

# CSC320: Lecture Notes

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May 2025

## Week 1

### Types of Machine Learning

- **Supervised Learning:** Have labeled examples of the correct output/behaviour
- **Unsupervised Learning:** no labeled examples – instead, looking for “interesting” patterns in the data
- **Reinforcement Learning:** (not covered) learning system (agent) interacts with the world and learns to maximize a scalar reward signal

### Implementing Machine Learning Models and Systems

- Step 1: Understand the problem (is it prediction, learning a good representation).
- Step 2: Formulate the problem mathematically (create notation for your inputs and outcomes and model).
- Step 3: Formulate an objective function that represents success for your model.
- Step 4: Find a strategy to solve the optimization problem on pencil and paper.
- Step 5: Translate the algorithm into code.
- Step 6: Analyze, iterate, improve design choices in your model and algorithm

### Nearest Neighbor Methods

#### Supervised Learning

##### Supervised Learning: Step-by-Step

**Step 1: Define the Problem** Build a system that uses training data to make predictions on new inputs.

Task	Inputs	Labels
object recognition	image	object category
image captioning	image	caption
document classification	text document	category
speech-to-text	audio waveform	text

*Examples of supervised learning tasks*

##### Step 2: Mathematical Notation

- Represent inputs as vectors  $x^{(i)} \in \mathbb{R}^d$
- Training set  $D = \{(x^{(1)}, y^{(1)}), \dots, (x^{(N)}, y^{(N)})\}$
- For regression:  $y^{(i)} \in \mathbb{R}$
- For classification:  $y^{(i)} \in \{1, \dots, C\}$

##### Step 3: Optimization Problem

- Given a novel input  $x$ , find optimal prediction
- First approach: Nearest Neighbor algorithm

Nearest Neighbor