CS 537

Advanced Topics in Internet of Things

Lecture 1 – Introduction (Course Organization)

Klara Nahrstedt

Fall 2024

Overview

- **Course information**
  - ☐ Personnel
  - ☐ Course Logistics
  - ☐ Format of Various Tasks
  - ☐ Projects Discussion
  - ☐ Grading

Instructor Introduction

- **Klara Nahrstedt**

  - PhD   1995 from Department of Computer and Information Science, University of Pennsylvania

  - Research:

- Networking (routing, QoS management, pricing),
- Multi-modal Distributed systems (overlay multicast, resource management)
- Mobile computing – smart phones protocols
- Operating systems (soft-real-time scheduling, caching),
- Multimedia applications (multi-view 3D tele-immersive systems, multi-camera systems, multi-view 360 Video Streaming)
- Multimedia and critical infrastructure security (watermarking, real- time security, anomaly detection)
- Cloud computing/Edge Computing
- Internet of Thing
- Systems for AI

Course Logistics

- *Office Assistant:*
  - ☐ Kristin Irle (kirle@illinois.edu)
  - ☐ If you need to meet with me outside of office hours, please ask Kristin for an appointment. She has access to my calendar and will help you very fast.

- *Teaching Assistant: no TA*
  - ☐ Any questions you have, please, email
    - Instructor klara@illinois.edu with subject line "CS537

- *Class Time:* Tuesday and Thursday 12:30-1:45pm

- *Class Place: 1302 Siebel Center*

- *Zoom link will be available as well*

Course Logistics

- *Instructor Office Hours:*
  - **Time: Tuesday and Thursday 2:00-3:00pm CST**
    - UIUC on-campus in-person students (3104 SC or zoom)
  - **Time: Thursday 3:00-4:00pm CST**
    - Online students (zoom)
- *Class Website – Reading List will be posted on September 23, 2024*
- *Discussion, Announcements, and Postings:*
  - *Campuswire app (please, check that you received invitation, can access and post on campuswire app)*
- *Grading Center: Canvas*

Required Readings for CS 537

- **Lecturing**
  - August 27 – October 4
- **Papers in Reading List**
  - Papers will be posted on September 23
  - Students will sign up for papers to present during September 23-26
  - Presentations start October 8, 2024
- Class website
  - https://courses.grainger.illinois.edu/cs537/fa2024

Other Readings for CS 537

- ## *IoT Books and Papers*
    - *"Internet of Things and Big Data Analytics", Edited by P. Raj et al, CRC Press, 2020*
    - *"Analytics for the Internet of Things (IoT)", Andrew Minteer, Packt Publishing, 2017*
    - *…. Many conference and journal papers from ACM and IEEE professional orgs*
        - *ACM IOTDI (Internet of Things Design and Implementation)*
        - *ACM IPSN (Information Processing of Sensor Networks)*
        - *IEEE MASS (International Conference on Mobile Ad-Hoc and Smart Systems)*
        - *ACM/IEEE CPS-IOT Week, (other symposia)*
        - *ACM SEC (Symposium on Edge Computing)*
        - *ACM SenSys*
        - *Many conferences on cloud computing (e.g., ACM SoCC – Symposium on Cloud Computing)*

- ## *Multimedia/Immersive Computing Books and Papers*
    - *Media Coding and Content Processing*, Ralf Steinmetz, Klara Nahrstedt, Prentice Hall, 2002
    - *Multimedia Systems*, Ralf Steinmetz, Klara Nahrstedt, Springer Verlag, 2004 (online book free)
    - … many other conference and journal papers from ACM and IEEE professional orgs
        - ACM International Conference on Multimedia,
        - ACM MMSys (Multimedia Systems)
        - ACM ICMR, (International Conference on Multimedia Retrieval)
        - IEEE ICME (International Conference on Multimedia and Expo)
        - IEEE CVPR (International Conference on Computer Vision and Pattern Recognition)
        - IEEE ICASSP (International Conference on Acoustics, Speech, and Signal Processing)
        - ACM and IEEE TMM (Transactions on Multimedia)
        - ACM SIGGRAPH

Course Prerequisites

- It is helpful if you have taken at least one of these classes in your undergrad studies
  - CS 425 (distributed systems undergrad) and/or
  - CS 438 (networking systems undergrad)
  - CS 437 (Internet of Things systems undergrad)
  - 400-level computer vision class

Goal of the Course

- **Expand breath of knowledge** in the area of multi-modal IoT systems through
  - ☐ Learn new Multi-Modal IoT-specific system and networking concepts
  - ☐ Learn new mathematical and design tools to model and design complex systems that run multi-modal IoT systems
- **Learn scientific tools for your MS/PhD theses**
  - ☐ Learn how to evaluate scientific papers
  - ☐ Learn how to prepare and present a scientific work as lecture
  - ☐ Learn how to present related work
  - ☐ Learn how to prepare project proposal
  - ☐ Learn how to prepare project presentation and final project report

Class Format

- **Class will consist of partially**
  - ☐ lecturing by instructor, guest lecturer and
  - ☐ lecturing by students based on reading list
  - ☐ paper discussions
- **Students' responsibility**
  - ☐ Attend lectures
  - ☐ Read papers!!
  - ☐ Work on presentations, take-home midterm exam, project, lectures
  - ☐ Look for new material and post on campuswire when you find interesting papers, tools, other material to share

Workload (1)

Lecturing and Q&A

- Student presents paper(s) (1-2 papers) – depending on the size of class by September 24

- There will be a sign-up sheet to sign up for presentation(s)

■ Instructions regarding sign-up sheet and selection will be placed on *campuswire.*

■ Paper assignment will be on a **first-come-first- serve policy**

  - Student presents the papers synchronously

  - Instructor evaluates the lectures, and discussions

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Workload (2)

- Take-Home Midterm Exam
  - ☐ Questions will be asked from Lectured material and papers presented prior to exam
  - ☐ Problems will include material covered in papers and lectures to answer the midterm questions

Workload (3)

- Final project will include three parts:
- 1. project proposal
- 2. project presentation in class
- 3. project paper

Lecturing

- Each student needs to present paper(s)
  - Each student selects choice of papers in sign-up sheet
    - Details about sign-up sheet will be posted on campuswire
    - Selection of papers will be based on First Come First Serve
    - Assignments will be posted on the class website in the **Reading List**

- The **sign-up sheet** will open on September 23 and close on September 26, 2023

Lecture Format for Papers' Presentation

- Paper presentation should be **20** minutes maximum (depending on the class size)
- You should plan 1-2 minutes per slide, so having around 15-20 slides
  - ☐ Use simple strong contrast colors
  - ☐ Do not make the slide too busy
- **Post your slides on campuswire before lecture or send it to instructor**

Lecture Format (2)

- Your presentation should include
  - Motivation of the problem (why are we looking at this issue? What is the environment where the problem resides?)
  - Problem Description (What is the problem and what are the challenges of the problem?)
  - Background (How did other people solve this problem and why isn't this enough?)
  - Novel approach (solution described in the paper)
  - Validation of approach
  - Conclusion with Pros and Cons of Paper

Take-Home Midterm Exam

- **Midterm exam will be**
  - Posted on October 21 (Monday 11:59pm)
  - Due on October 28 (Monday 11:59pm)
- **Use lectures, web material and papers to find answers**
- **Submit midterm-exam solutions in pdf format to klara@illinois.edu, subject line: "CS537 – Midterm"**

Final Project (1)

- **Each student must work on a class project in multi-modal/IoT system/network area**
  - ☐ Consider continuation of your research projects if it has IoT context
  - ☐ Consider exploring new topic towards your research
  - ☐ Come and see instructor during office hours if you need suggestions for class project (or setup a meeting via Candice with the instructor)
  - ☐ You can work **alone**, or in **group of 2-3 students**
    - **Depending on the size of the project group, corresponding complexity of the project and clear division 'who does what' is required and expected.**

Final Project (2)

- The project should have research flavor (so no survey for final project)

- You are encouraged to
  - develop new data analytics algorithms, IoT protocols and/or IoT applications and/or
  - improve existing algorithm/protocol/ application
  - validate IoT approaches via comparative simulation or real implementation
  - run QoE experiments on IoT data
  - develop analysis tool for public IoT data
  - evaluate/measure existing multi-modal IoT system/tool
  - evaluate existing analytics tools on existing IoT data
  - …..

Project Proposal Format (1)

- Format:

  - ACM format, single column, font 11 Arial (or Times New Roman), pdf

  - Specify name, title, class number

  - Length: max 4 pages;

- Proposal: Introduction

  - Motivation and description of problem

    - explain why it is a problem
    - How did others solve the problem?
    - How do you plan to solve the problem?
    - What is broader impact of your solution?

Project Proposal Format (2)

- Proposal: Possible Approaches you consider to take

  - ☐ Picture of framework/architecture you want to explore

  - ☐ Algorithm you want to explore and compare/ improve

  - ☐ Experiment(s) you want to conduct

- Proposal: Action Plan

  - ☐ By when you want to do what?

- Proposal: References

  - ☐ Papers you want to read and use in your research (at least 3 references must be included – read related work before you propose a project)

Project Presentation and Report Formats

- **Presentation format** should be similar to the lecture format
  - Talk about your problem, challenges, solution and validation.
  - Conclude with lessons learned
- **Report format** should be written like a scientific conference/workshop paper in ACM format (available on web)
  - Read and review papers carefully

Project Deadlines

- **Project Proposal**: October 8 (Tuesday), 11:59pm
  - ☐ Submit to klara@Illinois.edu
  - ☐ Subject: cs537: Project proposal
- Meet with Instructor for **Project Proposal feedback**:
  - ☐ October 10, 2-4 pm (Office Hours)
  - ☐ October 11: 2-4 pm
  - ☐ October 15: 2-4 pm
  - ☐ Sign-up sheet will be provided

Project Deadlines

- **Project Presentations**:
  - At the end of the semester
  - Based on the number of projects, we will have either a poster session or individual presentations
  - Sign-up sheets will be provided if individual presentations

Project Deadlines

- **Final Project Report** Deadline: December 18, 11:59pm (Wednesday)

- Depending on the size of the project group
  - □ 1 person project: min **6 pages** – double column ACM Format paper (with references, pictures, tables)

  - □ 2 person project: min **8 pages** – double column ACM Format paper (with references, pictures, tables)

  - □ 3 person project: min **10 pages** – double column ACM Format (with references, pictures, tables)

Facilities and Equipment

- Engineering workstations-linux machines
- Use laptop cameras or mobile-phones cameras
- Software: gstreamer, ffmpeg, GPAC, kvazaar (HEVC encoder), MATLAB, Jupyter Notebook, Phyton, Graphana, MQTT (and other pub/sub systems), other IoT and vision software packages
- Data: papers point to various data sources or ask instructor for dataset pointers
- If you have any further questions regarding the software, please, contact instructor
  - □ More software can be installed based on project demands – email for help to engrit-help@illinois.edu (and instructor)

Grading

- **Take-Home Midterm Exam**: 35 %

- **Paper(s) Presentation** : 15 %

- **Final Project** : 50%

  - □ Project Proposal (5%)

  - □ Project Poster or Presentation (15%)

  - □ Project Final Report (30%)

Grading policy

- Gradebook system: canvas
- It is your responsibility to **check** *announcements* in
  - Lectures
  - Campuswire – postings and lecture/paper presentation slides
  - Class website
  - Media space – lectures will be recorded and posted on media space
  - Canvas grade book

Re-grading policy

- Students have 1 week (after the grade is released into the gradebook) to request for re-grading

- Re-grading requests need to be in writing to the instructor

- After the re-grading period, no re-grading request will be granted.

Summary

- Lectures: August 27-October 4
- Paper Selection: September 23-26
- Paper Presentations start: October 8
- Project Proposal Deadline: October 8
- Project Proposal Feedback: meet with instructor
  - October 10, 2-4 pm (Office Hours)
  - October 11: 2-4 pm (extra time)
  - October 15: 2-4 pm (Office Hours)
- Take-Home Exam: October 21-28
- Project Presentations: end of semester (TBD)
- Project Reports: December 18

- Any questions you may have, please, email klara@illinois.edu

- **Have a great semester Fall 2024!**