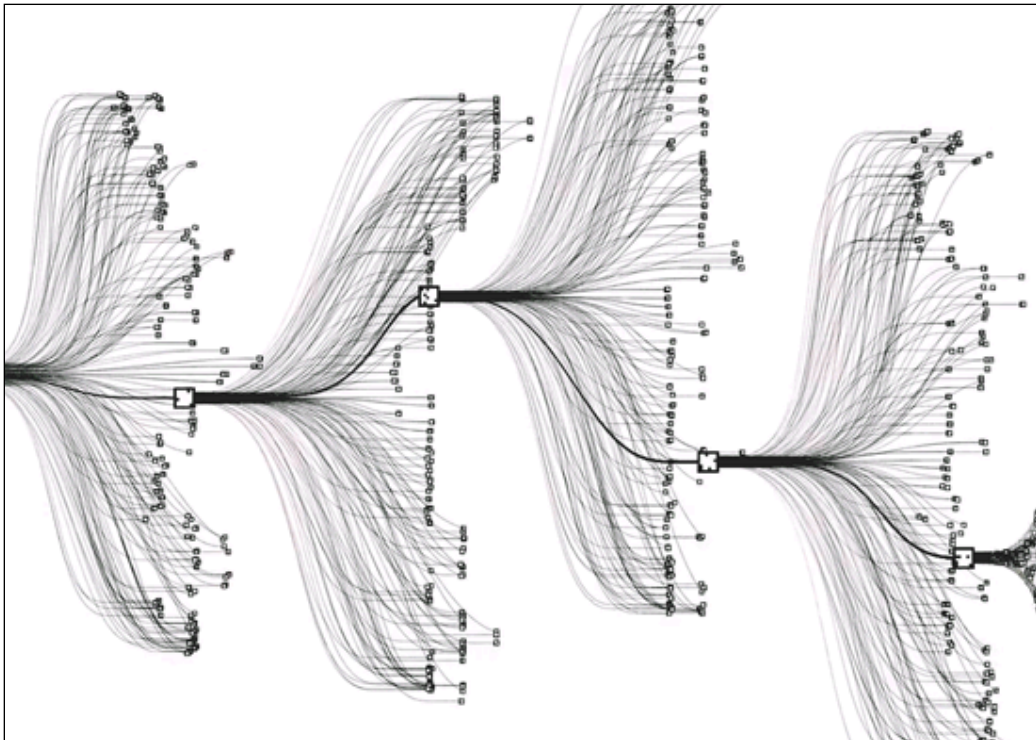# Important historical developments in Artificial Intelligence planning and search

by Ezenwere I.K Emmanuel

1) **STRIP** : Stanford Research Institute (SRI) Scientists developed the first AI robot called "Shakey" in 1966. Shakey used an algorithm that was a great improvement over the classical problem planning. STRIPS assumed that only one action could occur at any time, that nothing changed except as a result of the planned actions, and that actions were effectively instantaneous. It involves applying a sequence of actions to an initial state until a goal state is achieved. the STRIPS framework were needed in order to enable early progress to be made on the extreme difficulties of the general automatic planning problem. The STRIPS framework had sufficient intuitive appeal to most researchers for them to believe that it was a viable foundation on which to develop techniques that

would be effective in more realistic models. For example, techniques for abstract planning were developed as direct extensions to STRIPS. The developments on STRIPS also provided the context and motivation for development of the A* search algorithm.

2) Planning Graphs: In 1997, Avrium Blum and Merrick Furst at Carnegie Mellon developed a new approach to planing in STRIPS-like domains [2]. It involved constructing and analyzing a brand new object called a Planning Graph. They developed a routine called GraphPlan which obtains the solution to the planning problem using a Planning Graph construct. The Graph plan is an approximate representation of a goal tree; which is a tree of actions that leads to a goal, the edges are the actions and the nodes are the new states. Planning graphs allows for a faster goal search by reducing the search from an exponential order to a polynomial one. The planning graph can't answer definitively whether Goal is reachable from initial state, but it can estimate how many steps it takes to reach Goal.

3) Heuristic Search Planner (HSP) : Formulated in 1998, HSP is based on the idea of heuristic search. A heuristic search provides an estimate of the distance to the goal. In domain independent planning, heuristics need to be derived from the representation of actions and goals. A common way to derive a heuristic function is to solve a relaxed version of the problem. The main issue is that often the relaxed problem heuristic computation is NP-hard.
The HSP algorithm instead estimates the optimal value of the relaxed problem. The algorithm transforms the problem into a heuristic search by automatically extracting heuristics from the STRIPS encodings.

Conclusion
The STRIPS formulation provided general framework from which more advanced languages could be built. The Planning Graph construct was a revolutionary data structure which gave a whole new perspective on optimal planning techniques. Finally, the HSP algorithm gives an automated approach for determining heuristics to general planning problems.

References
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