Parallel Programming
Course Introduction for On-campus Students

Oregon State University
Mike Bailey
mjb@cs.oregonstate.edu

What this Course Is
This course is all about parallel programming on the “desktop” for applications that you are attempting to accelerate to improve user interaction and simulation and computational performance.

The goals of this course are to leave you “career-ready” (i.e., both work-ready and research-ready) for tasks that require desktop parallelism, both on a CPU and a GPU.

CS 475/575 topics include:
- Parallel computing: types, limitations
- Moore’s Law, Amdahl’s Law
- OpenMP
- Synchronization issues in parallel computing
- Cache issues in parallel computing
- SIMD
- GPU computing
- OpenCL
- CUDA

What this Course Isn’t
This course is not about supercomputers or clusters. A lot of the same principles that we will discuss about the desktop do apply to supercomputers and clusters so this will still be useful.

However, if we have time, we will lightly touch on the Message Passing Interface, MPI, which is used in supercomputers and clusters.

What You Should Know on the Way In
Above all, you should be a good C programmer. Being comfortable with function calls, arrays, for-loops, structures, arrays of structures, structures of arrays, pointers, and linked lists is a must. It is strongly suggested that you not use this class as an opportunity to learn C for the first time.

On the math side, you should know algebra. There will be times when we have an equation that solves for “Y given X” and I will ask, “What if we already know Y, can we then go back and find X?” It would be good if you can do that.

What We Will Be Covering
Note: this schedule is approximate!
I will try to keep the schedule on the class web site up-to-date.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction, Syntax, What this course is and isn’t, Project notes, timing, graphing, Examples, The three things we care about Parallel Processing for, Von Neumann architecture. Multithreading.</td>
</tr>
<tr>
<td>4</td>
<td>Caches, cont. False sharing. Designing parallel programs.</td>
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<tr>
<td>5</td>
<td>Tasks. A special kind of parallelism: Single Instruction Multiple Data (SIMD). SSE, AVX, AVX-512 instructions. What they are, how to use them, Types of problems that work this way. Text 8</td>
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<tr>
<td>6</td>
<td>OpenCL, the test answers. GPU 101. Architecture. What it’s good at, What it’s not good at. Why.</td>
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There is no textbook for this class. The course material will consist of handouts and notes taken while watching the videos.

If you need further reference material, there are a bunch of links at the end of the class website. You’re not required to go look at any of these. They are just some links that I have found useful. They are there if you need them.