Artificial Intelligence (521495A)
Spring 2025

Project 2 Introduction

6.2.2025
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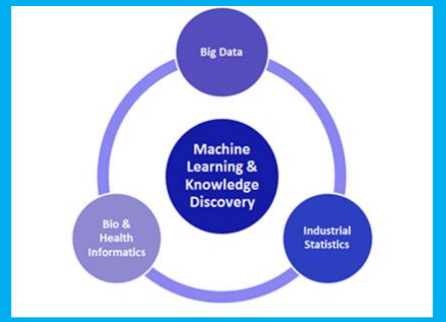
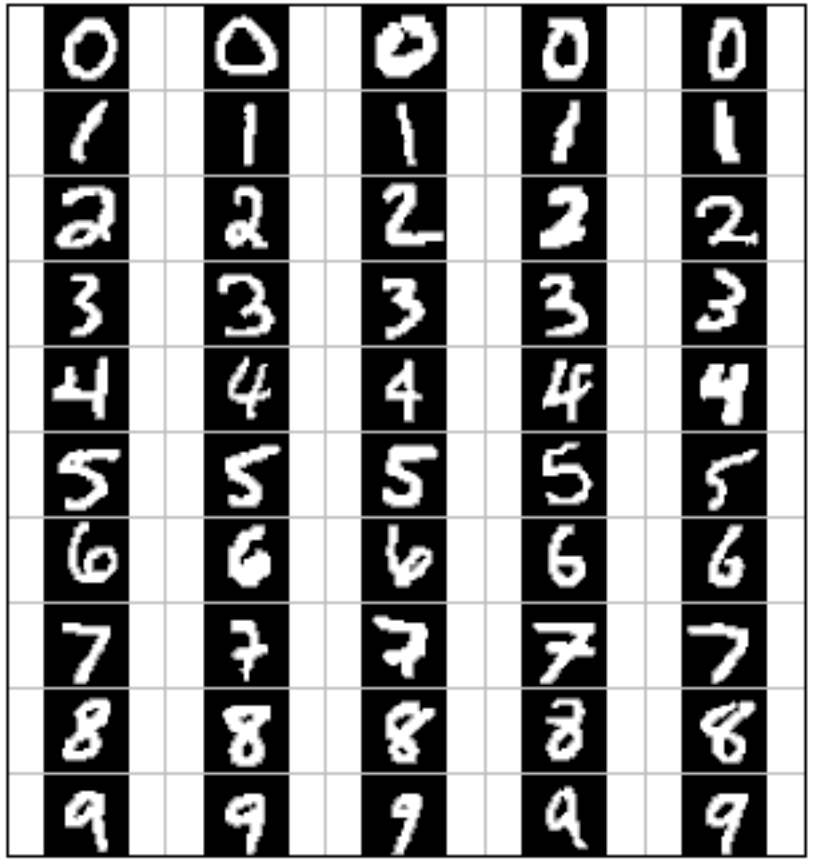
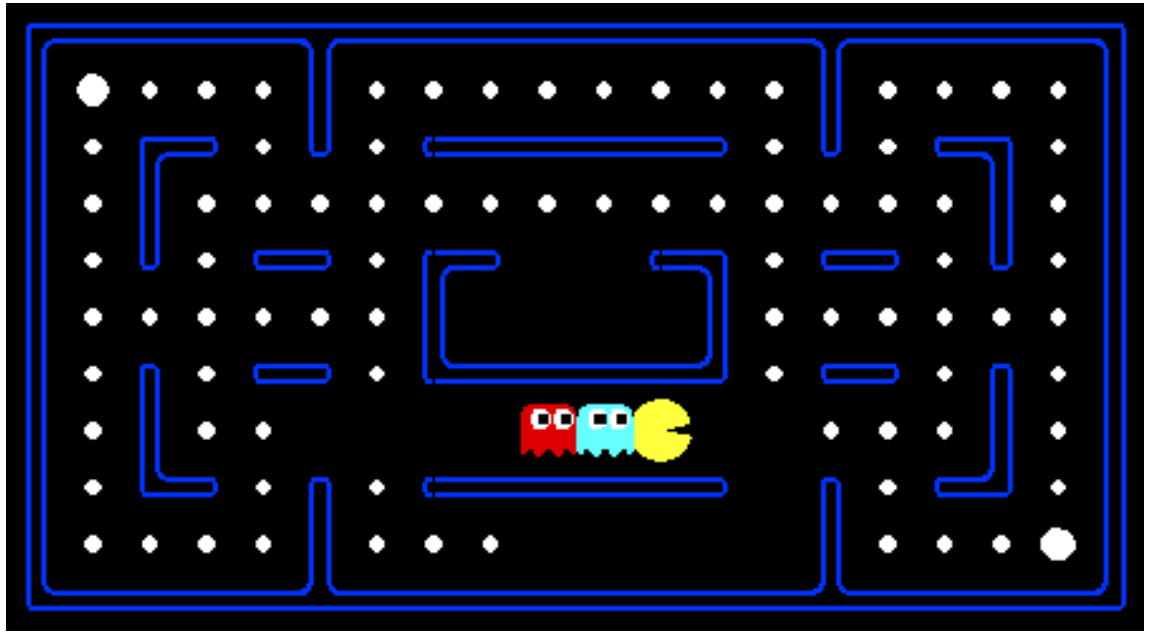


Data Analysis and Inference Group

Project 2: Classification (6 Questions)



Classification of handwritten digits:
Which digit?



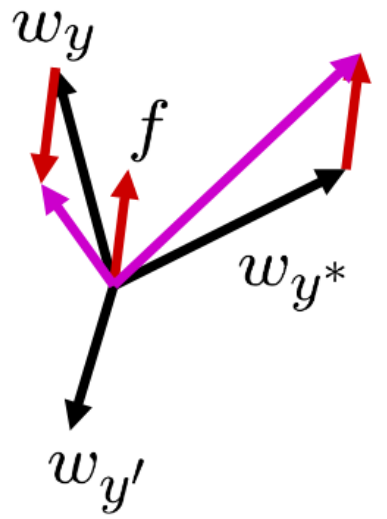
Classification of actions: Which action?

Question 1: Perceptron (4 points)

- **Implement the perceptron classifier for the handwritten digits**

- **Basic idea:**
  - Predict to the class which yields maximum score
  - If prediction was right; do nothing
  - If wrong; lower score of wrong answer, raise score of right answer

- **In this problem feature vector is the pixels of image**
  - Has value 1, if the pixel is "on"
  - 0, if the pixel is "off"



Question 2: Perceptron Analysis (1 point)

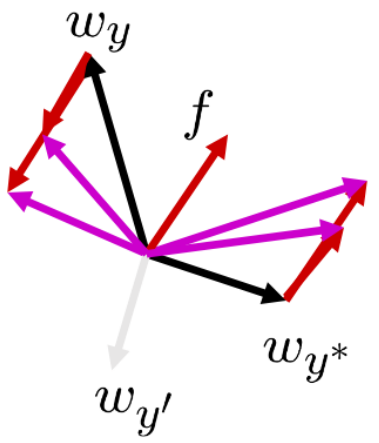
- **What did the classifier learn? What is the classification based on? Make visualization of the largest weights**

Question 3 : MIRA (6 points)

- **Implement the MIRA classification algorithm**

- **Improvement to some of the problems with perceptron**
  - Works better with non-separable data, better generalization, not so prone to overtraining problems

- **Main difference to perceptron: Adjust the weight update**
  - Choose an update size that fixes the current mistake
  - With minimal change to the weights

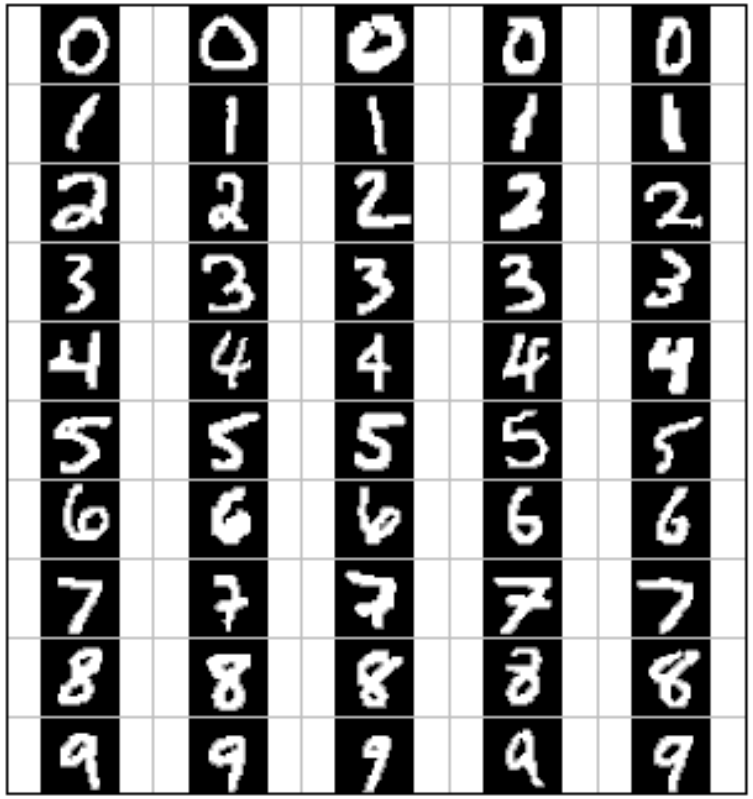


Guessed y instead of y^* on example x with features $f(x)$

$$w_y = w'_y - \tau f(x)$$
$$w_{y^*} = w'_{y^*} + \tau f(x)$$

Question 4: Digit Feature Design (6 points)

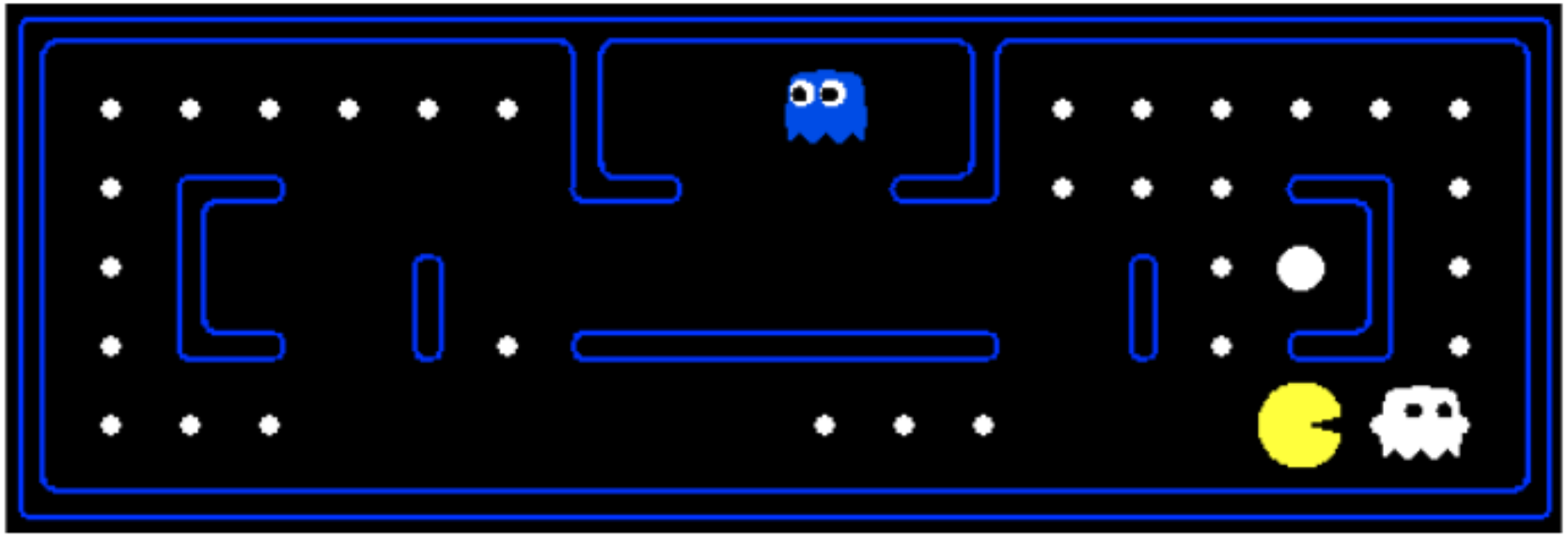
- **Try to improve digit classification accuracy with feature engineering**
- **One way is to calculate the number of black regions in the image (1, 2, or 3)**



Question 5: Behavioral Cloning (4 points)

- **Create modified version of the perceptron to clone Pacman behaviour**
  - Learn from Pacman agents playing the game

- **Data is now the states from the Pacman game of the first project**
- **Labels are the moves taken by the agent**



Question 6: Pacman Feature Design (4 points)

- **Feature design for the Pacman game**

- **Extra features can be extracted from the Pacman gameState object of the first project**

- **Should be able to clone behaviour from different agents:**
  - StopAgent: An agent that only stops
  - FoodAgent: An agent that only aims to eat the food, not caring about anything else in the environment
  - SuicideAgent: An agent that only moves towards the closest ghost
  - ContestAgent: Agent from the first project that smartly avoids ghosts, eats power capsules and food

General things

- Project is mandatory part of the course
- Deadline for Project 2 is **10.3.2025 23:59**
- Do not use any extra libraries or packages
- There is again autograder what you should use to verify your answers
- The project may be done in a group of two people at most
- Wrap all the codes into a ZIP file for submission in Moodle
- You should get at least score of 17 from the autograder to pass the project

How to get help

- **Exercise session every Tuesday 14:15-16:00 in room TS101**
  - Main way to get help with the Project
  - Last session is already on 28.2., note that the final session is on Friday
  - Start the Project 2 soon

- **You can also hask for help via email from TAs**

Enjoy the project