

(L-15)

SAT-Plan

Length 'd' → Sentence
depth

if it is TRUE
it is our plan

check whether it is TRUE or NOT

if it is
FALSE, we
increase the
depth to
'd+1'

SAT Solver

→ Set of TRUE sentences

Even length: Propositions
odd length: Actions

depth: # of odd lengths
(Action Stage)

Planning Problem

SAT Form

satisfiability problem:
CONJUNCTION of propositional
clauses

Solution Planning

→ satisfiability assignment

Dining Example

① Initial sentence (Initial clauses)

time
Step '0'

$Clean_0$ $Quiet_0$ $Grab_0$
 $\neg Dinner_0 \wedge \neg Present_0$

Initially, (in SAT)
clauses which
are not true
are also written.

~~Goal sentence~~

② Set of Axioms

$Action_t \rightarrow Precondition_{t-1} \wedge effect_{t+1}$

Actions

$Cook_1 \rightarrow Clean_0 \wedge Dinner_2$

\vdots

③ Frame Axioms (Explanatory Frame Axioms)

► For every state change, explain what could have caused it

$Grab_1 \wedge \neg Grab_3 \leftarrow [Cart_2 \vee Carry_2]$

Contrapositive reasoning: $p \rightarrow q$
 $\neg q \rightarrow \neg p$

④ Conflict Exclusion

\forall conflicting action 'a' and 'b' at time step t

ADD $\neg a_t \vee \neg b_t$

→ One action precondition is inconsistent with effect of other.

Assumptions:

1. Complete and correct model of the environment
 2. We know the initial state
 3. World is deterministic
- Conditional planning
- Learning → Replanning
- AI paradigm
(if the assumption is false)

Problem statement

1. You want to the airport and board your flight.
2. When ~~when~~ you are making a plan you don't know which gate your flight leaves from.
3. If you get to airport lobby you can read the display that will tell you which gate your flight is leaving from.



Solution:

Clause format / Boolean Variable

Action	Pre condition	Effect
* Read Display	At Lobby	<div style="border-left: 1px solid black; padding-left: 10px;"> <p>Know which Gate Know whether (Gate 1)</p> </div>
* Board Flight 1	At Gate 1, Gate 1	<div style="border-left: 1px solid black; padding-left: 10px;"> <p>On Flight, Gate 1 ¬ At</p> </div>

Gate 1 = 'T' → Flight is in Gate 1
 Gate 2 = 'F'

KB
↓ + Add info

Agent

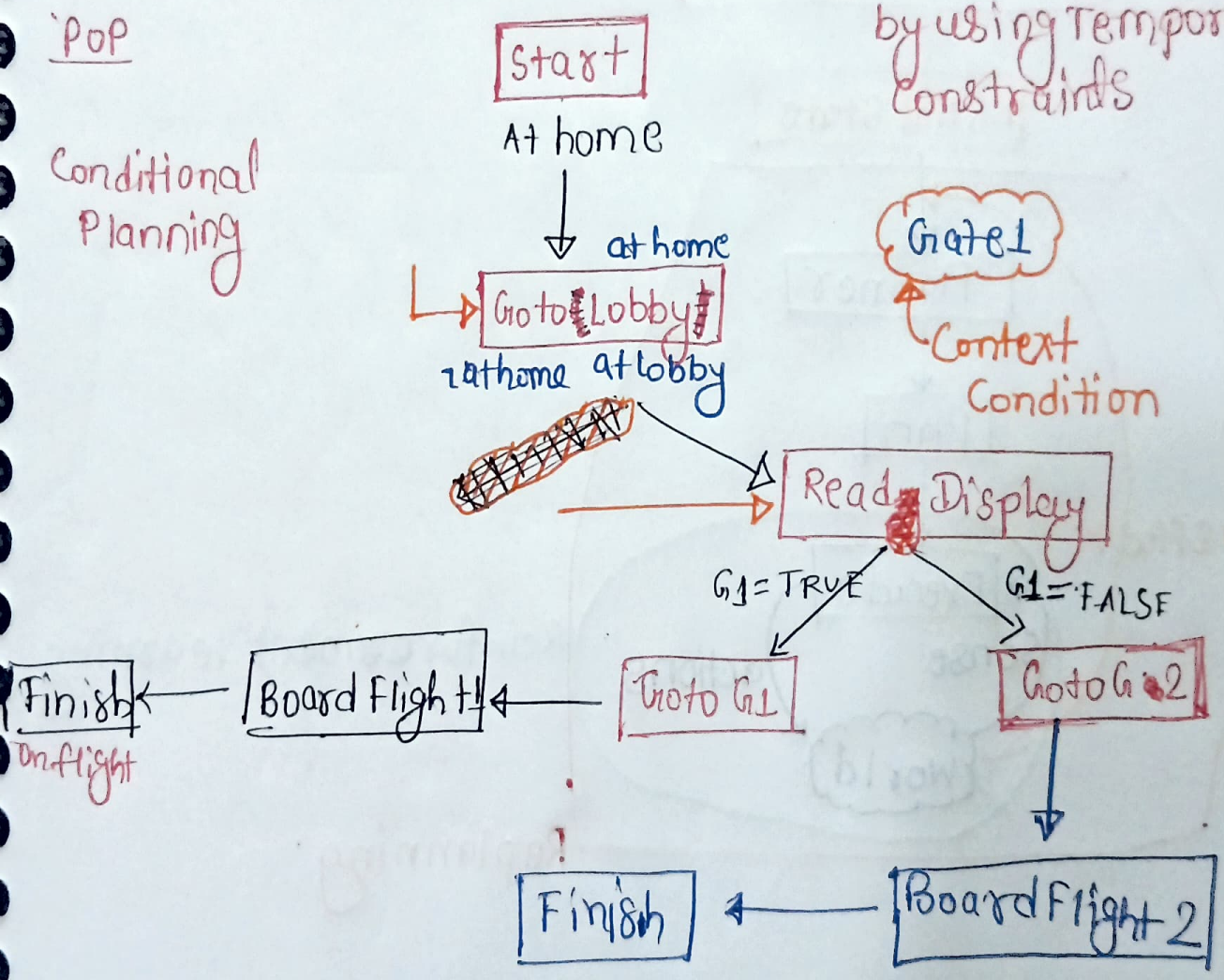
Airport
Gate 1
Gate 2

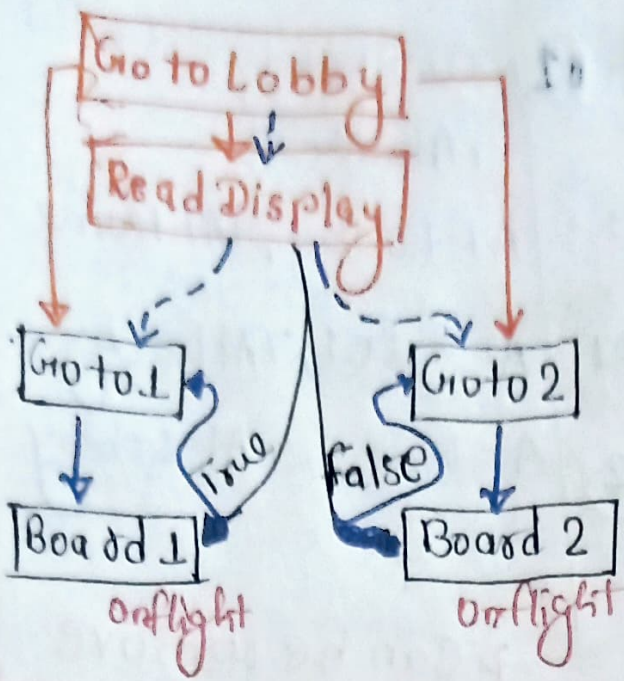
Action	Precondition	Effect
Board Flight 2	At Gate 2, \neg Gate 1	On Flight, \neg At Gate 2
Go to Lobby	At Home.	At Lobby, \neg At Home
Go to Gate 1	At Lobby, \neg Gate 1	At Gate 1, \neg At Lobby
Go to Gate 2	At Lobby, \neg Gate 2	At Gate 2, \neg At Lobby

→ Can be remove by using Temporal Constraints

POP

Conditional Planning





Replanning

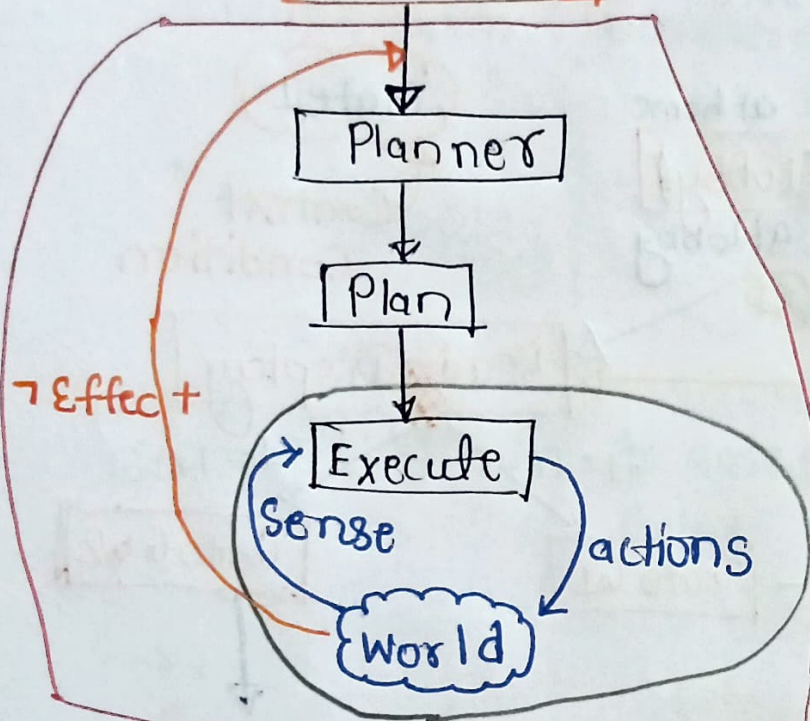
→ To fill in the steps in a very high level plan

Go to Airport

↓ (??) Initial Plan

Go to Gate

Initial State



Reinforcement learning

Replanning

Triangle Table

row → action
column → effect of
action above it

Row 1	Sell (TS, Tea)	Go to (TS)	X	
Row 2		At (TS)	Buy (Tea)	X
Row 3			Have (Tea)	