Face Social Traits and Political Election Analysis by SVM

STAT 231

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Part 1: Face Social Traits Classification (or Regression)

1.1 CLASSIFICATION BY LANDMARKS

OBJECTIVE:

In this part of the project, we train 14 SVRs– one for each social attribute (*Old, Masculine, Baby-faced, Competent, Attractive, Energetic, Well-groomed, Intelligent, Honest, Generous, Trustworthy, Confident, Rich, Dominant*). The features to be used are only landmarks.

OBSERVATIONS:

1. A split of the data set was done to get train and test sets. The split ratio was 9:1 (respectively).
2. For each of the 14 models, k-fold cross validation was done with k= 5 to find the best SVM parameters. The parameters that were tuned here were: C, Gamma, and epsilon.
3. With the best parameters chosen, we can see that each model does better than chance. In fact we can achieve a test accuracy and test precision above 55% for all the models.

RESULTS:

Tabulated results:

Table 1: The svm parameters that were hyper-tuned for 14 models using landmarks as features:

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
C	128	32	10	8	0.1	32	1000	32	1	1024	32	32	64	10
Gamma	0.000244140625	0.01	0.005	0.0001220703125	0.1	0.01	1	0.01	0.01	1.52587890625e-05	0.01	0.01	3.0517578125e-05	0.001
Epsilon	0.001953125	0.1	0.1	0.03125	0.1	0.1	0.1	0.1	0.001	0.015625	0.1	0.1	0.0078125	0.1

Table 2: Average Train and test accuracies for 14 models using landmarks as features:

Metric	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Average Training accuracy	0.6870	0.7755	0.7482	0.61224	0.680272	0.8253968	0.843537	0.7687074	0.705215	0.68707	0.77097	0.773242	0.639455	0.637188
Average Test accuracy	0.6	0.62	0.58	0.56	0.68	0.72	0.56	0.64	0.56	0.64	0.62	0.6	0.56	0.56

Table 3: Average Train and test precisions for 14 models using landmarks as features:

Metric	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Average Training precision	0.6260	0.715337	0.6986	0.56916	0.601683	0.77035603	0.825250 3	0.697925	0.65811	0.63951	0.716455	0.684587	0.59438775	0.57894
Average Test precision	0.5052	0.5163	0.5929	0.569093	0.5907246	0.6239319	0.456363	0.636825	0.5775	0.58580	0.61168	0.62095	0.533333	0.60178

Table 4: Average Train and test MSE for 14 models using landmarks as features:

Metric	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Average Training mse	0.15131	0.0691	0.09369	0.066756	0.099228	0.041288	0.008399 1	0.038933 37	0.049844	0.042385	0.03256510	0.04560	0.067162	0.075583
Average Test mse	0.2193	0.1046	0.1507	0.063934	0.133773	0.0673229	0.094299 2	0.057004	0.06234	0.05244	0.056574	0.06908	0.0642579	0.088633

Graphs:

Fig 1. Average train and test accuracies for poor features for 14 models:

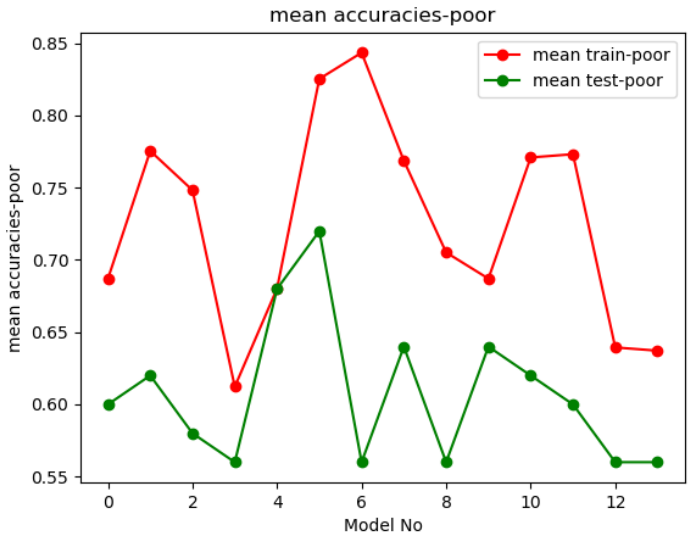


Fig 2. Average train and test precisions for poor features for 14 models:

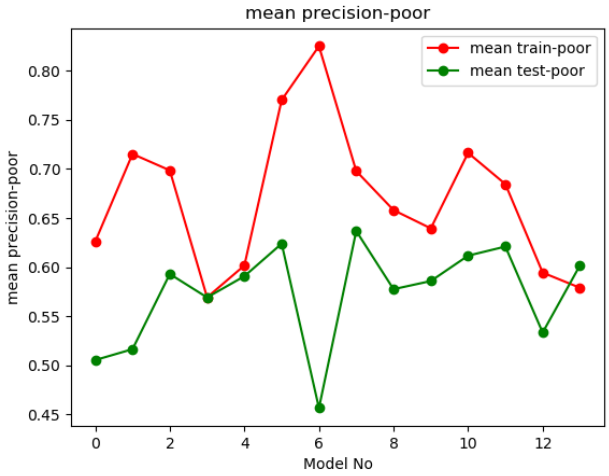
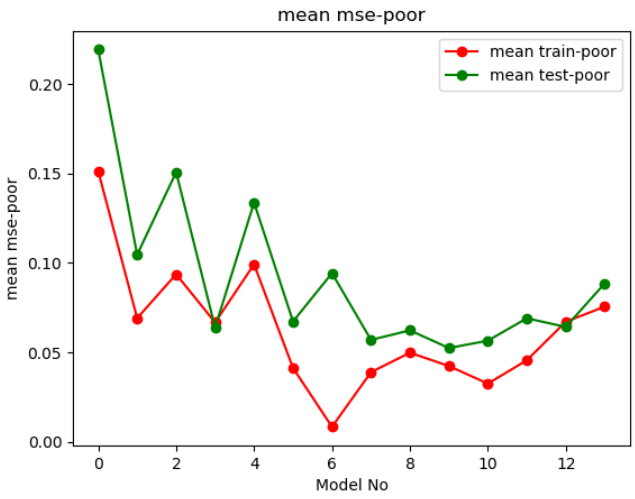


Fig 3. Average train and test MSE for poor features for 14 models:



1.2 CLASSIFICATION BY RICH FEATURES

OBJECTIVE:

In this part of the project, we train 14 SVRs– one for each social attribute (*Old, Masculine, Baby-faced, Competent, Attractive, Energetic, Well-groomed, Intelligent, Honest, Generous, Trustworthy, Confident, Rich, Dominant*). The features to be used are both landmarks and hog features.

OBSERVATIONS:

1. The hog features are extracted for the images using the following configurations:
    - Number of bins: 32
    - pixels_per_cell=(16, 16),
    - cells_per_block=(1, 1)
2. A split of the data set was done to get train and test sets. The split ratio was 9:1 (respectively).
3. For each of the 14 models, k-fold cross validation was done with k= 5 to find the best SVM parameters. The parameters that were tuned here were: C, Gamma, and epsilon.
4. With the best parameters chosen, we can see that each model does better than chance. In fact we can achieve a test accuracy and test precision above 55% for all the models.
5. We perform a comparison using the accuracies and precisions between the poor features (only landmarks) and the rich features (landmarks+hog), and observe that the models trained using rich features perform better.

RESULTS:

Tabulated results:

Table 5: The svm parameters that were hyper-tuned for 14 models using landmarks and hog as features:

Parameter	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
C	1024	4	16	2	32.0	32	32.0	32.0	32.0	32.0	32.0	32.0	1	8
Gamma	9.536743164 0625e-07	0.00048828 125	0.00012207 03125	0.00048 828125	3.814697265 625e-06	3.8146 97265 625e- 06	3.8146 97265 625e- 06	3.8146 97265 625e- 06	3.8146 97265 625e- 06	3.8146 972656 25e-06	3.8146 97265 625e- 06	3.8146 97265 625e- 06	0.001	0.0004 88281 25
Epsilon	0.125	0.015625	0.00390625	0.0625	0.00390625	0.0039 0625	0.0039 0625	0.0039 0625	0.0039 0625	0.0039 0625	0.0039 0625	0.0039 0625	0.1	0.0156 25

Table 6: Average Train and test accuracies for 14 models using landmarks and hog as features:

Metric	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Average Training accuracy	0.88662	0.990929	0.997732	0.870748	0.84807	0.91156	0.920634	0.94557	0.916099	0.9342403	0.913832	0.884353	0.8458049	0.76
Average Test accuracy	0.68	0.68	0.66	0.56	0.68	0.78	0.7	0.74	0.6	0.66	0.7	0.66	0.58	0.76

Table 7: Average Train and test precisions for 14 models using landmarks and hog as features:

Metric	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Average Training precision	0.8423298	0.9886417	0.997842	0.82271	0.78571	0.871053	0.89368	0.92616	0.8808	0.90266	0.87521532	0.8441203	0.792303	0.9655
Average Test precision	0.569155	0.5640909	0.641538	0.57116	0.5882	0.721403	0.58466	0.665	0.59428	0.598823	0.6294117	0.5176190	0.548	0.7785714

Table 8: Average Train and test MSE for 14 models using landmarks and hog as features:

Metric	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Average Training mse	0.023614	0.00090810	0.000384	0.00490	0.07279	0.050929	0.047696	0.0351	0.03318	0.0313	0.036079	0.05025	0.009905	0.000238
Average Test mse	0.1642350	0.0946984754	0.12540	0.05053	0.12445	0.098310	0.077856	0.0697	0.06037	0.05049	0.047166	0.0715	0.0513261	0.07295

Graphs:

Fig 4. Average train and test accuracies for rich features for 14 models:

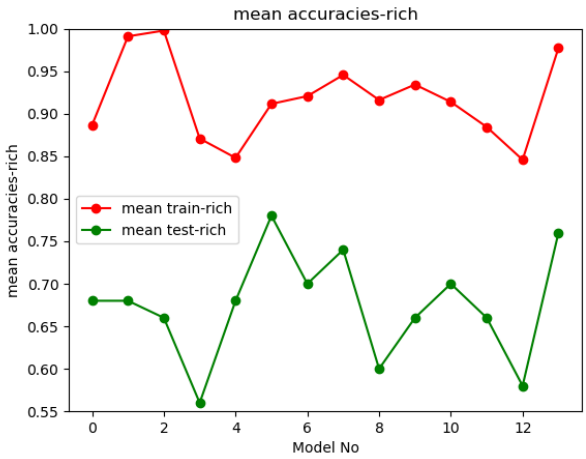


Fig 5. Average train and test precisions for rich features for 14 models:

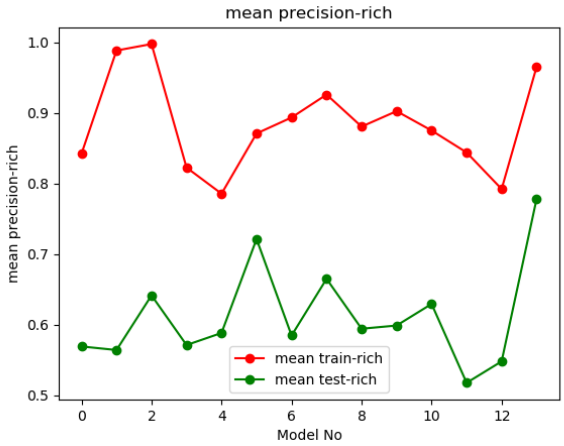
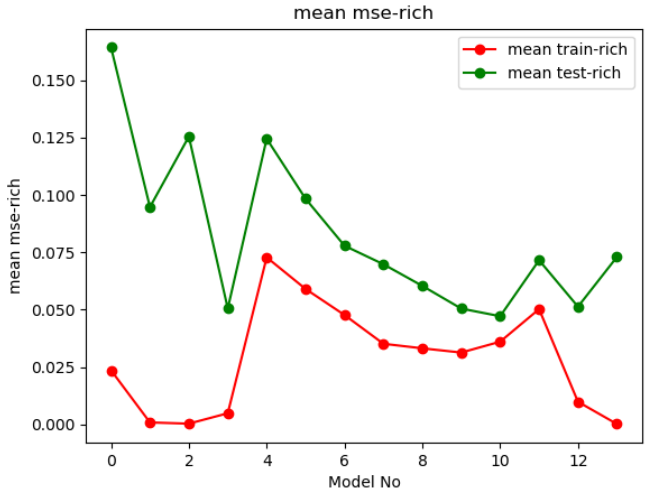


Fig 6. Average train and test MSE for rich features for 14 models:



We now compare the accuracies and precisions between the poor features (only landmarks) and the rich features (landmarks+hog):

Fig 7. Comparison of average train and test accuracies between poor and rich features for 14 models:

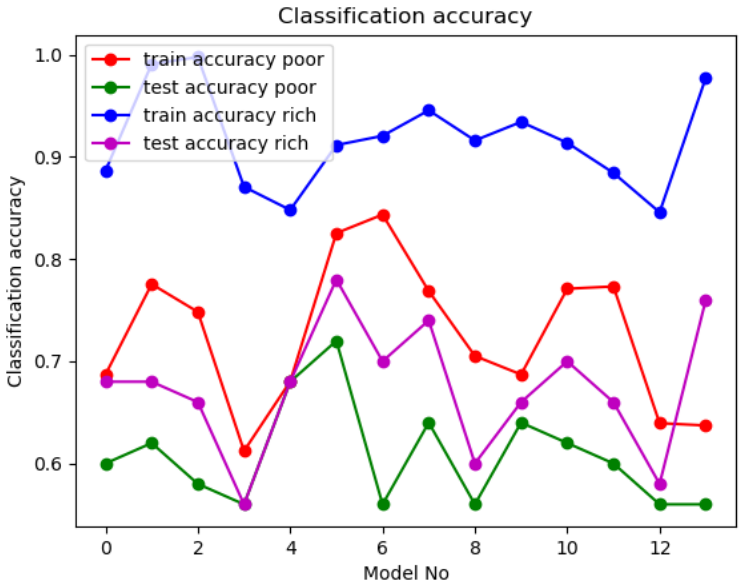
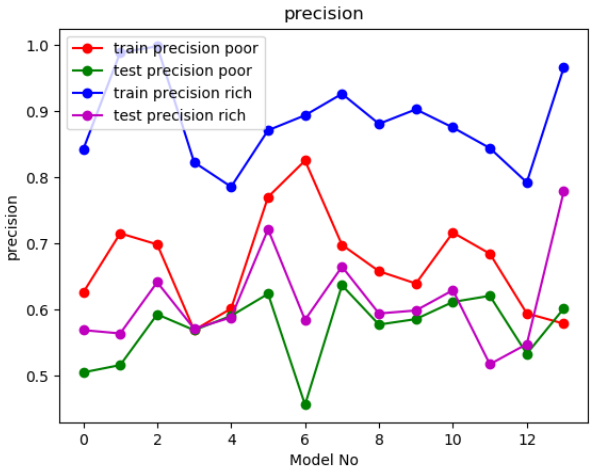


Fig 8. Comparison of average train and test precisions between poor and rich features for 14 models:



Part 2: Election Outcome Prediction

2.1 DIRECT PREDICTION BY RICH FEATURES

OBJECTIVE:

In this part of the project, we train 2 rank svms to predict the election outcome for senators and governors. The features used here are both landmarks and hog features of the senators and governors respectively.

OBSERVATIONS:

1. Rank SVM is used for the prediction. The formula for a rank svm is given by :

$$\text{Minimize : } \tfrac{1}{2}\,||w||^2_2 + C\sum\zeta_{i,j}$$

$$\text{Subject to: } w^t f(I_i) \geq w^t f(I_j) + 1 - \zeta_{i,j}$$

$$\zeta_{i,j} \geq 0, \text{ for all } (i,j) \in D$$

2. A linear svm can be used for rank rvm using the following trick :

$$F_{AB} = F_a - F_b$$

3. For both the models, k-fold cross validation was done with k= 5 to find the best SVM parameters. The parameters that were tuned here were: C.
4. With the best parameters chosen, we can see that each model does better than chance. In fact we can achieve a test accuracy above 55% for both the models.

RESULTS:

Table 9: Average Train and test accuracies for governors and senator models using landmarks and hog as features:

Metric	Governors	Senators
Average Training accuracy	0.9318181818181818	0.9818181818181818
Average Test accuracy	0.5833333333333334	0.6666666666666666

Table 10: Best parameter values for governors and senator models chosen after k-fold cross validation:

Paramter	Governors	Senators
'C'	1e-09	1

2.2 PREDICTION BY FACE SOCIAL TRAITS

OBJECTIVE:

In this part of the project, we use two-layer-model in which we first project each facial image in a 14-dimensional attribute space and second perform binary classification of the election outcome in the obtained feature space. We use the 14 svrs trained in 1.2 to get the 14 features for each governors and senators and then then train 2 linear svms to predict the election outcome

OBSERVATIONS:

1. Rank SVM is used for the prediction.
2. For both the models, k-fold cross validation was done with k= 5 to find the best SVM parameters. The parameters that were tuned here were: C.
3. With the best parameters chosen, we can see that each model does better than chance. In fact we can achieve a test accuracy above 55% for both the models.
4. Comparing the test accuracies between the direction prediction (using rich features of hog+landmarks) in 2.1 and the prediction using the 14 attributes in 2.2, we see that 2.2 does better than the direct features since we are use a two-layer model here.

RESULTS:

Table 11: Average Train and test accuracies for governors and senator models using the 14 social attributes as features:

Metric	Governors	Senators
Average Training accuracy	0.68	0.7115384615384616

Average Test accuracy	0.6666666666666666	0.6666666666666666

Table 12: Best parameter values for governors and senator models chosen after k-fold cross validation:

Paramter	Governors	Senators
'C'	1	1000.0

Table 13: Comparison of average test accuracies with direct features predicted in 2.1:

Model	Test accuracy – direct using hog+landmarks features (2.1)	Test accuracy – 14 features in 2.2
Governor	0.5833333333333334	0.6666666666666666
Senator	0.6666666666666666	0.6666666666666666

4.3 Analysis of Results

OBJECTIVE:

In this part of the project, we show the correlations between the facial attributes and the election outcomes.

OBSERVATIONS:

1. We calculate the correlation coefficient between the absolute values of the voting share differences and the 14 features that were used in 2.2 to predict the election outcomes.
2. ***From the radar plot shown below we can see that, Energetic, Well-groomed, Masculine, Intelligent, and Rich lead to electoral success (positive correlation). Whereas the attributes, Old, baby-faced, attractive, Generous, and honest lead to negative election results (negative correlation).***

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Fig 9. Radar plot of correlation co-efficient r

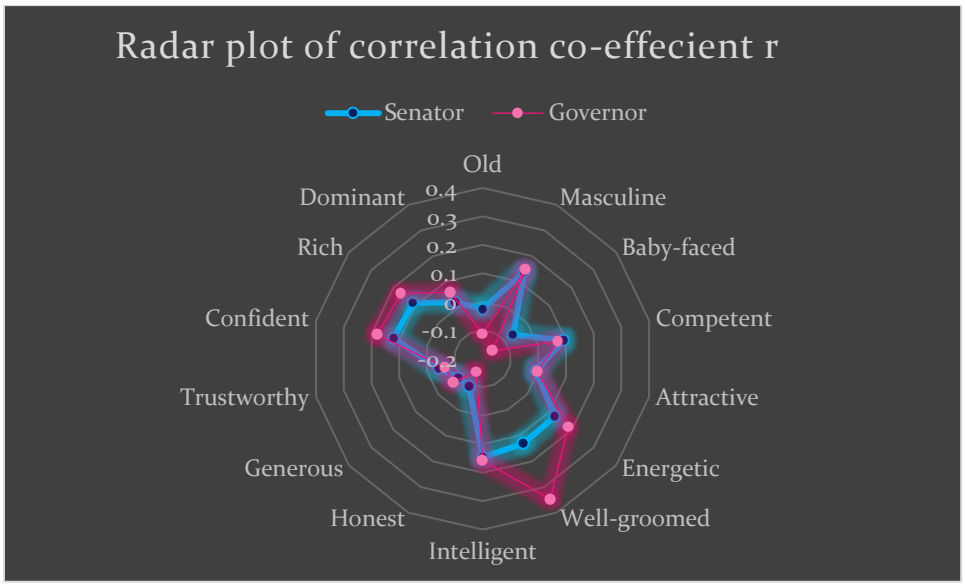

Table 14: values of the correlation-coefficient for senator and governor.

Attribute	Senator	Governor
Old	-0.026074494	-0.112037946
Masculine	0.139274805	0.147386306
Baby-faced	-0.064274445	-0.155340548
Competent	0.092779132	0.071235376
Attractive	-0.007684438	-0.002586516
Energetic	0.124771796	0.1843895
Well-groomed	0.131028093	0.348308024
Intelligent	0.145914859	0.157924263
Honest	-0.091647045	-0.148528075
Generous	-0.091647045	-0.068587209
Trustworthy	-0.041958291	-0.064920471
Confident	0.120578215	0.180556404
Rich	0.113544316	0.167415552
Dominant	0.021165352	0.059738813