UACEE International Journal of Artificial Intelligence and Neural Networks – IJAINN
Volume 3 : Issue 2 [ISSN 2250 – 3749]
Publication Date : 05 June 2013

# *A proposal of a novel model for Artificial Intelligence Planning*

*Shailendra Sharma,SouvikSamanta, NaveenVerma*

***Abstract:*** **Artificial Intelligence (AI) is the intelligence of machines and robots and the branch of computer science that aims to create it. And for making these machines intelligent planning is required.AI planning provides good solutions for solving real world problems like planning in NLP, Robotics, Computer-Vision, Cognitive analysis etc. This paper provides an overview of various AI application areas with a major focus on AI Planning, and proposes a model for AI Planning which includes better interface capabilities in conjunction with the available AI Planners.**

***Keywords*: Artificial Intelligence, AI Planning, machine intelligent.**

## I. Introduction

### *A*. Definition

AI planning is to build controlling algorithms, to enable an agent for synthesizing a course of plan and action in achieving its goals.[1]
The two approaches are very much in attention—

- Two phase Graph plan Planning algorithm.
- Compiling planning problems into, propositional formulae using latest stochastic and systematic algorithms (SAT).

Shailendra Sharma
University of Petroleum and Energy Studies, India
S21S@live.com

SouvikSamanta
University of Petroleum and Energy Studies, India
Samanta.souvik@gmail.com

Naveen Verma
University of Petroleum and Energy Studies,India
Naveenverma105@gmail.com

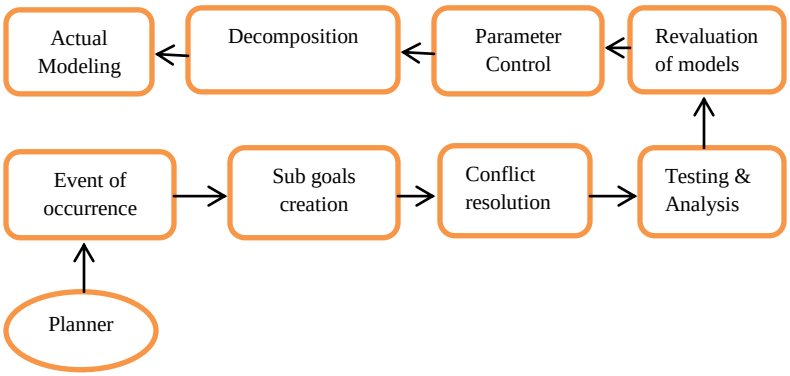



*Figure 1:- Planning Technique*

- Planning technique relies on encoding possible actions in the domain. It consists of three main mechanisms:-
- Goaling
- Decomposition
- Conflict analysis.

**Understanding intelligence in planning:-**
From last two decades artificial intelligence has shown clearly that intelligence requires the interaction of an agent with physical and social environment.
If number of cases are present, it can be demonstrated how artificial intelligence & planning can be used to interact with real world .the interaction has been mediated by physical body, with some definite morphology i.e. sensors etc. [2]

### *B.* Formal definition of "Planning problem"

1. Describing initial state by using formal language.
2. Describing agent's goal by using formal language.
3. Describing possible actions i.e. describing "domain theory".

Plan is a collection of action for performing specific tasks , but it is tedious to generate plans

automatically , therefore the planning and scheduling systems are used Planning is – given what to do (goals) , determine how (and when) to do it (plan).

**Intelligence without representation:-**

The present intelligence representation should be decomposed into independent & parallel activity that can interface through perception.[3].Artificial intelligence evolved as a matrix to make the machine intelligent so that it can replicate human intelligence. today no one believe in replicating full gamut of human intelligence, instead they go for some specialized sub-problem like natural language processing& machine vision etc. everybody think that in near future will have same intelligence like human. We believe that human level intelligence is much complex. By practicing with lots of simple level intelligence, we can decompose human intelligence into a machine.

## II. The AI planning Algorithms and Techniques

- **Planning a problem**

It is important to describe about problem in order to make planning problem accessible and what constitutes a solution. In simple a planning problem comprises of collection of actions, each characterized by preconditions (test-conditions), post-conditions(action ) , an initial state and description of goal to be achieved[4]. The initial state describes the state of domain immediately before any action have been carried out, with the goal state describing the facts which must be true after the plan has been completed. Planning task can be split into 2 closely related subtasks. The first subtask involves finding steps needed to solve each objective of the procedure. Second subtask involves detecting and resolving conflicts between the steps needed to achieve different objectives. This can be carried out by reordering conflicting actions, inserting actions to resolve the conflicts, or by re-planning. [5]In context to AI planning problems is about the decision making performed with the help of robots, humans or computer programs in search of achieving a goal .This whole process involves a concrete sequence of actions which is responsible for state transform , step by step , so as to satisfy goal.[6]We can say that planning is a key ability for intelligent system which helps in increasing their autonomy and flexibility with the concentration of sequence of actions for goals .Representation of actions and world models contributes to planning.[7]AI planning comprises of propositional logic , as well as translating the planning problem to integer programming , mixed integer linear programming , non-monotonic logic programming , constraint satisfaction and so on.[8]

**Relationship among Learning, Planning and Acting**

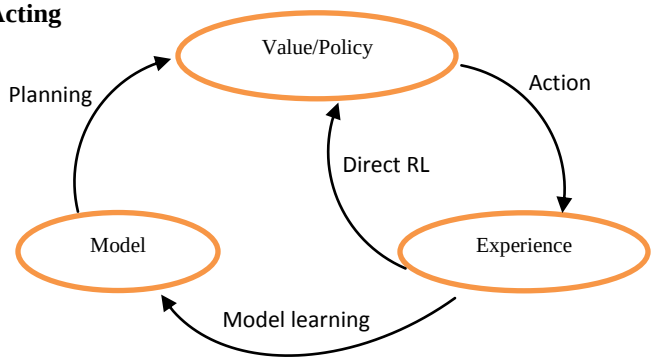



Figure 2:- Relationship among Learning, Planning and Acting.

AI planning techniques do not favor more traditionally used rule based systems , as the former is favorable for automation of supervision of process systems ,as they nourishes with rich planning representations and algorithms. As these techniques are capable as a powerful tool to support human operators to achieve tasks efficiently and effectively with fewer repetitions.[9]Planning systems works in a way so as to generate a plan which is one of the fissile/possible solutions to a specific problem. The plan obtained will be composed of operator schema, for each domain of applications.[10].

**Table I Searching Vs. Planning**

| Attributes | Searching | Planning |
|---|---|---|
| State | Data structure | Logical sentences |
| Action | Code | Precondition/outcome |
| Goal | Code | Logical sentences |
| Plan | Sequence from initial state | Constraints on action |

## III. Planning Models

### A. Classical Planning Model

I. Origins
• Stanford Research Institute Problem Solver
• derived from GPS = human problem solving.
II. States described by propositions currently true.
III. Actions: general state transformations described by sets of pre- and post-condition.
IV. represents a state-transition system (but more compact). [11]

UACEE International Journal of Artificial Intelligence and Neural Networks – IJAINN
Volume 3 : Issue 2 [ISSN 2250 – 3749]
Publication Date : 05 June 2013

## B. Strips algorithm

STRIPS(s, g)
returns: a sequence of actions that transforms s into g.
*1. Calculate the difference set d=g-s.*
1.1 If d is empty, return an empty plan.
2. Choose action a, whose add-list has most formulas contained in g.
3. p'= STRIPS(s, precondition of a)
4. Compute the new state s' by applying p' and a to s.
5. p= STRIPS( s', g)
6. return p'; a ;p[12]

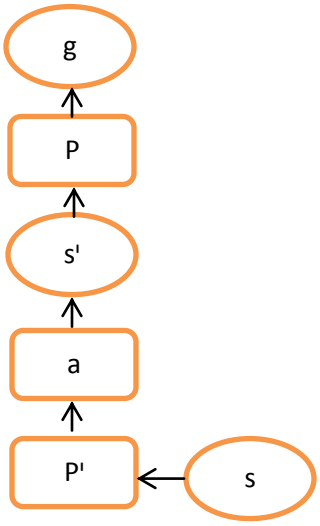
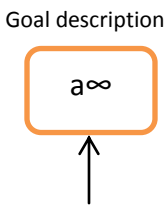



Figure 3:- Flow diagram of strips algorithm

## C.POP (Partial Order Planning)

1. Set of ( Actions/Operators) making up the steps of plan.
2. Set of
2.1 Ordering Constraints.
2.2 Causal Links
**2.2** Open preconditions
3. Consistent Plan
3.1 No Cycling in ordering constraints
3.2No Conflictions with causal links.
4.Solution – Consisting of a plan, having no open precondition.

**Algorithm**
Start with
1 .Null (empty) plan
2. Agenda
2.1list of (precondition, actions) goals
2.2{(g1,g∞),(g2,g∞),(g3,g∞),…}
3. Deal with one (g,a) at a time.



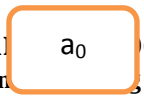




Figure 4:-state diagram of POP

## D. Plan es

**A. Condition g**
1. Planning for obtaining information (Observational actions)
2.
3. plans for many unlikely cases.

**B. Re-planning / Monitoring**
1. Leads to failure, because of unanticipated outcomes.
2. Re-planning of checking progress, during execution if necessary.
3. Assuming normal states, outcomes.

**C. Regression Planning**
The basic idea of Regression Planning is to search backward from the goal description, nodes corresponds to sub goals , and arcs to actions.

1. The *nodes* are *goals*, that must be achieved . A goal is a set of assignments to (some of ) features.
2. The *arcs* correspond to *actions.* In particular, an *arc* from node g to g' , labeled with action *act* ,means *act* is the last action that is carried out before the goal g is achieved , and the node g' is the goal that must be true immediately after before *act* so that g is true immediately after *act.*
3. The start node is the goal to be achieved. Here we assume it is the conjunction of assignments of values to features.
4. The goal condition for the search , *goal(g),* is true for all of the elements of *g* are true of the initial state
5. A plan is a path from the state representing the initial state to a state that satisfies the goal.Therefore, the Regression Planning may serve as the important functionality in "Graph Plan" management in AI Planning. [13]

**D. Graph plan**
Graph plan basically flows in two phases:-
1. Graph Expansion: - It extends "planning graph "in time (forward) until a necessary condition is achieved for plan existence.

2. Solution Extraction: - This phase performs backward-chaining on graph, for selecting a plan that solves the problem. [14]

# IV. Proposed Model

## Expert System as AI planning tool and Heuristics in AI planning

*A.* **Heuristics in STRIPS** [15]

The heuristic Δ(s, g) estimates the minimum cost (number of actions) needed from s to g. The estimation is made by considering only EFF+

- Δ(s, {p}) = 0 if p ∈ s
- Δ(s, {p}) = ∞ if ∀a ∈A: p ∈/ EFF+ (a)
- Δ(s, {p}) = 1 + min a∈A {Δ(s, PRECOND (a) | p ∈ EFF+ (a))}
- Δ(s, g) = maxp∈g{Delta(s, {p})}

This heuristic is admissible.[16]

*B.* **Heuristics for deterministic AI Planning (STRIPS Heuristics)**

1.Problem with STRIPS Heuristics

*1.1 Uninformative:* - The small range of heuristic values in a given task.

*1.2Reformulation:*- Transforms planning task into an equivalent, where h(s) =1, for all non-goal states, by ignoring almost all problem structure.

2. Obtaining a heuristic

2.1Abstraction**:-** Considering the problem, which is the less constrained version of the original one.

2.2Relaxation**:-**Considering problem version, which is smaller than the original one.

2.2.1Route planning for road network:- Using Euclidean Plane (Weighted graph over points of road network).

2.2.2 Manhattan heuristic: - Ex- 15 Puzzle: - Ignoring fact (One user can't move through occupied tiles).

2.2.3 Straight-Line Heuristic: - Route Planning-> Ignoring fact (One must stay on roads).

*C.* **Expert System as AI Planning Tool**

As far as the Expert Systems are concerned, they provide the better facility to infer from the given knowledge-base .In AI Planning Expert Systems may help in a variety of ways, if we are required to infer the most optimal plan specifics from the given planning algorithms and techniques then these techniques and algorithms can provide higher degree of optimal solutions when used with the Expert Systems, hence in this way Expert Systems can be a great tool in the field of AI Planning. [17]

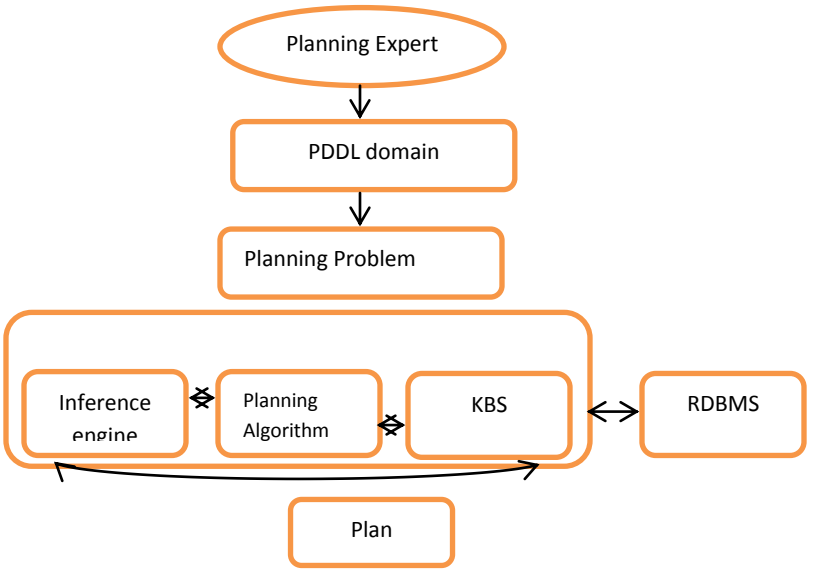



Figure5:- flow diagram of expert system in AI

# V. Applications

- Action choice + resource handling
- For transportation of goods
- At schools, hospitals
- Hubble Space Telescope scheduler
- Interactive decision making
- For military operations
- For astronomic observations
- Plan-based interfaces (plan recognition)

# VI. Conclusion

In spite of half a century of research in Artificial Intelligence, we are still lacking a profound understanding of the mechanism of intelligent behavior[18] of a system in many application domains. By the introduction of a good planning technique, we may improvise the intelligent behavior of a system more effectively. Hence the author provides a novel model for AI planning in the process of devise an intelligent behavior. The preparation of the model carried out by the adaptation of many of human behavioral aspects and examples to teach the machine to enable human behavior more efficiently.

# VII. References

[1]Daniel S. Weld "Recent Advances in AI Planning "Department of Computer Science & Engineering, *University of Washington.*

[2] Rolf Pfeifer and Gabriel Gome"Interacting with the real world – design principles for intelligent systems".
[3] Rodney *A. Brooks "Intelligence without representation*".*
[4] Progress in AI Planning Research and Applications, Derek Long and Maria Fox.
[5] Progress in AI Planning Research and Applications, Derek Long and Maria Fox.
[6] A brief overview of AI planning, JussiRintanen, June 2010
[7] CS541, Artificial Intelligence, Course era
[8]An overview of recent algorithms for AI planning, JussiRintanen and J¨org Hoffmann, Albert-Ludwig's-Universit¨at Freiburg, Institutf¨urInformatikGeorges-K¨ohler-Allee, 79110 Freiburg imBreisgau, Germany
[9] AI planning in Supervising Control Systems, LuizEdival de Souza, Manuela M.Veloso.
[10] AI Magazine Volume, 11 November 2, AI Planning : Systems and Techniques, James Hendler,AustinTate,and Mark Drummond.
[11]Mathijs de Weerdt ,CeesWitteveen "AI Planning "Faculty of Electrical Engineering, Mathematics and Computer Science, Department of Software Technology
CWI, Amsterdam.
[12] F. C. Langbein "Artificial Intelligence- *Knowledge & Reasoning, Planning "*
School of Computer Science and InformaticsCardiff University
[13] Daniel S. Weld "Recent Advances in AI Planning "*Department of Computer Science &Engineering, University of Washington.*
*[14]* James Hendler, Austin Tate, and Mark Drummond "*AI Planning: Systems and Techniques ".*
[15] Alban Grastien "Planning: Planning with state-space search "The Aurstralian National University.
*[16]Automated AI Planning " Relaxation and Relaxation Heuristics"*
[*17]Mathijs de Weerdt ,CeesWitteveen "AI planning "Faculty of Electrical Engineering, Mathematics and Computer Science Department of Software Technology,CWI, Amsterdam.*
*[18]*Rolf Pfeifer and Gabriel Gome"Interacting with the real world – design principles for intelligent systems".