KING'S COLLEGE LONDON

MASTER OF SCIENCE – INTELLIGENT SYSTEMS – 2018-19

COURSEWORK (MARKED)

7CCSMPRJ - INDIVIDUAL PROJECT (100%)

PREDICTING TRUTHFULNESS IN DATA SHARING (A MACHINE LEARNING RESEARCH PROJECT)

LANGUAGE: PYTHON

a. Implemented end-to-end machine learning pipeline and applied **unweighted**, **imbalanced** and **cost-sensitive** learning to predict whether users were likely to be truthful or not about data.
b. Re-defined the problem as an **unsupervised** learning to identify **customer segments** within shared data.
c. Learned Bayesian networks from data to draw **meaningful inferences** from the survey responses.

7CCSMAIN - ARTIFICIAL INTELLIGENCE (20%)

CODING AND REPORT PREPARATION
LANGUAGE: PYTHON

I. Implemented simplistic code to control Pacman in standardGrid and win games despite the **limitations of observability.**
   a. Met the requirement to win games when there were no ghosts.
   b. Met the requirement to win one game in five, on average, when there were ghosts.
   c. Generalized to run in any other grid.
II. Created an **MDP-solver** to control Pacman and win games.
   a. Met the requirement to win at least four games out of ten in smallGrid. On average, the MDP Agent achieved 64% win-rate when experimented with three rounds of 50 runs each.
   b. Met the requirement to win at least two games out of ten in mediumClassic. On average, the win-rate was 50.67% when experimented with three rounds of 50 runs each.
   c. Generalized to run in any other grid.

7CCSMCVI - COMPUTER VISION (35%)

CODING AND REPORT PREPARATION
LANGUAGE: MATLAB

I. MODELING LOW-LEVEL COMPUTER VISION
   Performed convolution on images with:
   a. Smoothing Masks: Box and Gaussian Masks.
   b. Difference Masks: 1-D, 2-D and others.
   c. Gaussian Derivative Masks, Laplacian of Gaussian (LoG) Mask and Difference of Gaussian (DoG) Masks for Edge Detection.
   d. Gaussian Image Pyramid and Laplacian Image Pyramid for multi-scale representations.
   e. Edge Detection algorithms.
II. MODELING LOW-LEVEL BIOLOGICAL VISION
   a. Identified redundancy in natural images.
   b. Modelled Retinal Ganglion Cells using DoG Masks.
   c. Modelled V1 Orientation Selective Cells using Gabor Masks.
III. MODELING HIGH-LEVEL COMPUTER VISION
   a. Designed and implemented Computer Vision system which could read in a LEGO image and count the number of Blue 2 by 4 bricks (object A) and Red 2 by 2 bricks (object B). The colored mask, morphological operations, blob detection (image segmentation) and bounding box were computed/ applied to the images in order to detect specific objects (bricks).

7CCSMML1 - Machine Learning (20%)

Language: Python

I. Created **Naïve Bayes Classifier** that helped make Pacman Agent decisions on how to move in the classic game.
   a. Applied **m-estimation** technique for samples having conditional probability value equal to zero.
   b. Selected next action/ move based on **Epsilon-Greedy** algorithm against normalized cumulative probabilities for effective decision-making rather than using the move with maximum probability from NB classifier.
   c. Met the requirement for code to run until the game was won or lost within time limit.

II. Implemented **Q-Learning** and **Adaptive Dynamic Programming** (ADP) Reinforcement Learning algorithms helping Pacman agent choose how to move in the classic game.
   a. Met the requirement to win at least eight games out of ten in smallGrid.

7CCSMPNN - Pattern Recognition (40%)

Coding and Report Preparation
Language: MATLAB

I. Bayesian Decision Theory and Discriminant Functions
   a. Performed **Parzen Density Estimation** and classified patterns/ samples using **Bayes Decision Rule**.
   b. Implemented k-Nearest-Neighbor classifier.
   c. Determined a linear discriminant function using **Sequential Widrow-Hoff Learning** Algorithm for classification.

II. Neural Networks and Feature Extraction
   a. Learned the weights of a Linear Threshold Unit using **Sequential Delta Learning Algorithm** for classification.
   b. Implemented **Karhunen-Loeve Transform** method to perform **Principal Component Analysis** (PCA) on the given dataset.
   c. Performed classification using **Sparse Coding** method.

III. Support Vector Machines (SVMs)
   a. Designed and implemented **multi-class classifier** using self-generated linearly separable dataset. Identified support vectors of the linear SVMs by “inspection" and designed their hyperplanes by hand.

IV. Ensemble Methods
   a. Designed and implemented **Bagging** and **Boosting** classifiers from scratch and predicted the classification of test samples.

7CCSMAMS - Agents and Multi-Agent Systems (20%)

Coding and Report Preparation
Environment: NetLogo

I. Forest Fires and Reactive Agents
II. Forest Fires and Cooperative Agents

7CCSMART - Advanced Research Topics (100%)

Literature Review: Learning to Improve AI Planning (6000-8000 words)