**Deadline:** April 29, 6:00 PM (Tuesday)  
**Submission Format:** One submission per group (no duplicate submissions)

**Project Overview**

Each group will complete **two major tasks**:

**Part A: Image Generation, Object Detection, and Image Captioning**

You will build a pipeline that performs:

1. Image generation using GAN or VAE models
2. Object detection on the generated images
3. Image captioning

You are required to use the MS COCO dataset for training these models. The dataset can be accessed and downloaded from the official COCO website: <https://cocodataset.org/#download>. Please randomly select 20,000 images from the MS COCO dataset to build and train your models.

**Part B: Reinforcement Learning Strategy Design**

Design an optimal strategy for a computer (AI) to play a video game using **Reinforcement Learning**.  
**Note:** No coding is required for this part. Focus on hypothesis and design.

**Submission Requirements**

Each group must submit the following **three files separately** as part of a **single group submission**:

1. **Jupyter Notebook (.ipynb)**
   * All relevant code for Part A
   * Make sure it runs correctly and is clearly documented
2. **Project Report (minimum 7 pages)**
   * Organized by sections described below
3. **Presentation Slides (approx. 20 slides)**
   * Based on the report content, but more concise
   * To be used during in-class presentations

**Presentation Guidelines**

* Each student must participate in the group presentation.
* Each group will have **20 minutes** total.
* Presentation will be graded based on:

**(Presenting = 20 points)**

* + Clarity and professionalism of delivery
  + Ability to answer questions effectively

**Detailed Project Components**

**Part A: Image-Based Deep Learning Tasks (55 points total)**

**Python Coding Tasks**

1. Generate 5 images using a GAN or VAE model
2. Perform object detection on these images
3. Generate captions for the images

**Report Requirements for Part A**

* Task overview and dataset summary
* Detailed explanation of your models, architectures, and rationale
* Visual outputs:
  + Display the 5 generated images
  + Show detected objects
  + Include generated captions

**Part B: Reinforcement Learning Game Strategy (25 points)**

**(No coding required)**

Your design should include:

1. **Game Description**
   * Choose any video game (e.g., a simplified version of *Plants vs. Zombies*)
   * Describe actions, states, rewards, and penalties
2. **Modeling Hypothesis**
   * Outline your action rules and reward/state distribution
   * Specify what kind of neural network structure (layers, activation functions) you plan to use
3. **Reward Strategy**
   * Define your final reward structure (e.g., binary win/loss, cumulative rewards, risk-adjusted rewards)
4. **Analysis Framework**
   * Write down your proposed analytical procedure
   * Assume someone else will implement the code based on your description

**Formatting and Minor Requirements**

* Use your **business question or project title** as the main title for both the report and slides.
* List your **group number and members (sorted by last name)** on the first page of both the report and slides.
* **Avoid using raw Python code screenshots** in your slides and report.
  + Instead, present results in **tables**, **diagrams**, and **visualizations** where possible.