Proposed Changes and Results

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1 Changes Proposed

1.1 Multi-Scale Convolutional Pathways

We introduced multiple parallel layers with size 3X3, 5X5, 7X7, this allows model to see make sense of both fine and larger details. , helping it generalize better across different scenes. We made the corressponding changes in **models/vgg19** directory of our code respository tackle our taks

1.2 Added Early Stopping Condition

Since by adding a few extra convolution layers, and setting epochs to 1000, we could have over generalize on training data leading to overfitting, to overcome this issue we added early stopping criteria of stopping the training if validation loss don't improve upon consecutive 10 epochs. Corresponding changes were made in **utils/regression.py** file in our code repository

1.3 Test-Time Data Augmentation

At test time, we apply transformations like rotations and flips to the image. Each trans- formed version is passed through the model to produce a density map. The resulting maps are then aligned back to the original orientation and averaged to produce the final output. However the results that we got we not better than the original one , suggesting that there might have been Inconsistencies Across Augmentations, i.e TTA works best when each augmented view gives a similar prediction, which is then averaged to improve robustness. However, if predictions vary significantly across different transformations, averaging them can actually blur or distort the output rather than enhancing it. Hence this idea was **dropped** from our implementation

2 Improvement in Results

Earlier Results: **MAE: 95.108, MSE: 169.597**
New Results: **MAE: 89.404, MSE: 157.435**

```
('img_0330',) -48.3897705078125 1668 1716.3897705078125
('img_0331',) -162.296875 2607 2769.296875
('img_0332',) 19.88543701171875 770 750.1145629882812
('img_0333',) -129.67413330078125 601 730.6741333007812
('img_0334',) -65.2188720703125 1508 1573.2188720703125
Final Test: mae 95.10819326617761, mse 169.57934000290606
```

(a) Earlier Results

```
('img_0329',) 449.8538818359375 962 512.1461181640625
('img_0330',) -49.043701171875 1668 1717.043701171875
('img_0331',) -327.194091796875 2607 2934.194091796875
('img_0332',) -84.4473876953125 770 854.4473876953125
('img_0333',) -147.62872314453125 601 748.6287231445312
('img_0334',) -94.3382568359375 1508 1602.3382568359375
Final Test: mae 89.40480580586873, mse 157.4353189169205
```

(b) Results after making the proposed changes