Fundamentals of Artificial Intelligence and Knowledge Representation

Project Report

State Collapse Network

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1 Dataset

The objective of this project is to apply Bayesian networks to the modelling of causes that lead to a state's collapse. The project aims to answer questions involving the probabilistic relationships between the causes of a state's collapse.

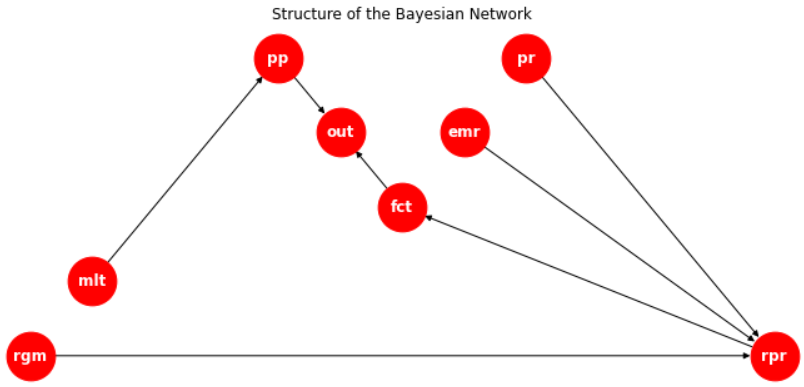
The data that is selected has been composed by the University of Duisburg-Essen, Germany. The data consists of 43 rows and 31 columns with each column representing a cause that can lead to a state's collapse. The rows represent the countries at different points in time when they are stable (outcome = 0) and when they have collapsed (outcome = 1).

For this project, only political factors are selected to build the Bayesian Network. This is in part to simplify the design and study of the network. As such, the following causes have been selected: `regime`, `eth_min_rule`, `personal_rule`, `repression`, `factional`, `milit` and `power_prop`. The causes are defined as follows by the dataset:

- **Regime Type (REGIME)**
  Regime type, classified as "Democracy", "Hybrid", or "Autocracy".
- **Ethnic Minority Rule (ETH_MIN_RULE)**
  Political monopoly, or dominant political position in politics of an ethnic group which constitutes a numerical minority in the country.
- **Personal Rule (PERSONAL_RULE)**
  A type of state authority structure in which the ruler is an individual leader whose decision making power is institutionally unconstrained, who presides over a neopatrimonial public administration and who uses the patron client network as the principal institutional mechanism for wielding political power.
- **Repression (REPRESSION)**
  Intensity of state repression against the population.
- **Factionalism (FACTIONAL)**
  Political competition shaped by parochial or ethnic based political factions promoting particularist agendas.
- **Militarised Opposition Groups (MILIT)**
  Relevant oppositional actors are organised as armed groups.
- **Power Proportions (POWER PROP)**
  Opposition's perception of the chance to take over government, based on actual power relations to and attitude towards rulers.

2 Network Design

The network has been designed with the following logic:



- **Regime**, **Ethnic Minority Rule** and **Personal Rule** will determine if the **Repression** is applied by the government. The type of regime and the needs of its ruling class will determine if repression is required to stay in power.
- **Repression** will determine if **Factionalism** appears within the government. A government that represses its political class will have a lower factionalism as internal opposition is removed from positions of power, thus leading to less factionalism within the government.
- **Militarised Oppositional Groups** will determine the **Power Proportions** of external oppositional groups to the government. This is the belief of such groups of overthrowing the government by force.
- **Factionalism** and **Power Proportions** will determine the **Outcome** of a state. If the government is divided into many factions internally and if external opposition groups are confident in their force of arms, a state is more likely to collapse in such a scenario.

After designing the network, it is then fitted to the prepared dataset. This produces the conditional probability tables (CPTs) for each conditional probability of the network.

3 Network Inferencing

Once the network has been fitted, inferencing can now be applied to determine the probability of a query given certain evidence. For this, two types of inference methods are applied, specifically: exact inference using variable elimination and approximate inference using likelihood weighted sampling.

This is done in order to compare both methods as well as to learn how to apply both methods in practice.

The following questions are inferred from the network:

1. **What form of government will ethnic minority rule most likely take that does not lead to state collapse?**
   In countries such as South Africa during the Apartheid period, what form of government is necessary to prevent state collapse and is democracy possible for minority rule to be maintained?

2. **What is the probability that a democracy with personal rule will lead to repression?**
   During the Trump presidency, personal rule and loyalty defined the White House and the USA. In such a case, is it possible that a democracy with personal rule will lead to repression?

3. **What is the probability that a united government and a militarised opposition will lead to state collapse?**
   When a government is united and not split by internal factions, is it able to overcome any attempt of state overthrow by an emboldened militarised opposition group?

The following conclusions are obtained from the results of both exact and approximate inferencing:

1. **What form of government will ethnic minority rule most likely take that does not lead to state collapse?**
   An ethnic minority government will most likely take the form of an autocracy to prevent state collapse. This is due to the need to control the ethnically different population of a much larger demographic. A democracy will probably lead to the ethnic minority rulers being swept away in an election.

2. **What is the probability that a democracy with personal rule will lead to repression?**
   The probability of repression by a democracy with personal rule is low. This is most likely due to the checks and balances that still exist within democracies to prevent such abuses of power.

3. **What is the probability that a united government and a militarised opposition will lead to state collapse?**

If the government is united without factionalism, the probability of a militarised opposition leading to a state collapse is relatively low. A united government will be able to coordinate military action against such groups more easily, thus reducing the probability of government overthrow.

4 Conclusion

In conclusion, the project has demonstrated the design and usage of Bayesian networks in modelling a given dataset. In this case, the model was used to answer questions involving the causes of state collapse. Such a model can be further improved by having more representative data and also a better model design by a human expert.