Multithreading in C

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What is a Thread?

A thread is a single sequence stream within a process. Because threads have some of the properties of processes, they are sometimes called *lightweight processes*.

What are the differences between process and thread?

Threads are not independent from each other unlike processes. As a result, threads shares with other threads their code section, data section and OS resources like open files and signals. But, like processes, a thread has its own program counter (PC), a register set, and a stack space.

Why Multithreading? Threads are popular way to improve application through parallelism. For example, in a browser, multiple tabs can be different threads. MS word uses multiple threads, one thread to format the text, other thread to process inputs, etc.

Threads operate faster than processes due to following reasons:

1) Thread creation is much faster.

2) Context switching between threads is much faster.

3) Threads can be terminated easily

4) Communication between threads is faster.

Can we write multithreading programs in C?

Unlike Java, multithreading is not supported by the language standard. POSIX Threads (or Pthreads) is a POSIX standard for threads. Implementation of pthread is available with gcc compiler.

A simple C program to demonstrate use of pthread basic functions

Please note that the below program may compile only with C compilers with pthread library.

C

```c
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>  //Header file for sleep(). man 3 sleep for details.
#include <pthread.h>

// A normal C function that is executed as a thread
// when its name is specified in pthread_create()
void *myThreadFun(void *vargp)
{
    sleep(1);
    printf("Printing GeeksQuiz from Thread \n");
    return NULL;
}

int main()
{
    pthread_t thread_id;
    printf("Before Thread\n");
    pthread_create(&thread_id, NULL, myThreadFun, NULL);
    pthread_join(thread_id, NULL);
    printf("After Thread\n");
    exit(0);
}
```

In main(), we declare a variable called thread_id, which is of type pthread_t, which is an

The second argument specifies attributes. If the value is NULL, then default attributes shall be used.

The third argument is name of function to be executed for the thread to be created.

The fourth argument is used to pass arguments to the function, myThreadFun.

The pthread_join() function for threads is the equivalent of wait() for processes. A call to pthread_join blocks the calling thread until the thread with identifier equal to the first argument terminates.

How to compile above program?

To compile a multithreaded program using gcc, we need to link it with the pthreads library. Following is the command used to compile the program.

```
gfg@ubuntu:~/$ gcc multithread.c -lpthread
gfg@ubuntu:~/$ ./a.out
Before Thread
Printing GeeksQuiz from Thread
After Thread
gfg@ubuntu:~/$
```

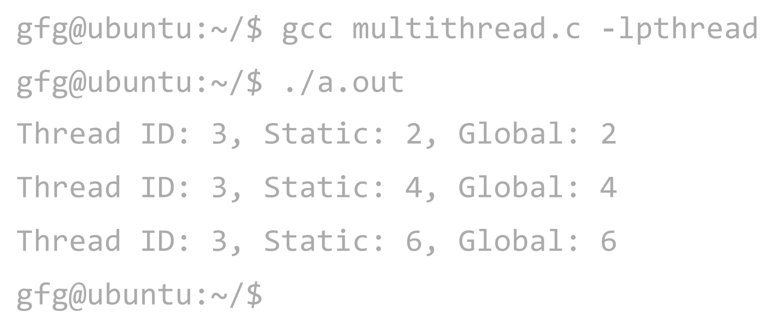
A C program to show multiple threads with global and static variables

As mentioned above, all threads share data segment. Global and static variables are stored in data segment. Therefore, they are shared by all threads. The following example program demonstrates the same.

C

```
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <pthread.h>
```

```
    // Store the value argument passed to this thread
    int *myid = (int *)vargp;

    // Let us create a static variable to observe its changes
    static int s = 0;

    // Change static and global variables
    ++s; ++g;

    // Print the argument, static and global variables
    printf("Thread ID: %d, Static: %d, Global: %d\n", *myid, ++s, ++g);
}

int main()
{
    int i;
    pthread_t tid;

    // Let us create three threads
    for (i = 0; i < 3; i++)
        pthread_create(&tid, NULL, myThreadFun, (void *)&tid);

    pthread_exit(NULL);
```



```
gfg@ubuntu:~/$ gcc multithread.c -lpthread
gfg@ubuntu:~/$ ./a.out
Thread ID: 3, Static: 2, Global: 2
Thread ID: 3, Static: 4, Global: 4
Thread ID: 3, Static: 6, Global: 6
gfg@ubuntu:~/$
```

Please note that above is simple example to show how threads work. Accessing a global variable in a thread is generally a bad idea. What if thread 2 has priority over thread 1 and thread 1 needs to change the variable. In practice, if it is required to access global variable by multiple threads, then they should be accessed using a mutex.

References:

incorrect, or you want to share more information about the topic discussed above

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