Deep Active Learning

Learn Effectively!

Cifar 10

10 Different classes

Fashion MNIST

10 Different Classes (Clothes and Accessories)

Stanford NLP

Premis, Conclusion -> Natural, Contradiction, Entailment

Face Emotions

8 Classes represents different facial emotions

Table of contents

01 Deep Learning Architecture

02 Accuracy Measures before AL

03 The Effect of each AL strategy

04 Accuracy Measures after AL

05 Notes and Challenges

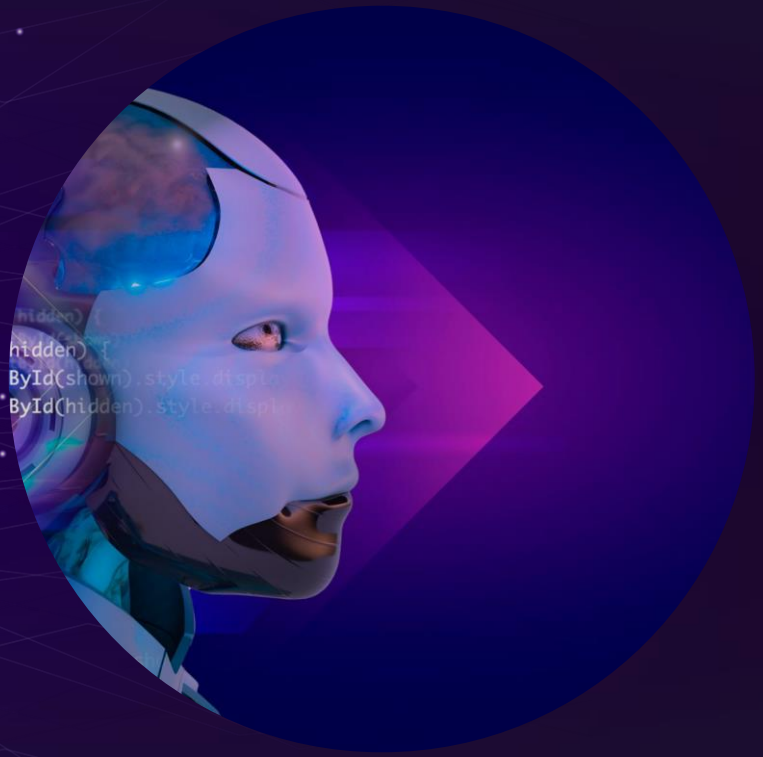
06 Additional Improvements done

Cifar 10

Classes : 10
Dimension: 32*32*3
Samples : 60,000

01

Deep Learning Architecture

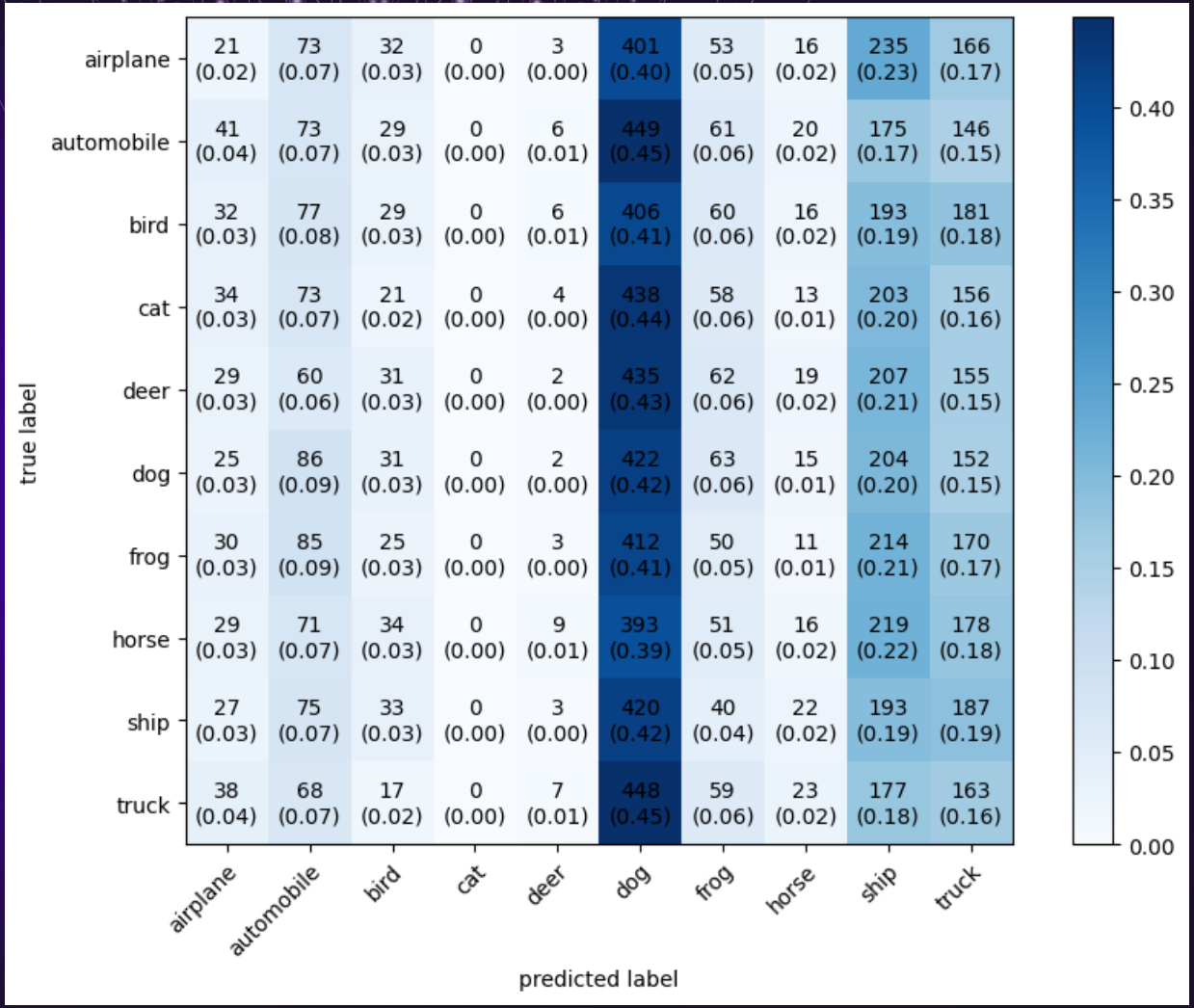


Resnet Architecture

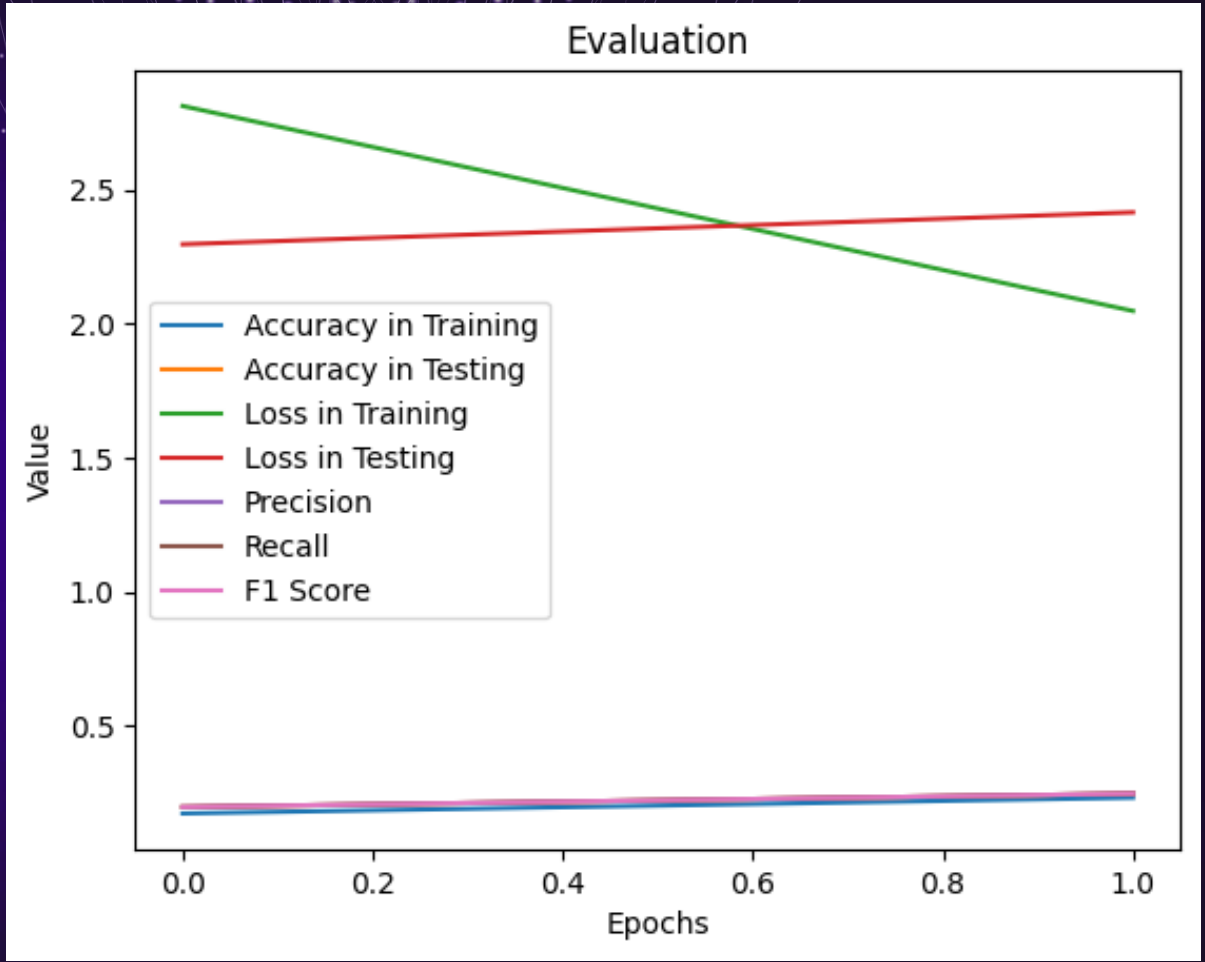
- **Innovation**: Introduces residual connections for deep network training.
- **Architecture**: 50 layers structured around residual blocks. (50M Parameters)
- **Efficiency**: Allows efficient learning of complex representations.
- **Performance**: State-of-the-art results in image classification.
- **Applicability**: Widely used across various computer vision tasks.

02

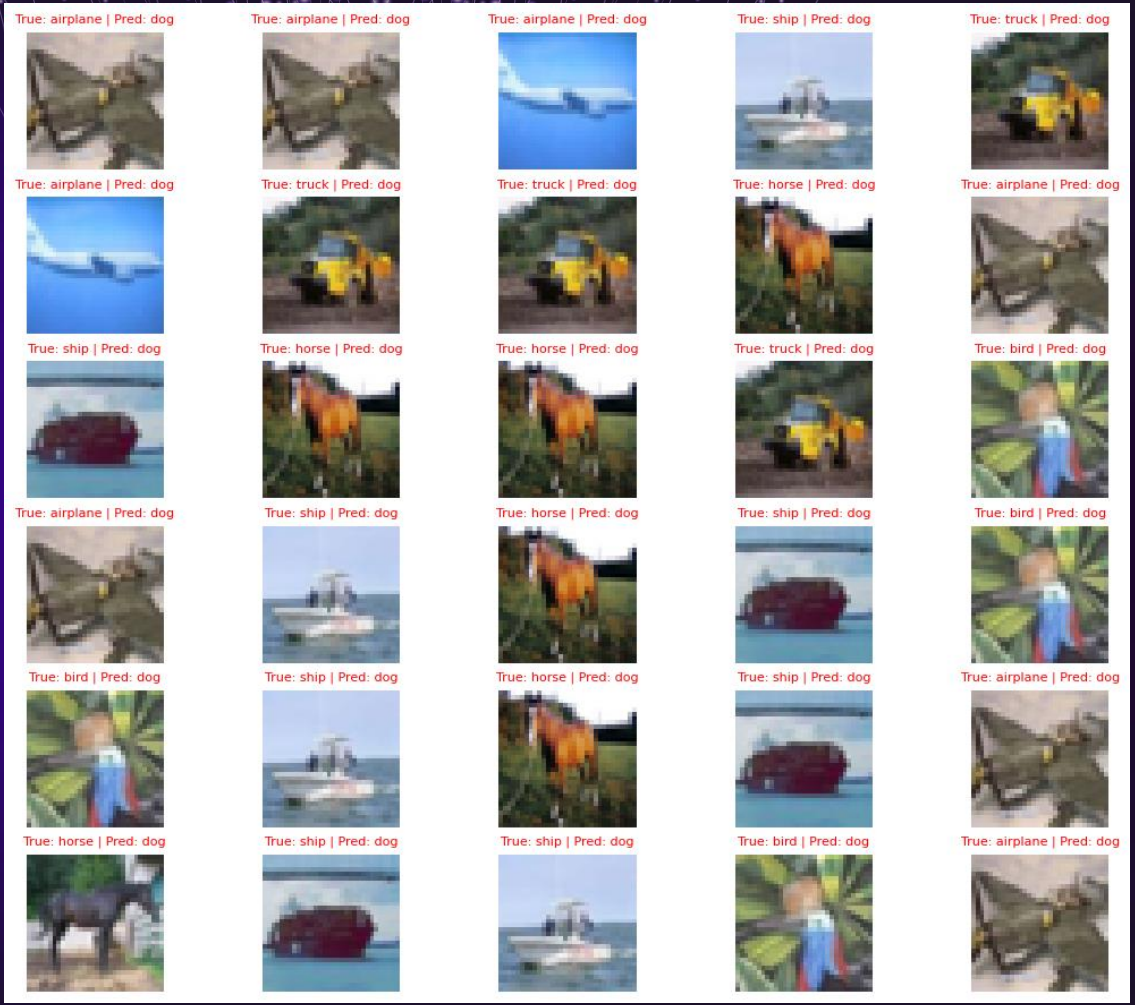
Accuracy Measures before AL



Confusion Matrix



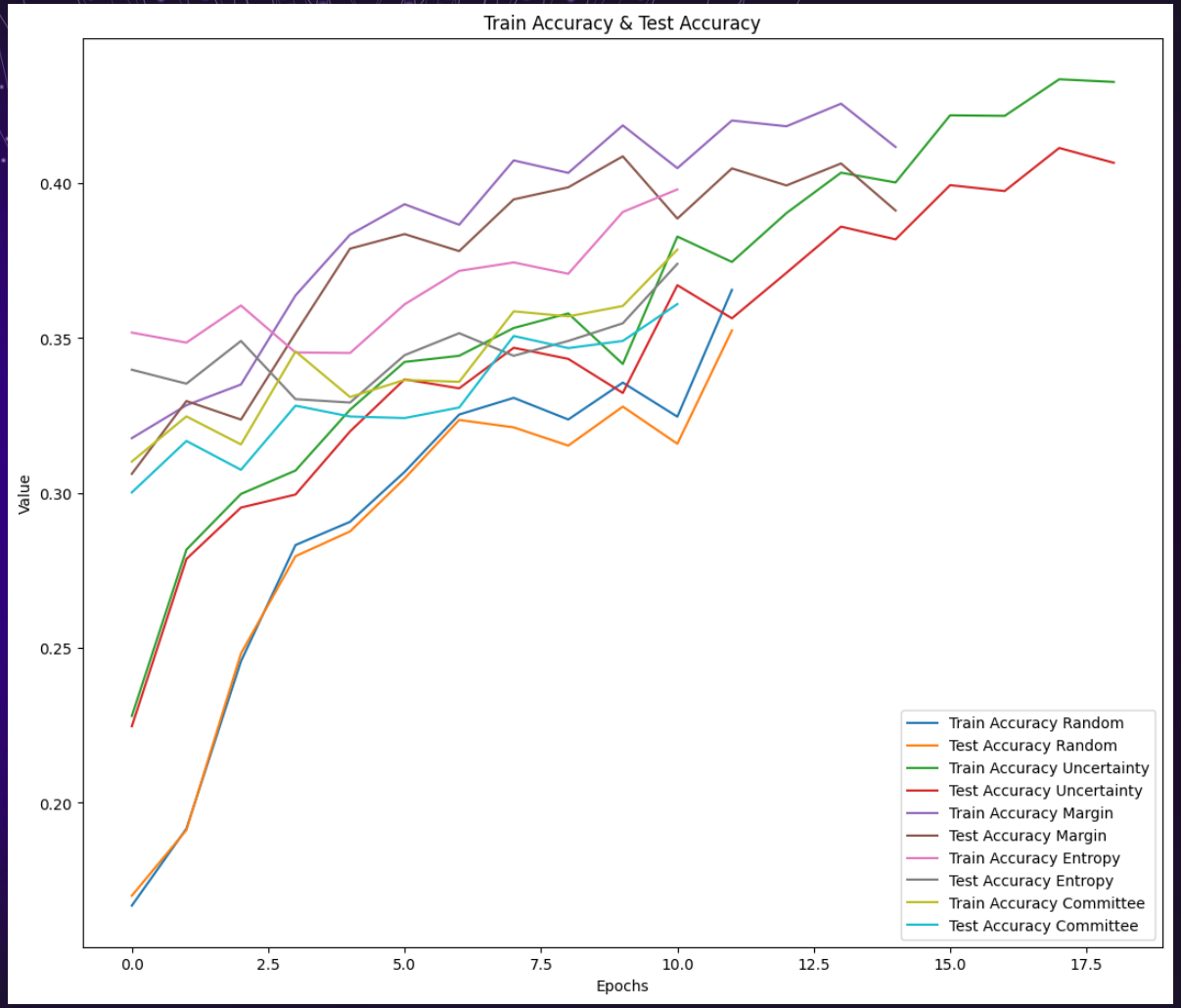
Evaluation Metrics



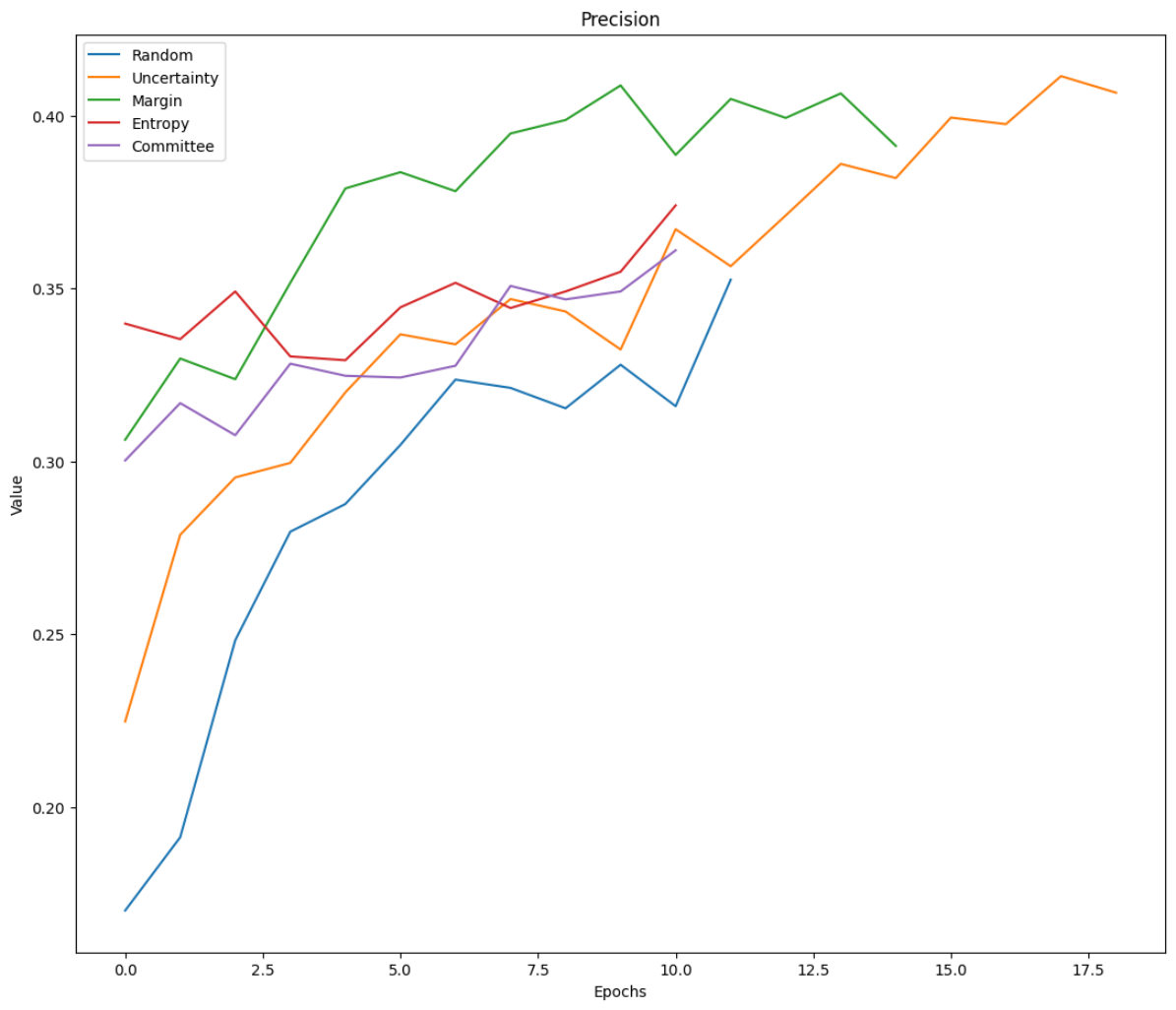
Visual Evaluation

03

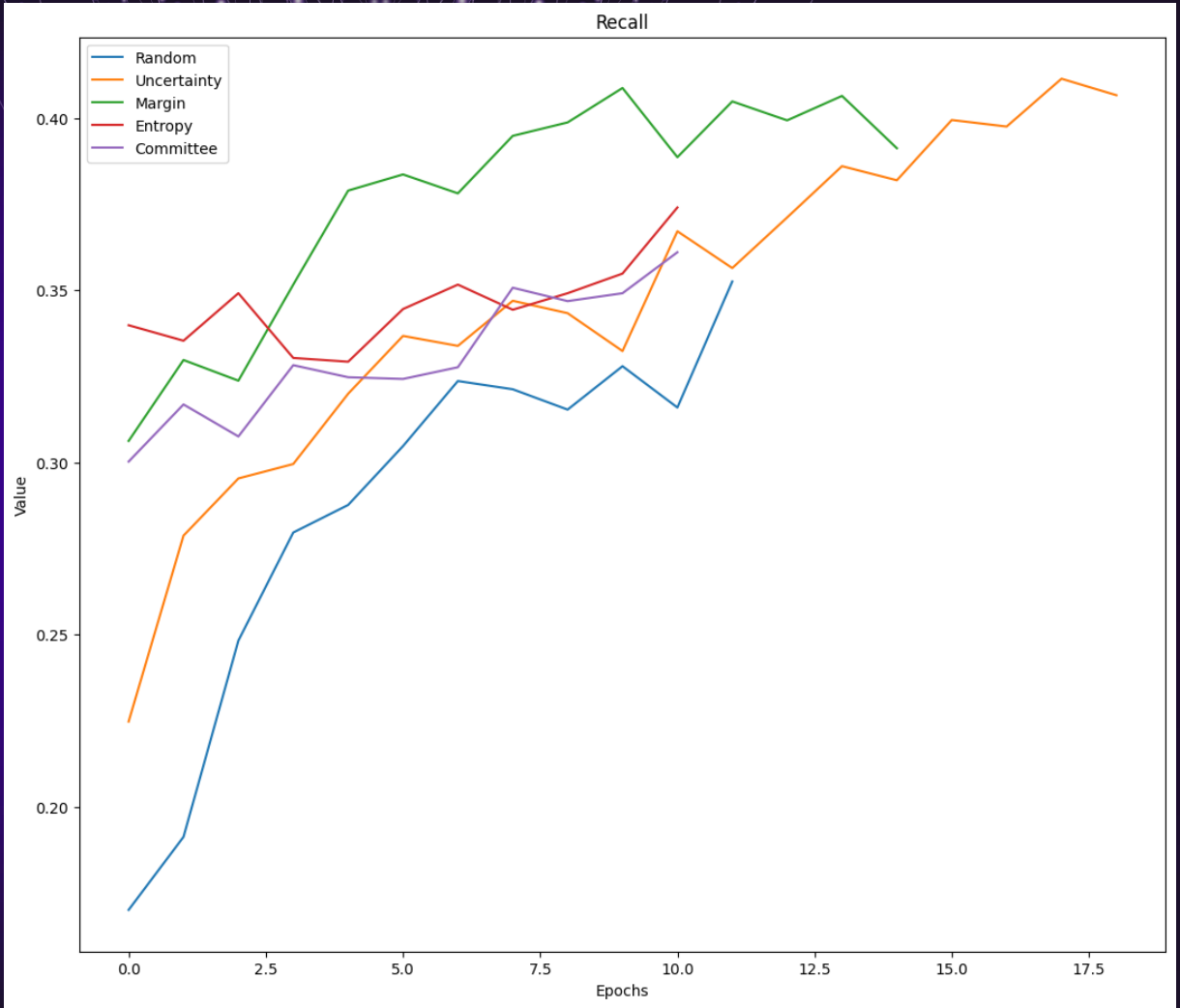
The Effect of each AL strategy


Train Accuracy & Test Accuracy
Value
Epochs
0.20
0.25
0.30
0.35
0.40
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Train Accuracy Random
Test Accuracy Random
Train Accuracy Uncertainty
Test Accuracy Uncertainty
Train Accuracy Margin
Test Accuracy Margin
Train Accuracy Entropy
Test Accuracy Entropy
Train Accuracy Committee
Test Accuracy Committee

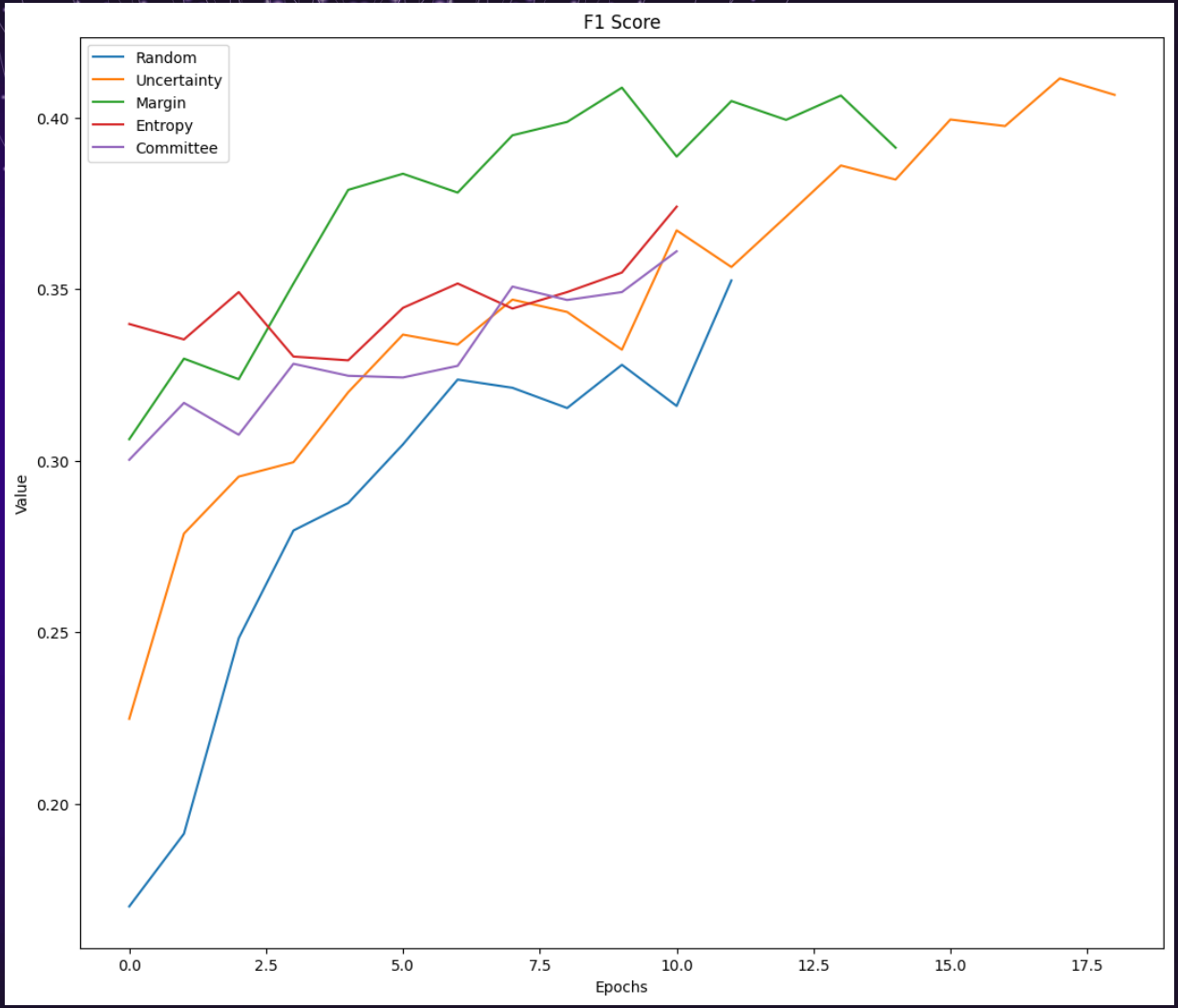
Accuracy


Precision
Random
Uncertainty
Margin
Entropy
Committee
0.40
0.35
0.30
0.25
0.20
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Epochs

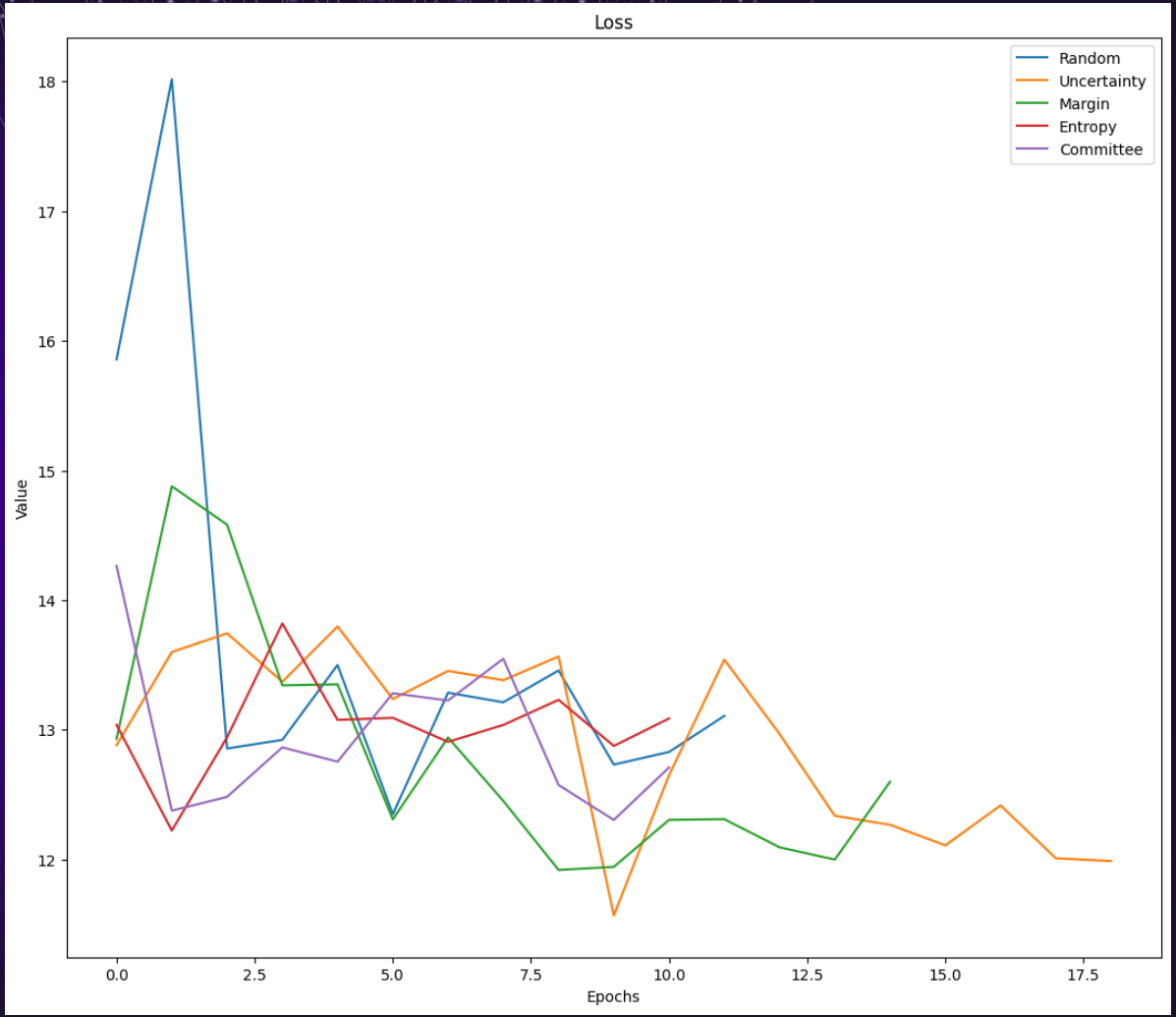
Precision


Recall
Random
Uncertainty
Margin
Entropy
Committee
0.40
0.35
0.30
0.25
0.20
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Epochs

Recall


F1 Score
Random
Uncertainty
Margin
Entropy
Committee
0.40
0.35
0.30
0.25
0.20
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Epochs

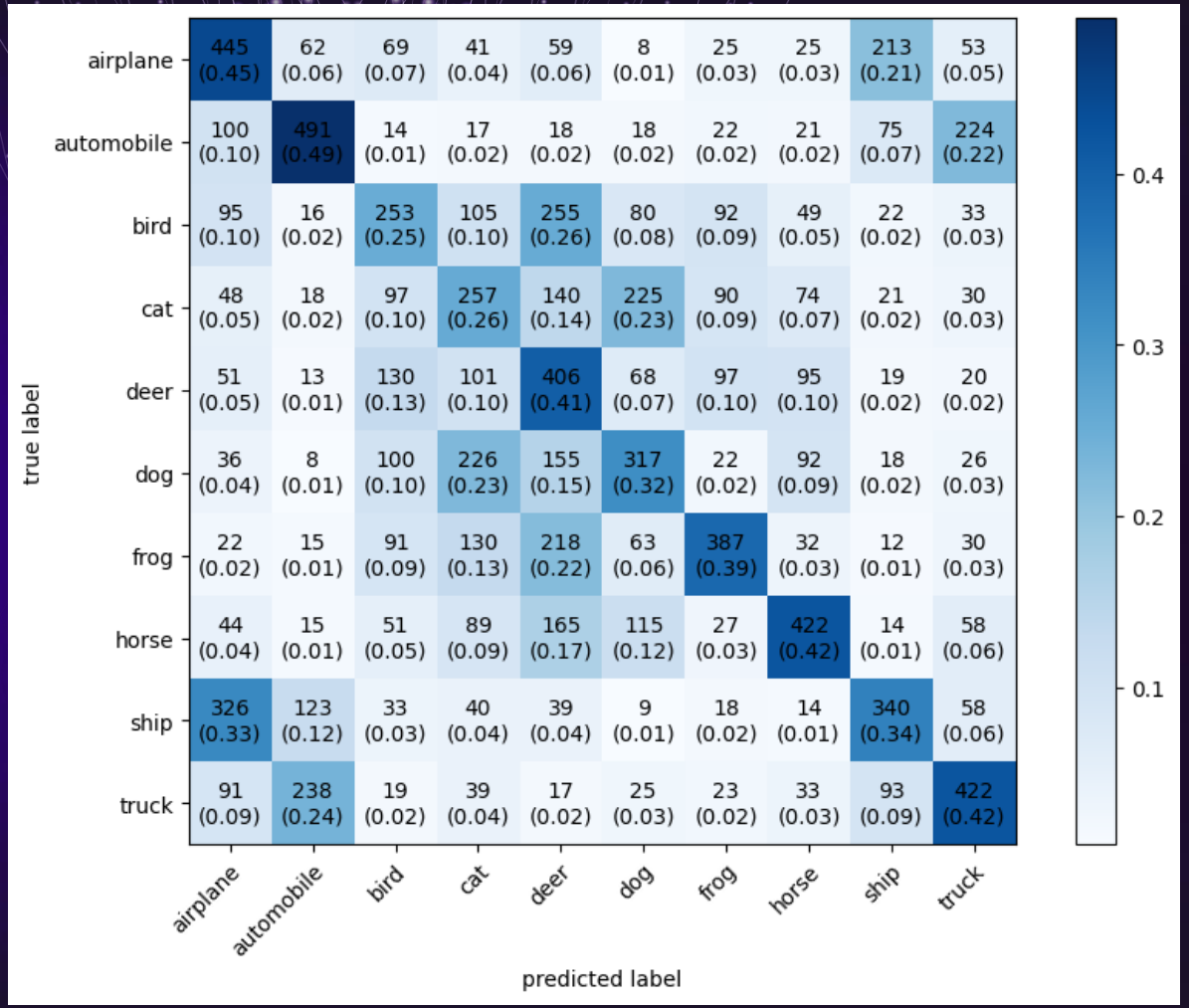
F1 Score


Loss
Random
Uncertainty
Margin
Entropy
Committee
Value
Epochs
18
17
16
15
14
13
12
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

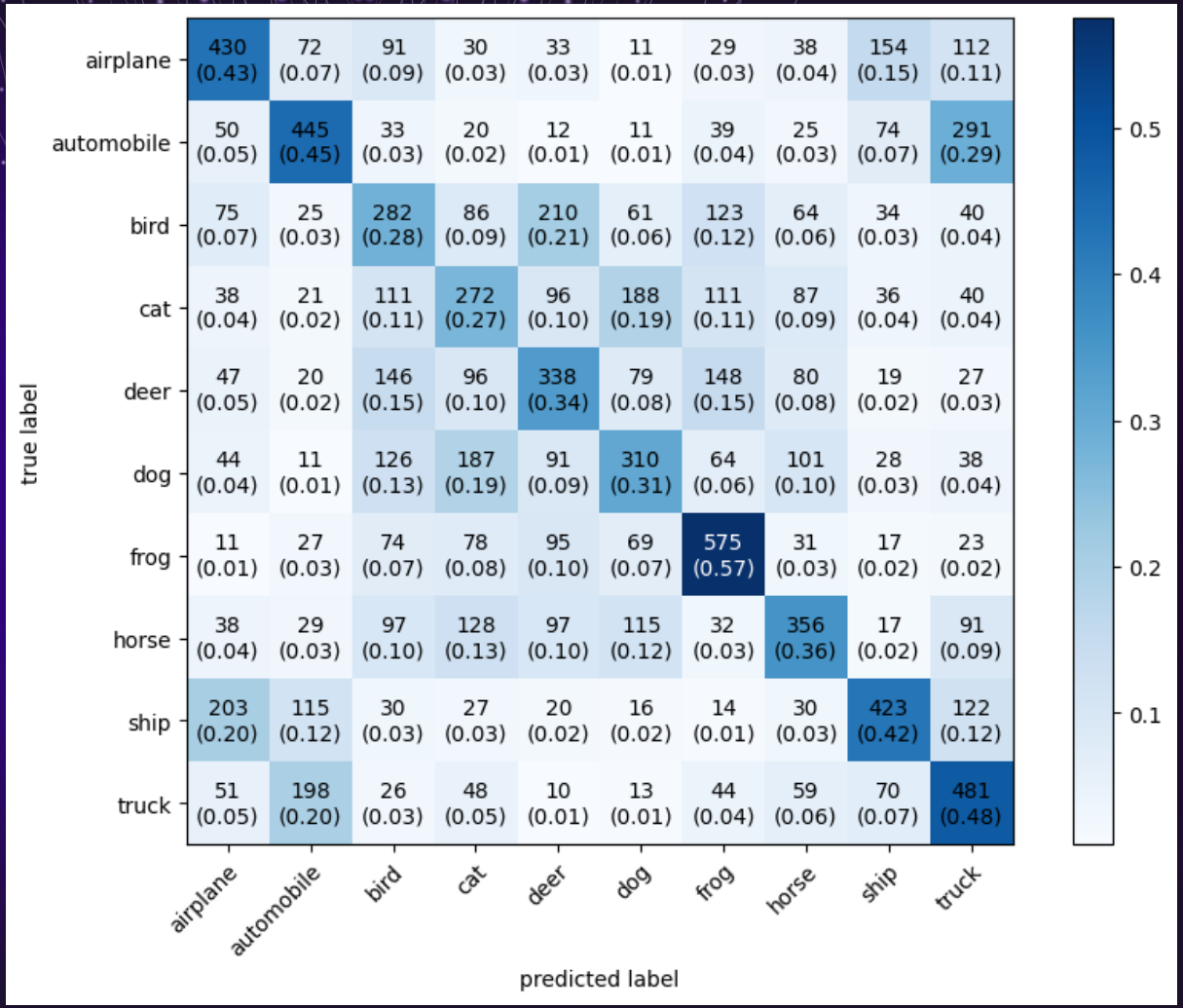
Loss

04

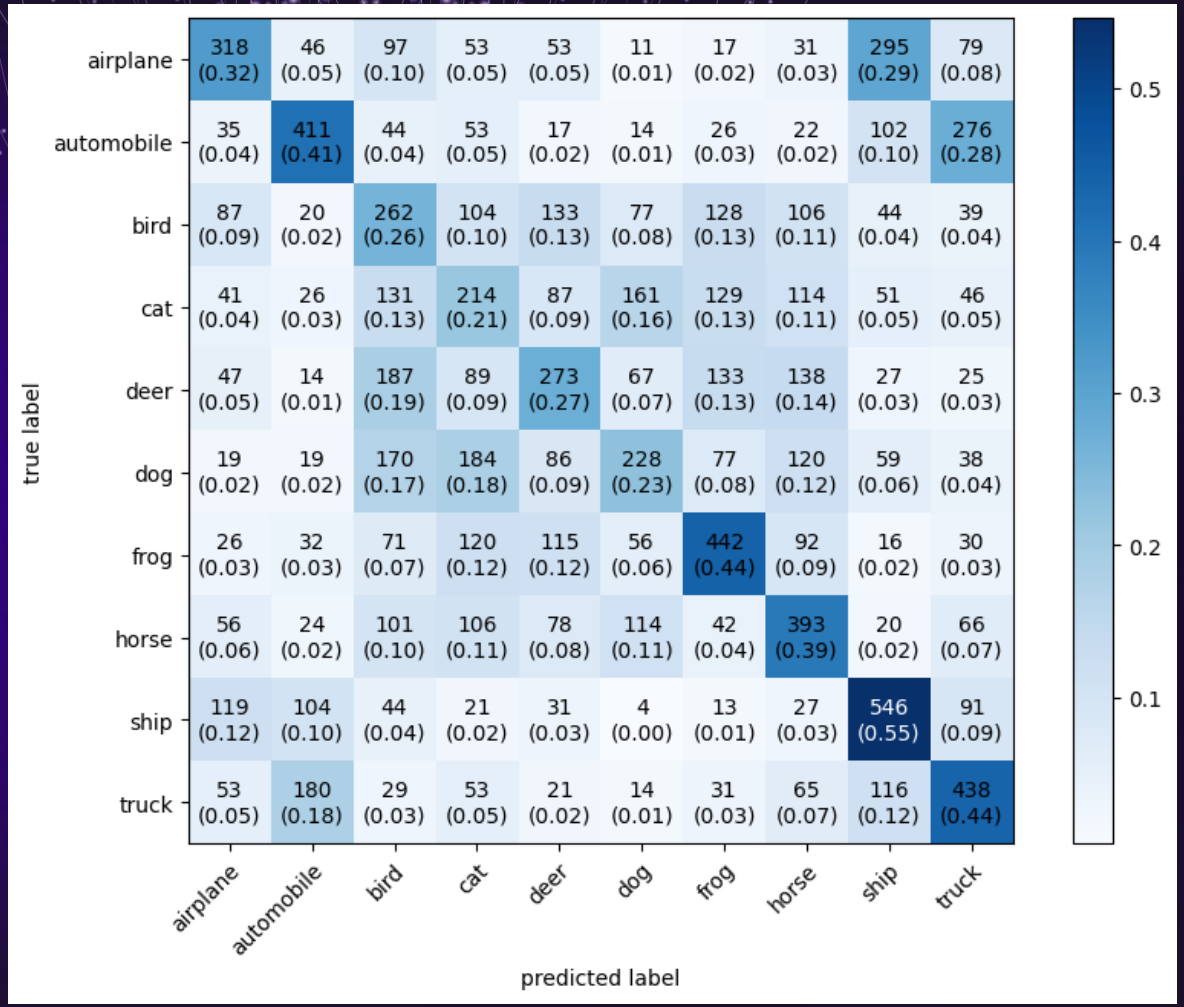
Accuracy Measures after AL



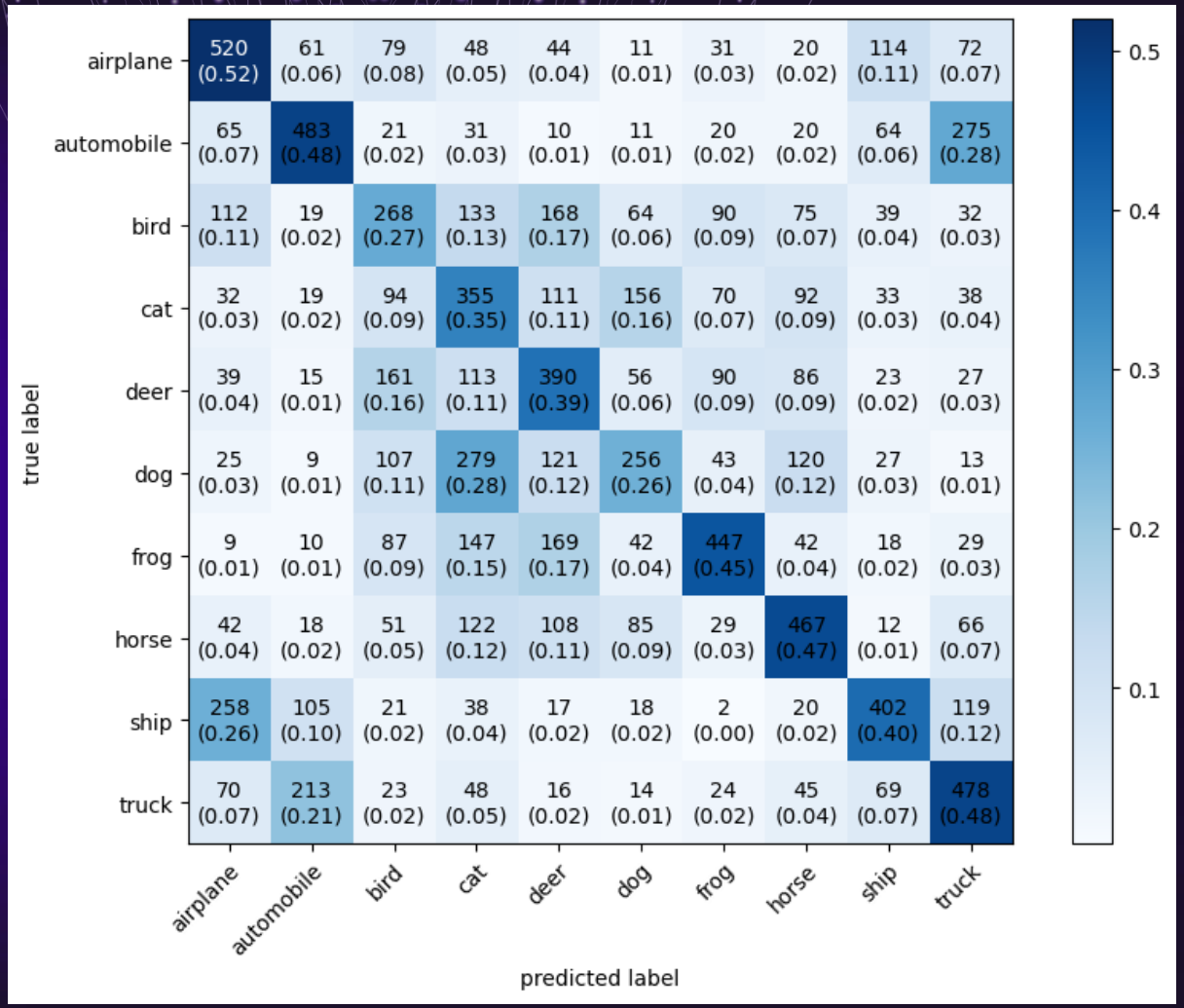
Entropy Based Sampling



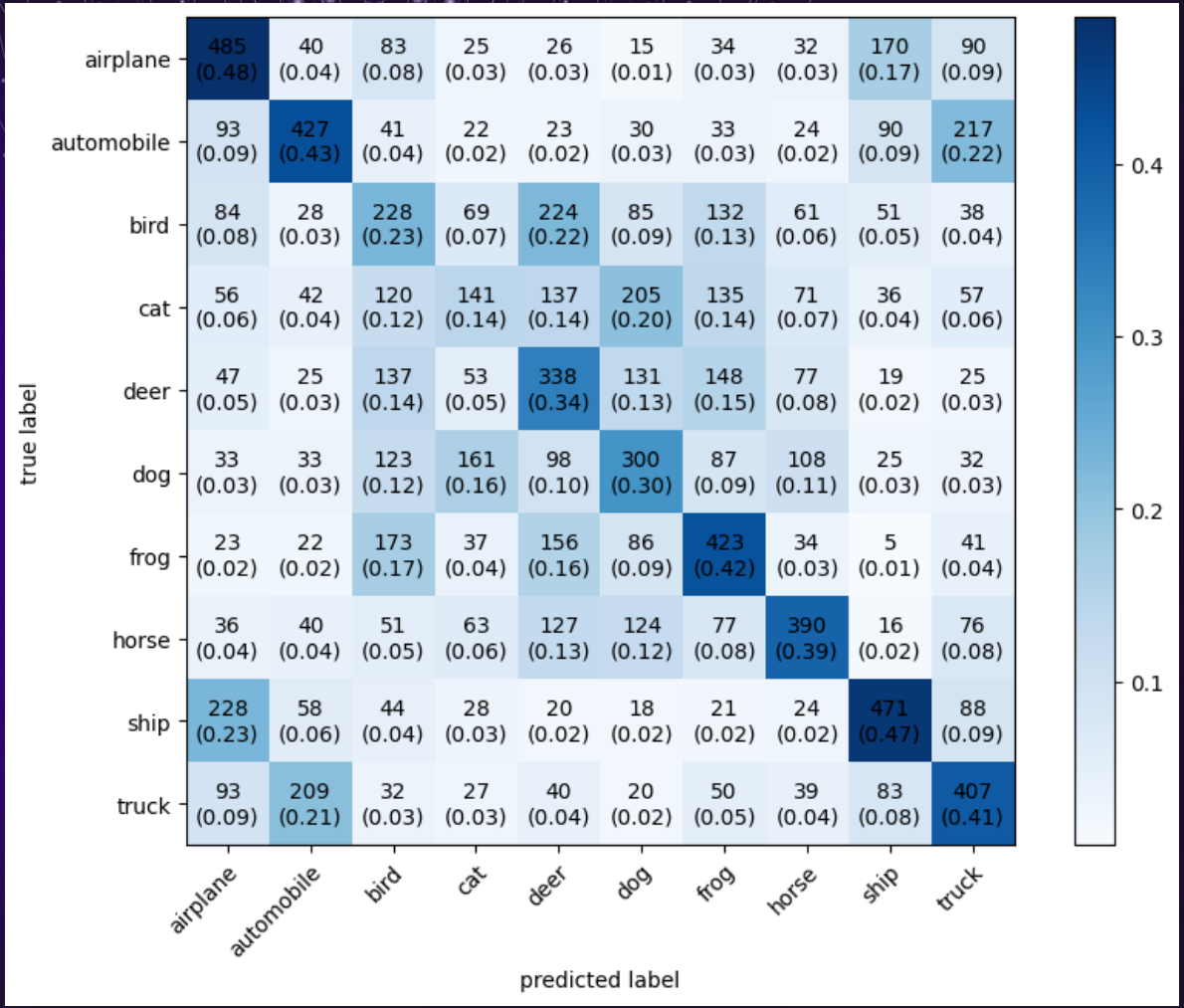
Margin Sampling



Random Sampling



Uncertainty Sampling



Query By Committee

05

Notes and Challenges

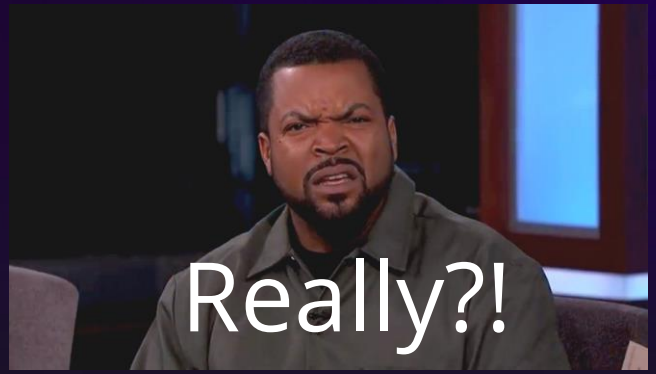
Notes and Challenges

D-type Compatibility Problem

The default dtype of pytorch datasets is (torch.Float) for some datasets and (torch.Int) for others.
The default dtpye is not complatiple with the ModAl package

Solution

We had to convert the dtype of the dataset into (torch.float32)



Notes and Challenges

Managing Devices

There was a problem to unify the device between the pytorch model and dataset and the Modal learner

Solution

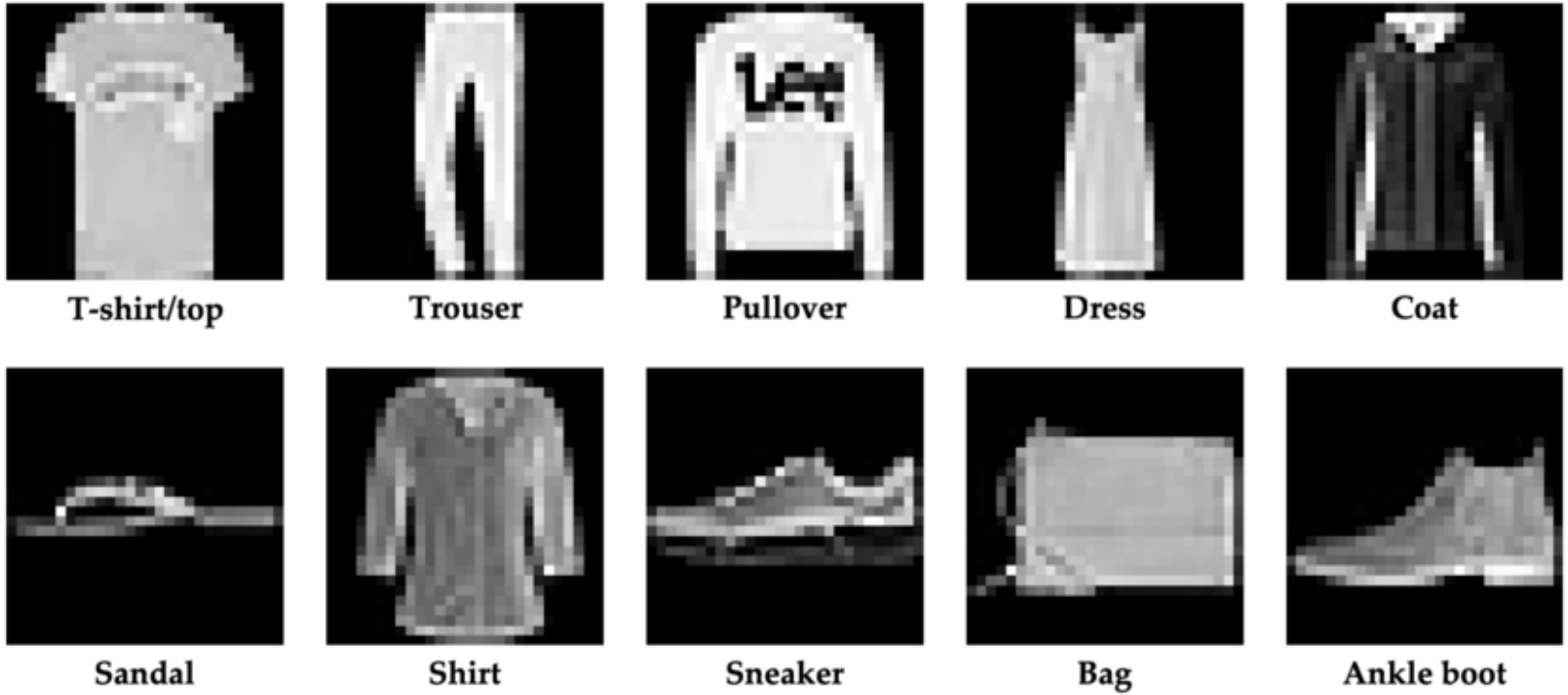
Data has to be transferred manually between devices in Modal

06

Additional Improvements done

No Improvements!

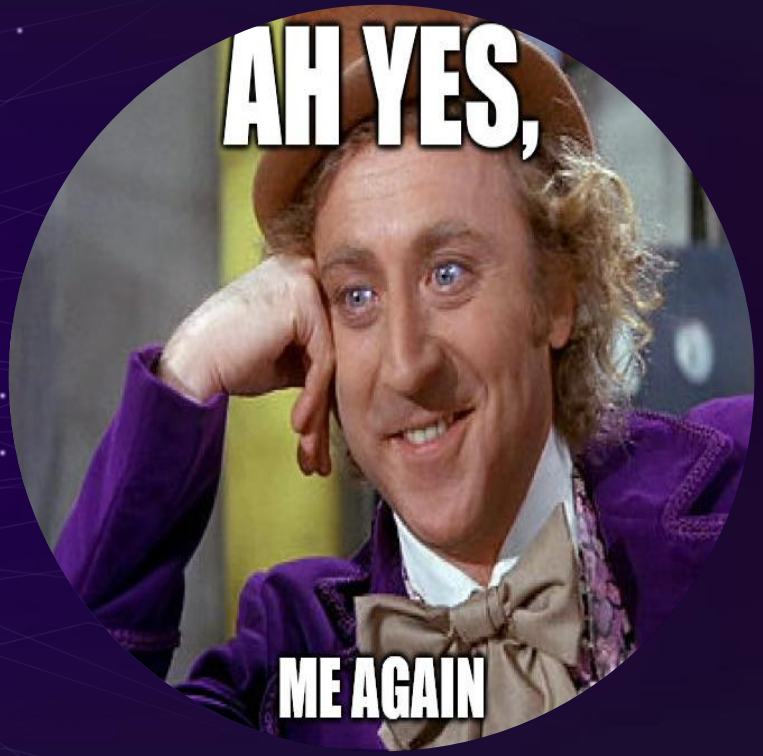
Fashion MNIST



Classes : 10
Dimension: 28*28*3
Samples : 10,000

01

Deep Learning Architecture

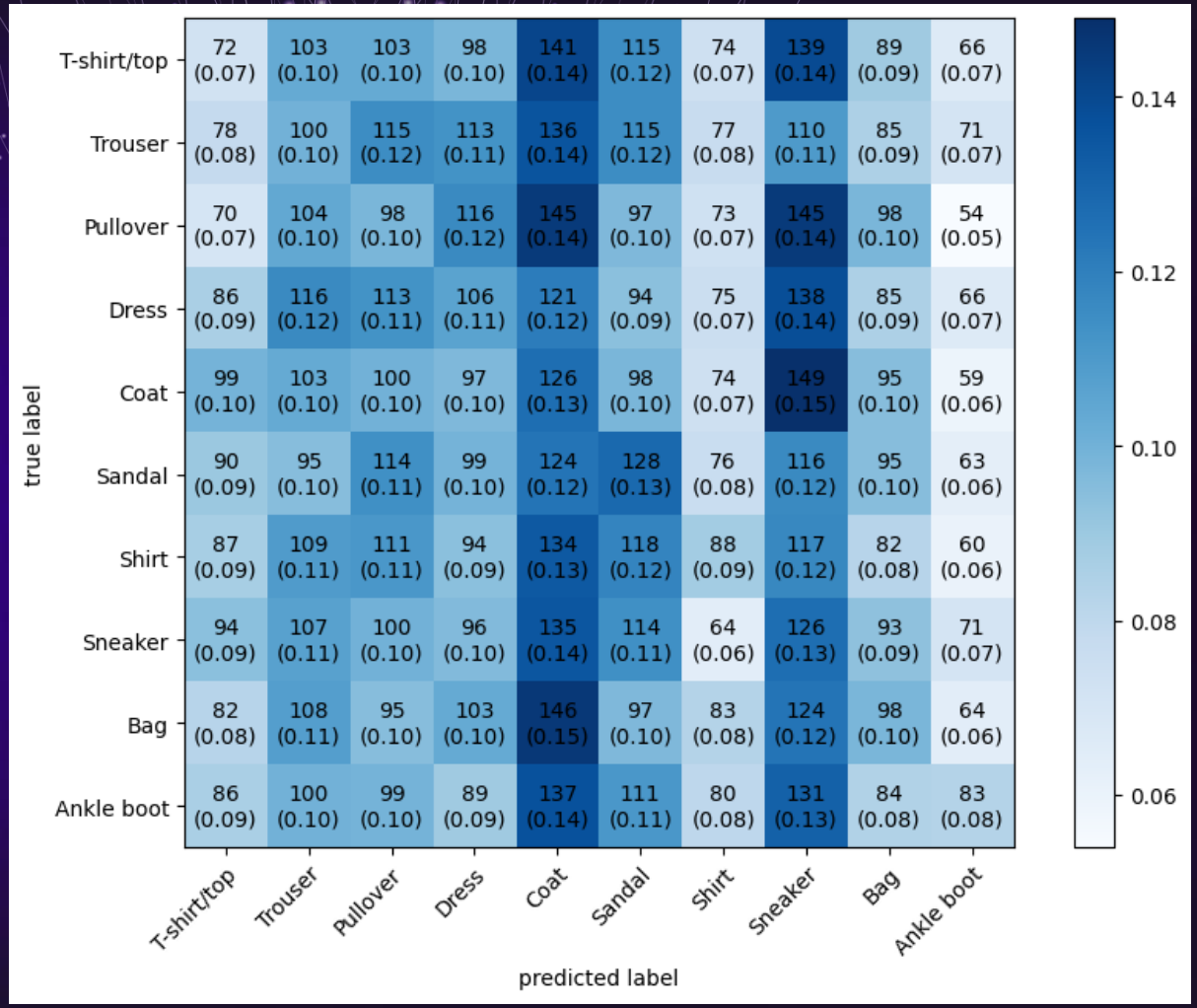


Resnet Architecture

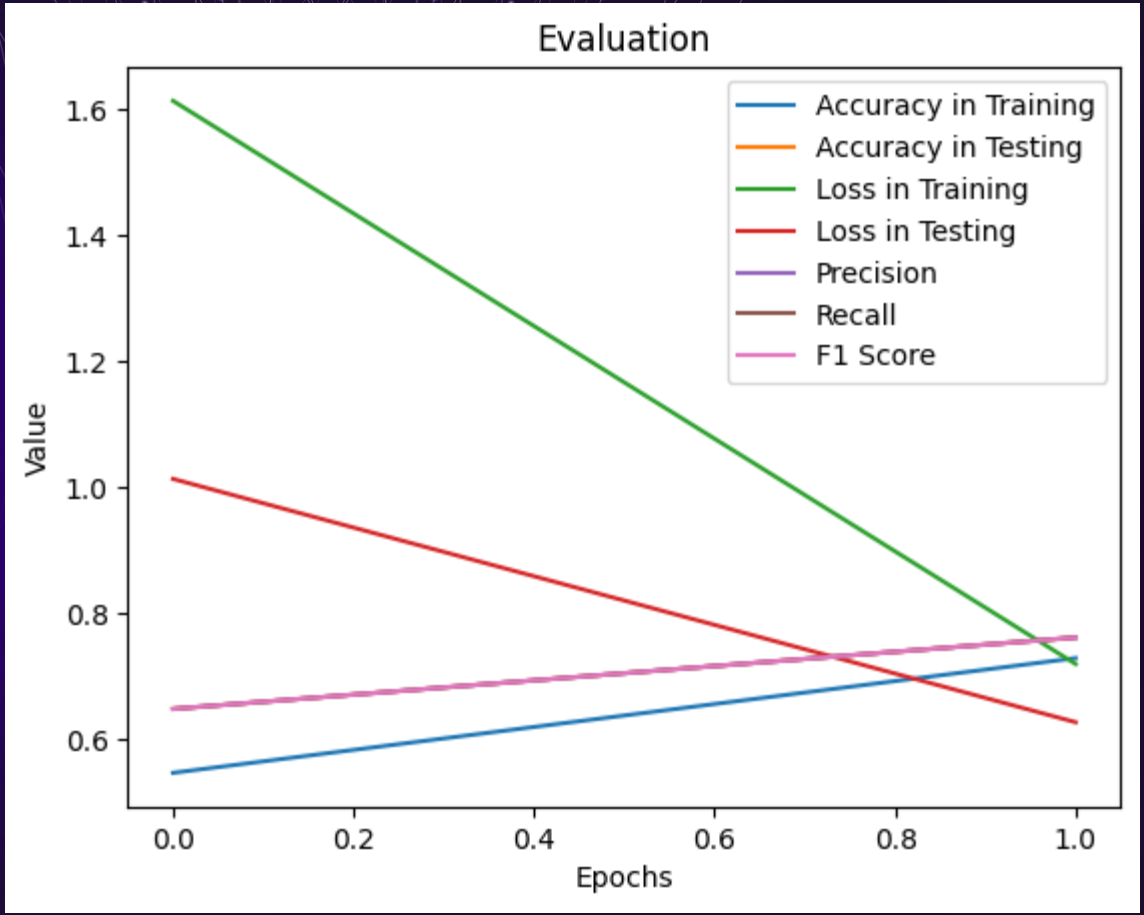
- **Innovation**: Introduces residual connections for deep network training.
- **Architecture**: 50 layers structured around residual blocks. (50M Parameters)
- **Efficiency**: Allows efficient learning of complex representations.
- **Performance**: State-of-the-art results in image classification.
- **Applicability**: Widely used across various computer vision tasks.

02

Accuracy Measures before AL



Confusion Matrix

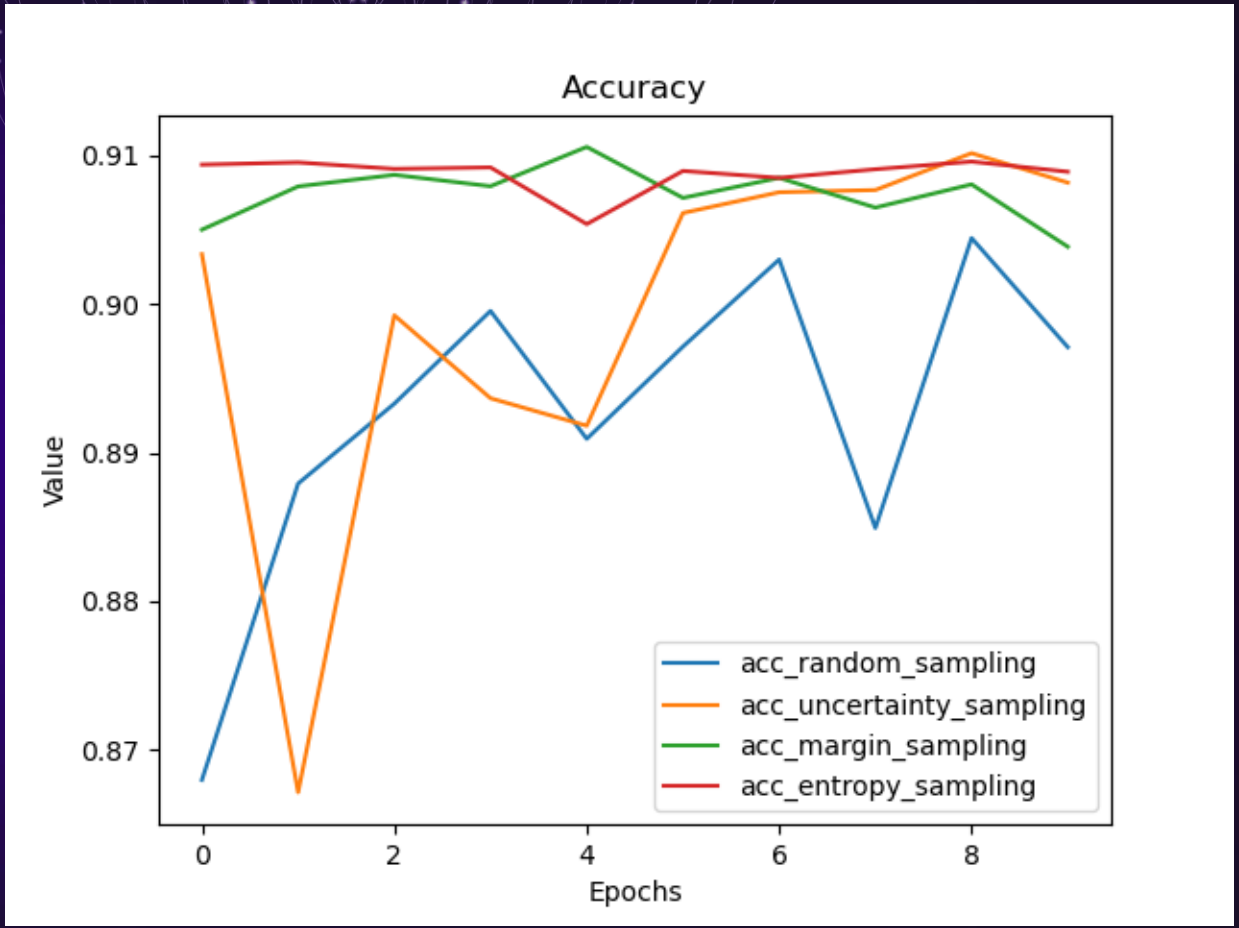


Evaluation Metrics

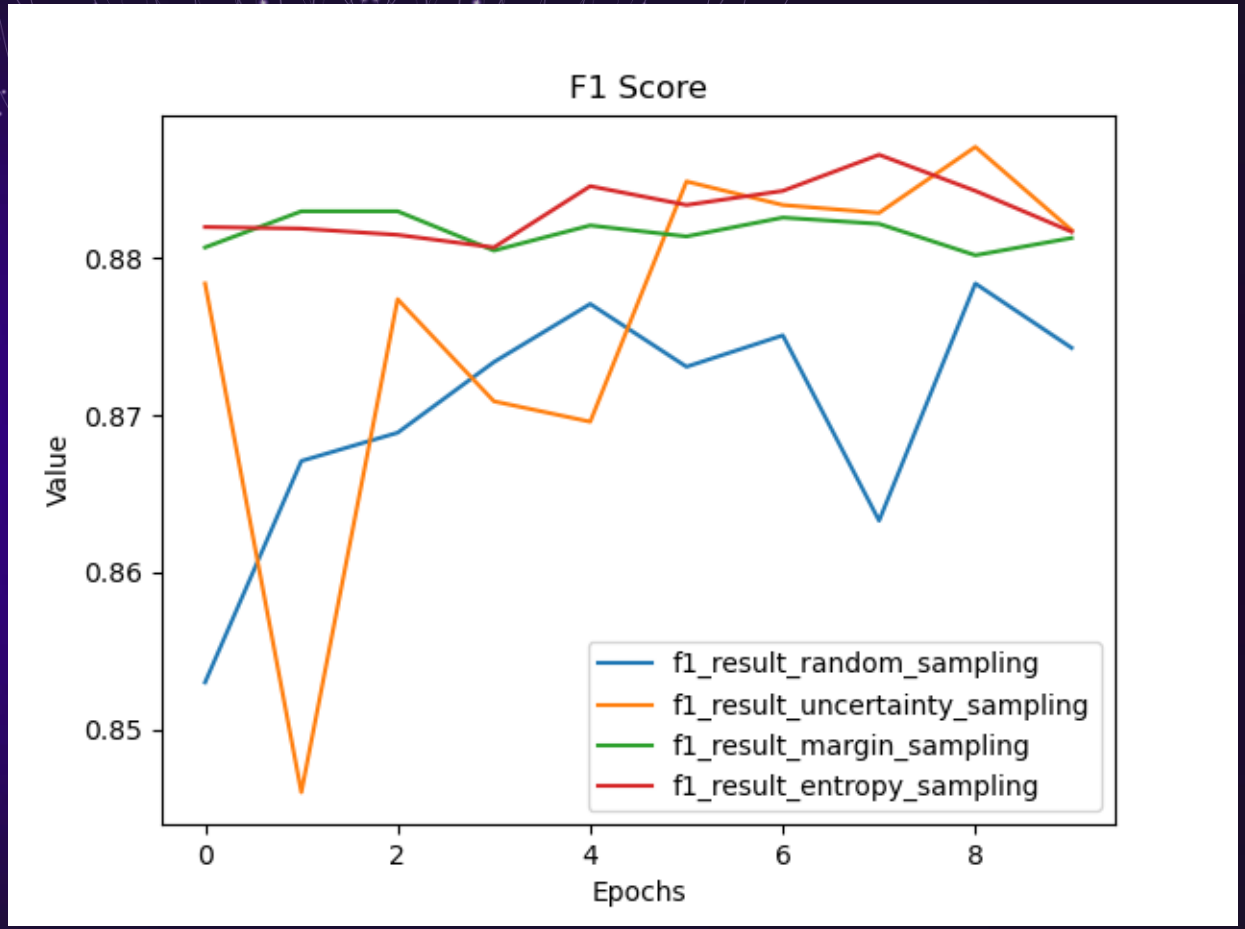
Visual Evaluation

03

The Effect of each AL strategy


Accuracy
0.91
0.90
0.89
0.88
0.87
Value
0
2
4
6
8
Epochs
acc_random_sampling
acc_uncertainty_sampling
acc_margin_sampling
acc_entropy_sampling

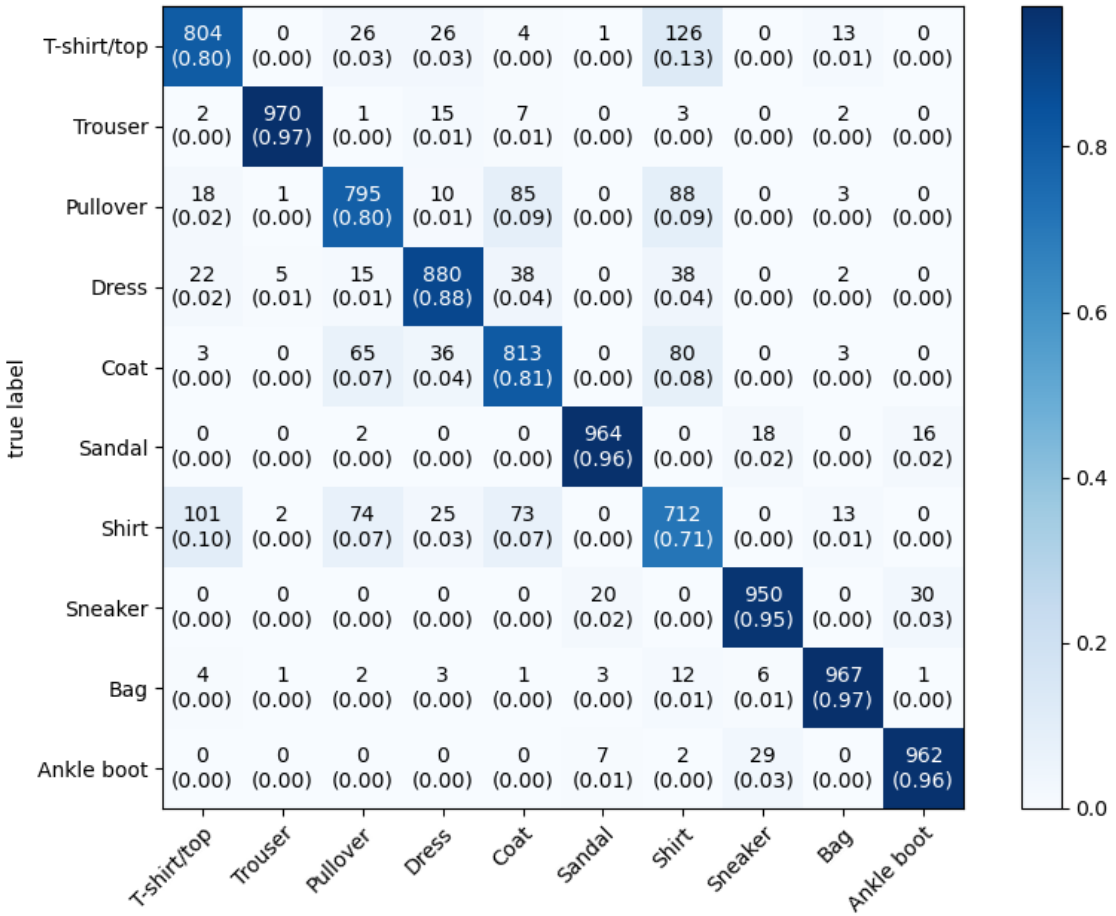
Accuracy


F1 Score
0.88
0.87
0.86
0.85
Value
0
2
4
6
8
Epochs
f1_result_random_sampling
f1_result_uncertainty_sampling
f1_result_margin_sampling
f1_result_entropy_sampling

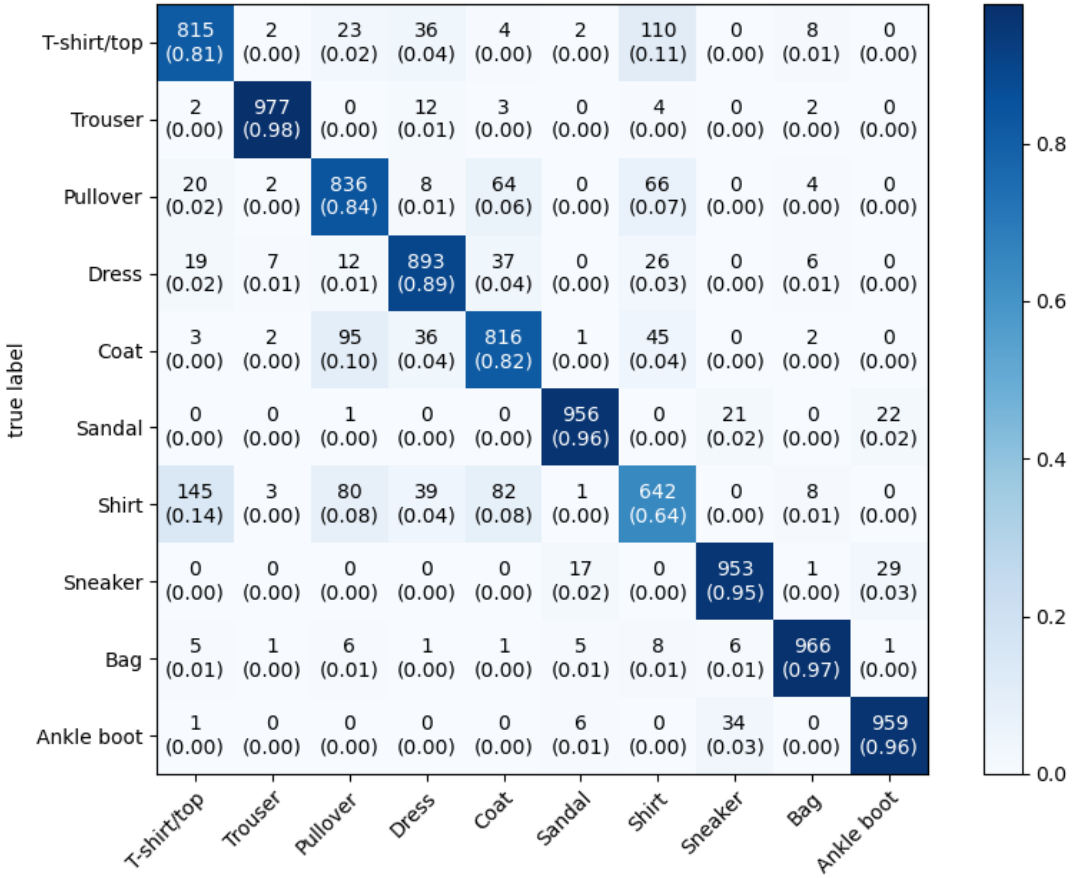
F1 Score

04

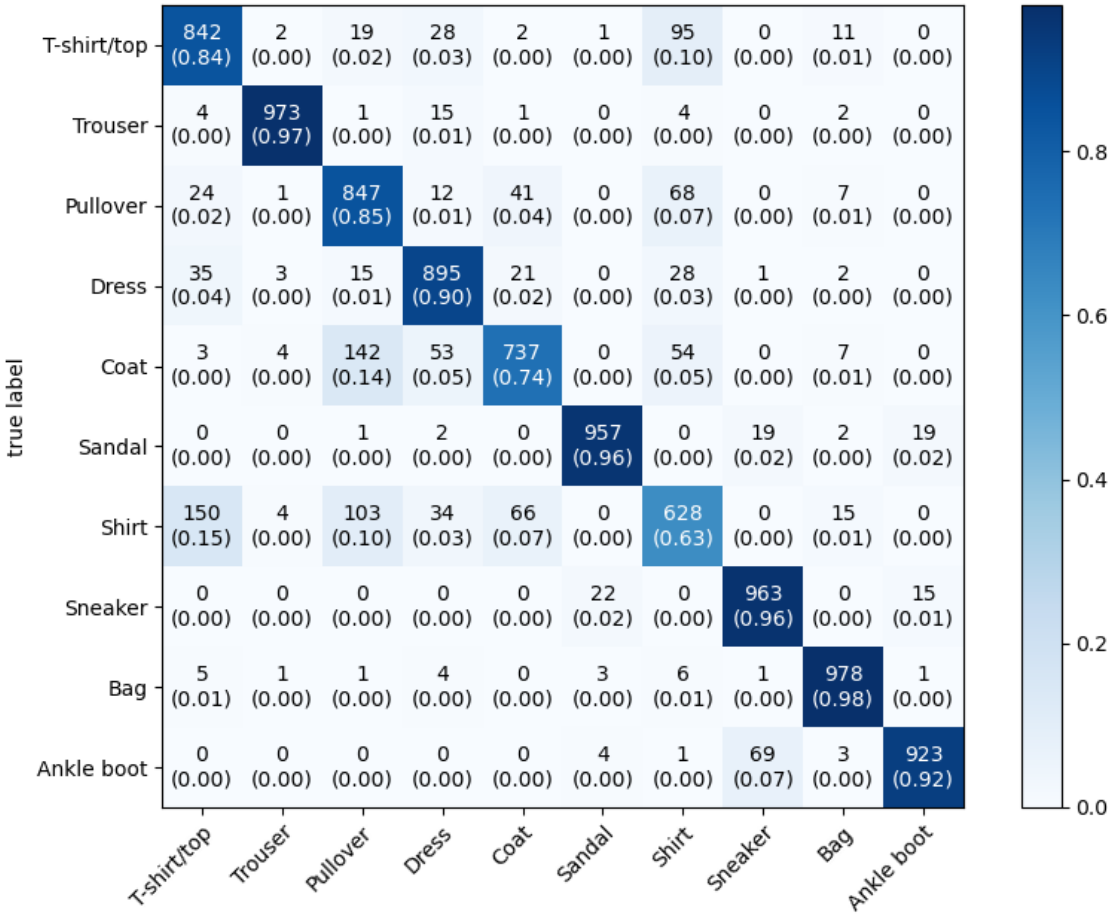
Accuracy Measures after AL



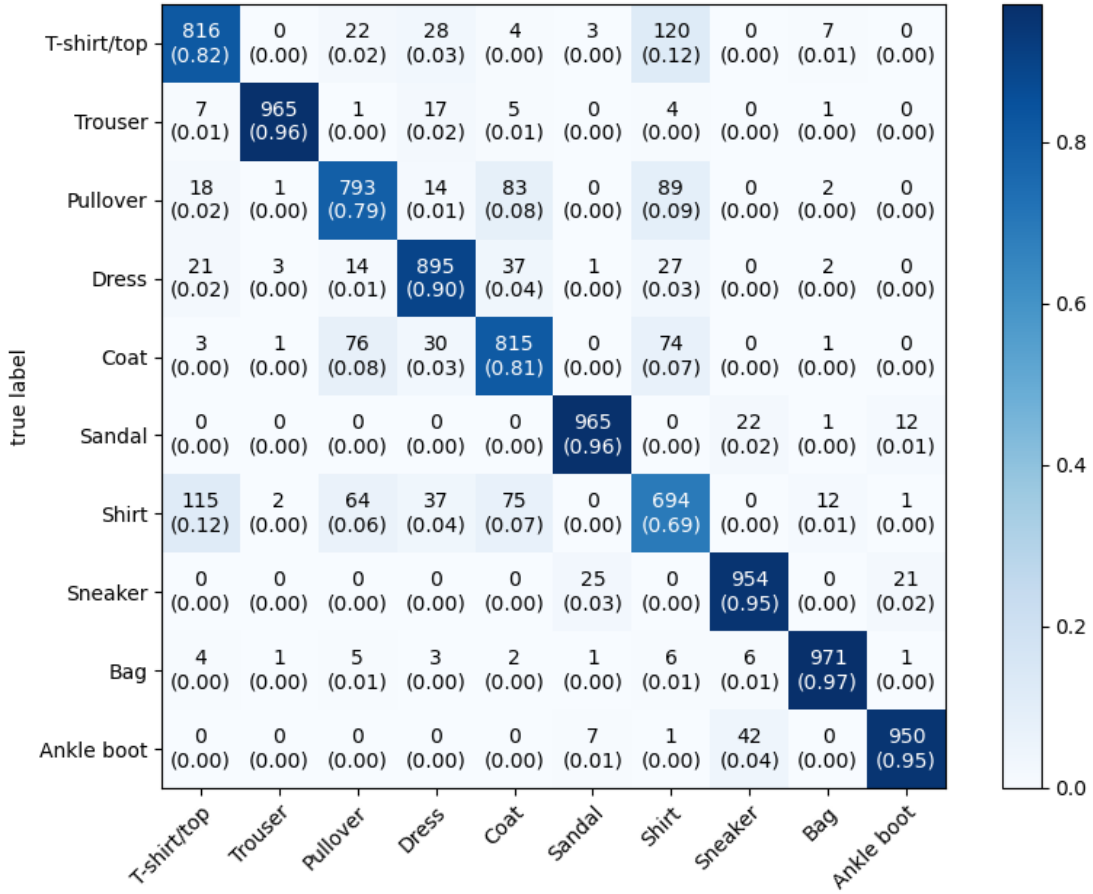
Entropy Based Sampling



Margin Sampling



Random Sampling



Uncertainty Sampling

05

Notes and Challenges

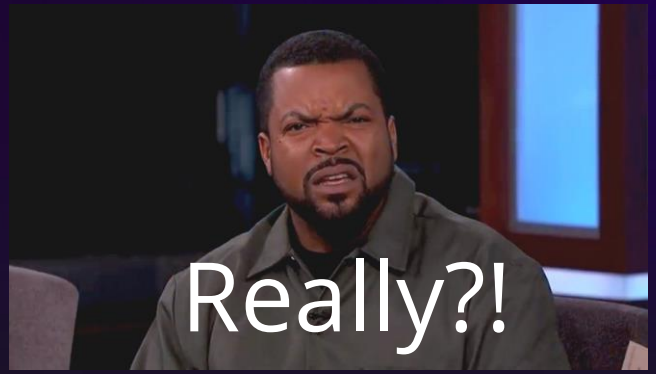
Notes and Challenges

D-type Compatibility Problem

The default dtype of pytorch datasets is (torch.Float) for some datasets and (torch.Int) for others.
The default dtpye is not complatiple with the ModAl package

Solution

We had to convert the dtype of the dataset into (torch.float32)



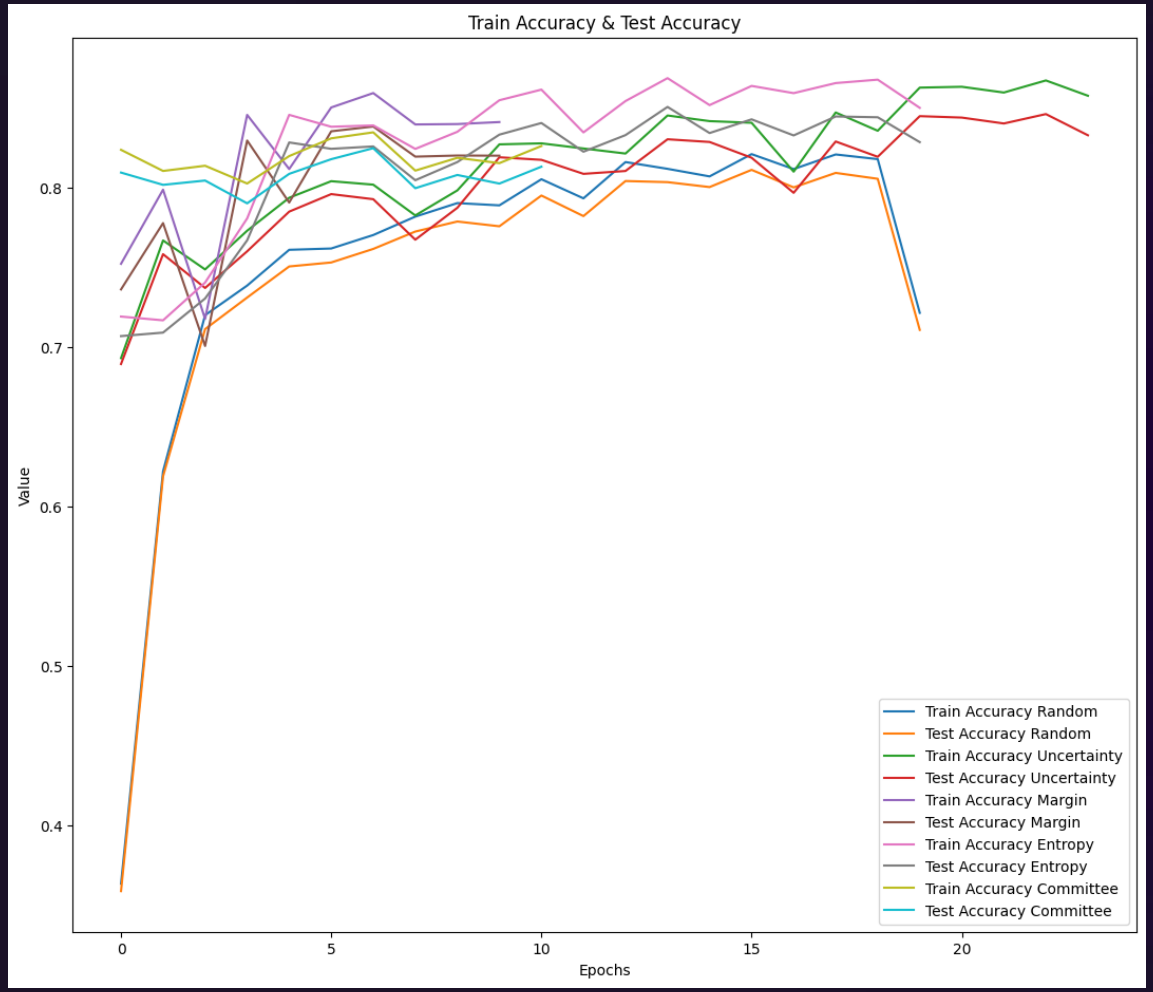
Notes and Challenges

Managing Devices

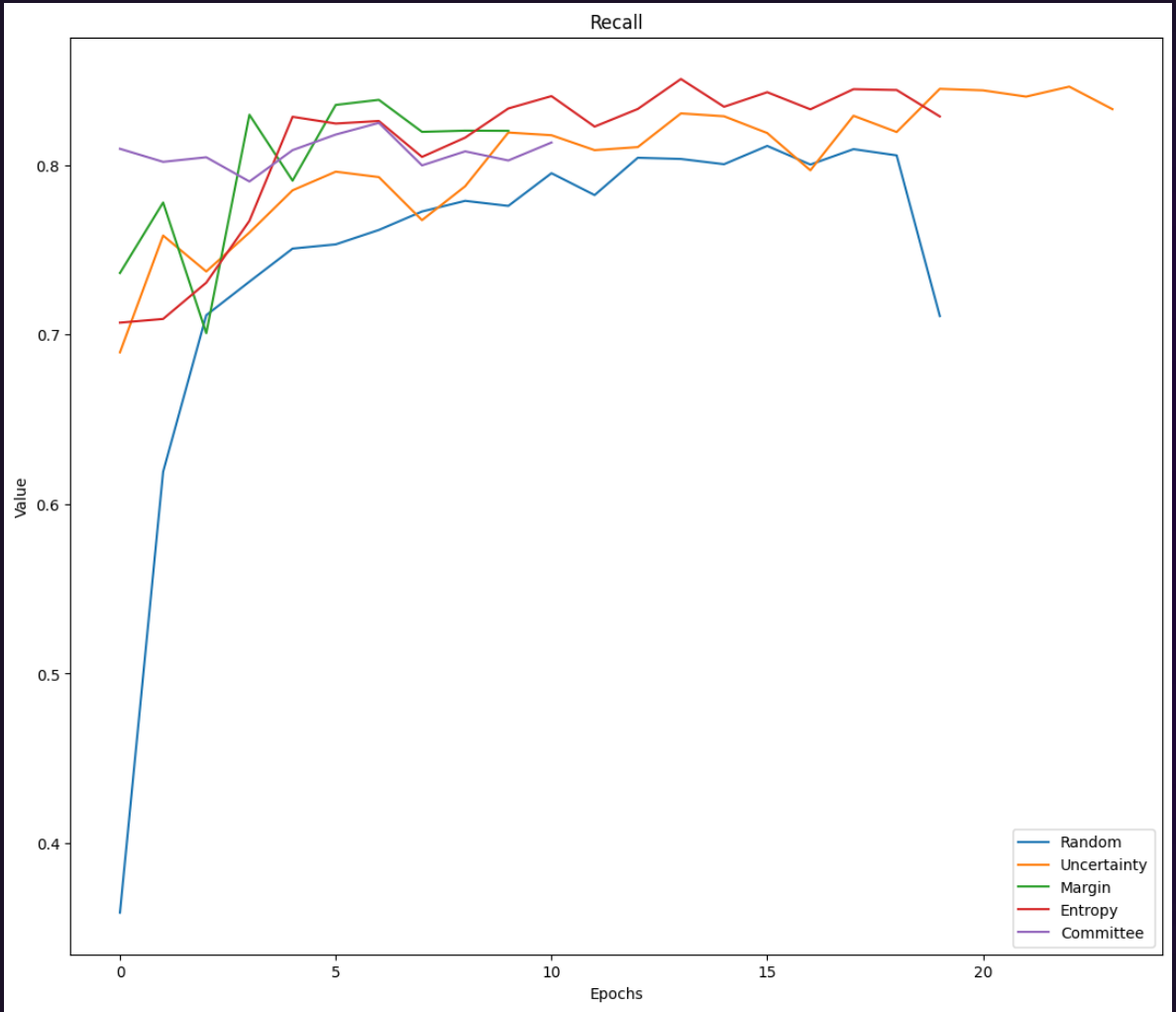
There was a problem to unify the device between the pytorch model and dataset and the Modal learner

Solution

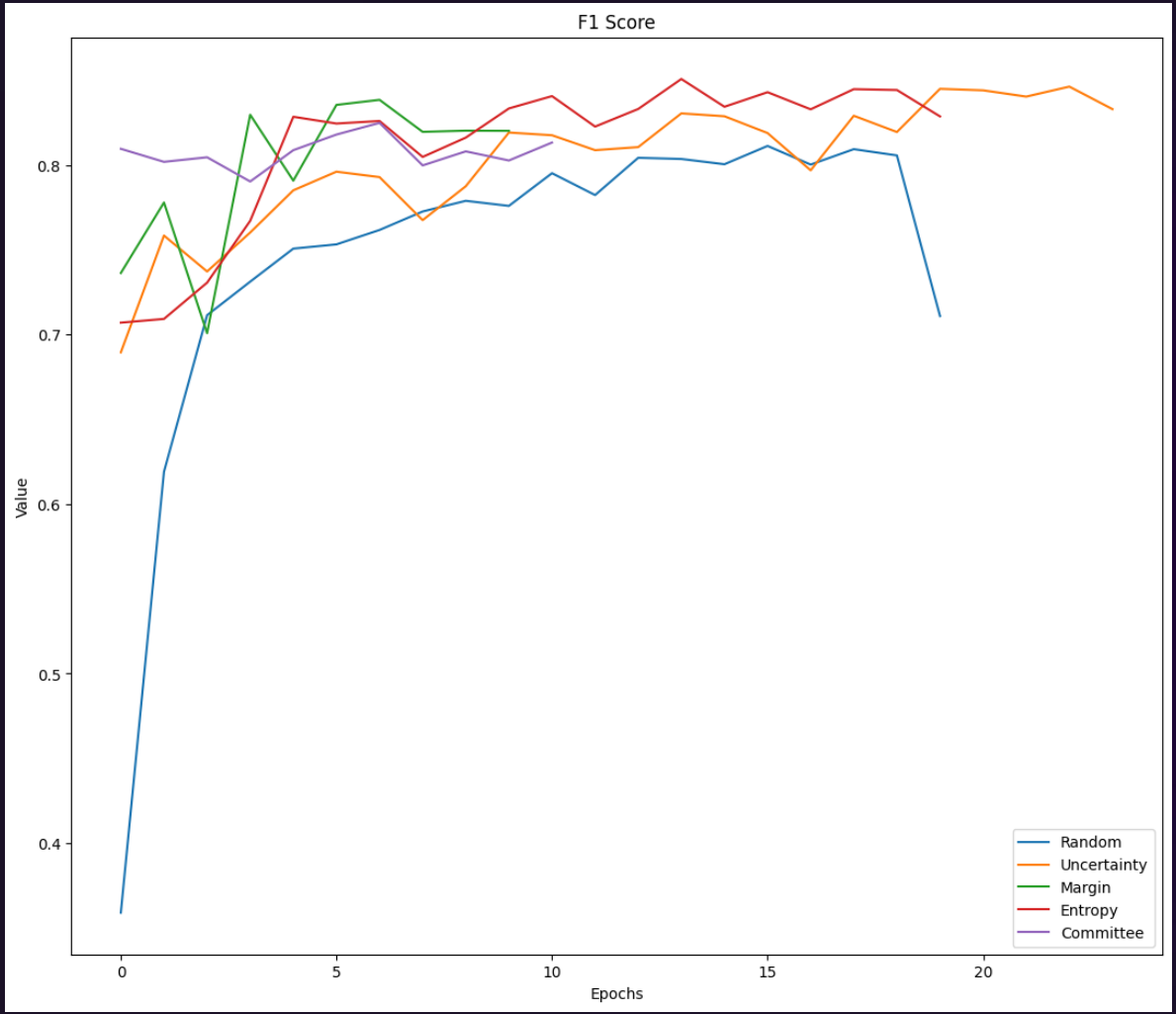
Data has to be transferred manually between devices in Modal


Train Accuracy & Test Accuracy
Value
Epochs
0.4
0.5
0.6
0.7
0.8
0
5
10
15
20
Train Accuracy Random
Test Accuracy Random
Train Accuracy Uncertainty
Test Accuracy Uncertainty
Train Accuracy Margin
Test Accuracy Margin
Train Accuracy Entropy
Test Accuracy Entropy
Train Accuracy Committee
Test Accuracy Committee

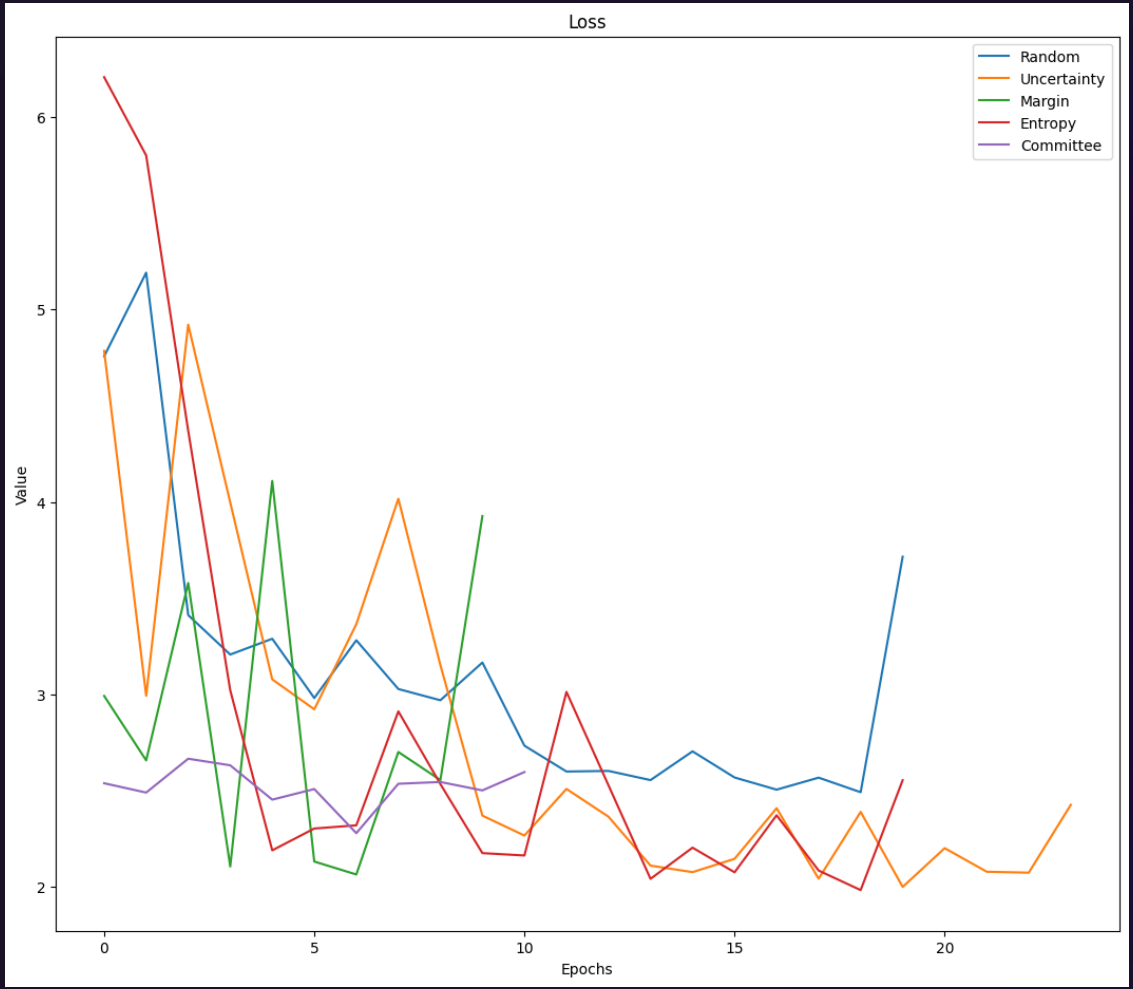
Accuracy


Recall
Value
Epochs
0.8
0.7
0.6
0.5
0.4
0
5
10
15
20
Random
Uncertainty
Margin
Entropy
Committee

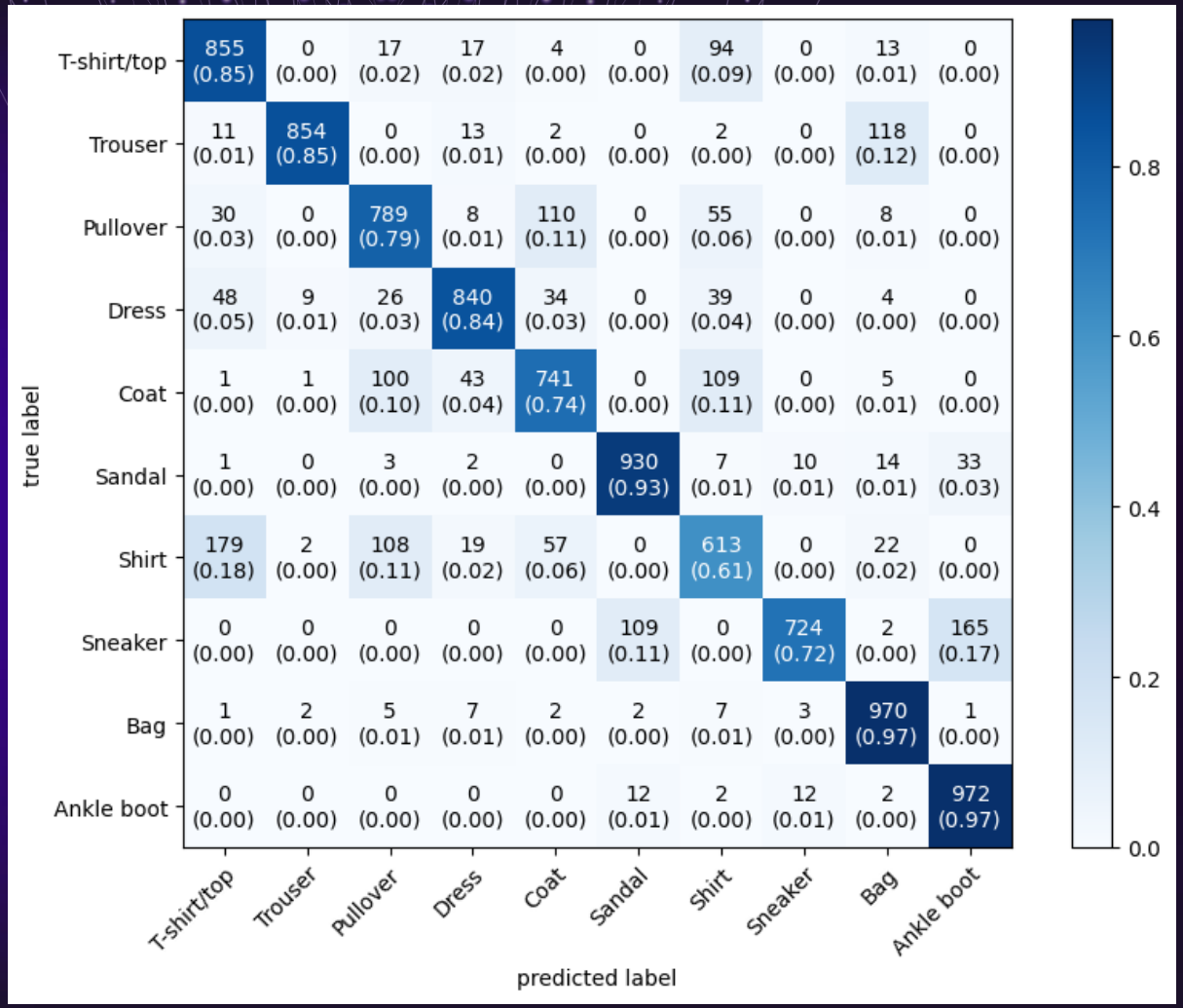
Recall


F1 Score
Value
Epochs
0.8
0.7
0.6
0.5
0.4
0
5
10
15
20
Random
Uncertainty
Margin
Entropy
Committee

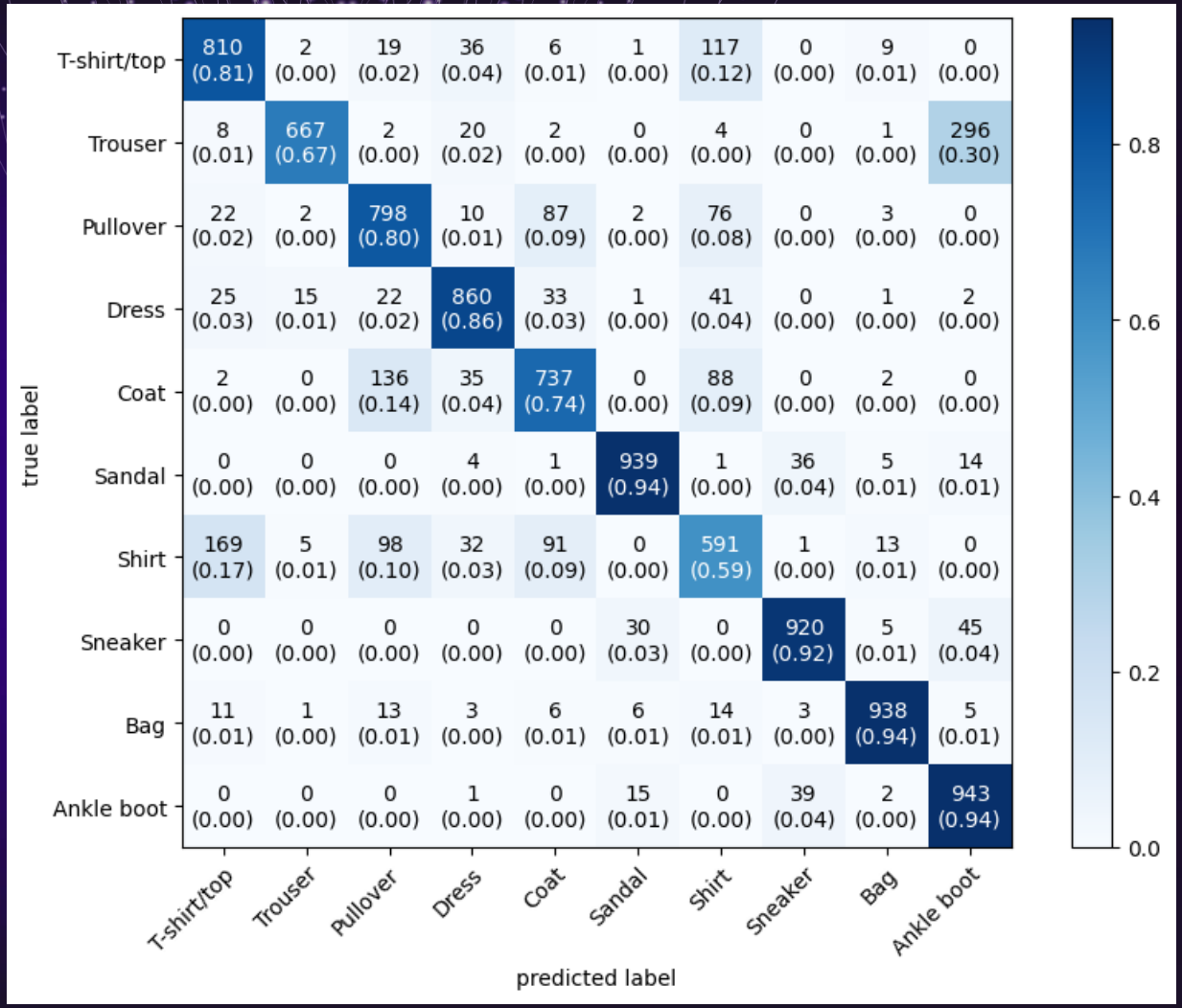
F1 Score


Loss
Random
Uncertainty
Margin
Entropy
Committee
Value
Epochs
6
5
4
3
2
0
5
10
15
20

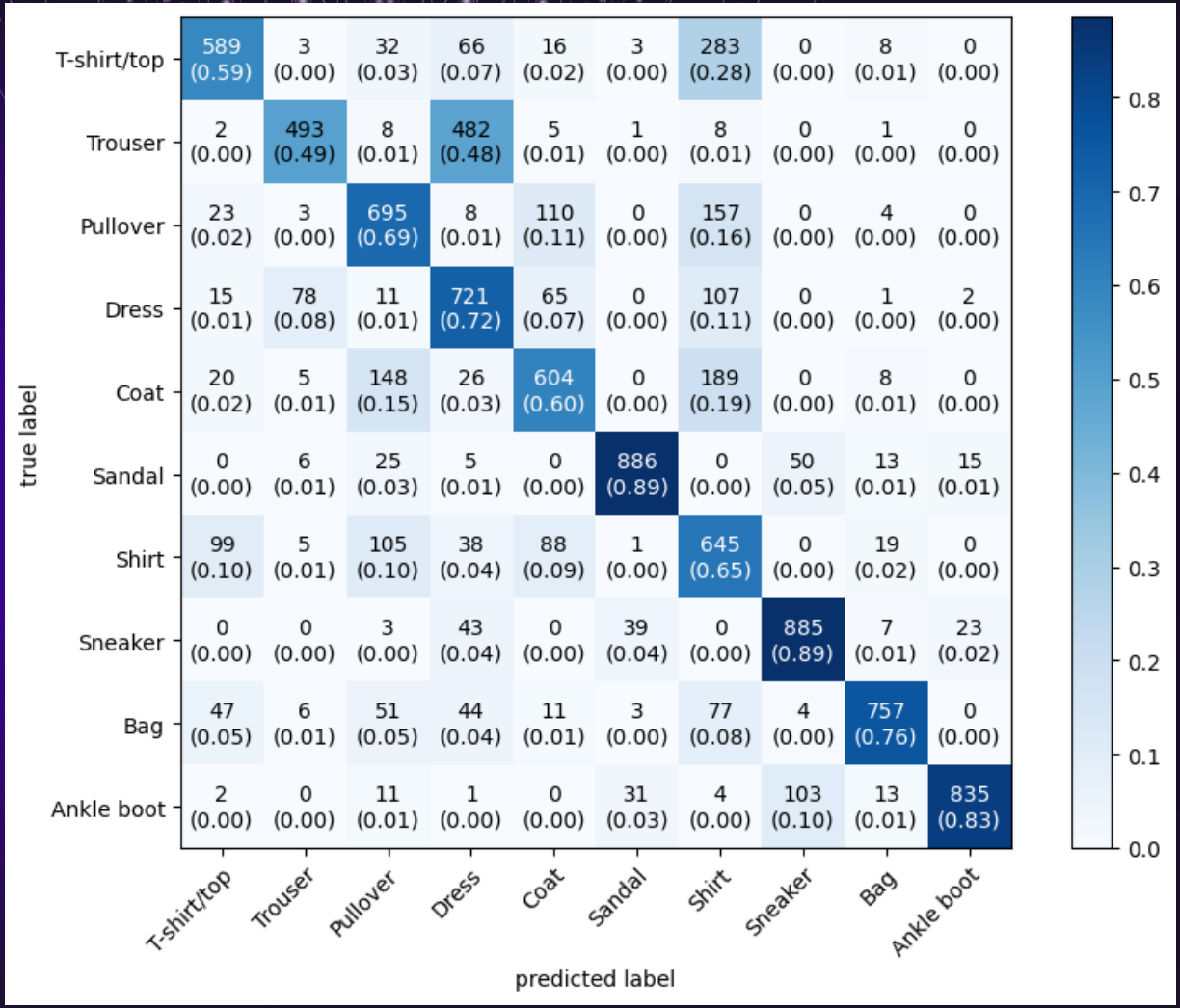
Loss



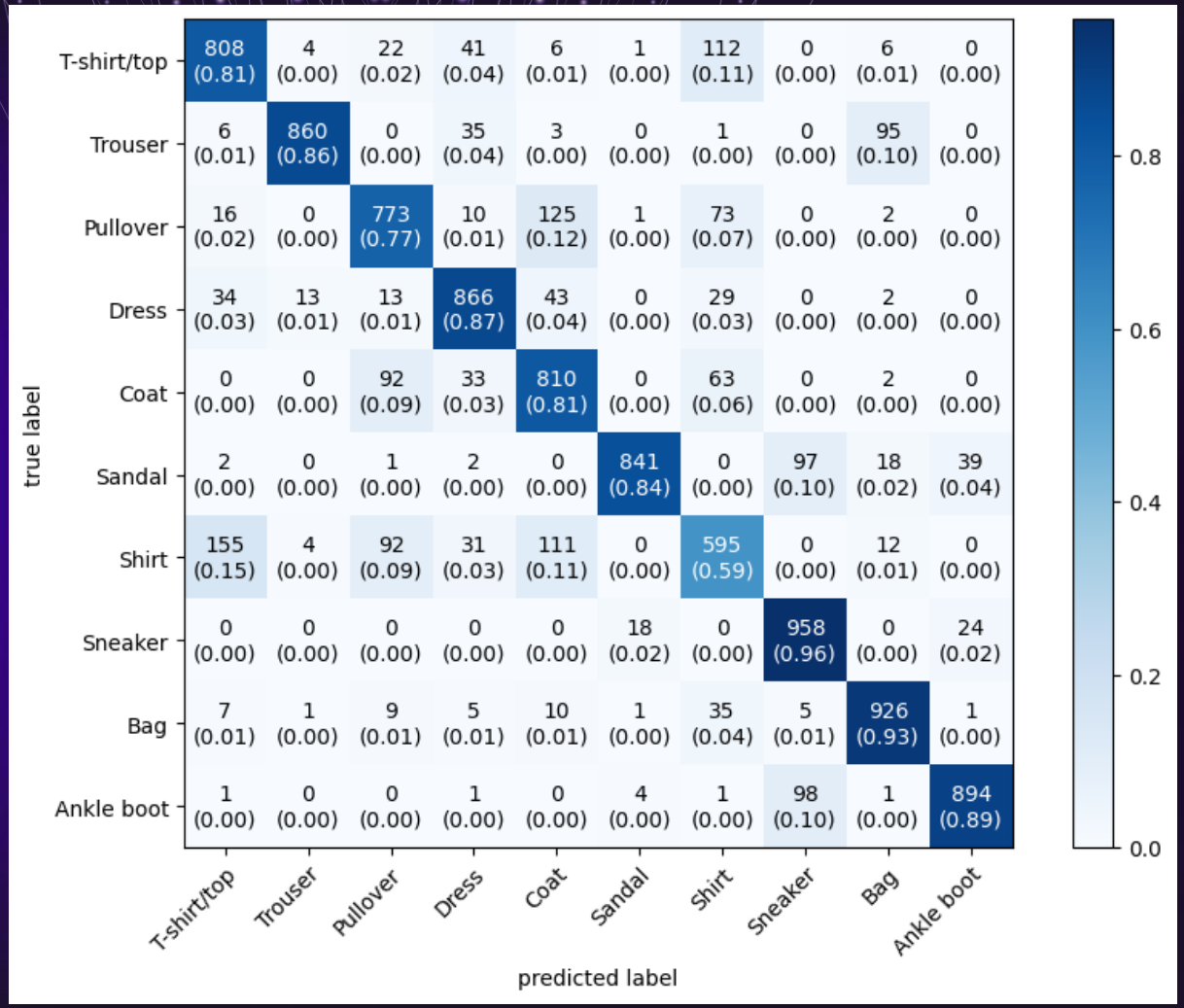
Entropy Based Sampling



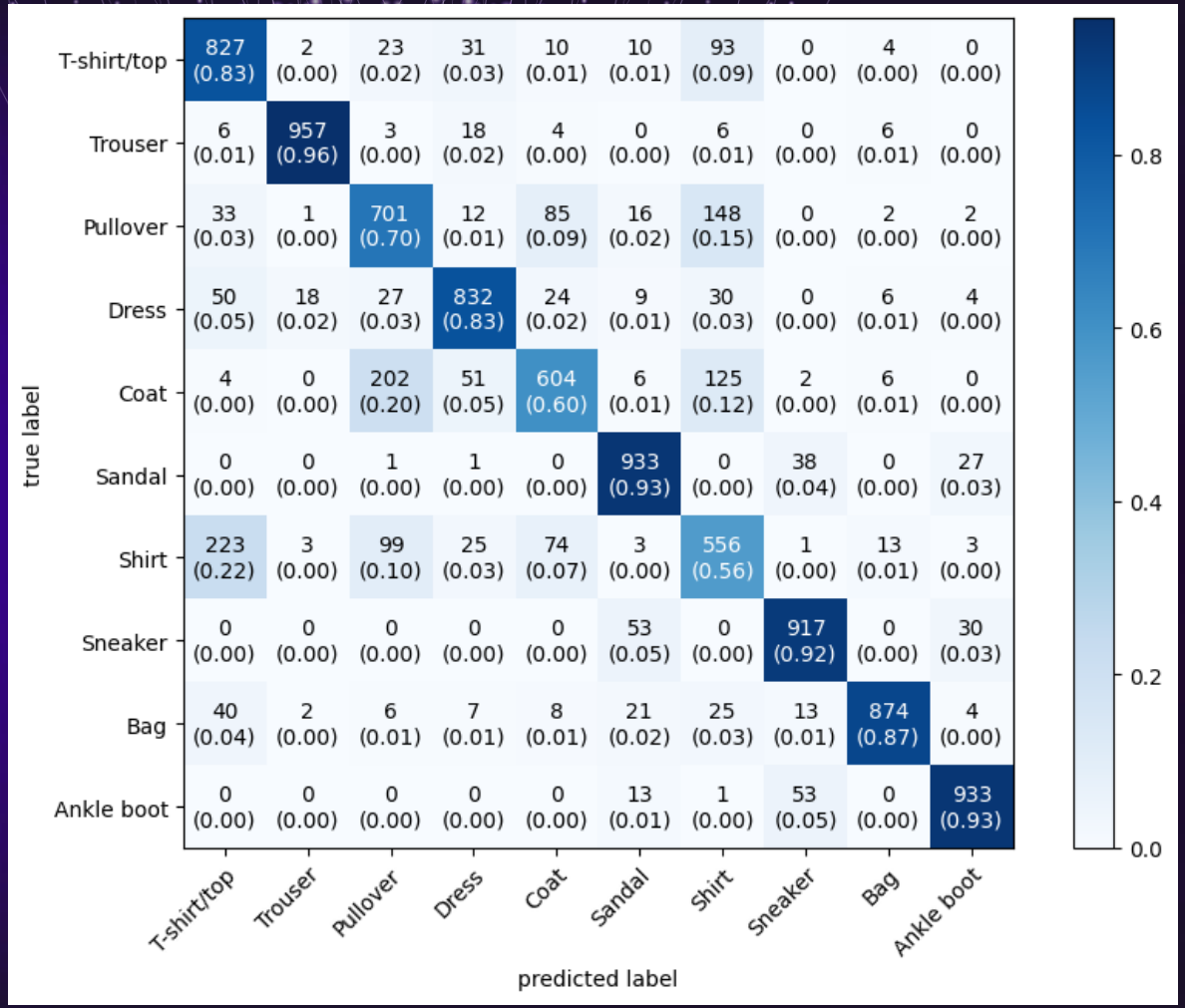
Margin Sampling



Random Sampling



Uncertainty Sampling



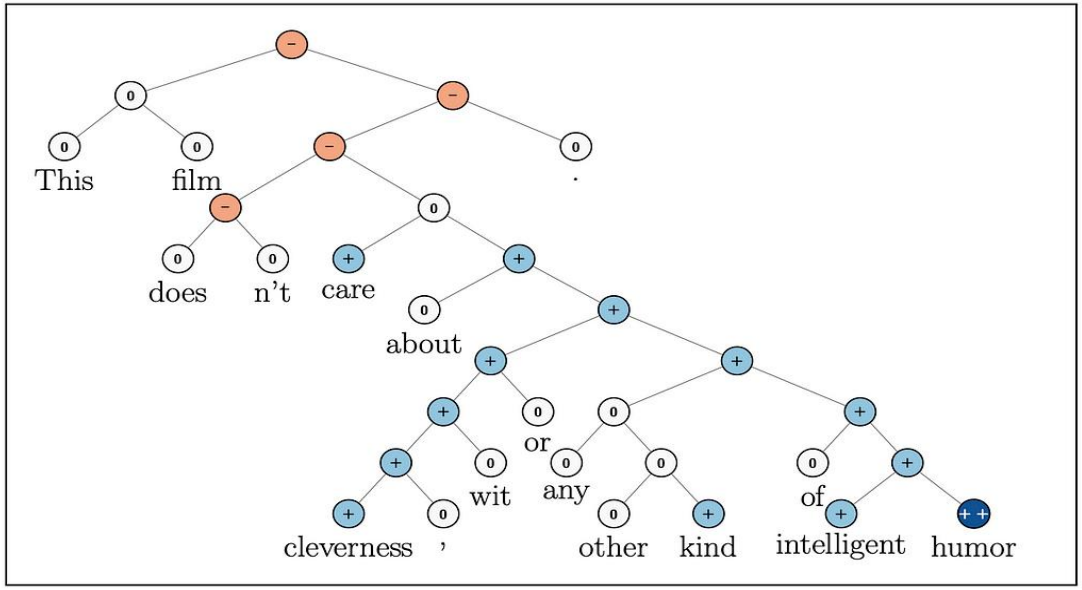
Query by Committee

06

Additional Improvements done

No Improvements!

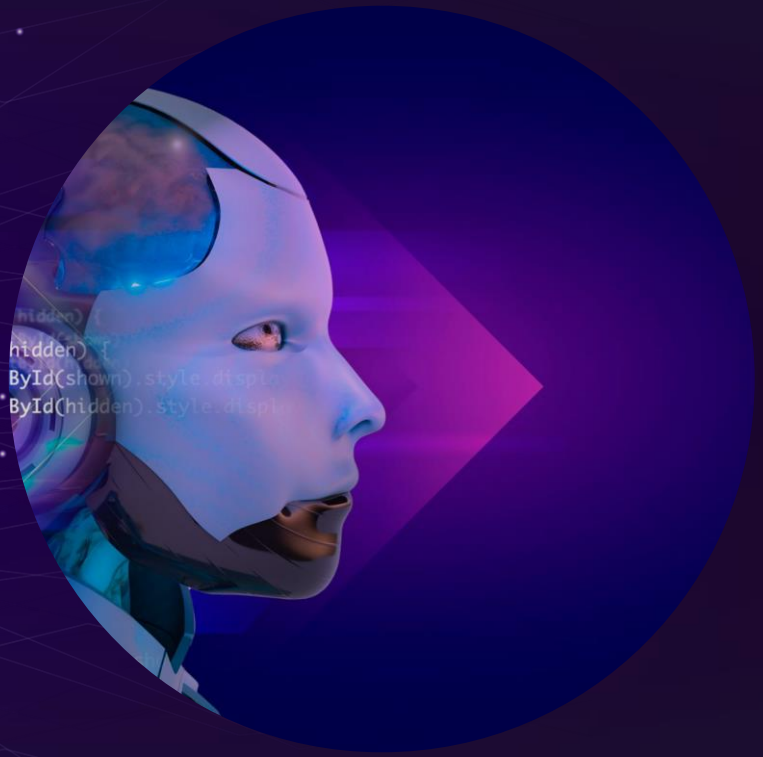
Stanford NLP



A collection of 570k human-written English sentence pairs manually labeled for balanced classification with the labels entailment, contradiction, and neutral.

01

Deep Learning Architecture



Logistic Regression

- **Innovation:** Introduces a streamlined approach to binary classification through logistic regression.
- **Architecture:** A simple yet powerful linear model consisting of a single layer of trainable parameters.
- **Efficiency:** Efficiently learns decision boundaries between classes in data space.
- **Performance:** Provides reliable performance for binary classification tasks, particularly when the data exhibits linear separability.

02

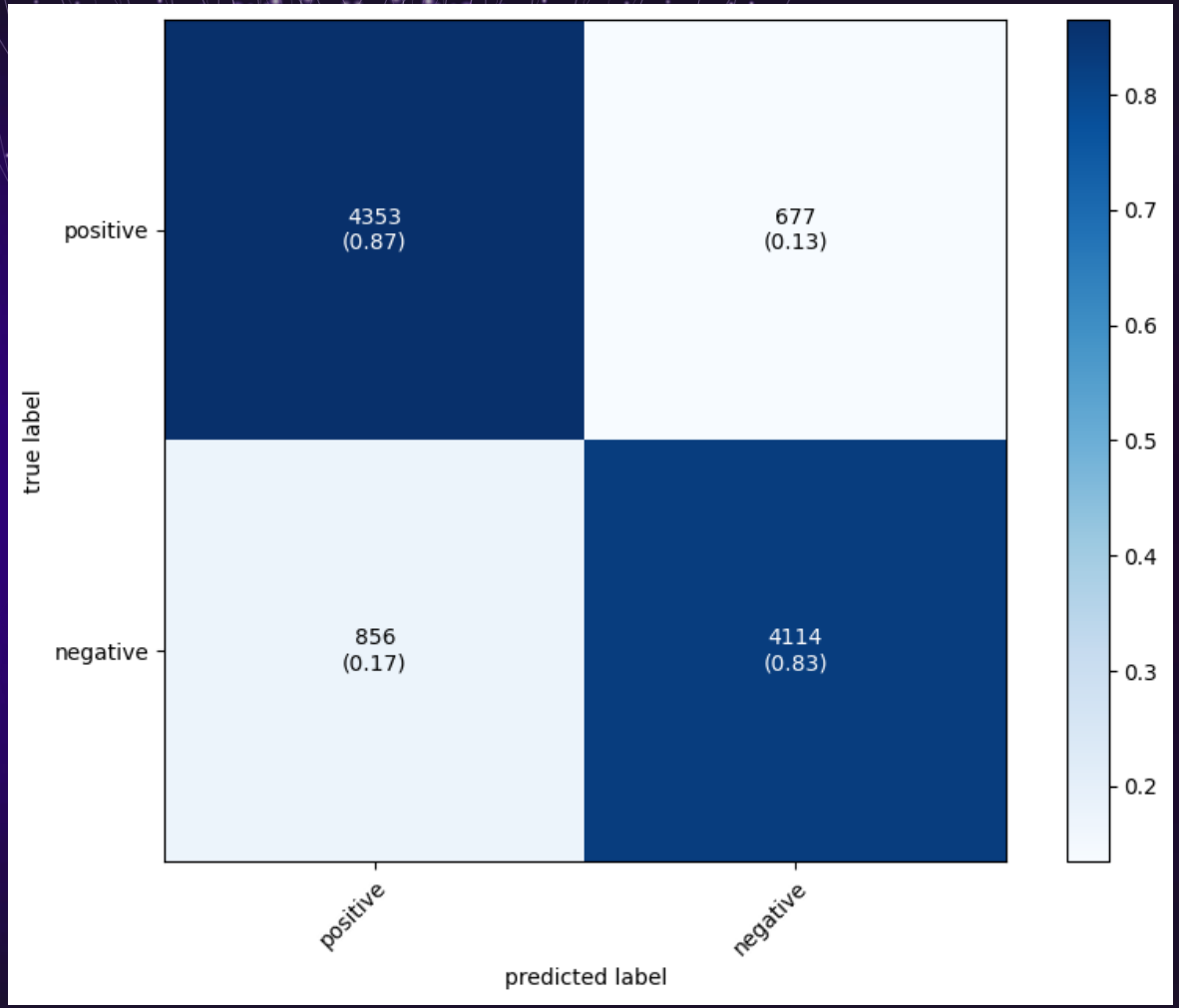
Accuracy Measures before AL

Resnet Architecture

- **Innovation**: Introduces residual connections for deep network training.
- **Architecture**: 50 layers structured around residual blocks. (50M Parameters)
- **Efficiency**: Allows efficient learning of complex representations.
- **Performance**: State-of-the-art results in image classification.
- **Applicability**: Widely used across various computer vision tasks.

Before Active Learning:

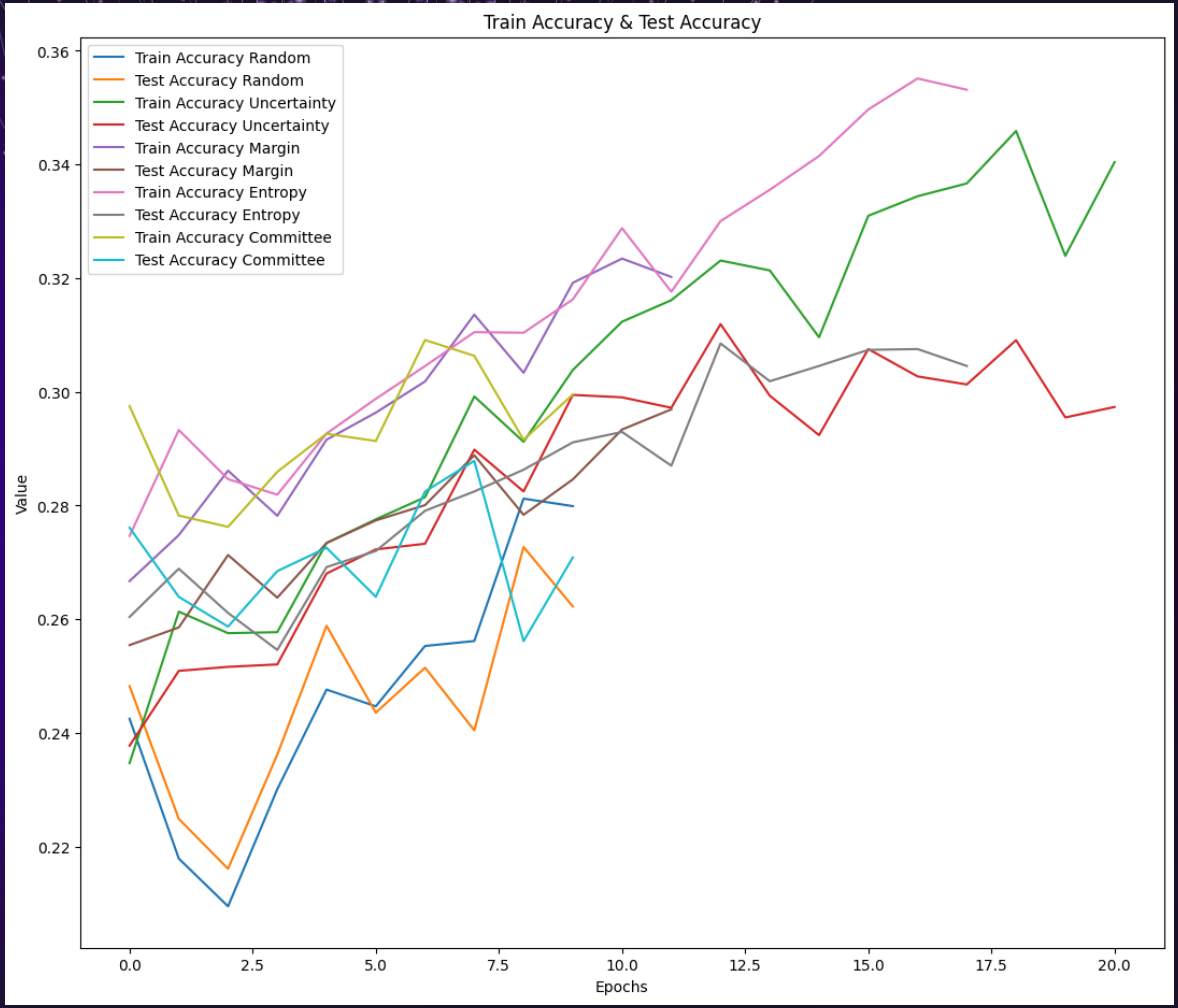
Training accuracy: 0.8775
Score: 0.8467
Precision: 0.858693
Recall: 0.82776659



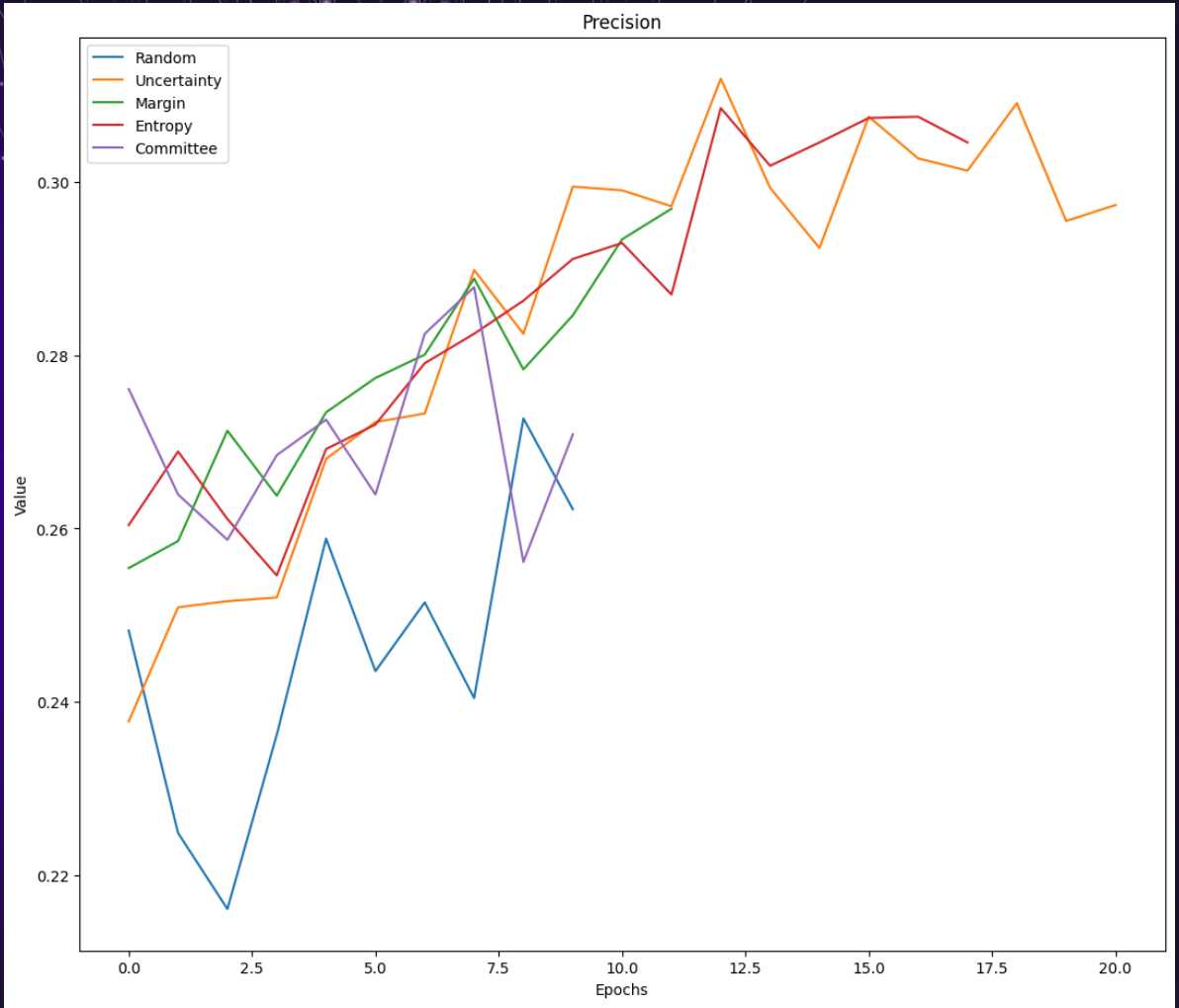
Confusion Matrix

03

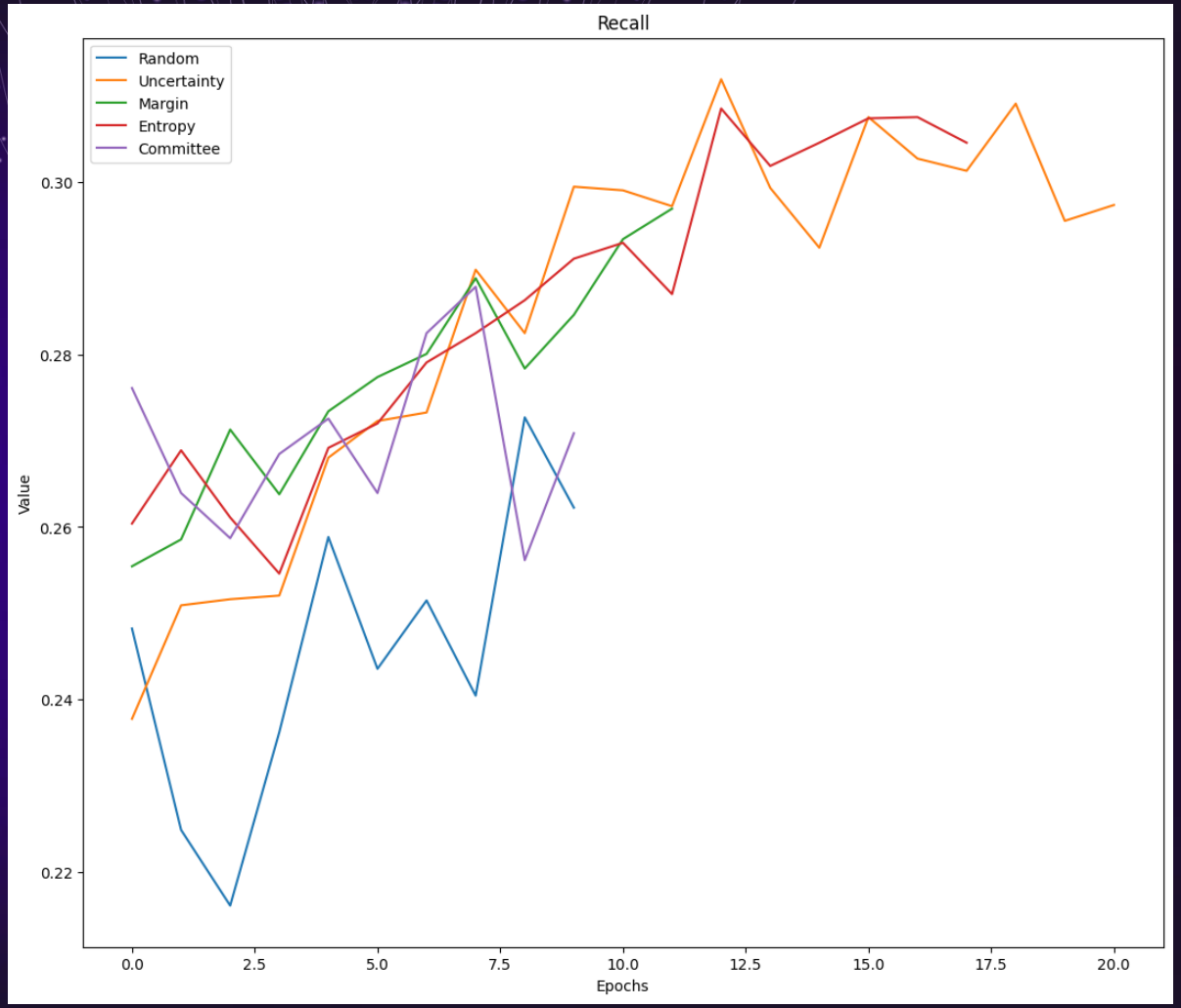
The Effect of each AL strategy


Train Accuracy & Test Accuracy
Train Accuracy Random
Test Accuracy Random
Train Accuracy Uncertainty
Test Accuracy Uncertainty
Train Accuracy Margin
Test Accuracy Margin
Train Accuracy Entropy
Test Accuracy Entropy
Train Accuracy Committee
Test Accuracy Committee
Value
Epochs
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0

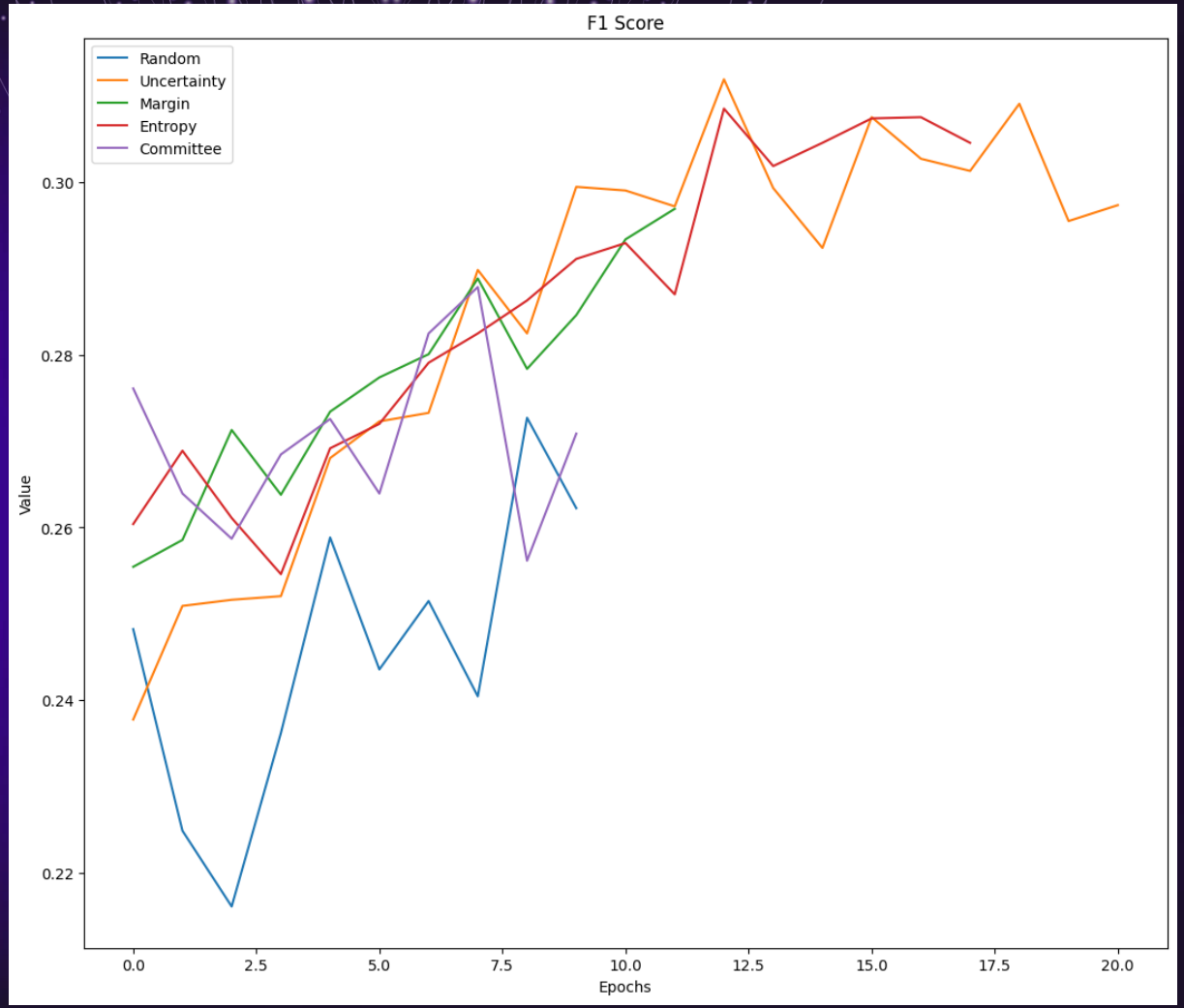
Accuracy


Precision
Random
Uncertainty
Margin
Entropy
Committee
0.30
0.28
0.26
0.24
0.22
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Epochs

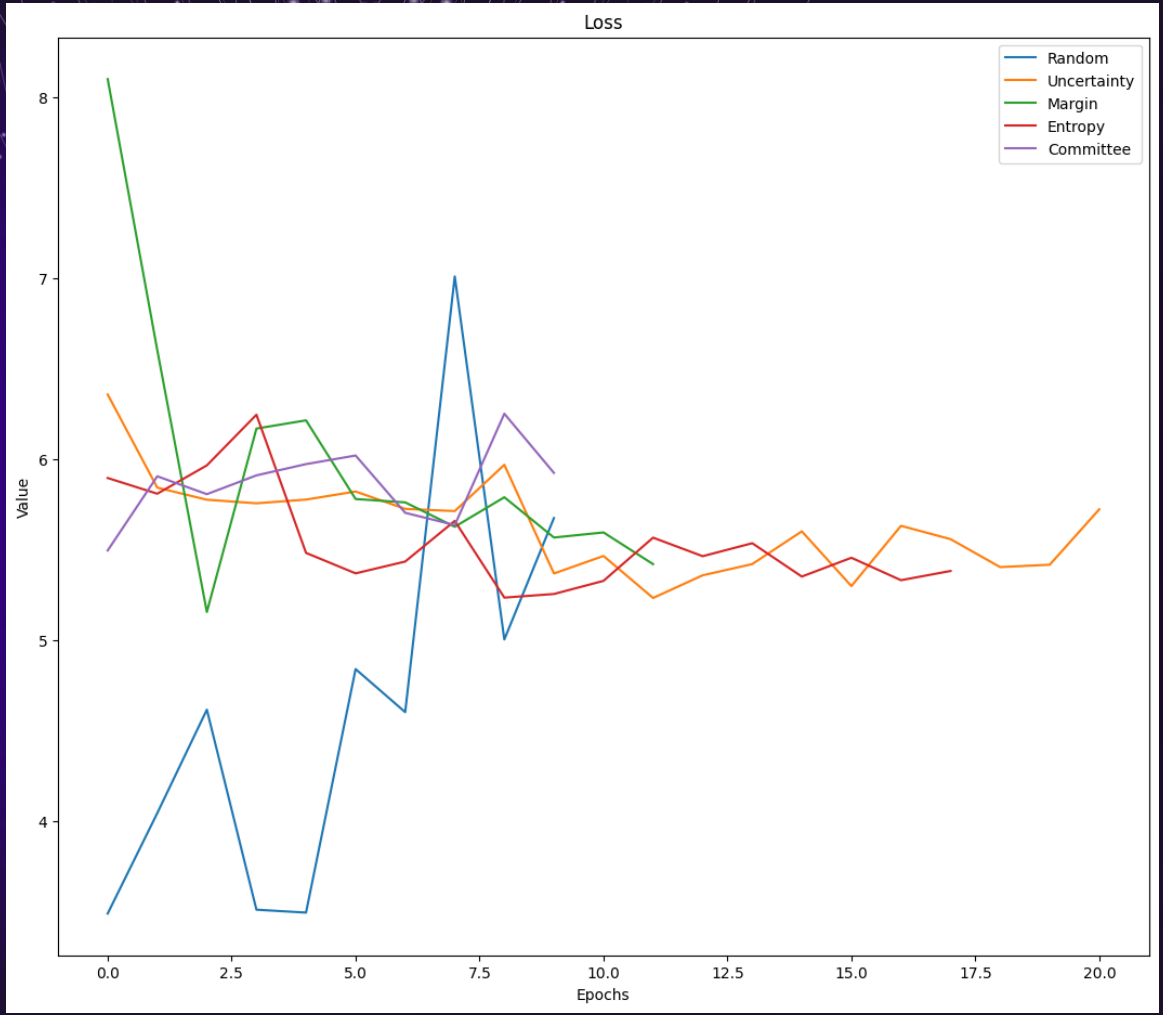
Precision


Recall
Random
Uncertainty
Margin
Entropy
Committee
0.30
0.28
0.26
0.24
0.22
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Epochs

Recall


F1 Score
Random
Uncertainty
Margin
Entropy
Committee
0.30
0.28
0.26
0.24
0.22
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Epochs

F1 Score


Loss
Random
Uncertainty
Margin
Entropy
Committee
Value
Epochs
8
7
6
5
4
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0

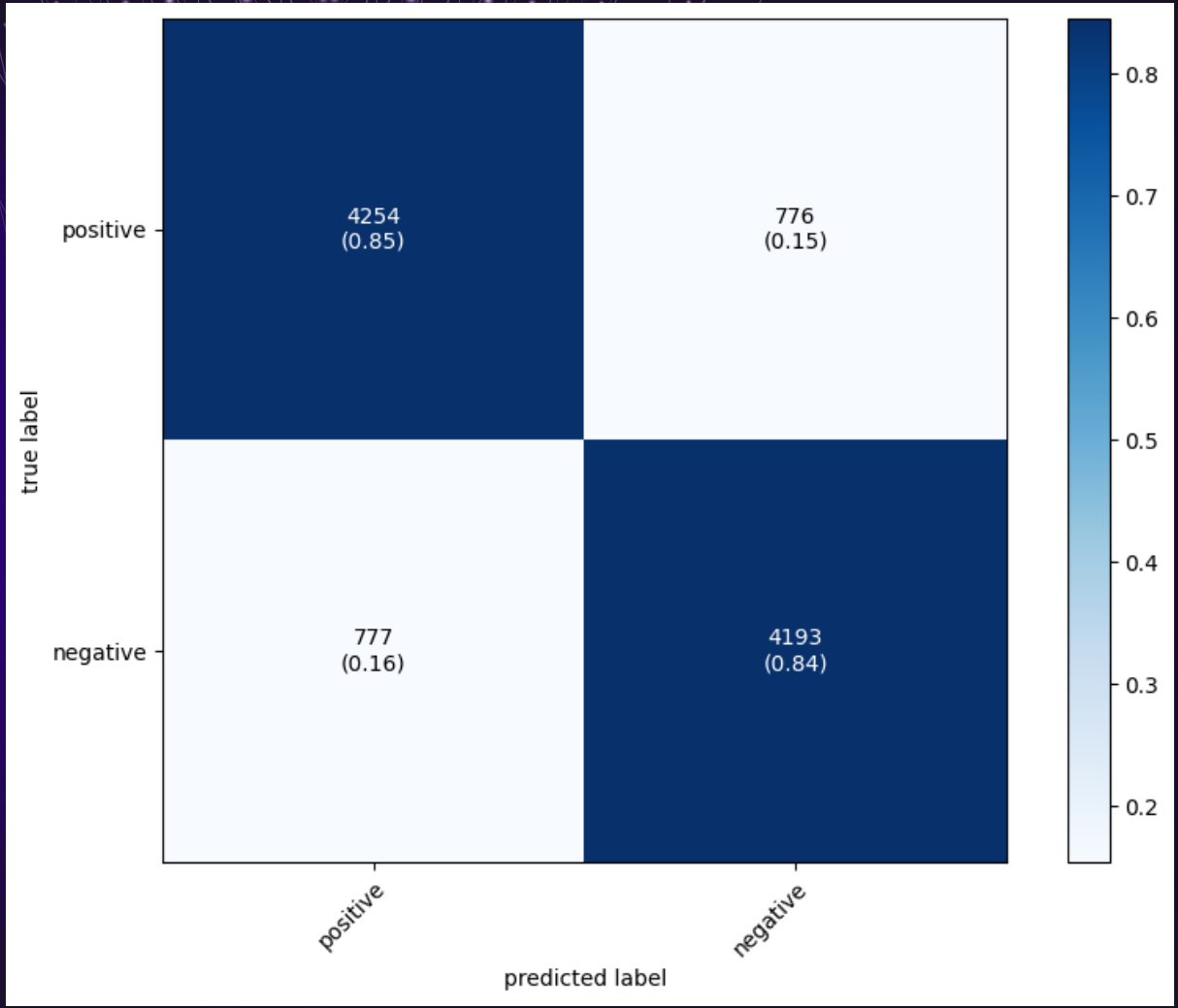
Loss

After 10 Cycles:

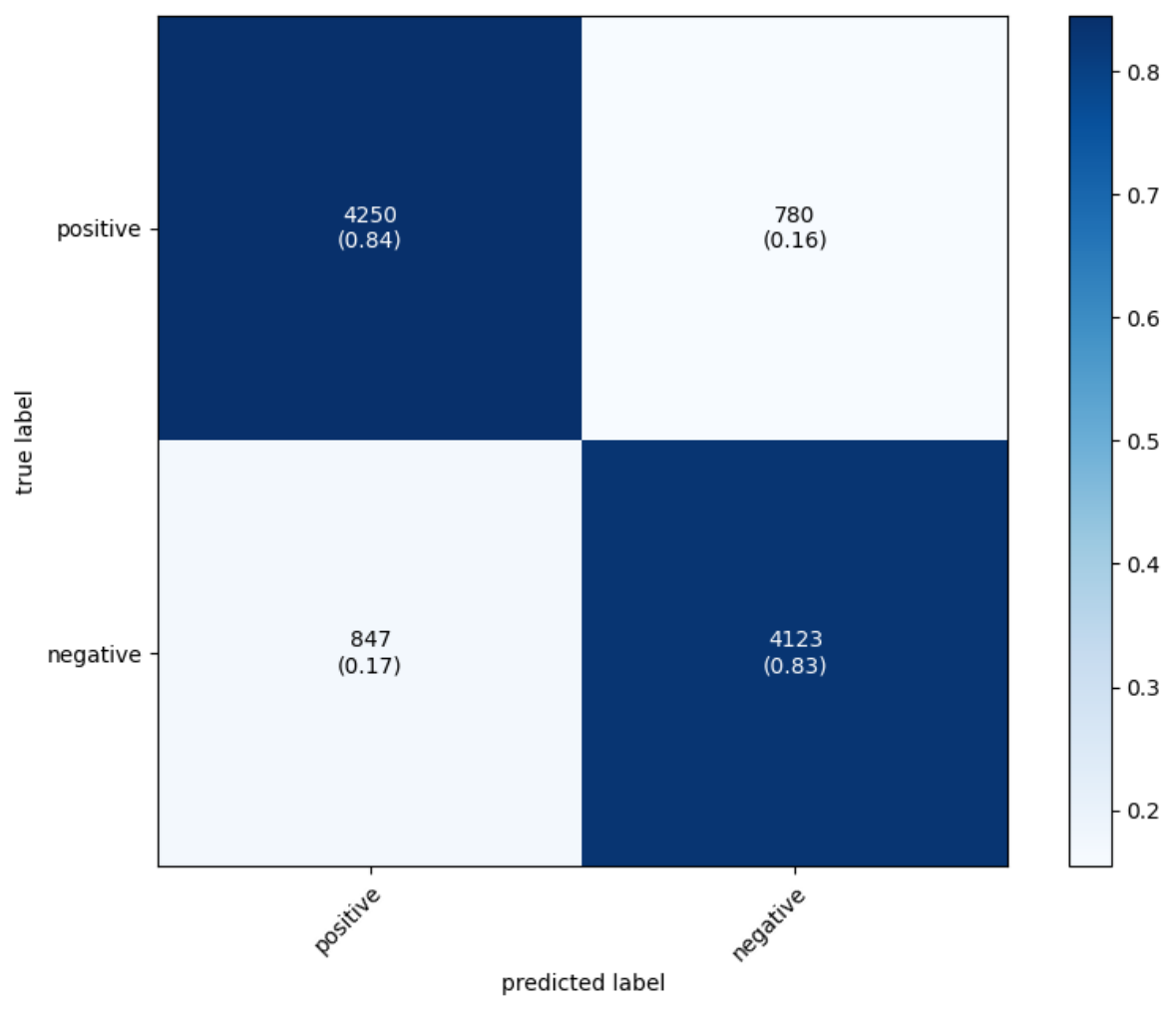
Random : 0.26224172115325 93
Uncertainty: 0.29733937978744507
Margin : 0.29691481590270996
Entropy : 0.30455702543258667
Committee : 0.27087461948394775

04

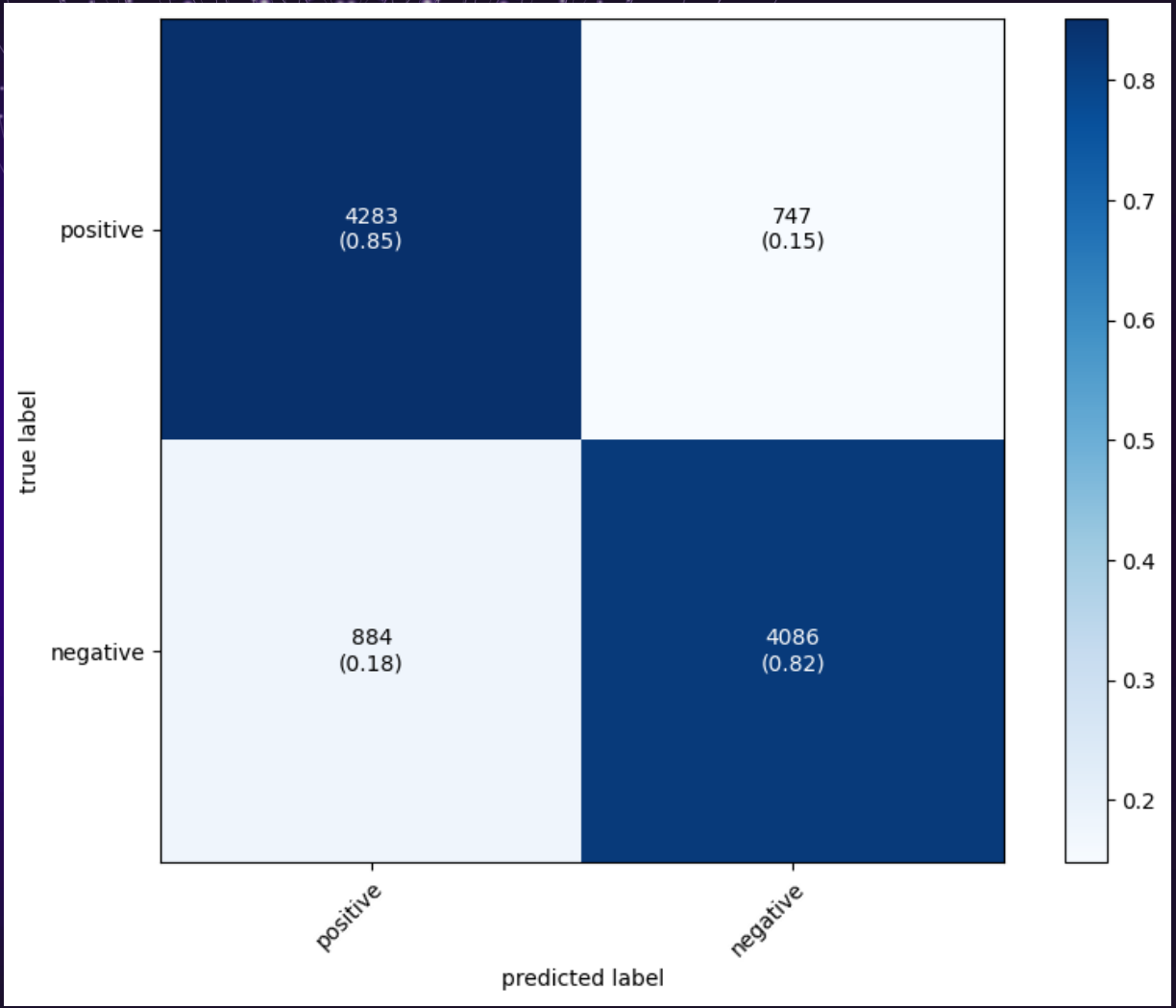
Accuracy Measures after AL



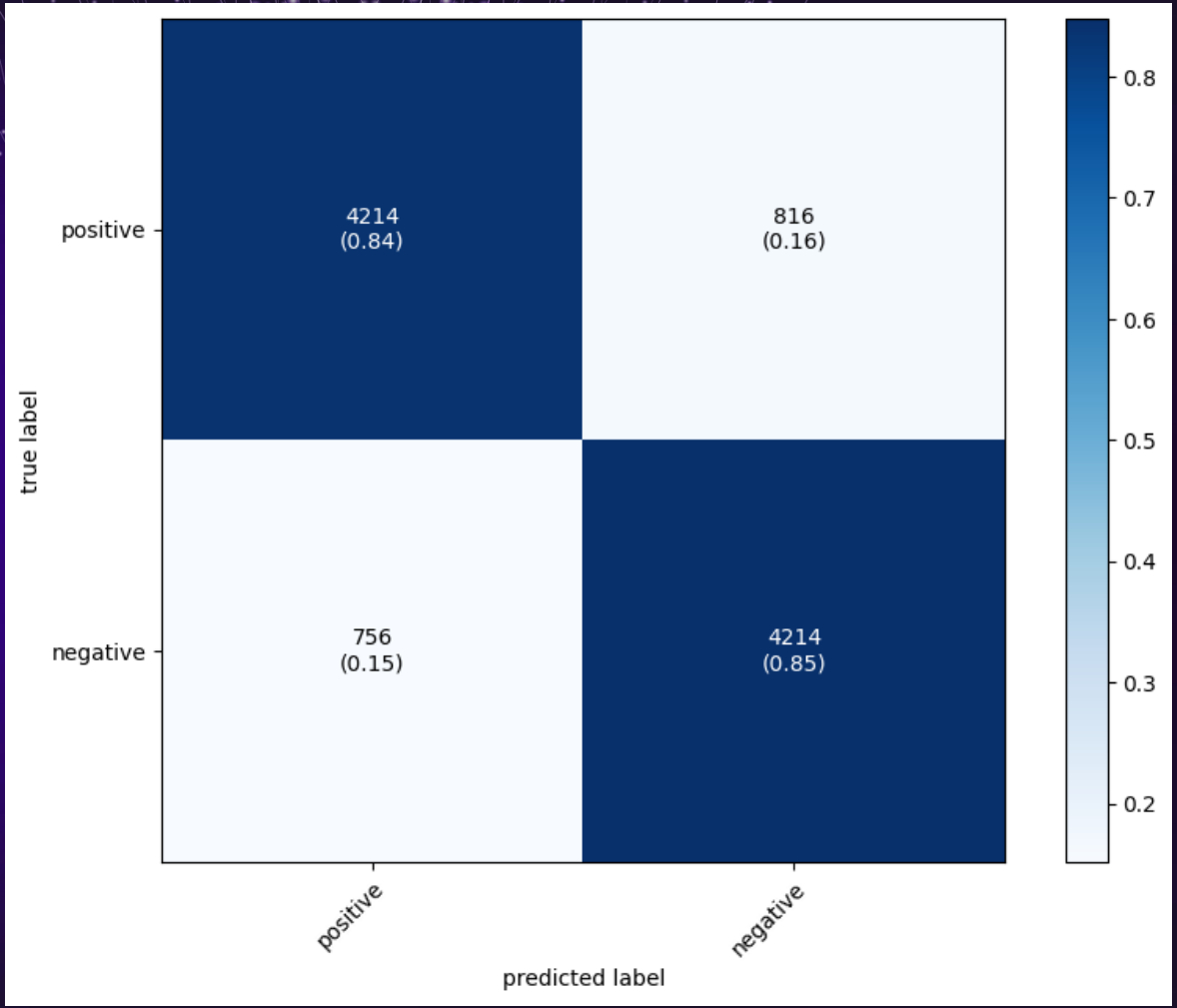
Entropy Based Sampling



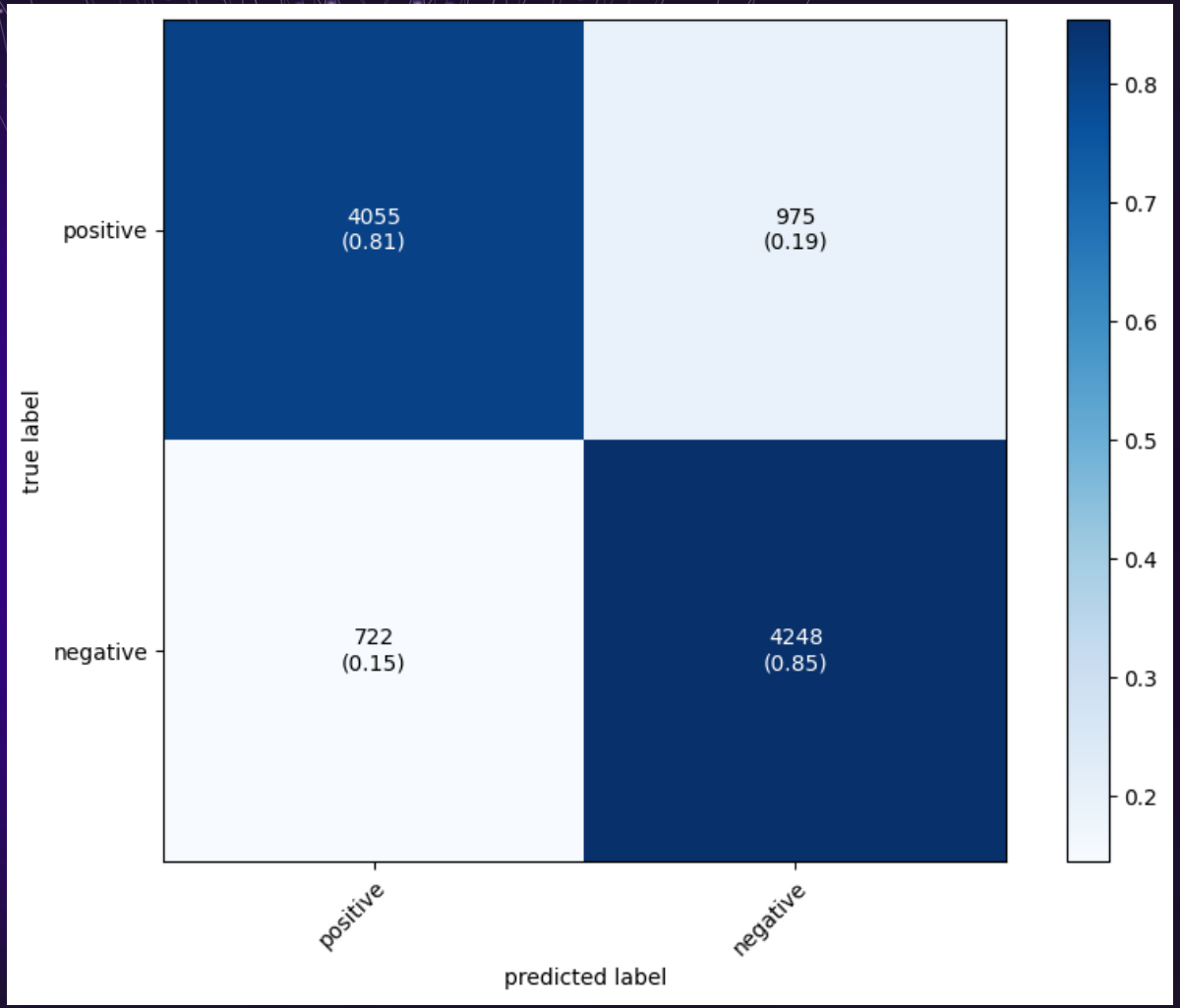
Margin Sampling



Random Sampling



Uncertainty Sampling



Query By Committee

05

Notes and Challenges

Notes and Challenges

Takes Too long

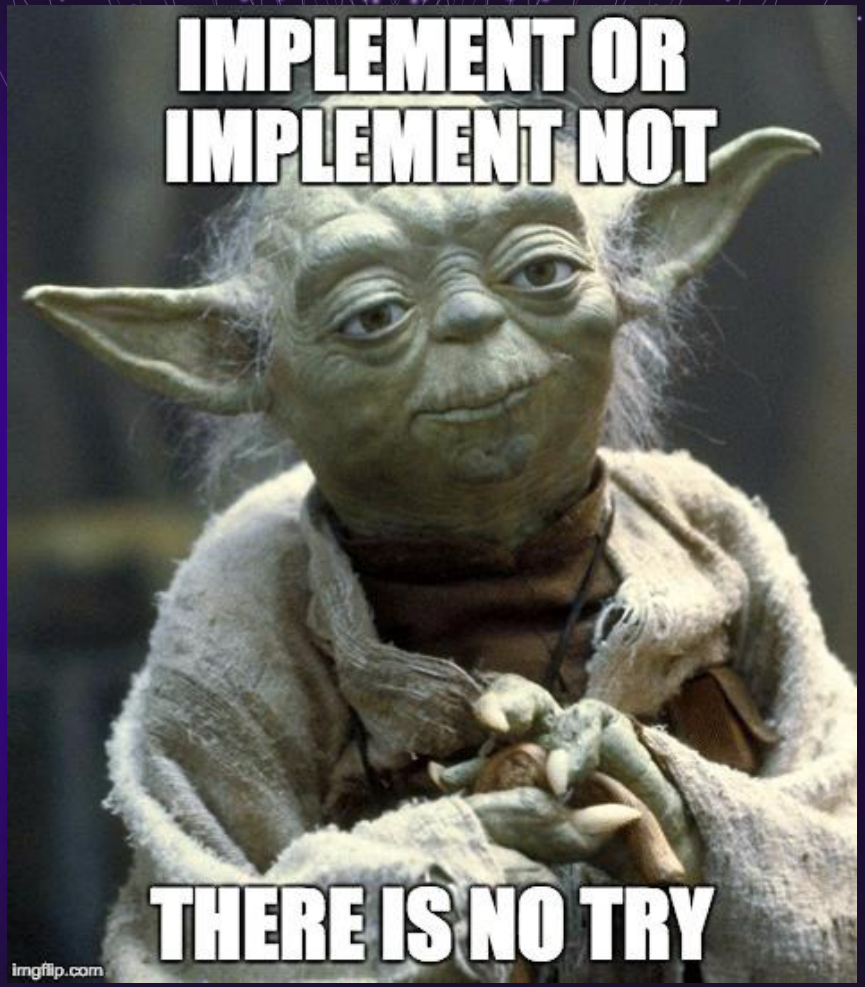
Although the model used is too simple, applying active learning using ModAl took much time

Solution

patience

06

Additional Improvements done



No Improvements!

Face Emotion Recognition

Classes : 8
Dimension: 48*48*1
Samples : 30,000

01

Deep Learning Architecture

02

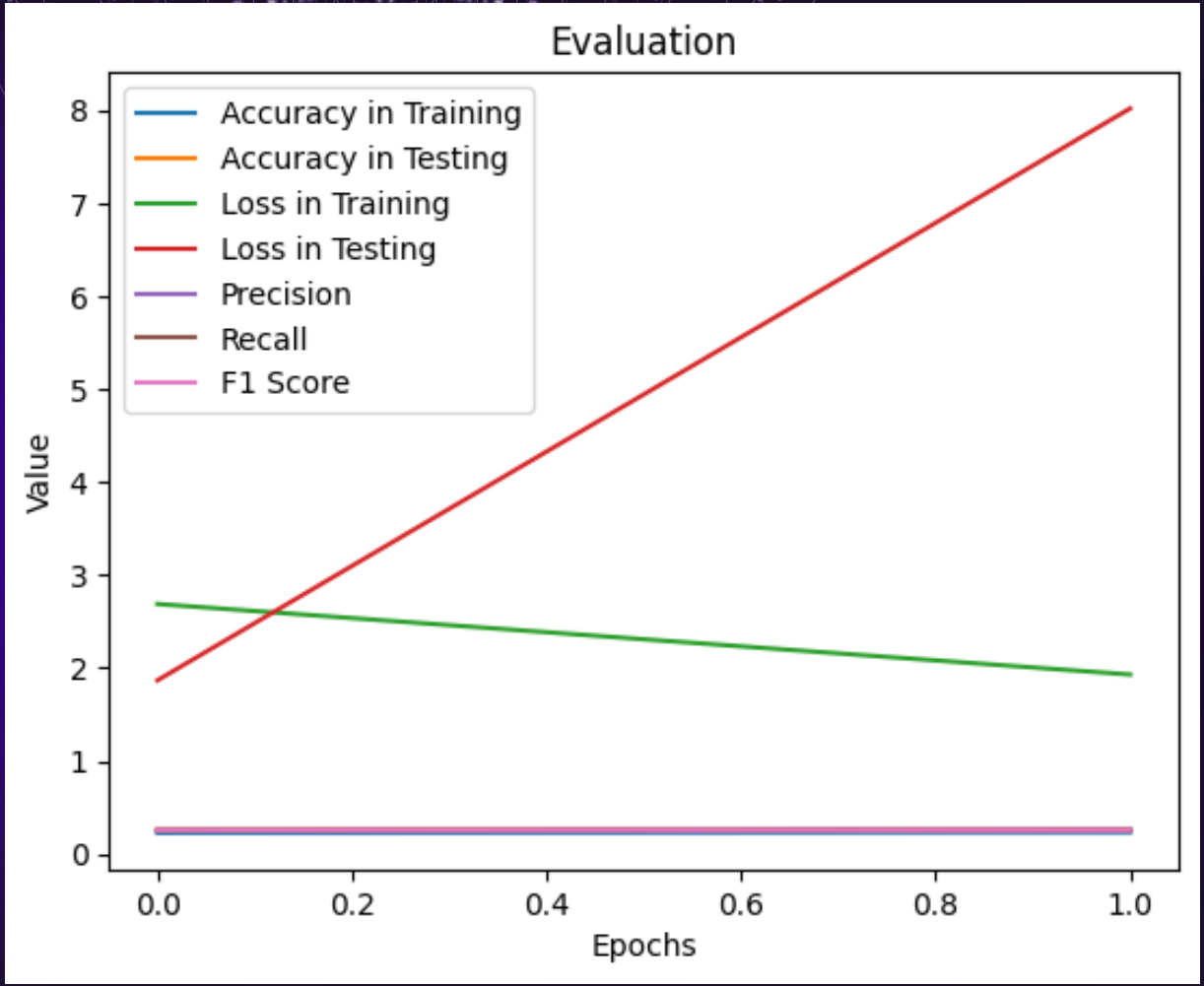
Accuracy Measures before AL

Resnet Architecture

- **Innovation**: Introduces residual connections for deep network training.
- **Architecture**: 50 layers structured around residual blocks. (50M Parameters)
- **Efficiency**: Allows efficient learning of complex representations.
- **Performance**: State-of-the-art results in image classification.
- **Applicability**: Widely used across various computer vision tasks.

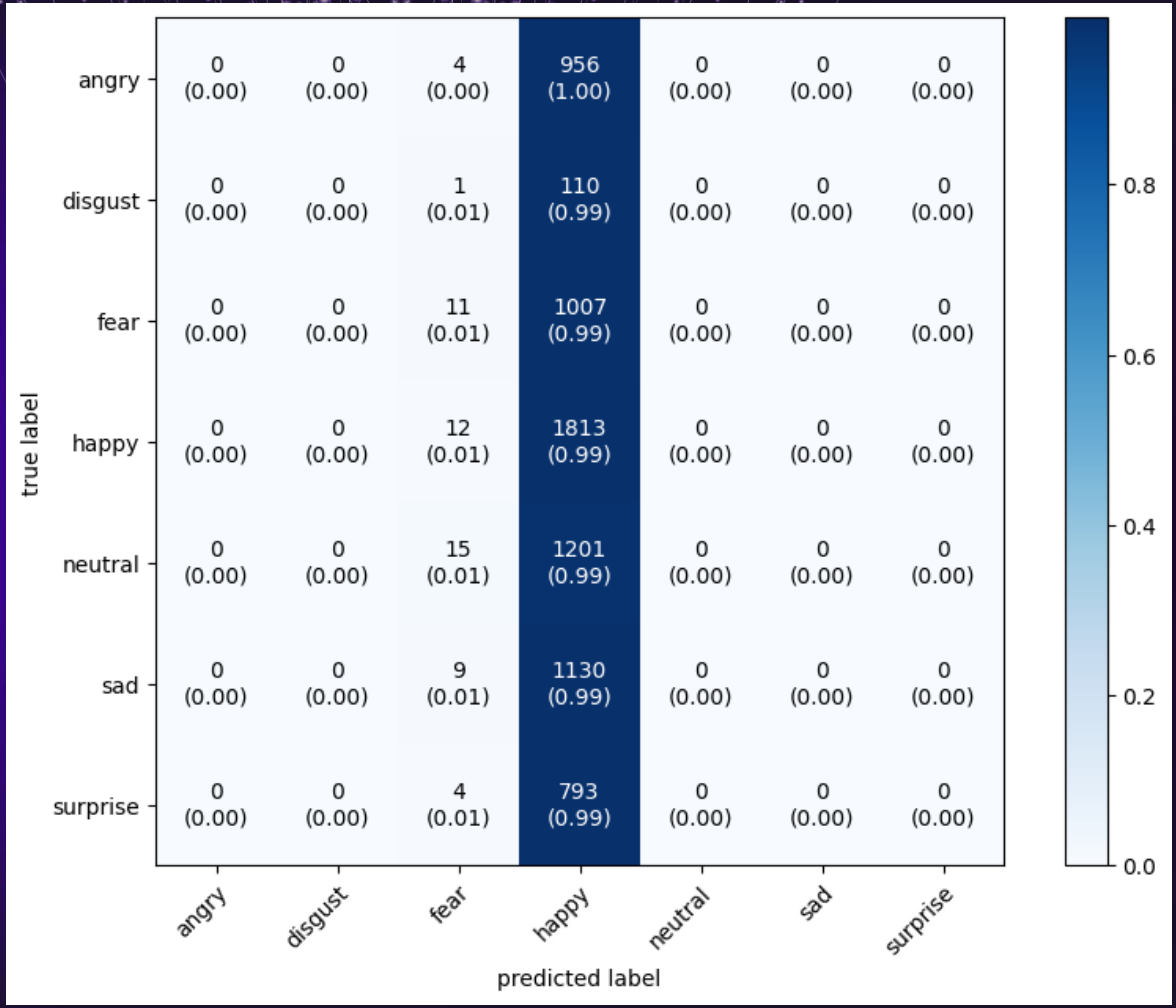
Before Active Learning:

Training loss: 1.930
Training accuracy: 0.233
Testing Loss: 8.017
Testing accuracy: 0.258
F1 Score: 0.258
Precision: 0.258
Recall: 0.258



Evaluation Metrics

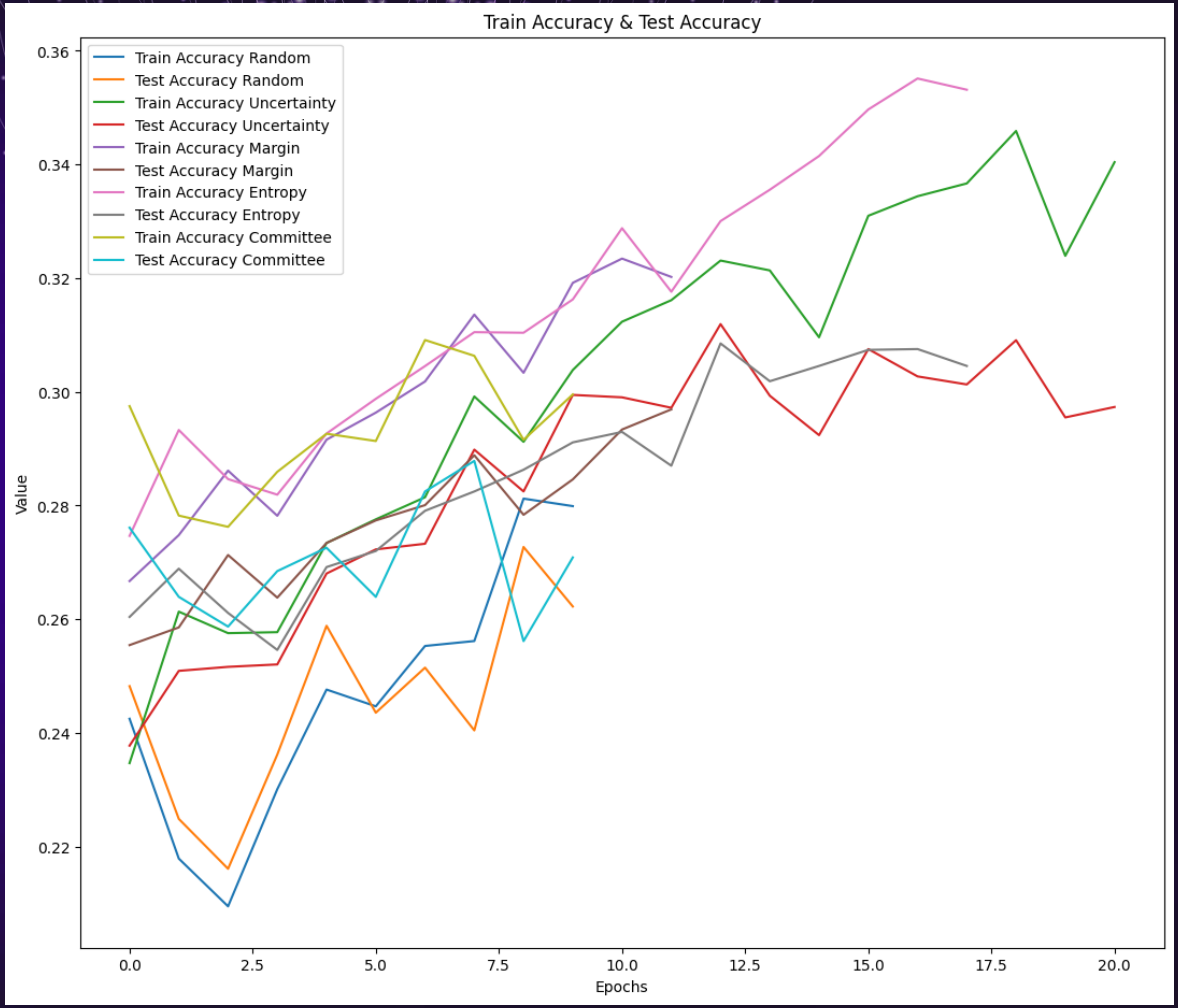
Visual Evaluation



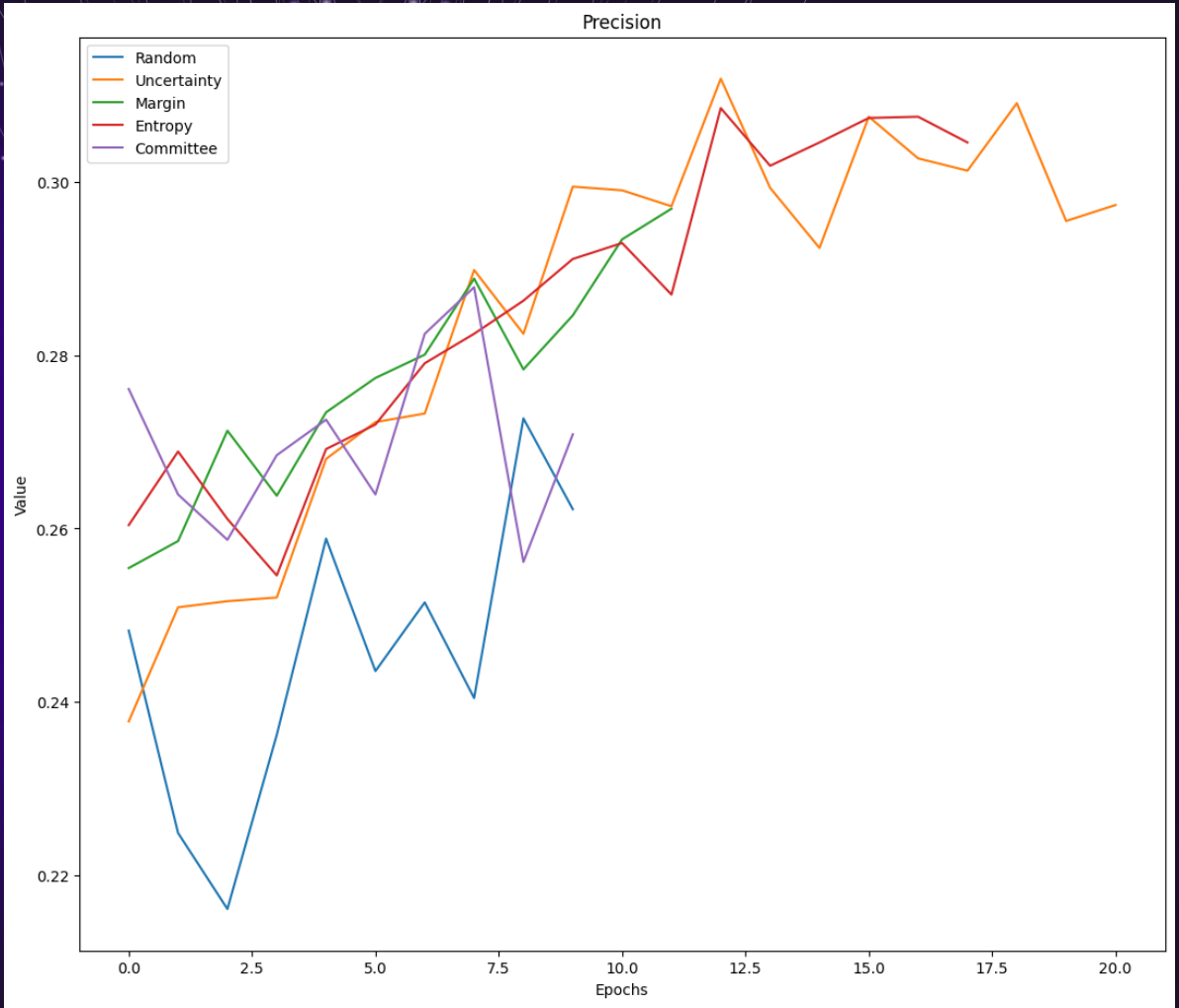
Confusion Matrix

03

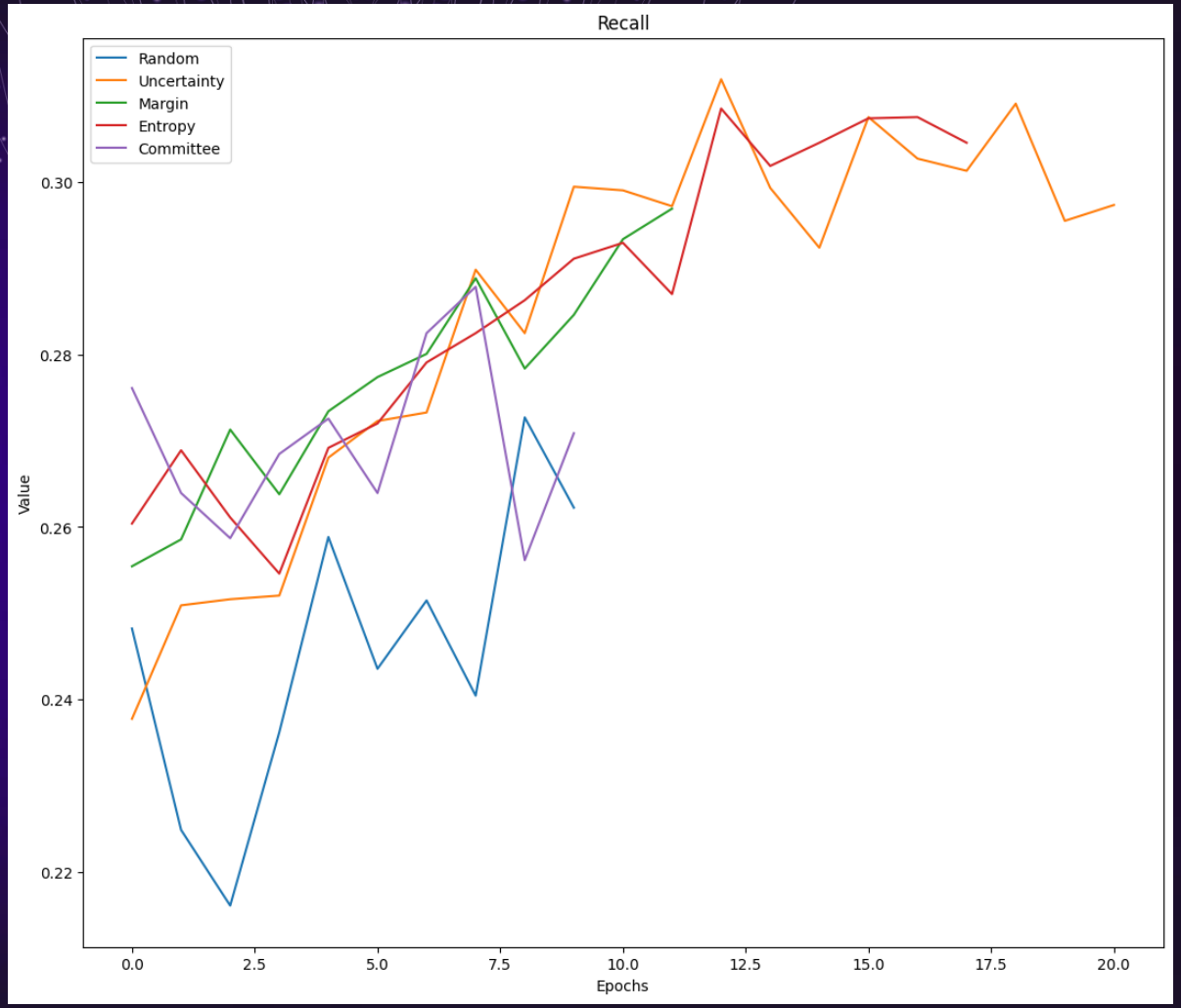
The Effect of each AL strategy


Train Accuracy & Test Accuracy
Train Accuracy Random
Test Accuracy Random
Train Accuracy Uncertainty
Test Accuracy Uncertainty
Train Accuracy Margin
Test Accuracy Margin
Train Accuracy Entropy
Test Accuracy Entropy
Train Accuracy Committee
Test Accuracy Committee
Value
Epochs
0.36
0.34
0.32
0.30
0.28
0.26
0.24
0.22
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0

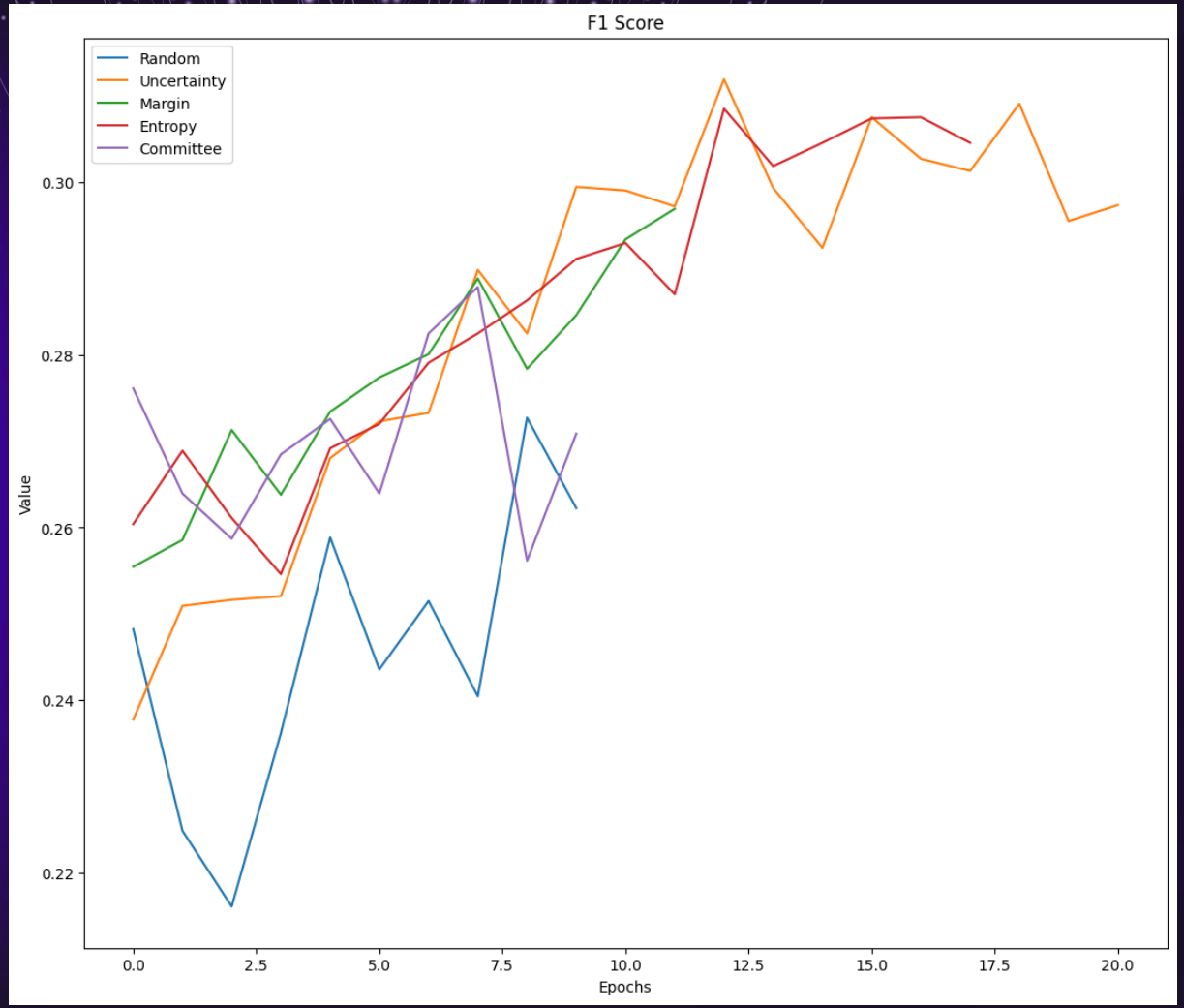
Accuracy


Precision
Random
Uncertainty
Margin
Entropy
Committee
0.30
0.28
0.26
0.24
0.22
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Epochs

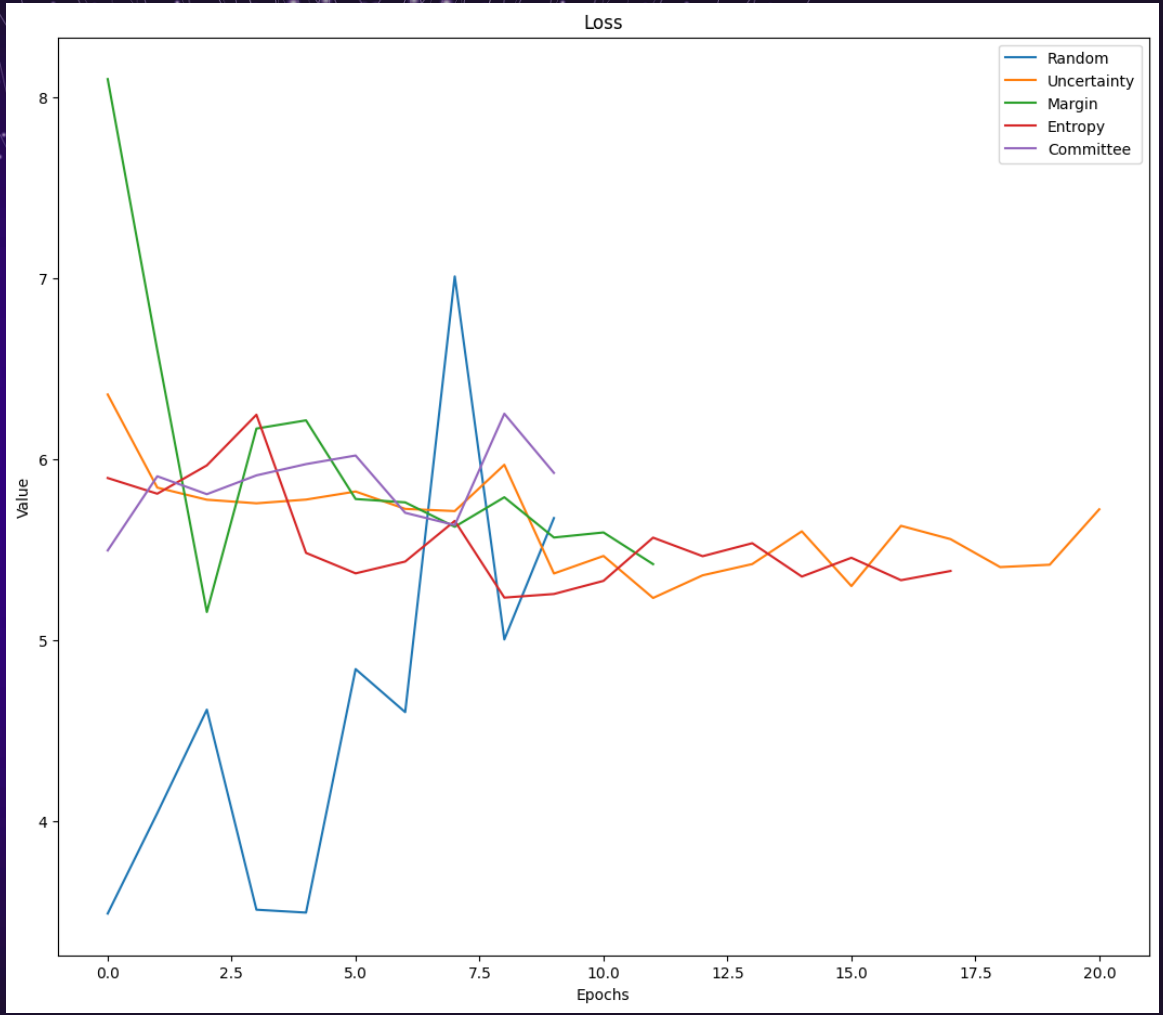
Precision


Recall
Random
Uncertainty
Margin
Entropy
Committee
0.30
0.28
0.26
0.24
0.22
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Epochs

Recall


F1 Score
Random
Uncertainty
Margin
Entropy
Committee
0.30
0.28
0.26
0.24
0.22
Value
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Epochs

F1 Score


Loss
Random
Uncertainty
Margin
Entropy
Committee
Value
Epochs
8
7
6
5
4
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0

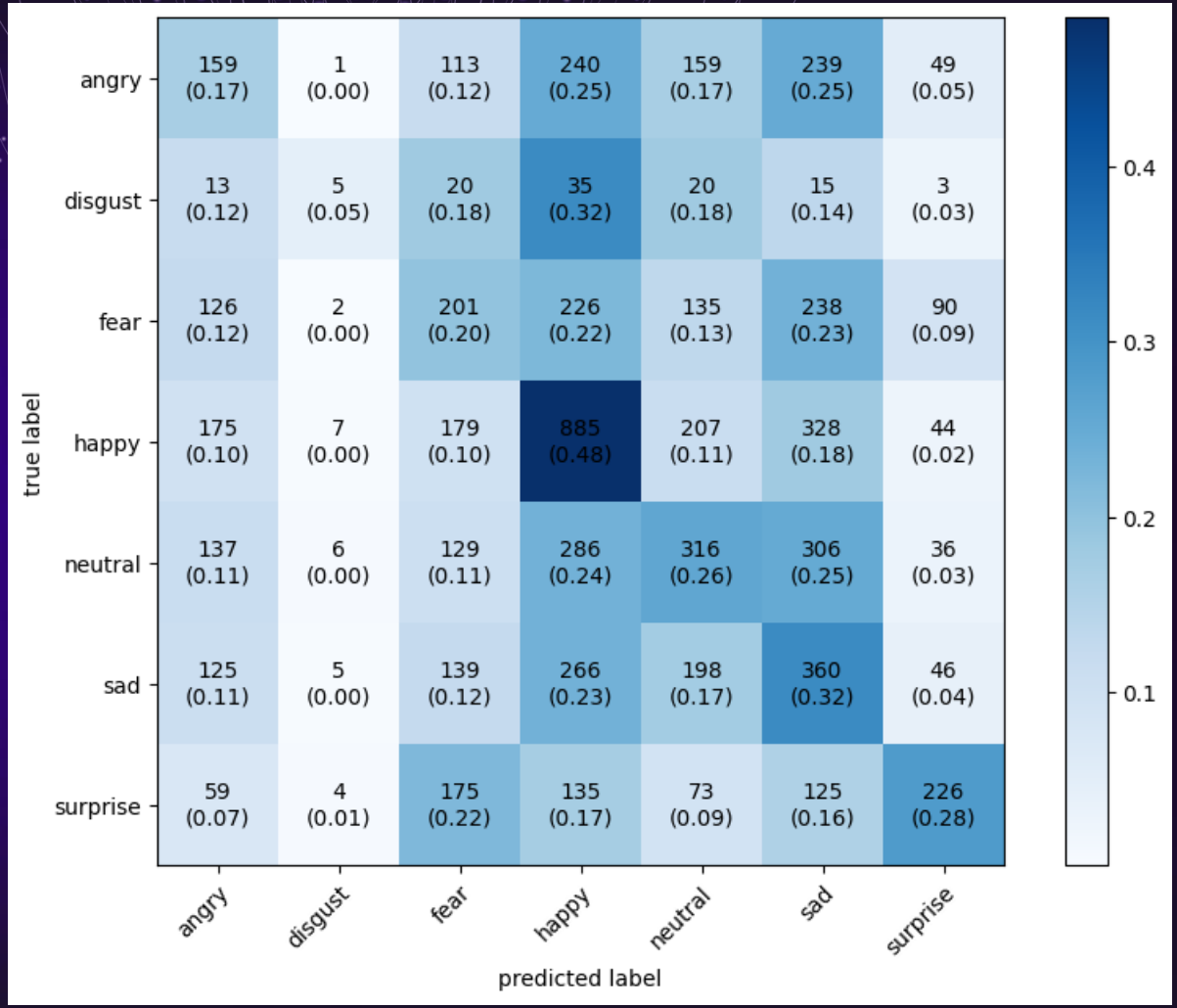
Loss

After 10 Cycles:

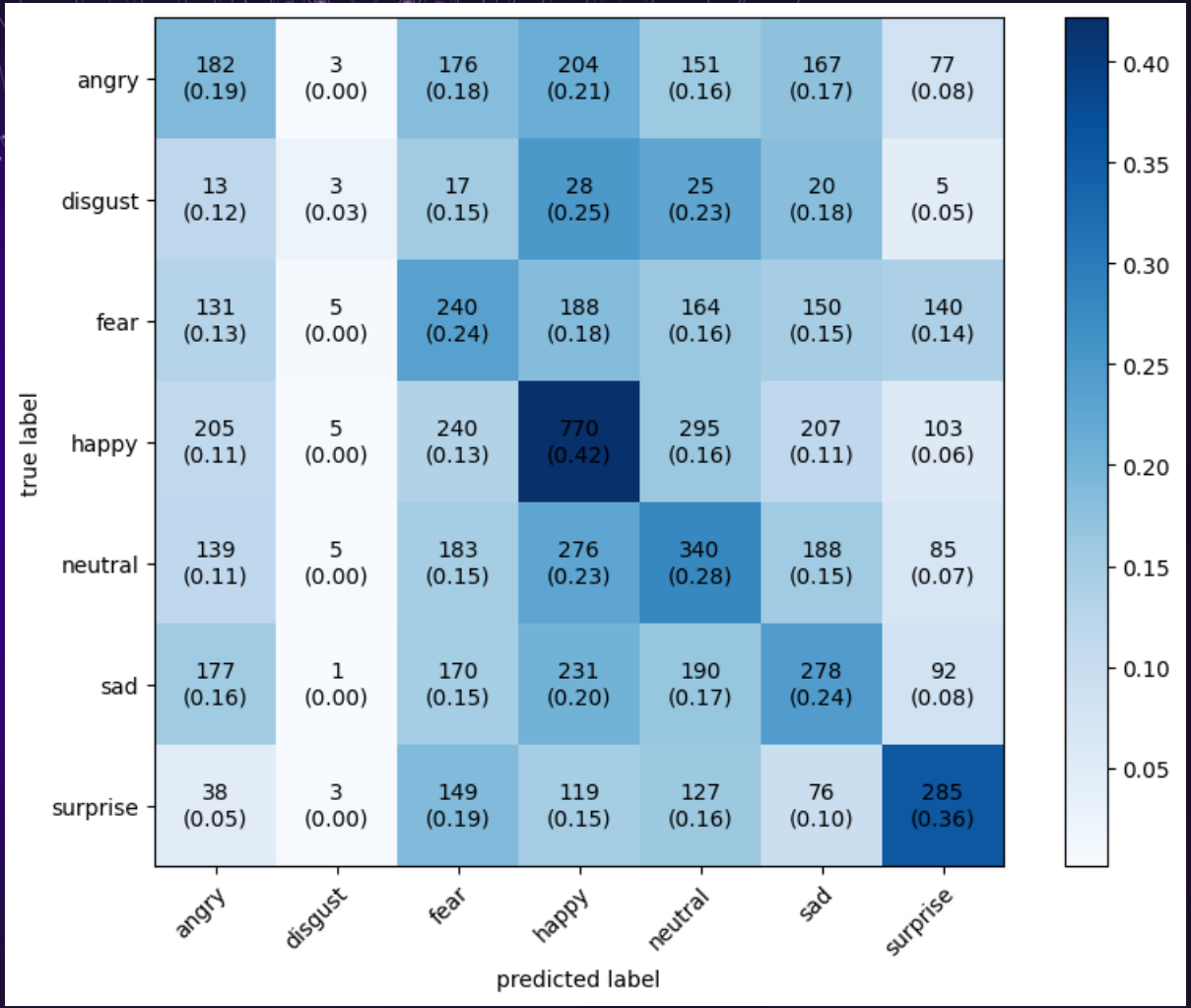
Random : 0.26224172115325 93
Uncertainty: 0.29733937978744507
Margin : 0.29691481590270996
Entropy : 0.30455702543258667
Committee : 0.27087461948394775

04

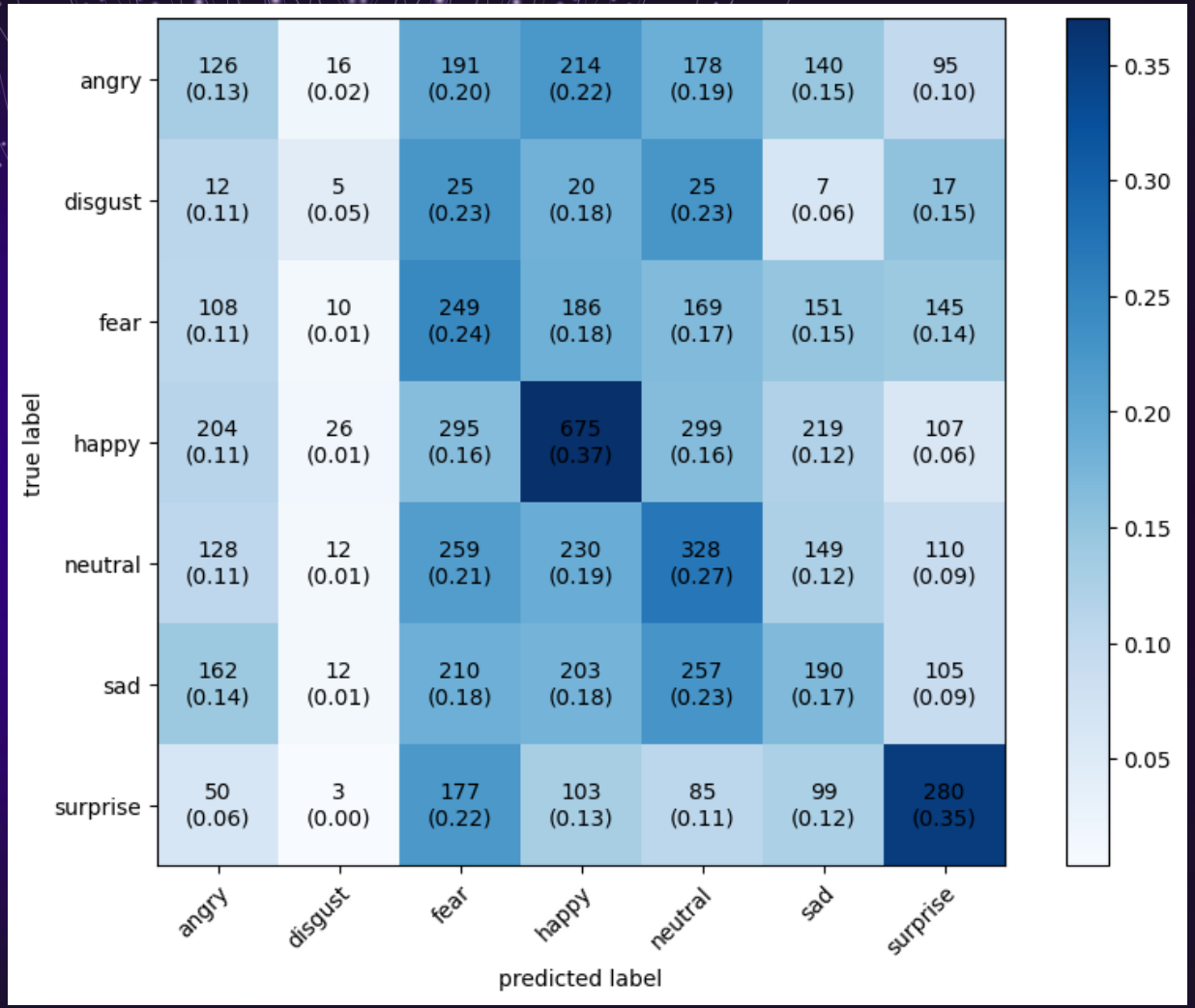
Accuracy Measures after AL



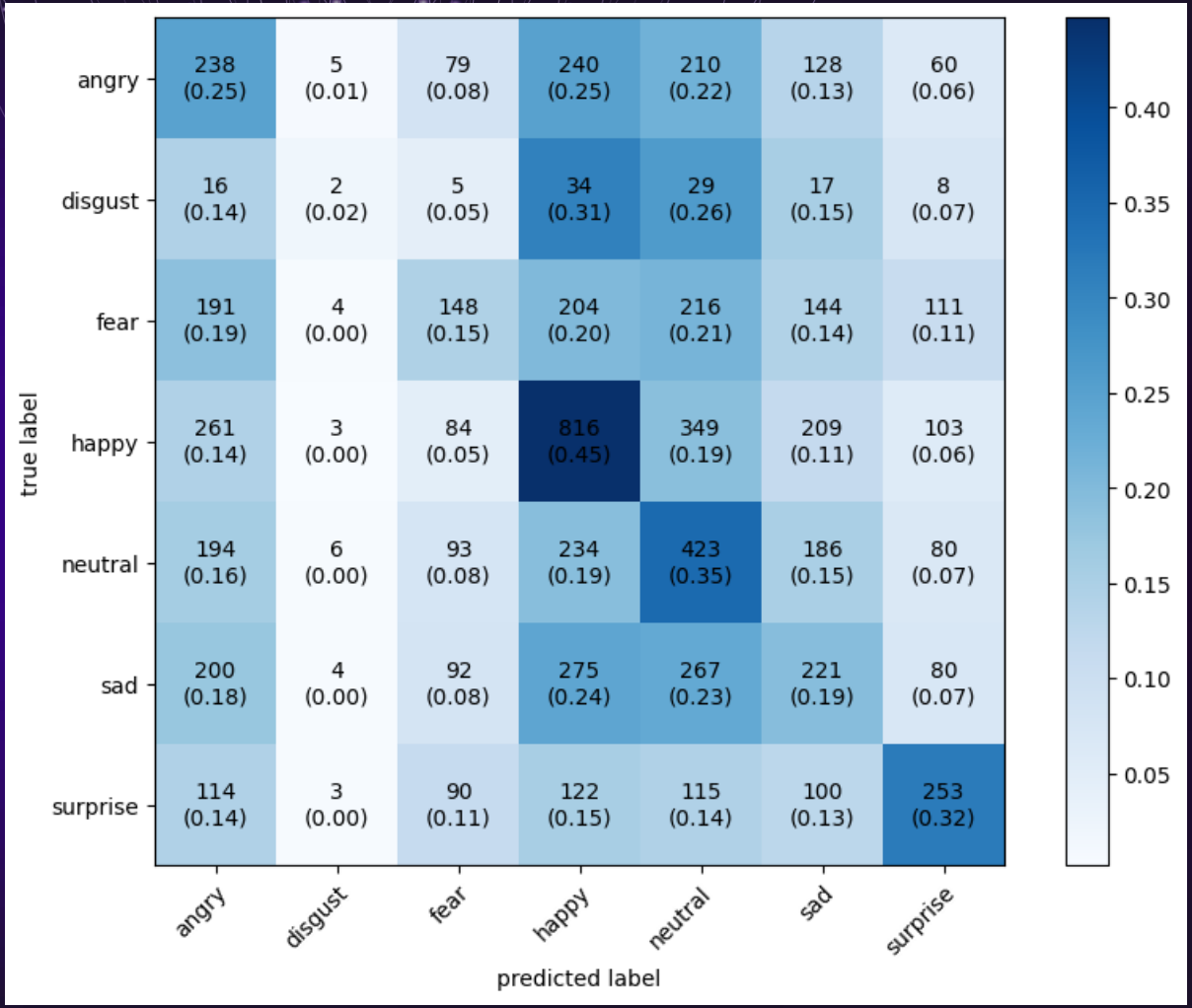
Entropy Based Sampling



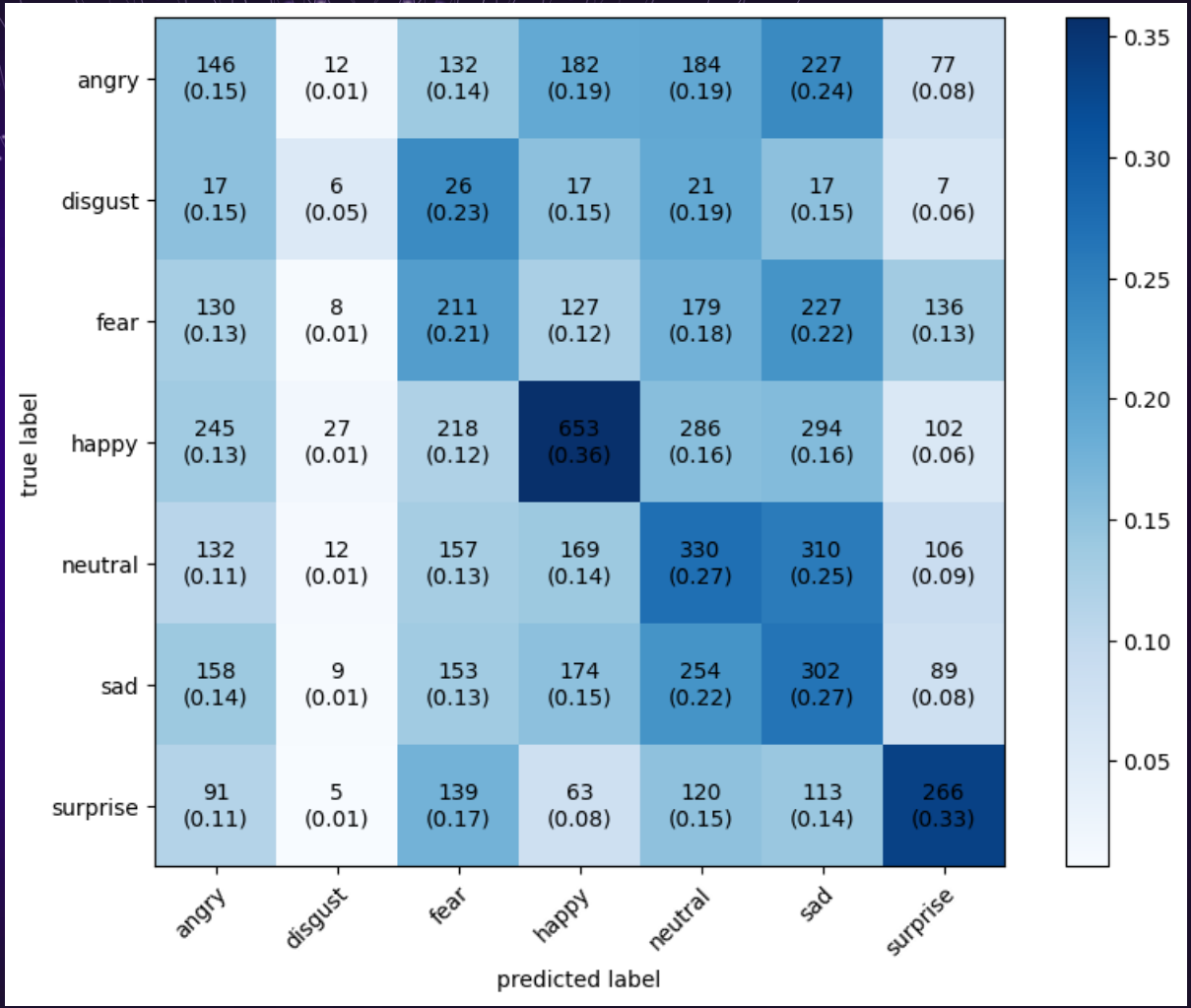
Margin Sampling



Random Sampling



Uncertainty Sampling

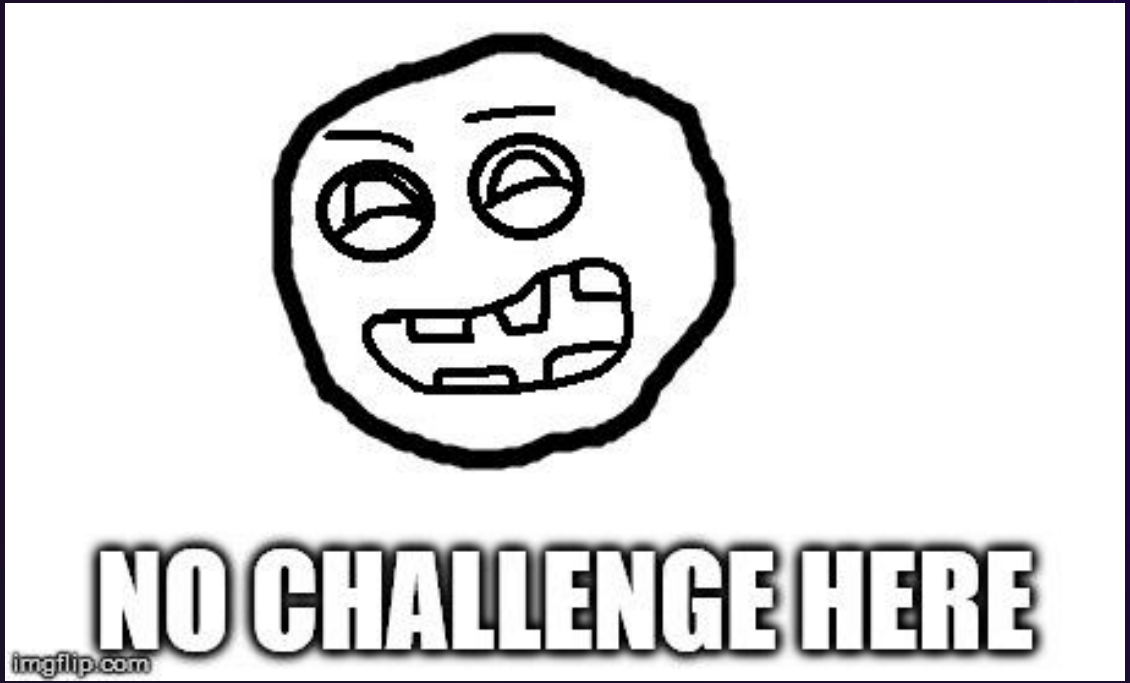


Query By Committee

05

Notes and Challenges

Notes and Challenges



06

Additional Improvements done

No Improvements!

Team Members

Youssef Mohammed

Abdelrahman Mostafa

Mohammed Hisham

Abdelrahman Amin

Thanks!