Computer Networks
COL 334/672

Lec 41

Tarun Mangla

Sem 1, 2024-25

Agenda

- Quiz
- Research
- Course Next Semester
- Course feedback

Quiz: Bringing it all together?

Instruction:

- Attempt in groups of 4
- No mobile/laptops

Explain what happens when you type www.google.com into your browser and press enter when connected on IITD WiFi network?

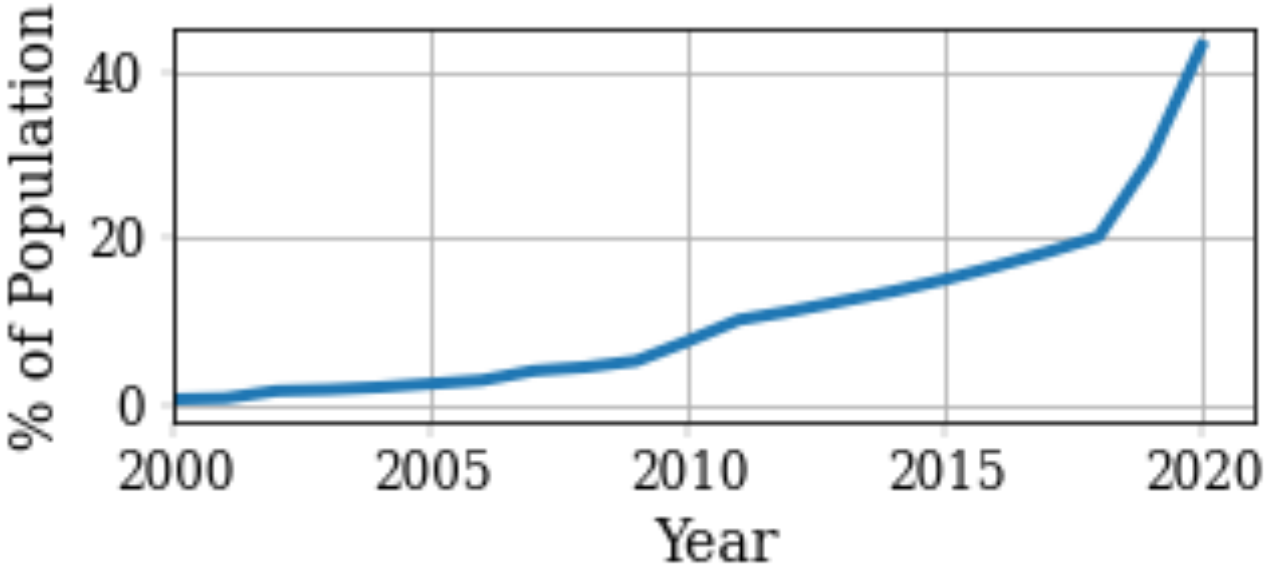
- You should trace the flow of information across various steps in time as well in the network stack
- Be systematic and coherent
- Relative grading ☺

Agenda

- Quiz
- **Research**
- Course Next Semester
- Course feedback

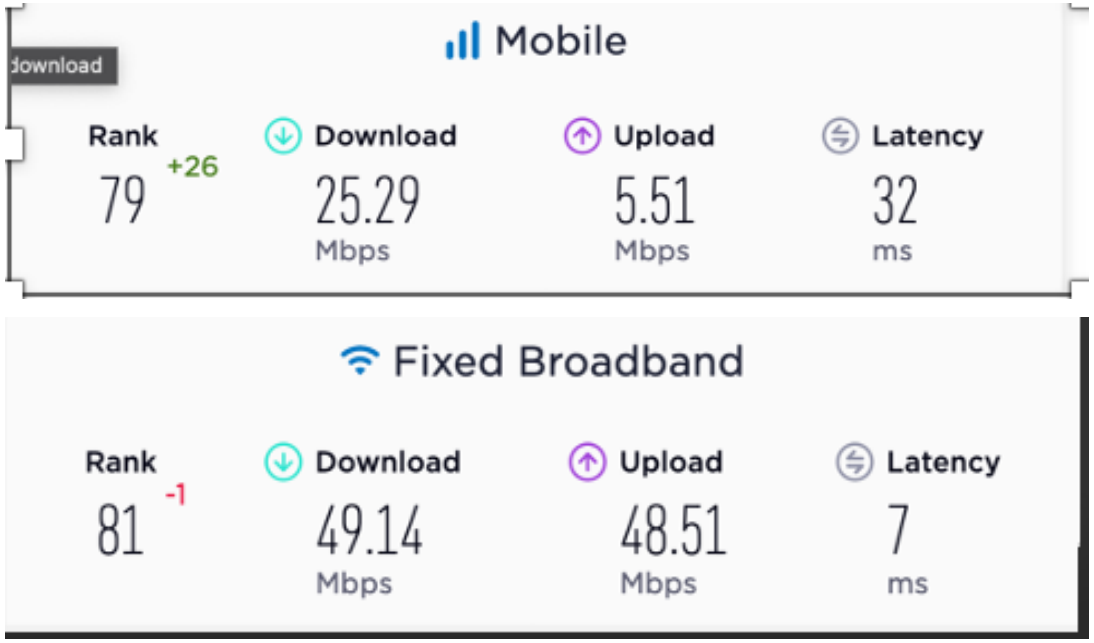
Vision: High-quality, Low-cost Internet for All

Internet Access in India



Source: World Bank

Median Internet Speeds in India



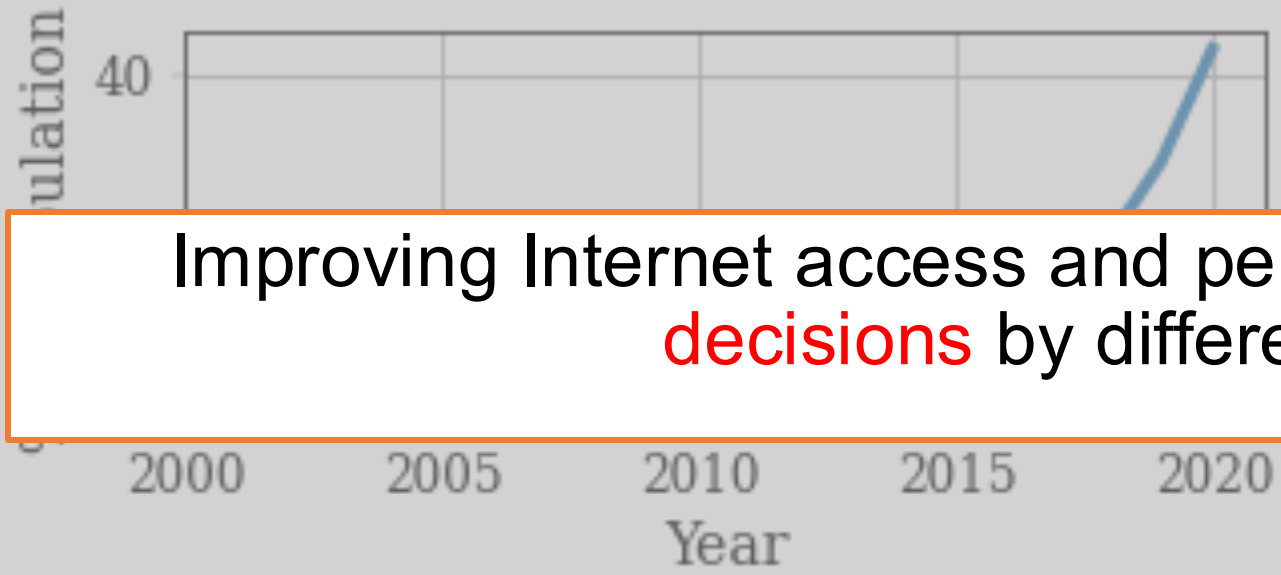
Source: Ookla

43% → 100%

Improve Internet performance

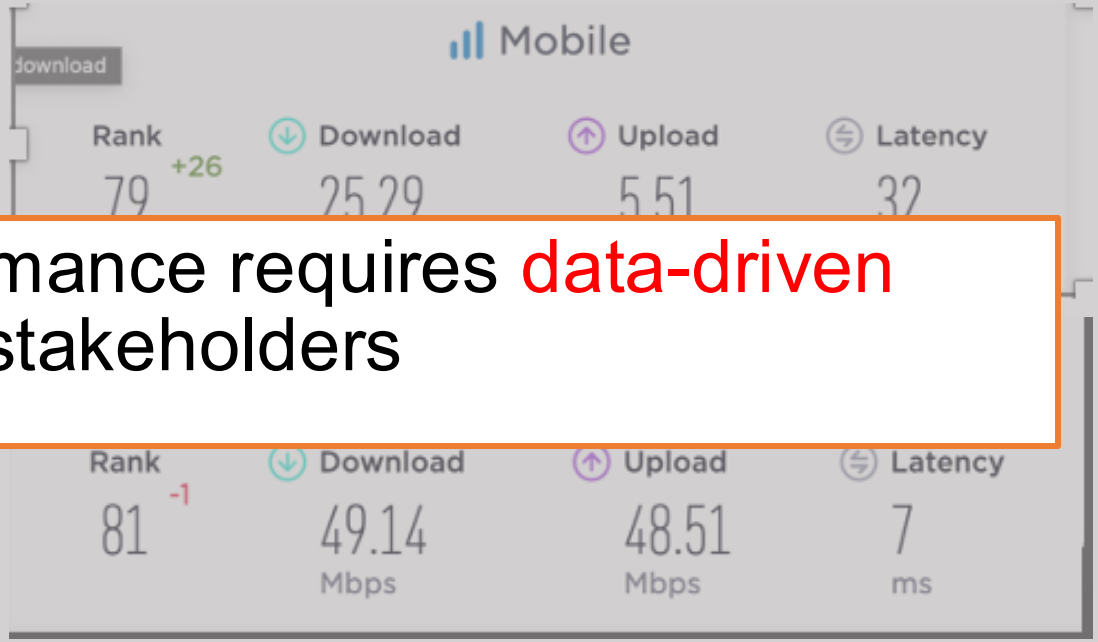
Vision: High-quality, Low-cost Internet for All

Internet Access in India



Source: World Bank

Median Internet Speeds in India



Source: Ookla

Improving Internet access and performance requires data-driven decisions by different stakeholders

43% → 100%

Improve Internet performance

Ongoing Work

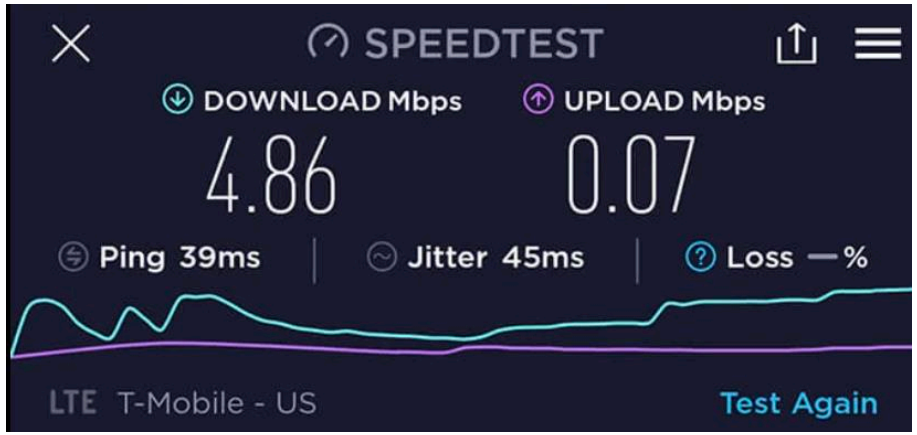
Goal: Build measurement systems and methods to improve Internet access and performance

Specific Problems

- Map and Mitigate Internet Inequity
- Enable automated network management using machine learning
- Improving application design

Mapping and Mitigating Internet Inequity

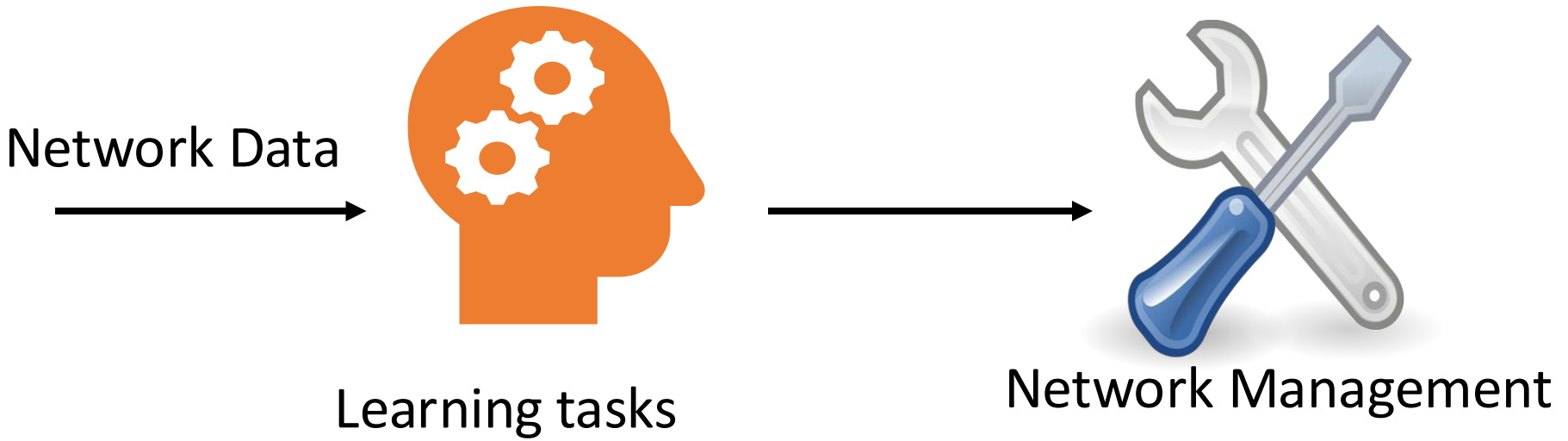
Holistically measure different dimensions of Internet access



Measuring cellular network performance in India*
[In collab with IITB, IIITD, and IITKGP]

Improving measurement tools such as speedtest

Using ML for Automated Network Management



Design ML methods for specific learning tasks:

- Application classification
- QoE inference
- Intrusion detection

General purpose data collection pipelines and ML models

Application design

Measure and improve network dynamics of different networked applications

Digital payment apps

Understanding network dynamics of digital payment applications

Video streaming performance and smart TVs

Agenda

- Quiz
- Research
- **Next Semester Course**
- Course feedback

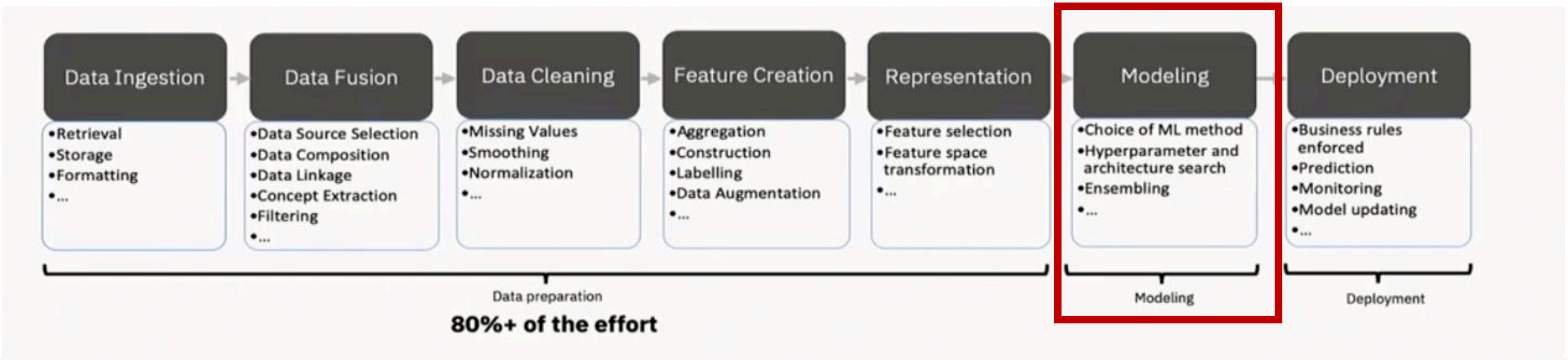
Next Semester Course

COL867: Special Topics for Networks
Machine Learning for Networks

Machine Learning (ML) for Networking

- Machine learning (ML) wave everywhere
- Internet is no exception!
- As a networking researcher/engineer, I want to understand how ML can be used to make networks more fast, secure, efficient ..
- Easy-peasy: Take an ML course, right?
- But ..

Existing ML Course Geared Towards ML Researcher



Data preparation:

- **Affects the final predictive accuracy** -- generally *more* than the modeling step does!
- Like modeling, also *contains parameters* which **should be tuned**
- **80%+ of the effort** in a data project is in data preparation (some say 90%+)
- Not treated in textbooks: left as black art → gives rise to **many conceptual errors** in practice -- *most* errors in data science happen in data preparation

Learning Objectives

- **Learning problems in networking**
  - Identify different learning problems in networking that enhance network security, efficiency, and performance
  - Explore the role of ML in solving these learning problems

- **ML pipelines (for networking)**
  - Understand the stages of ML pipelines including data collection, data representation, model evaluation
  - Learning strategies to develop ML models that are robust, explainable, and performant
  - All within a networking context but can be applied to other domains

Syllabus from Last Year

We will first study ML solutions proposed for specific network tasks.

- Module 1: Traffic Classification
- Module 2: Resource Allocation
- Module 3: Application Performance Estimaton
- Module 4: Security

Next we will delve into the task-agnostic ML pipelines for networking.

- Module 5: Data Collection
- Module 6: Data Representation
- Module 7: Evaluation
- Module 8: Explainability
- Module 9: Synthetic Data Generation

Attendance

Course Feedback

https://forms.gle/NbjmbsFWVZX94LrC9