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

Start

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

Move(C,D)

Move(D,B)

Start Finish

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

On(C,D)
On(D,B)
Example - after D is moved onto B

Start

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

Someone moved D
- Move(C,D)
- On(C,F)
- Clear(C)
- Clear(D)

Dropped C
- Move(D,B)
- On(D,B)
- Clear(D)
- Clear(G)

Tried again

Finish
Example - Move(D,B) was redundant

Start

Someone moved D

dropped C

tried again

Start

Finish

Sec. 12.6-12.7 – p.6/10
Example - Move(C,D) was executed

Start

Someone moved D

dropped C

tried again

Start

Finish

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

- On(C,D)
- On(D,B)
Example - put Move(C,D) back in

Start

Someone moved D

dropped C

tried again

On(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)

Move(C,D)

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

Finish

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Example - plan complete

Start

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td>E</td>
<td>F</td>
<td>G</td>
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Someone moved D

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dropped C

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tried again

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

On(C,D) ➔ Finish
On(D,B) ➔ Finish

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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