Key Developments in Early AI Planning

This is a brief summary of the creation of the General Problem Solver (GPS) and the STRIPS automated problem solver, and some examples of their effect on subsequent AI planning.

In 1959, Herbert A. Simon, J. C. Shaw, and Allen Newell published "Report on a General Problem-Solving Program," detailing their work that "grew out of [Newell and Simon's] earlier computer program, 'The Logic Theorist,' which discovered proofs to theorems" using propositional logic. (From p.2 of the 1959 GPS Report) Their general approach with GPS was to mimic the thought processes of a group of college students as they solved symbolic logic problems. As Russell and Norvig state, "AI from the start embraced the idea of duplicating human faculty." (Artificial Intelligence: A Modern Approach, 3rd ed., p.18) GPS relied on the widely used "means-end analysis" as one heuristic. "The second system of heuristic used by GPS is a form of planning that allows GPS to construct a proposed solution in general terms before working out the details." (ibid., p.18) In other words, the problem is abstracted by suppressing certain details and thus can be solved more quickly, albeit possibly incorrectly.

In 1971, Richard E. Fikes and Nils J. Nilsson presented "STRIPS: A New Approach to the Application of Theorem Proving to Problem Solving." The specific problems they had been solving were how to make a robot perform physical tasks. Like GPS, STRIPS "is of the class of problem solvers that search a space of 'world models' to find one in which a given goal is achieved….For searching through the space of world models, STRIPS uses a GPS-like means-end analysis strategy." (Fikes and Nilsson, in Artificial Intelligence 2, 1971, pp. 189-190) The theorem-proving techniques from the Logic Theorist and GPS are used in a separate process, which involves maintaining a set of first-order predicates that represent each world state, and querying it to determine which operators/actions are applicable in that state and whether the state satisfies the conditions of the goal state. (ibid., p.190)

Russell and Norvig explain that "the representation language used by STRIPS has been far more influential than its algorithmic approach," leading to the widely used Action Description Language (Pednault, 1986), which "made it possible to encode more realistic problems," as well as the Problem Domain Description Language (PDDL, Ghallab et al., 1998), "which has been used as the standard language for the International Planning Competition since 1998." (Russell and Norvig, p.400) In a sense, STRIPS was like a historical version of heuristic abstraction that advanced automated planning: "Perhaps the severe simplifying assumptions of the STRIPS framework were needed to enable early progress to be made on the extreme difficulties of the general automatic planning problem," encouraging researchers to "believe that it was a viable foundation on which to develop techniques that would be effective in more realistic models." (Fikes and Nilsson, "STRIPS, a Retrospective," Artificial Intelligence 59, 1993, pp.229-30)