bin/false
ghhwang@www ~ $ who
root    tty1       Sep  6 08:08
u89405  pts/0      Nov 11 08:37 (140.122.65.54)
ghhwang pts/2      Nov 11 10:38 (61-216-119-89.dynamic.hinet.net)
zordius pts/1      Nov  8 21:06 (61-230-65-68.dynamic.hinet.net)
ghhwang@www ~ $
```

W3

```
W1://ls –l
W2://cp temp1.c temp2.c
W0://ps aux|grep ghhwang
```
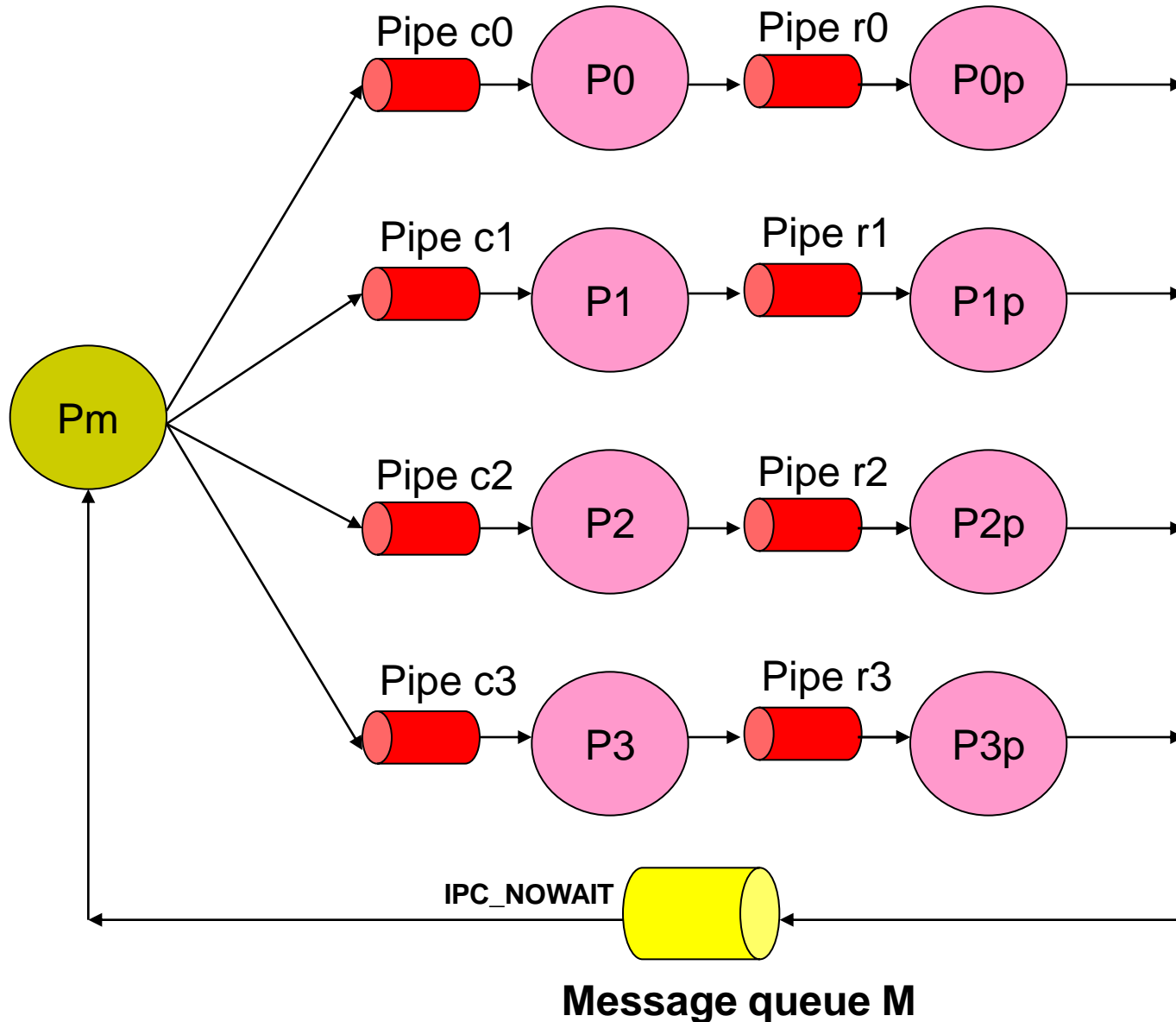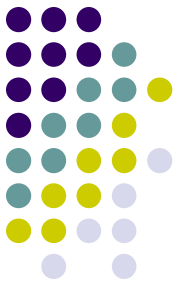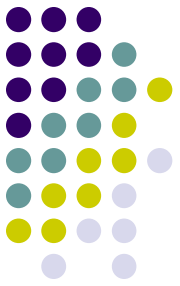
Command window

Syntax of command

- W?://[shell command]
  - W0://ls –l
  - W1://cp temp1.c temp2.c
  - W3://ps aux|grep ghhwang

Suggested system architecture

Pipe c0 → P0 → Pipe r0 → P0p

Pipe c1 → P1 → Pipe r1 → P1p

Pm

Pipe c2 → P2 → Pipe r2 → P2p

Pipe c3 → P3 → Pipe r3 → P3p

IPC_NOWAIT
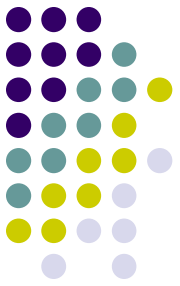
Message queue M

Suggested system architecture (Cont'd)

- Processes
  - Pm:
    - To receive command from the user
    - To fork processes to execute shell commands
    - To print the execution result to the appropriate screen
  - P1, P2, P3, and P4:
    - forked process to execute shell commands
  - P1p, P2p, P3p, and P4p:
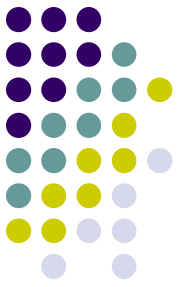   - Processes which add prefixes to the execution results received from P1, P2, P3, and P4

Suggested system architecture (Cont'd)

- Pipes
  - Pipe c0, c1, c2, c3: transmit commands
  - Pipe r0, r1, r2, c3: transmit execution results
- Message queue M
  - Store the prefixed execution results

Suggested system architecture (Cont'd)

- Message format of the prefixed execution results in message queue M
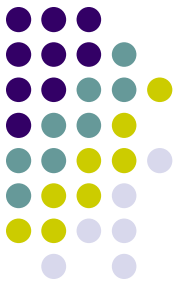
W0/234/……………………………………………………..

234 bytes

It represents the name of the window which the execution results should be shown.

Length of the execution results in bytes.

I/O system

- UNIX 螢幕導向程式的發展利器 – curses
  - Check the homepage of the teacher.
- manual page of curses

```c
#include <curses.h>
#include <sys/signal.h>
  void initial();

  main()
  {
   WINDOW *win[3],*curwin,*helpwin;
   int nowwin;
   int x,y;
   int i,j;
   int ch;
   x=2;y=2;

   initial();
   nodelay(stdscr,TRUE);

   win[0]=newwin(LINES/3-1,COLS-1,0,0);      /* 設定兩個視窗的大小*/
   win[1]=newwin(LINES/3-1,COLS-1,LINES/3,0);
   win[2]=newwin(4,COLS-1,20,0);

   scrollok(win[0],TRUE);
   scrollok(win[1],TRUE);
   scrollok(win[2],TRUE);
j=1;
for (;;)
{
                    j++;
  wprintw(win[0],"test%d for window1 \n",j);
 /*  wrefresh(win[0]);
*/
  curwin=win[2];
  wmove(curwin,y,x);
  if ((ch = getch()) != ERR) {
  waddch(win[2],ch);
  wrefresh(win[2]);
  x++;
  }
  else
  {
                    if ( (j%100)==0)  { wrefresh(win[0]); wrefresh(win[1]);}
  }
  wprintw(win[1],"test%d for window2 \n",j);
 /*  wrefresh(win[1]);
 */
}

}
```
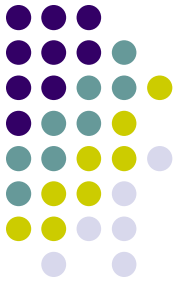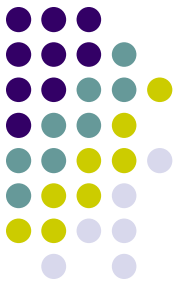
```c
void initial()
  {
   initscr();
   cbreak();
   nonl();
   noecho();
   intrflush(stdscr,FALSE);
   keypad(stdscr,TRUE);
   refresh();

  }
```
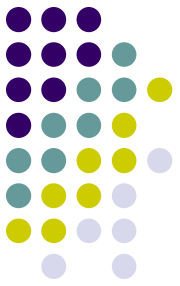
Bonus points

- In case you can design your own architecture
- You can relinquish the use of the command window
  - For example, you can set up to hit the TAB key to switch between output windows W0, W1, W2, and W3 and input command in the selected output window.
- Your system can handle signal
- Others
  - Whatever you think is reasonable.

Project report

- The student should prepare a report which contains at least the follows:
  - The architecture of the implemented software
  - What you have learned and experienced during the implementation.
    - E.g., you could show your daily record of the implementation.
  - In case you implement more than the required specification, please itemize it.
  - Copyright Claim
    - Do you make the implementation yourself?
  - Any thing you would like to let G.H.Hwang know.
    - E.g. Suggestion, …
- Who will be reading the report?
  - Not TAs but G. H. Hwang
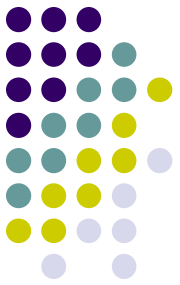
How to hand in your report?

- Please send a mail to TA with a zip file
  - Mail title: OS final project + your student id
    - E.g., "OS final project D828302"
  - Attached filename: your_student_id.zip
  - It should have at least the following items:
    - Electronic files of your report
      - PDF format
    - Source codes
      - A readme.txt to show how to compile your code