

Assignment Project Exam Help

Introduction to OpenMP

<https://powcoder.com>

Amitava Datta

University of Western Australia

Add WeChat powcoder

Compiling OpenMP programs

Assignment Project Exam Help

- ▶ OpenMP programs written in C are compiled by (for example): `gcc -fopenmp -o prog1 prog1.c`
- ▶ We have assumed the name of the C file is `prog1.c` and the name of the executable is `prog1`
- ▶ The compiler will look for OpenMP directives in your program for generating code.
- ▶ No action is taken if there are no OpenMP directives in your program.

<https://powcoder.com>

Add WeChat powcoder

pragma directive

If you want the compiler to generate code using OpenMP, you have to use the pragma directive

Assignment Project Exam Help

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

```
int main()
{
#pragma omp parallel
{
    printf("The parallel region is executed by thread
    %d\n",omp_get_thread_num());

}
}
```

<https://powcoder.com>

Add WeChat powcoder

#pragma parallel

- ▶ When the compiler encounters the `parallel` directive, it generates multi-threaded code.

Assignment Project Exam Help

- ▶ How many threads will execute the code will depend on how many threads are specified (more later).
- ▶ The default is number of threads equal to number of cores.

- ▶ The parallel region is executed by thread 4

The parallel region is executed by thread 3

The parallel region is executed by thread 7

The parallel region is executed by thread 2

The parallel region is executed by thread 5

The parallel region is executed by thread 1

The parallel region is executed by thread 6

The parallel region is executed by thread 0

- ▶ But I have only 4 cores in my machine.

<https://powcoder.com>

Add WeChat powcoder

Hyperthreading

Assignment Project Exam Help

- ▶ Hyperthreading is an Intel technology that treats each physical core as two logical cores.
- ▶ Two threads are executed at the same time (logically) on the same core.
- ▶ Processors (or cores) do not execute instructions in every clock cycle.
- ▶ There is an opportunity to execute another instruction from another thread when the core is idle.
- ▶ Hyperthreading schedules two threads to every core.
- ▶ So, my processor has 4 physical cores and 8 logical cores.

<https://powcoder.com>

Add WeChat powcoder

Hyperthreading

Assignment Project Exam Help

- ▶ The purpose of hyperthreading is to improve the throughput (processing more per unit time).
- ▶ This may or may not happen. In fact hyperthreading may actually have slower performance.
- ▶ Your process will run slower when hyperthreading is turned on.
- ▶ It all depends on how well the L1 cache is shared.
- ▶ It is possible to turn hyperthreading off through the BIOS (more on lab sheet).

<https://powcoder.com>

Add WeChat powcoder

Threads run independently

Assignment Project Exam Help

- ▶ There is only one thread until the `parallel` directive is encountered.
- ▶ 7 other threads are launched at that point.
- ▶ Thread 0 is usually the master thread (that spawns the other threads).
- ▶ The `parallel` region is enclosed in curly brackets.
- ▶ There is an implied barrier at the end of the parallel region.

<https://powcoder.com>

Add WeChat powcoder

What is a barrier?

- ▶ A barrier is a place in the process where all threads must reach before further processing occurs.
- ▶ Threads may run away without barriers and it is necessary many times to have barriers at different places in a process.
- ▶ Barriers are sometime implicit (like here), barriers sometime can be removed (more later).
- ▶ Barriers are expensive in terms of run time performance. A typical barrier may take hundreds of clock cycles to ensure that all threads have reached the barrier.
- ▶ It is better to remove barriers, but this is fraught with danger.

A variation of our code

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

```
#include <omp.h>
```

```
int main()
```

```
{
```

```
    #pragma omp parallel
```

```
{
```

```
    if (omp_get_thread_num()==3) sleep(1);
```

```
    printf("The parallel region is executed by thread %d\n",omp
```

```
}
```

```
}
```

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Output

Assignment Project Exam Help

The parallel region is executed by thread 4

The parallel region is executed by thread 7

The parallel region is executed by thread 1

The parallel region is executed by thread 2

The parallel region is executed by thread 5

The parallel region is executed by thread 6

The parallel region is executed by thread 0

The parallel region is executed by thread 3

<https://powcoder.com>
Add WeChat powcoder

- ▶ Thread 3 is now suspended for 1 second, so all other threads complete before thread 3.

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder

Assignment Project Exam Help

<https://powcoder.com>

Add WeChat powcoder