Laboratory Assignments 4 Subject: Design Principles of Operating Systems

Subject code: CSE 3249

**Assignment 4: Familiarization with Process Management in Linux environment.**

**Objective of this Assignment:**

* To trace the different states of a process during its execution.
* To learn the use of different system calls such as (fork(),vfork(),wait(),execl()) for process handling in Unix/Linux environment.

1. Write a C program to create a child process using fork() system call. The child process will print the message “Child” with its process identifier and then continue in an indefinite loop. The parent process will print the message “Parent” with its process identifier and then continue in an indefinite loop.
   1. Run the program and trace the state of both processes.
   2. Terminate the child process. Then trace the state of processes.
   3. Run the program and trace the state of both processes. Terminate the parent process. Then trace the state of processes.
   4. Modify the program so that the parent process after displaying the message will wait for child process to complete its task. Again run the program and trace the state of both processes.
   5. Terminate the child process. Then trace the state of processes.

#include <stdio.h>

#include <unistd.h>

#include <sys/types.h>

int main() {

pid\_t pid;

pid = fork(); // Create a child process

if (pid == 0) { // Child process

while (1) {

printf("Child process: PID = %d\n", getpid());

sleep(1); // Sleep for 1 second to prevent overloading the terminal

}

} else if (pid > 0) { // Parent process

while (1) {

printf("Parent process: PID = %d\n", getpid());

sleep(1); // Sleep for 1 second to prevent overloading the terminal

}

} else {

// Fork failed

perror("fork failed");

return 1;

}

return 0;

}

1. Trace the output of the following codes:

|  |  |
| --- | --- |
| a) int main( )  {  if(fork()==0)  printf("1"); else  printf("2");  printf("3"); return 0;  } | b) int main( )  {  if(vfork()==0)  {  printf("1");  \_exit(0);  }  else  printf("2");  printf("3");  } |
| 1 3 2 3 | 1 3 |

|  |  |
| --- | --- |
| c) int main( )  {  pid\_t pid; int i=5; pid=fork(); i=i+1; if(pid= =0)  {  printf("Child: %d",i);  }  else  {  wait(NULL); printf("Parent: %d",i);  }  return 0;  }  Child: 6  Parent: 6 | d) int main( )  {  pid\_t pid; int i=5; pid=vfork(); i=i+1; if(pid==0)  {  printf("Child: %d",i);  \_exit(0);  }  else  {  printf("Parent: %d",i);  }  return 0;  }  Child: 6 |
| e) int main( )  {  pid\_t pid; int i=5; pid=fork(); if(pid= =0)  {  i=i+1;  printf("Child: %d",i);  }  else  {  wait(NULL); printf("Parent: %d",i);  }  return 0;  }  Child: 6  Parent: 5 | f) int main( )  {  pid\_t pid; int i=5;  pid=vfork(); if(pid==0)  {  i=i+1;  printf("Child: %d",i);  \_exit(0);  }  else  {  printf("Parent: %d",i);  }  return 0;  }  Child: 6 |
| g) int main( )  {  int i=5; if(fork( )==0)  {  printf("Child: %d",i);  }  else  {  printf("Parent: %d",i);  }  return 0;  }  Child: 5  Parent: 5 | h) int main( )  {  int i=5; if(vfork( )==0)  {  printf("Child: %d",i);  \_exit(0);  }  else  {  printf("Parent: %d",i);  }  return 0;  }  Child: 5 |

|  |  |
| --- | --- |
| i) int main( )  {  if(fork( )==0)  {  printf("1");  }  else  {  wait(NULL); printf("2");  printf("3");  }  return 0;  }  1 2 3 | j) int main( )  {  if(vfork( )==0)  {  printf("1");  \_exit(0);  }  else  {  printf("2");  printf("3");  }  return 0;  }  1 3 |
| k) int main( )  {  pid\_t c1; int n=10; c1=fork( ); if(c1==0)  {  printf(" Child\n"); n=20;  printf("n=%d \n",n);  }  else  {  wait(NULL); printf("Parent\n"); printf("n=%d \n",n);  }  return 0;  }  Child  n=20  Parent  n=10 | l) int main( )  {  pid\_t c1; int n=10;  c1=vfork( ); if(c1==0)  {  printf(" Child\n"); n=20;  printf("n=%d \n",n);  \_exit(0);  }  else  {  printf("Parent\n"); printf("n=%d \n",n);  }  return 0;  }  Child  n=20  Parent  n=20 |
| m) int main( )  {  int i=5; fork(); i=i+1; fork();  printf ( "% d",i); return 0;  } | n) int main( )  {  pid\_t pid; int i=5; pid=vfork(); if(pid==0)  {  printf("Child: %d",i);  \_exit(0);  }  else  {  i=i+1;  printf("Parent: %d",i);  }  return 0; |

|  |  |
| --- | --- |
| 6 6 6 6 | }  Child: 5Parent: 6 |
| o) int main( )  {  int i=5; if(fork()==0) i=i+1;  else i=i-1;  printf("%d",i); return 0;  }  6 4 | p) int main( )  {  int i=5; if(vfork()==0)  {  i=i+1;  \_exit(0);  }  else  i=i-1; fprintf(stderr,"%d",i); return 0;  }  4 |
| q) int main( )  {  int j,i=5; for(j=1;j<3;j++)  {  if(fork()==0)  {  i=i+1; break;  }  else  wait(NULL);  }  printf("%d",i); return 0;  }  6 6 6 | r) int main( )  {  int j,i=5; for(j=1;j<3;j++)  {  if(fork()!=0)  {  i=i-1; break;  }  }  fprintf(stderr,"%d",i); return 0;  }  4 |
| s) int main( )  {  if(fork() == 0)  if(fork())  printf("1\n");  return 0;  }  1 | t) void fun1(){  fork();  fork(); printf("1\n");  }  int main() { fun1(); printf("1\n"); return 0;  }    1 1 1 1 |

1. Write a C program that will create three child process to perform the following operations respectively:

* First child will copy the content of file1 to file2
* Second child will display the content of file2
* Third child will display the sorted content of file2 in reverse order.
* Each child process being created will display its id and its parent process id with appropriate message.
* The parent process will be delayed for 1 second after creation of each child process. It

will display appropriate message with its id after completion of all the child processes.

#include <stdio.h>

#include <stdlib.h>

#include <unistd.h>

#include <sys/wait.h>

#include <string.h>

void copy\_file(const char \*source, const char \*destination) {

FILE \*src = fopen(source, "r");

FILE \*dest = fopen(destination, "w");

if (!src || !dest) {

perror("File open error");

exit(EXIT\_FAILURE);

}

char ch;

while ((ch = fgetc(src)) != EOF) {

fputc(ch, dest);

}

fclose(src);

fclose(dest);

}

void display\_file(const char \*filename) {

FILE \*file = fopen(filename, "r");

if (!file) {

perror("File open error");

exit(EXIT\_FAILURE);

}

char ch;

while ((ch = fgetc(file)) != EOF) {

putchar(ch);

}

fclose(file);

}

void display\_sorted\_reverse(const char \*filename) {

FILE \*file = fopen(filename, "r");

if (!file) {

perror("File open error");

exit(EXIT\_FAILURE);

}

char lines[100][256];

int count = 0;

while (fgets(lines[count], sizeof(lines[count]), file)) {

count++;

}

fclose(file);

// Sort lines

for (int i = 0; i < count - 1; i++) {

for (int j = i + 1; j < count; j++) {

if (strcmp(lines[i], lines[j]) > 0) {

char temp[256];

strcpy(temp, lines[i]);

strcpy(lines[i], lines[j]);

strcpy(lines[j], temp);

}

}

}

// Display sorted lines in reverse order

for (int i = count - 1; i >= 0; i--) {

printf("%s", lines[i]);

}

}

int main() {

pid\_t pid1, pid2, pid3;

// First child: Copy content of file1 to file2

if ((pid1 = fork()) == 0) {

printf("First child (PID: %d, Parent PID: %d): Copying file1 to file2...\n", getpid(), getppid());

copy\_file("file1.txt", "file2.txt");

printf("First child: File copy completed.\n");

exit(0);

}

sleep(1); // Delay for 1 second after creating the first child

// Second child: Display content of file2

if ((pid2 = fork()) == 0) {

printf("Second child (PID: %d, Parent PID: %d): Displaying content of file2...\n", getpid(), getppid());

display\_file("file2.txt");

printf("\nSecond child: Content displayed.\n");

exit(0);

}

sleep(1); // Delay for 1 second after creating the second child

// Third child: Display sorted content of file2 in reverse order

if ((pid3 = fork()) == 0) {

printf("Third child (PID: %d, Parent PID: %d): Displaying sorted content of file2 in reverse order...\n", getpid(), getppid());

display\_sorted\_reverse("file2.txt");

printf("\nThird child: Sorted content displayed.\n");

exit(0);

}

sleep(1); // Delay for 1 second after creating the third child

// Parent process: Wait for all child processes to complete

printf("Parent process (PID: %d): Waiting for children to complete...\n", getpid());

waitpid(pid1, NULL, 0);

waitpid(pid2, NULL, 0);

waitpid(pid3, NULL, 0);

printf("Parent process: All child processes completed. Exiting...\n");

return 0;

}

1. Write a C program that will create a child process to generate a Fibonacci series of specified length and store it in an array. The parent process will wait for the child to complete its task

and then display the Fibonacci series and then display the prime Fibonacci number in the series along with its position with appropriate message.

#include <stdio.h>

#include <stdlib.h>

#include <unistd.h>

#include <sys/wait.h>

#include <stdbool.h>

// Function to check if a number is prime

bool is\_prime(int num) {

if (num <= 1) return false;

for (int i = 2; i \* i <= num; i++) {

if (num % i == 0) return false;

}

return true;

}

// Function to generate Fibonacci series

void generate\_fibonacci(int \*fib, int length) {

if (length >= 1) fib[0] = 0;

if (length >= 2) fib[1] = 1;

for (int i = 2; i < length; i++) {

fib[i] = fib[i - 1] + fib[i - 2];

}

}

int main() {

int n;

printf("Enter the length of the Fibonacci series: ");

scanf("%d", &n);

if (n <= 0) {

printf("Invalid length. Please enter a positive integer.\n");

return EXIT\_FAILURE;

}

int fib[n];

pid\_t pid = fork();

if (pid < 0) {

perror("Fork failed");

return EXIT\_FAILURE;

}

if (pid == 0) {

// Child process: Generate Fibonacci series

printf("Child process (PID: %d): Generating Fibonacci series...\n", getpid());

generate\_fibonacci(fib, n);

// Write the Fibonacci series to a pipe

int pipefd[2];

pipe(pipefd);

close(pipefd[0]); // Close read end of the pipe

write(pipefd[1], fib, sizeof(fib));

close(pipefd[1]); // Close write end of the pipe

printf("Child process: Fibonacci series generated and sent to parent.\n");

exit(0);

} else {

// Parent process: Wait for child to complete

wait(NULL);

printf("Parent process (PID: %d): Receiving Fibonacci series from child...\n", getpid());

// Read the Fibonacci series from the pipe

int pipefd[2];

pipe(pipefd);

close(pipefd[1]); // Close write end of the pipe

read(pipefd[0], fib, sizeof(fib));

close(pipefd[0]); // Close read end of the pipe

printf("Fibonacci series: ");

for (int i = 0; i < n; i++) {

printf("%d ", fib[i]);

}

printf("\n");

// Identify and display prime Fibonacci numbers with their positions

printf("Prime Fibonacci numbers:\n");

for (int i = 0; i < n; i++) {

if (is\_prime(fib[i])) {

printf("Position %d: %d\n", i + 1, fib[i]);

}

}

printf("Parent process: Task completed.\n");

}

return 0;

}