

Research and Development @ CSE, IITB

Varsha Apte, Faculty@CSE-IITB (Currently, Head)

ACM ROCS 2024

Feb 24th, 2024



Essential Stats

46 Faculty Members



1000+ Students



100 Staff Members



**85400 Square feet
of Space Across two buildings**



Research Areas

Three major *streams*-:

Intelligent Systems

Computing Systems

Theory

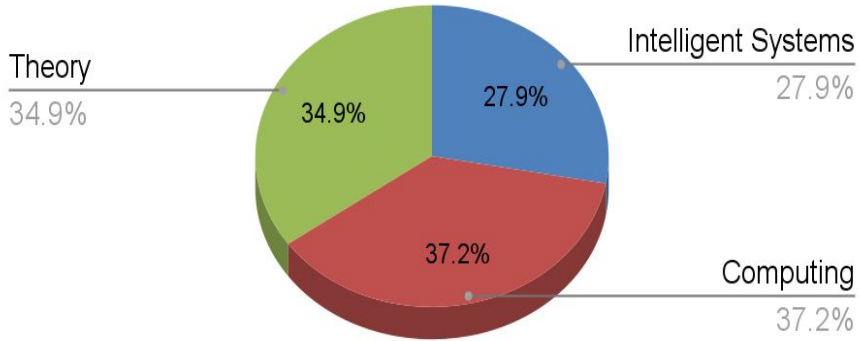
Research area spanning different streams.

1. NLP: Speech, Text
2. Representation, Learning, Agents
3. Visual Computing (Graphics/Image/Vision)
4. Computer Networks, Systems software and Computer Architecture
5. Compilers, programming languages, Software engineering
6. Algorithms, Complexity
7. Formal methods
8. Computing for Development
9. Digital Trust

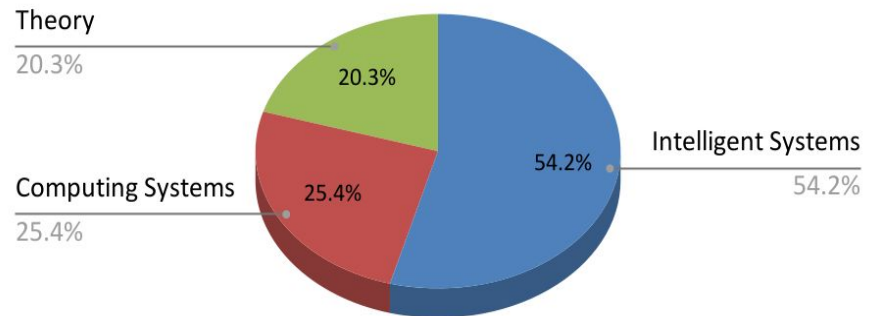


Strengths (Numbers, Distribution) Stream wise

Faculty Distribution by Streams



Ph.D. students distribution by Stream



Research is about
asking questions -
Why? What? How?
When? Which?
Where? Can ?

Let's see **some examples**
of the questions CSE
Faculty and Students are
asking

Join us for answers !



Example 1: Digital Trust

Amar, Akbar, Anthony want to buy a car which is for Rs 10L. They want to know whether together they have the total amount of money, without revealing how much each one of them has. Can this be done? How?

Secure Multi-Party Computation (SMPC) : two or more parties would like to jointly compute a function F on their inputs, while keeping these inputs private

mpC: first-of-its-kind protocol description language, with unique features (e.g., protocol transformations) tailor-made for MPC protocol constructions from literature



Theoretical Computer Science

Example 2:

Formal Methods

Can a protocol developed for SMPC be *formally verified*?

I.e. Can we *prove* its correctness using formal mathematical methods?

Example 3:

Complexity Analysis

What's the computational complexity of a given SMPC? Can it be made more efficient?



Computing Systems

Examples 4,5,6,7

Computer Architecture

Can we cleverly prefetch *critical* data (data that can result in processing stalls) from low-bandwidth DRAMs in many-core systems?

Compilers

Can we make Just-In-Time compiling more efficient by reusing compiled code from a previous run?

OS/Virtualization

How can we make container migrations use less CPU?

Networks

Can we optimize 5G software components so that data throughput is at almost 'line rate'?



Computing for Development

Example 8:

Computing for Climate Resilience in Agriculture

Can we predict how vulnerable a farm is to a dry spell, based on geo-spatial and other data ?

Example 9:

Transport Planning

Can we improve MSRTC services using prior data and geospatial data?



AI/ML, Speech/NLP and Visual Computing

Example 10 :

Medical Imaging

Can we segment objects in a medical image with less supervision?

Example 11:

Speech Recognition

How can we recognized 'code switched' speech (e.g. Hinglish) while not having enough data?

Example 12:

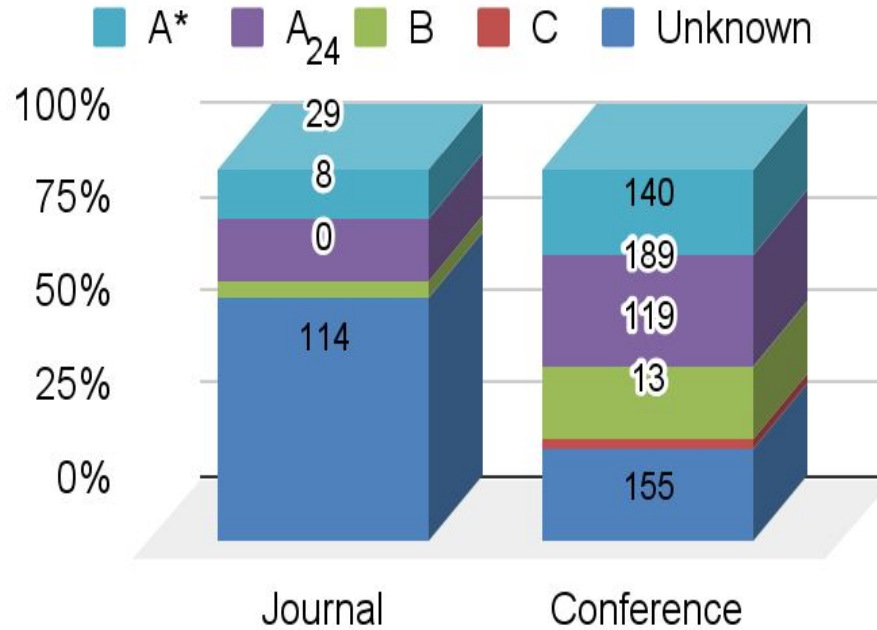
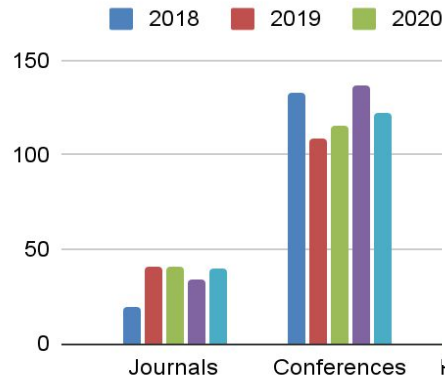
Transport Planning

Can we use reinforcement learning techniques for scheduling trains so as to reduce delays ?



One Result of all this work: Publications

Published Papers



Another Result: Translational Research/Products

Many products released for use, some examples-

- SAFE quiz app
- Video Analytics AI solutions for Safety and Compliance applications
- End-to-end document translation framework
- 5G core components technology
- SDN router

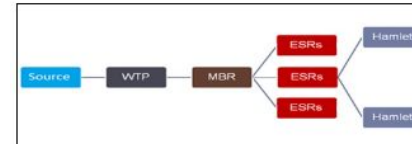
Description



Jaltantra - water distribution planning software used in 15+ states

Above is a Google Earth image of tanker fed villages in the Mokhada taluka of Thane. We would like to design a piped water network to alleviate their water problems. A typical multi village design consists of the following components:

Source
MBR (Mass Balancing Reservoir)
WTP (Water Treatment Plant)
ESR (Elevated Storage Reservoirs)
Demand points
Pipes connecting all of the above
Pumps
Valves



Designing a particular scheme means locating and sizing each of the above components.

Which source do we use?

Where do we place our ESRs in terms of location as well as elevation.

What should be its capacity?

What should be the diameter of the pipes?

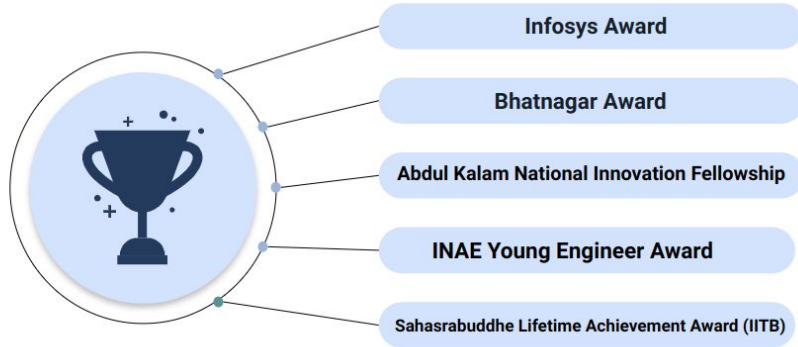
The aim of the design is to satisfy the water demand of each village and at the same time minimize capex. Therefore the questions have to be answered in light of that objective.

In the first iteration of our system, we attempt to optimize the pipe diameters given the location and der. We have now also integrated ESR selection (location, height, capacity as well as which nodes it serves)

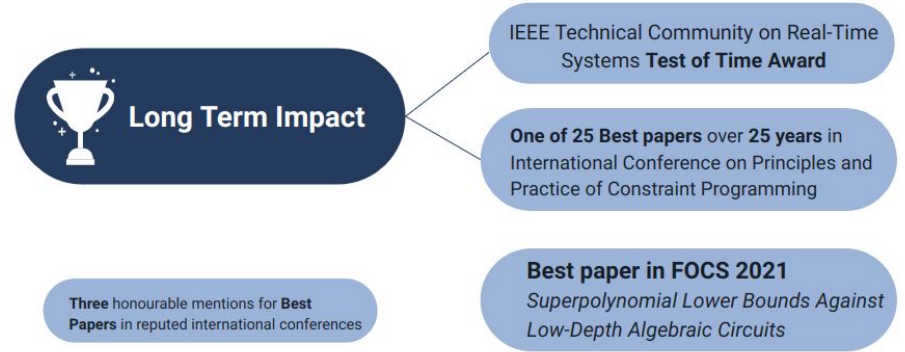


Honours for Faculty

Accolades for Faculty - Individual Awards



Accolades for Faculty - Awards For Research Work



Accolades for Faculty - Impactful R&D Work

National and international accolades for work done for solving pressing development problems



Triennial IFORS Prize for Operations Research in Development, given by the International Federation of Operational Research Societies



Daniel. H. Wagner Prize for Excellence in the Practice of Advanced Analytics and Operations Research, given by the Institute for Operations Research and the Management Sciences (INFORMS).



National E-Governance Gold Award

More Awards and Recognition For Our Faculty

1 Faculty member became a **Distinguished Member** of the **ACM**.

1 Faculty member received the **Krithi Ramamritham Award**

2 projects received **D. K. Patwardhan Technology development awards**

2 faculty members received the **IIT Bombay Research Publication Award**

3 faculty members received **Impactful Research awards** from IIT Bombay

3 faculty members received the **IIT Bombay H. H. Mathur Research Excellence Award**

4 faculty members received the **Distinguished Alumnus award** from their alma mater

5 faculty members became **Fellows** of prestigious professional

6 faculty members were awarded **Chair Professorships**

13 **Industry lab fellowship awards** received by the faculty members.

Major Funded Labs

IITB TRUST LAB

DIGITAL : SECURE : RESPONSIBLE

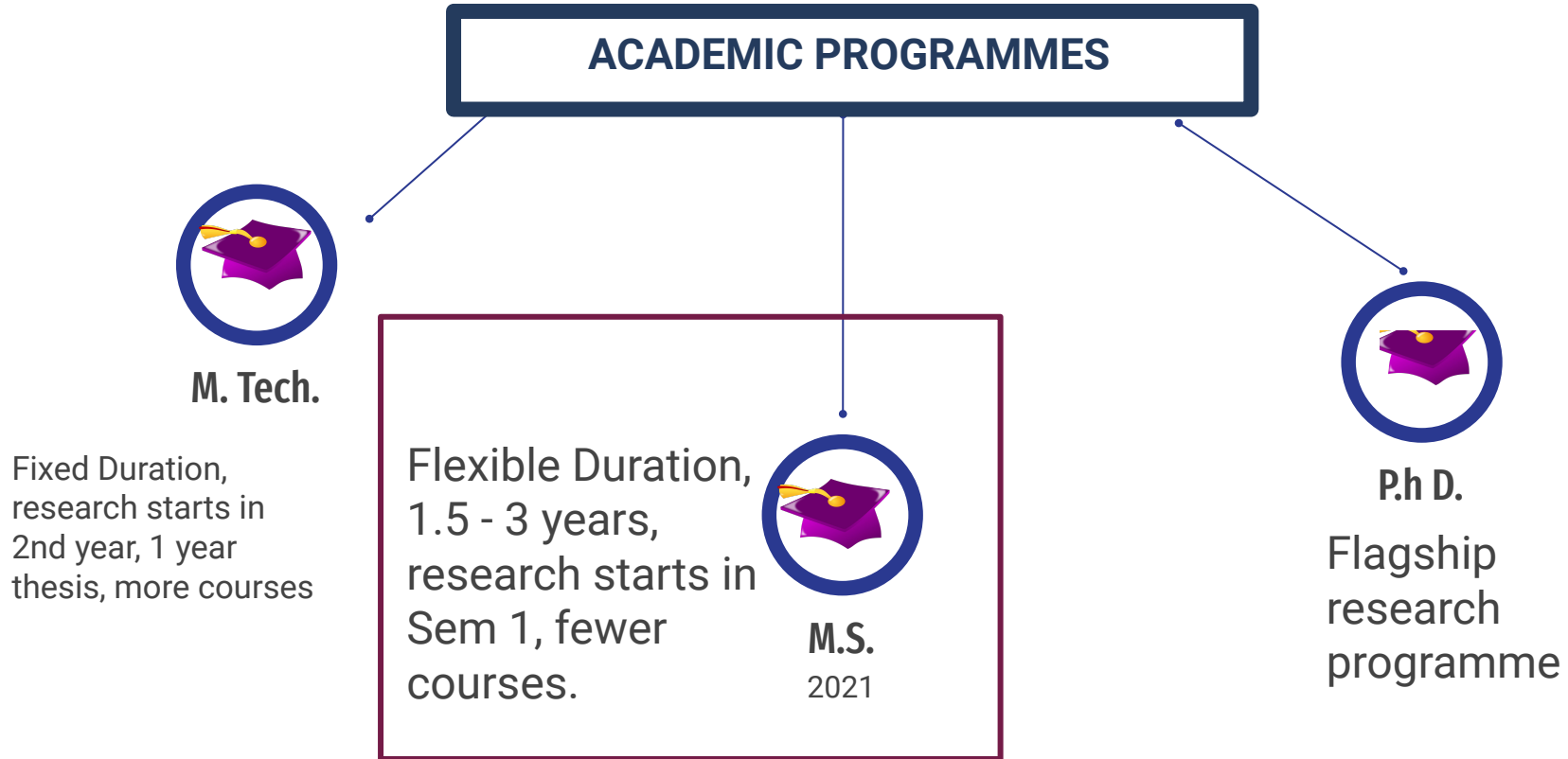
Launched In September 2022, with a donation of about Rs **30 crore** by **IITB-EE alumnus Dr. Shridhar Shukla**, with the vision to “**be a leading contributor to the enterprise of making our digital environment trustworthy**”.

GISE | Geospatial Information
HUB | Science & Engineering

A Rs **33 crore** DST funded activity: an interdisciplinary hub with the objective to be a **centre of excellence in geospatial data management and applications**.



Academic Programmes for Research in the CSE Department



Accolades for Students - Research



Winners of the **ACM India Doctoral Dissertation Award 2022**



Honourable Mention in **ACM Dissertation 2020**



Runner-up for **Beth Outstanding Dissertation Award**



Winners and runner-up at the **NeurIPS Reconnaissance Blind Chess Tournament** in 2021 and 2022 respectively.



Various **Best Paper** awards at conferences



12 PhD students received **Prime Minister's Research Fellowship** and **6** received **industry lab** and other government fellowships

Fellowships with stipends ranging from Rs 60K - Rs 1L per month for outstanding students!



Facilities

- Two buildings: **Kanwal Rekhi (KR) Building** (30K sq ft) and the **Computing Complex (CC, 50K sq ft)**
- **R&D workspace**
 - 16 R&D labs, 451 seats (current need: 260), ~34K sq feet area
- **Computing**
 - Each Research student gets dedicated desk space and desktop
 - Servers, High Speed LAN, WiFi



Other Facilities



Faculty and RS lounge



A library and a 'common room' with WiFi

Both buildings have **wheelchair access**



ROCS is the trailer

See the movie **two weeks from now,**
same place, same time!

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at IIT Bombay presents



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Department of Computer Science and Engineering
Indian Institute of Technology Bombay,
Powai, Mumbai 400076
Main office : Kanwal Rekhi Building.



Post Graduate Admissions ~~2023-2024~~ 2024-25
coming soon

Introduction

The CSE department at IIT Bombay offers three postgraduate programmes for the information and communication technologies in India. In the long run, our contribution to the field of services, but by the quality of intellectual property we produce, capital is our most valuable asset. If you aspire to distinguish a leading role in transforming the industry through research, a degree in computer science and engineering is essential. Please refer to the following for details on the admissions process of each programme.

1. **Ph.D. admissions**
2. **M.S. by research admissions**
3. **M.Tech. admissions**

The admission to M.Tech. and MS by research is held online and is held in May and December.

Please direct all queries related to cutoffs, shortlisting criteria, hostel accommodation, and certificate submissions for admission to pgadm@iitb.ac.in. If there is any query specific to CSE interviews/test processes, please contact pgadm@cse.iitb.ac.in.

The entire admissions process is **OFFLINE**, except for foreign applicants.

PG admissions at CSE, IITB will start soon, watch this space for more details!

www.cse.iitb.ac.in/admission/pg.php

Follow us on X, LinkedIn and YouTube

Thank You
Hope to see many
of you as research
students here in
July 2024 :)