Artificial Intelligence : Paper Critique

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Paper Title: An AI Planning Solution to Scenario Generation for Enterprise Risk Management

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I. SUMMARY

Most companies commonly use a method called Scenario Planning to develop their long-term plans. Risk Management puts extra emphasis on a business or policy- maker to incorporate Scenario Planning in their system to lay-out the possible alternative futures and anticipate them. This paper presents a system - Scenario Planning Advisor (SPA) - which generates various scenarios highlighting the potential indicators likely to lead to a scenario, consequences of a scenario, and the business implications a scenario may have.

A. Scenario Planning Advisor (SPA)

The Scenario Planning Advisor is broadly based on three major components : Scenario Generation and Presentation, Domain Knowledge and News Aggregator.

The News Aggregator extracts relevant information from the raw news and social media data and outputs the key risk drivers.

Domain Knowledge consists of two sub components - Forces Model and Forces Impact. Forces model encapsulates the causes and description of a force in the form of a mind map, which is a graph with nodes signifying the forces and edges representing the relation between the forces. So if an edges goes from force 1 to force 2, force 1 signifies the cause, and force 2 signifies the consequence.

A valid path (A valid path maps directly to a plan for the planning task) in a mind map starts with a cause, goes through at least one main force and terminates in a business implication. A Mind Map *M* is a three tuple :

$$M =< \tau, \sigma, \theta >$$

where $\sigma \, \varepsilon \, C$ is the main force, θ is the consequence structure, and τ denotes the sequence of forces resulting to the main force σ. Forces impact gives the impact a force may have. This information is received by domain experts by asking them a series of automatically generated Mind Map based questions.

The outputs of Domain Knowledge and News Aggregator components are fed into the Scenario Generation component, which generates a set of alternative scenarios after clustering the solutions of the planning problem.

A Scenario problem can hence be denoted with a three tuple:

SP = <Forces Model, Forces Impact, Key Risk Drivers>

B. Transforming to Planning

The Scenario problem as described above can be shown to be NP-hard by reducing it to a Hamiltonian Path problem, which is well known to be NP-hard. The authors define a plan recognition problem to be a three tuple :

$$SPPR = < \Pi, O, G, PROB >$$

where Π is defined in the STRIPS formalism defined by Forces Model and Forces Impact, O is the set of observations (Key risk drivers), G is the set of possible goals (Business implication) with PROB being the probability distribution over G. Using the above formulation of the problem, the authors follow their own previous research to calculate a set of plans, and present these groups as scenarios to the user. Each such plan traverses through one of the business implication (Goal States) and either explains or discards the key risk drivers (Observations).

C. Computation of Scenarios

The authors calculate scenarios by ensuring that at least one goal be satisfied while building the set of observations, calculate the set of plans explaining the largest possible subset of the key risk drivers and cluster them into scenarios by a clustering algorithm.

'k' number of sets of plans of the highest quality are computed by following a research done earlier [1], incorporating a heuristic search algorithm K*[2] and LM-cut[3]. A clustering algorithm proposed earlier[4] is used to group a set of plans having similarity in them into scenarios. The leading indicators are identified to determine the likelihood of a scenario occurring in the business model(suppose).

Only 3-5 of such scenarios are then presented to the users as both text summaries and on a graph. The graph also shows the inter-connectivity of mind maps and how they share various forces among them.

D. Evaluation

For experimental evaluation, four sets of Mind Maps were created. Two of them had a different number of goal states, while the other two were partially grounded mirror images

of the first two sets of mind maps.
Experiments were conducted on these sets with both the heuristic techniques.

E. Limitations

The key limitations of the proposed system of Scenario Planning Advisor are as follows:

1) The time duration to go from one force (cause) to another (effect) is not considered while creating mind maps, which may lead to inaccurate computation of the cost of a particular valid path (plan) to the goal state (business implication).
2) The fact that a particular force may lead to multiple resulting forces is not considered. Such a scenario may lead to non-determinism in a path.

F. Suggestions for Improvements

Some suggestions for the above limitations are as follows:

1) Incorporate the duration in the transition of cause to effect in the mind map so as to include it the total cost of the path and hence, a correct set of top k plans can be computed.
2) Consider both the paths and split them into two, treating them as two different paths leading to different main forces.

II. REFERENCES

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