Historical Developments in AI Planning & Search

Research Review by Andrew Quaife

The field of AI Planning and Search is a Broad field consisting of a timeline of sizable achievements big and small to propel our human intelligence forward. In this paper I am going analyze three historical developments: "*Extending Graphplan to Handle Uncertainty & Sensing Actions*" by Daniel Weld, Corin Anderson, and David Smith; "*Conformant Planning through Classical Planning*" by Hector Palacios, and Hector Geffner; "*Planning with Incomplete Information as Heuristic Search in Belief Space*" by Blai Bonet, and Hector Geffner. Highlighting on the relationships between the developments and their impact on AI.

First off, "*Extending Graphplan to Handle Uncertainty & Sensing Actions*" by Daniel Weld, Corin Anderson, and David Smith describes "*SGP, a descendant of Graphplan …*" (EGHUSA pg1) which solves small problems quickly, and provides quantitative measures for metrics where other papers do not (see EGHUSA pg8,col1). One of the main methods was its alternating two phases, Graph Expansion and Solution Extraction illustrated here: "*The graph expansion phase extends a planning graph until it has achieved a necessary condition for plan existence. The solution extraction phase then performs a backward-chaining search for an actual solution; if no solution is found, the cycle repeats*" (EGHUSA, pg2). The effect of this is a Forward search along with a Regressive search, this helps the problem come to the solution more efficiently. Graph Expansion and Solution Extraction, along with other parts like "*SSM sensor definitions*" (see EGHUSA pg4), and how quickly it solves simple problems adds to why SGP is such a great impact on the AI as a whole.

Next, "*Conformant Planning through Classical Planning*" by Hector Palacios, and Hector Geffner has an algorithm called T0 and "*… is based on a framework for the mapping conformant planning problems into classical planning problems that are then solved by an off-the-shelf classical planner*" (CPTCP pg1). T0 is written in C++ and OCaml, and with big grounded PDDL files larger than 100 MB T0 works quite well. Lastly, The idea has an interesting impact on AI, taking a complex algorithm into a simpler well known framework, encountering the known wisdom that 'Simpler is Better' really is something to be looked at.

Finally, "*Planning with Incomplete Information as Heuristic Search in Belief Space*" by Blai Bonet, and Hector Geffner experiments with Planning & search algorithms with incomplete information, and introduces belief states or probability distribution over states (RTDP algorithm). The RTDP algorithm is illustrated here: "*We have developed a planner that supports these extensions, and maps descriptions of conformant or contingent planning problems, with or without probabilities into the corresponding models*"(PIIHSBS pg6). Additionally, they experimented with RTDP and other common algorithms like A* and Breath-First-Search to truly understand planning with uncertainly. This paper gave the reader strong heuristics metrics (A*,

Breath-First-Search, etc.) (see PIIHSBS pg9) to decipher along with detailed explanations, and strong methods of creating a model with probabilistic states. These three above accurate reasons legitimately benefited the AI Community.

In conclusion, the AI community should be pleased how much research and detail went into these papers amongst others to help us exceed as a body to impact AI.

Cited:

EGHUSA: "*Extending Graphplan to Handle Uncertainty & Sensing Actions*":
by Daniel Weld, Corin Anderson, and David Smith;

CPTCP: "*Conformant Planning through Classical Planning*":
by Hector Palacios, and Hector Geffner;

PIIHSBS: "*Planning with Incomplete Information as Heuristic Search in Belief Space*":
by Blai Bonet, and Hector Geffner