**Chapter 11**

Planning and Learning

**The chapter consist of Short type Questions & Answers , Descriptive Question & Answer and MCQs & answers**

Contents

[Short type Questions & Answers 2](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943791)

[The STRIPS representation for an action consists of what? 2](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943792)

[What is the STRIPS assumption? 3](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943793)

[What is the frame problem in planning? How does it relate to the STRIPS assumption? 3](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943794)

[What are some key limitations of STRIPS? 3](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943795)

[Define passive learning. 3](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943796)

[When will a learning problem is said to be realizable or unrealizable? 3](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943797)

[What are the types of Machine learning? 3](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943798)

[What is reinforcement? 4](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943799)

[What is learning? 4](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943800)

[What do you mean by Bayesian learning? 4](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943801)

[What is communication? 4](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943802)

[Define language. 5](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943803)

[Why would an agent bother to perform a speech act when it could be doing a “regular” action? 5](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943804)

[Differentiate formal language Vs natural language. 5](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943805)

[Define Grammar. 6](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943806)

[What are the component steps of communication? 6](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943807)

[Define Lexicon. 6](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943808)

[What are called open classes and closed classes? 7](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943809)

[Define grammar overgenerates, undergenerates. 7](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943810)

[Define parsing (or) Syntactic parsing. 7](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943811)

[Define Semantic Interpretation. 8](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943812)

[What are the properties of Intermediate form? 8](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943813)

[Define metaphor. 8](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943814)

[What are the models of knowledge? 8](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943815)

[Define discourse. 9](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943816)

[Define Reference resolution. 9](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943817)

[Mention the list of coherence relations. 9](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943818)

[What is grammar induction? 9](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943819)

[What is information retrieval? 9](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943820)

[What is information extraction? 10](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943821)

[What is context-sensitive grammar? 10](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943822)

[Define Language Modeling. 10](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943823)

[What is a regular expression? 11](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943824)

[What is cascaded finite-state transducer? 11](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943825)

[QThe first choice in designing a learning algorithm is the choice of hypothesis space. What are the advantages and disadvantages of a large hypothesis space versus a small one? 11](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943826)

[Descriptive Question & Answer 12](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943827)

[Q E xplain planning with state space search. 12](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943828)

[Q Explain Panning with example 13](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943829)

[What are basic components of planning system 14](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943830)

[How do you assess the performance of the learning algorithm? 17](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943831)

[Consider a scenario where you want to get from home (off campus) to UBC during a bus strike. You can either drive (if you have a car) or bike (if you have a bike). How would you represent this in STRIPS? (a) What are the actions, preconditions and effects? What are the relevant variables? (b) If we select the action goByBike, what is the value of haveBike after the action has been carried out. (c) If we are at UBC and and select the action goByCar, what will the value of loc be after the action has been carried out? 18](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943832)

[Write a short note on Various Planning Techniques 18](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943833)

[Describe how learning can be done from observation 20](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943834)

[Give a short description of inductive learning 26](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943835)

[MCQs & answers 28](file:///C:\0.%20RNDas_WORKING%20FOLDER\D%20Drive%20Data%20from%20Desktop%20PC\0.%20RNDas_WILEY\Intelligent%20System\AI_RESOURCES\AI_Students'%20Resources\AI_App%20B_Testing\Chapter_11.docx#_Toc14943836)

# Short type Questions & Answers

## The STRIPS representation for an action consists of what?

Answer: Preconditions - a set of assignments of values to variables that must be true for the action to occur. Effects - a set of resulting assignments of values to those variables that change as the result of the action.

## What is the STRIPS assumption?

Answer: All of the variables not mentioned in the describtion of an action stay unchanged when the action is carried out.

## What is the frame problem in planning? How does it relate to the STRIPS assumption?

Answer: The frame problem is the problem of representing all things that stay unchanged. This is important because most actions affect only a small fraction of variables, e.g. filling a cup with coffee changes the state of the cup and of the pot but not the location of the robot, the layout of the building, etc. The STRIPS assumption just says that all variables not mentioned in the description of an action remain unchanged. •

## What are some key limitations of STRIPS?

Answer: States are represented simply as a conjuction of positive literals, e.g. poor ∧ unknown, goals are conjunctions (no disjunction allowed), no support for equality.

## Define passive learning.

The agent’s policy is fixed and the task is to learn the utilities of states, this could also involve learning a model of the environment.

## When will a learning problem is said to be realizable or unrealizable?

A hypothesis space consisting of polynomials of finite degree represent sinusoidal functions accurately, so a leaner using that hypothesis space will not be able to learn from sinusoidal data.

A Learning process is realizable if the hypothesis space contains the true function, otherwise it is unrealizable

## What are the types of Machine learning?

a)                                         Supervised

b)                                        Unsupervised

c)                                         Reinforcement

## What is reinforcement?

The problem is this without some feedback about what is good and what is bad, the agent will have no grounds for deciding which move to make. The agent needs to when it loses. This kind of feedback is called a reward, or reinforcement.

## What is learning?

Learning takes many forms, depending on the nature of the performance element, the component to be improved, and the available feedback.

## What do you mean by Bayesian learning?

Bayesian learning methods formulate learning as a form of probabilistic inference, using the observation to update a prior distribution over hypotheses. This approach provides a good way to implement Ockham’s razor, but quickly becomes intractable for complex hypothesis spaces.

## What is communication?

Communication is the intentional exchange of information brought about by the production and perception of signs drawn from a shared system of conventional signs. Most animals use signs to represent important messages.

## Define language.

Language enables us to communicate most of what we know about the world.

## Why would an agent bother to perform a speech act when it could be doing a “regular” action?

A group of agents exploring together gains an advantage by being able to do the following.

                                                              Query

                                                              Inform

                                                              Request

                                                              Acknowledge

                                                              Promise

## Differentiate formal language Vs natural language.

**Formal language:**

A formal language is defined as a set of strings. Each string is a concatenation of terminal symbols called words.

For example, a language in the first order logic, the terminal symbols include ^ and

P, and a typical string is “P ^ Q”. The String is not a member of the language.

Formal languages always have grammar.

**Natural language:**

Formal language is in contrast to natural Languages, such as Chinese, English, that have no strict definition but are used by a community of speakers.

Natural languages have no grammar.

## Define Grammar.

A grammar is a finite set of rules that specifies a language. Formal languages always have grammar. Natural languages have no grammar.

## What are the component steps of communication?

                                                              Intention

                                                              Generation

                                                              Synthesis

                                                              Perception

                                                              Analysis

                                                              Disambiguation

                                                              Incorporation

## Define Lexicon.

The list of allowable words called lexicon. The words are grouped into the categories or parts of speech familiar to dictionary users. Nouns, pronouns and names to denote things, verbs to denote events, adjective to modify nouns and adverbs to modify verbs.

## What are called open classes and closed classes?

Nouns, Verbs, Adjectives and Adverbs are called open classes.

Pronoun, Article, Preposition and Conjunction are called closed classes.

## 

## 

## Define grammar overgenerates, undergenerates.

The grammar overgenerates is that generates sentences that are not grammatical.

**Ex: I smell pit fold wumpus nothing east.**

The grammar undergenerates is that generates sentence with grammar.

**Ex: “I think the wumpus is smelly”**

## Define parsing (or) Syntactic parsing.

Parsing is the process of finding a parse tree for a given input string.

That is, a call to the parsing function PARSE, such as

PARSE(“the wumpus is dead”, ε0, S)

Should return a parse tree with root S whose leaves are the “the wumpus is dead” and whose internal nodes are nonterminal symbols from the grammar ε0.

## Define Semantic Interpretation.

The extraction of the meaning of utterance is called Semantics. Semantic interpretation is the process of associating a First Order Logic expression with a phrase.

## What are the properties of Intermediate form?

The Intermediate form is to mediate between syntax and semantics. It has two key properties.

                                                              First, it is structurally similar to the syntax of the sentence and thus can that it can be easily constructed through compositional means.

                                                              Second, it contains enough information that it can be translated into a regular first order logical sentence.

## Define metaphor.

A Metaphor is a figure of speech in which a phrase with one literal meaning is used to suggest a different meaning by way of an analogy.

## 

## What are the models of knowledge?

                                                              World model

                                                              Mental model

                                                              Language model

                                                              Acoustic model

## Define discourse.

A discourse is any string of language usually that is more than one sentence

long.

## Define Reference resolution.

Reference resolution is the interpretation of a pronoun or a definite noun phrase that refers to an object in the world.

## Mention the list of coherence relations.

                                                              Enable or cause

                                                              Explanation

                                                              Ground-figure

                                                              Evaluation

                                                              Exemplification

                                                              Generalization

                                                              Violated Expectation

## What is grammar induction?

Grammar induction is the task of learning a grammar from data.

## What is information retrieval?

Information retrieval is the task of finding documents that are relevant to a user’s need for information. The best known example of information retrieval systems are

search engines on the World Wide Web.

An information retrieval can be characterized by:

1.                                                                       A document collection

2.                                                                       A query posed in a query language

3.                                                                       A result set

4.                                                                       A representation of the result set.

## What is information extraction?

Information extraction is the process of creating database entries by skimming a text and looking for occurrences of a particular class of object or event and for relationships among those objects and events.

## What is context-sensitive grammar?

Context-sensitive grammars are restricted only in that the right-hand side must contain at least as many symbols as the left-hand side. The name “context sensitive”

comes from the fact that a rule such as A S B  A \* b says that an S can be rewritten as an X in the context of a preceding A and following.

## Define Language Modeling.

Language modeling approach is one which estimates a language model for

each document and then, for each query, computes the probability of the query, given the document’s language model.

## What is a regular expression?

A regular expression defines a regular grammar in a single text string. These are used in UNIX commands such as grep, in programming languages such as Perl, and in word processors such Microsoft word.

## 

## What is cascaded finite-state transducer?

Cascaded finite-state transducer consist of a series of finite-state automata, where automation receives text as input, transducers the text into a different format, and passes it along to the next automation.

## QThe first choice in designing a learning algorithm is the choice of hypothesis space. What are the advantages and disadvantages of a large hypothesis space versus a small one?

**Answer:**The advantage of a large hypothesis set is that it is more likely to contain the true theory of the classification, or something close to the true theory. The disadvantages of a large hypothesis set are, first, that it is harder to search; second, that it is more susceptible to overfitting.

# Descriptive Question & Answer

## Q E xplain planning with state space search.

The agent first generates a goal to achieve and then constructs aplan to achieve it from the Current state

problemsolving to planning

Representation Using Problem Solving Approach

                    Forward search

                    Backward search

                    Heuristic search

Representation Using Planning Approach

              STRIPS-standard research institute problem solver.

              Representation for states and goals

                    Representation for plans

              Situation space and plan space

                    Solutions

Why Planning ?

Intelligent agents must operate in the world. They are not simply passive reasoners (Knowledge Representation, reasoning under uncertainty) or problem solvers (Search), they must also acton the world.

We want intelligent agents to act in “intelligent ways”. Taking purposeful actions, predicting the expected effect of such actions, composing actions together to achieve complex goals.

E.g. if we have a robot we want robot to decide what to do; how to act to achieve our goals

Planning Problem

How to change the world to suit our needs

Critical issue: we need to reason about what the world will be like after doing a few actions, not just what it is like now

GOAL: Craig has coffee

CURRENTLY: robot in mailroom, has no coffee, coffee not made, Craig in office etc.

## Q Explain Panning with example

The process of doing a sequence of actions to achieve a goal is called planning. A plan is a representation of the crude structure of the input scene by the various object labels. The process of planning is a bottom up process to provide clues concerning which knowledge can be applied to different parts of the scene. The knowledge of the task world is represented by sets of productions rules. Each rule in the bottom up process has a fuzzy predicate which describes the properties of relations between objects. Generally there are various agents who act to plan. The environments for an agent may be deterministic, finite, static in which change happens only when the agent acts. The discrete environment includes the time factor, objects, effects etc. These environments are called classical planning environments. On the other hand, the non classical planning environments are partially observable and involves a different set of algorithms and agent designs. Planning refers to the process of computing several steps of a problem solving procedure before evaluation of that problem.

Computer cannot solve any problem without planning it. For example, in 8-puzzle game, the computer can’t replace the tiles onto their positions without the planning procedure of that problem. When we discuss the computer solution of the 8-puzzle game, what we are really doing was outlining the way the computer might generate a plan for solving it. A computer could look for a solution plan in the same way as a person who was actually trying to solve the problem by moving tiles on a board. If solution steps in the real world cannot be ignored or undone, though planning becomes extremely important. Although real world steps may be irrevocable, computer simulation of those steps is not. So we can circumvent the constraints of the real world by looking for a complete solution in a simulated world in which backtracking is allowed. After we find a solution, we can execute it in the real world. The fact that we can leave out properties of world states that are irrelevant to the problem at hand or that are not known is one of the powerful aspects of using a feature based approach. This aspect is particularly important is describing the goal condition that we want the agent to achieve by its actions.

## What are basic components of planning system

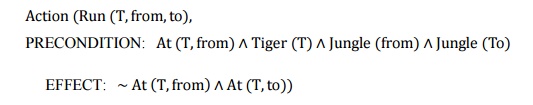
**Basic Components of a Planning System**

When a particular problem will be solved, at that time some specific rules regarding to that problem are to be applied. Then apply the choosen rule to compute the new problem state that arises from its application. Detect when a solution has been found and calculate the active and inactive ends of that problem. Various components of a planning system are described as follows.

(a) **States:**For a planning process, the planners decompose the world into some environments. Thenenvironments are defined by some logical conditions and states. The problems can be viewed as the task of finding a path from a given starting state to some desirable goal state. The state can be viewed as a conjunction of positive literals. For example, Rich A famous might represent the state of a best agent.

(b)**Goal:**A goal is a specified state. To find a solution to a problem using a search procedure is togenerate moves through the problem space until a goal state is reached. In the context of game playing programs, a goal state is one in which we win. Unfortunately, for interesting games like chess, it is not usually, possible, even with a good plausible move generator, to search until a goal state is found.

(c) **Actions:**An action is specified en terms of the pre-conditions that must hold before it can be executed and then the effects that ensue when it is executed. For example, an action for running a **Action**tigerfrom**Run**one**T,**locationfrom,to**,**another is



(d)**Precondition:**The precondition is a conjunction of function free positive literals stating whatmust be true in a state before the action can be executed.

(e) **Effect:**It is a conjunction of function free literals describing how the state changes when theaction is executed.

(f)  **Finding a solution:**A planning system has succeeded in finding a solution to a problem when ithas found a sequence of operators that transforms the initial problem state into the goal state. The way it can be solved depends on the way that state descriptions are represented.

(g) **Calculating the Dead State:**As a planning system is searching for a sequence of operators tosolve a particular problem, it must be able to detect when it is exploring a path that can never lead to a solution. The same reasoning methods that can be used to detect a solution can often be used for detecting a dead path. If the search process is reasoning in forward direction from the initial state, it can prune any path that leads to a state from which the goal state cannot be reached. If the search process is reasoning backward from the goal state, it can also terminate a path either because it is sure that the starting state cannot be reached.

## How do you assess the performance of the learning algorithm?

A learning algorithm is good if it produces hypotheses that do a good job of predication the classifications of unseen examples. We do this on a set of examples known as the test set. It is more convenient to adopt the following methodology:

a)          Collect a large set of examples.

b)                            Divide it into two disjoint sets: the training set and the test set.

c)                             Apply the learning algorithm to the training set, generating a hypothesis h.

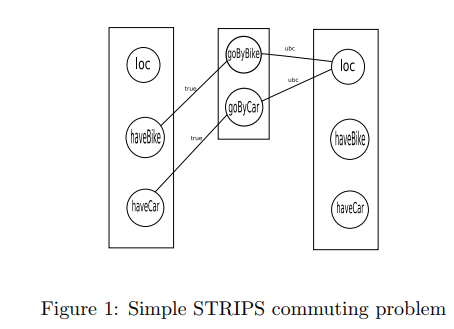
d)                            Measures the percentage of examples in the test set that are correctly classified by h.

e)                             Repeat steps 1 to 4 for different sizes of training sets and different randomly selected training sets of each size.

## Consider a scenario where you want to get from home (off campus) to UBC during a bus strike. You can either drive (if you have a car) or bike (if you have a bike). How would you represent this in STRIPS? (a) What are the actions, preconditions and effects? What are the relevant variables? (b) If we select the action goByBike, what is the value of haveBike after the action has been carried out. (c) If we are at UBC and and select the action goByCar, what will the value of loc be after the action has been carried out?

(a) Answer: The actions could be something like goByBike and goByCar. In a very simple representation, there are variables loc, haveBike, and haveCar, indicating location, whether or not you have a bike (t/f), and whether or not you have a car (t/f). The precondition for goByBike is that haveBike = true, and likewise the precondition for goByCar is that haveCar = true. The effect of each action is that loc = UBC.Figure ?? shows this representation.

(b) Answer: It will equal true, as it had to be true for the action to take place, and since it is not mentioned in the action effects its value will be unchanged.



(c) Answer: After the action loc = UBC as this is a specified effect. Notice that there is no loc precondition for action, so if you begin at UBC or at home and select either action, you will wind up at UBC.

## Write a short note on Various Planning Techniques

Several planning techniques are described below.

(1) **Hierarchical Planning:**In hierarchical planning, at each level of hierarchy the objectivefunctions are reduced to a small number of activities at the next lower level. So the computational cost of finding the correct way to arrange these activities for the current problem is small. Hierarchical methods can result in linear time. The initial plan of hierarchical planning describes the complete problem which is a very high level description. The plans are refined by applying action decompositions. Each action decomposition reduces a high level description to some of the individual lower level descriptions. The action decomposers describe how to implement the actions.

(2) **Conditional Planning:**It deals with the planning by some appropriate conditions. The agentsplan first and then execute the plan that was produced. The agents find out which part of the plan to execute by including sensing actions in the plan to test for the appropriate conditions.

(3) **Exact Planning:**It is also called as conformation planning. It ensures that the plan achieves thegoal in all possible circumstances regardless of the true initial state and the actual actions outcome. This planning is based on the idea that the world can be forced into a given state even when the agent has only partial information about the current state.

(4) **Replanning:**It occurs when there is any wrong information regarding with the planning. Theagent can plan the same plan as the conditional planner or some new steps.

(5) **Continuous Planning:**In this planning, the planner at first achieves the goal and then only canstop. A continuous planner is designed to persist over a lifetime. It can handle any unfavorable circumstances in the environment.

(6) **Multiagent Planning:**In multiagent planning some other new agents may involved with oursingle agent in the environment. This may lead to a poor performance because dealing with other agents is not the same as dealing with the nature. It is necessary when there are other agents in the environment with which to cooperate, compete or coordinate.

(7) **Multibody Planning:**This planning constructs joint plans, using an efficient decomposition ofjoint action descriptions, but must be augmented with some form of co-ordination of two cooperative agents are to agree on which joint plan to execute.

## Describe how learning can be done from observation

Learning denotes changes in the system that are adaptive in the sense that they enable the system to do the same task or tasks drawn from the same population more effectively the next time (Simon, 1983).

Learning is making useful changes in our minds (Minsky, 1985).

Learning is constructing or modifying representations of what is being experienced

(Michalski, 1986).

A computer program learns if it improves its performance at some task through experience

(Mitchell, 1997).

So what is learning?

(1)         acquire and organize knowledge (by building, modifying and organizing internal representations of some external reality);

(2)         discover new knowledge and theories (by creating hypotheses that explain some data or phenomena);

(3)         acquire skills (by gradually improving their motor or cognitive skills through repeated practice,

sometimes involving little or no conscious thought).

(4)         Learning results in changes in the agent (or mind) that improve its competence and/or efficiency.

(5)           Learning is essential for unknown environments, (1)  i.e., when designer lacks omniscience

o                 Learning is useful as a system construction method,

o                 Expose the agent to reality rather than trying to write it down

o                 Learning modifies the agent's decision mechanisms to improve performance

**1 FORMS OF LEARNING:**

Learning agents:

• Four Components

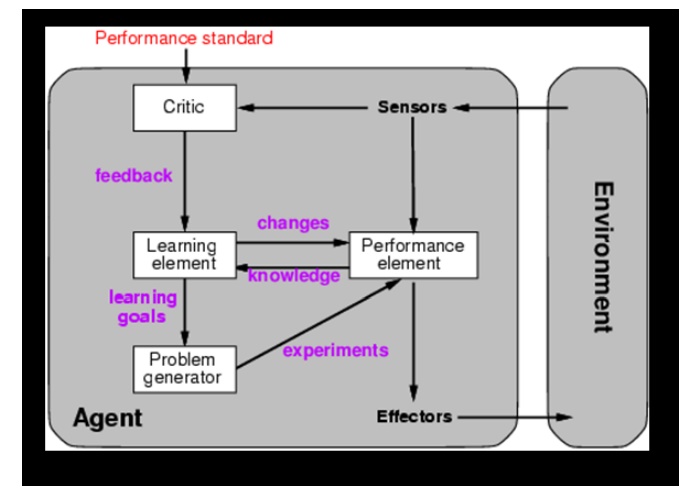
1.          Performance Element: collection of knowledge and procedures to decide on the next action

E.g. walking, turning, drawing, etc.

2.         Learning Element: takes in feedback from the critic and modifies the performance element accordingly.

3.  Critic: provides the learning element with information on how well the agent is doing based on a fixed performance standard. E.g. the audience

Problem Generator: provides the performance element with suggestions on new actions to take. Components of the Performance Element



•                   A direct mapping from conditions on the current state to actions

•                     Information about the way the world evolves

•                     Information about the results of possible actions the agent can take

•                     Utility information indicating the desirability of world states

**Learning element**

•                     Design of a learning element is affected by

–Which components of the performance element are to be learned

–What feedback is available to learn these components

–What representation is used for the components

Type of feedback:

–Supervised learning: correct answers for each example

–Unsupervised learning: correct answers not given

–Reinforcement learning: occasional rewards

## Give a short description of inductive learning

Inductive Learning in supervised learning we have a set of {xi, f (xi)} for 1≤i≤n, and our aim is to determine 'f' by some adaptive algorithm. It is a machine learning approach in which rules are inferred from facts or data. In logic, reasoning from the specific to the general Conditional or antecedent reasoning. Theoretical results in machine learning mainly deal with a type of inductive learning called supervised learning. In supervised learning, an algorithm is given samples that are labeled in some useful way. In case of inductive learning algorithms, like artificial neural networks, the real robot may learn only from previously gathered data. Another option is to let the bot learn everything around him by inducing facts from the environment. This is known as inductive learning. Finally, you could get the bot to evolve, and optimise his performance over several generations.

f(x) is the target function

An example is a pair [x, f(x)]

Learning task: find a hypothesis h such that h(x)

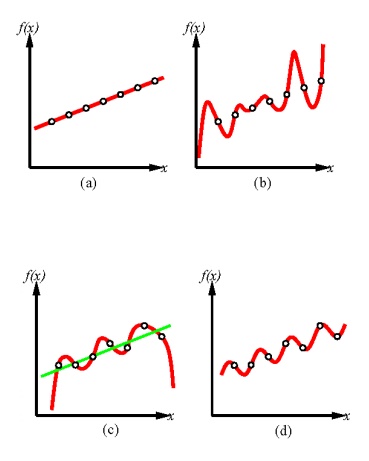
F(x) gives a training set of examples D = {[xi,

f(xi) ]}, i = 1,2,…,N Construct h so that it agrees with f.

The hypothesis h is consistent if it agrees with f on all observations.

Ockham’s razor: Select the simplest consistent hypothesis.

How achieve good generalization?



**Simplest:**Construct a decision tree with one leaf for every example = memory based learning.Not very good generalization.

**Advanced:**Split on each variable so that the purity of each split increases (i.e. either only yes oronly no)

# MCQs & answers

**1.** The process by which the brain orders actions needed to complete a specific task is referred as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(a) Planning problem

(b) Partial order planning

(c) Total order planning

(d) Both planning problem and partial order planning

**2.** The famous spare tire problem or scheduling classes for bunch of students or air cargo transport are the best example of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(a) Planning problem

(b) Partial order planning problem

(c) Total order planning

(d) None of the above

**3.** To eliminate the inaccuracy problem in planning problem or partial order planning problem we can use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ data structure/s.

(a) Stacks

(b) Queue

(c) BST

(d) Planning graphs

**4.** Planning graphs consists of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(a) A sequence of levels

(b) A sequence of levels which corresponds to time steps in the plan

(c) A sequence of actions which corresponds to the state of the system

(d) None of the above

**5.** The process by which the brain incrementally orders actions needed to complete a specific task is referred as\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(a) Planning problem

(b) Partial order planning

(c) Total order planning

(d) Both planning problem and partial order planning

**Answers**

**1. (d) 2. (a) 3. (d) 4. (b) 5. (b)**