DATASET1

Introduction to Dataset1

Dataset1 files data class distribution

Dataset1_costDist_v3.mat
Class = 1 Count = 9685700 Percentage = 91.249465
Class = 0 Count = 928828 Percentage = 8.750535
Dataset2_costDist_v3.mat
Class = 1 Count = 52,020,076 Percentage = 82.211872
Class = 0 Count = 11,255,549 Percentage = 17.788128
dataset3_costDist_v3.mat
Class = 1 Count = 9480832 Percentage = 92.177751
Class = 0 Count = 804548 Percentage = 7.822249

To have a better view of the dataset the descriptive statistics for the raw data set can be used:

	f1	f2	f3	f4	\
count	138668.000000	138668.000000	138668.000000	138668.000000	
mean	71.285795	0.851381	0.757690	0.084168	
std	62.414522	2.963187	2.969936	0.063560	
min	0.000000	0.000000	0.000000	0.000000	
25%	15.952616	0.511135	0.397869	0.019826	
50%	52.218544	0.673275	0.557780	0.084117	
75%	124.013852	0.776086	0.680946	0.128085	
max	253.339462	41.863719	41.851058	0.428756	

	f5	y2
count	138668.000000	138668.000000
mean	10.522218	0.500000
std	21.928400	0.500002
min	0.000000	0.000000
25%	0.386769	0.000000
50%	1.246207	0.500000
75%	4.702240	1.000000
max	82.508918	1.000000

Tools

Python 2.7 with Scikit-Learn library 15.0.2 were used for the modeling and visualization

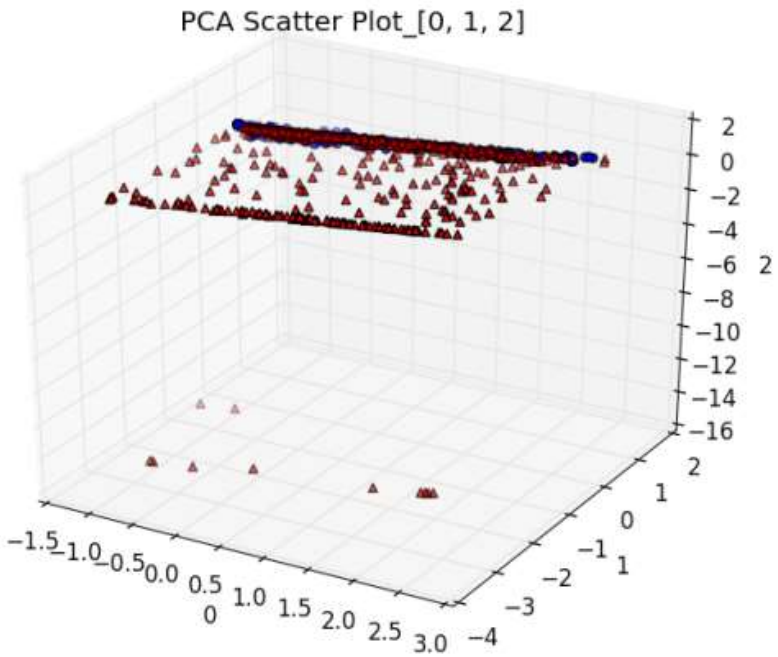
Preprocessing

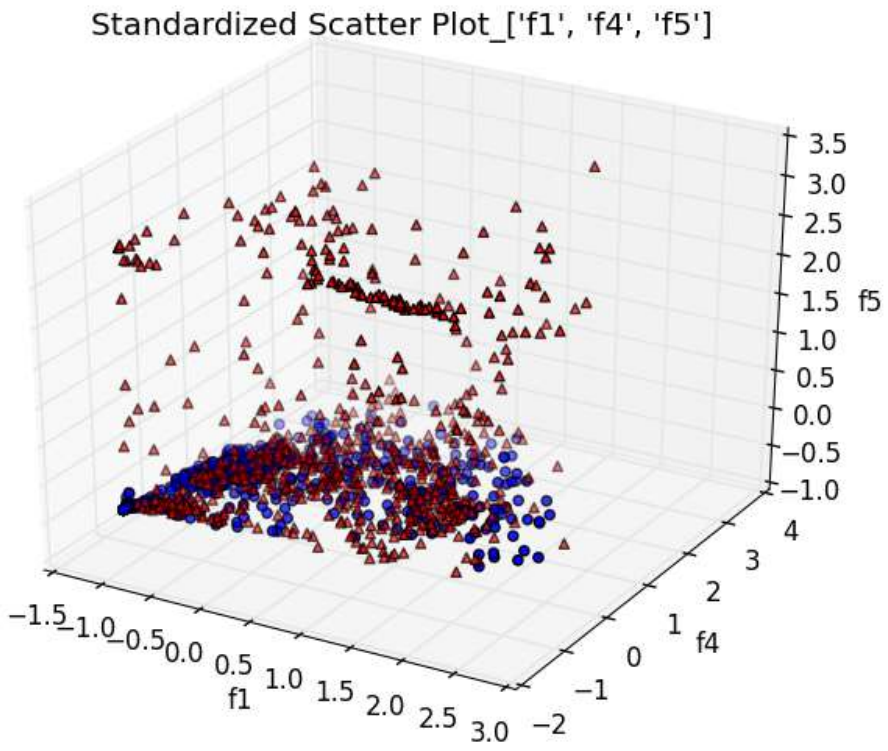
- Scaled features by 0-to-1 scaling scheme.

- Features are plotted to obtain their spatial distribution and potential identification of separation plane
    - Scatterplots are constructed for all combinations of the 5 features in several modes
        - Raw features
        - Scaled features
            - 0-to-1 scaling scheme
            - Standard normal scaling scheme
            - Winsorized data by shrinking lower and upper 5% realization of each feature. It shows that much of the variability is lost in the figure. So winsorizing is discarded
- To visualize the interaction between all 5 feature together in 3D plots, the scaled features were PCA decomposed by SVD method and enabling whitening to further remove possible correlations between the scaled features
- PCA decomposition %variance explained is [0.8992, 0.0971, 0.0037, 0. , 0.]
- So 3dimensions after PCA reduction would suffice in practice. But having only 5 features, PCA reduction is discarded because dimensionality is not a great issue in this case

Outcome: The scaled features themselves do not show much promise in 3D plots for possible separation hyperplanes. The PCA may have been a better approach but to avoid losing some of the information, all 5 features were retained in the models.

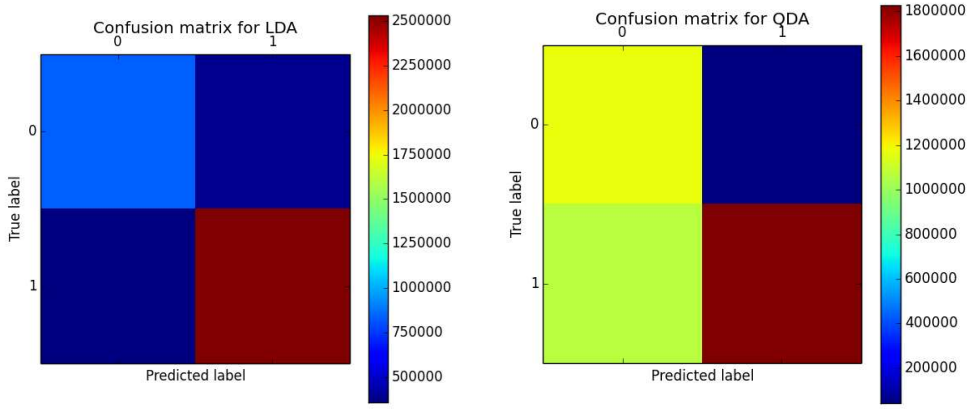
The data set is too large to handle. So the data were randomly resampled and ~5% data were taken for training and testing which is nearly 130thousand.





Classifiers

The two confusion matrices are plotted bellow are for LDA and QDA. Similar graphs were not constructed for other classifications as it would be cumbersome.



Feature set:

The features are only 5 in number. So, all possible combinations of the features were used to find the best feature combination.

For each classification, the best feature combination is marked in color. In addition to the slides, the details of the classifiers are showed below. In summary the AdaBoost on Decision Tree base classifier comes out with a76% accuracy with a standard validation procedure.

The classifier outputs can be found below and the summary can be found in the Vugraphs.

LDA

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	67.94	68.03	
1	[f2]	59.73	59.87	
2	[f3]	60.71	60.64	
3	[f4]	57.78	57.85	
4	[f5]	66.10	65.91	
5	[f1, f2]	68.11	67.99	
6	[f1, f3]	68.35	67.98	
7	[f1, f4]	70.12	69.96	
8	[f1, f5]	70.78	70.40	
9	[f2, f3]	58.25	58.32	
10	[f2, f4]	58.67	58.30	
11	[f2, f5]	66.04	66.01	
12	[f3, f4]	58.39	58.59	
13	[f3, f5]	66.24	65.75	
14	[f4, f5]	69.26	69.30	
15	[f1, f2, f3]	67.81	67.83	
16	[f1, f2, f4]	70.09	70.17	
17	[f1, f2, f5]	70.58	70.63	
18	[f1, f3, f4]	70.31	70.10	

19	[f1, f3, f5]	70.72	70.42
20	[f1, f4, f5]	71.86	72.11
21	[f2, f3, f4]	58.33	58.19
22	[f2, f3, f5]	65.61	65.81
23	[f2, f4, f5]	69.22	69.38
24	[f3, f4, f5]	69.42	69.12
25	[f1, f2, f3, f4]	69.99	70.15
26	[f1, f2, f3, f5]	70.41	70.70
27	[f1, f2, f4, f5]	72.07	72.05
28	[f1, f3, f4, f5]	72.24	71.91
29	[f2, f3, f4, f5]	69.10	69.41
30	[f1, f2, f3, f4, f5]	72.13	71.85

	CONFUSION_MATRIX
0	[[38.13, 12.0], [19.97, 29.9]]
1	[[47.76, 2.23], [37.9, 12.11]]
2	[[46.53, 3.49], [35.87, 14.11]]
3	[[28.93, 21.07], [21.09, 28.92]]
4	[[49.81, 0.04], [34.05, 16.1]]
5	[[37.91, 11.77], [20.24, 30.08]]
6	[[37.91, 12.13], [19.9, 30.06]]
7	[[36.75, 13.31], [16.73, 33.21]]
8	[[40.92, 9.23], [20.37, 29.47]]
9	[[32.4, 17.68], [24.0, 25.93]]
10	[[29.71, 20.04], [21.65, 28.59]]
11	[[50.03, 0.06], [33.93, 15.98]]
12	[[29.59, 20.5], [20.91, 29.0]]
13	[[49.78, 0.05], [34.21, 15.97]]
14	[[40.14, 9.94], [20.76, 29.16]]
15	[[37.52, 12.33], [19.84, 30.3]]
16	[[37.04, 12.88], [16.95, 33.13]]
17	[[40.9, 9.17], [20.2, 29.73]]
18	[[36.98, 13.08], [16.82, 33.13]]
19	[[40.81, 9.24], [20.35, 29.61]]
20	[[38.56, 11.53], [16.36, 33.55]]
21	[[29.53, 20.15], [21.66, 28.66]]
22	[[49.32, 0.67], [33.52, 16.49]]
23	[[40.6, 9.42], [21.2, 28.78]]
24	[[40.19, 9.81], [21.07, 28.93]]
25	[[36.62, 13.2], [16.65, 33.52]]
26	[[40.79, 9.31], [19.99, 29.91]]
27	[[38.47, 11.55], [16.4, 33.58]]
28	[[38.29, 11.71], [16.38, 33.62]]
29	[[40.27, 9.77], [20.83, 29.14]]
30	[[38.05, 11.63], [16.52, 33.8]]

QDA

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	67.78	67.60	
1	[f2]	50.58	50.39	
2	[f3]	50.79	50.18	
3	[f4]	58.03	57.87	
4	[f5]	66.39	66.80	
5	[f1, f2]	55.18	55.24	
6	[f1, f3]	55.69	55.60	
7	[f1, f4]	69.25	69.22	
8	[f1, f5]	66.50	66.58	

9	[f2, f3]	51.01	50.82
10	[f2, f4]	50.65	50.78
11	[f2, f5]	66.49	66.65
12	[f3, f4]	50.70	50.77
13	[f3, f5]	66.41	66.77
14	[f4, f5]	66.68	66.46
15	[f1, f2, f3]	57.84	58.18
16	[f1, f2, f4]	59.17	59.19
17	[f1, f2, f5]	66.60	66.31
18	[f1, f3, f4]	60.27	59.73
19	[f1, f3, f5]	66.35	66.66
20	[f1, f4, f5]	67.62	67.59
21	[f2, f3, f4]	51.64	51.20
22	[f2, f3, f5]	66.68	66.60
23	[f2, f4, f5]	66.73	66.43
24	[f3, f4, f5]	66.76	66.46
25	[f1, f2, f3, f4]	60.57	60.58
26	[f1, f2, f3, f5]	66.40	66.69
27	[f1, f2, f4, f5]	66.89	66.77
28	[f1, f3, f4, f5]	67.02	66.74
29	[f2, f3, f4, f5]	66.62	66.59
30	[f1, f2, f3, f4, f5]	66.81	67.27

	CONFUSION_MATRIX
0	[[38.29, 11.65], [20.75, 29.31]]
1	[[49.91, 0.02], [49.59, 0.48]]
2	[[49.66, 0.02], [49.8, 0.51]]
3	[[30.32, 19.74], [22.39, 27.55]]
4	[[49.07, 1.03], [32.16, 17.73]]
5	[[47.64, 2.45], [42.31, 7.6]]
6	[[46.98, 2.97], [41.43, 8.62]]
7	[[35.12, 14.66], [16.13, 34.09]]
8	[[48.79, 1.23], [32.19, 17.79]]
9	[[49.86, 0.03], [49.15, 0.96]]
10	[[49.8, 0.26], [48.96, 0.98]]
11	[[48.95, 1.07], [32.28, 17.7]]
12	[[49.78, 0.24], [48.99, 0.99]]
13	[[49.12, 1.05], [32.18, 17.65]]
14	[[48.72, 1.12], [32.42, 17.74]]
15	[[45.96, 4.17], [37.66, 12.22]]
16	[[47.12, 2.9], [37.91, 12.07]]
17	[[48.97, 1.07], [32.62, 17.34]]
18	[[46.1, 3.59], [36.69, 13.63]]
19	[[48.94, 1.05], [32.29, 17.72]]
20	[[47.91, 2.04], [30.38, 19.68]]
21	[[49.04, 0.72], [48.08, 2.16]]
22	[[48.73, 1.3], [32.11, 17.87]]
23	[[48.77, 1.12], [32.45, 17.67]]
24	[[48.55, 1.14], [32.4, 17.91]]
25	[[46.4, 3.77], [35.65, 14.18]]
26	[[48.89, 1.22], [32.09, 17.8]]
27	[[48.65, 1.42], [31.81, 18.12]]
28	[[48.66, 1.33], [31.92, 18.08]]
29	[[48.76, 1.14], [32.27, 17.83]]
30	[[48.49, 1.61], [31.12, 18.78]]

KNN, k=1

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	99.99	63.34	
1	[f2]	100.00	62.80	
2	[f3]	100.00	63.32	
3	[f4]	99.96	58.99	
4	[f5]	99.99	65.58	
5	[f1, f2]	100.00	68.04	

6	[f1, f3]	100.00	67.51
7	[f1, f4]	100.00	66.70
8	[f1, f5]	100.00	69.67
9	[f2, f3]	100.00	64.70
10	[f2, f4]	100.00	64.47
11	[f2, f5]	100.00	66.20
12	[f3, f4]	100.00	64.83
13	[f3, f5]	99.99	66.62
14	[f4, f5]	100.00	67.07
15	[f1, f2, f3]	100.00	69.23
16	[f1, f2, f4]	100.00	69.68
17	[f1, f2, f5]	99.99	71.68
18	[f1, f3, f4]	100.00	69.45
19	[f1, f3, f5]	99.99	70.91
20	[f1, f4, f5]	100.00	71.86
21	[f2, f3, f4]	100.00	66.14
22	[f2, f3, f5]	100.00	68.03
23	[f2, f4, f5]	100.00	67.81
24	[f3, f4, f5]	100.00	68.57
25	[f1, f2, f3, f4]	100.00	70.41
26	[f1, f2, f3, f5]	99.99	71.81
27	[f1, f2, f4, f5]	100.00	72.79
28	[f1, f3, f4, f5]	100.00	72.43
29	[f2, f3, f4, f5]	100.00	69.51
30	[f1, f2, f3, f4, f5]	100.00	73.37

	CONFUSION_MATRIX
0	[[31.62, 18.48], [18.19, 31.72]]
1	[[31.17, 18.73], [18.47, 31.63]]
2	[[31.53, 18.51], [18.17, 31.8]]
3	[[29.16, 20.74], [20.27, 29.84]]
4	[[32.67, 17.4], [17.02, 32.91]]
5	[[34.06, 16.01], [15.95, 33.98]]
6	[[33.84, 16.22], [16.27, 33.67]]
7	[[33.07, 16.84], [16.46, 33.63]]
8	[[34.89, 15.12], [15.21, 34.78]]
9	[[32.57, 17.6], [17.7, 32.13]]
10	[[32.24, 17.69], [17.83, 32.24]]
11	[[33.16, 16.91], [16.89, 33.04]]
12	[[32.39, 17.53], [17.64, 32.44]]
13	[[33.42, 16.65], [16.73, 33.2]]
14	[[33.49, 16.51], [16.42, 33.57]]
15	[[34.78, 15.22], [15.55, 34.45]]
16	[[35.09, 14.91], [15.41, 34.59]]
17	[[35.78, 13.95], [14.38, 35.9]]
18	[[34.89, 15.17], [15.38, 34.56]]
19	[[35.53, 14.47], [14.62, 35.39]]
20	[[36.0, 14.0], [14.14, 35.86]]
21	[[32.88, 17.14], [16.73, 33.25]]

22	[[33.89, 16.1], [15.86, 34.14]]
23	[[33.81, 16.19], [16.0, 33.99]]
24	[[34.3, 15.76], [15.67, 34.27]]
25	[[35.45, 14.71], [14.88, 34.96]]
26	[[35.96, 14.03], [14.16, 35.85]]
27	[[36.77, 13.49], [13.72, 36.02]]
28	[[36.42, 13.65], [13.91, 36.01]]
29	[[34.74, 15.51], [14.98, 34.77]]
30	[[36.82, 13.23], [13.4, 36.55]]

KNN, k=3

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	81.65	65.37	
1	[f2]	81.43	63.01	
2	[f3]	81.54	63.98	
3	[f4]	79.30	59.46	
4	[f5]	82.64	65.60	
5	[f1, f2]	84.27	69.90	
6	[f1, f3]	83.68	69.40	
7	[f1, f4]	83.15	68.53	
8	[f1, f5]	84.80	71.28	
9	[f2, f3]	82.25	65.53	
10	[f2, f4]	82.29	65.34	
11	[f2, f5]	82.88	66.69	
12	[f3, f4]	82.27	65.54	
13	[f3, f5]	83.27	67.42	
14	[f4, f5]	83.27	67.74	
15	[f1, f2, f3]	84.77	71.10	
16	[f1, f2, f4]	84.92	71.24	
17	[f1, f2, f5]	85.70	73.16	
18	[f1, f3, f4]	84.80	70.88	
19	[f1, f3, f5]	85.41	72.74	
20	[f1, f4, f5]	85.83	73.78	
21	[f2, f3, f4]	83.29	67.42	
22	[f2, f3, f5]	84.27	68.81	
23	[f2, f4, f5]	84.11	69.03	
24	[f3, f4, f5]	84.42	69.53	
25	[f1, f2, f3, f4]	85.33	71.75	
26	[f1, f2, f3, f5]	86.07	73.94	
27	[f1, f2, f4, f5]	86.50	74.40	
28	[f1, f3, f4, f5]	86.49	74.24	
29	[f2, f3, f4, f5]	84.78	70.28	
30	[f1, f2, f3, f4, f5]	86.89	74.58	

	CONFUSION_MATRIX
0	[[31.48, 18.61], [16.02, 33.9]]
1	[[31.03, 19.03], [17.97, 31.97]]
2	[[31.34, 18.61], [17.4, 32.65]]

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3    [[28.34, 21.6], [18.93, 31.13]]
4   [[33.08, 16.82], [17.58, 32.52]]
5   [[34.57, 15.42], [14.69, 35.32]]
6    [[34.49, 15.6], [14.99, 34.92]]
7    [[33.64, 16.52], [14.95, 34.9]]
8     [[35.7, 14.23], [14.5, 35.57]]
9    [[32.1, 17.92], [16.55, 33.43]]
10   [[32.19, 18.1], [16.56, 33.15]]
11  [[33.62, 16.43], [16.88, 33.07]]
12  [[32.03, 17.82], [16.64, 33.51]]
13  [[33.57, 16.36], [16.22, 33.85]]
14  [[34.33, 15.67], [16.58, 33.41]]
15   [[35.47, 14.6], [14.29, 35.63]]
16    [[35.7, 14.4], [14.36, 35.54]]
17  [[36.71, 13.29], [13.55, 36.45]]
18    [[35.28, 14.6], [14.53, 35.6]]
19  [[36.62, 13.15], [14.11, 36.11]]
20  [[37.23, 12.74], [13.48, 36.54]]
21   [[33.0, 17.07], [15.51, 34.42]]
22  [[34.42, 15.42], [15.77, 34.39]]
23   [[34.74, 15.2], [15.77, 34.28]]
24  [[35.05, 15.01], [15.46, 34.48]]
25  [[35.77, 14.09], [14.17, 35.98]]
26   [[37.14, 12.83], [13.23, 36.8]]
27  [[37.58, 12.43], [13.17, 36.82]]
28  [[37.43, 12.32], [13.44, 36.82]]
29   [[35.1, 14.83], [14.89, 35.18]]
30  [[37.57, 12.37], [13.05, 37.01]]
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KNN, k=5

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	77.09	66.55	
1	[f2]	76.77	63.08	
2	[f3]	77.12	64.12	
3	[f4]	74.04	59.75	
4	[f5]	78.44	65.83	
5	[f1, f2]	80.42	71.27	
6	[f1, f3]	80.36	70.33	
7	[f1, f4]	79.34	69.10	
8	[f1, f5]	81.34	72.10	
9	[f2, f3]	77.98	66.17	
10	[f2, f4]	78.09	65.81	
11	[f2, f5]	79.04	66.96	
12	[f3, f4]	78.21	66.22	
13	[f3, f5]	79.25	67.52	
14	[f4, f5]	79.75	68.10	
15	[f1, f2, f3]	81.21	72.12	

16	[f1, f2, f4]	81.33	72.11
17	[f1, f2, f5]	82.76	74.04
18	[f1, f3, f4]	81.28	71.89
19	[f1, f3, f5]	82.42	73.79
20	[f1, f4, f5]	82.73	74.40
21	[f2, f3, f4]	79.18	67.93
22	[f2, f3, f5]	80.36	69.41
23	[f2, f4, f5]	80.52	69.18
24	[f3, f4, f5]	80.68	69.79
25	[f1, f2, f3, f4]	81.56	72.94
26	[f1, f2, f3, f5]	83.03	74.61
27	[f1, f2, f4, f5]	83.27	75.29
28	[f1, f3, f4, f5]	83.37	75.11
29	[f2, f3, f4, f5]	81.20	70.68
30	[f1, f2, f3, f4, f5]	83.92	75.57

	CONFUSION_MATRIX
0	[[31.21, 18.69], [14.76, 35.34]]
1	[[30.64, 19.38], [17.54, 32.44]]
2	[[30.67, 19.21], [16.67, 33.45]]
3	[[27.8, 22.09], [18.16, 31.95]]
4	[[33.24, 16.61], [17.56, 32.58]]
5	[[35.22, 14.68], [14.06, 36.04]]
6	[[34.57, 15.4], [14.26, 35.77]]
7	[[33.56, 16.38], [14.51, 35.54]]
8	[[35.96, 14.05], [13.86, 36.14]]
9	[[31.88, 18.17], [15.67, 34.28]]
10	[[32.14, 17.82], [16.36, 33.67]]
11	[[33.86, 16.14], [16.9, 33.1]]
12	[[31.99, 17.88], [15.9, 34.23]]
13	[[33.93, 16.13], [16.35, 33.59]]
14	[[34.35, 15.42], [16.48, 33.74]]
15	[[35.47, 14.25], [13.63, 36.65]]
16	[[35.78, 14.29], [13.6, 36.33]]
17	[[37.4, 12.77], [13.19, 36.64]]
18	[[35.6, 14.28], [13.84, 36.29]]
19	[[36.97, 12.88], [13.33, 36.81]]
20	[[37.62, 12.26], [13.35, 36.78]]
21	[[32.94, 16.98], [15.1, 34.99]]
22	[[34.91, 15.24], [15.35, 34.5]]
23	[[34.72, 15.34], [15.48, 34.46]]
24	[[35.12, 14.88], [15.33, 34.67]]
25	[[36.08, 13.63], [13.43, 36.86]]
26	[[37.38, 12.62], [12.78, 37.22]]
27	[[38.04, 11.87], [12.84, 37.25]]
28	[[38.08, 11.92], [12.97, 37.03]]
29	[[35.04, 14.73], [14.59, 35.64]]
30	[[38.29, 11.77], [12.66, 37.28]]

PNN

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	None	52.34	
1	[f2]	None	62.08	
2	[f3]	None	61.64	
3	[f4]	None	47.51	
4	[f5]	None	62.29	
5	[f1, f2]	None	52.99	
6	[f1, f3]	None	47.51	
7	[f1, f4]	None	66.04	
8	[f1, f5]	None	61.36	
9	[f2, f3]	None	63.45	
10	[f2, f4]	None	47.51	
11	[f2, f5]	None	63.52	
12	[f3, f4]	None	56.45	
13	[f3, f5]	None	63.09	
14	[f4, f5]	None	66.19	
15	[f1, f2, f3]	None	52.85	
16	[f1, f2, f4]	None	63.81	
17	[f1, f2, f5]	None	62.65	
18	[f1, f3, f4]	None	66.55	
19	[f1, f3, f5]	None	63.01	
20	[f1, f4, f5]	None	68.49	
21	[f2, f3, f4]	None	57.75	
22	[f2, f3, f5]	None	66.62	
23	[f2, f4, f5]	None	64.38	
24	[f3, f4, f5]	None	65.75	
25	[f1, f2, f3, f4]	None	64.24	
26	[f1, f2, f3, f5]	None	63.88	
27	[f1, f2, f4, f5]	None	68.64	
28	[f1, f3, f4, f5]	None	69.79	
29	[f2, f3, f4, f5]	None	64.89	
30	[f1, f2, f3, f4, f5]	None	68.42	

	CONFUSION_MATRIX
0	[[4.04, 47.66], [0.0, 48.31]]
1	[[13.34, 37.92], [0.0, 48.74]]
2	[[13.19, 38.36], [0.0, 48.45]]
3	[[0.0, 52.49], [0.0, 47.51]]
4	[[13.99, 37.71], [0.0, 48.31]]

```
5        [[4.9, 44.41], [2.6, 48.09]]
6        [[0.0, 52.49], [0.0, 47.51]]
7    [[28.41, 22.57], [11.39, 37.64]]
8     [[47.95, 1.23], [37.42, 13.41]]
9      [[12.98, 36.55], [0.0, 50.47]]
10       [[0.0, 52.49], [0.0, 47.51]]
11    [[17.45, 34.46], [2.02, 46.07]]
12    [[46.36, 2.52], [41.02, 10.09]]
13    [[17.02, 35.04], [1.87, 46.07]]
14    [[50.47, 1.37], [32.44, 15.72]]
15     [[4.54, 46.07], [1.08, 48.31]]
16   [[27.47, 23.58], [12.62, 36.34]]
17     [[48.38, 1.8], [35.54, 14.28]]
18   [[29.42, 22.64], [10.81, 37.13]]
19    [[48.88, 1.23], [35.76, 14.13]]
20     [[36.7, 12.83], [18.67, 31.8]]
21    [[45.28, 4.69], [37.56, 12.47]]
22    [[21.41, 28.84], [4.54, 45.21]]
23    [[49.32, 0.65], [34.97, 15.07]]
24     [[50.76, 1.15], [33.09, 15.0]]
25    [[28.41, 21.56], [14.2, 35.83]]
26    [[49.39, 1.51], [34.61, 14.49]]
27   [[37.49, 12.69], [18.67, 31.15]]
28   [[37.71, 13.05], [17.16, 32.08]]
29     [[49.1, 0.29], [34.82, 15.79]]
30    [[37.71, 11.18], [20.4, 30.71]]
```

SVM with Gaussian RBF Kernel

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	69.73	70.33	
1	[f2]	64.35	64.07	
2	[f3]	65.68	65.45	
3	[f4]	57.05	56.85	
4	[f5]	67.35	67.46	
5	[f1, f2]	70.23	69.89	
6	[f1, f3]	70.42	69.77	
7	[f1, f4]	70.77	70.24	
8	[f1, f5]	72.43	72.31	
9	[f2, f3]	66.08	65.43	
10	[f2, f4]	64.97	64.67	
11	[f2, f5]	67.33	67.34	
12	[f3, f4]	65.09	64.64	
13	[f3, f5]	67.33	67.48	
14	[f4, f5]	69.33	69.51	
15	[f1, f2, f3]	69.75	70.40	
16	[f1, f2, f4]	70.76	70.40	

17	[f1, f2, f5]	72.26	72.28
18	[f1, f3, f4]	70.23	70.95
19	[f1, f3, f5]	72.69	71.94
20	[f1, f4, f5]	73.40	72.40
21	[f2, f3, f4]	65.22	64.74
22	[f2, f3, f5]	67.07	67.39
23	[f2, f4, f5]	69.56	69.17
24	[f3, f4, f5]	69.76	69.18
25	[f1, f2, f3, f4]	70.40	70.83
26	[f1, f2, f3, f5]	72.28	72.26
27	[f1, f2, f4, f5]	72.68	72.93
28	[f1, f3, f4, f5]	72.55	73.06
29	[f2, f3, f4, f5]	69.25	69.55
30	[f1, f2, f3, f4, f5]	73.32	72.31

	CONFUSION_MATRIX
0	[[31.97, 17.69], [11.99, 38.35]]
1	[[21.77, 28.49], [7.44, 42.3]]
2	[[27.22, 23.04], [11.51, 38.23]]
3	[[20.36, 29.96], [13.19, 36.49]]
4	[[45.84, 4.49], [28.06, 21.62]]
5	[[33.02, 17.3], [12.81, 36.87]]
6	[[32.92, 17.06], [13.17, 36.85]]
7	[[33.05, 17.06], [12.71, 37.19]]
8	[[34.2, 15.82], [11.86, 38.11]]
9	[[24.08, 26.19], [8.38, 41.35]]
10	[[20.0, 29.83], [5.5, 44.67]]
11	[[46.65, 3.33], [29.33, 20.69]]
12	[[20.65, 29.54], [5.82, 43.98]]
13	[[46.34, 4.01], [28.5, 21.14]]
14	[[44.29, 5.77], [24.72, 25.22]]
15	[[33.49, 16.41], [13.2, 36.91]]
16	[[33.28, 16.61], [12.99, 37.12]]
17	[[34.66, 15.68], [12.03, 37.63]]
18	[[33.24, 16.79], [12.26, 37.7]]
19	[[34.39, 15.59], [12.47, 37.55]]
20	[[34.19, 15.8], [11.8, 38.21]]
21	[[20.17, 29.58], [5.67, 44.57]]
22	[[47.42, 2.78], [29.83, 19.97]]
23	[[44.0, 5.72], [25.11, 25.17]]
24	[[43.5, 6.45], [24.37, 25.68]]
25	[[33.58, 16.82], [12.36, 37.25]]
26	[[34.52, 15.55], [12.19, 37.74]]
27	[[34.91, 15.2], [11.87, 38.02]]
28	[[35.11, 15.16], [11.79, 37.95]]
29	[[43.61, 6.49], [23.96, 25.93]]
30	[[34.58, 15.41], [12.28, 37.73]]

Perceptron

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	53.81	54.35	
1	[f2]	62.04	62.05	
2	[f3]	62.22	62.62	
3	[f4]	54.21	53.94	
4	[f5]	67.17	66.93	
5	[f1, f2]	65.42	65.67	
6	[f1, f3]	53.96	53.65	
7	[f1, f4]	64.63	64.66	
8	[f1, f5]	70.03	69.95	
9	[f2, f3]	55.74	55.84	
10	[f2, f4]	54.38	54.37	
11	[f2, f5]	63.71	64.01	
12	[f3, f4]	54.13	54.02	
13	[f3, f5]	63.88	63.84	
14	[f4, f5]	69.77	69.44	
15	[f1, f2, f3]	54.15	54.00	
16	[f1, f2, f4]	57.07	56.99	
17	[f1, f2, f5]	69.80	69.75	
18	[f1, f3, f4]	69.09	68.90	
19	[f1, f3, f5]	69.18	69.37	
20	[f1, f4, f5]	65.73	65.78	
21	[f2, f3, f4]	61.86	62.29	
22	[f2, f3, f5]	67.09	67.35	
23	[f2, f4, f5]	63.98	64.30	
24	[f3, f4, f5]	64.56	64.50	
25	[f1, f2, f3, f4]	54.56	54.63	
26	[f1, f2, f3, f5]	62.04	62.05	
27	[f1, f2, f4, f5]	71.06	70.76	
28	[f1, f3, f4, f5]	70.24	70.13	
29	[f2, f3, f4, f5]	54.05	54.10	
30	[f1, f2, f3, f4, f5]	72.33	72.22	

	CONFUSION_MATRIX
0	[[4.03, 45.65], [0.0, 50.31]]
1	[[35.06, 14.94], [23.01, 26.99]]
2	[[36.24, 13.82], [23.56, 26.38]]
3	[[4.13, 46.06], [0.0, 49.81]]
4	[[47.58, 2.42], [30.66, 19.35]]
5	[[41.3, 8.77], [25.56, 24.36]]
6	[[49.82, 0.02], [46.33, 3.83]]
7	[[39.93, 10.17], [25.17, 24.73]]
8	[[42.3, 7.62], [22.43, 27.64]]
9	[[50.14, 0.02], [44.14, 5.7]]

10	[[49.98, 0.02], [45.61, 4.39]]
11	[[13.94, 35.99], [0.0, 50.07]]
12	[[4.12, 45.98], [0.0, 49.89]]
13	[[13.93, 36.15], [0.0, 49.91]]
14	[[41.21, 8.62], [21.94, 28.23]]
15	[[4.1, 46.0], [0.0, 49.9]]
16	[[49.6, 0.37], [42.64, 7.39]]
17	[[33.26, 16.81], [13.44, 36.49]]
18	[[26.46, 23.63], [7.47, 42.44]]
19	[[37.29, 12.57], [18.07, 32.08]]
20	[[49.79, 0.25], [33.97, 15.99]]
21	[[40.81, 9.36], [28.35, 21.48]]
22	[[37.0, 12.95], [19.7, 30.35]]
23	[[50.05, 0.02], [35.68, 14.25]]
24	[[49.95, 0.03], [35.47, 14.55]]
25	[[50.04, 0.02], [45.35, 4.59]]
26	[[49.98, 0.02], [37.93, 12.07]]
27	[[37.93, 12.04], [17.2, 32.83]]
28	[[38.52, 11.43], [18.44, 31.62]]
29	[[4.02, 45.89], [0.0, 50.09]]
30	[[34.59, 15.58], [12.2, 37.63]]

Logistic Regression

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	68.08	68.26	
1	[f2]	63.86	64.44	
2	[f3]	64.06	64.02	
3	[f4]	57.74	57.91	
4	[f5]	67.48	67.30	
5	[f1, f2]	68.86	69.00	
6	[f1, f3]	68.99	69.11	
7	[f1, f4]	69.90	70.14	
8	[f1, f5]	71.24	70.94	
9	[f2, f3]	64.92	64.61	
10	[f2, f4]	65.79	65.77	
11	[f2, f5]	67.38	67.37	
12	[f3, f4]	66.48	66.08	
13	[f3, f5]	67.53	67.32	
14	[f4, f5]	69.58	69.90	
15	[f1, f2, f3]	69.15	69.22	
16	[f1, f2, f4]	70.62	71.08	
17	[f1, f2, f5]	70.89	70.92	
18	[f1, f3, f4]	70.58	71.12	
19	[f1, f3, f5]	71.08	70.86	
20	[f1, f4, f5]	72.00	72.33	
21	[f2, f3, f4]	66.25	66.09	

22	[f2, f3, f5]	67.27	67.42
23	[f2, f4, f5]	69.94	69.56
24	[f3, f4, f5]	69.58	69.82
25	[f1, f2, f3, f4]	71.13	70.83
26	[f1, f2, f3, f5]	70.87	70.82
27	[f1, f2, f4, f5]	71.97	72.18
28	[f1, f3, f4, f5]	72.17	72.02
29	[f2, f3, f4, f5]	69.79	69.65
30	[f1, f2, f3, f4, f5]	72.36	72.03

	CONFUSION_MATRIX
0	[[37.79, 12.16], [19.58, 30.48]]
1	[[28.98, 21.06], [14.5, 35.47]]
2	[[30.87, 19.13], [16.85, 33.15]]
3	[[29.04, 20.88], [21.21, 28.87]]
4	[[44.01, 5.92], [26.78, 23.29]]
5	[[37.27, 12.73], [18.27, 31.73]]
6	[[37.33, 12.76], [18.13, 31.78]]
7	[[37.0, 13.17], [16.7, 33.14]]
8	[[40.45, 9.57], [19.48, 30.49]]
9	[[29.82, 20.24], [15.14, 34.8]]
10	[[28.87, 21.15], [13.07, 36.9]]
11	[[42.77, 7.16], [25.47, 24.6]]
12	[[29.67, 20.3], [13.62, 36.41]]
13	[[43.34, 6.63], [26.06, 23.98]]
14	[[39.55, 10.29], [19.81, 30.35]]
15	[[36.94, 13.14], [17.65, 32.28]]
16	[[36.44, 13.27], [15.65, 34.64]]
17	[[40.38, 9.56], [19.52, 30.55]]
18	[[36.81, 13.03], [15.85, 34.32]]
19	[[40.13, 9.55], [19.59, 30.73]]
20	[[38.51, 11.47], [16.19, 33.82]]
21	[[29.3, 20.38], [13.53, 36.8]]
22	[[42.31, 7.68], [24.9, 25.11]]
23	[[39.03, 10.69], [19.75, 30.53]]
24	[[39.31, 10.53], [19.65, 30.51]]
25	[[35.8, 14.17], [15.0, 35.03]]
26	[[40.01, 9.9], [19.29, 30.81]]
27	[[38.48, 11.41], [16.41, 33.7]]
28	[[38.59, 11.26], [16.72, 33.43]]
29	[[38.41, 11.45], [18.9, 31.25]]
30	[[38.46, 11.54], [16.42, 33.58]]

GAUSSIAN PROCESSES

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	70.18	69.83	

1	[f2]	65.50	65.84
2	[f3]	67.19	67.63
3	[f4]	62.55	62.08
4	[f5]	68.18	67.93
5	[f1, f2]	72.82	72.84
6	[f1, f3]	72.37	72.30
7	[f1, f4]	71.09	70.88
8	[f1, f5]	75.38	74.94
9	[f2, f3]	68.01	67.45
10	[f2, f4]	67.93	68.04
11	[f2, f5]	69.08	68.77
12	[f3, f4]	68.68	68.30
13	[f3, f5]	69.10	68.41
14	[f4, f5]	70.55	70.37
15	[f1, f2, f3]	72.91	72.98
16	[f1, f2, f4]	74.49	73.86
17	[f1, f2, f5]	74.70	74.78
18	[f1, f3, f4]	72.84	72.48
19	[f1, f3, f5]	74.90	75.29
20	[f1, f4, f5]	75.01	74.99
21	[f2, f3, f4]	69.76	69.20
22	[f2, f3, f5]	69.45	69.08
23	[f2, f4, f5]	71.03	71.14
24	[f3, f4, f5]	71.62	71.82
25	[f1, f2, f3, f4]	73.99	73.64
26	[f1, f2, f3, f5]	75.82	75.42
27	[f1, f2, f4, f5]	76.12	75.42
28	[f1, f3, f4, f5]	76.21	75.59
29	[f2, f3, f4, f5]	72.18	71.80
30	[f1, f2, f3, f4, f5]	76.15	75.48

	CONFUSION_MATRIX
0	[[29.28, 20.82], [9.35, 40.55]]
1	[[23.0, 26.99], [7.16, 42.85]]
2	[[21.42, 28.27], [4.1, 46.21]]
3	[[23.83, 26.24], [11.68, 38.25]]
4	[[35.05, 14.93], [17.13, 32.88]]
5	[[31.75, 18.18], [8.99, 41.09]]
6	[[30.68, 19.39], [8.31, 41.62]]
7	[[32.08, 17.6], [11.52, 38.8]]
8	[[34.26, 15.63], [9.43, 40.68]]
9	[[25.01, 25.18], [7.37, 42.44]]
10	[[33.5, 16.42], [15.54, 34.53]]
11	[[36.29, 13.44], [17.79, 32.48]]
12	[[33.72, 16.11], [15.6, 34.57]]
13	[[35.32, 14.71], [16.88, 33.1]]
14	[[39.17, 10.96], [18.67, 31.2]]
15	[[31.82, 18.11], [8.91, 41.17]]
16	[[33.32, 16.66], [9.48, 40.55]]

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17  [[36.51, 13.21], [12.01, 38.27]]
18   [[32.01, 17.74], [9.78, 40.47]]
19   [[36.22, 13.51], [11.2, 39.07]]
20   [[36.7, 13.35], [11.66, 38.29]]
21  [[29.77, 19.92], [10.88, 39.44]]
22  [[32.82, 17.09], [13.83, 36.26]]
23  [[38.71, 11.12], [17.74, 32.42]]
24  [[37.38, 12.61], [15.57, 34.44]]
25     [[33.14, 16.77], [9.6, 40.5]]
26  [[35.64, 14.47], [10.12, 39.78]]
27   [[35.41, 14.98], [9.61, 40.01]]
28  [[36.76, 12.93], [11.49, 38.83]]
29   [[37.45, 12.61], [15.6, 34.35]]
30   [[35.45, 14.93], [9.59, 40.03]]
```

Decision_Tree

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	99.65	63.44	
1	[f2]	88.05	62.55	
2	[f3]	89.12	63.15	
3	[f4]	99.42	58.97	
4	[f5]	96.76	65.65	
5	[f1, f2]	100.00	68.20	
6	[f1, f3]	100.00	67.43	
7	[f1, f4]	99.99	66.38	
8	[f1, f5]	99.99	69.50	
9	[f2, f3]	100.00	64.37	
10	[f2, f4]	99.99	64.49	
11	[f2, f5]	100.00	66.11	
12	[f3, f4]	99.99	64.94	
13	[f3, f5]	99.99	66.56	
14	[f4, f5]	100.00	67.12	
15	[f1, f2, f3]	100.00	69.45	
16	[f1, f2, f4]	99.99	70.75	
17	[f1, f2, f5]	100.00	71.91	
18	[f1, f3, f4]	100.00	69.64	
19	[f1, f3, f5]	100.00	70.86	
20	[f1, f4, f5]	100.00	71.68	
21	[f2, f3, f4]	100.00	66.25	
22	[f2, f3, f5]	100.00	67.96	
23	[f2, f4, f5]	100.00	68.34	
24	[f3, f4, f5]	99.99	68.49	
25	[f1, f2, f3, f4]	100.00	71.60	
26	[f1, f2, f3, f5]	100.00	72.41	
27	[f1, f2, f4, f5]	100.00	74.01	
28	[f1, f3, f4, f5]	99.99	72.99	
29	[f2, f3, f4, f5]	99.99	69.84	
30	[f1, f2, f3, f4, f5]	100.00	74.04	

	CONFUSION_MATRIX
0	[[31.52, 18.37], [18.19, 31.92]]
1	[[33.37, 16.34], [21.12, 29.17]]
2	[[33.63, 16.44], [20.41, 29.52]]
3	[[29.27, 20.62], [20.41, 29.7]]
4	[[33.64, 16.3], [18.05, 32.0]]
5	[[34.38, 15.77], [16.03, 33.82]]
6	[[33.59, 16.36], [16.21, 33.84]]
7	[[33.26, 16.65], [16.97, 33.12]]
8	[[34.88, 15.14], [15.36, 34.61]]
9	[[32.16, 17.81], [17.83, 32.2]]
10	[[32.39, 17.68], [17.83, 32.1]]
11	[[33.09, 16.91], [16.98, 33.02]]
12	[[32.4, 17.66], [17.41, 32.54]]
13	[[33.16, 16.83], [16.61, 33.4]]
14	[[33.5, 16.27], [16.61, 33.62]]
15	[[34.33, 15.35], [15.21, 35.11]]
16	[[35.58, 14.43], [14.82, 35.17]]
17	[[35.72, 14.01], [14.09, 36.19]]
18	[[34.8, 15.26], [15.1, 34.84]]
19	[[35.42, 14.61], [14.53, 35.43]]
20	[[35.75, 14.2], [14.12, 35.93]]
21	[[33.13, 16.91], [16.84, 33.13]]
22	[[34.04, 15.99], [16.05, 33.91]]
23	[[34.45, 15.44], [16.22, 33.89]]
24	[[34.57, 15.56], [15.96, 33.92]]
25	[[35.75, 14.2], [14.2, 35.85]]
26	[[35.85, 14.18], [13.41, 36.55]]
27	[[36.93, 13.1], [12.89, 37.08]]
28	[[36.39, 13.64], [13.37, 36.6]]
29	[[34.81, 14.87], [15.29, 35.03]]
30	[[37.41, 12.69], [13.27, 36.63]]

ADABOOST on base Decision Trees

	FEATURES	TRAIN_ACCURACY	TEST_ACCURACY	\
0	[f1]	69.78	70.23	
1	[f2]	65.69	65.63	
2	[f3]	67.35	67.41	
3	[f4]	62.53	62.38	
4	[f5]	67.98	67.66	
5	[f1, f2]	73.11	73.14	
6	[f1, f3]	72.24	72.09	
7	[f1, f4]	70.93	70.55	
8	[f1, f5]	75.39	74.75	
9	[f2, f3]	67.86	67.57	
10	[f2, f4]	68.46	68.16	

11	[f2, f5]	69.43	68.83
12	[f3, f4]	68.67	68.78
13	[f3, f5]	68.35	67.89
14	[f4, f5]	70.33	70.47
15	[f1, f2, f3]	72.95	72.74
16	[f1, f2, f4]	74.23	74.04
17	[f1, f2, f5]	75.29	75.58
18	[f1, f3, f4]	73.75	73.66
19	[f1, f3, f5]	75.46	75.48
20	[f1, f4, f5]	75.41	74.82
21	[f2, f3, f4]	69.43	69.21
22	[f2, f3, f5]	69.71	69.23
23	[f2, f4, f5]	70.67	70.71
24	[f3, f4, f5]	71.91	71.62
25	[f1, f2, f3, f4]	74.04	74.17
26	[f1, f2, f3, f5]	75.87	76.08
27	[f1, f2, f4, f5]	75.74	75.59
28	[f1, f3, f4, f5]	75.94	75.67
29	[f2, f3, f4, f5]	71.74	71.54
30	[f1, f2, f3, f4, f5]	76.63	76.07

	CONFUSION_MATRIX
0	[[29.57, 20.5], [9.28, 40.65]]
1	[[22.62, 27.07], [7.31, 43.01]]
2	[[21.06, 28.96], [3.63, 46.34]]
3	[[29.45, 20.55], [17.06, 32.93]]
4	[[38.26, 11.71], [20.63, 29.4]]
5	[[32.97, 16.71], [10.14, 40.17]]
6	[[31.16, 19.03], [8.88, 40.93]]
7	[[31.25, 18.81], [10.64, 39.3]]
8	[[34.18, 15.8], [9.45, 40.56]]
9	[[24.09, 26.0], [6.42, 43.48]]
10	[[32.03, 18.04], [13.8, 36.13]]
11	[[38.49, 11.48], [19.68, 30.35]]
12	[[32.41, 17.31], [13.9, 36.37]]
13	[[32.68, 17.34], [14.77, 35.21]]
14	[[38.84, 11.23], [18.29, 31.63]]
15	[[32.2, 17.81], [9.44, 40.54]]
16	[[33.19, 16.72], [9.24, 40.85]]
17	[[35.77, 14.28], [10.13, 39.81]]
18	[[33.05, 17.12], [9.22, 40.61]]
19	[[35.55, 14.33], [10.2, 39.93]]
20	[[36.44, 13.53], [11.64, 38.39]]
21	[[30.34, 19.34], [11.45, 38.88]]
22	[[31.13, 18.94], [11.82, 38.1]]
23	[[39.39, 10.69], [18.6, 31.32]]
24	[[37.98, 12.11], [16.28, 33.63]]
25	[[33.18, 16.88], [8.95, 40.99]]
26	[[35.8, 14.36], [9.56, 40.27]]

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27  [[35.88, 14.14], [10.26, 39.72]]
28    [[36.87, 13.13], [11.2, 38.8]]
29  [[37.55, 12.33], [16.14, 33.99]]
30  [[36.66, 13.24], [10.69, 39.41]]
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