**Please select at least TWO of the tasks below. Of course, you are more than welcomed to attempt more questions, which further displays your research potential.**

**We will evaluate your ability by considering the following factors:**

1. **The difficulty of the task itself,**
2. **The amount of task completed, and**
3. **Number of questions attempted**

**Please email your completed code and report to ridlltest@gmail.com**

**Task 1: Probability and Optimization**

**Problem Description:**

Suppose you are a timetable scheduler for a transport company. You are required to schedule 80 trains at a specific train station between 4:00 am to 11:59 pm (20 hours). You are given the passengers’ arrival time data for a typical day (PessengerArrivalTime.csv – this is simulated data).

Your goal is to **minimize the average waiting time for all these passengers**.

You are required to carry out the following tasks:

1. Solve the above using Linear Programming based on the above requirements and to obtain an optimal solution;
2. Given a set of additional constraints:
3. the minimal interval for consecutive trains is 5 minutes and,
4. the maximal interval is 30 minutes,
5. also the first train must leave the station at exactly 4:00 am,

How to formulate the new optimization task? Please then solve it and to obtain its optimal solution.

1. Additionally, try to solve it from a Probability perspective: Fit the passenger arrival patterns with a probability distribution (hint: a mixture model), construct a Non-Linear Programming task with/without the additional conditions in (2), and to obtain both optimal solutions.

**Submission Requirements:**

Submit the code and final solutions (as a report) for the above problems respectively.

The programming language can be Python or Matlab;

You are not required to write the solver by yourself since both languages have already provided very powerful optimization toolboxes.

**Task 2: Computer Vision and SSD**

**Problem Description:**

1. Read and understand Single Shot MultiBox Detector (SSD) paper
2. Find an implementation or implement by your own (if so, please indicate in your report)
3. Since SSD calculates scores for each class and bounding box coordinates at the same time, modify the original method by: refining class scores after deriving bounding box coordinates first
4. Implement the refinement and (Optional: compare the two approaches in terms of speed and accuracy).
5. Explain in details how the refinement is designed (Optional: report the comparison)

**Submission Requirements:**

The programming language must be Python, you can choose to use Tensorflow, Pytorch Deep Learning Framework to solve the problem.

Submit the code and final solutions (as report) for the above problem.

**Task 3: NLP and Sentiment Analyses**

**Problem Description:**

1. Collect Trump’s tweets from recent 2 months
2. Extract key information from each tweet. E.g. subject and Trump’s attitude towards the subject.
3. Explain in details (in report) how the information is extracted

**Submission Requirements:**

The programming language must be Python.

Submit the code and final solutions (as report) for the above problem.

**Task 4: Resnet and Dilated Convolution**

**Problem Description:**

1. Read and understand Resnet paper
2. Download fashion MNIST dataset.
3. Find an implementation of Resnet-50. Replace traditional CNN to Dilated CNN and maintain the other part in Resnet-50.
4. Training classification on the fashion MNIST using your dilated Resnet.

**Submit Requirements:**

The programming language must be Python you can choose Tensorflow, Pytorch Deep Learning Framework to solve the problem.

Submit the code and final solutions (as report) for the above problem.

**Task 5: Simple Probability Question**

**Problem Description:**

Suppose that you have a positive random variable *X*, which is distributed from an Exponential Distribution with its parameter set to one, i.e., exp(1); Then, what is the probably density (function) of the integer and fractional part of this random variable *X*?

**Submit Requirements:**

Submit a verbose proof using LATEX, both its source and pdf file.

**Task 6: Nail Detection using Deep Learning**

**Problem Description:**

1. Collect a set of images containing your own hand where the nails can be seen
2. Label a dataset containing the locations of your five nails.
3. Build a neural network model to train and test the locations of all five nails.
4. Report its classification accuracy

**Submit Requirements:**

The programming language must be Python you can choose Tensorflow, Pytorch Deep Learning Framework to solve the problem.

Submit the code and final solutions (as report) for the above problem.

**Task 7: SeqGAN**

**Problem Description:**

1. Read and understand SeqGAN Paper.

2. DownloadBarack Obama political speeches as your experiment data.

(<https://github.com/samim23/obama-rnn/blob/master/input.txt>)

3. Implement SeqGAN model, you can choose to use tensorflow or pytorch.

4. Compare the model performance with simple RNN model.

(Remove your discriminator part and define another loss function).

**Submission Requirements:**

The programming language must be Python you can choose Tensorflow, Pytorch Deep Learning Framework to solve the problem.

Submit the code and final solutions (as report) for the above problem.