# Baseline Model

## Coordinate unimodal

* + 1. Baseline Architecture(32 batch size, 10 epochs)
       1. Baseline PyTorch:
          1. After 10 epochs:

Train Topk accuracies are : Top 1: 0.2129, Top 5: 0.5774, Top 10: 0.755,Top 50 0.984

Dev Topk accuracies are : Top 1: 0.313, Top 5: 0.7059, Top 10: 0.856,Top 50 0.980

Test Topk accuracies are : Top 1: 0.253, Top 5: 0.689, Top 10: 0.815,Top 50 0.970

* + - * 1. After 50 epochs:

Test Topk accuracies are : Top 1: 0.25332225913621265, Top 5: 0.6894725913621262, Top 10: 0.815718438538206,Top 50 0.9700996677740864

Dev Topk accuracies are : Top 1: 0.42725409836065575, Top 5: 0.8616803278688525, Top 10: 0.9144467213114754,Top 50 0.9892418032786885

Test Topk accuracies are : Top 1: 0.23826827242524917, Top 5: 0.7341154485049833, Top 10: 0.8492524916943521,Top 50 0.9764327242524917

* + - 1. Baseline Tensorflow:
         1. Train:

Top 1: 0.1221,0.18

Top 5: 0.4396,0.523

Top 50: 0.9536,0.9786

* + - * 1. Dev:

Top1 : 0.1617,0.2286

Top 5: 0.5378,0.5582

Top 50: 0.9668,0.9857

* + 1. More Dense Architecture:
       1. After 10 epochs
          1. Train Topk accuracies are : Top 1: 0.2722, Top 5: 0.673, Top 10: 0.8128,Top 50 0.991
          2. Dev Topk accuracies are : Top 1: 0.416, Top 5: 0.847, Top 10: 0.9098,Top 50 0.988
          3. Test Topk accuracies are : Top 1: 0.2289, Top 5: 0.7286, Top 10: 0.835,Top 50 0.976
       2. After 50 epochs:
          1. Train Topk accuracies are : Top 1: 0.290, Top 5: 0.695, Top 10: 0.8272,Top 50 0.9946
          2. Dev Topk accuracies are : Top 1: 0.44, Top 5: 0.862, Top 10: 0.9149,Top 50 0.98975
          3. Test Topk accuracies are : Top 1: 0.2585, Top 5: 0.7297, Top 10: 0.8484,Top 50 0.983
    2. A slightly more dense architecture is not working properly. So, above are the best results we can get in coord unimodal. Also, it is almost equal to NU huskies Coord unimodal

## Image unimodal:

* + 1. Baseline Architecture (32 batch size, 10 epochs):
       1. Baseline\_Pytorch
          1. Train:

Top 1: 0.183

top 5 0.6025

top 10 0.8304

top 50 0.99

* + - * 1. Dev:

Top 1: 0.126

top 5 0.479

top 10 0.658

top 50 0.961

* + - 1. Baseline\_TF:
         1. Train:

Top 1 : 0.1417

Top 5: 0.4977

top\_50\_accuracy: 0.9853

* + - * 1. Dev:

Top1: 0.1327

Top 5: 0.4898

val\_top\_50\_accuracy: 0.9556

* + 1. No significant difference is observed when passing all the three images separately to the model and concating when the color space is gray.
       1. Color space: Gray
       2. Dim : 48X27 (48X81)
    2. No significant difference is observed when passing all the three images separately to the model and concating when the color space is ‘BGR’.
       1. Color space: BGR
       2. Dim : 48X27 (48X81)
    3. No significant difference is observed when passing all the three images separately to the model and concating when the color space is ‘RGB’.
       1. Color space: RGB
       2. Dim : 48X27 (48X81)
    4. No significant difference is observed when passing all the three images separately to the res18 model and concating when the color space is ‘RGB’.
       1. Color space: RGB
       2. Dim : 224X224
       3. Model : res18
       4. Pretrained = False
       5. Resnet completely unfreezed
    5. No significant difference is observed when passing all the three images separately to the res18 model and concating when the color space is ‘RGB’.
       1. Color space: RGB
       2. Dim : 224X224
       3. Model : res18
       4. Pretrained = True
       5. Resnet completely unfreezed
    6. No significant difference is observed when passing all the three images separately to the res18 model and concating when the color space is ‘RGB’.
       1. Color space: RGB
       2. Dim : 224X224
       3. Model : res18
       4. Pretrained = True
       5. Resnet completely freezed

## Lidar:

* + 1. Baseline\_TF/ Baseline\_pytorch (after 10 epochs ) :
       1. Train Topk accuracies are : Top 1: 0.50, Top 5: 0.826, Top 10: 0.917,Top 50 0.99
       2. Dev Topk accuracies are : Top 1: 0.50, Top 5: 0.856, Top 10: 0.918,Top 50 0.98
       3. Test Topk accuracies are : Top 1: 0.31, Top 5: 0.70, Top 10: 0.821,Top 50 0.967
    2. More dense architecture (after 10 epochs): Perform very poor as compared to baseline architecture

# NU Huskies

## Coord Unimodal

* + 1. Without increasing the frequency of lower classes(40 epochs) :
       1. Train Topk accuracies are : Top 1: 0.2924, Top 5: 0.6995, Top 10: 0.8247,Top 50: 0.9949
       2. Dev Topk accuracies are : Top 1: 0.4252, Top 5: 0.8407, Top 10: 0.9119,Top 50: 0.9892
       3. Test Topk accuracies are : Top 1: 0.2600, Top 5: 0.7416, Top 10: 0.8472,Top 50: 0.9819

## Lidar Unimodal (Able to replicate their results in TF)

**Top1: 49% Top10: 88% on testing**

* + 1. Without increasing the frequency of lower class:
       1. Train Topk accuracies are : Top 1: 0.5463, Top 5: 0.8558, Top 10: 0.9324,Top 50: 0.9992
       2. Dev Topk accuracies are : Top 1: 0.5610, Top 5: 0.8945, Top 10: 0.9288,Top 50: 0.9846
       3. Test Topk accuracies are : Top 1: 0.3587, Top 5: 0.7368, Top 10: 0.8446,Top 50: 0.9768
    2. Incorporating balance dataset(~10% improvement on train acc) (with drop, but no l1,l2):
       1. Train Topk accuracies are : Top 1: 0.6593, Top 5: 0.9295, Top 10: 0.9737,Top 50: 0.9997
       2. Dev Topk accuracies are : Top 1: 0.4991, Top 5: 0.8067, Top 10: 0.8973,Top 50: 0.9879
       3. Test Topk accuracies are : Top 1: 0.3675, Top 5: 0.7240, Top 10: 0.8183,Top 50: 0.9753
    3. Without (dropout on linear and l1,l2 reg) -> Overfitting on train (80%)
       1. With l2 reg in optimizer -> Overfitting on train (81%)
       2. With l1 and l2 -> Still Overfitting (78%)
       3. With l1 and l2 and drop after linear(512) : -> Still overfitting with train acc (70%) and dev around 50 and test 35
       4. With l1,l2,drop complete :
          1. Train Topk accuracies are : Top 1: 0.6467, Top 5: 0.9217, Top 10: 0.9723,Top 50: 0.9998
          2. Dev Topk accuracies are : Top 1: 0.4929, Top 5: 0.8362, Top 10: 0.9040,Top 50: 0.9884
          3. Test Topk accuracies are : Top 1: 0.3722, Top 5: 0.7274, Top 10: 0.8341,Top 50: 0.9630
    4. With L1 and L2 manually implemented:
       1. With dropout on linear:
          1. Train Topk accuracies are : Top 1: 0.6646, Top 5: 0.9351, Top 10: 0.9804,Top 50: 0.9999
          2. Dev Topk accuracies are : Top 1: 0.4790, Top 5: 0.8174, Top 10: 0.8844,Top 50: 0.9888
          3. Test Topk accuracies are : Top 1: 0.3612, Top 5: 0.7153, Top 10: 0.8235,Top 50: 0.9756
       2. Without dropout
    5. Final Conclusion: Unable to increase the lidar acc from 37 to 47 in PyTorch
    6. Able to achieve accuracy equivalent to NU\_Huskies lidar model, when training data is a combination of (training data and validation data) and validation data is training data.
       1. Train Topk accuracies are : Top 1: 0.5377, Top 5: 0.6844, Top 10: 0.6952,Top 50: 0.7684
       2. Dev Topk accuracies are : Top 1: 0.4705, Top 5: 0.7719, Top 10: 0.8317,Top 50: 0.8634

# Imperial\_IPC1 :

They combine training and validation data into training data and testing data act as validation data

They also convert 3D lidar input into a 2D lidar input and run a convolutional network over it

* 1. Github - Pytorch Repo :
     1. On test dataset :
        1. Top-1: 0.5554 Top-5: 0.8643 Top-10: 0.9161
     2. On train dataset
        1. Top-1: 0.5919 Top-5: 0.8758 Top-10: 0.9359

# Beam-Soup:

They increase the lidar range and also increase the shape of lidar they are taking, which results in final shape of [180,330,10] as compared to

They use complete S008 for training and using only S009 for validation as done in Imperial\_IPC1

Channel Output (or labels) is not converted into power ; although doesnt matter

* 1. Github - tensorflow
     1. On Train:
        1. Top1 :0.5734 Top5 : 0.8333 Top10: 0.9129 Top50: 0.9937
     2. On test(not the best results, because unable to load both train and val simultaneously):
        1. Top1: 0.5663 Top5: 0.8735 Top10: 0.9272 Top50: 0.9873
  2. For best test acc:
     1. On train:
        1. Top1: 0.5265 Top5: 0.8052 Top10: 0.8926 Top50: 0.9895
     2. On Test:
        1. Top1: 0.5983 Top5: 0.8658 Top10: 0.9171 Top50: 0.9862