



Introduction

State primaries are very important in a presidential candidate's campaign for office. They can easily decide the fate of a candidate's campaign. If a primary goes poorly, it can easily end a candidate's race for the election. Alternatively, if the primary goes well, it can boost a candidate's confidence and push him or her further along in the race.

Our artificial intelligence class at Lincoln University has recently been working on a fuzzy logic program to help predict these outcomes. A fuzzy logic system is a rule based AI program that is created to allow the use of terms used in the human language. Many words we use can have a variation or 'fuzziness' in their meaning. Some examples of these descriptors would be *very*, *slightly*, or *somewhat*. Words such as these allow for a factor to hold a range of meaning. These values can overlap and result with a factor belonging to more than one rule or set of rules.

Our fuzzy logic system is based on certain criteria we found to be key in determining a primary's results [1]. Some of the key factors we used in our system were the black voting population in a state, how liberal the population was in the state, and if the state was a home state for the candidate. These factors are just a small sample of the possible factors that could be used. There could be an endless number of factors that you could identify and use in a fuzzy system. Some of these factors may be difficult to put a specific value to, such as the liberalness of a state. This leads to the need of a fuzzy system where we can have words that describe the factor's value but can also overlap if needed.

Question addressed by this research:

Can we successfully predict the outcomes of state primaries based on common factors with a fuzzy logic system?

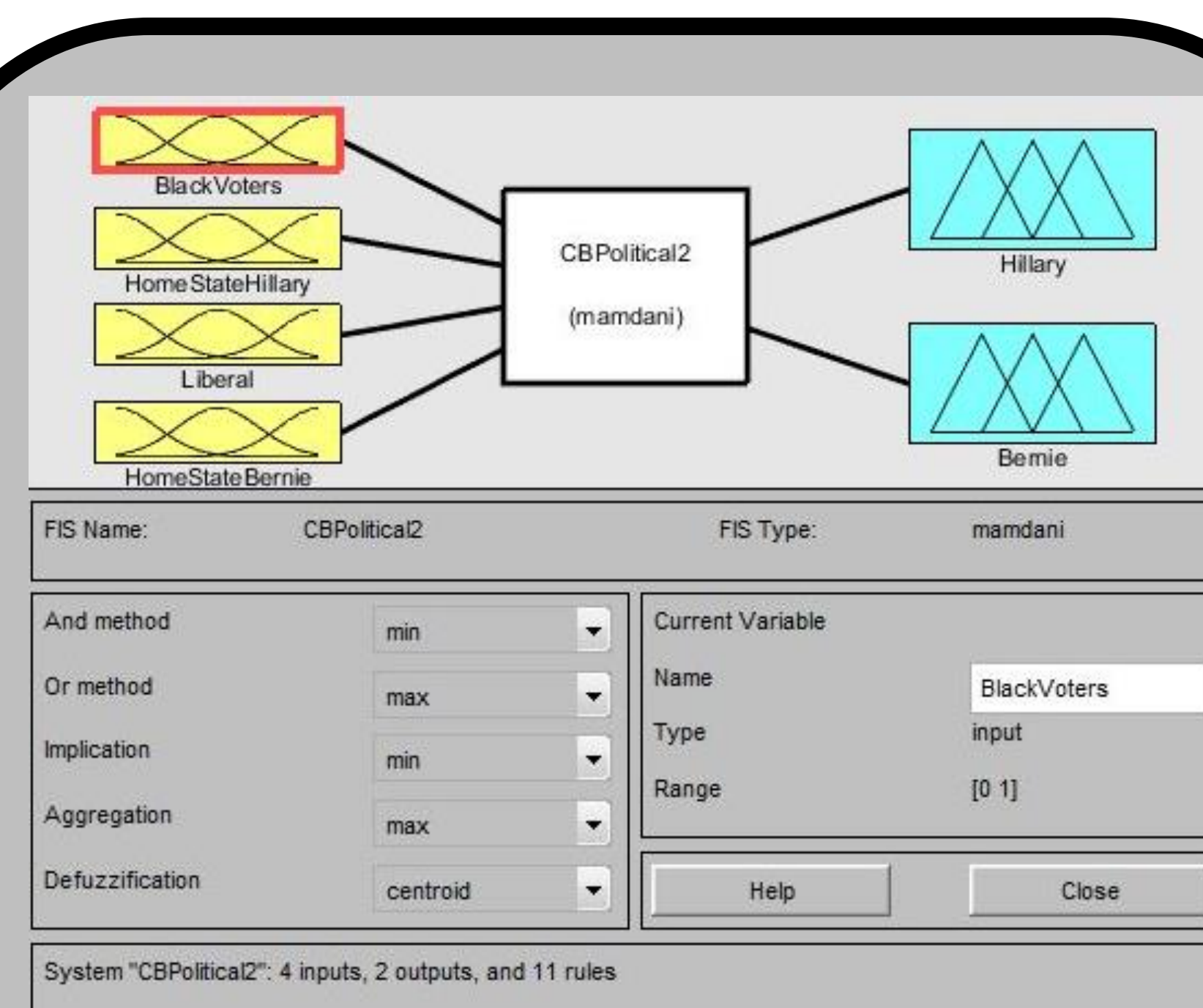
Factors/Trends

Factors

- The size of the registered Black voting population.
- How Liberal the voting population is in each state.
- If the state is a Home State for the candidate.

Trends

- A larger black voting population tends to favor Hillary Clinton as the winning candidate.
- A very liberal voting population tends to favor Bernie Sanders as the winning candidate.
- The home state advantage provides the resident candidate a large advantage at winning the primary for that state.



Here is the base structure of our fuzzy system. We have four inputs each with their own descriptors and two outputs displaying the results for each candidate.

Our (representative) input descriptors are:

High Black Population: 20 - 100%
Medium Black Population: 10 - 25%
Low Black Population: 0 - 15%

Very Liberal: 60 - 100%
Moderately Liberal: 10 - 90%
Not Very Liberal: 0 - 40%

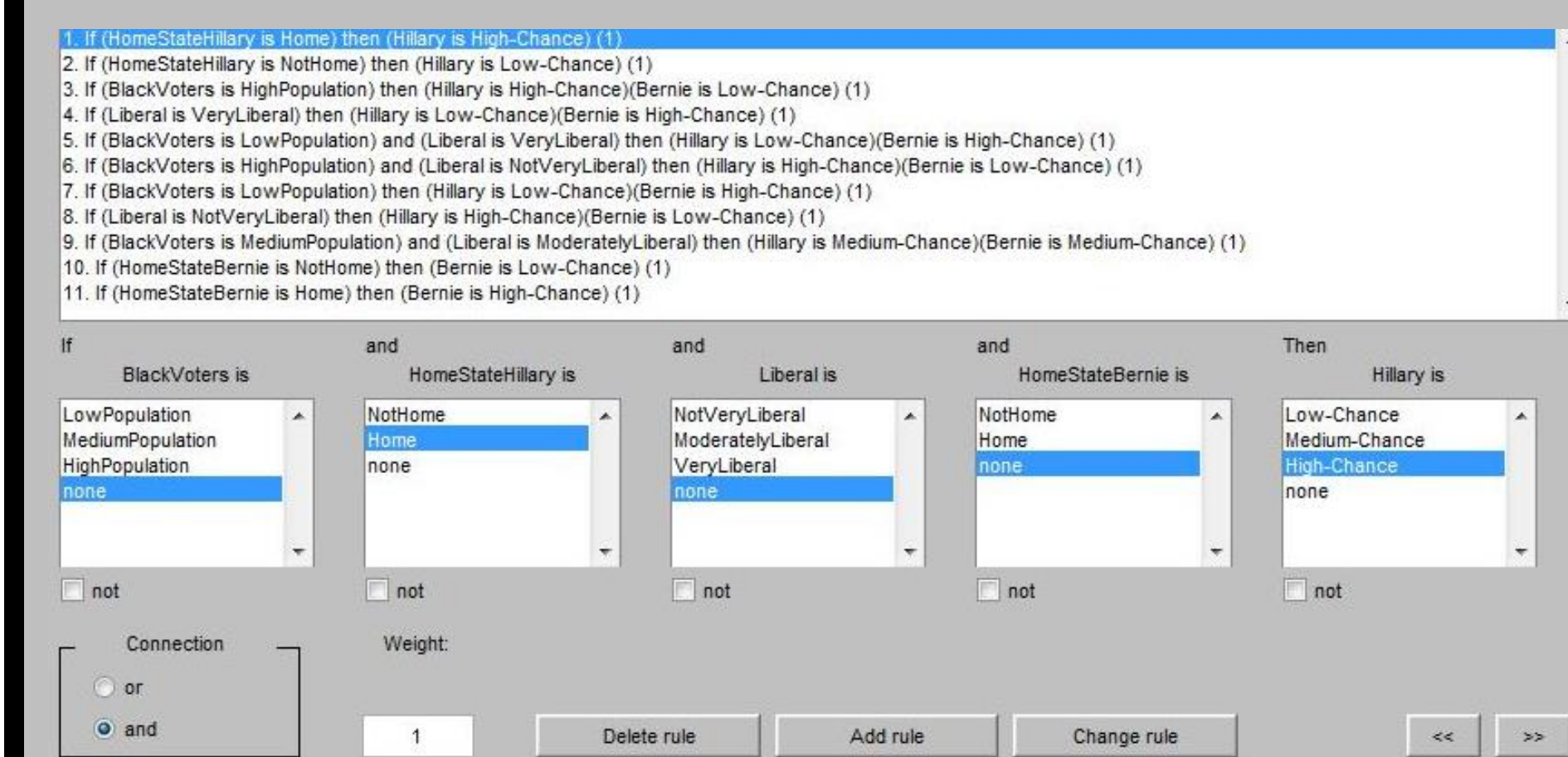
Home State: 50 - 100%
Not Home State: 0 - 50%
(two input values, one for Bernie, one for Hillary)

Data

Our fuzzy logic system was created using the MATLAB programming language. The data we used was pulled from the US Census of 2014 [3] and from Graphiq [2].

State	% of Black Voters	Home State for Hillary	Liberalness	Home State for Bernie
Alabama	0.25	0	0.11	0
Alaska	0.04	0	0	0
Arizona	0.05	0	0.36	0
Arkansas	0.14	1	0	0
California	0.07	0	0.75	0
Colorado	0.04	0	0.44	0

Here is a sample of the states that we collected data on.

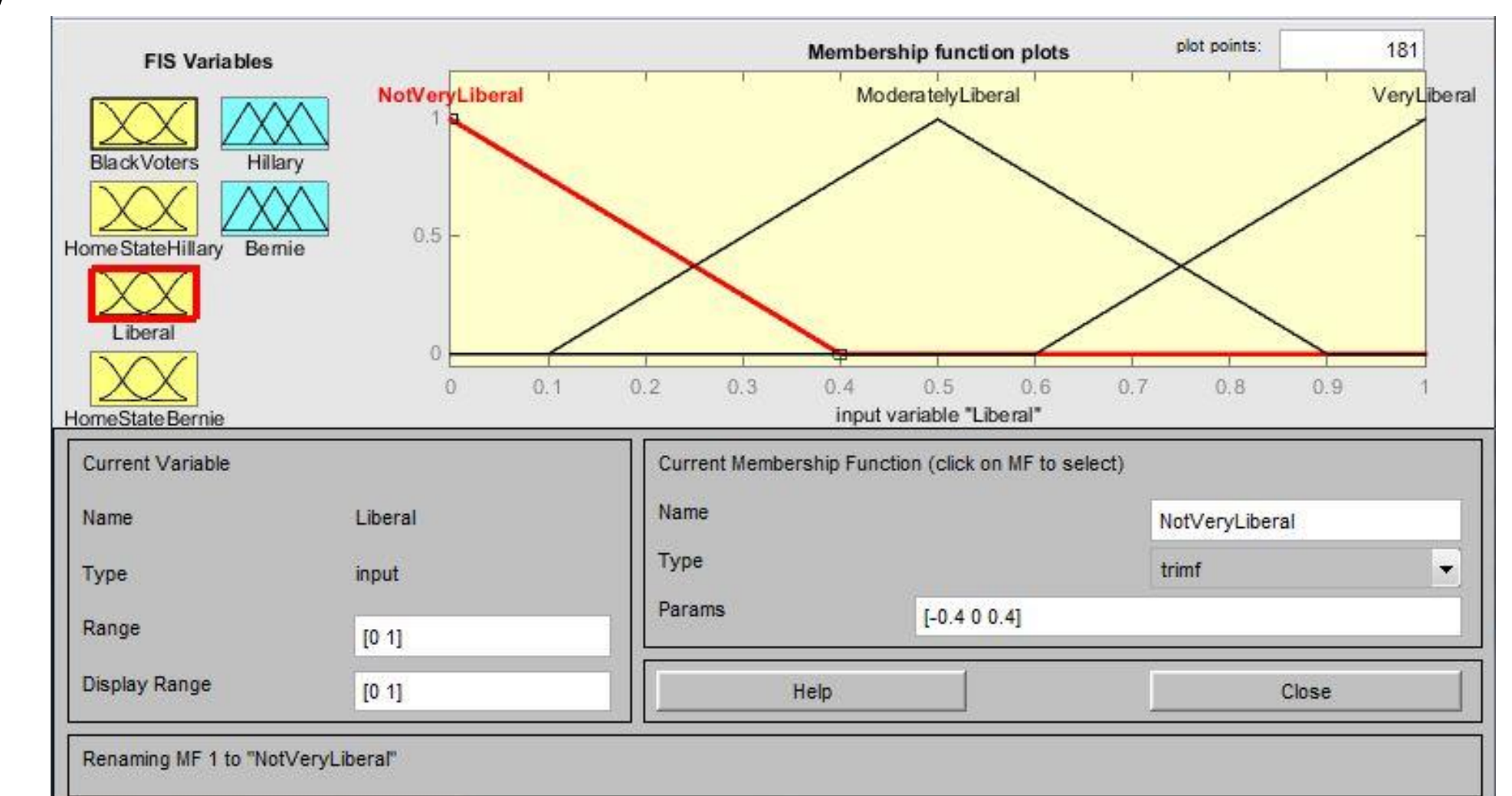


Here is a sample of some of the rules that we have created to test our inputs.

Discussion/Conclusion

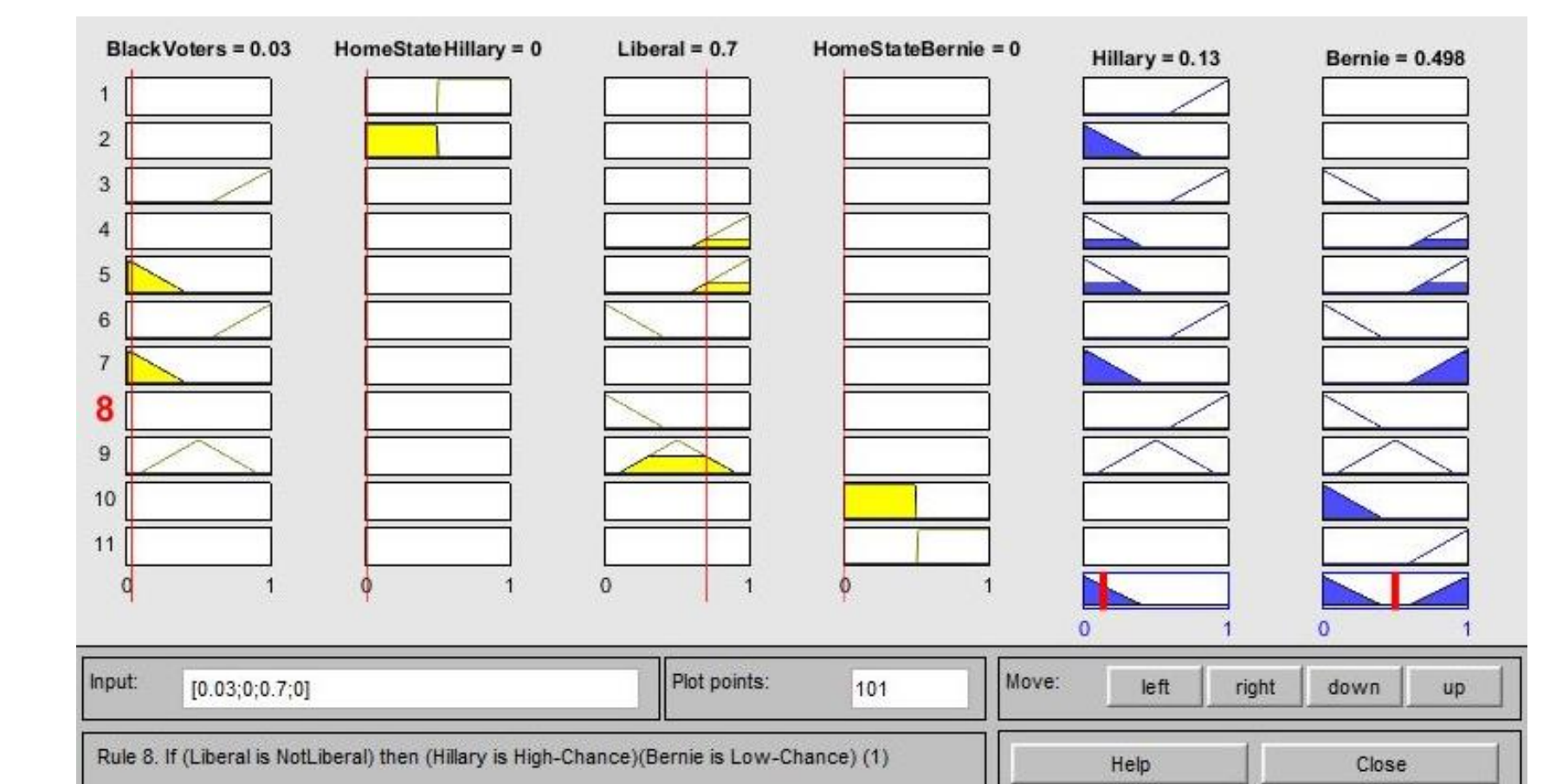
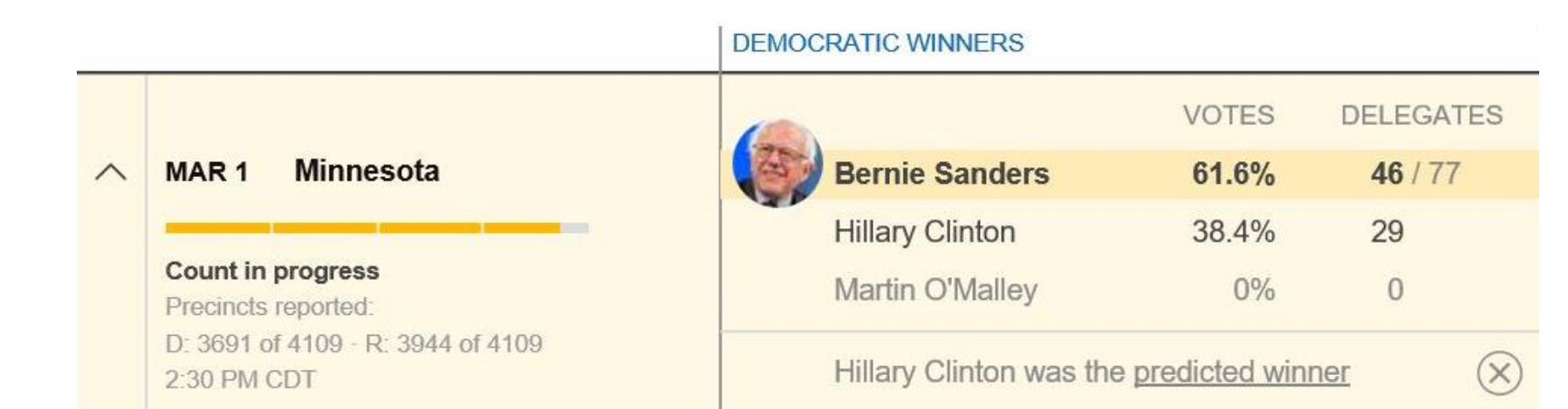
Overall our system works fairly well and generally the predictions it generated were similar to the real results. In Vermont, our system correctly predicted the outcome of the primary, giving Bernie a 87% likelihood of winning. In Missouri, Hillary was the predicted winner from our system by a small margin. Hillary had a 39% likelihood of winning compared to Bernie's 34%. The actual winner of the Missouri primary was Hillary by a small margin. Sometimes our results were off, but this could be from some unknown factor or factors that we did not account for. Another reason for errors might be that our system needs more fine tuning as we gather more data.

Results



Here is an example of one of our membership functions.

Primary results and predictions



The red bar in the diagram allows you to change your input values for the membership functions and see the different output results.

Primary results were provided by Bing search engine.

References

1. Cox, Amanda, Josh Katz, and Kevin Quealy. "Who Will Win Super Tuesday? Live Estimates of Tonight's Final Democratic Results." *The New York Times*. The New York Times, 1 Mar. 2016. Web. 29 Mar. 2016. <http://www.nytimes.com/interactive/2016/03/01/upshot/super-tuesday-live-democrat-delegate-estimates.html?_r=0>.
2. Graphiq. "Here Are the Most Conservative and Liberal States in Congress." *The Huffington Post*. TheHuffingtonPost.com, 5 Mar. 2015. Web. 29 Mar. 2016. <http://www.huffingtonpost.com/findthebest/one-map-shows-the-most-conservative-liberal-congress_b_6804276.html>.
3. "Voting and Registration." *United States Census Bureau*. Web. 29 Mar. 2016. <<http://www.census.gov/hhes/www/socdemo/voting/publications/p20/2014/tables.html>>.