**Lecture Notes – Objective Function in Machine Learning**

**1. Definition of Objective Function**

* The **objective function** measures how well a model’s outputs match the correct desired values.
* It’s a core building block of machine learning algorithms.

**2. Types of Objective Functions**

1. **Loss Functions (Cost Functions)**
   * Measure **error of prediction**.
   * Goal: **Minimize** the loss → higher accuracy.
   * Common in **supervised learning**.
   * Example: Mean Squared Error in regression.
2. **Reward Functions**
   * Opposite of loss functions.
   * Goal: **Maximize** the reward → higher accuracy.
   * Common in **reinforcement learning**.
   * Example: Game score in Super Mario → algorithm tries to maximize score.

**3. Loss Functions in Supervised Learning**

* Main focus in the course: **Loss functions** (used in supervised learning).
* Two main supervised learning types:
  + **Regression**
  + **Classification**

**4. Targets and Outputs**

* **Target (T)**: The correct/desired value for each input.
  + Example: In cats vs. dogs classification, target is the true label for the image.
* **Output (Y)**: The model’s prediction.
* Goal: Make **Y** as close as possible to **T**.
* Loss function evaluates how far **Y** is from **T**.

**5. Common Loss Function for Regression**

* **Regression Output**: Continuous values.
* **Squared Loss** (L2-norm loss):
  + Formula: Sum of squared differences between **Y** and **T**.
  + Also known as **Least Squares Method** in statistics.
  + Lower sum → lower prediction error → better model performance.
* **Target (T)** → The **correct answer** we already know.  
  Example: In a dog vs. cat task, if the picture is of a cat, the target is “cat.”
* **Output (Y)** → The **model’s guess**.  
  Example: The model looks at the picture and says “dog” or “cat.”

**Key point:**

* The **target** is the truth.
* The **output** is what the model predicts.
* The loss function checks **how far** the output is from the target.

It’s like in school: the target is the **answer key**, and the output is **your answer on the test**. The closer your answer is to the key, the better you score.