



csinparallel.org

# CSinParallel Four Corners Workshop

## *Introduction to CSinParallel*

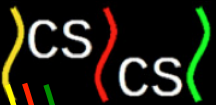
Dick Brown, St. Olaf College

Thursday morning, 7/24/2014  
Haverford College



CALVIN  
MINDS IN THE MAKING





csinparallel.org

## Workshop site

On CSinParallel.org:

[http://serc.carleton.edu/csinparallel/  
workshops/northeast/](http://serc.carleton.edu/csinparallel/workshops/northeast/)

See also workshop handouts

## Take-home messages

- The **traditional CS curriculum** is “**striking out**” against the fastballs and curve balls of current computing technologies
- Our students need **preparation in parallel and distributed computing (PDC)** for their careers
- The **CSinParallel strategy** for effective, quicker *curricular change*
- **Strategic resources** for teaching PDC

The **BIG** challenge: **Forming an effective community to support this curricular transition**

# Striking out against new PDC technologies

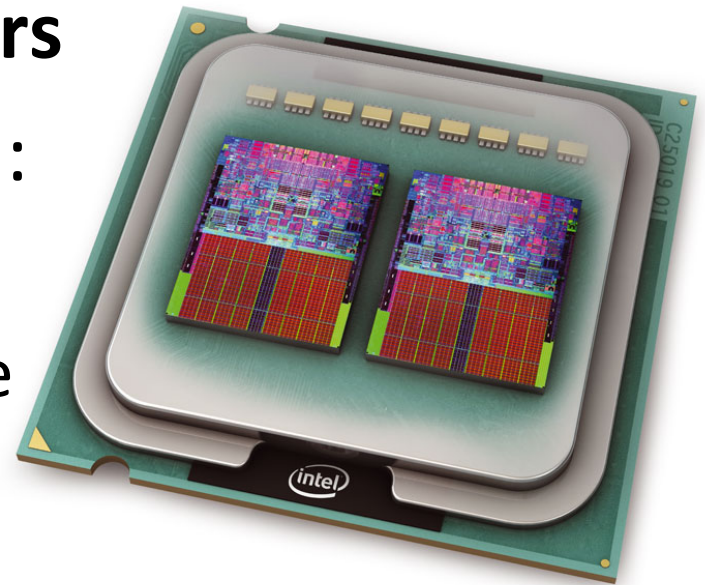


[http://armchairgm.wikia.com/File:1206127655\\_Strikeout.gif](http://armchairgm.wikia.com/File:1206127655_Strikeout.gif)

# Striking out against new PDC technologies

## Strike 1: Multicore processors

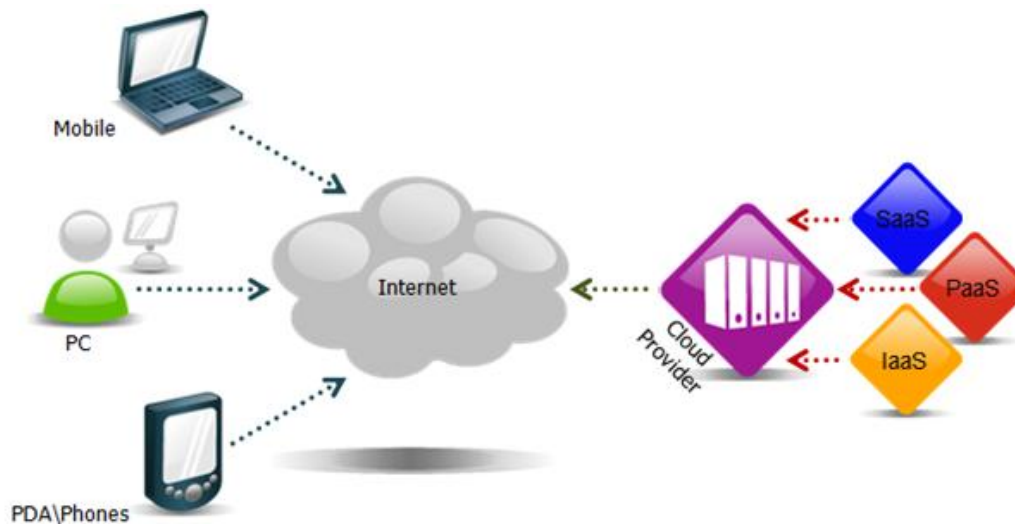
- The norm for about **10 years**
- *Why?* “Hitting the wall” in:
  - a. (Electrical) **power**
  - b. **ILP** (can't hide much more parallelism within core)
  - c. Deepening **memory hierarchy**



[http://media.soundonsound.com/sos/jan08/images/PCMusician\\_01\\_l.jpg](http://media.soundonsound.com/sos/jan08/images/PCMusician_01_l.jpg)

# Striking out against new PDC technologies

## Strike 2: Cloud computing revolution



- Distributed computing empowers exciting new web services

[http://cloudcomputingadvices.com/wp-content/uploads/2012/08/cloud\\_computing-Features.jpg](http://cloudcomputingadvices.com/wp-content/uploads/2012/08/cloud_computing-Features.jpg)

# Striking out against new PDC technologies

## Strike 3: Heterogeneous computation

(It's not just for HPC anymore)

- Commodity chips with multiple core types
  - Intel vector cores; AMD GPU + CPU cores
- Multicore and heterogeneous multicore as distributed/cluster computing nodes

# Educating students for their careers

- Parallelism and concurrency traditionally taught in Architecture and Operating Systems
  - **Still necessary, just no longer sufficient**
- **Commodity computing**, not just HPC research
- **Hardware *and* software** evolving rapidly
  - Including languages, libraries, frameworks
- Recent **curriculum recommendations**
  - ACM/IEEE CS2013, for undergraduate CS majors
  - TCPP recommendations for PDC



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*... Rapid curricular change??*

# The CSinParallel strategy

## 1. Brief, flexible PDC teaching modules

- Almost any CS course, at almost any level
- 1- to 3-day course units, for feasible incremental modifications to a syllabus
- Broad variety of topics, technologies, languages, etc.
- Adaptable/editable for local modification
- Emphasis on hands-on exercises with current technologies
- Learning objectives, teaching tips, etc.

# The CSinParallel strategy

## 2. Pedagogical effectiveness

- **Small interventions, big impact**
  - Opportunities for broad exposure to PDC
- Effective **hands-on learning** with PDC tools
- **Spiral approach**
  - Recurring topics in multiple contexts leads to better retention and deeper understanding
- Early and often
  - Delivered message: **PDC is natural, pervasive in CS**

## The CSinParallel strategy

### 3. Community of folks seeking to teach PDC

- **Community support**

- Communicating with others trying same things (modules, institution types, courses, techs,...)
- Resources for recording others' past experiences (e.g., Piazza, teaching tips)

**Creating community/human networking is the primary goal for this workshop event**

## Some strategic resources

- **Platform resources**
  - Example: WebMapReduce (WMR), for beginning or advanced students to learn about scalable computations that fuel cloud-powered services
  - Example: Intel Manycore Testing Lab (MTL), free educational access to 40-core computers
- **Students helping** profs, other students
  - Scalable collaborative resource
  - Student capacity for **exploring new technologies**

# Some strategic resources

- **Basic CSinParallel modules**
  - Examples: WMR for CS1; Multicore Programming (intro); Concurrent Data Structures (C++ or Java); Parallel Sorting
- **“Exemplar” modules**
  - Present a significant domain application (e.g., drug design, epidemiology, traffic flow) together with a sequential implementation
  - Choice of parallel/distributed implementations
  - Pedagogical possibilities + student motivation
- **“Taste” modules**
  - Brief introductory experience of a new technology, or parallel language, larger educational work, etc., pointing to the original source for further explorations

## Some strategic resources

- Relating local courses and CSinParallel materials to **latest curriculum recommendations** (CS2013, TCPP)
- **Parallel Programming Patterns**
  - Recurring design strategies for parallel programs, distilled from practices of experienced pros
  - Guides to problem solving and parallel thinking for undergraduate learners of PDC

# This workshop

- **Planned, but not a fixed program, since your interests should drive this workshop**

Overview of schedule:

|                         |   |
|-------------------------|---|
| <i>Thurs. morning</i>   | Intro to CSinParallel (✓); overview of PDC; modules and resources |
| <i>Thurs. afternoon</i> | 1. *What participants want<br>2. Breakout sessions by interests   |
| <i>Fri. morning</i>     | PDC in latest CS curriculum reports                               |
| <i>Fri. lunch</i>       | How shall we proceed?   |



## Refined BIG challenge

How can we form a supportive community that benefits professors more than it “costs”

What are the “costs”?

- **Learning new systems** (e.g., piazza)
- **Competition for time** during the term
- **Weight of inertia against change**

## Recap

- Hardware and software parallel and distributed computing (PDC) technologies are **evolving rapidly, with no end in sight**
  - Multicore; cloud/distributed; *heterogenous*
- **Students need to know about PDC** as they enter the workforce.
- *CSinParallel offers modules, resources, and strategies for teaching PDC, in a context of **supportive community***
- Biggest unsolved problem:  
**Creating a support community worth the effort**



# Questions?