Threat-Removal Strategies for Partial-Order Planning

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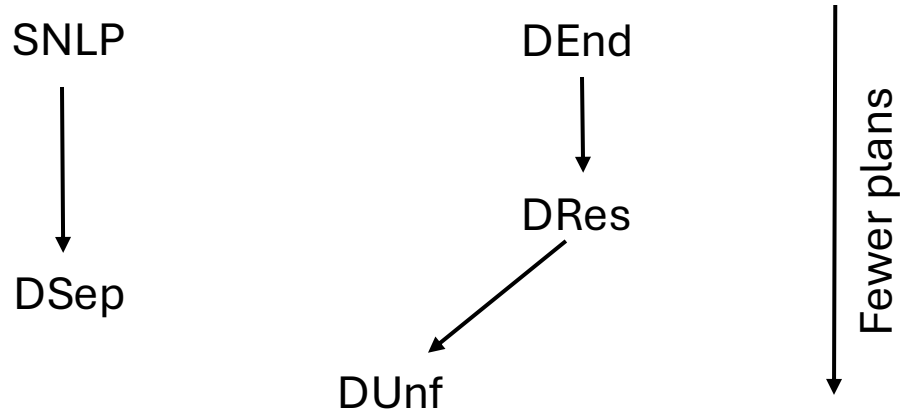
- Positions for resolving threats
  - Resolve a threat immediately
  - Wait until situation gets simpler
  - Resolve threats at the end
- Delaying threat resolution improves performance

- Immediate Resolution (Default SNLP)
  - Resolve a threat as it arises
    - Promotion/Demotion/Separation
- Delaying Separable Threats (DSep)
  - Postpones resolving threats until they become unavoidable
    - Promotion/Demotion
  - No extra branches beyond SNLP

- Delaying Unforced Threats (DUnf)
  - Resolve a threat when there is only one (or no) resolution remaining
    - Only one way of separating variables: add appropriate not-equals constraint
- Delay Resolvable Threats (DRes)
  - Ignore a threat until it is unresolvable -> discard the partial plan
  - Explores more partial plans before realizing that some are infeasible

- Delaying Threat Resolution Until the End (DEnd)
  - Delay resolving threats until all open conditions have been satisfied

- Search space relationships

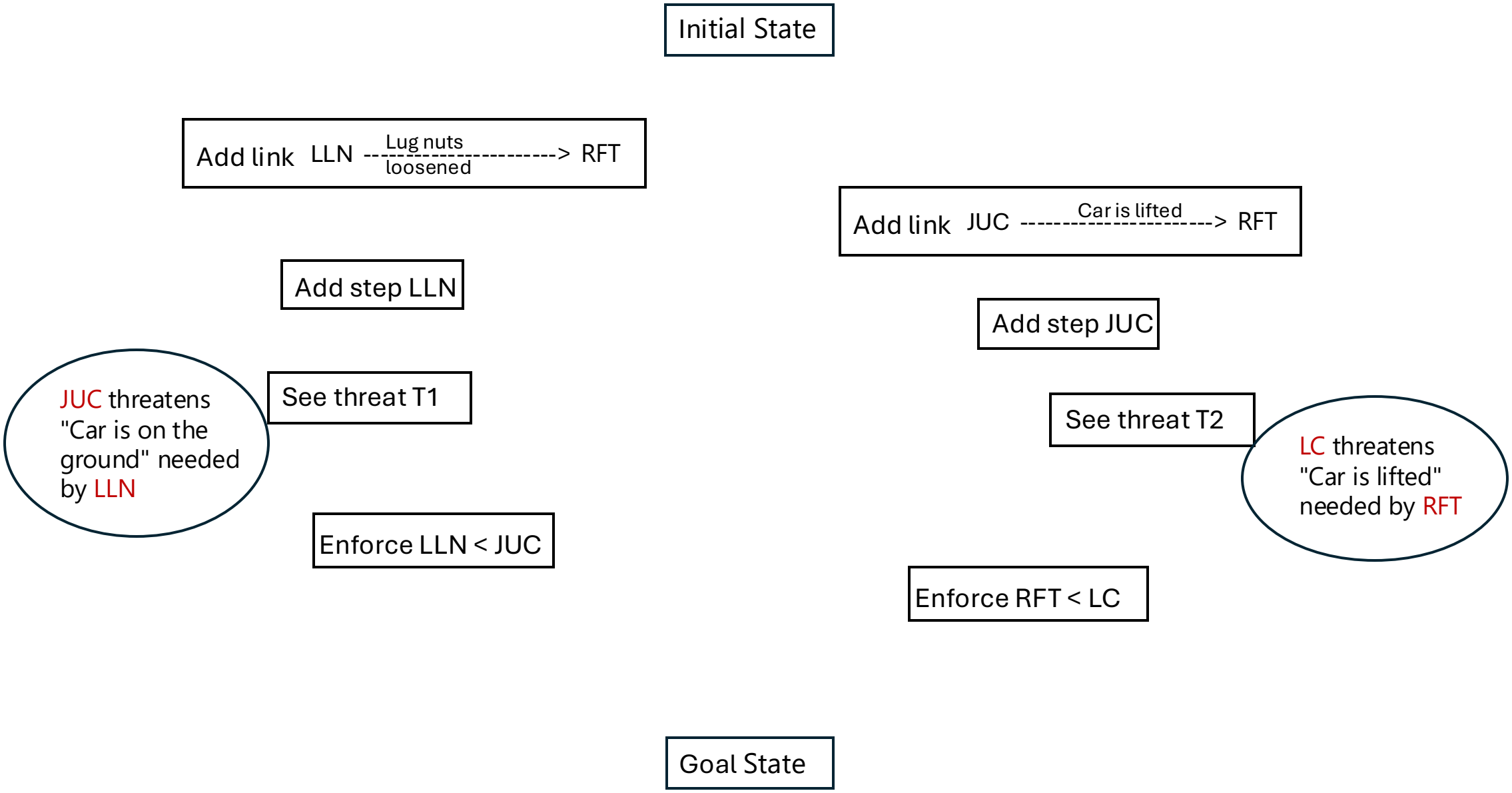


Russell's Tire Changing Problem

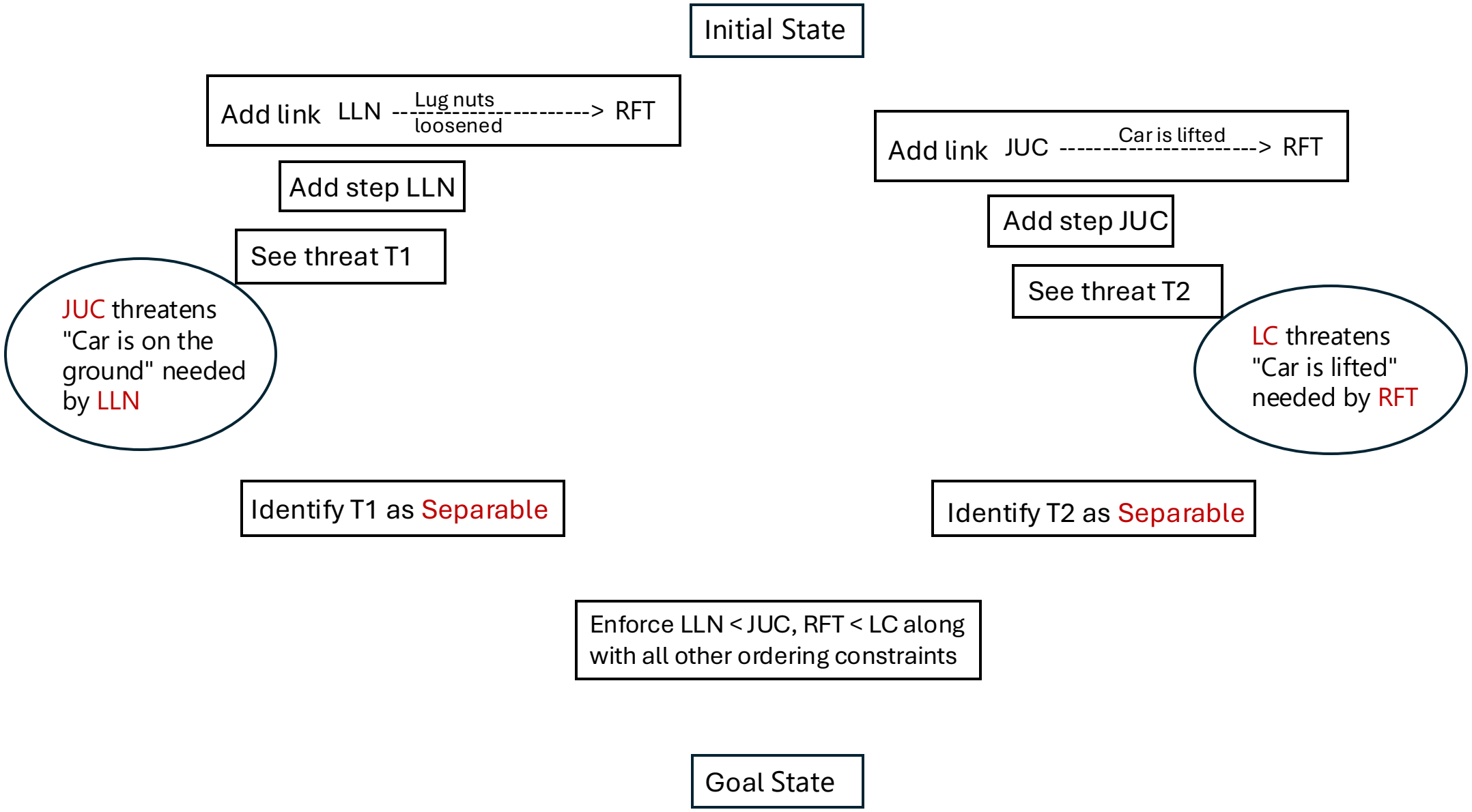
- Initial State
  - The car has a **flat tire**
  - The spare tire is **in the trunk**
  - The car is **on the ground**
  - The lug nuts are **tight**
  - The jack is **available**
- Goal State
  - The **spare tire** is **mounted**
  - The **flat tire** is **removed**
  - The **lug nuts** are **tightened**
- Actions
  - Loosen Lug Nuts (LLN)
  - Tighten Lug Nuts (TLN)
  - Jack Up Car (JUC)
  - Lower Car (LC)
  - Remove Flat Tire (RFT)
  - Install Spare Tire (IST)

- Example Threats
  - T1: Jack Up Car threatens "Car is on the ground" needed by Loosen Lug Nuts
  - T2: Lower Car threatens "Car is lifted" needed by Remove Flat Tire

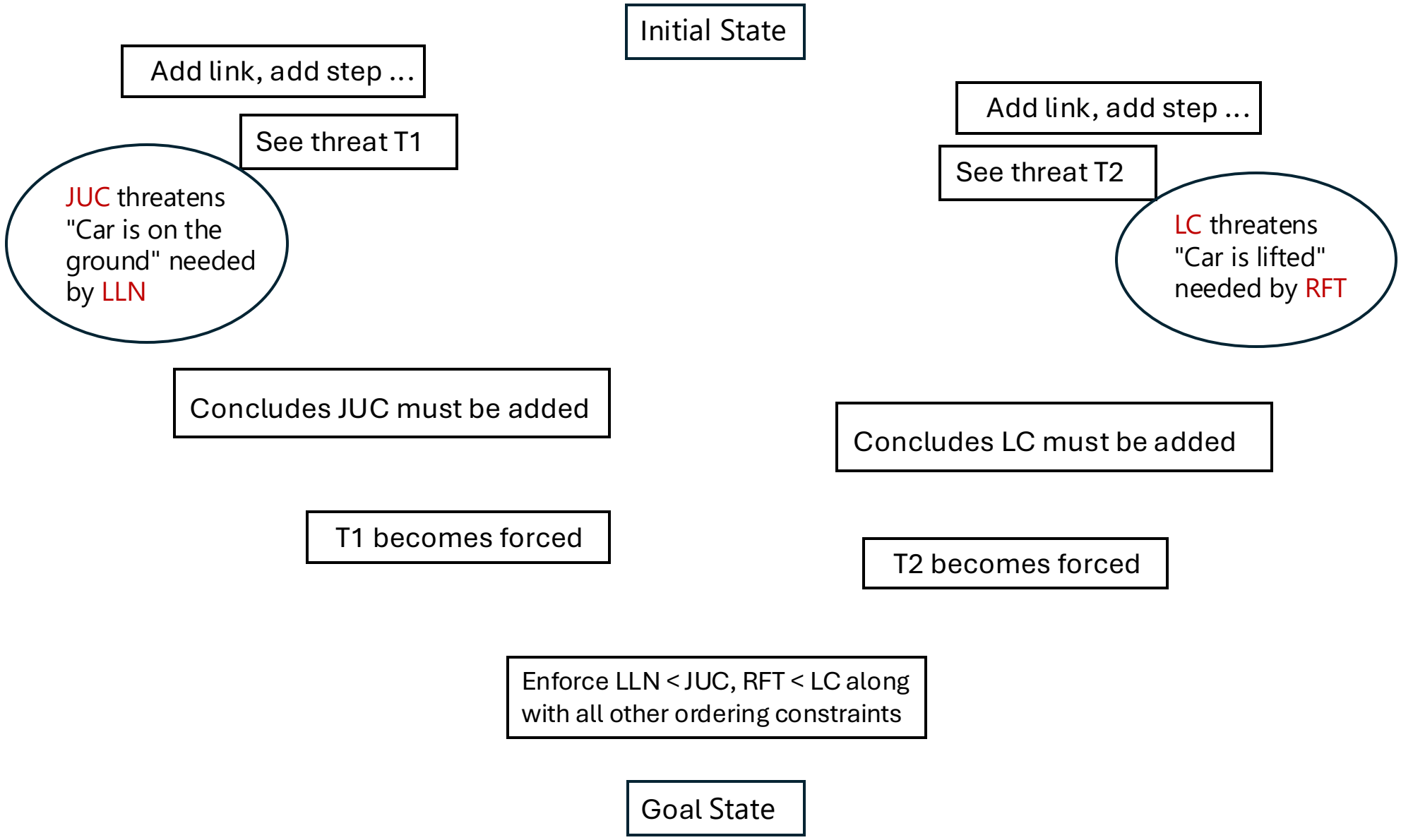
Immediate Resolution (Default SNLP)



Delaying Separable Threats (DSep)



Delaying Unforced Threats (DUnf)



Delay Resolvable Threats (DRes)

Initial State

Ignore a threat until it is unresolvable --> discard partial plan

T1, T2 are "resolvable" by simple ordering constraints

Enforce LLN < JUC, RFT < LC along with all other ordering constraints

Goal State

Delaying Threat Resolution Until the End (DEnd)