Lecture 2

Note: Some slides and/or pictures are adapted from Lecture slides / Books of

- Dr Zafar Alvi.
- Text Book - *Aritificial Intelligence Illuminated* by Ben Coppin, Narosa Publishers.
- Ref Books
  - *Artificial Intelligence- Structures & Strategies for Complex Problem Solving by* George F. Luger, 4th edition, Pearson Education.
  - *Artificial Intelligence A Modern Approach* by Stuart Russell & Peter Norvig.
  - Artificial Intelligence, Third Edition by Patrick Henry Winston

Outline

- Knowledge Representation
- Problem solving
- Problem solving steps

Knowledge Representation

- The representation that is used to represent a problem is very important.
- The way in which the computer represents a problem, the variables it uses, and the operators it applies to those variables can make the difference between an efficient algorithm and an algorithm that doesn’t work at all.

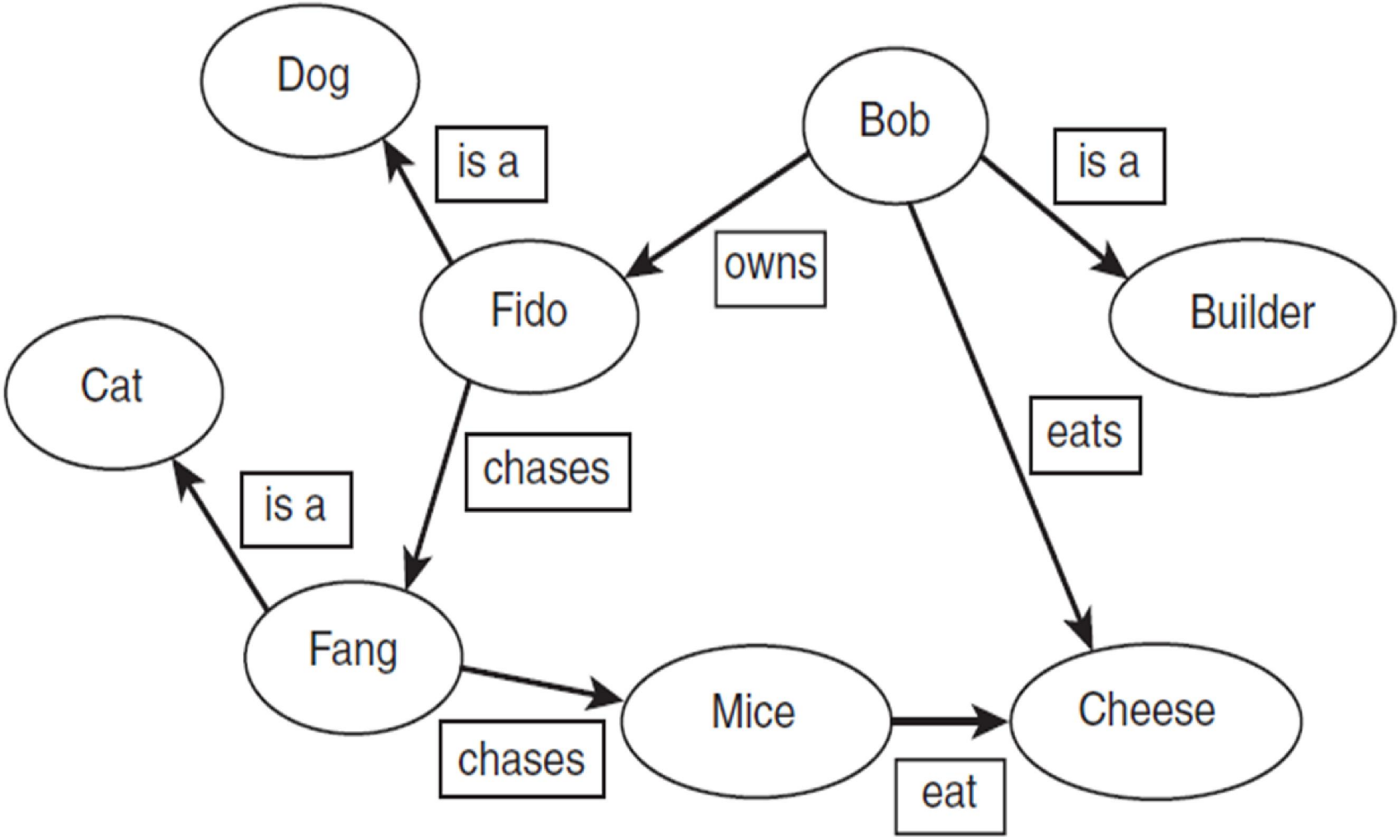
Knowledge Representation

- There are many ways to represent knowledge
  - Semantic Nets
  - Inheritance
  - Frames

Semantic Nets

- A semantic net is a **graph** consisting of **nodes** that are connected by **edges**.
- The nodes represent objects, and the links between nodes represent relationships between those objects.
- The links are usually labeled to indicate the nature of the relationship.

Semantic Nets



Semantic Trees

- A semantic tree is a kind of semantic net that has the following properties:
  - Each node (except for the root node) has exactly one predecessor (parent) and one or more successors (children).
  - When searching a semantic tree, we start at the root node.
  - Some nodes have no successors. These nodes are called leaf nodes. One or more leaf nodes are called goal nodes. These are the nodes that represent a state where the search has succeeded.
  - An ancestor of a node is a node further up the tree in some path. A descendent comes after a node in a path in the tree.

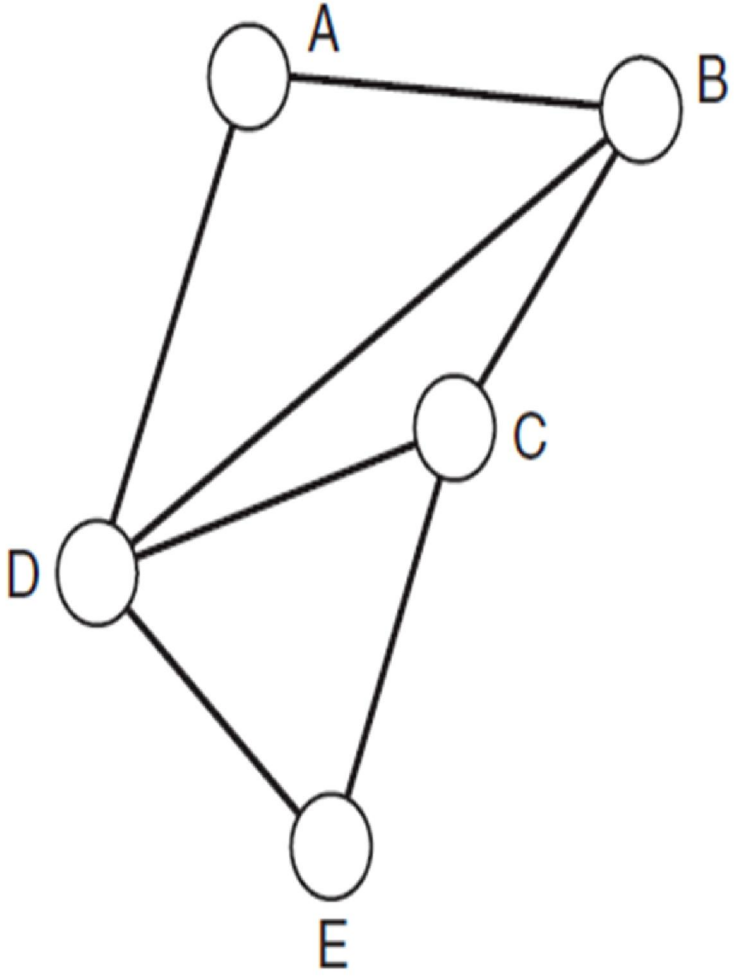
Semantic Trees

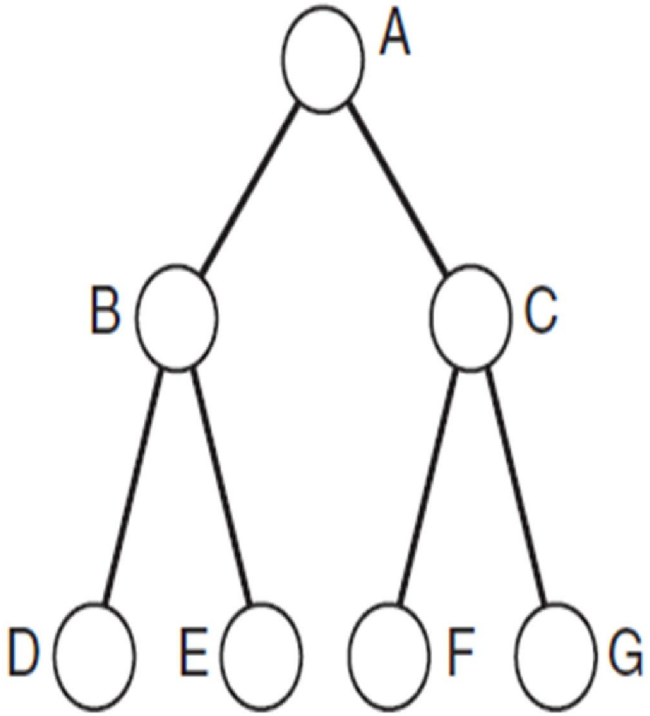
- A **path is a route through the semantic tree, which may consist of just one** node (a path of length 0).A path of length 1 consists of a node, a branch that leads from that node, and the successor node to which that branch leads.
- A path that leads from the root node to a goal node is called a **complete path.**
- **A path that leads from the root node to a leaf node that is not a** goal node is called a **partial path.**

Semantic Trees

- When comparing semantic nets and semantic trees visually, one of the most obvious differences is that semantic nets can contain cycles, but semantic trees cannot.
- A **cycle is a path through the net that visits the same** node more than once.
- In semantic trees, an edge that connects two nodes is called a **branch.**
- **If a** node has *n successors, that node is said to have a* ***branching factor of n.***
- A tree is often said to have a branching factor of *n if the average branching* factor of all the nodes in the tree is *n.*
- The root node of a tree is said to be at level 0, and the successors of the root node are at level 1. Successors of nodes at level *n are at level n + 1.*

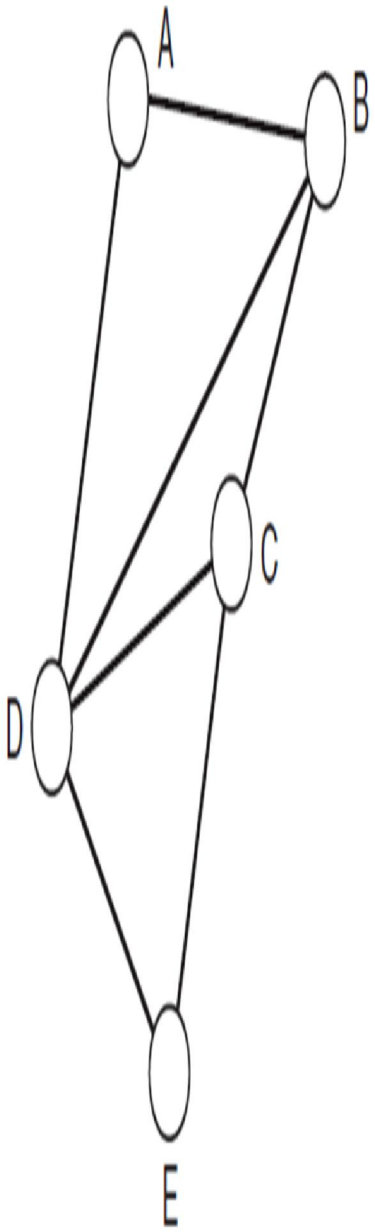
Semantic Net vs Semantic Tree

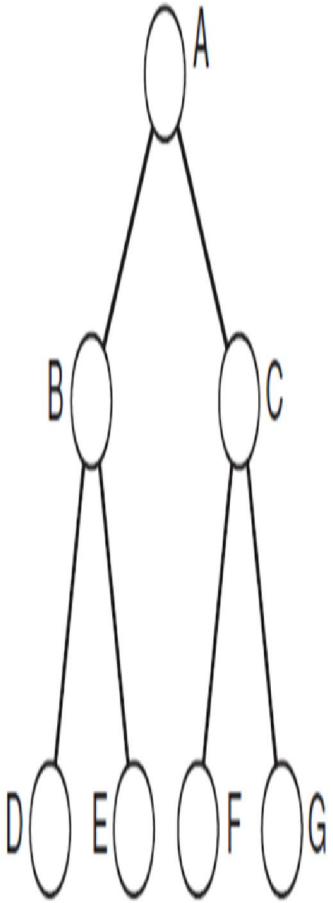




Search Tree

- Searching a semantic net involves traversing the net systematically (or in some cases, not so systematically), examining nodes, looking for a goal node.
- Clearly following a cyclic path through the net is pointless because following A,B,C,D,A will not lead to any solution that could not be reached just by starting from A.
- We can represent the possible paths through a semantic net as a search tree, which is a type of semantic tree.


A
B
C
D
E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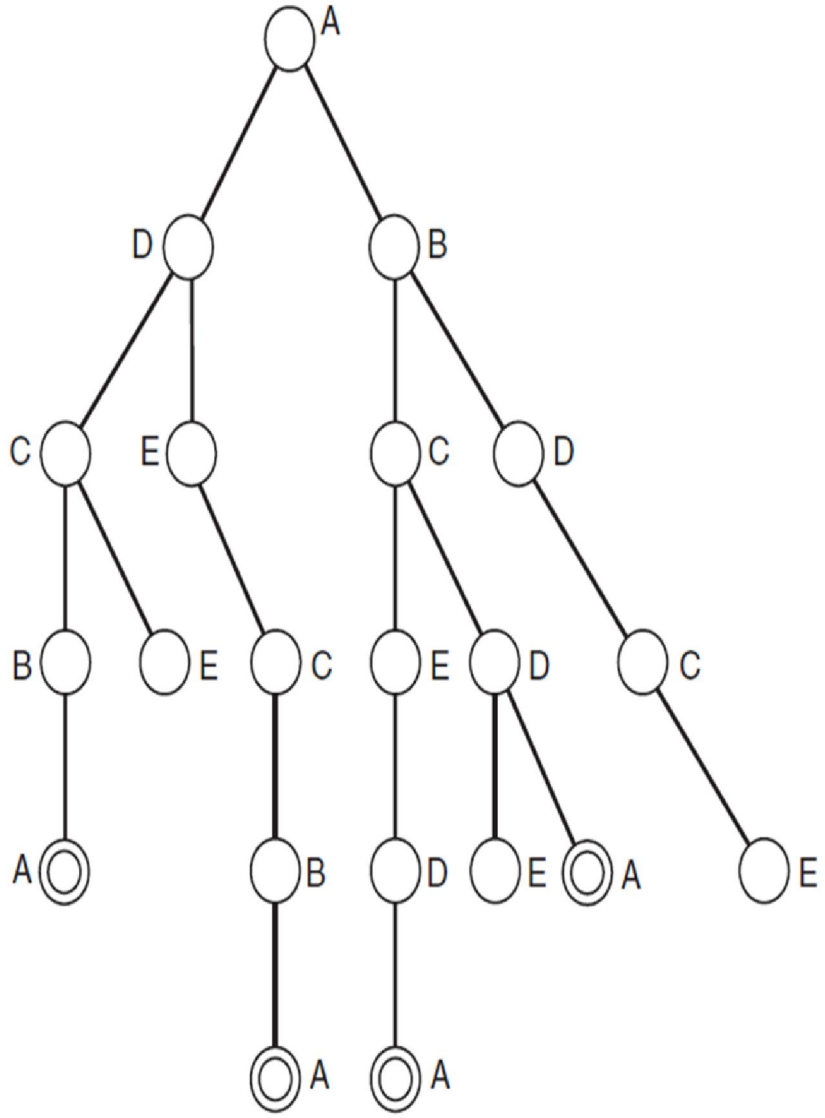
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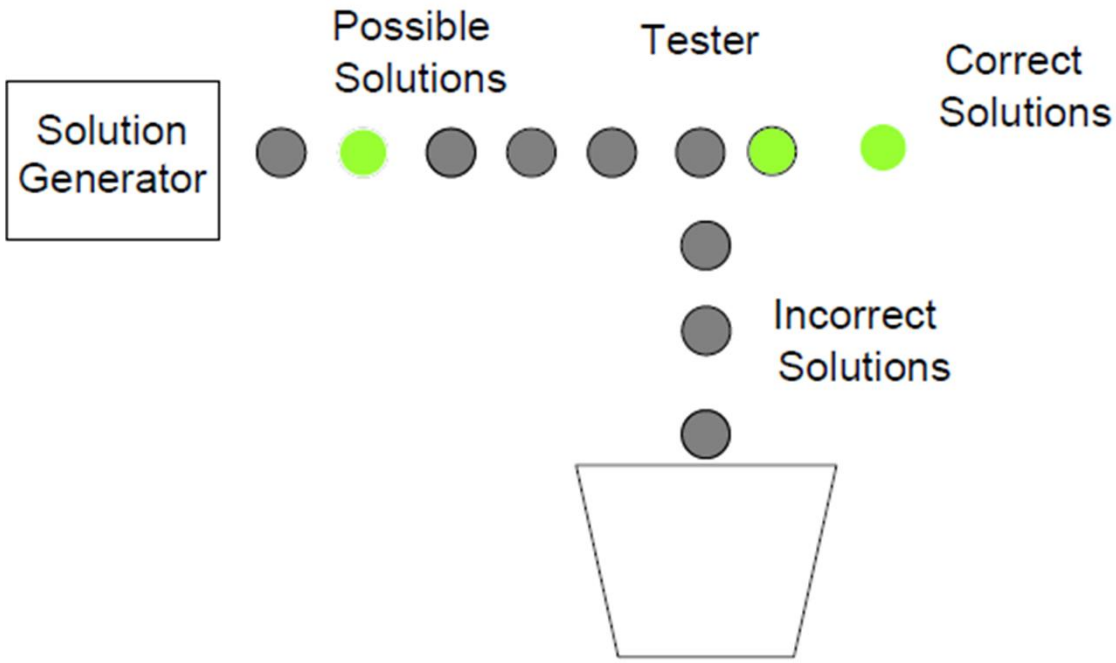
Problem Solving

- Historically people viewed the phenomena of intelligence as strongly related to problem solving.
- They used to think that the person who is able to solve more and more problems is more intelligent than others.

Ways of solving a problem

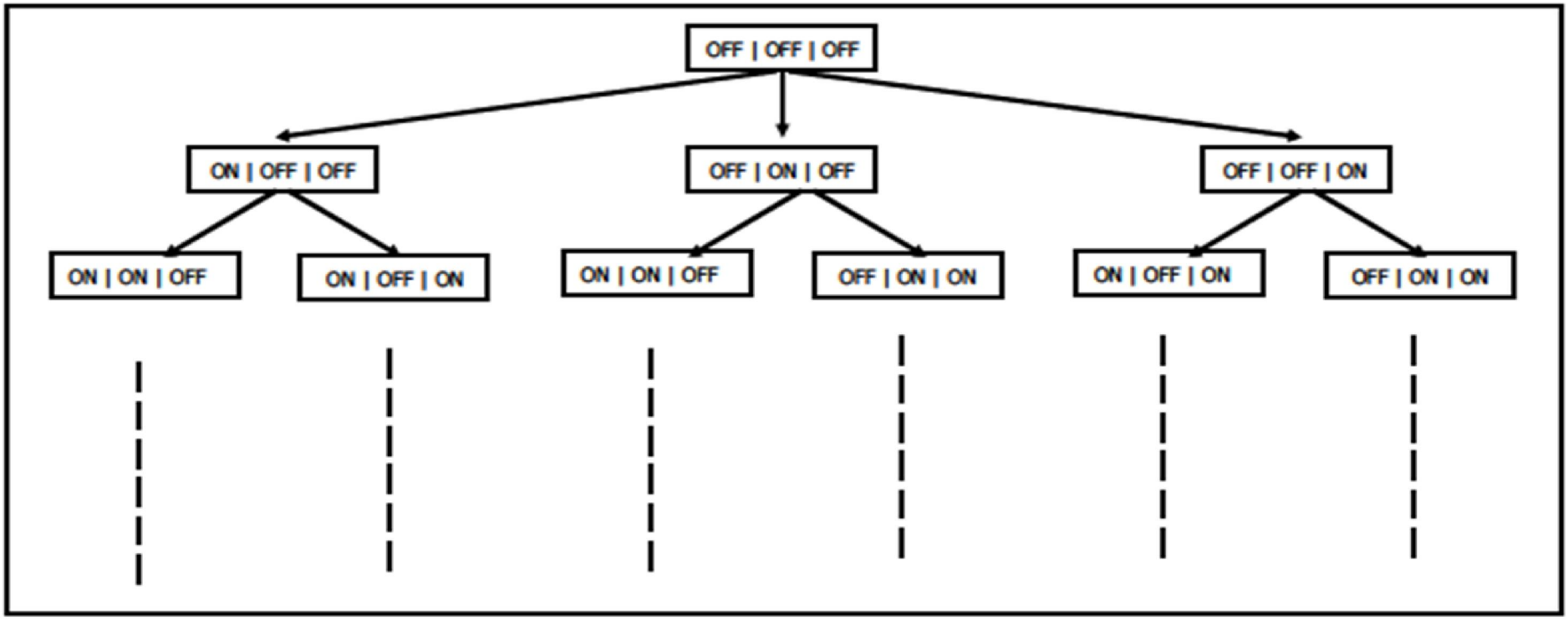
- Hit and trail method (classical approach)
  - Mouse example
  - Consider that a child is to switch on the light in a dark room
- Technical name given (generate and test)
  - where we generate different combinations to solve our problem, and the one which solves the problem is taken as the correct solution.
  - The rest of the combinations that we try are considered as incorrect solutions and hence are destroyed.

Generate and test



Problem Representation

- The key to problem solving is actually good representation of a problem.
- Natural representation of problems is usually done using graphics and diagrams to develop a clear picture of the problem in your mind.



- It shows the problem of switching on the light by a child in a graphical form.
- Each rectangle represents the state of the switch board.
- Goal can be found at different levels

Components of Problem Solving

- **Problem Statement** (The two major things that we get to know about the problem is the Information about what is to be done and constraints to which our solution should comply)
- **Problem Solution** (Ultimate aim or Goal State or the state that represents the solution of the problem)

Components of Problem Solving

- **Solution space** (The set of the start state, the goal state and all the intermediate states)
- **Travelling in solution space** (travel inside solution space in order to find a solution to our problem. The traveling inside a solution space requires something called “operators”. The action that takes us from one state to the other is referred to as an **operator.** In case of the mouse example, turn left, turn right, go straight are operators