

PCSE: General Remarks

Lars Koesterke & Charlie Dey

lars@tacc.utexas.edu

charlie@tacc.utexas.edu

sruthis@utexas.edu (TA)

PCSE

Jan 19, 2017

What we teach

Introduction

- What is parallel computing?
- Why do we do parallel computing?

OpenMP

- Multithreading on a shared-memory architecture

MPI

- Distributed memory architecture, aka. 'a cluster'

Special topics

- TBD

The most important things you can do

Participate in class

Ask questions

Make the class interactive

Make this class a success for all of us!



The most important things you can do

Participate in class

Ask questions

Make the class interactive

Help each other

- You current knowledge differs a lot
- No better grades by demonstrating that you are ahead
- Standard rules for quizzes, home works, etc. apply!
- Help others: you will experience how much you will learn from explaining 'stuff' to others
- We will use slack for communication

Grading

Current plans:

- 3 quizzes
- 3 home works (+ home work 0)
- Project

Each segment will count roughly the same



We will try to accommodate you

Focus your project on your actual research

- Parallelize your research code
- Pick something you are interested in
- Or pick a 'canned' project
- We will discuss details later

Let us know what is of interest to you

- Of course, within the confines of the general topic



Technical details

You need a TACC account

- If you have already a TACC account → let us know the user name
- If not: Create a user account at **tacc.utexas.edu**
- Click 'Use TACC' and then 'TACC User Portal'

Do this today and Jason will add you right on the spot

jasona@tacc.utexas.edu

Resources

TACC offers many resources, we will use 2 of them

Stampede2: our current flagship

Maverick: an older system which is 'draining'

We will teach how to logon, to compile, how to submit a job, and how to start an interactive session etc.

What we do not teach (in great detail)

General use of a computer (HPC = Linux)

- Intro to Unix/Linux
 - We may discuss shortly a list of the 'ten most important' commands
- Intro to Editor
 - Join the UNIX world
 - It is either 'vi' or 'emacs' (that's really a bad list of choices)
- Find a tutorial online if you start at 'zero'
- Ask your fellow students for help!

We do this for a good reason

There are so many more interesting things to learn

And TACC provides other classes for this

Start early with your assignments

We have some good and bad news

- Good news, if you like to code
- Bad news, because you will realize that the semester has started

We have home work #0 for you

- Write a serial code
- You will parallelize this code later in the OpenMP and MPI home works
- There is no due date, there is no grade
- But please be ready when home work #1 is presented

Outline on the next slide, we will discuss details in class

Home Work #0

A common operation in scientific computing is digital convolution, by which each element in a multi-dimensional grid is replaced by a weighted sum of its neighbors. This has applications in graphics, in which such operations are done to both blur and sharpen images, and in numerical simulations, in which this may be a single step in a Poisson solver.

Write serial code for CPUs either in Fortran90 or in C/C++. In upcoming homework you will parallelize the code with OpenMP and MPI and will compare timings of the serial and parallel code versions.

Outline:

Define two 2D arrays (x, y) in your code. Initialize one array (x) with random numbers between 0 and 1. Derive the elements of the second array (y) from the first array by smoothing over the elements of the first array, using three constants a, b and c:

$$\begin{aligned} y(i,j) = & a * (x(i-1,j-1) + x(i-1,j+1) + x(i+1,j-1) + x(i+1,j+1)) + \\ & b * (x(i-1,j+0) + x(i+1,j+0) + x(i+0,j-1) + x(i+0,j+1)) + \\ & c * x(i+0,j+0) \end{aligned}$$

Count the elements that are smaller than a threshold t in both arrays and print the number for both arrays. Collect timings for three major steps in the code:

- Populating the first array (x) with random numbers
- Calculating the second array (y)
- Counting of elements below threshold

Outline for today

- Technical details (these slides)
- Part 1 of 'Intro to Parallel Computing'
- Lecture will stop 15 minutes early
 - Please create your TACC account
 - Talk to Jason, he will add you to the project

Slides will be posted on Canvas

