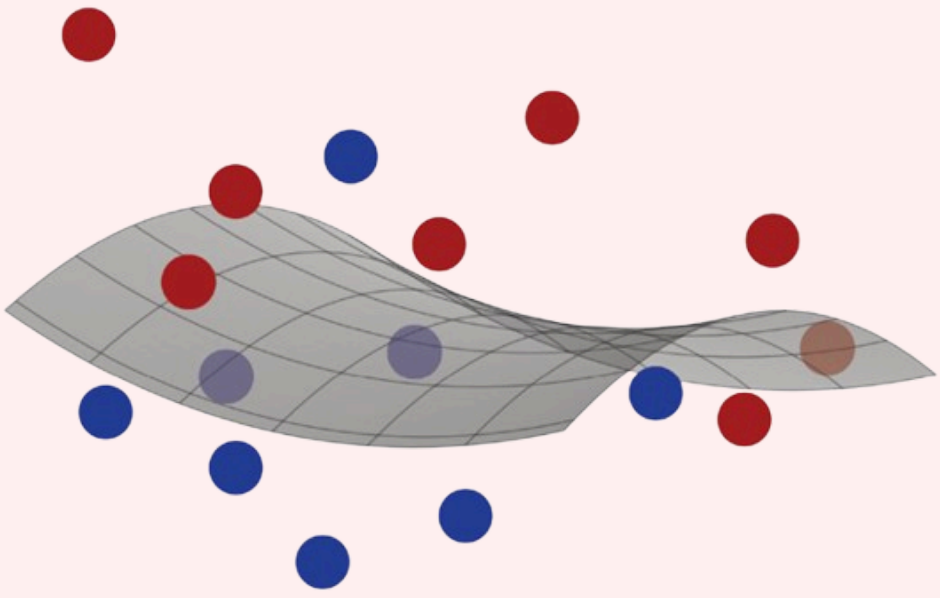
Foundations of Machine Learning

DAY - 1

What is Machine Learning?



What is Machine Learning?

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- Machine Learning (ML) is all about computers learning from experience (data) so they can perform tasks better over time — just like we do.
- This experience usually comes from electronic data, which can be:
  - Labeled by humans (like a dataset where each email is marked spam or not)
  - Collected automatically from interactions (like a robot learning by trial and error)
- Key idea: The more data we have — and the better quality it is — the smarter and more accurate our model becomes.
- Example: Imagine you have 1000 news articles labeled with topics (sports, politics, etc.). Now, given a new, unlabeled article, ML tries to predict its topic.
  - If your training data is large and the labels are correct → easy to predict accurately.
  - If your data is messy or labels are wrong → bad predictions.
- Machine Learning is about building algorithms that can:
  - Learn patterns from data
  - Make predictions on new/unseen data
  - Do this efficiently (fast, with low memory usage)
- In ML, apart from regular CS concerns like time and space complexity, we also care about:
  - Sample complexity = how much data do we need to learn something reliably?
- ML connects Computer Science with:
  - Statistics (to understand and model data)
  - Probability (for prediction and uncertainty)
  - Optimization (to improve models and find best solutions)