*Department of Computer Science and Engineering*
*Institute of Technical Education & Research, SOA, Deemed to be University*

# WEEK-END ASSIGNMENT-S01
# Processes in UNIX
## Operating Systems Workshop (CSE 3541)

## Problem Statement:

Experiment with programs, processes, memory allocation and manipulation for processes in UNIX.

## Assignment Objectives:

Students will be able to differentiate programs and processes, also able to learn how to create processes and able to explore the implication of process inheritance.

## Instruction to Students (If any):

**Students are required to write his/her own program/output by avoiding any kind of copy from any sources. Additionally, They must be able to realise the outcome of that question in relevant to systems programming.** You may use additional pages on requirement.

## Programming/ Output Based Questions:

1. Construct the process tree diagram and also find the number of processes along with output of the following code snippet.

```
int main(void) {
    fork();
    fork();
    fork();
    printf("ITER\n");
    printf("ITER\n");
    return 0;
}
/* Any formula can be
    devised for number
     of processes
    created here?
If so, state.*/
```

**Process tree, # of processes and output**

2. Construct the process tree diagram and also find the number of processes along with output of the following code snippet.

```
int main(void){
  printf("hello\n");
  fork();
  printf("hello\n");
  fork();
  printf("hello\n");
  fork();
  printf("hello\n");
  return 0;
}
/* Any formula for
    nuber of outputs?
If so, state.*/
```

**Process tree, # of processes and output**

3. Run the following code on your machine and write the output. Suggest a way to avoid the mismatch of machine output w.r.t. dry run output.

```
#include<stdio.h>
#include<unistd.h>
int main(void)
{
   printf("A");
   fork();
   printf("P\n");
   return 0;
}
```

**Output, Reason and Suggestion**

4. Draw the process tree and write the output of the following code snippet.

```
int main()
{
   fork() && fork();
   printf("Able to\n");
   return 0;
}
```

**Process tree and output**

5. Draw the process tree and write the output of the following code snippet.

```
int main()
{
   fork();
   fork() && fork();
   fork();
   printf("Got!!!\n");
   return 0;
}
```

**Process tree and output**

6. Draw the process tree and write the output of the following code snippet.

```
int main()
{
   fork();
   fork() + fork();
   fork();
   printf("doing!\n");
   return 0;
}
```

**Process tree and output**

7. Draw the process tree and write the output of the following code snippet.

```
int main(){
   fork();
   fork() || fork();
   fork();
   printf("Really!!!\n");
   return 0;
}
```

**Process tree** | **Output**

**Remark**

8. Draw the process tree and write the output of the following code snippet.

```
int main(){
 fork();
 fork()&& fork()||fork();
 fork();
 printf("guess\n");
 return 0;
}
```

**Process tree** | **Output**

**Remark**

9. Draw the process tree and write the output of the following code snippet.

```
int main(){
 fork()&&fork();
 fork()||fork();
 printf("Hi\n");
 return 0;
}
```

**Process tree** | **Output**

**Remark**

10. Construct the process tree diagram and also find the number of processes along with output of the following code snippet.

```
int main(){
 int pid,pid2;
 pid=fork();
 if(pid){
   pid2=fork();
   printf("I\n");
 }
 else{
     printf("C\n");
     pid2=fork();
 }
 return 0;
}
```

| Process tree, # of processes and output | | |
|---|---|---|
| | | |

11. Construct the process tree diagram and also find the number of processes along with output of the following code snippet.

```
int
main(void){
 pid_t childpid;
 int i, n=3;
 for(i=1;i<n;i++){
  childpid=fork();
  if(childpid==-1)
     break;
 }
 printf("i:%d\n",i);
 return 0;
}
```

| Process tree, # of processes and output | | |
|---|---|---|
| | | |

12. Draw the process tree because of the following code snippet and state number of times **x=0** as well as **x≠0**will be displayed.

```
pid_t
add(pid_t a, pid_t b){
  return a+b;
}
int main(void){
 pid_t x=10;
 printf("%d\n",x);
 x=add(fork(),fork());
 printf("%d\n",x);
 return 0;}
```

| Process tree | # of x=0 | # of x≠0 |
|---|---|---|
| | | |

13. Determine the total number of displayed for the given code snippet.

```
int main(void){
 int x[]={10,20,fork(),fork()+fork()};
 int len=sizeof(x)/sizeof(int);
 for(int i=0;i<len;i++)
   fprintf(stderr," %d ",x[i]);
 printf("\n");
 return 0;
}
```

| # of display | # of Processes |
|---|---|
| | |

14. Determine the number of process(s) will be created when the below program becomes process and also write the output.

```
void show(){
  if(fork()==0)
   printf("1\n");
  if(fork()==0)
   printf("2\n");
 if(fork()==0)
   printf("3\n");
}
int main(void){
 show();
 return 0;
}
```

| # of processes | Output |
|---|---|
| | |

15. Draw the process tree of the following code snippet. Also give a count of processes and the output of the following code. Can the code segment generate fan of processes.

```
int main(void){
 if(fork()==0)
  printf("1\n");
else if(fork()==0)
  printf("2\n");
else if(fork()==0)
  printf("3\n");
else if(fork()==0)
  printf("4\n");
else
  printf("5\n");
return 0;
}
```

| Process tree, # of processes and output | | |
|---|---|---|
| | | |

16. Find the output of the code segment showing the corresponding process tree.

```
int main(){
 pid_t p1,p2;
 p2=0;
 p1=fork();
 if (p1 == 0)
    p2 = fork();
 if (p2 > 0)
    fork();
 printf("done\n");
return 0;
}
```

| Process tree | Output |
|---|---|
| | |

17. Find the number of direct children to the main process, the total number of processes and the output.

```
int main(){pid_t c1=1,c2=1;
 c1=fork();
 if(c1!=0)
    c2=fork();
 if(c2==0){
    fork();printf("1\n");
  }
return 0;}
```

| # of direct children to main process | Total processes | Output |
|---|---|---|
| | | |

18. Find the output of the code segment.

```
int main(){
  struct stud s1={1,20};
  pid_t pid=fork();
  if(pid==0){
     struct stud s1={2,30};
     printf("%d %d\n",s1.r,s1.m);
     return 0;
  }
  else{
    sleep(10);
    printf("%d %d\n",s1.r,s1.m);
    return 0;
  }
}
```

```
struct stud{
  int r;
  int m;
};
```

**Output**

19. Find the output of the code segment showing the corresponding process tree.

```
int main(){
  if(fork()){
    if(!fork()){
      fork();
      printf("S ");
    }
    else{
      printf("T ");
    }
 }
 else{
      printf("D ");
 }
 printf("A ");
 return 0;
}
```

**Process tree** **Output**

20. Calculate the number of processes the following code snippet will generate.

```
int main(){int i;
  for(i=0;i<12;i++){
     if(i%3==0){
          fork();
     }
 }
 return 0;
}
```

**Process tree** **Output**

21. State the possible values of x for the given code snippet;

```
int x;
int a[2]={10,20};
x=5+a[fork() || fork()];
printf("%d ",x);
```

**Process tree** **Output**

22. Suppose four user-defined exit handlers X, Y, P, and Q are installed in the order X then Y then P then Q using atexit() function in a C program. Exit hadler X is designed to display 1, Y is designed to display 2, P is designed to display 3, and Q to display 4. State the order of their display, when the program is going to terminate after calling return 0/exit(0).

(A) 4, 3, 2 1
(B) 1,2,3,4
(C) 1, 2, 4, 3
(D) none

**Choice**

23. You know that the **ps** utility in UNIX reports a snapshot of the current processes. Determine the state code of the given program, that became a process.

```
int main(void){
 fprintf(stderr,"PID=%ld\n",(long)getpid());
 while(1);
 return 0;
}
```

(A) R
(B) S
(C) T
(D) Z

**Choice**

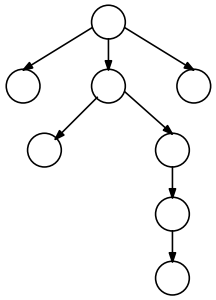
24. Find the process state code of the given program, that became a process using the Unix utility **ps**. As you know **ps** displays information about a selection of the active processes.

```
int main(void){
 fprintf(stderr,"PID=%ld\n",(long)getpid());
 while(1)
     sleep(1);
 return 0;
}
```

(A) R
(B) S
(C) T
(D) Z

**Choice**

25. Develop a C code to create the following process tree. Display the process ID, parent ID and return value of `fork()` for each process.



**OBSERVARIONS:**

- Use ps utility to verify the is-a-parent relationship?
- Are ypu gettig any orphan process case?
- Are you getting any ZOMBIE case?

Figure 1: Process tree

**Code here**

26. Create two different user-defined functions to generate the following process hierarchy shown in **Figure-(a)** and **Figure-(b)**. Finally all the processes display their process ID and parent ID.

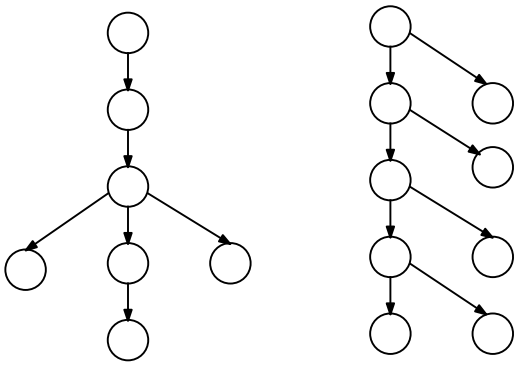



Figure 2: Process tree

**Code here**

**Code here**

27. What output will be at Line X and Line Y?

```
#define SIZE 5
int nums[SIZE] = { 0,1,2,3,4 } ;
int main(){
 int i;
 pid t pid;
 pid = fork();
 if(pid == 0){
    for (i = 0; i < SIZE; i++) {
       nums[i] *= nums[i] *-i;
       printf("CHILD:%d ",nums[i]);   /* LINE X */
    }
 }
 else if (pid > 0) {
    wait(NULL);
    for (i = 0; i < SIZE; i++)
       printf("PARENT: %d ",nums[i]);   /* LINE Y */
    }
  return 0;
}
```

**Output**

28. The Fibonacci sequence is the series of numbers 0, 1, 1, 2, 3, 5, 8,

    Write a C program using the fork() system call that generates the Fibonacci sequence in the child process. The number of the sequence will be provided in the command line. For example, if 5 is provided, the first five numbers in the Fibonacci sequence will be output by the child.

**Code here**

29. Write a **`MulThree.c`** program to multiply three numbers and display the output. Now write another C program **`PracticeExecl.c`**, which will fork a child process and the child process will execute the file **`MulThree.c`** and generate the output. The parent process will wait till the termination of the child and the parent process will print the process ID and exit status of the child.

**Code here**

30. You know the usages of the command **`grep`**. Implement the working of **`grep -n pattern filename`** in a child process forked from the parent process using **`execl`** system call. The parent process will wait till the termination of the child and the parent process will print the process ID and exit status of the child.

**Code here**

31. Implement the above question using **`execv`**, **`execlp`**, **`execvp`**, **`execle`**, **`execve`** system calls.

**Code here for `execv`**

**Code here for `execlp`**

**Code here for `execvp`**

**Code here for `execve`**

**Code here for `execle`**