Welcome

CS771: Introduction to Machine Learning

Purushottam Kar

Course Details

Name: CS771 Introduction to Machine Learning

Lectures: Mon, Wed, Fri, 6:30-7:30 PM RM101

Course Team: wait for next slide

Course Website: https://tinyurl.com/ml19-20ww

Piazza Website: https://tinyurl.com/ml19-20wp (Enroll yourself!)

Office hours: uploaded on Piazza
https://piazza.com/iitk.ac.in/secondsemester2020/cs771/staff

Course Team

Soumya Banerjee (soumyab)
Incremental Learning, Computer Vision, Machine Learning

Amit Chandak (amitch)
Decremental Learning, Bayesian Optimization, Representational Learning on Graphs

Debojyoti Dey (debojyot)
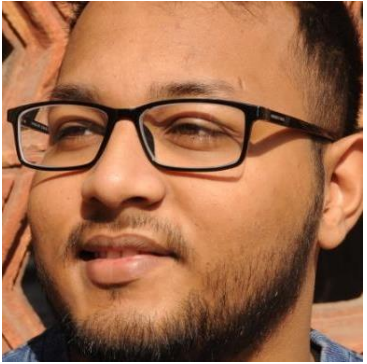Optimization, Bayesian machine learning, Markov Chains, Dynamical systems

Nitish Mangesh Kalan (nitismk)
Reinforcement Learning, Computer Vision

ALL EMAIL IDS ARE @CSE.IITK.AC.IN

Course Team

Jimmy Kumar (jimmy)
Extreme Classification, Recommendation Systems, Bayesian Inference

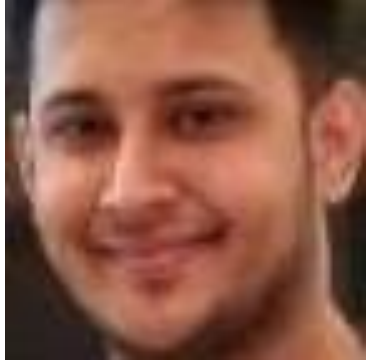**Neeraj Matiyali (neermat)**
Computer Vision

Bhaskar Pratim Mukhoty (bhaskarm)
Robust Learning, Security in ML, Time-series forecasting

Shailesh Vishweshwar Nandkule (nandkule)
Recommendation Systems, Reinforcement Learning

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Course Team

Avijit Roy (avijit)
Deep Learning, Computer Vision

Saiteja Utpala (sait)
Probabilistic ML

Purushottam "Puru" Kar (purushot)
ML in Education, Extreme Classification, Robust Learning

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Auditors

Please enrol yourself on Piazza (there is no separate mailing list)

Auditors will have access to several aspects of the course

Lectures and lecture material

Discussion forum activities

Assignment, quiz and examination questions and solutions

We regret our inability to extend the following services

Submit assignments and receive graded submissions

Appear for quizzes, examinations and receive graded answer scripts

Grading Scheme

Quizzes – 20%

Mini-projects – 30%

Mid-semester Exam – 20%

End-semester Exam – 30%

Quizzes – 20%

Two (2) quizzes to be conducted – each worth 10%

Jan 22 (Wed), Mar 25 (Wed)

Quizzes will be held in a separate lecture hall (L20) – details later

Only registered students will be allowed to appear for quizzes

Syllabus for each quiz will cover roughly 8-10 lectures – short quiz

If you are regular with lectures, practice problems, then you should not have to prepare excessively for these quizzes

Mini-projects (assignments) – 30%

Three (3) mini projects to be done (weightages to be decided)
  Replaces the single monolith project in previous offerings of CS771

Mini-projects to be done in groups of five (5) students each

Start forming your group today
  Will ask you to submit group details once add-drop is over
  Groups can only contain registered students (no auditors)

Will have 1-2 weeks to finish each mini-project

Submission will include code + report

Code should be in Python – start learning Python today

Report must be in LaTeX – start learning LaTeX today

Reference Material

No single textbook for the course

Lecture slides, course notes will be uploaded onto course website

List of reference material is already up on course website

Python Resources: several available – choose your favourite
www.geeksforgeeks.org/python-programming-language/

LaTeX resources: several available – choose your favourite
www.sharelatex.com/blog/latex-guides/beginners-tutorial.html
www.overleaf.com/learn/latex/Tutorials

Course Website

Detailed syllabus for this course

Course calendar : schedule for holidays, exams, quizzes

Course policies: assessment, course drop, make-up

Use of unfair means

Course etiquettes

To Do for You

Registered Students

    Register yourself on Piazza

    Start forming groups of five (5) students – do not wait long
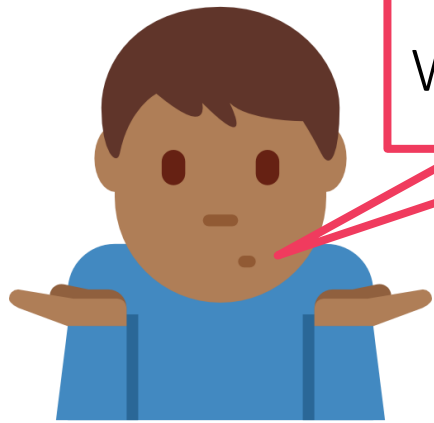
Auditors

    Register yourself on Piazza

Everybody

    Refresh your calculus, probability theory, linear algebra basics
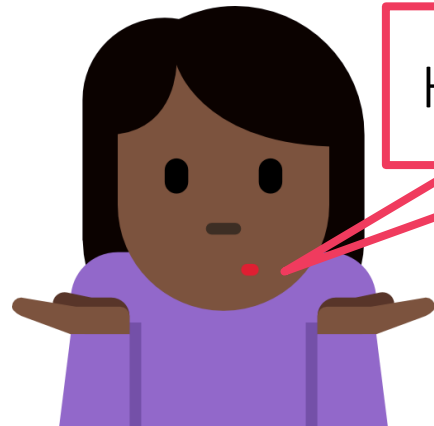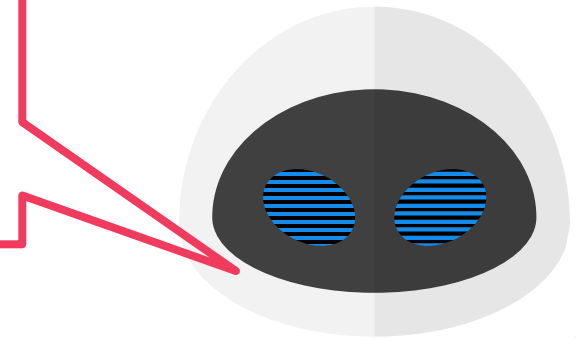
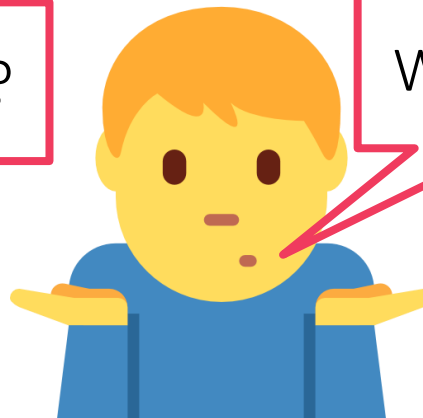   Start learning Python and LaTeX

What is Machine Learning

Why is it needed?

Hi, I am Ms. M and I will accompany you as you learn about ML
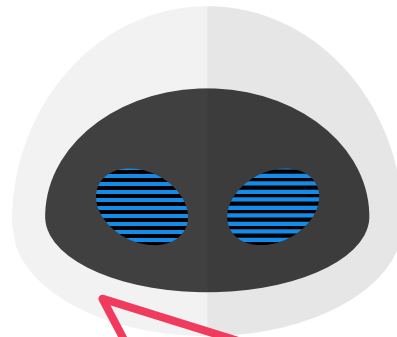
How is it done?

What is it?

Machine Learning

" The art and science of designing adaptive algorithms "

A Non-adaptive Algorithm

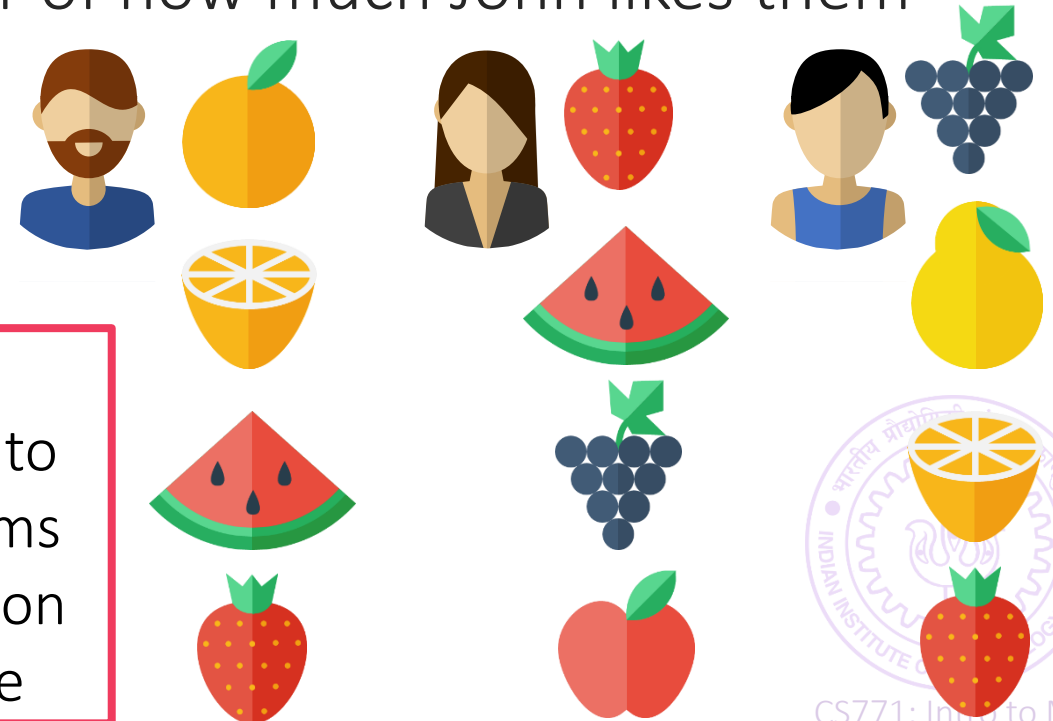**Sorting**: given n numbers, sort them in decreasing order of their value

4	9
1	7
5	5
9	4
3	3
7	2
2	1

5	5
-6	4
4	1
-3	0
-2	-2
1	-3
0	-6

An Adaptive Algorithm

Recommendation: given a person John and n items, sort items in decreasing order of how much John likes them

I can help you learn patterns that allow you to sort the same set of items differently for each person according to their taste

Machine Learning

" The art and science of designing adaptive algorithms "

Subject: [all] New Pizza Counter at New SAC
From: "DOSA" <dosa@iitk.ac.in>
Date: Wed, October 28, 2015 10:07 am
To: all@lists.iitk.ac.in
Cc: dosa@iitk.ac.in (more)
Priority: Normal
Options: View Full Header | View Printable Version | Download this as a file

Subject: [all] Lost and Found
From: "DOSA" <dosa@iitk.ac.in>
Date: Wed, October 28, 2015 10:07 am
To: all@lists.iitk.ac.in
Cc: dosa@iitk.ac.in (more)
Priority: Normal
Options: View Full Header | View Printable Version | Download this as a file

Machine Learning

" The art and science of designing adaptive algorithms "

When to apply ML

Complexity: no "closed form" solutions

    Humans cannot specify simple rules to get solution

    Detecting spelling mistakes not a good ML problem

    A simple dictionary lookup (binary search) is enough

Presence of immense variety

    Too many variants to be solved independently

    Correcting spelling mistakes a very good ML problem

Need for automation
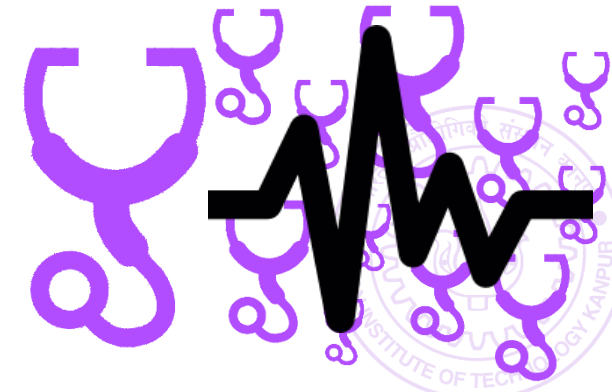
    Scalability and speed are main criterion

    Do we need to automate medicine, driving?

macine

macine

machine

A few cool applications of ML

- ML + Programming Languages
- ML + Logic/Cognition
- ML + Image Processing
- ML + Video Processing
- ML + Earth Sciences

Program Correction with ML

IITK offers a C programming course to ~1000 students each year

```
#include <stdio.h>
int main(){
    int a;
    scanf("%d", a);
    printf("ans=%d",a+10);
    return 0;

}
```

```
#include <stdio.h>
int main(){
    int a;
    scanf("%d", &a);
    printf("ans=%d",a+10);
    return 0;

}
```

Line-4, Column-9: warning: format '%d' expects argument of type 'int *', but argument 2 has type 'int'

AHMED ET AL. COMPILATION ERROR REPAIR: FOR THE STUDENT PROGRAMS, FROM THE STUDENT PROGRAMS, ICSE-SEET 2018.

Program Correction with ML

IITK offers a C programming course to ~1000 students each year

```
#include <stdio.h>
int main(){
        int x, x1 ,d;
        d=(x-x1)(x-x1);
        return d;

}
```

```
#include <stdio.h>
int main(){
        int x, x1 ,d;
        d=(x-x1)*(x-x1);
        return d;

}
```

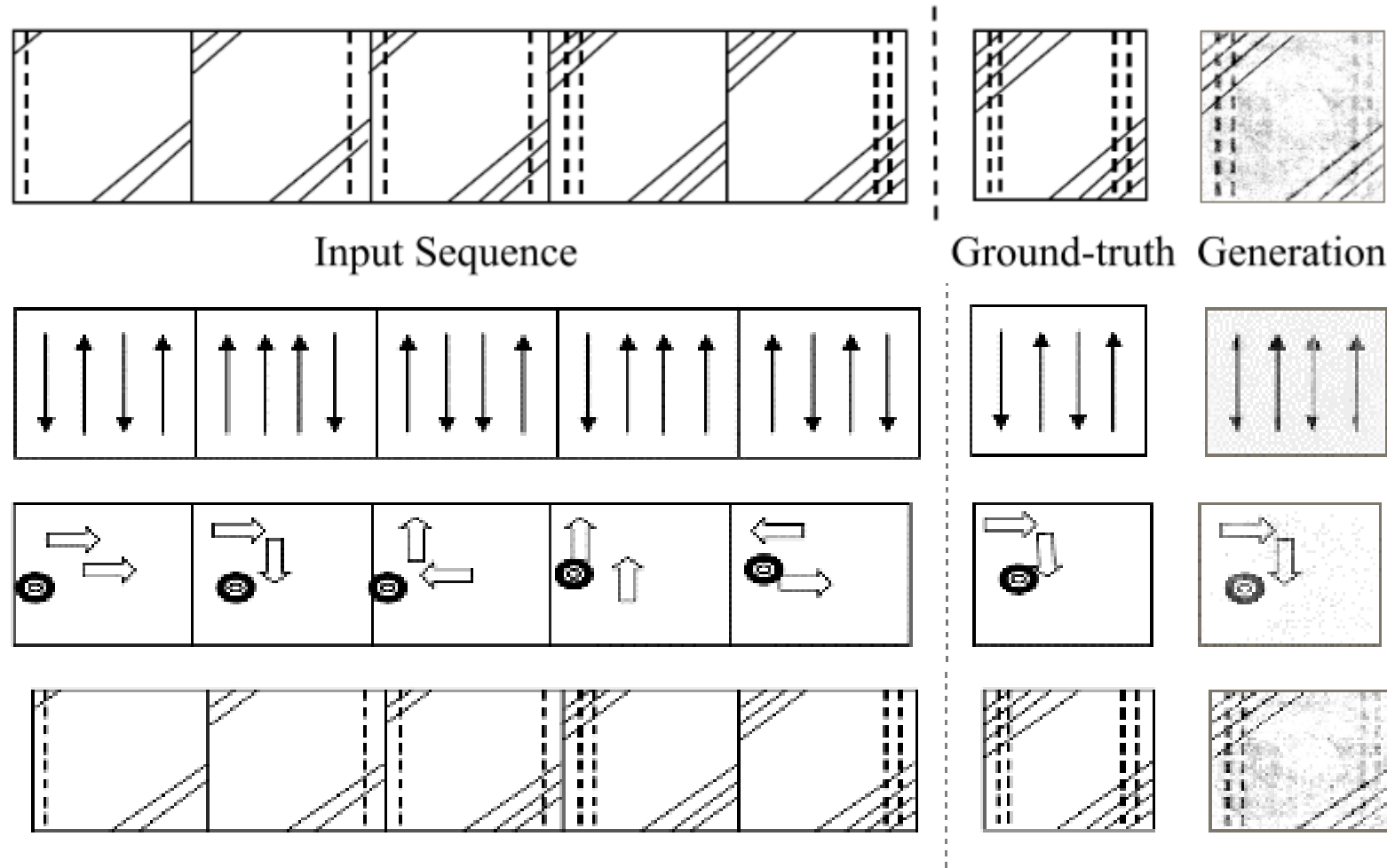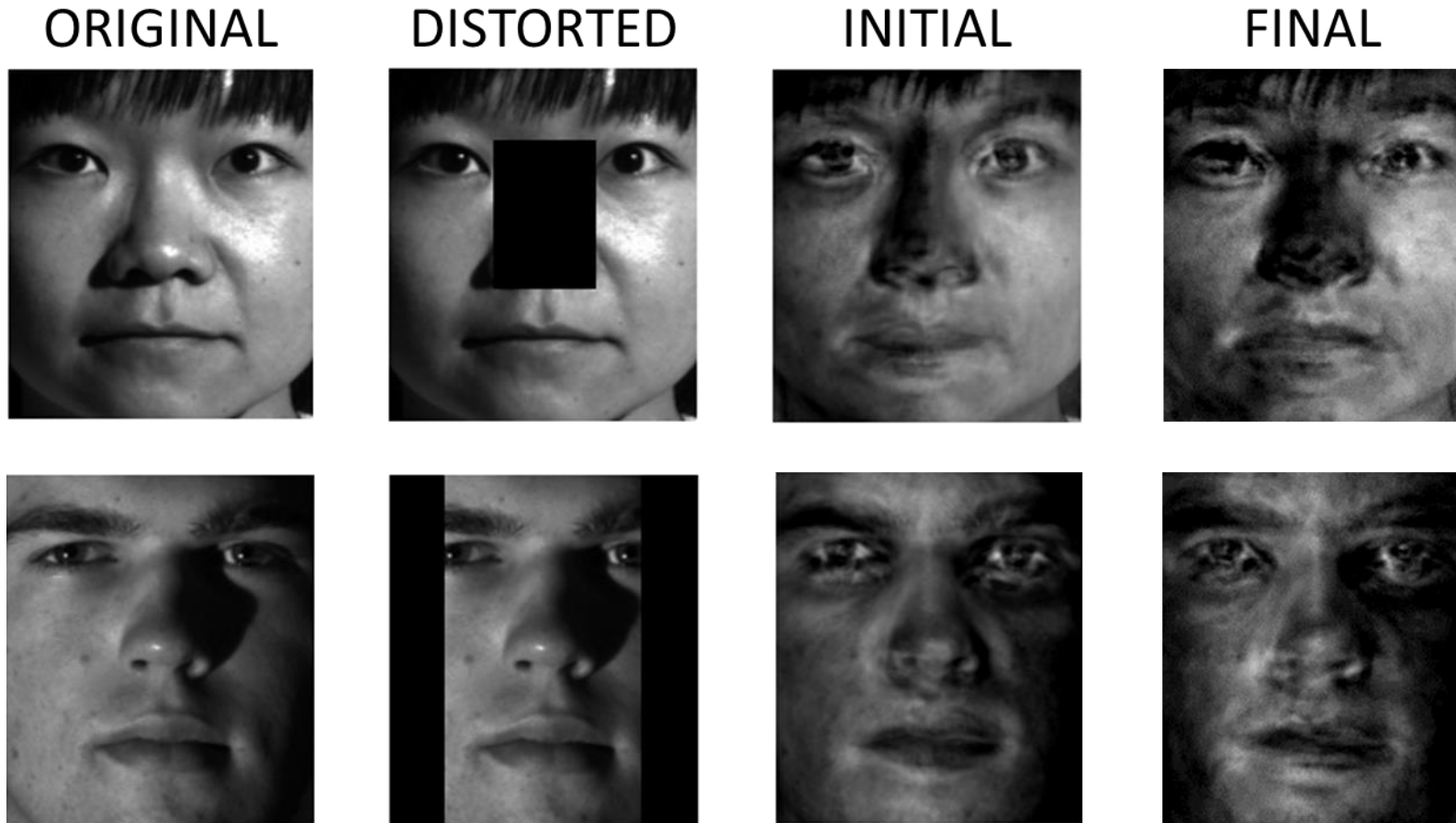Line-4, Column-11: error: called object type 'int' is not a function or function pointer

AHMED ET AL. COMPILATION ERROR REPAIR: FOR THE STUDENT PROGRAMS, FROM THE STUDENT PROGRAMS, ICSE-SEET 2018.

Abstract Reasoning with ML

Input Sequence | Ground-truth | Generation

GHOSH ET AL. CONTEXTUAL RNN-GANS FOR ABSTRACT REASONING DIAGRAM GENERATION. AAAI 2017.

Image Reconstruction with ML

ORIGINAL   DISTORTED   INITIAL   FINAL

BHATIA ET AL. ROBUST REGRESSION VIA HARD THRESHOLDING, NIPS 2015

Video Surveillance with ML

NETRAPALLI ET AL. NON-CONVEX ROBUST PCA, NIPS 2014.
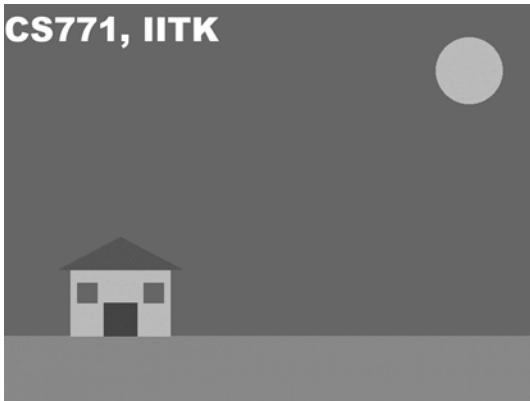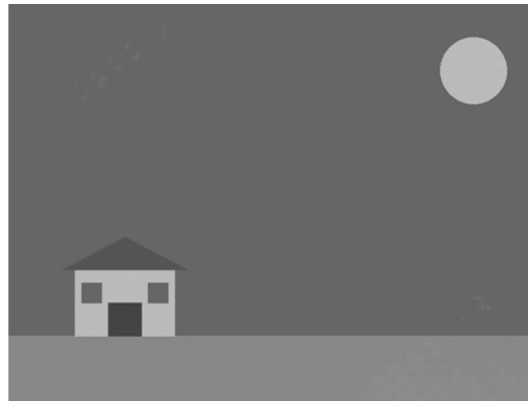
AQ Prediction with ML

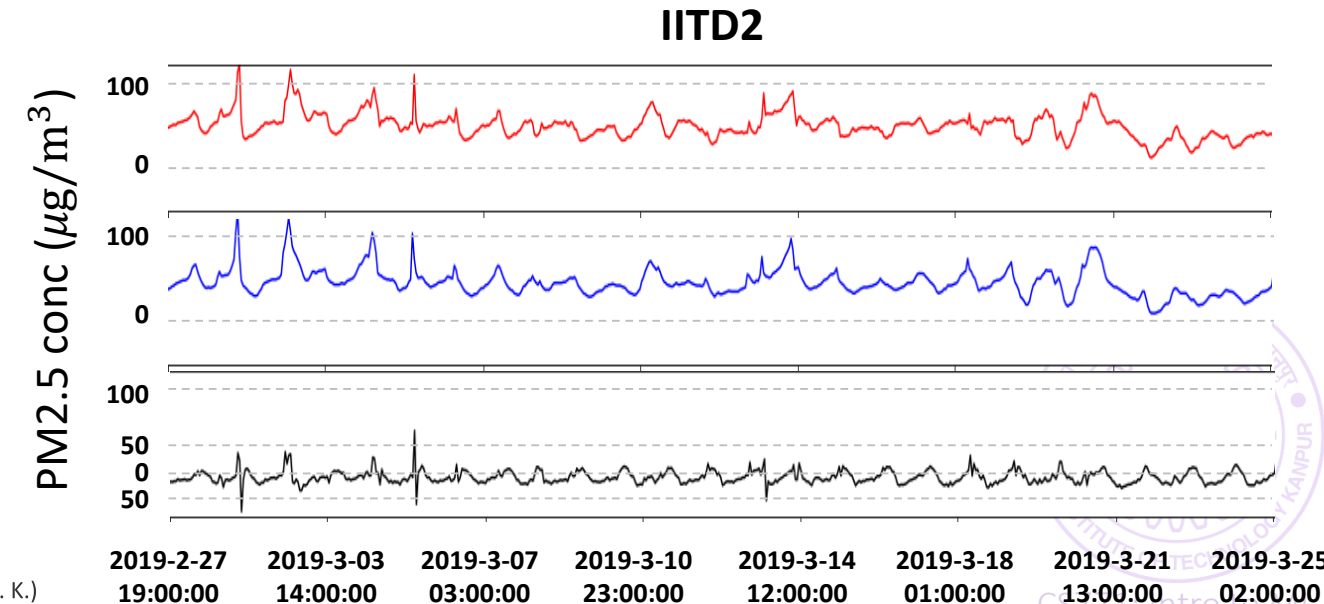**Legend**: Predicted, Measured, Absolute Error
x-axis: time of day, **y-axis**: PM2.5 conc ($\mu g/m^3$)
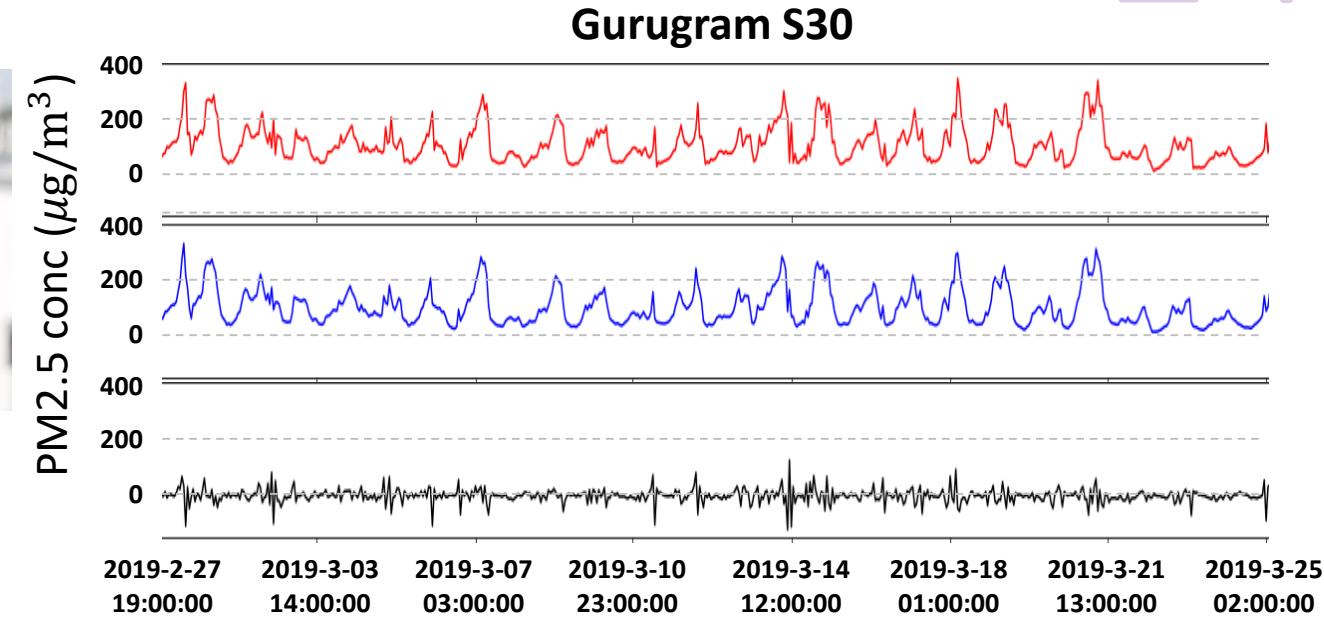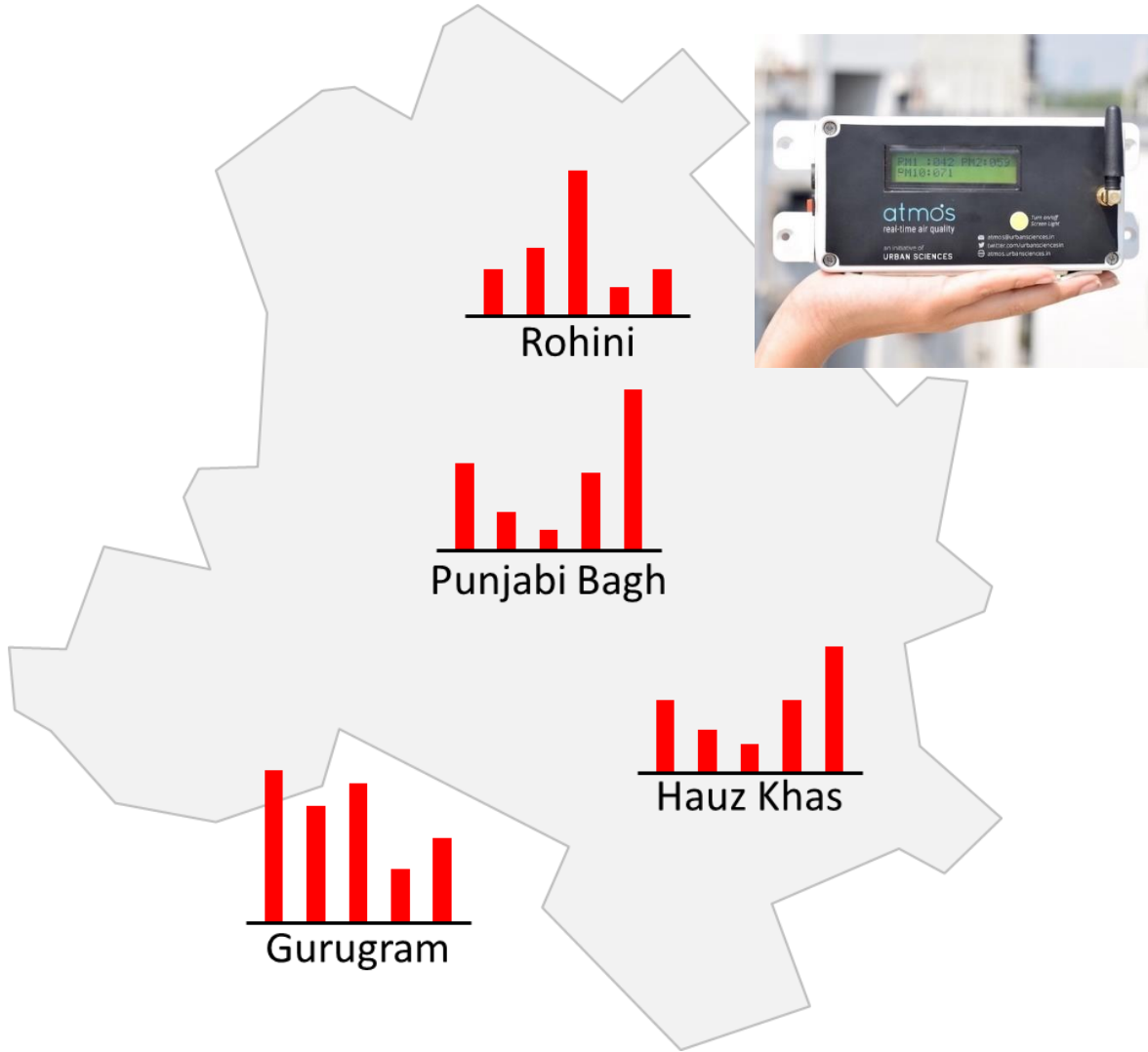

IMAGE SOURCE: HTTP://ATMOS.URBANSCIENCES.IN
CASE STUDY BY IITK CONSULTING GROUP (TUSHAR GOSWAMY, NAISHADH PARMAR, RAUNAK SHAH, BHAVJEET SINGH, VATSALYA TANDON), RESPIRER LIVING SCIENCES (RONAK SUTARIA), IITK (SACHCHIDA NAND TRIPATHI, P. K.)