

Machine Learning – I

Richa Singh

Google classroom code: jwpk5zn

Slides are prepared from several information sources on the web and books

About the instructors

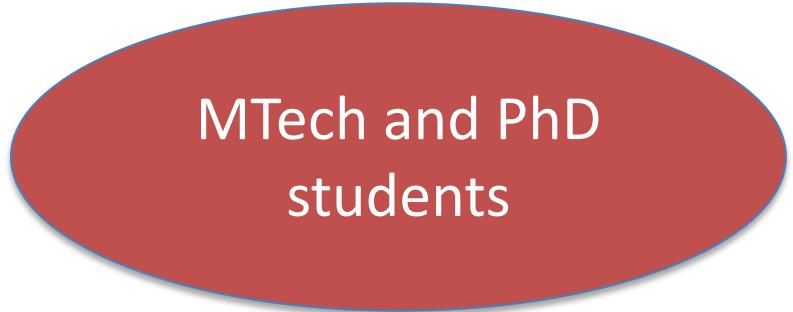
- Richa Singh:
 - Professor, IIT Jodhpur
 - Faculty, IIIT Delhi (2009 – 2019)
 - home.iitj.ac.in/~richa
 - Adjunct Professor, West Virginia University
 - Vice President – Publications, IEEE Biometrics Council
 - Associate Editor-in-Chief, Pattern Recognition Journal

About the instructors

- Dr. Rajendra Nagar
 - Assistant Professor, EE
 - home.iitj.ac.in/~rn
- Dr. Anand Mishra
 - Assistant Professor, CSE
 - home.iitj.ac.in/~mishra

Teaching Assistants

- Will be announced early next week.



MTech and PhD
students

Background

- What is your background?

Please fill the questionnaire shared on WebEx chat.

Course Objectives

- The students are expected to have the ability to:
 - Develop a sense of Machine Learning in the modern context, and independently work on problems relating to Machine Learning
 - Design and program efficient algorithms related to Machine Learning, train models, conduct experiments, and deliver ML-based applications

Course Content

- **Introduction:** Definitions, Datasets for Machine Learning, Different Paradigms of Machine Learning, Data Normalization, Hypothesis Evaluation, VC-Dimensions and Distribution, Bias-Variance Tradeoff, Regression (Linear) (7 Lectures)
- **Bayes Decision Theory:** Bayes decision rule, Minimum error rate classification, Normal density and discriminant functions (5 Lectures)
- **Parameter Estimation:** Maximum Likelihood and Bayesian Parameter Estimation (3 Lectures)
- **Discriminative Methods:** Distance-based methods, Linear Discriminant Functions, Decision Tree, Random Decision Forest and Boosting (5 Lectures)
- **Feature Selection and Dimensionality Reduction:** PCA, LDA, ICA, SFFS, SBFS (4 Lectures)
- **Clustering:** k-means clustering, Gaussian Mixture Modeling, EM-algorithm (4 Lectures)
- **Kernel Machines:** Kernel Tricks, SVMs (primal and dual forms), K-SVR, K-PCA (6 Lectures)
- **Artificial Neural Networks:** MLP, Backprop, and RBF-Net (4 Lectures)
- **Foundations of Deep Learning:** DNN, CNN, Autoencoders (4 lectures)

Pre-requisites

- Programming
- Probability and Statistics
- Linear Algebra (matrices and vectors)
- Revise: resources will be uploaded on classroom
- First assignment zero (will be announced next week)

Class Resources

- Google classroom: jwpk5zn
 - Announcements
 - Assignment posting and submission
 - Discussions
- Mailing list: mtech_exec_ML@iitj.ac.in
- Communications channel:
 - Email
 - Google classroom

Reading Resources

- Textbooks:
 - Pattern Classification, 2nd Edition, [Richard O. Duda, Peter E. Hart, David G. Stork, Wiley](#)
 - Tom Mitchell, Machine Learning
 - Shalev-Shwartz,S., Ben-David,S., (2014), Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press
- Reference Books:
 - C. Bishop, Pattern Recognition and Machine Learning, Springer
 - K. Murphy, Machine Learning: a Probabilistic Perspective, MIT Press

Evaluation Components

- Grading
 - Assignments (programming and written): 30%
 - Exams: 40%
 - Project: 20%
 - Quiz : 10%
- Project team size: 2 students
 - Predefined project topics: you have to select one
- Assignments: individually

Collaboration Policy

- Discussion with friends and colleagues is good... but
 - the objective should be to improve understanding and learning
 - Not getting answers
- If you have discussed with anyone, you should acknowledge who helped you – from the class or outside the class
- Academic dishonesty policy of IITJ will apply

**Any questions regarding
administrative guidelines?**

Please ask via Webex chat

What is Machine Learning?

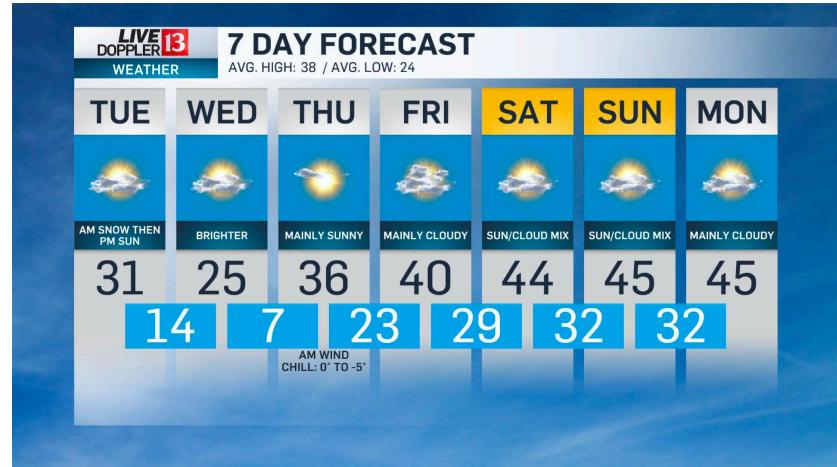
Applications of ML



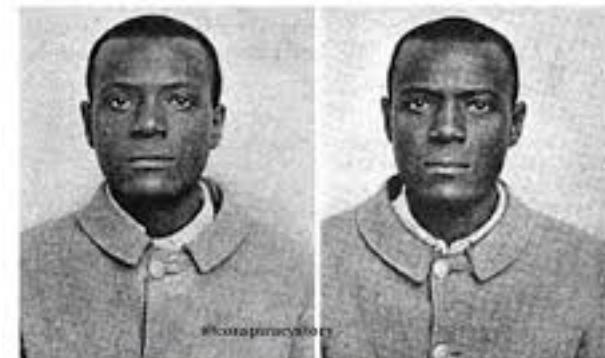
What are the facial expressions?



What are these letters?

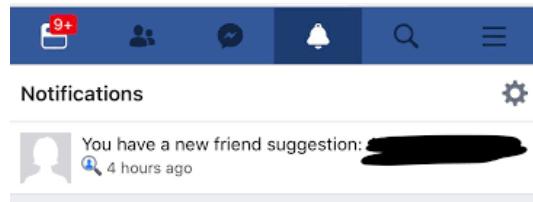


Weather forecast



Are they same or different?

Applications of ML



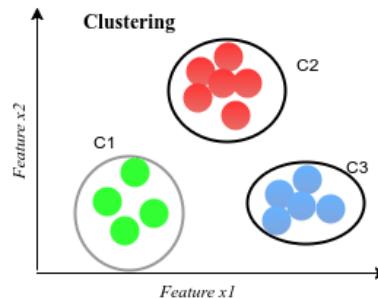
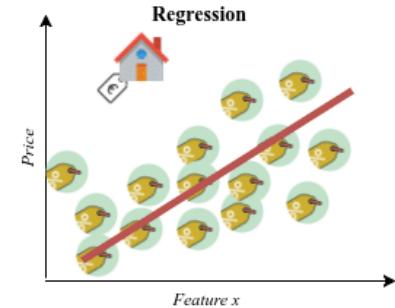
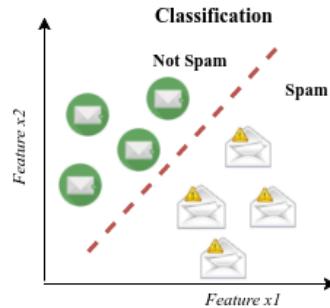
Machine Learning

- What do we understand by learning?
 - Learning is any process by which a system improves performance from experience.”
 - Herbert Simon (1950)
- Machine Learning is the study of algorithms that
 - improve their performance P
 - at some task T
 - with experience E.A well-defined learning task is given by $\langle P, T, E \rangle$.

- Tom Mitchell (1998)

Task, T

- Classification
- Regression
- Ranking
- Recommendation
- Clustering
- Density estimation
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Performance, P

- Metric used to evaluate the performance of T
 - Classification: error rate or accuracy
 - Regression: mean squared error
 - Density estimation: probability assigned to samples