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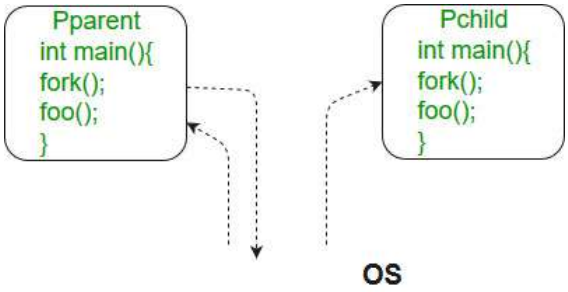
fork() in C

Last Updated: 09-12-2019

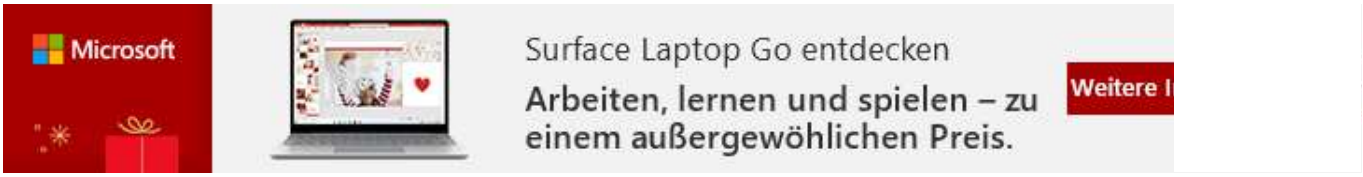
Fork system call is used for creating a new process, v
with the process that makes the fork() call (parent p
processes will execute the next instruction following the fork() system call. A child process uses the same pc(program counter), same CPU registers, same open files which use in the parent process.

It takes no parameters and returns an integer value. Below are different values returned by fork().

Negative Value: creation of a child process was unsuccessful.
Zero: Returned to the newly created child process.
Positive value: Returned to parent or caller. The value contains process ID of newly created child process.



Please note that the above programs don't compile in Windows environment.



1. **Predict the Output of the following program:**.

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```
    // make two process which run same
    // program after this instruction
    fork();

    printf("Hello world!\n");
    return 0;
}
```

Output:

```
Hello world!
Hello world!
```

2. **Calculate number of times hello is printed:**

```
#include <stdio.h>
#include <sys/types.h>
int main()
{
    fork();
    fork();
    fork();
    printf("hello\n");
    return 0;
}
```

Output:

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```
hello
hello
```

The number of times 'hello' is printed is equal to
Processes = 2^n, where n is number of fork syste

Let us put some label names for the three lines:

```
fork ();   // Line 1
fork ();   // Line 2
fork ();   // Line 3

       L1       // There will be 1 child process
    /     \     // created by line 1.
  L2      L2    // There will be 2 child processes
 /  \    /  \   //  created by line 2
L3  L3  L3  L3  // There will be 4 child processes
                // created by line 3
```

So there are total eight processes (new child processes and one original process).

If we want to represent the relationship between the processes as a tree hierarchy it would be the following:

The main process: P0
Processes created by the 1st fork: P1
Processes created by the 2nd fork: P2, P3
Processes created by the 3rd fork: P4, P5, P6, P7

```
             P0
          /   |   \
        P1    P4   P2
      /  \          \
    P3    P6         P5
   /
 P7
```

3. **Predict the Output of the following program:**

```
#include <stdio.h>
```

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```
    // parent process because return va
    else
        printf("Hello from Parent!\n");
}
int main()
{
    forkexample();
    return 0;
}
```

Output:

```
1.
Hello from Child!
Hello from Parent!
     (or)
2.
Hello from Parent!
Hello from Child!
```

In the above code, a child process is created. fork() returns 0 in the child process and positive integer in the parent process.
Here, two outputs are possible because the parent process and child process are running concurrently. So we don't know whether the OS will first give control to the parent process or the child process.

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of these processes can be different. See next ex

4. **Predict the Output of the following program:**

```
#include <stdio.h>
#include <sys/types.h>
#include <unistd.h>

void forkexample()
{
    int x = 1;

    if (fork() == 0)
        printf("Child has x = %d\n", ++x);
    else
        printf("Parent has x = %d\n", --x);
}
int main()
{
    forkexample();
    return 0;
}
```

Output:

```
Parent has x = 0
Child has x = 2
     (or)
Child has x = 2
Parent has x = 0
```

Here, global variable change in one process does not affected two other processes because data/state of two processes are different. And also parent and child run simultaneously so two outputs are possible.

fork() vs exec()

The fork system call creates a new process. The new process created by fork() is a copy of the current process except for the returned value. The exec() system call replaces the current process with a new program.

Exercise:

1. A process executes the following code:

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(C) 2^n

(D) 2^(n+1) - 1;

See this for solution.

2. Consider the following code fragment:

```
if (fork() == 0) {
    a = a + 5;
    printf("%d, %d\n", a, &a);
}
else {
    a = a -5;
    printf("%d, %d\n", a, &a);
}
```

Let u, v be the values printed by the parent process, and x, y be the values printed by the child process. Which one of the following is TRUE? (GATE-CS-2005)

(A) u = x + 10 and v = y

(B) u = x + 10 and v != y

(C) u + 10 = x and v = y

(D) u + 10 = x and v != y

See this for solution.

3. Predict output of below program.

```
#include <stdio.h>
#include <unistd.h>
int main()
{
    fork();
    fork() && fork() || fork();
    fork();

    printf("forked\n");
    return 0;
}
```

See this for solution

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