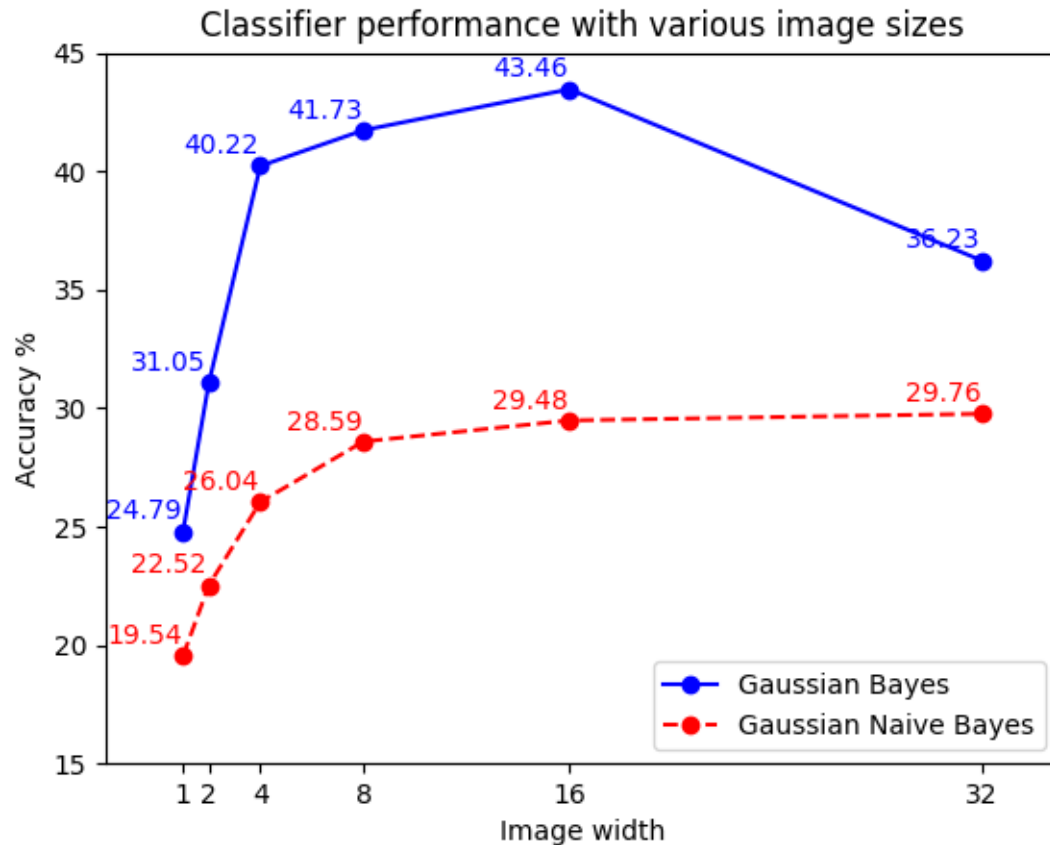


CIFAR-10 – Bayesian classifier (super powerful) (20 points)

Here is the graph that compares Bayes & Naive Bayes classifier's accuracy for 1x1 to 32x32 images:



Also some screenshots to verify that I used my own code:

```

154 pool = Pool(4)
155 classified=pool.map(bclassify, testX)
156 classified=np.concatenate(classified)
157 bacc=class_acc(classified, testY)
158 baccuracy.append(round(bacc*100,2))
159
160 print('Evaluate Gaussian Naive Bayes model...')
161 pool = Pool(4)
162 classified=pool.map(nbclassify, testX)
163 classified=np.concatenate(classified)
164 nbacc=class_acc(classified, testY)
165 nbaccuracy.append(round(nbacc*100,2))
166
167 print('{}x{} Gaussian Bayes-classifier accuracy: {}'.format(

```

```

[Line 170, Column 59]
[tuomas@localhost Ex3]$ python task3.py
Estimating model parameters for 1x1 images...
Resizing test images...
Evaluate Gaussian Bayes model...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Evaluate Gaussian Naive Bayes model...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
1x1 Gaussian Bayes-classifier accuracy: 24.79%
1x1 Gaussian Naive Bayes-classifier accuracy: 19.54%
Estimating model parameters for 2x2 images...

```

```

133
134
135
136
137
138 # Define these as a global variables.
139 start=time.time()
140 trainX, trainY = load_whole_trainset()
141 testX1, testY = load_testset()
142
143 ns=[1,2,4,8,16,32]
144 nbaccuracy=[]
145 baccuracy=[]
146 for n in ns:

```

```

[Line 170, Column 59]
Estimating model parameters for 2x2 images...
Resizing test images...
Evaluate Gaussian Bayes model...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Evaluate Gaussian Naive Bayes model...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
2x2 Gaussian Bayes-classifier accuracy: 31.05%
2x2 Gaussian Naive Bayes-classifier accuracy: 22.52%
Estimating model parameters for 4x4 images...
Resizing test images...

```

```
143 ns=[1,2,4,8,16,32]
144 nbaccuracy=[]
145 baccuracy=[]
146 for n in ns:

Line 170, Column 59

2x2 Gaussian Bayes-classifier accuracy: 31.05%
2x2 Gaussian Naive Bayes-classifier accuracy: 22.52%
Estimating model parameters for 4x4 images...
Resizing test images...
Evaluate Gaussian Bayes model...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Evaluate Gaussian Naive Bayes model...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
4x4 Gaussian Bayes-classifier accuracy: 40.22%
4x4 Gaussian Naive Bayes-classifier accuracy: 26.040000000000000
```

```
143 ns=[1,2,4,8,16,32]
144 nbaccuracy=[]
145 baccuracy=[]
146 for n in ns:

Line 170, Column 59

Estimating model parameters for 16x16 images...
Resizing test images...
Evaluate Gaussian Bayes model...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Evaluate Gaussian Naive Bayes model...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
16x16 Gaussian Bayes-classifier accuracy: 43.46%
16x16 Gaussian Naive Bayes-classifier accuracy: 29.48%
Estimating model parameters for 32x32 images...
Resizing test images...
```

```
143 ns=[1,2,4,8,16,32]
144 nbaccuracy=[]
145 baccuracy=[]
146 for n in ns:

Line 170, Column 59

16x16 Gaussian Bayes-classifier accuracy: 43.46%
16x16 Gaussian Naive Bayes-classifier accuracy: 29.48%
Estimating model parameters for 32x32 images...
Resizing test images...
Evaluate Gaussian Bayes model...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Bayes classifier Classifying...
Evaluate Gaussian Naive Bayes model...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
32x32 Gaussian Bayes-classifier accuracy: 36.230000000000004%
32x32 Gaussian Naive Bayes-classifier accuracy: 29.759999999999999
```

```
143 ns=[1,2,4,8,16,32]
144 nbaccuracy=[]
145 baccuracy=[]
146 for n in ns:

Line 170, Column 59

Naive Bayes classifier Classifying...
Naive Bayes classifier Classifying...
32x32 Gaussian Bayes-classifier accuracy: 36.230000000000004%
32x32 Gaussian Naive Bayes-classifier accuracy: 29.759999999999999
Total running time: 618.9189963340759s
Bayes classifier accuracies: [24.79, 31.05, 40.22, 41.73, 43.46, 43.46]
Naive Bayes classifier accuracies: [19.54, 22.52, 26.04, 28.52, 29.48, 29.76]
Gtk-Message: 01:46:27.735: Failed to load module "appmenu-gtk3-module"
[туомас@localhost Ex3]$
```

Classification were performed on 4 threads and by utilizing nymphy's vectorization features.

Actual classification part is quite fast (excluding 32x32 images). I didn't had time to optimize the image preprocessing steps, so it somewhat slows the program (overall run time ~619 s).