Dataset:

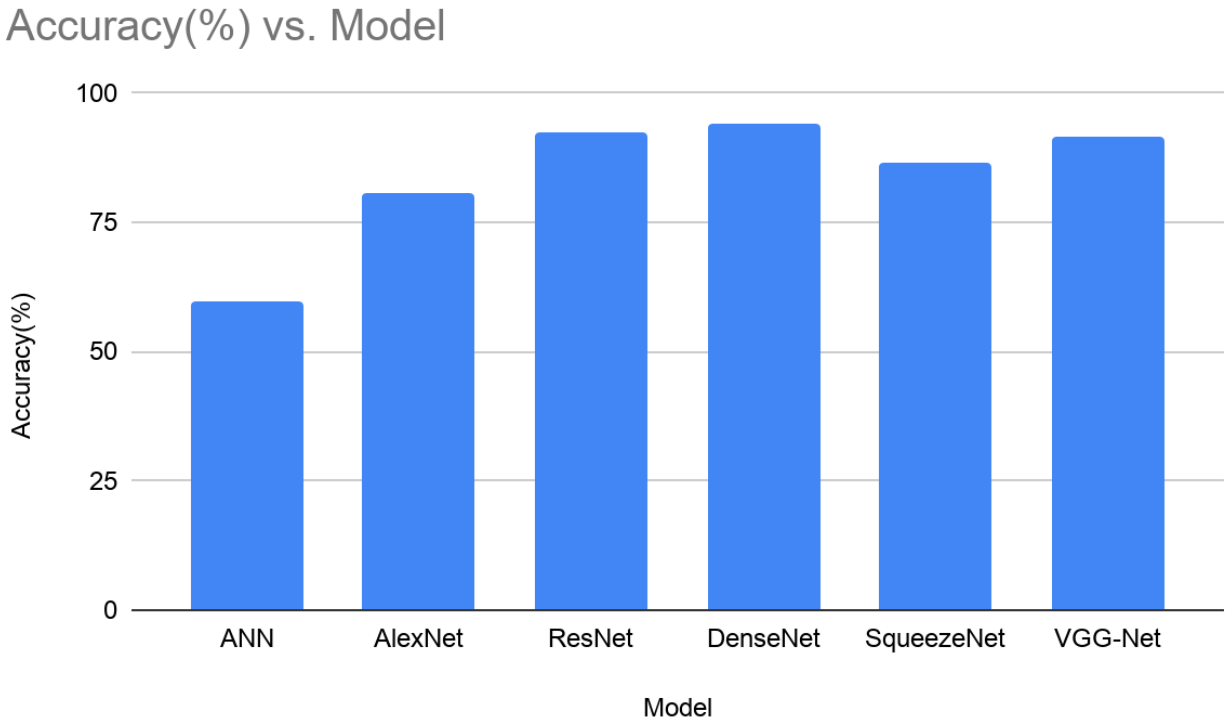
- Sample of Food101 Dataset
- Total 10 classes.
- 150 training samples for each class, ence training set size=10*150
- 50 testing images for each class. Hence testing set size=10*50
- Classes:
  - **['edamame', 'ramen', 'sushi', 'bibimbap', 'apple_pie', 'falafel', 'ice_cream', 'french_toast', 'tiramisu', 'cannoli'**

Methodology:

We have performed Data Augmentation(random transformation and resizing) on training and testing images and then normalized the images.

- Machine Learning Models- Random Forest ,Decision Tree,KNN , Naive Bayes and applied feature extraction using HOG.
- Deep Learning:
  - Artificial Neural Network(from Scratch)
  - Alex-net
  - Densenet
  - Resenet
  - Squeezenet
  - Vgg

Results


Accuracy(%) vs. Model
100
75
50
25
0
Accuracy(%)
ANN
AlexNet
ResNet
DenseNet
SqueezeNet
VGG-Net
Model

Artificial Neural Network

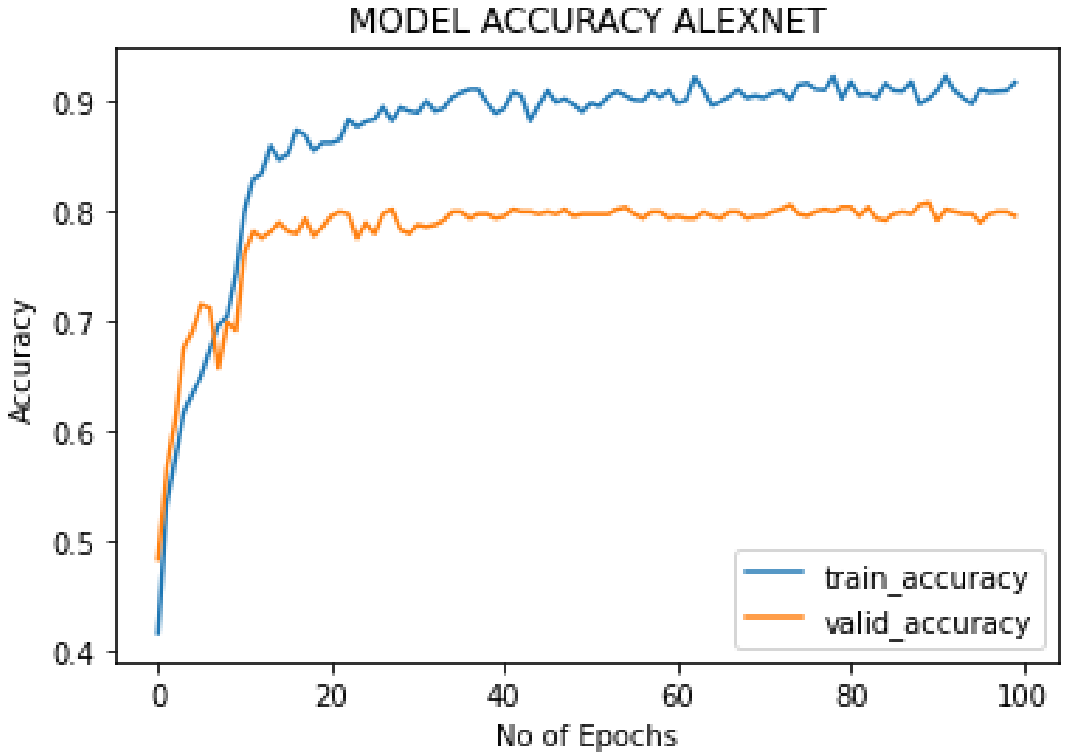
```
Model: "sequential_11"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_39 (Conv2D)           (None, 198, 198, 32)      896
_________________________________________________________________
max_pooling2d_39 (MaxPooling (None, 99, 99, 32)        0
_________________________________________________________________
conv2d_40 (Conv2D)           (None, 97, 97, 32)        9248
_________________________________________________________________
max_pooling2d_40 (MaxPooling (None, 48, 48, 32)        0
_________________________________________________________________
conv2d_41 (Conv2D)           (None, 46, 46, 32)        9248
_________________________________________________________________
max_pooling2d_41 (MaxPooling (None, 23, 23, 32)        0
_________________________________________________________________
conv2d_42 (Conv2D)           (None, 21, 21, 32)        9248
_________________________________________________________________
max_pooling2d_42 (MaxPooling (None, 10, 10, 32)        0
_________________________________________________________________
conv2d_43 (Conv2D)           (None, 8, 8, 32)          9248
_________________________________________________________________
max_pooling2d_43 (MaxPooling (None, 4, 4, 32)          0
_________________________________________________________________
flatten_10 (Flatten)         (None, 512)               0
_________________________________________________________________
dense_11 (Dense)             (None, 4)                 2052
=================================================================
Total params: 39,940
Trainable params: 39,940
Non-trainable params: 0
```

Model-Architecture

```
Train for 75 steps, validate for 19 steps
Epoch 1/60
75/75 [==============================] - 23s 301ms/step - loss: 0.3524
- accuracy: 0.8783 - val_loss: 1.1435 - val_accuracy: 0.6433
Epoch 2/60
75/75 [==============================] - 22s 293ms/step - loss: 0.3195
- accuracy: 0.8817 - val_loss: 1.2213 - val_accuracy: 0.6150
Epoch 3/60
75/75 [==============================] - 21s 286ms/step - loss: 0.2722
- accuracy: 0.9021 - val_loss: 1.3231 - val_accuracy: 0.6133
Epoch 4/60
75/75 [==============================] - 22s 292ms/step - loss: 0.2521
- accuracy: 0.9121 - val_loss: 1.5011 - val_accuracy: 0.6050
Epoch 5/60
75/75 [==============================] - 22s 289ms/step - loss: 0.1915
- accuracy: 0.9333 - val_loss: 1.5108 - val_accuracy: 0.6050
Epoch 6/60
75/75 [==============================] - 22s 289ms/step - loss: 0.1436
- accuracy: 0.9517 - val_loss: 1.8637 - val_accuracy: 0.6100
Epoch 7/60
75/75 [==============================] - 22s 292ms/step - loss: 0.1231
- accuracy: 0.9596 - val_loss: 1.7044 - val_accuracy: 0.6217
Epoch 8/60
75/75 [==============================] - 22s 292ms/step - loss: 0.0875
- accuracy: 0.9737 - val_loss: 1.8034 - val_accuracy: 0.5950
Epoch 9/60
75/75 [==============================] - 22s 292ms/step - loss: 0.0905
- accuracy: 0.9700 - val_loss: 1.9439 - val_accuracy: 0.6117
Epoch 10/60
75/75 [==============================] - 22s 291ms/step - loss: 0.0759
- accuracy: 0.9742 - val_loss: 2.0855 - val_accuracy: 0.5850
Epoch 11/60
75/75 [==============================] - 22s 290ms/step - loss: 0.1163
- accuracy: 0.9563 - val_loss: 2.1855 - val_accuracy: 0.5967
```

Accuracy: 59.67%

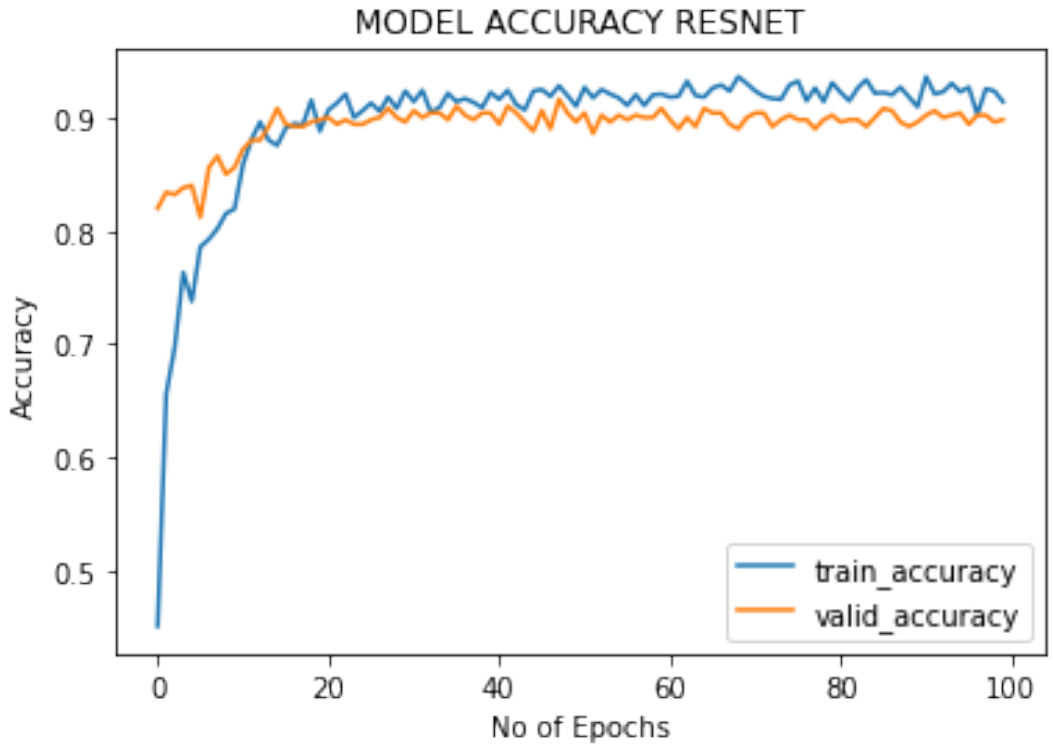
Alex-net




```
----------
Current learning rate is 1e-05
train Loss: 0.2739 Acc: 0.9033
valid Loss: 0.7111 Acc: 0.7980
Epoch 94/99
----------
Current learning rate is 1e-05
train Loss: 0.3248 Acc: 0.8980
valid Loss: 0.7187 Acc: 0.7980
Epoch 95/99
----------
Current learning rate is 1e-05
train Loss: 0.2700 Acc: 0.9113
valid Loss: 0.7150 Acc: 0.7900
Epoch 96/99
----------
Current learning rate is 1e-05
train Loss: 0.2930 Acc: 0.9087
valid Loss: 0.7138 Acc: 0.7980
Epoch 97/99
----------
Current learning rate is 1e-05
train Loss: 0.2819 Acc: 0.9093
valid Loss: 0.7124 Acc: 0.8000
Epoch 98/99
----------
Current learning rate is 1e-05
train Loss: 0.2671 Acc: 0.9100
valid Loss: 0.7109 Acc: 0.8000
Epoch 99/99
----------
Current learning rate is 1e-05
train Loss: 0.2818 Acc: 0.9173
valid Loss: 0.7086 Acc: 0.7960
Training complete in 20m 40s
Best val Acc: 0.808000
```

Accuracy: 80.8%

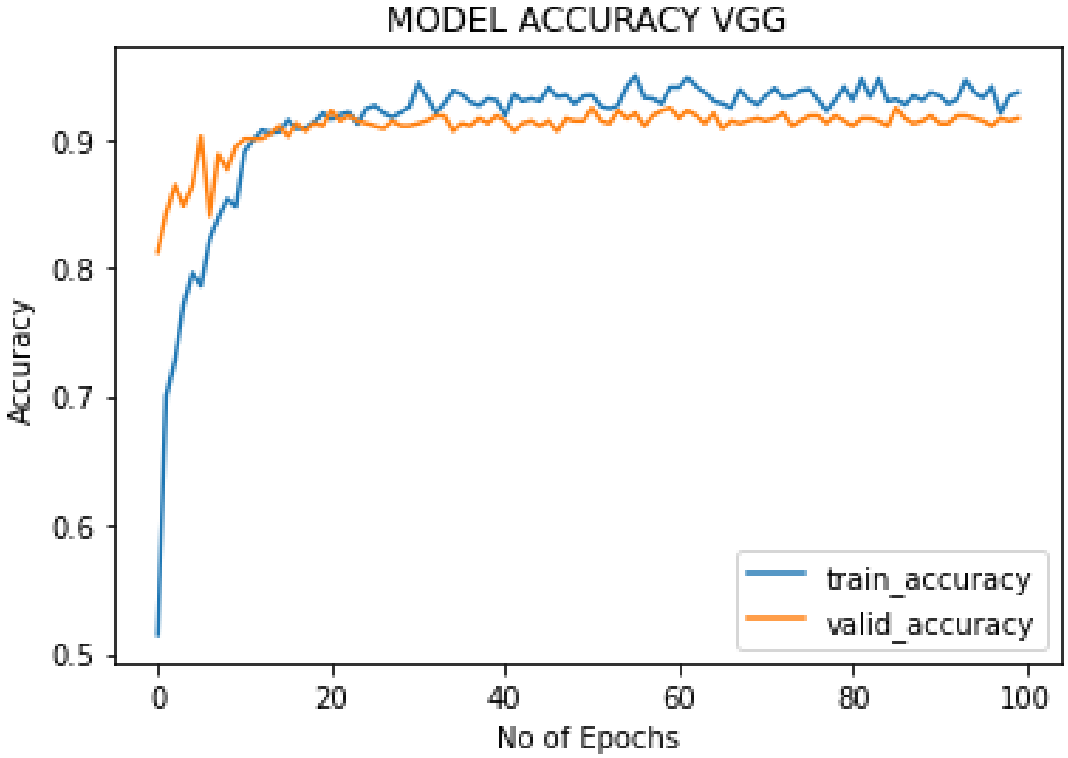
Resnet




```
Epoch 93/99
----------
Current learning rate is 1e-05
train Loss: 0.1763 Acc: 0.9453
valid Loss: 0.2429 Acc: 0.9180
Epoch 94/99
----------
Current learning rate is 1e-05
train Loss: 0.2054 Acc: 0.9360
valid Loss: 0.2407 Acc: 0.9160
Epoch 95/99
----------
Current learning rate is 1e-05
train Loss: 0.2090 Acc: 0.9320
valid Loss: 0.2556 Acc: 0.9140
Epoch 96/99
----------
Current learning rate is 1e-05
train Loss: 0.1774 Acc: 0.9407
valid Loss: 0.2478 Acc: 0.9100
Epoch 97/99
----------
Current learning rate is 1e-05
train Loss: 0.2358 Acc: 0.9200
valid Loss: 0.2536 Acc: 0.9160
Epoch 98/99
----------
Current learning rate is 1e-05
train Loss: 0.2022 Acc: 0.9333
valid Loss: 0.2538 Acc: 0.9140
Epoch 99/99
----------
Current learning rate is 1e-05
train Loss: 0.1986 Acc: 0.9360
valid Loss: 0.2482 Acc: 0.9160
Training complete in 43m 12s
Best val Acc: 0.924000
```

Accuracy: 92.40%

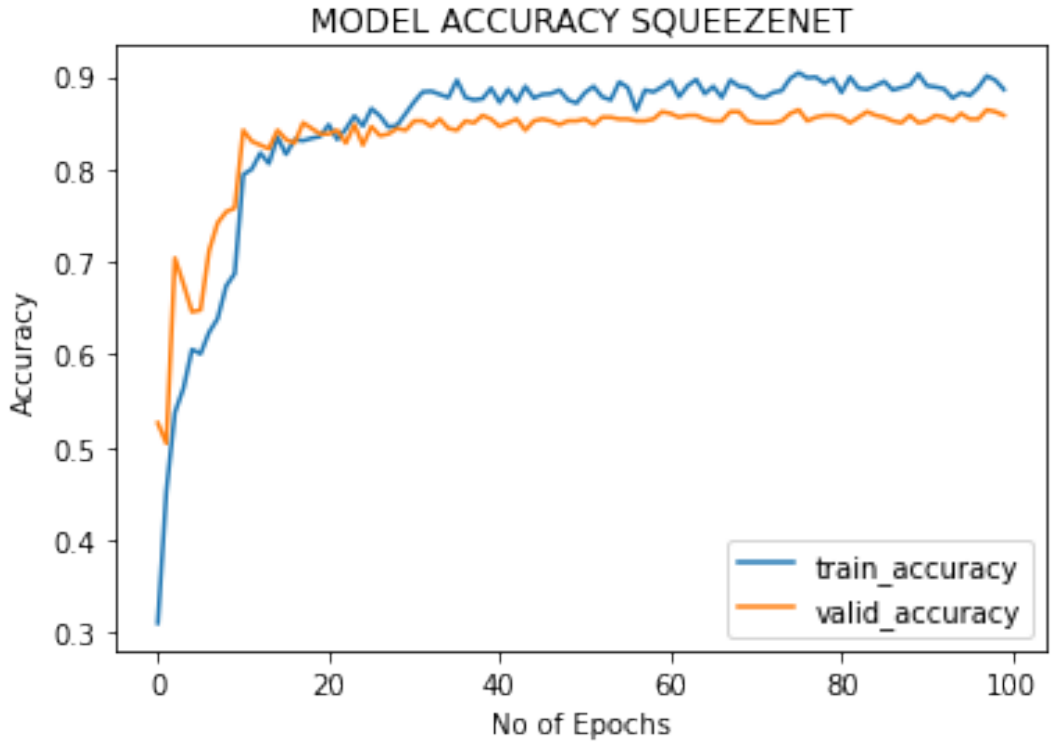
Vgg-net




```
----------
Current learning rate is 1e-05
train Loss: 0.2369 Acc: 0.9300
valid Loss: 0.3270 Acc: 0.9020
Epoch 94/99
----------
Current learning rate is 1e-05
train Loss: 0.2580 Acc: 0.9227
valid Loss: 0.3341 Acc: 0.9040
Epoch 95/99
----------
Current learning rate is 1e-05
train Loss: 0.2350 Acc: 0.9267
valid Loss: 0.3411 Acc: 0.8940
Epoch 96/99
----------
Current learning rate is 1e-05
train Loss: 0.2907 Acc: 0.9027
valid Loss: 0.3350 Acc: 0.9020
Epoch 97/99
----------
Current learning rate is 1e-05
train Loss: 0.2441 Acc: 0.9253
valid Loss: 0.3329 Acc: 0.9020
Epoch 98/99
----------
Current learning rate is 1e-05
train Loss: 0.2490 Acc: 0.9233
valid Loss: 0.3340 Acc: 0.8960
Epoch 99/99
----------
Current learning rate is 1e-05
train Loss: 0.2607 Acc: 0.9140
valid Loss: 0.3273 Acc: 0.8980
Training complete in 23m 54s
Best val Acc: 0.916000
```

Accuracy: 91.60%

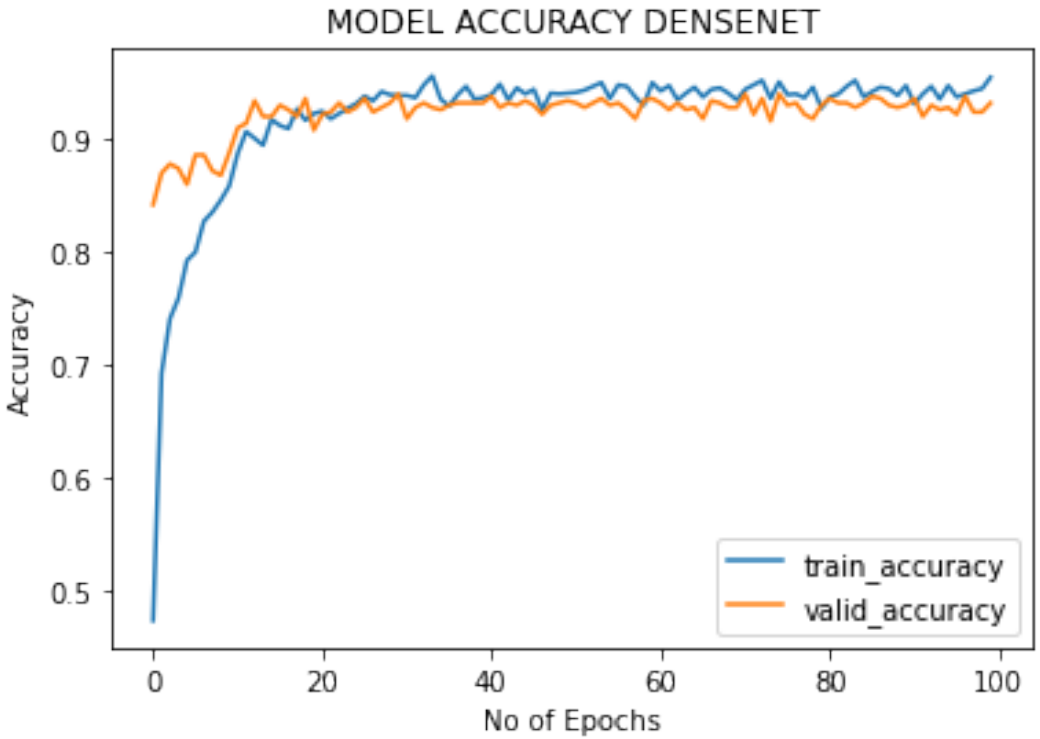
SqueezeNet




```
----------
Current learning rate is 1e-05
train Loss: 0.3778 Acc: 0.8827
valid Loss: 0.4552 Acc: 0.8600
Epoch 95/99
----------
Current learning rate is 1e-05
train Loss: 0.3747 Acc: 0.8793
valid Loss: 0.4538 Acc: 0.8540
Epoch 96/99
----------
Current learning rate is 1e-05
train Loss: 0.3483 Acc: 0.8880
valid Loss: 0.4592 Acc: 0.8540
Epoch 97/99
----------
Current learning rate is 1e-05
train Loss: 0.3272 Acc: 0.9007
valid Loss: 0.4484 Acc: 0.8640
Epoch 98/99
----------
Current learning rate is 1e-05
train Loss: 0.2981 Acc: 0.8960
valid Loss: 0.4468 Acc: 0.8620
Epoch 99/99
----------
Current learning rate is 1e-05
train Loss: 0.3750 Acc: 0.8860
valid Loss: 0.4557 Acc: 0.8580
Training complete in 22m 58s
Best val Acc: 0.864000
```

Accuracy: 86.40%

Densenet




```
Epoch 95/99
----------
Current learning rate is 1e-05
train Loss: 0.2018 Acc: 0.9373
valid Loss: 0.2181 Acc: 0.9220
Epoch 96/99
----------
Current learning rate is 1e-05
train Loss: 0.1997 Acc: 0.9400
valid Loss: 0.2140 Acc: 0.9380
Epoch 97/99
----------
Current learning rate is 1e-05
train Loss: 0.1797 Acc: 0.9427
valid Loss: 0.2298 Acc: 0.9240
Epoch 98/99
----------
Current learning rate is 1e-05
train Loss: 0.1748 Acc: 0.9447
valid Loss: 0.2161 Acc: 0.9240
Epoch 99/99
----------
Current learning rate is 1e-05
train Loss: 0.1793 Acc: 0.9547
valid Loss: 0.2149 Acc: 0.9320
Training complete in 45m 47s
Best val Acc: 0.940000
```

Accuracy: 94.0%

READ ME FILES:-

- Colab LINK for Deep Learning :- https://colab.research.google.com/drive/1byMuagYD03kxSIVNsiu3jD42LOy4DD67?usp=sharing
- Colab Link for ML techniques:- https://colab.research.google.com/drive/1yylvWvfUSgDTsriCnM6ndHuLrhgVCsf-?usp=sharing

- Used Data is food 101 dataset which is sampled for 10 classes and 150 training and 50 testing images.
- Various Experiments were performed for results generation they are performed by modifying code that are commented or changed in between.
- DenseNet model and ResNet model has given best accuracy approx 94-95% for valiadtion among all models.
- Some Machine Learning models were also tried but their results was not good to show .
- One Manual self-designed CNN architecture is also applied that gives 65% accuracy.