Partial order planning

- A **partial-order plan** or **partial plan** is a plan which specifies all actions that need to be taken, but only specifies the order between actions when necessary. It is the result of a partial-order planner. A partial-order plan consists of four components:
- A set of **actions** (also known as **operators**).
- A **partial order** for the actions. It specifies the conditions about the order of some actions.
- A set of **causal links**. It specifies which actions meet which preconditions of other actions. Alternatively, a set of **bindings** between the variables in actions.
- A set of **open preconditions**. It specifies which preconditions are not fulfilled by any action in the partial-order plan.
- In order to keep the possible orders of the actions as open as possible, the set of order conditions and causal links must be as small as possible.
- A plan is a solution if the set of open preconditions is empty.

Cont…

Example

- For example, a plan for baking a cake might start:
- go to the store
- get eggs; get flour; get milk
- pay for all goods
- go to the kitchen
- This is a partial plan because the order for finding eggs, flour and milk is not specified, the agent can wander around the store reactively accumulating all the items on its shopping list until the list is complete.

Cont...

Disadvantages to partial-order planning

- One drawback of this type of planning system is that it requires a lot more computational power for each node.
- This higher per-node cost occurs because the algorithm for partial-order planning is more complex than others.
- When coding a robot to do a certain task, the creator needs to take into account how much energy is needed.
- Though a partial-order plan may be quicker it may not be worth the energy cost for the robot.
- The creator must be aware of and weigh these two options to build an efficient robot.

Cont...

Total Order planning (TOP)

- FSSS and BSSS are examples of TOP.
- They only explore linear sequences of actions from start to goal state, They cannot take advantage of problem decomposition,
- i.e. splitting the problem into smaller sub-problems and solving them individually.

Partial Order Planning (POP)

- It works on problem decomposition.
- It will divide the problem into parts and achieve these sub goals independently.

Cont…

- It solves the sub problems with sub plans and then combines these sub plans and reorders them based on requirements.

- In POP, ordering of the actions is partial. It does not specify which action will come first out of the two actions which are placed in the plan

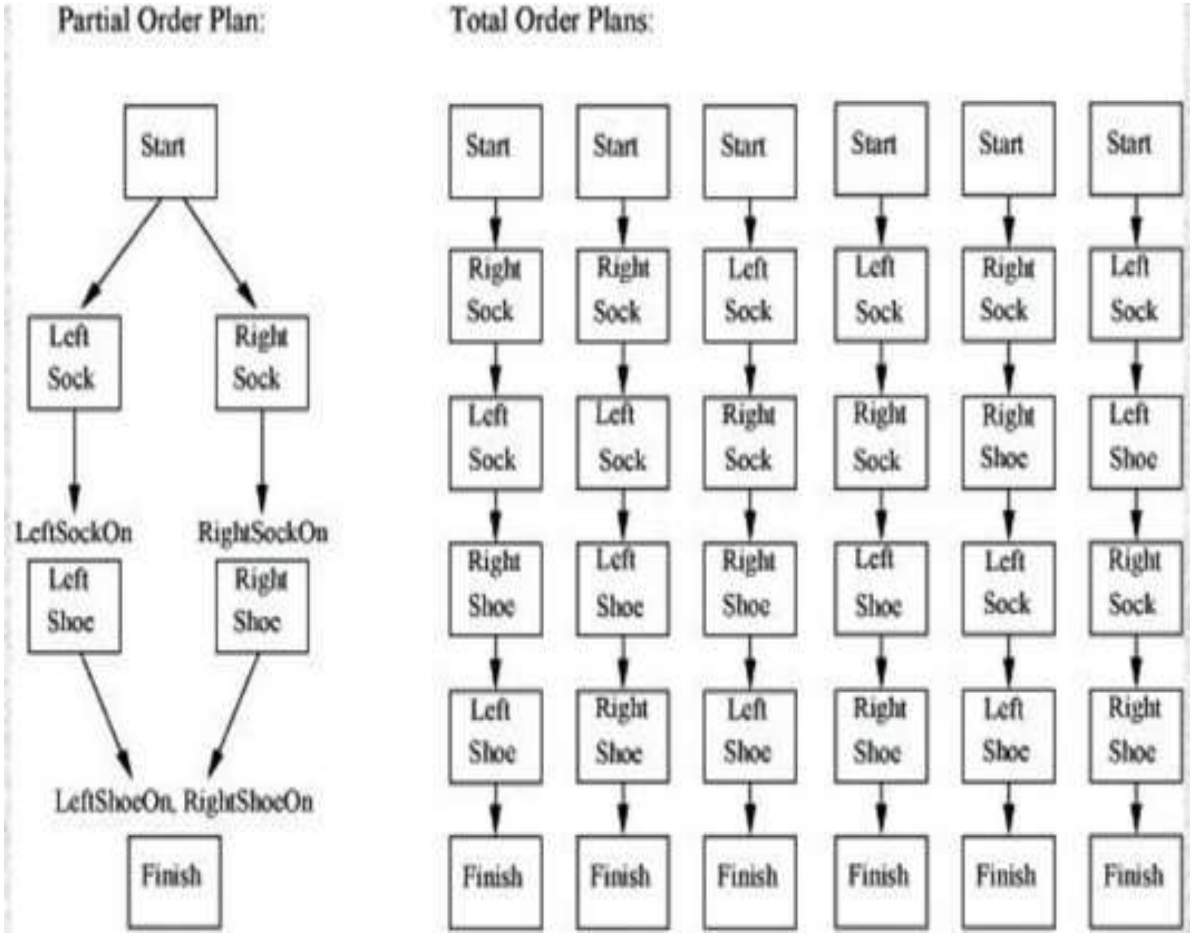
- Let’s look at this with the help of an example.

- The problem of wearing shoes can be performed through total order or partial order planning.

Cont…

- *Init: Barefoot*
- *Goal: RightShoeOn ^ LeftShoeOn*
- *Action: 1. RightShoeOn*
- *Precondition: RightSockOn*
- *Effect: RightShoeOn*
- *2. LeftShoeOn*
- *Precondition: LeftSockOn*
- *Effect: LeftShoeOn*
- *3. LeftSockOn*
- *Precondition: Barefoot*
- *Effect: LeftSockOn*
- *4. RightSockOn*
- *Precondition: Barefoot*
- *Effect: RightSockOn*

Cont…


Partial Order Plan:
Start
Left Sock
Right Sock
LeftSockOn
RightSockOn
Left Shoe
Right Shoe
LeftShoeOn, RightShoeOn
Finish
Total Order Plans:
Start
Right Sock
Left Sock
Left Shoe
Right Shoe
Finish

Cont…

- The TOP consists of six sequences, one of which can be taken in order to reach the finish state.
- However, the POP is less complex.
- It combines two action sequences.
- The first branch covers the left sock and left shoe.
- To wear left shoe, wearing the left sock is a precondition.
- Similarly the second branch covers the right sock and right show. Once