Milestone III – (Max 40 points)

Section A. How to deliver your code (10 points): (*same as Milestone II*)

1. Divide the project into three files.
    a. Training.py: This must include all code related to loading training data, pre-processing and training model. This also includes the code related to validation data, and model evaluation during training.
    b. Model file: The final trained model must be saved as a pickle file. Please find instructions on how to save a trained model in Pytorch and how to save it in an sklearn . ***You may also save your model has H5 files***.
    c. Test.py: This file must include all testing code for performing prediction/inference on test set, ***and evaluations on test set.***
2. If your preprocessing technique involves using other pre-trained models, you should include your data features as a `train_features.npy` file and `test_features.npy`. The extracted features (for both train and test set) must be dumped as *.npy files. Do not submit the pre-trained model (model that you have not trained and only used for feature extraction). Please reach out to us, if you are facing issues in this part.
3. If your data file is larger than 5 MB, please do not submit your data. Instead, include the links and the sources where the data can be downloaded from. Your training code should include functions to read train_features.npy file. It must also include the code to convert the original data to train/test feature numpy arrays.
4. This milestone has 2 deliverables
    a. the code + data + model zip file (as indicated above),
    b. a report in a **pdf** format containing all the above details in Times New Roman, Font Size 12, **Maximum 2 pages of new content (highlighted as red below) and 4 pages of old content (highlighted as green below)**.
5. Any files with greater than the specified page limit or with different font sizes, WILL NOT be evaluated.
6. **IMPORTANT**: Please merge the 2 new pages with the previous 2 pages of your milestone 1 + 2 pages from milestone 2 in case you are not making any changes in your approach. So, you will submit 6 pages of the report in this milestone (all 4 pages from the previous two milestones + max 2 pages from this milestone). You can either merge or copy paste.
7. Please name the files as <member1_id>_<member2_id>_< member3_id>.pdf and <member1_id>_<member2_id>_< member3_id>.zip.

Section B. How to organize your report (30 points):

IMPORTANT: As I have emphasized in the class, the goal of milestone III is to give you an opportunity to refine your ML system. We have learned that ML system design is an **iterative process** requiring informed fine tuning to achieve the best performing system. With this goal in mind, you are writing only 2 new pages of content for milestone III (unless your milestone II experiments failed miserably and revealed a big flaw in your approach).

1. **Team** members roles and responsibilities (**1 point**): This should be same as Milestone II. You can copy paste or simply merge the new pdf with existing pdf.

2. **Context** (**1 point**): This should be same as submitted in Milestone II. You can copy paste or simply merge the new pdf with existing pdf.

3. **Dataset** (**1 point**): This should be same as submitted in Milestone II. You can copy paste or simply merge the new pdf with existing pdf.

4. **Preprocessing** (**3 points**): This should be same as submitted in Milestone II. You can copy paste or simply merge the new pdf with existing pdf.

5. **Preprocessing Improvements** (**4 points**): Here you describe the changes made in the preprocessing technique to get better (or worse) performance. These improvements may include:

   a. Alternate set of features selected. This may include, but not limited to:
      i. Using more correlated features,
      ii. dropping certain feature variables,
      iii. changing dataset size,
      iv. image resizing to different dimensions,
      v. adding different kind of noise to data
   b. Alternate preprocessing technique used (e.g. MinMax scalar instead Standard scalar).
   c. Alternate feature extraction model used (e.g. using Glove instead of Word2Vec, using an alternate pre-trained model to extract image features)

   Please note that you do not have to select ALL possible options. Just include a justification of 2-3 improvements you are selecting and *why* and only work with them.

6. **Model Specifications** (**3 points**): This should be same as submitted in Milestone II. You can copy paste or simply merge the new pdf with existing pdf.

   Modifications to model specifications are accepted if your original selection of model was conceptually flawed. As I have discussed in several lectures, you can build absolutely any machine learning model with any data, and claim it to be correct and high performing, however, that does not mean the model is conceptually correct and usable.

   For instance, you may very easily use an SVM to work with many categorical, discrete and continuous scale data types, and claim that the model works well on training set. However, we know that with large number of feature vectors, SVM breaks down, and therefore you must perform detailed evaluation to prove that the ML system you have

designed is accounting for this factor. You may also learn at this stage that while you promised in your proposal to build an algorithm for anomaly detection task, and after Milestone 2, you learned that with the given data, you cannot achieve it. Under such circumstances, you may change your modelling technique. *Please contact use before making any major changes here.*

7. **Model Specifications Improvements (5 points):** Here you must include any change in model specifications to improve model performance. This may include but is not limited to:
   a. Hyperparameter tuning
        i. Different epochs,
        ii. Different batch size,
        iii. Different learning rate,
        iv. Different initialization parameters, e.g. different random seed.
        v. Different tolerance (e.g. C parameter in SVMs)
   b. Model architecture changes
        i. Increasing network depth.
        ii. Changing activation functions,
        iii. Improving regularization techniques.

Please note that you do not have to select ALL possible options. Just include a justification of which 2-3 improvements you are selecting and ***why***, and only experiment with them.

8. **Evaluation (8 points)**: This section **extends** the results you reported in Milestone 2 and must include all details of your evaluation strategy. You may copy some of the results from your Milestone 2 and include results of experiments that you could not perform in detail. You may include here:
   a. Charts and images that show how well your model performs. If you are generating images, the code to generate them should be included.
   b. All comparisons across different model specification tuning choices. (B.7)
   c. Please include examples where your model gets it right, and where it fails. ***Remember that since you are working with stochastic systems, it will be inaccurate to claim that your ML system is perfect.***

9. **Limitations (2 point)**: Address the limitations of your ML system. This can be borrowed from your overall observation of the entire project. Maximum 3-4 lines is acceptable. No detailed reflection necessary.

10. **References (2 point)**: Include all references that lead to your work, feel free to include them as footnotes on each page to save space (in case your images and charts need more space).