Continuous Planning (and Multiagent Planning)

Sections 12.6 (and 12.7)

Fixing plan flaws continually

- *Missing goal*: adding new goals

- *Open precondition*: close using causal links (POP)

- *Causal conflict*: resolve threats (POP)

- *Unsupported link*: remove causal links supporting conditions that are no longer true

- *Redundant action*: remove actions that supply no causal links

- *Unexecuted action*: return an action that can be executed

- *Unnecessary historical goal*: if the current goal set has been achieved, remove them and allow for new goals

Continuous planning algorithm

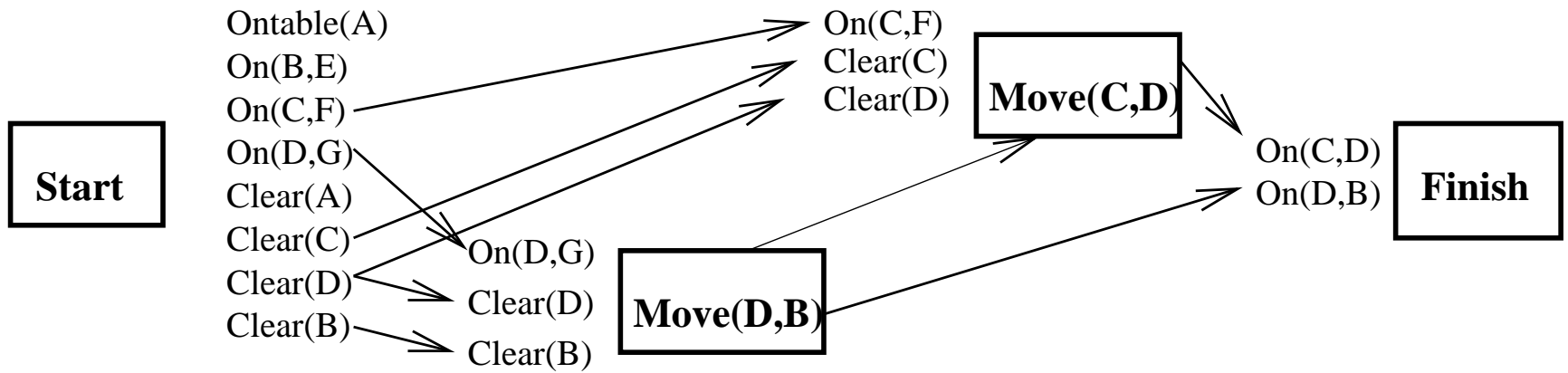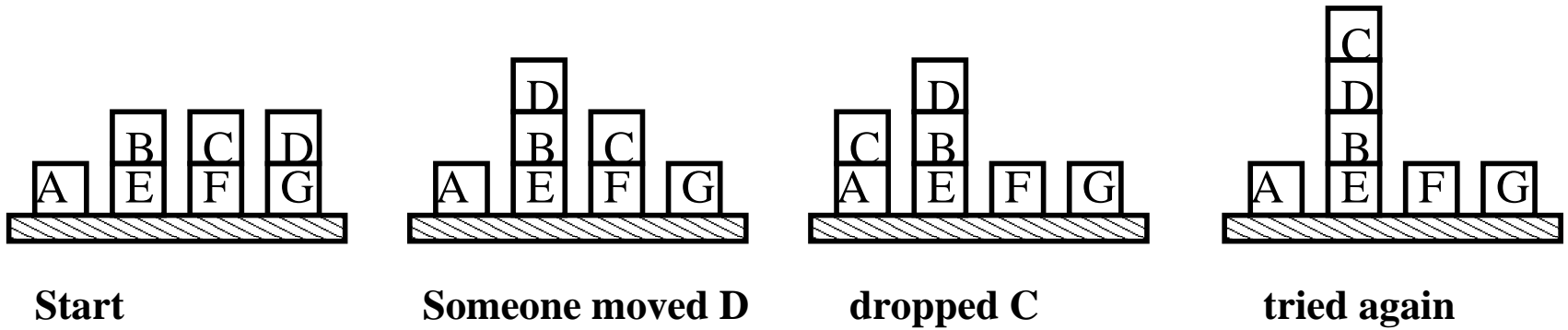**function** CONTINUOUS-POP-AGENT(*percept*) **returns** an action

    action ← *NoOp* (the default)
    EFFECTS[*Start*] = UPDATE(EFFECTS [*Start*], *percept*)
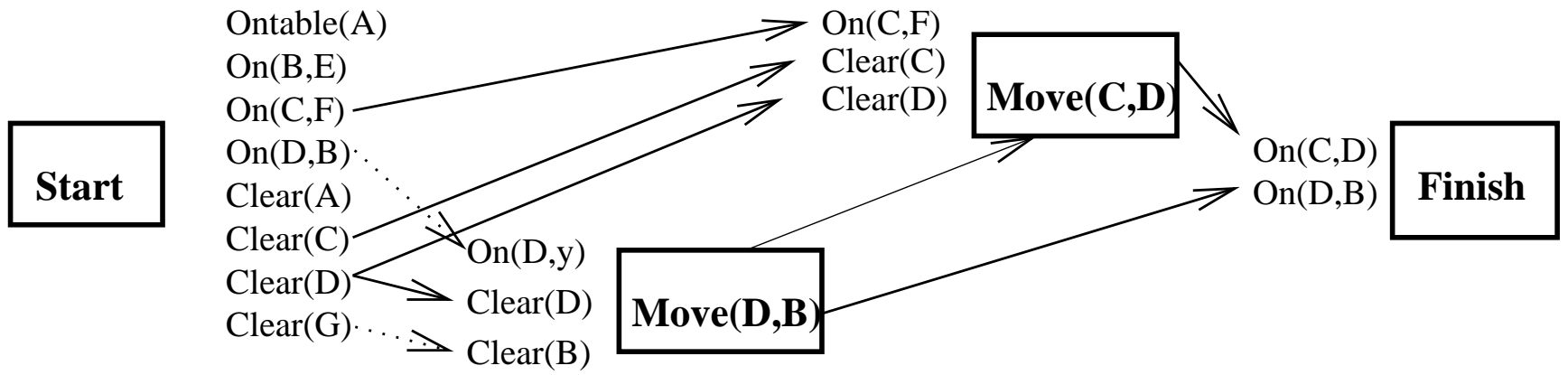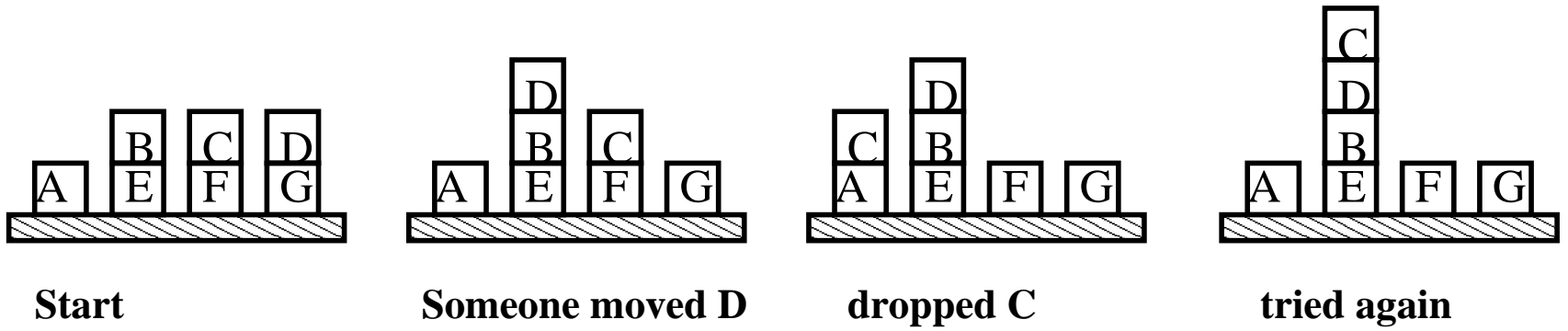   REMOVE-FLAW(*plan*)   // possibly updating action
    return *action*
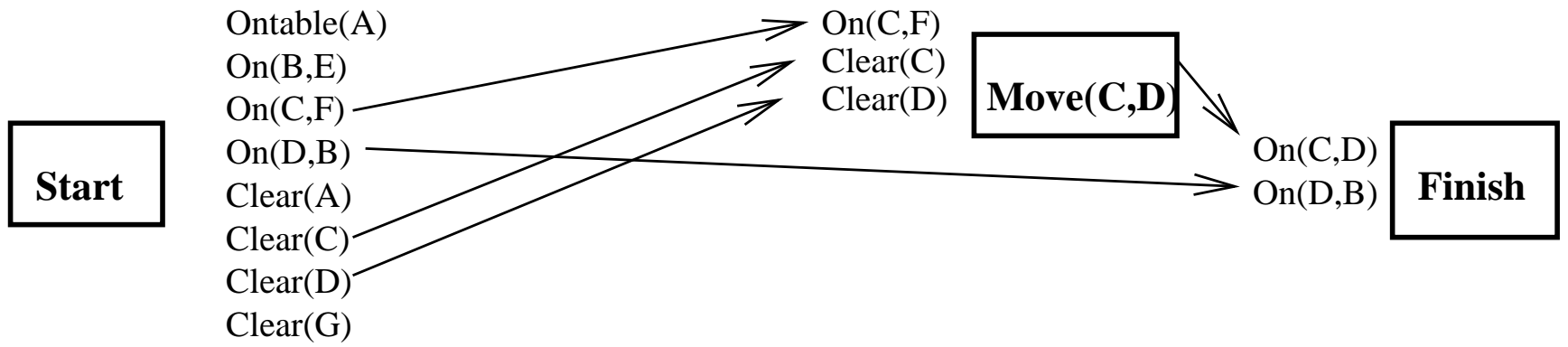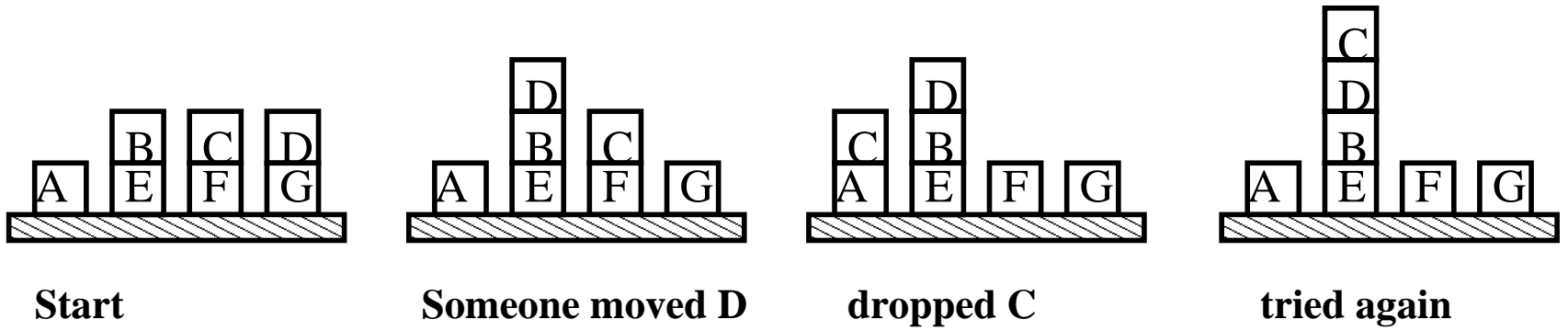
| Start | Someone moved D | dropped C | tried again |

Ontable(A)
On(B,E)
On(C,F)
On(D,G)
Clear(A)
Clear(C)
Clear(D)
Clear(B)

On(C,F)
Clear(C)
Clear(D)

On(D,G)
Clear(D)
Clear(B)

Start

Move(C,D)

Move(D,B)

On(C,D)
On(D,B)

Finish

Start   Someone moved D   dropped C   tried again

Start

Ontable(A)
On(B,E)
On(C,F) → On(C,F)
On(D,B) → Clear(C)
Clear(A) → Clear(D)
Clear(C)   **Move(C,D)**
Clear(D) → On(D,y)
Clear(G) → Clear(D)   **Move(D,B)**
         → Clear(B)

On(C,D)
On(D,B)   **Finish**

Example - Move(D,B) was redundant
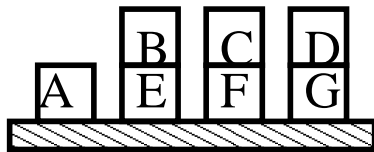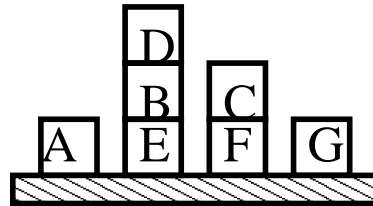
Start **Someone moved D** **dropped C** **tried again**

Start

Ontable(A)
On(B,E)
On(C,F)
On(D,B)
Clear(A)
Clear(C)
Clear(D)
Clear(G)

On(C,F)
Clear(C)
Clear(D)

Move(C,D)

On(C,D)
On(D,B)

Finish

Start
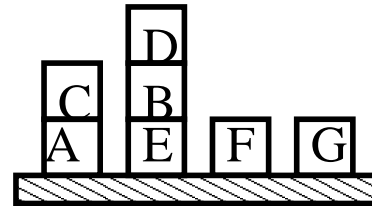
Someone moved D

dropped C

tried again

Start

Ontable(A)
On(B,E)
On(C,A)
On(D,B)
Clear(F)
Clear(C)
Clear(D)
Clear(G)

On(C,D)
On(D,B)

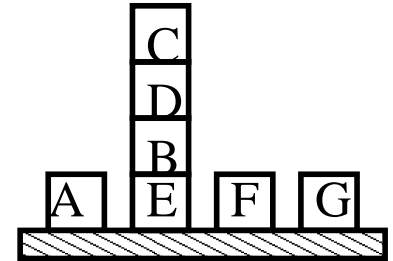| Finish |
|--------|

Start   Someone moved D   dropped C   tried again

Ontable(A)
On(B,E)
On(C,A)
On(D,B)
Clear(F)
Clear(C)
Clear(D)
Clear(G)

On(C,A)
Clear(C)
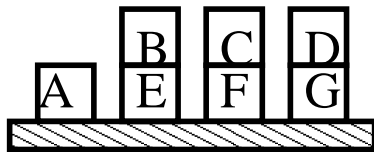Clear(D)

Start

Move(C,D)
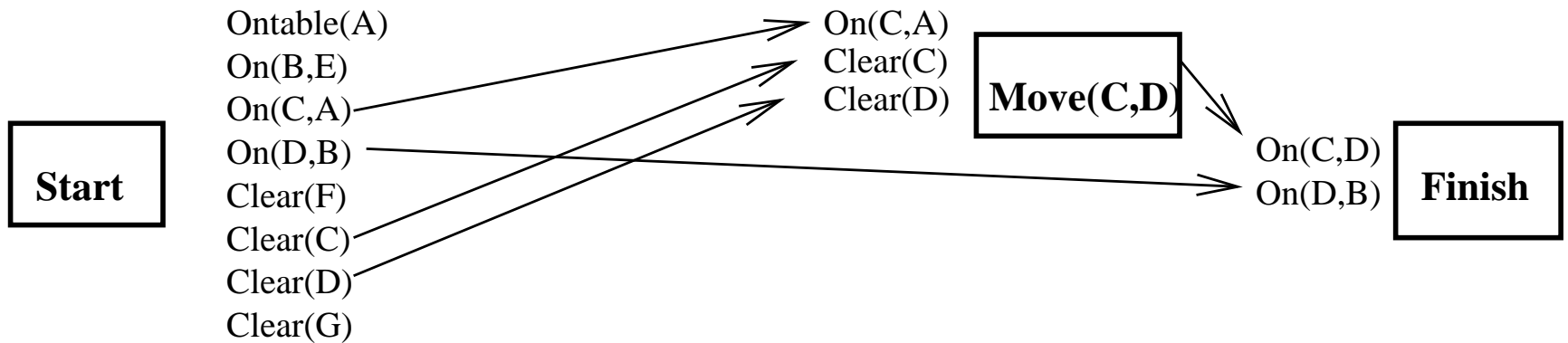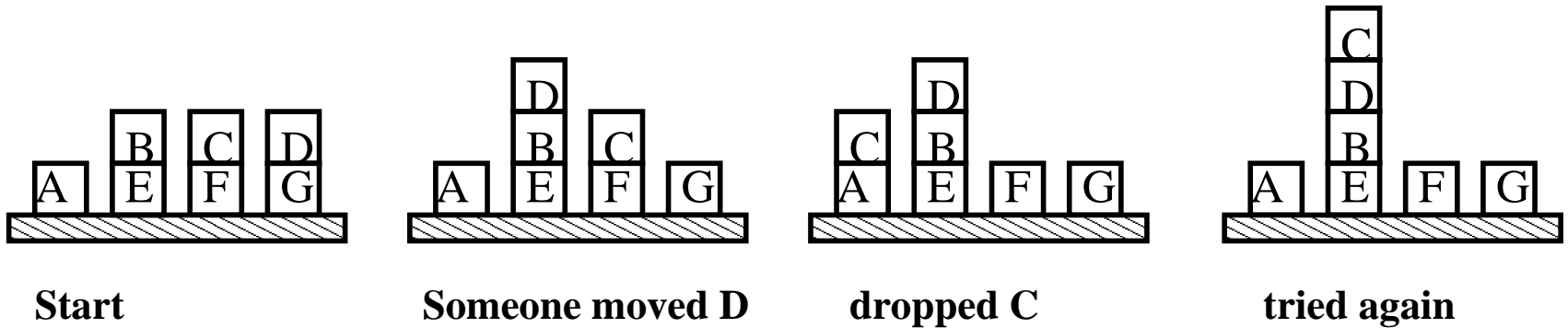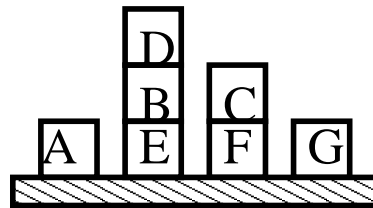
On(C,D)
On(D,B)

Finish

Start   **Someone moved D**   **dropped C**   **tried again**
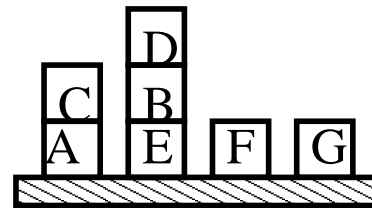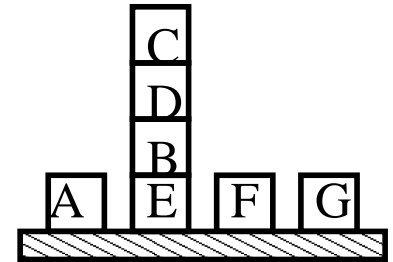
Ontable(A)
On(B,E)
On(C,D)
On(D,B)
Clear(F)
Clear(C)
Clear(D)
Clear(G)

Start

On(C,D)
On(D,B)

Finish
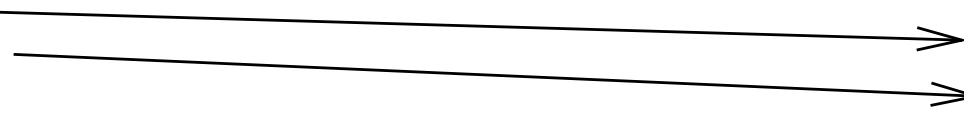
Multiagent planning

- *Cooperation:* Joint goals and plans

- *Multibody planning:* Synchronization, joint actions, concurrent actions

- *Coordination mechanisms:* convention, social laws, emergent behavior, communication, plan recognition, joint intention

- *Competition:* agents with conflicting utility functions