*CS*06201*a*01: Network Computing and Efficient Algorithms

Syllabus

Xiang-Yang Li and Xiaohua Xu

School of Computer Science and Technology
University of Science and Technology of China (USTC)

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Couse Info.

Instructors

- Prof. Xiang-Yang Li (xiangyangli@ustc.edu.cn)
- Dr. Xiaohua Xu (xiaohuaxu@ustc.edu.cn)

Lecture info.

- Classroom and Class-time: Week 2 18 GT110: 2(11,12,13)
- Recommended books, notes, journals and conference proceedings Principles of Distributed Computing, lecture notes, by Roger Wattenhofer, ETH, 2016 (`https://disco.ethz.ch/courses/fs18/podc/`)
- Nancy A. Lynch. Distributed Algorithms. Morgan Kaufmann Publishers Inc., San Francisco, CA, USA, 1996.
- Xiang-Yang Li, Wireless Ad Hoc and Sensor Networks: Theory and Applications, ISBN-13: 9780521865234, Cambridge University Press, 2008
- ACM PODC, DISC
- IEEE transactions (e.g. TPDS)

Course Outline

- Basic Principles and Techniques in Distributed Computing
  - Vertex Coloring
  - Tree Algorithms
  - Leader Election
  - Maximal Independent Set
  - Consensus
  - Communication Complexity
- Recent Hot Research Topics

Course Objectives

- To understand
  - basic concepts in Distributed Computing
  - basic techniques to design distributed algorithms
  - how to analyze distributed algorithms, i.e., time complexity, message complexity, and lower bounds
  - applications of distributed computing
- Besides, to learn and practice basic research skills.

Course Structure

The course is an integration of two components

- 1st component
  - Lectures (slides and research papers will be provided)
  - Invited speakers from industry and other academic institutes
- 2nd component
  - Seminars: students read, present, and discuss up-to-date research results
  - Course projects or chapter writing

Communication convention

- Please use prefix: CS06201a01 in your email subject for expedited response

Course Load

Course Load

- Seminar: Technical Paper presentation (30%)
  - (15%) Each group of students is expected to read and present at least ONE research paper and be able to lead the discussion about the paper, which is better related to your term project.
  - (15%) Write 3-5 page summary
- One term project (60%)
  - Problem Solving: Apply the techniques covered in this course to some area and solve a specific problem.
  - Chapter Writing: Alternatively, choose one topic covered in this course and write a detailed Chinese technical note, which could be regarded as a chapter of a lecture book.
  - Team project is encouraged, the REQUIRED team size is 2. However 3 members is possible (special approval required).
- Class Attendance and Activity (10%)
  - Attendance (5%). Active students (e.g., interacting with instructors) will win the other 5 points.

Grading policy

Seminar: Technical Paper Presentation

- Technical Paper Presentation: every Wednesday starting from fourth week.
- The Technical paper presentation:
  - EACH group has to do one technical paper presentation. The paper is selected from the list of papers provided by us(or approved by us)
  - The selection of the paper from the list is first-come-first-service. No TWO groups are allowed to select the SAME papers.
  - All students MUST attend ALL presentations, and provide feedbacks.

Seminar: Technical Paper presentation

- To prepare the PPT presentation, you need to read several papers related to the one you read and present
  - Check the most recent conferences and journals for related papers
  - Check news reports also, and IEEE Spectrum, or ACM Communication
- You also need to submit a written summary about the papers you read (within 1 week of your presentation)
  - The summary is about 3-5 pages in IEEE format.
  - See the following link on how to write a good summary paper
  - `http://www.cs.ucf.edu/~lboloni/Teaching/EEL6788_2008/slides/SurveyTutorial.pdf`

Term Project (Solve)

- All students are required to do group term project
  - Typically 2 students a group.
  - 3 students a group at maximum (need special approval for this)
- Apply the techniques covered in this course to some areas and solve a specific problem (Preferred)
  - The topics can be selected yourselves but approved by us. Most probably the problem will come from your current research area.
  - A technical paper should be written based on your results:
    - Background and a clear motivation
    - Problem definition
    - Detailed solution and analysis with novel ideas
    - Simulations and Discussion
    - References

Term Project (Chapter Writing)

- All students are required to do group term project
  - Typically 2 students a group.
  - 3 students a group at maximum (need special approval for this)
- Choose one topic covered in this course and write a detailed technical note, which could be regarded as a chapter of a lecture book. (Alternative)
  - The topics can be selected yourselves but approved by us.
  - The technical note (like a book chapter with 15+ pages) should cover
    - the motivation and the formal definition of the topic
    - the up-to-date solution in the literature including analysis, and comparison of their pros and cons.
    - discussions on the applications and future work
    - References

Project deliverables

- 1-2 page project proposal (before Nov 1st)
  - An early start is strongly encouraged. Especially for solving a specific problem, you can set out as long as you find an interesting one.
- 10-15min presentation to introduce your project (Nov 10th)
- 10-15min presentation to demo the progress of your project (Dec 8th)
- 10-15min presentation at the end of the semester to demo the final results of your project (Dec 29th).
- 5-10 pages paper in IEEE conference format (thus counted as term paper for team project).

Choosing Projects

- Pick a problem that is intellectually interesting
- And improves the practice.

Most important: you are able to complete and who cares.

Look for blind spots

- Question old school assumptions
  Challenge the assumptions!
- Open your heart and mind to people who question assumptions

Project Proposal

- Your project title
- Team members
- Challenges in your project
- Relation to the topic: distributed methods or issues
- Current literature on this topic
- What are the network model, evaluation data?
- Your evaluation plan and metrics (how to evaluate the success of your project)
- Management aspects such as your project plan, critical paths, means of team communication (e-mail, chat room, meetings, version control system).

Project Presentation

- Presentation Kickoff
  - What is your proposed project?
  - Define clearly the goal of your project and what we should expect from your project.
  - The background and literature review related to your proposed project.
  - The possible challenges in your projects.
  - The possible design and implementation approaches.

Project Presentation

- Presentation Mid-Stage
  - Explain your design. Discuss design alternatives, such as model settings, algorithms, and simulations.
  - The current status of your project;
  - The possible challenges faced by your group in implementing the project;
  - Management aspects such as your project plan, critical paths, means of team communication (e-mail, chat room, meetings, version control system).

Project Presentation

- Final Presentation
  - Explain your design. Discuss design alternatives, such as model settings, algorithms, and simulations.
  - The challenges faced by your group in implementing the project and how you address these challenges;
  - Results achieved in your project, and comparisons with state of the art
  - Lessons learned from the project, and future plan for the project.

Guideline for Projects: Science-led Research Project

- Good science responds to real problems
- Good science is in the details
- Good science makes a difference

Good science/theory responds to real problems

What is the scientific issue in your research project?

- Dont pick fantasy problems
- Dont pick trivial proof-of-concept problems
- Too many real pressing real-world problems!
- Pick severe and pressing problems

Good science/theory is in the details

- Takes the form of a working model
  - The artifact is about understanding, not building
  - Must build when analysis is too complex
- Includes detailed analysis or implemented models
  - Allows others to benefit from work at an abstract level
  - Enables comparisons between different approaches

Good science/theory makes a difference

- Measures of contribution:
  - How it solves a real problem
  - How it shapes the work of other
- Solves a real problem
  - The problem sets the crucial context for the work
  - A million ideas to pursue, but which ones are worth doing?
- Shapes the work of others
  - Highest goal: change other peoples thinking
  - Paradigm changes are the most impactful [Kuhn]
  - Lay the foundation of some field, or
  - Summarize the fundamental results in the field

Examples of projects Clock Synchronization Science/Theory

- Tight Bounds for Clock Synchronization Christoph Lenzen, Thomas Locher and Roger Wattenhofer. Journal of the ACM, Volume 57, Number 2, January 2010. Documents: PDF
- Clock Synchronization: Open Problems in Theory and Practice Christoph Lenzen, Thomas Locher, Philipp Sommer and Roger Wattenhofer. 36th International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM), January 2010. Documents: PDF

Examples of projects Clock Synchronization Science/Theory

- FLIGHT: Clock Calibration Using Fluorescent Lighting, (Slides), Zhenjiang Li, Wenwei Chen, Cheng Li, and Mo Li (Nanyang Technological University, Singapore);Xiang-Yang Li (Illinois Institute of Technology, USA); and Yunhao Liu (Tsinghua University, China)

Wish you enjoy this course!