IEEE-TCPP Parallel and Distributed Computing Curriculum for Computer Science and Engineering Undergraduates - Revision Update

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TCPP Curriculum Initiative:
http://www.cs.gsu.edu/~tcpp/curriculum/

Outline

- IEEE-TCPP Curriculum – 5 mins
  - History, Opportunities
  - Key Activities and Milestones
    - ACM/IEEE 2013 CS Curriculum Taskforce
      - provided direct link to us for rigorous coverage
  - How formulated? Getting evaluated? Resources?
- Curriculum Revisions => Version 2 – 15 mins
  - Revision Aspects: Big Data, Energy, Distributed Computing, Cross-cutting topics
  - Areas:
    - Algorithms
    - Programming
    - Architecture

Curriculum Planning Workshops at DC (Feb-10) and at Atlanta (April-10)

- Goals
  - setup mechanism and processes which would provide periodic curricular guidelines
  - employ the mechanism to develop sample curriculums
- Agenda:
  - Review and Scope
  - Formulate Mechanism and Processes
  - Preliminary Curriculum Planning
    - Core Curriculum
    - Introductory and advanced courses
  - Impact Assessment and Evaluation Plan

Main Outcomes

- Priority:
Core curriculum revision at undergraduate level

- Preliminary Core Curriculum Topics

-Sample Intro and Advanced Course Curriculums

Some Participants at the Planning Workshop, Washington DC, Feb 5-6, 2010

4 Curriculum Areas
Architecture, Programming, Algorithms, Cross-cutting

TCPP Curriculum Example

Algorithms Topics	Bloom#	Course	Learning Outcome
Algorithmic problems			*The important thing here is to emphasize the parallel/distributed aspects of the topic*
Communication			
broadcast	**C/A**	Data Struc/Algo	*represents method of exchanging information - one-to-all broadcast (by recursive doubling)*
multicast	**K/C**	Data Struc/Algo	*Illustrate macro-communications on rings, 2D-grids and trees*
scatter/gather	**C/A**	*Data Structures/Algorithms*	
gossip	**N**	*Not in core*	
Asynchrony	**K**	CS2	*asynchrony as exhibited on a distributed platform, existence of race conditions*
Synchronization	**K**	CS2, Data Struc/Algo	*aware of methods of controlling race condition,*
Sorting	**C**	CS2, Data Struc/Algo	*parallel merge sort,*
Selection	**K**	CS2, Data Struc/Algo	*min/max, know that selection can be accomplished by sorting*

Early Adopter and Training Programs

- Over 100 institutions worldwide
  - Spring-11: 16 institutions ; Fall'11: 18;
  - Spring-12: 21; Fall-12: 25 institutions, Fall-13: 25 institutions, Fall-14: 25, Fall-15: 13
  - Most from US (4 year to research institutions, one high school)
  - Some from South America, a few from Europe, fewer from Asia (India, China, Indonesia, Singapore), Middle East
- **NSF CyberTraining Training Workshops - Summer 2018-19**
  - **UMass/Maryland; Tennessee Tech**
  - NSF/Intel funded Stipend up to $1500-5000/proposal
  - *Instructor training + adoption plans*

Edu* Workshop Series

- **EduPar-11** at Alaska, IPDPS-2011
  - Receive feedback from the Adopters
  - Stimulate discussion of curricular and other educational issues.
- EduPar-12 at Shanghai, IPDPS-2012
  - A regular satellite workshop of IPDPS
  - EduPar-15 @IPDPS, May, India; EduPar-16, Chicago, EduPar-17 in Orlando; EduPar-18 in Vancouver, **EduPar-19 @ IPDPS, Brazil**
- **EduHPC** Workshop at SC-13 + BOF at SIGCSE-14
  - EduHPC-14 @ SC-14, Nov – New Orleans; EduHPC-15 in Austin, EduHPC-16, EduHPC-17, EduHPC-18 in Dallas
  - **EduHPC-19 @ SC in Denver in Nov'19**
- **Euro-EduPar** Aug 2015; Euro-EduPar-2016, EEP-2017, EEP-18,
- **EduHiPC 2018 @ HiPC in Banglore** – for India and the region
  - **EduHiPC 2018 @ HiPC in Hyderabad in Dec'19**

CDER Courseware Website

Upload and Search Course Material

- **Type:**
  - Slides, Syllabus, Tutorial, Video
  - Animation, Article, Award, Blog, Book, Competition
  - Course Template, Course Module, Data
  - Hardware Access, Software/Tools
  - Proposal, Report
- **Courses:**
  - CS1, CS2, Systems, Data Structures and Algorithms, …

- **NSF/TCPP Topic/Subtopic Classification:**

ALGORITHMS
- Parallel and Distributed Models and Complexity
- Algorithmic Paradigms
  - Divide & conquer (parallel aspects)
- Algorithmic problems

ARCHITECTURE

PROGRAMMING

CROSS-CUTTING

- Now open - Work in Progress

CDER Book Project

- Lack of suitable textbooks to integrate PDC topics into the core courses
  - CS1, CS2, Systems, and Data Structures and Algorithms
  - Part I - For instructors: Basic Concepts and References on what and how to teach
  - Part 2: For students: Supplemental teaching material for core courses
  - 9 chapters
    - over 27K chapter downloads – free downloads
- 2nd Volume – Published Nov'18
- **Vol 3** – Early Adopter course and topic exemplars and accompanying resources

Curriculum Version II Activities

	Areas	Architecture	Algorithms	Programming
New Aspects	**Area Lead/** Aspect Lead	Chip Weems	Anshul Gupta	Alan Sussman
Exemplars	Sushil Prasad	Karen Karavanic, Eric Freudenthal	Erik Saule, Duane Merril, David Bunde	David Brown, Eric Freudenthal
Distributed	Vaidyanathan Ramachandran	Vaidyanathan Ramachandran, Manish Parashar	Vaidyanathan Ramachandran, Costas Busch, Denis Trystram	Alan Sussman, Chi Shen
Big Data	Trilce Estrada	Craig Stunkel	Cynthia Phillips,	Debzani Deb
Energy	Krishna Kant, Craig Stunkel	Craig Stunkel, Karen Karavanic	Denis Trystram	John Dougherty
Crosscutting	Sheikh Ghafoor Arny Rosenberg Anshul Gupta	Craig Stunkel, Eric Freudenthal	Robert Robey, Martina Barnas	Sheikh Gafoor, Eric Freudenthal

NSF/TCPP Curriculum Initiative

What should every Computer Science and Engineering Student know about Parallel and Distributed Computing (PDC)? http://www.cs.gsu.edu/~tcpp/curriculum/

- Aspects: Energy, Distributed, Big Data, Pervasive topics
- Timeline:
  - Beta Version-1.9 @ IPDPS'19
  - Ongoing revision based on expert reviews
  - Public review release Dec'19
- 2 pm: Session on Curriculum Update:
  - Feedback/Participation needed
- New: NSF Institute Planning Grant => 4 planning workshops
  - SC'19 (Mon - tomorrow) – by invitation
  - SIGCSE'20
  - IPDPS'20
  - NSF – Fall'20