COMP.4220 - Machine Learning

Homework 7

student name:

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1. Solve the following optimization problem using **Lagrange multipliers**.

$$\begin{aligned} &\text{minimize}_{\mathbf{x}} \;\; f(\mathbf{x}) = 8x_1^2 - 2x_2 \\ &\text{s.t.} \;\; x_1^2 + x_2^2 = 1 \end{aligned}$$

   (a) Show all the steps of your solution. For each solution, also calculate the function value $f(\mathbf{x})$. What is the minimum?

   (b) Validate your solution by plotting the problem including the objective and its constraint as well the solution you found.

(10 mark)

2. (Programming) In this question, you investigate Support Vector Machines for classification.
   (a) Use the `fetch_lfw_pairs` function from `scikit-learn` to import the data set.
   (b) Write a complete description of the data set.
   (c) Use the following commands to split the data set into training and test sets (do not use `train_test_split`.

```
lfw_pairs_train = fetch_lfw_pairs(subset='train')
lfw_pairs_test = fetch_lfw_pairs(subset='test')


```

   Then grab the data and targets from each to build X_{train}, X_{test}, t_{train}, t_{test}.
   (d) Train a Support Vector Classifier on the training set and report the results. Your results should include a `classification_report` and a `ConfusionMatrixDisplay`.
   (e) Tune your classifier using the `RandomizedSearchCV` method that performs a randomized search on hyper-parameters. To do this you need to define the lower and upper bounds for each hyper-parameter.
   (f) Report results for the best classifier settings by producing a `classification_report` and a `ConfusionMatrixDisplay`.
   (g) Explain the performance of your classifier.
   (h) Explain how you go about improving the results you have.

(15 marks)