CS 492
Overview of CS Research Areas

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Agenda

- Some of the areas of CS research and some important current problems in those areas

High-Level Areas

- AI, Machine Learning, and Data Science
- Systems and Networking
- High-Performance and Parallel Computing
- CS Theory
- Programming Languages and Compilers
- Security and Privacy
- CS + X

Where Research Goes

- In CS: most strive to publish their work at peer-reviewed conference proceedings
- Also peer-reviewed journals (less lucrative in CS, more common in physical sciences)
- Sometimes non-peer reviewed places, e.g. Tech Reports, open articles, blogs, or arXiv

AI and ML

- Sub-areas:
  - Natural Language Processing and Machine Translation
  - Computer Vision
  - Automated Decision Making and Reasoning
  - Social Network Analysis
  - Deep Learning
  - Reinforcement Learning
  - Planning
  - Optimization
  - Learning Theory
  - Fairness, Privacy, and Transparency

Problems in AI, ML, and DS

- How to build (and understand) intelligent machines
  - That have same capabilities of human intelligence: strong AI
  - That will help make our lives better: increase pattern matching, insight abilities of machines
- How to help machines make insights on large amounts of data?
- How to help machines effectively interact with and understand humans? e.g. Natural language processing, knowledge representation, automated reasoning, problem solving
- How to help machines understand the world and interpret data? e.g. computer vision, knowledge representation, etc.
- How to make sure they AI makes positive (and ethical) impact on humanity
- How to make intelligent machines efficient?
- Transparent machine learning: how do we understand *why* and *how* a machine did what it did?
- Are thinking machines conscious? How is our brain different? Philosophy of mind

Where to look for papers

- Top Conferences: NeurIPS, ICML, AAAI, KDD, ICLR
- More specialized:
  - CVPR, ICCV: computer vision
  - COLT: learning theory

Systems and Networking

- Sub-areas:
  - Computer architecture
  - Operating systems
  - Databases
  - Compilers
  - Networks and Wireless
  - Distributed Systems
  - Virtualization
  - Systems Performance and Analysis
  - Sensor Networks
  - Embedded Systems

Where to look for papers

- **Databases**: SIGMOD, VLDB, SIGKDD, ICDE
- **Computer Architecture**: ISCA, MICRO, ASPLOS, HPCA, DAC
- **OS**: SOSP, OSDI, EuroSys, HotOS, USENIX ATC, HPDC, ASPLOS
- **Networking**: SIGCOMM, NSDI, INFOCOMM
- **Mobile**: MobiSys, HotMobile
- **Cross-layer**: ASPLOS
- **Compilers**: CGO, PACT, CC

HPC: think “supercomputers”

- Sub-areas
  - Parallel and HPC computer architectures
  - OS for HPC
  - Technical, scientific computing, numerical codes (“applications”)
  - High-performance networks
  - High-performance storage and IO
  - Data analytics, visualization
  - Programming systems

HPC: Where to look for papers

- SC (supercomputing conference): all-around big conference
- HPDC: focus on systems
- PACT: parallel architectures and compilers
- IPDPS
- ICS (Int'l Conference on Supercomputing)
- IEEE Cluster
- HiPC

Programming Languages

- Sub-areas
  - PL theory
  - Type systems
  - Interactive programming
  - Program synthesis
  - PL design
  - Program Verification
  - Concurrent, Distributed, and Parallel programming languages
  - Debugging
  - Logic and Semantics

PL: Where to look for papers

- PLDI
- OOPSLA
- PPoPP
- POPL
- ICFP
- CGO
- ASPLOS

Theory

- Sub-areas:
  - Algorithms
  - Complexity
  - Data Structures
  - Theory of Computation
  - Theory of ML
  - Game Theory
  - Computational Economics (auctions, etc.)

Theory: Where to look for papers

- STOC: Theory of Computing
- EC: (Economics and Computation)
- SODA: Algorithms
- SPAA: Parallel Algorithms
- COLT: ML theory
- FOCS: broadly CS theory

Security and Privacy

- Sub-areas:
  - Attacks
  - Threat Intelligence
  - Binary Analysis
  - Fuzzing
  - Malware Analysis
  - Systems security
  - Privacy
  - Security for X

S&P: Where to look for papers

- CCS: general security
- IEEE S&P: general security and privacy
- USENIX Security: general security
- NDSS: distributed systems security

CS+X

- Computational Biology
- Computational Social Science
- Computational Physics
- Computational Chemistry
- Computational Economics
- Computational Neuroscience
- …see the trend?