



Lecture 1

- What is Learning?
 - Gain knowledge or understanding of or skill in by
 - Study
 - Instruction
 - Experience

What is Learning?



“Gain **knowledge or **understanding of** or **skill in** by **study**, **instruction** or **experience**” - Webster**

- Learning is any process by which a system improves performance from experience
 - More authentic definition

What is Learning?

“**Learning** is any process by which a system improves **performance** from **experience**.” - **Herbert Simon**

Researcher in

- ✓ Artificial Intelligence
- ✓ Cognitive psychology
- ✓ Computer science
- ✓ Economics
- ✓ Political science

Professor @

- ✓ Carnegie Mellon University
- ✓ University of California,
Berkeley
- ✓ Illinois Institute of Technology

Awards:

- ✓ Turing Award, 1975
- ✓ Nobel Prize in Economics 1978
- ✓ National Medal of Science 1986
- ✓ von Neumann Theory Prize 1988



1916 - 2001

- What is Machine Learning?

- It 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 $\langle P, T, E \rangle$

What is Machine Learning?

Machine Learning is study of algorithms that

- improve their **performance P**
- at **some task T**
- with **experience E**

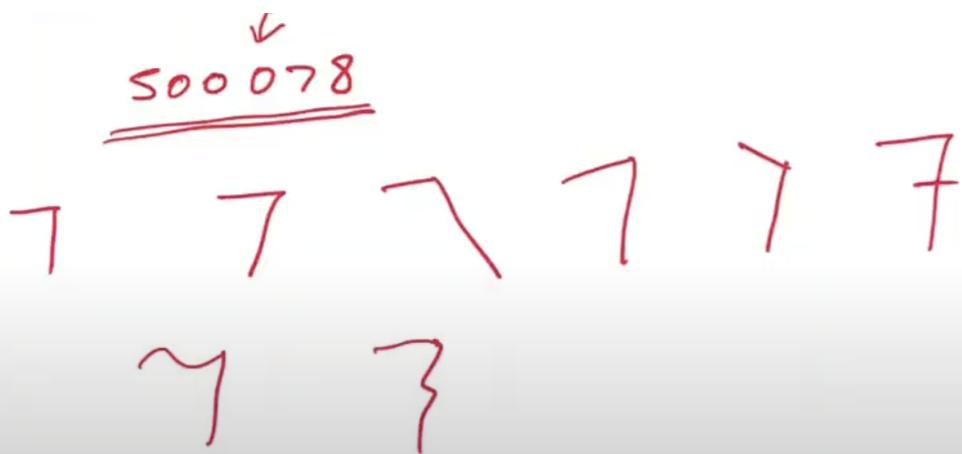


Tom Mitchell (1990)



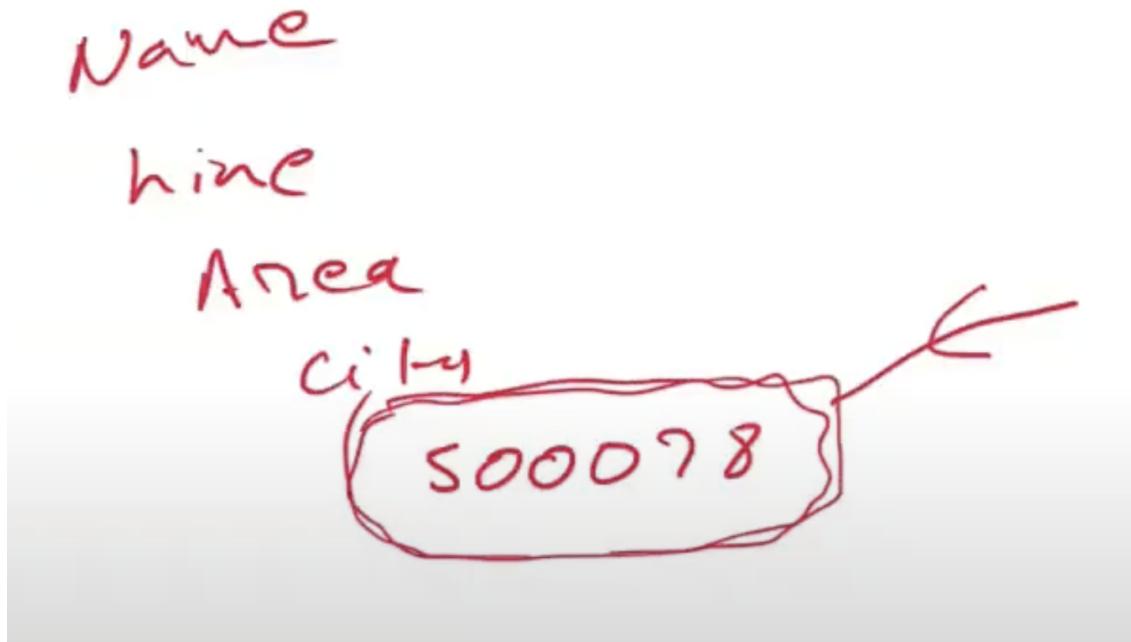
Well-defined learning task: <**P,T,E**>

- Consider a real-life example
 - A postman needs to put letters of different zip codes into different boxes
 - The zip code is handwritten so there can be different shapes corresponding to the same number



- The above zip code has the number seven and this can be written in many ways but the human interpretation power is good enough to understand it is the same number (seven in this case)

- This can be automated to prevent a human being to sit there and manually group the letters by their respective zip code



- The structured information provided helps make it more relevant
- Identify by getting the patterns at a pixel level (smallest unit of an image)
- A non-learning algorithmic solution performs better than a machine-learning solution if the given data has no variety or augmentation and has co-defined rules
- What is machine learning?
 - Given all the experiences of writing seven
 - Some algorithms A see the experience (list of different ways in which seven can be written)
 - It gives a generic formula to generalise the experience in the form of a model M
 - This model can be used to find the output of a new experience
 - The experience of what is not a seven should also be provided to improve the model

- The data used to provide the experience to the model is called the training data
- To check the performance of the model, the new unseen experiences called testing data are given to the model and the performance measure (like accuracy) is calculated

$$\Rightarrow \text{Accuracy} = \frac{\text{Correctly Predicted Samples}}{\text{Total Samples}} * 100$$
- What is machine learning?
 - Given a task T and given an experience E a generalised function is found and is compared with other solutions using different performance metrics P and this should increase with more experiences

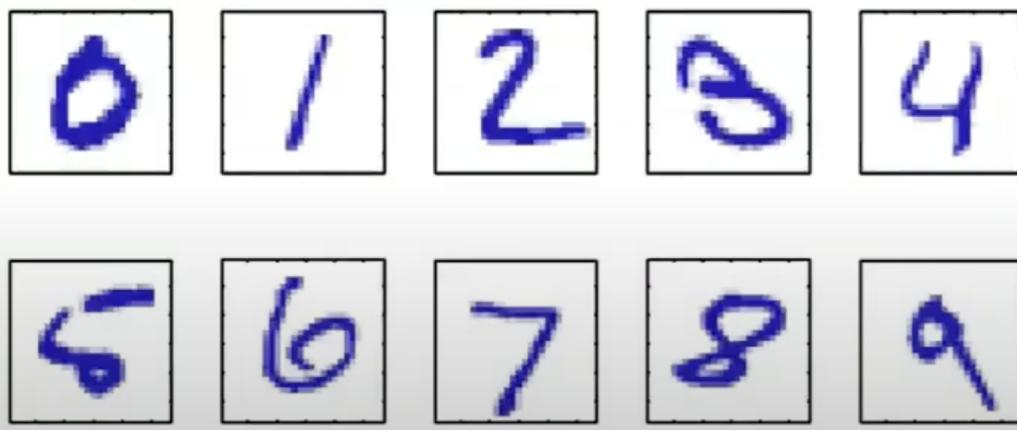
Example - Machine Learning

Handwritten Digit Recognition

T: Recognizing hand-written words

P: Percentage of words correctly classified

E: Database of human-labeled images of handwritten words



Example - Machine Learning

Self-driving Vehicles



Little Ben, 60 miles of autonomous, safe, efficient driving