Simple OpenMP

Mike Bailey

mjb@cs.oregonstate.edu

OpenMP Multithreaded Programming

- OpenMP stands for "Open Multi-Processing"
- It is run by a consortium of companies, labs, and universities
- OpenMP (IMHO) gives you the biggest multithread benefit per amount of work you have to put into using it

Much of your use of OpenMP will be accomplished by issuing C/C++ "pragmas" to tell the compiler how to build the threads into the executable

#pragma omp directive [clause]

That's it! That's where the compiler comes in.

But, as you are about to find out, doing parallel processing ***at all*** is not difficult.

The trick is doing parallel processing ***well***.
That's where *you* come in.

Oregon State University
Computer Graphics

Using OpenMP on Linux

g++ -o proj proj.cpp -lm -fopenmp

Using OpenMP in Microsoft Visual Studio

1. Go to the Project menu ⟶ Project Properties

2. Change the setting Configuration Properties ⟶ C/C++ ⟶ Language ⟶ OpenMP Support to **"Yes (/openmp)"**

If you are using Visual Studio 2019 and get a compile message that looks like this:
1>c1xx: error C2338: two-phase name lookup is not supported for C++/CLI, C++/CX, or OpenMP; use /Zc:twoPhase-
then do this:

1. Go to "Project Properties"⟶ "C/C++" ⟶ "Command Line"
2. Add **/Zc:twoPhase-** in "Additional Options" in the bottom section
3. Press OK

Oregon State University
Computer Graphics

Seeing if OpenMP is Supported on Your System

```
#ifdef _OPENMP
    fprintf( stderr, "OpenMP version %d is supported here\n", _OPENMP );
#else
    fprintf( stderr, "OpenMP is not supported here – sorry!\n" );
    exit( 0 );
#endif
```

This gives you a year and month of the OpenMP you are using

To get an OpenMP version number:

OpenMP 5.0 – November 2018
OpenMP 4.5 – November 2015
OpenMP 4.0 – July 2013
OpenMP 3.1 – July 2011

Oregon State University
Computer Graphics

- By default, flip is using g++ 11.4.1, which uses OpenMP version 4.5
- Looks like Visual Studio 2019's is even older (?)

Threads

We will get into more detail pretty soon, but for now, know that a thread is an independent execution path for your code to take.

Threads are at their very best when each one can run on a separate hardware core.

Oregon State University
Computer Graphics

Seeing if OpenMP is Supported on Your System:


```
#ifndef  _OPENMP
    fprintf( stderr, "OpenMP is not supported – sorry!\n" );
    exit( 0 );
#endif
```

How to find out how many cores your system has:

```
int  numprocs  =  omp_get_num_procs( );
```

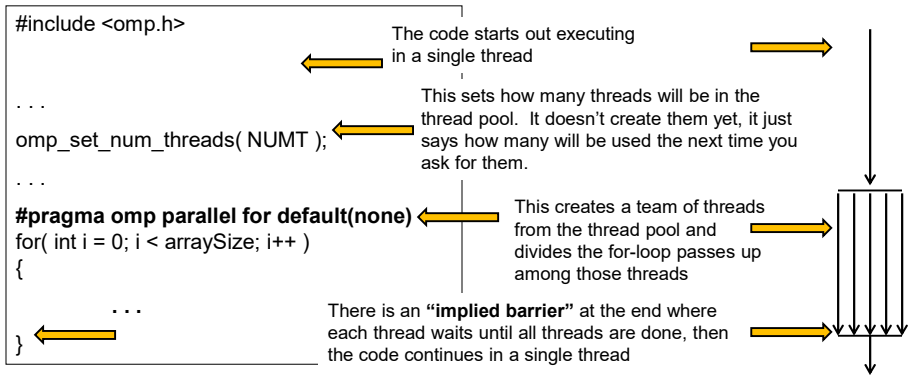
How to specify how many OpenMP threads you want to reserve starting now:

```
omp_set_num_threads( num );
```

How to use one thread per core:

```
omp_set_num_threads(  omp_get_num_procs( )  );
```

Creating OpenMP threads for a for loop



This tells the compiler to parallelize the for-loop into multiple threads. Each thread automatically gets its own personal copy of the variable *i* because it is defined within the for-loop body.

The **default(none)** directive forces you to explicitly declare all variables declared outside the parallel region to be either private or shared while they are in the parallel region. Variables declared within the for-loop statement are automatically private