



## Abstract

Our research explored the effectiveness of using various machine learning algorithms (GLMs, SVMs, and Naive Bayes) to model the voting behavior of a congressperson, based on past voting record. Bill information for all past votes was aggregated for three congresspeople. Our approach can be extended across all members of congress to predict bill passage.

## Approach

Machine learning methods were tested on a subset of features collected from the bill data.

**Subset Features:** Congress, Bill, Chamber, DW1 Score  $\in [-1, 1]$  for [L, R], Major Topic, Minor Topic

*Examples:* [112, 1, 0, 0.531, 16, 1600]; [108, 1018, 0, -0.322, 20, 2008];

**Congresspeople Examined:**

- ▶ Roy Blunt: (R) Senator from MO, Age 65, N = 1767
- ▶ Nancy Pelosi: (D) Representative from CA, Age 75, Speaker of the House ('07 - '11), N = 1960
- ▶ Paul Ryan: (R) Representative from WI, Age 45, Current Speaker of the House, N = 1911

## Results (*k*-fold % Error)

### Logistic Regression

Person	Train	Test	F1-score
Blunt	12.36%	14.08%	0.9213
Pelosi	20.42%	22.75%	0.8635
Ryan	12.75%	14.40%	0.9167

### SVM with a Gaussian Kernel

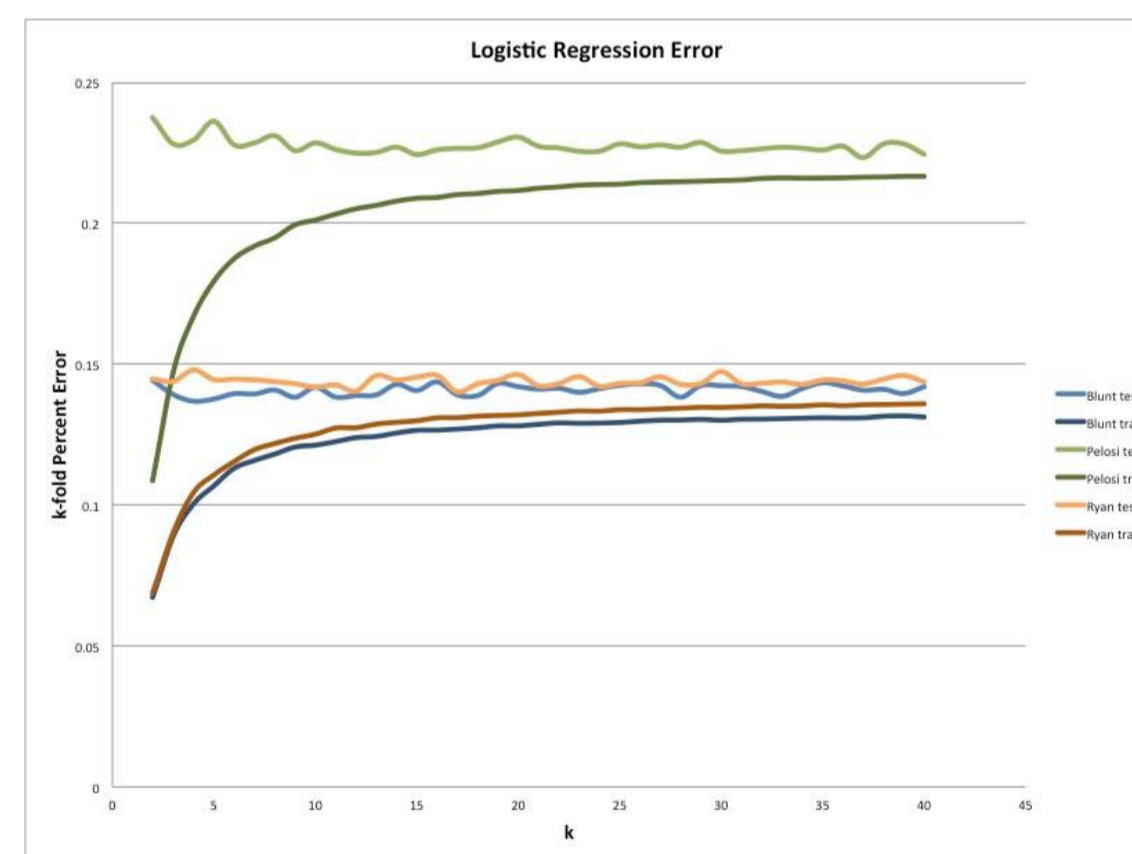
Person	Train	Test	F1-score
Blunt	0.08%	13.87%	0.9310
Pelosi	0.05%	22.84%	0.8736
Ryan	0.11%	14.45%	0.9251

### Naive Bayes

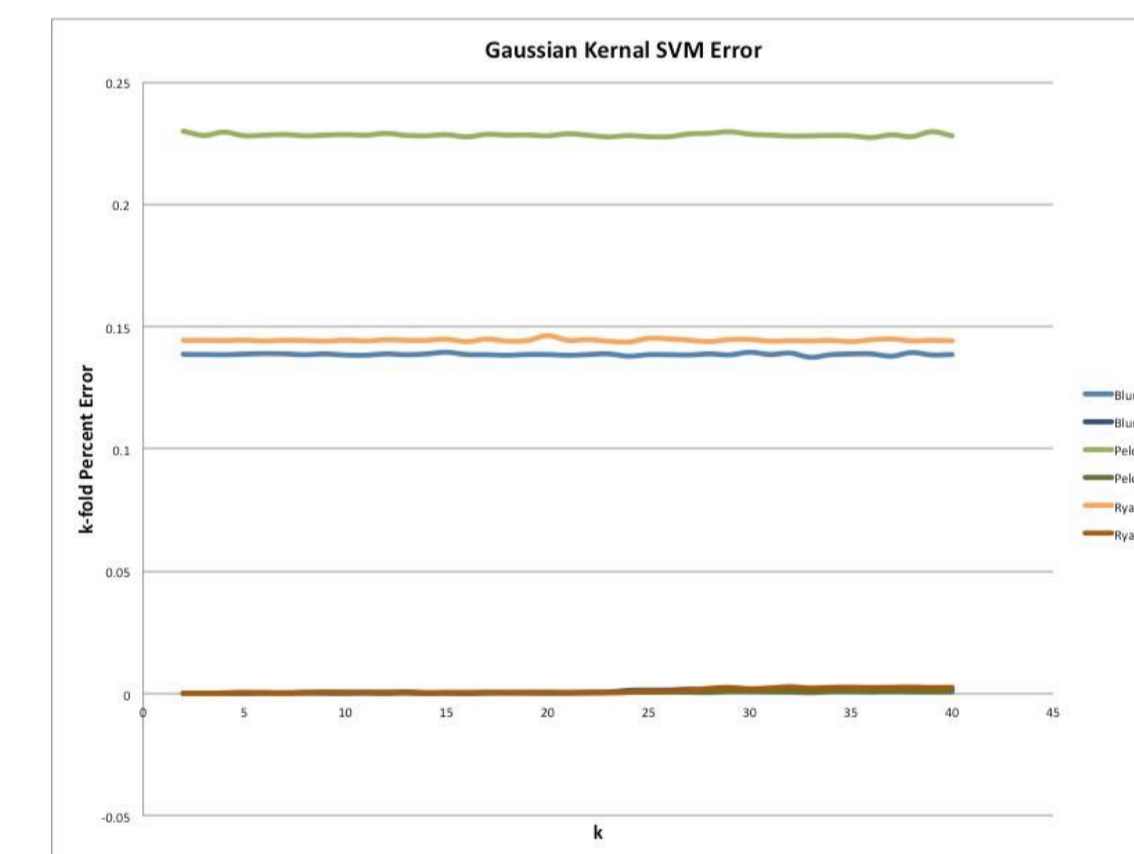
Person	Train	Test	F1-score
Blunt	13.53%	13.86%	0.9212
Pelosi	21.34%	21.93%	0.8192
Ryan	13.99%	14.34%	0.9266

## Graphs

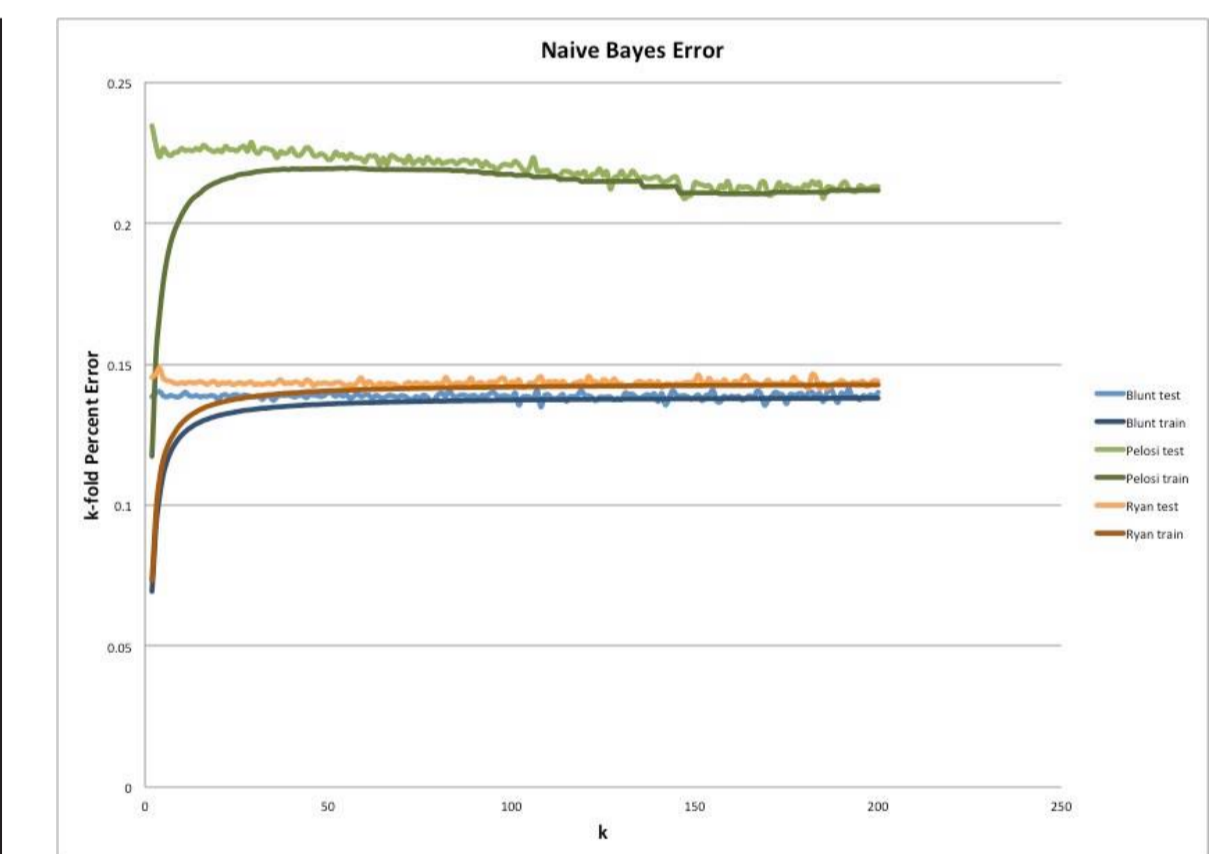
### Logistic Regression



### SVM with a Gaussian Kernel



### Naive Bayes



## Analysis

- ▶ Data aggregation for this project was nontrivial. We used SQL to merge bill data with congressperson vote history, and the resulting data required further processing.
- ▶ Data has unbalanced classes. Correcting for this did not significantly improve results.
- ▶ All M.L. algorithms explored outperform "Party Line" voting per congressperson.
- ▶ Similar approaches to tackling this problem focused on analyzing bill text. Our approach focused on features outside the language of the bill to produce the results showcased here.