Chapter 13.2

A Simple Replanning Agent

Real-World domains are sometimes incomplete and may have incorrect information.

- **Incompleteness** is due to the agent’s world being inaccessible; In other words, the agent’s percepts cannot detect everything the agent needs to know about its environment.
- **Incorrectness** occurs when the agent’s representation of the world does not fully match all of the true conditions of the world; For example, a hurricane suddenly hits a city.
- There are two ways to deal with these problems…
• **Conditional (Contingency) Planning** fixes *incompleteness* by creating a plan to deal with every possible situation that could come up. The part of the plan to be executed next is determined by *sensing actions* that check for certain current conditions.

• An example in a painting program would be to compare the color of a new can of paint to the empty can’s color before continuing to paint the wall.

• **Execution Monitoring** fixes *incorrectness* by keeping track of what is going while a plan is executing, so the agent can tell if there is anything going wrong. If something did go wrong, the agent can use a *replanning* method to figure out how to reach its goals in the altered situation.

• An example of this is if a cooking agent notices that the oven temperature is incorrect, then it can raise or lower the temperature to fix it.

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**Conditional Planning versus Execution Monitoring:**

• *Conditional Planning* agents decide what could go wrong and how to deal with these problems *beforehand*, while…

• *Execution Monitoring* agents only plan out and deal with irregular situations *when they happen to come up*. 
• **Preconditions** are conditions that must be true in order for an operation to continue.

• **Action Monitoring** checks the preconditions of a single action as it is executed.

• **Execution Monitoring** checks the preconditions of the entire remaining plan.

• **Action Monitoring** is good to use when:
  • Action failure can be limited to one specific step (for example, a Car agent bumps into a tree that has fallen across the road – it then figures out how to get around it).
  • A goal is achieved by something other than the agent, therefore the agent can stop the execution of the rest of its plan.

• **Execution Monitoring** is more effective than *Action Monitoring* though, because it can look ahead to see action failures before they happen (for example, a Car agent could see the fallen tree and avoid bumping into it, instead of bumping into it then figuring out how to get around it).
With complex A.I. agents, things can go wrong.

- **Bounded Indeterminacy** is when possible problems are limited in number and can be planned ahead for. *Conditional Planning* can be used in these cases.

- **Unbounded Indeterminacy** is when the number of possible problems is too big to be fully planned ahead for. Some possibilities can be planned ahead for (in the Car agent, an example is traffic), but other random elements cannot be planned for ahead of time (like falling rocks or earthquakes). In the latter cases, the agent must be able to **replan** its desired path in order to keep moving ahead.

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**Replanning with Execution Monitoring**  
- a simple example - Painting a wall:

- The replanning agent initially assumes that the wall will be painted perfectly (i.e. no unpainted spots left).
- During the painting process, the agent will look for failures (i.e. unpainted spots).
- If any failures are noticed by the agent, it will **replan** its painting procedure to fix them (in other words, when it is done painting the wall once, it will go back and fill in the unpainted spots).
- The program will continue to loop though its painting procedure until the entire wall is painted perfectly.
• This process is similar to the way a *Conditional Planning* agent would paint a wall, except that the conditional agent would plan for things such as unpainted spots and spilled paint buckets before the execution of the process begins.

**Conclusion**

• So basically, *Conditional Planning* agents plan for problems and devise solutions for them before execution, while *Execution Monitoring* processes with *Replanning* agents find and fix problems as they are about to occur.