Why did legislator “X” vote on bill “Y” as “YEA”? (Interpretable Model)

**Motivation**
- Political ideal points are expressed by legislative voting
- Political ideal points affects public behavior patterns
- It is necessary to understand the Congressional votes

**Research Questions**
- RQ 1) Quantifying the ideal points of bills / legislators
- RQ 2) Quantification of trust between legislators
- RQ 3) Modeling the behavior of individual legislators, taking into account ideal points and trust
- RQ 4) Voting predictions for individual legislators

**Methodology**
- We adopted VAE / SDAE to model the bills and combined it with various causalities to create a model with high explanatory power
- In order to consider the correlation between the topics in the bills, we adopted a tensor-based operation
- NIPEN-Tensor is a more generalized model than the existing models (including NIPEN-VAE/SDAE).

**VAE for bill modeling**:
- \[ L = -D_{KL}(q_{θ}(z|x)||p_{θ}(z)) + \frac{1}{2} \sum_{i=1}^{K} \log p_{θ}(w|x_i) \]

Voting modeling with contents and network component:
- \[ p(u = 1) = \sigma(a_u \sum_{d,k} x_u d x_u a_k + y_u \alpha) + \beta \sum_{u,d,k} x_u d x_u a_k r_{u,d} \]
- \[ \phi = \text{Latent of Bill} \]
- \[ y_u = \text{Legislator Ideal points} \]
- \[ \eta_d = \text{Network State Parameter} \]

**Dataset**
- Roll call data: The recorded votes of deliberative bodies
- Politic2013 and Politic2016 include records 1990–2013 and 1990–2016 respectively
- Politic2013 is a more sparse dataset than Politic2016 in the ratings and the vocabulary sizes.

**Results**
- The major topic of H.Res.794 (114th) is “Business and Finance” with negative ideal points
- There is greatest disagreement between the Republicans and the Democrats on that topic
- The voting was very partisan (92.2% republican voted YEA and 90.5% Democrat voted NAY)

**RQ 3) Modeling the behavior of individual legislators, taking into account ideal points and trust**
- Top-five legislators who are affected by contents or network factors & trust
- Majority of legislators are voting to focus on contents rather than network effect
- A small numbers of legislators are highly dependent on the network effect.

**RQ 4) Voting predictions for individual legislators**
- Variations of NIPEN shows the best performance in every metric and dataset
- NIPEN-Tensor is a model that considers the correlation between topics, and NIPEN-Tensor may have a better performance when a bill text has multiple topics with complex and rich textual information

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**Neural Ideal Point Estimation Network (NIPEN)**

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