

New Course Proposal
Department of Computer Science and Engineering
Indian Institute of Technology, Kanpur

Course number: CS888

Course title: Introduction to Profession and Communication

Prerequisites: None

Credits: [6] (2-0-0-0) (S/X mode)

Course duration: Full semester

Course type: PG Department Compulsory

Proposing Instructor: Convener DPGC, Department of Computer Science and Engineering

Other faculty members interested in teaching the course: all CSE faculty members

Other departments interested in the proposed course: None

Course description:

- a. *Objectives:* The course will skill students on effective research communication as well as introduce them to some commonly used research methodologies and paper-writing techniques used in various sub-areas of computer science including theory, systems and data science.
- b. *Logistics:* The course will be offered once every academic year by a team of 4 faculty members, one of whom will assume the position of instructor-in-charge and the other three members representing the areas of theory, systems and data science. All PhD students will be required to register for this course in their second year.
- c. *Content:* The course will have 5 parts
 - i. **Part 1 (Communication):** students will be introduced to effective research communication. Specifically, the students will be given general guidelines on preparing posters and oral presentations and writing a research paper. The students may be asked to prepare a short poster, presentation and write-up followed by a discussion on these topics that highlight general communication guidelines such as grammatical correctness, precision, effective use of images and the importance of legible figures, organization, flow of argument, pace of presentation, and others.
 - ii. **Part 2 (Research Methodology and Paper writing in Theory):** introduction to proof techniques (deduction, induction, contrapositive, contradiction, diagonalization) with some examples, power of randomization in algorithm design, notions of intractability, and how hardness can be a boon. The difference between Conjecture, Axiom, Hypothesis and Theorem; The difference between an efficient algorithm and an efficient heuristic. How to survey the literature, do research, and prove something new and publication-worthy. How to structure a theory paper and make it readable for non-experts.
 - iii. **Part 3 (Research Methodology and Paper writing in Systems):** Overview of different dimensions of system research:
 - A. *Problem formulation* – Building/evolving hypotheses and problem statements, motivating problems and proposed solution ideas.
 - B. *Empirical analysis* – experiment design, analysis, reporting, tools and techniques

- C. *Design and implementation* – Root cause analysis and development involving existing systems, tools and techniques for navigating large code bases, integration of proposed ideas, checking correctness, bug fixing approaches and tools.
- iv. **Part 4 (Research Methodology and Paper writing in Data Science):** Much of the theoretical and empirical aspects of data science are already covered in the earlier two parts. This part will additionally introduce students to more specialized aspects relevant for data science research pipelines such as:
 - A. Typical research design: problem definition, mathematical solution, algorithmic implementation, evaluation.
 - B. Considerations for evaluation: cross-validation, leaderboards, data leakage, hypothesis testing, dataset decay.
- v. **Part 5 (Hands-on Application):** This part will require students to prepare an extended abstract (around 4 pages) for a research paper.
- d. *Evaluation:* An S/X grade will be awarded based on satisfactory completion of assignments and preparation of an extended abstract for a research paper.

Tentative breakup of Lectures: Topics in the course may be shifted across parts as deemed fit by the instructors. For each of the first four parts, assignments would be provided to help students appreciate research methodologies and communication skills. For instance, the 1st lecture of the week may conclude with an assignment, and the 2nd lecture of the week may focus on discussing that assignment. A suggestive breakup of lectures for each part is given below with parts 1 and 5 being overseen by the instructor in-charge and the rest being overseen by instructors representing the areas of theory, systems, and data science.

- Part 1: Week 1-3 (6 Lectures)
- Part 2: Week 4-6 (6 Lectures)
- Part 3: Week 7-9 (6 Lectures)
- Part 4: Week 10-11 (4 Lectures)
- Part 5: Week 12-13 (4 Lectures)

Short summary for inclusion in the Courses of Study booklet: the course is intended to introduce CSE PhD students to effective research communication and common research methodologies and paper-writing techniques used in theory, systems, and data science.

Reference texts: None

Course proposer: Convener DPGC, Department of CSE

Date:

Convener DPGC

Date:

The course is approved / not approved

Chairman, SPGC

Date: