Planning Research review

The planning problem in Artificial Intelligence is generally about finding the sequence of actions when trying to achieve some goal. Most works on planning use a state-transition system model, in which the world consists of a (finite or infinite) number of states, and actions/transitions change the current state to a next state. There are several possible representations for state-transition systems and there has been active research going on in this field. Three of such representations of transition systems are described below.

1. STRIPS

The simplest language used for formalizing actions is the **STRIPS** language. In **STRIPS**, the state variables have the domain {0,1} (equivalently {FALSE, TRUE}), and an action consists of three sets of state variables, the **PRECONDITION**, the ADD list, and the DELETE list. An action is possible in a state if all the variables in **PRECONDITION** have the value 1. All the assignments are instantaneous and take place simultaneously. In **STRIPS planning**, a goal is usually expressed as a set of state variables. A state is a goal state if all the goals have the value 1 in it.

2. Petri nets

Petri nets are a model of state transition systems in which several transitions may take place simultaneously in the sense that they are independent.
For Petri nets, the state variables are the places. In state-transition nets, each place can hold 0 or more tokens.
Essentially, a place is a state variable with the set of natural numbers as its domainTransitions (actions) in Petri nets are described slightly differently. Each transition has a set of predecessor places and a set of successor places. The transition is possible if all predecessor places N have a token (this corresponds to the **PRECONDITION** in **STRIPS**). When the transition is fired, all the successor places will receive an additional token.

3. PDDL/ADL

PDDL/ADL is a generalization of **STRIPS**. **PDDL** is different from **STRIPS** in a sense that the **PRECONDITION** may be an arbitrary Boolean combination of atomic facts about the state variables. Atomic facts say something about one state variable.
PDDL can be reduced to **STRIPS**, but several **STRIPS** actions may be needed for one **PDDL** action.

References:

1. http://ai.stanford.edu/~nilsson/OnlinePubs-Nils/PublishedPapers/strips.pdf
2. https://inst.eecs.berkeley.edu/~ee249/fa07/discussions/PetriNets-Murata.pdf
3. *Artificial Intelligence: A Modern Approach* by Stuart Russell and Peter Norvig.