Exercise 5

Signal 1

Assume we want to create one child process and count how many times the user press Ctrl-C. Here is the code:

```
 1  void handle_ctrlc(int sig) {
 2      kill(getppid(), SIGUSR1);
 3  }
 4  void handle_usr1(int sig) {
 5      static int cnt = 0;
 6      printf("Ctrl-C pressed %d times\n", ++cnt);
 7  }
 8  int main() {
 9      if (fork() == 0) {
10          signal(_____, handle_ctrlc);
11          for (;;);
12      } else {
13          signal(SIGUSR1, handle_usr1);
14          for (;;); // stuck the main process
15      }
16      return 0;
17  }
```

1. Please fill the blank in line 10.

   SIGINT

2. There are two bugs in the above code, please explain why the program won't work, what's the phenomenon and **TRY** to fix them.
   (Note: actually there is a bug that you can't fix completely)

bug 1:	when hit ctrl-c, main process will be killed and the shell consider your program exit.
phenomen 1:	program may print (parent receive SIGUSR1 before SIGINT) or not (SIGINT before SIGUSR1, most cases), then the parent process exits, prompt shows up and the program won't react to ctrl-c any more, as the shell won't send SIGINT to the process group. But the child process will continue to run in background.
fix 1:	add `signal(SIGINT, SIG_IGN);` before line 14
bug 2:	if you press ctrl-c frequently, child may send several SIGUSR1 to parent continuously while parent will receive only once, or shell send several SIGINT but child only receive once.
phenomen 2:	wrong ctrl-c count
fix 2:	no solution

Signal 2

```
 1. volatile sig_atomic_t pre_alarm = 0, post_alarm = 0;
 2. void handler_alrm(int sig) {
 3.     if (post_alarm != 0) return;
 4.     if (pre_alarm != 0) {
 5.         sio_puts("forth alarm: "); sio_putl(alarm(0));
 6.         sio_puts("\n");
 7.     } else {
 8.         pre_alarm = 1;
 9.         sio_puts("third alarm: "); sio_putl(alarm(1));
10.         sio_puts("\n");
11.         Kill(getppid(), SIGUSR1);
12.         sleep(5);
13.         Kill(getpid(), SIGUSR2);
14.         post_alarm = 1;
15.         sio_puts("alarm done\n");
16. }}
17. volatile sig_atomic_t child_exit, pid;
18. void handler_usr1(int sig) { sio_puts("usr1\n"); }
19. void handler_usr2(int sig) { sio_puts("usr2\n"); }
20. void handler_chld(int sig) { sio_puts("chld\n"); child_exit = 1; }
```

```
21. int main() {
22.     sigset_t mask_all, prev_one;
23.     Sigfillset(&mask_all);
24.     Sigprocmask(SIG_BLOCK, &mask_all, &prev_one);
25.     Signal(SIGUSR1, handler_usr1);
26.     Signal(SIGUSR2, handler_usr2);
27.     Signal(SIGALRM, handler_alrm);
28.     Signal(SIGCHLD, handler_chld);
29.     if ((pid = Fork()) == 0) {
30.         printf("first alarm: %u\n", alarm(2));
31.         printf("second alarm: %u\n", alarm(3));
32.         Sigprocmask(SIG_SETMASK, &prev_one, NULL);
33.         Pause();
34.         exit(0);
35.     }
36.     printf("I'm parent\n");
37.     child_exit = 0;
38.     Kill(pid, SIGALRM);
39.     Sigprocmask(SIG_SETMASK, &prev_one, NULL);
40.     while (!child_exit)
41.         Pause();
42. }
```

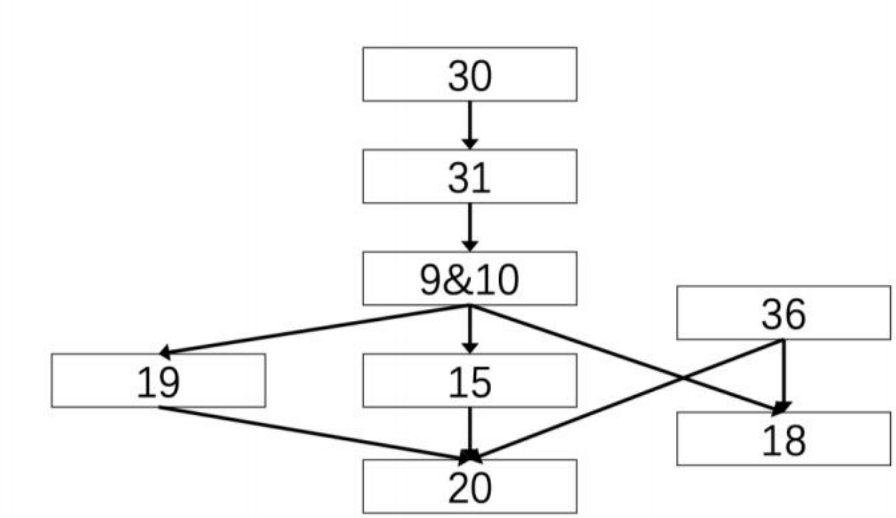
Note: the kernel check the pending bits when it switches from kernel to user (e.g. returning from system call). The return of signal handler will trigger an **sigreturn** system call.

1. Please fill the following table:

   For visibility, please write **T** if the line will always be printed, **F** if the line will never be printed, **M** if the line might be printed.

Line	Visibility	Possible return values of **alarm()**
5&6	[1] F	[7] ----
9&10	[2] M	[8] 0/1/2/3
15	[3] M	------
18	[4] M	------
19	[5] M	------
20	[6] M	------
30	T	[9] 0
31	T	[10] 0/1/2
36	T	------

2. Please draw the dependency diagram of output:
   Note: You could use line number to represent one output line in the diagram. And you do **NOT** need to show the values in the output.



3. Please show the maximum number of SIGALRM **sent** to child and **received** by child, and give one corresponding execution flow for each.

Sent: 4 Received: 3

[Send] line 30, 31, 38 and 9 could send SIGALRM to child. Though 31 is directly behind 30, OS may still interrupt the execution so 31 won't cancel the alarm in 30 directly.

[Receive] Even if alarm in line 31 does not cancel the alarm in line 30.Only one of the signal from line 31 or 9 will be received finally after the handle return.