

# On Temporally Annotating Goal Models

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University of Toronto

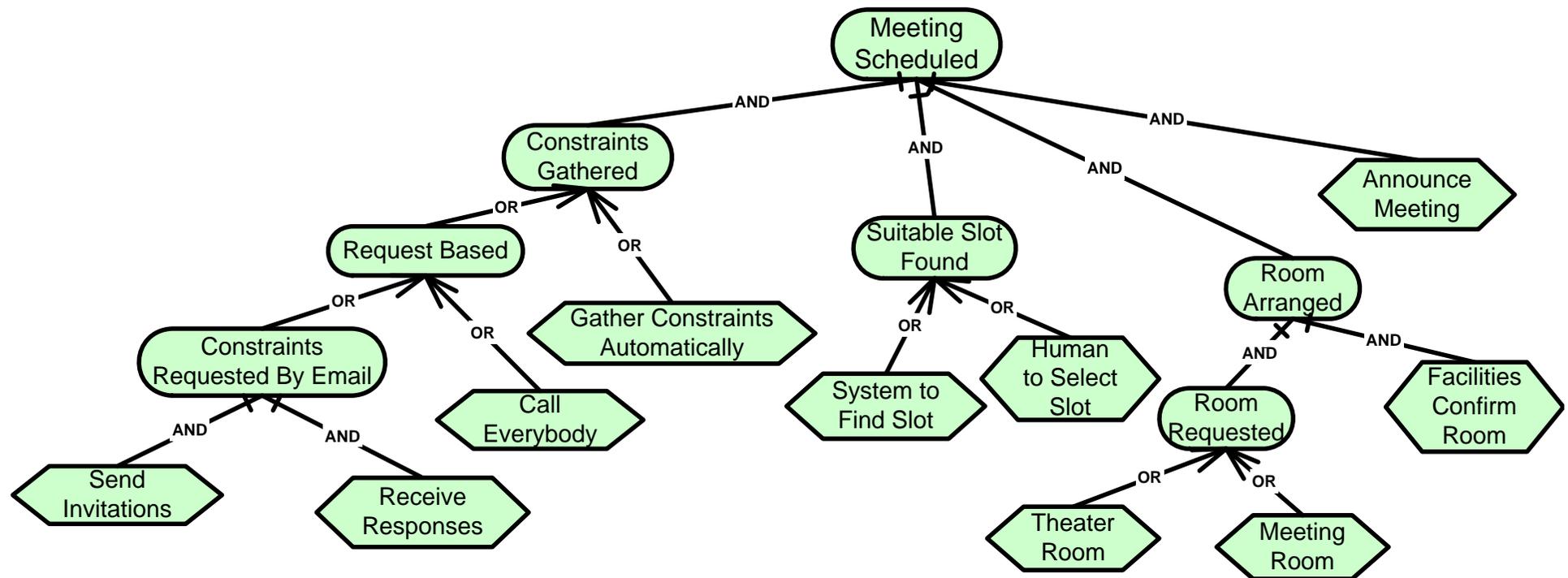


also: **Sheila McIlraith, Shirin Sohrabi**, University of Toronto

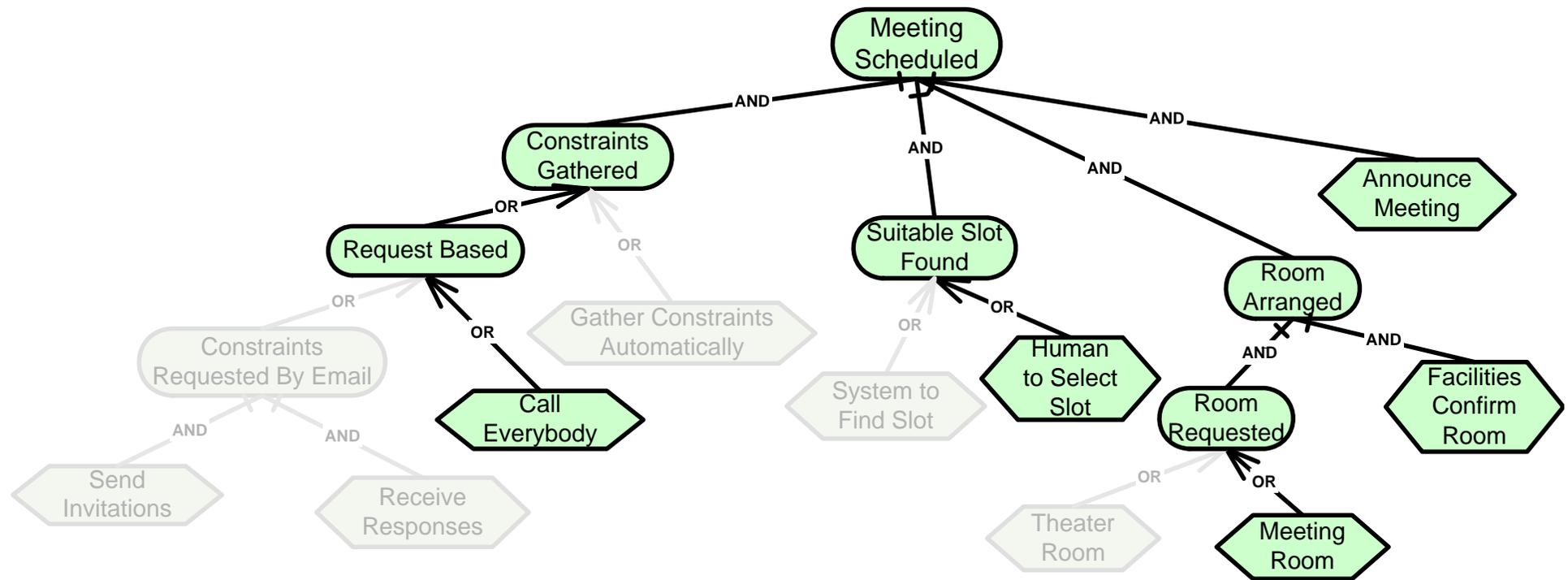
# Outline

- Variability in Goal Models
- Variability in Satisfaction Ordering.
- Possible visual ordering constraints.
- Caveats.
- (Also, off-topic: optionality in goal models)

# Goal Models

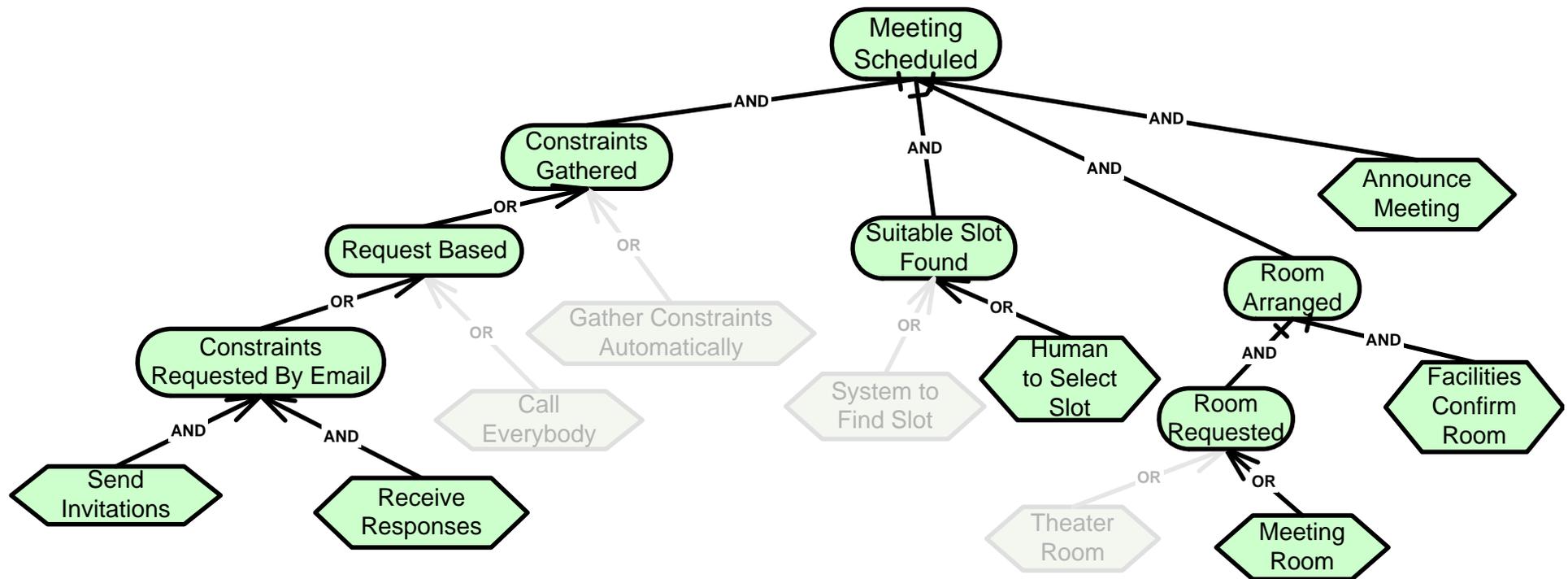


# Goal Variability



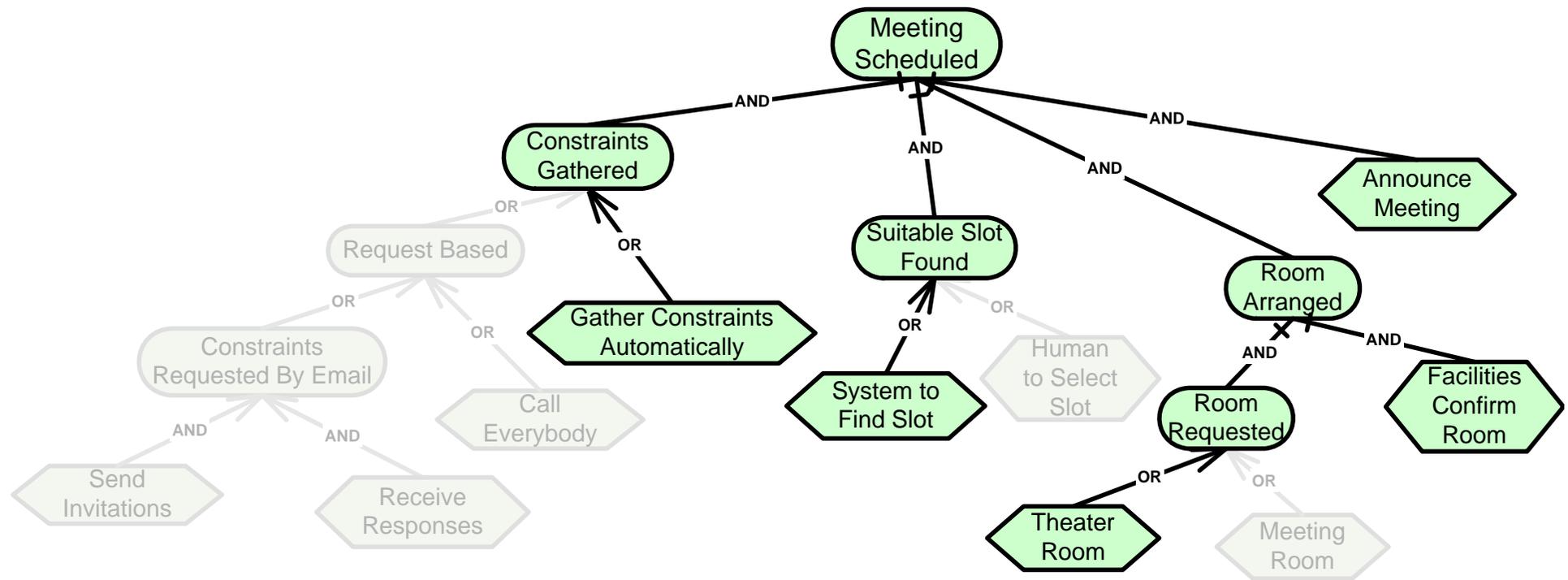
{Call Everybody, Human to Select Slot, Meeting Room (requested), Facilities Confirm Room, Announce Meeting}

# Goal Variability



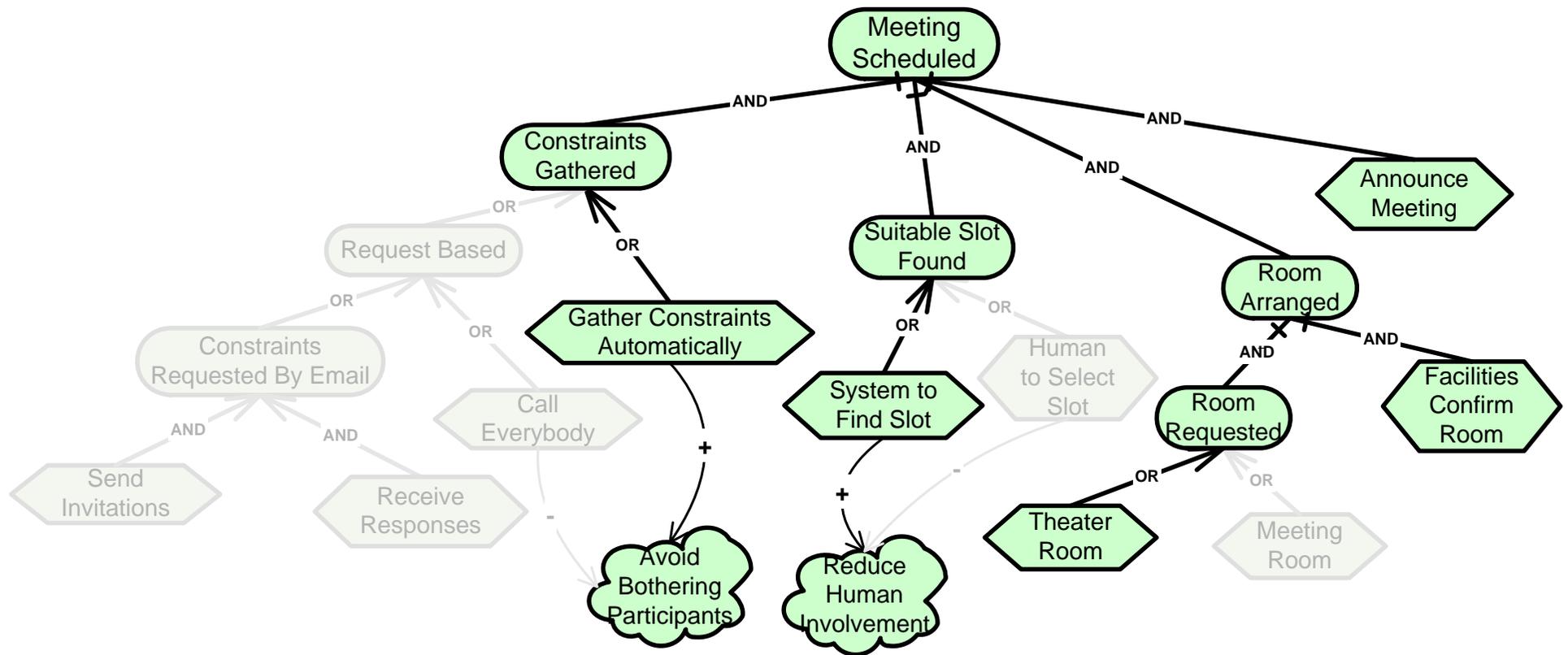
{Send Invitations, Receive Responses, Human to Select Slot, Meeting Room (requested),  
Facilities Confirm Room, Announce Meeting}

# Goal Variability

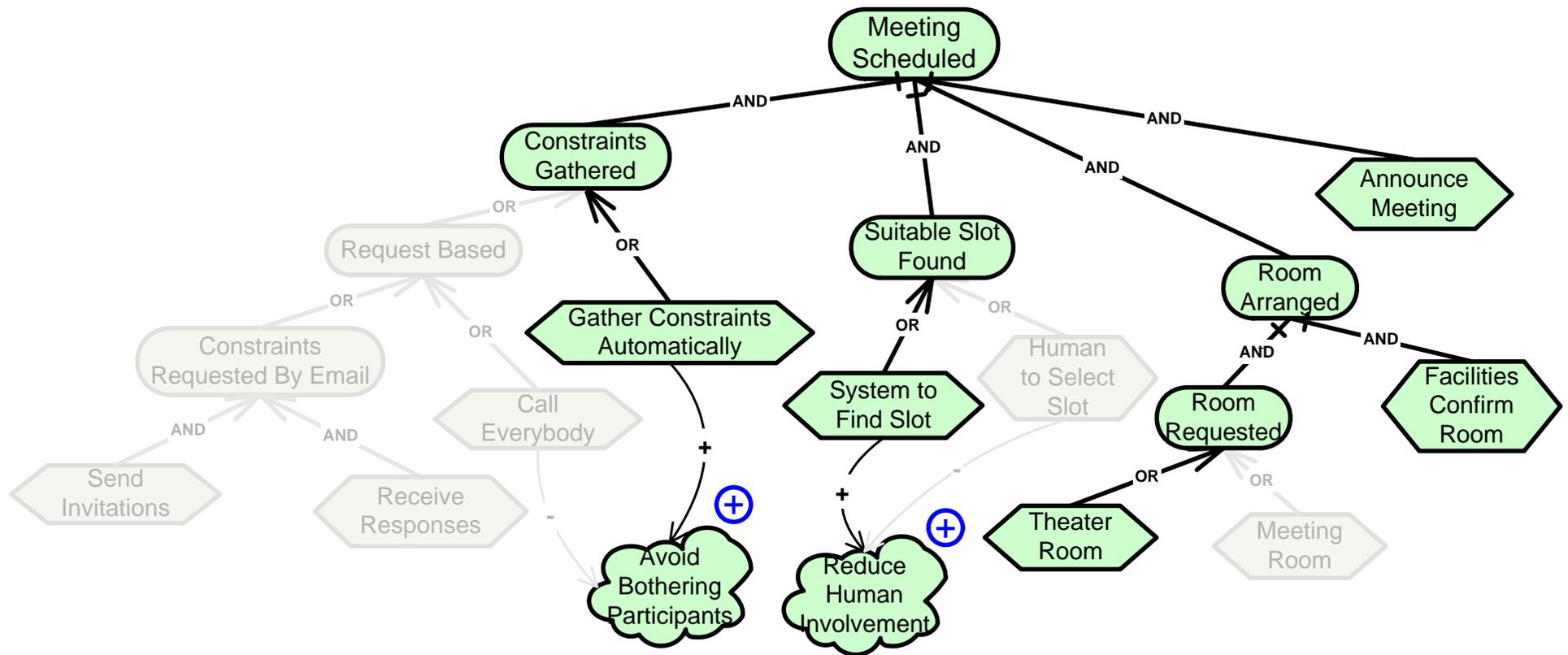


{Gather Constraints Automatically, System to Find a Slot, Theater Room (requested),  
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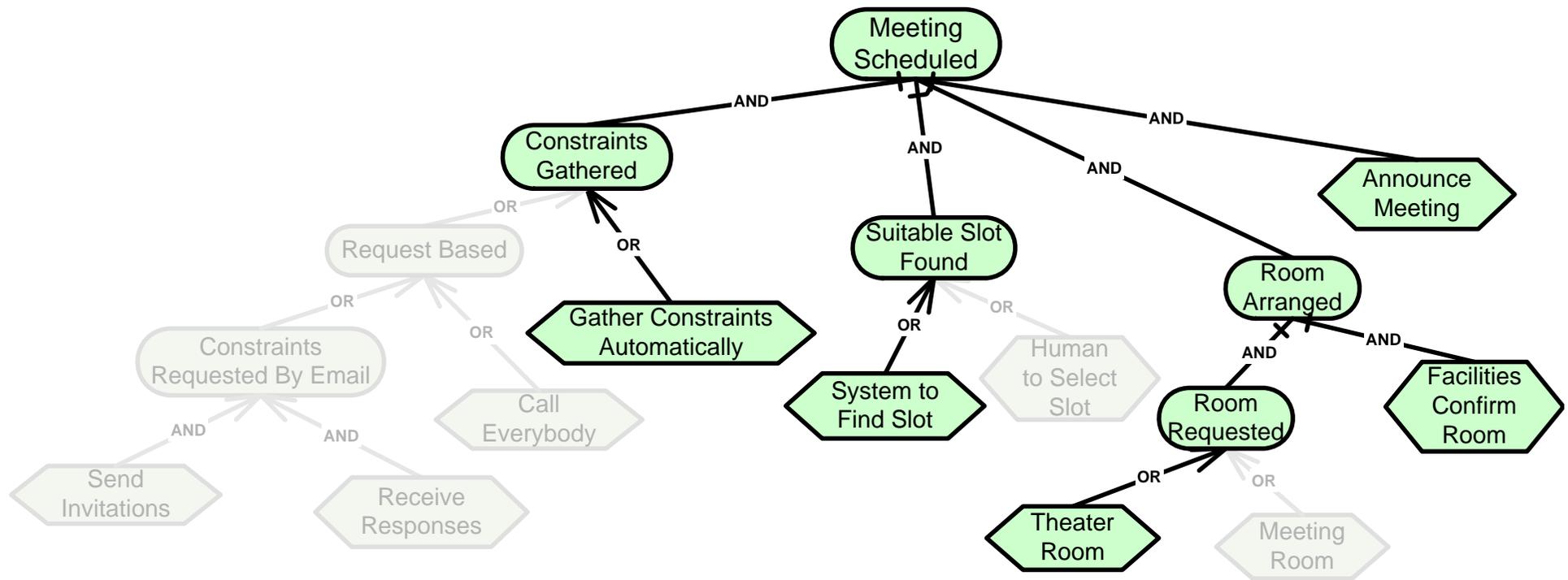


# Goal Variability





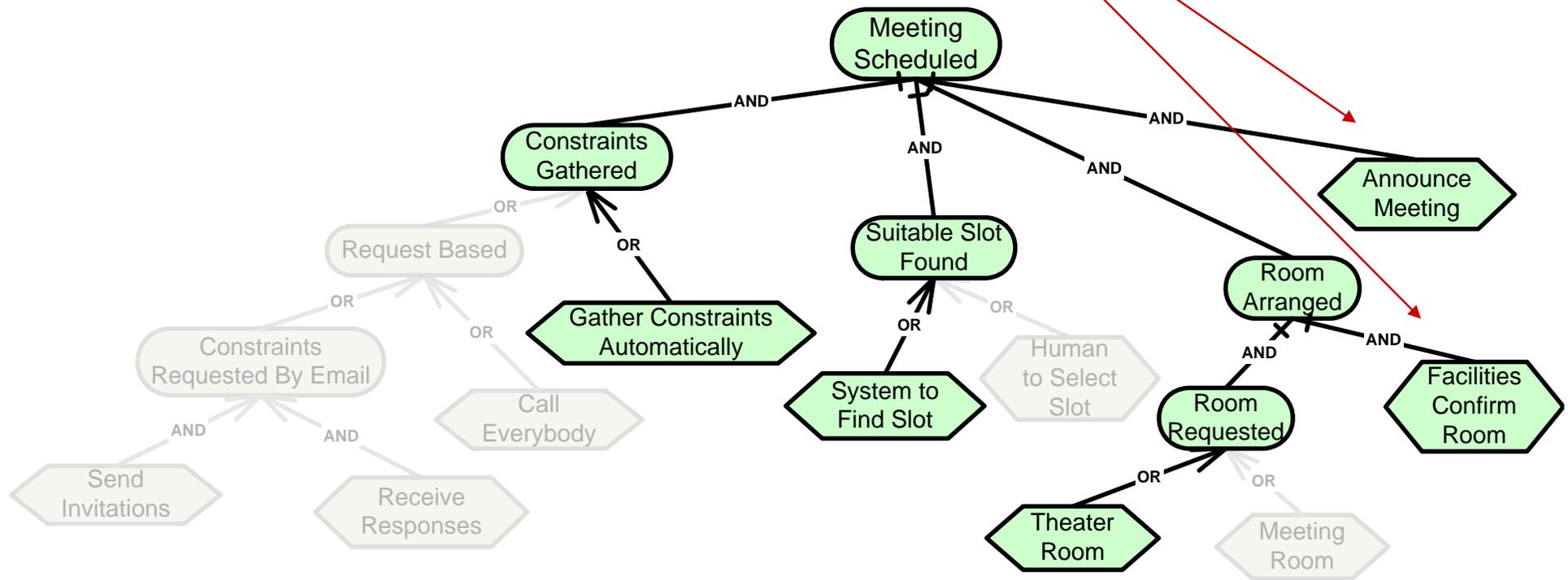
# Temporal Variability



{Gather Constraints Automatically, System to Find a Slot, Theater Room (requested),  
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# Temporal Variability

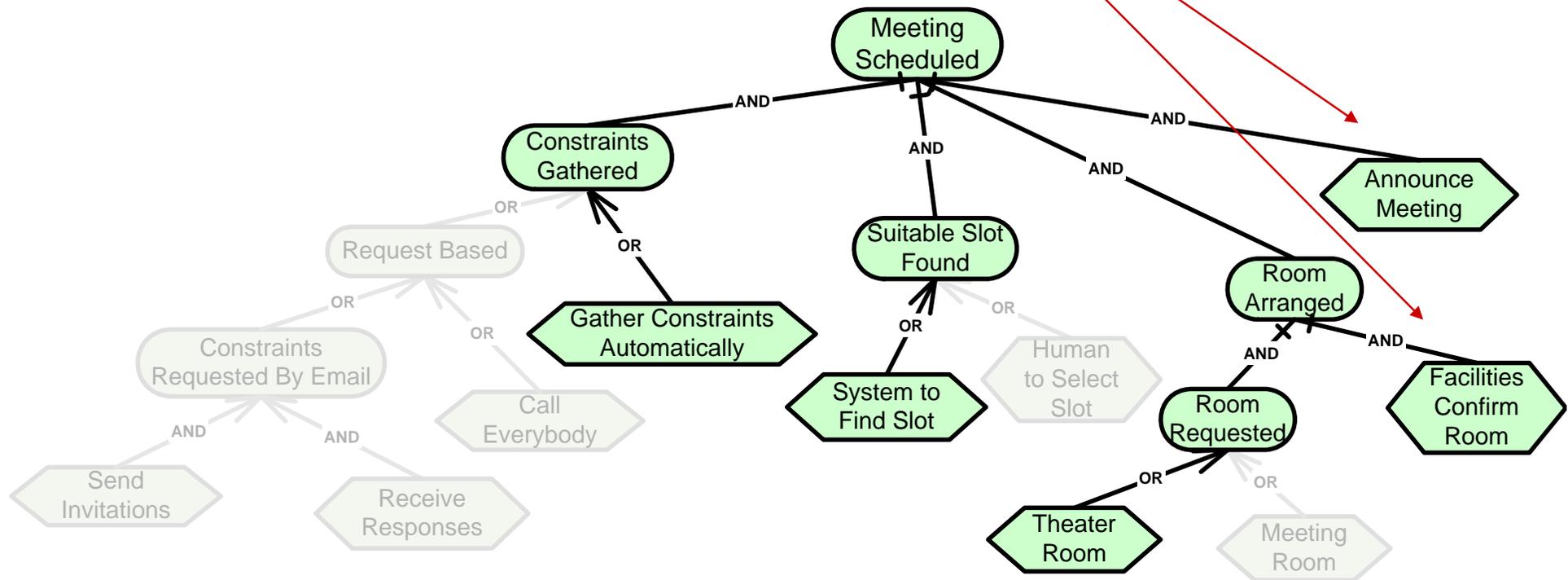
Which one happens first?



{Gather Constraints Automatically, System to Find a Slot, Theater Room (requested),  
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# Temporal Variability

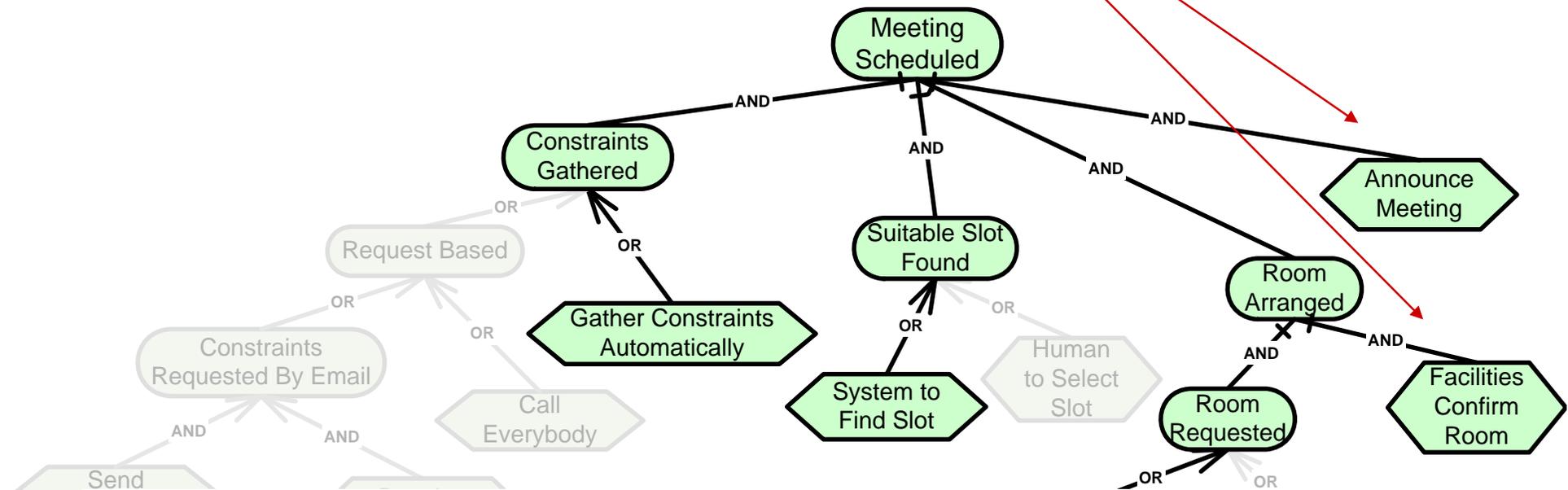
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{Gather Constraints Automatically, System to Find a Slot, Theater Room (requested),  
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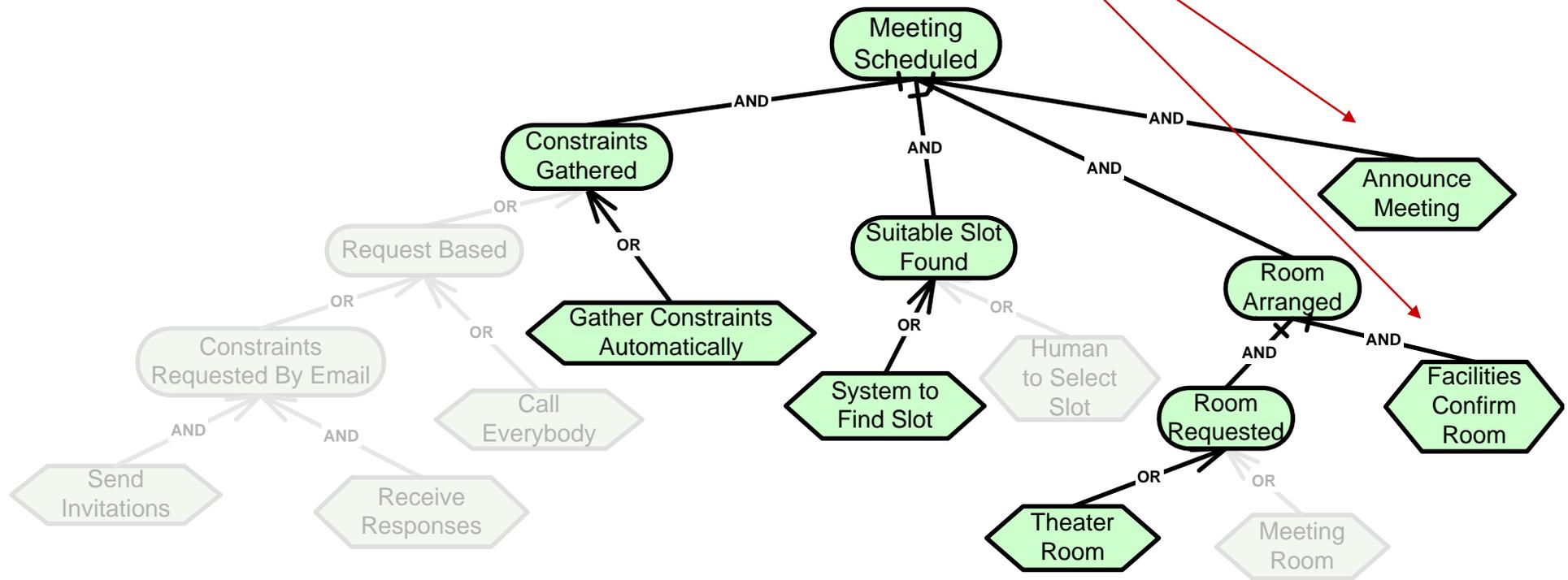
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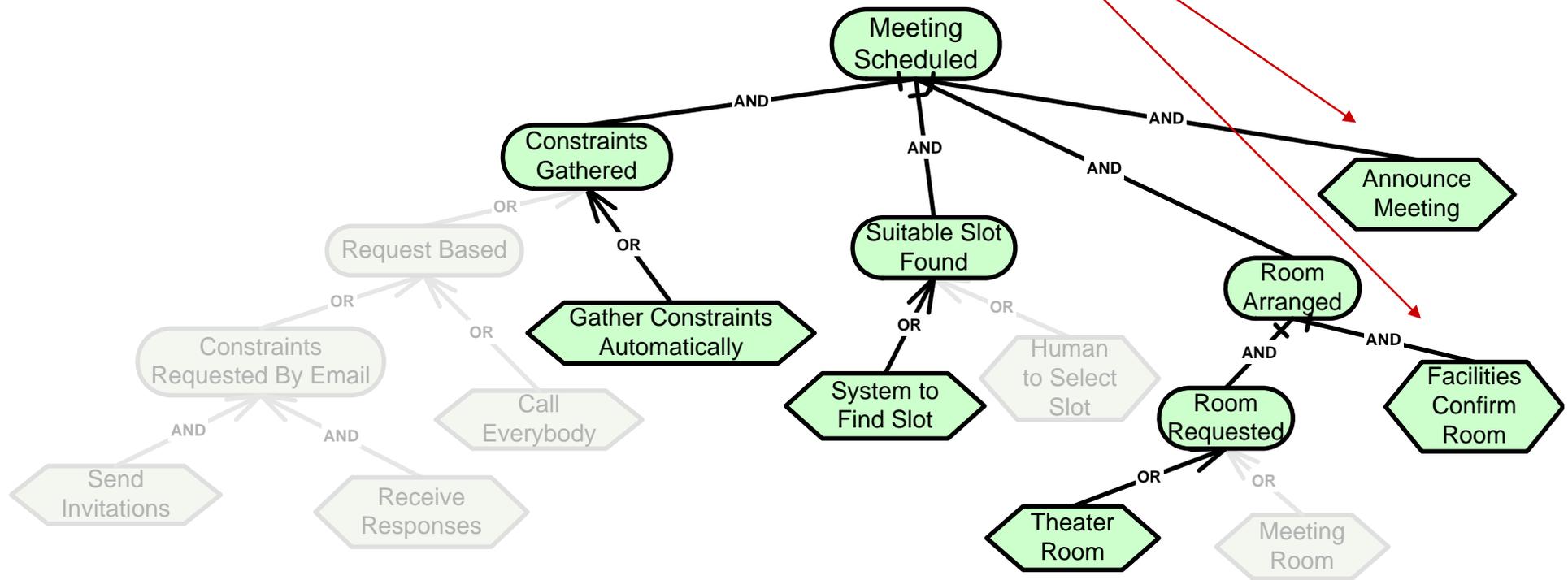
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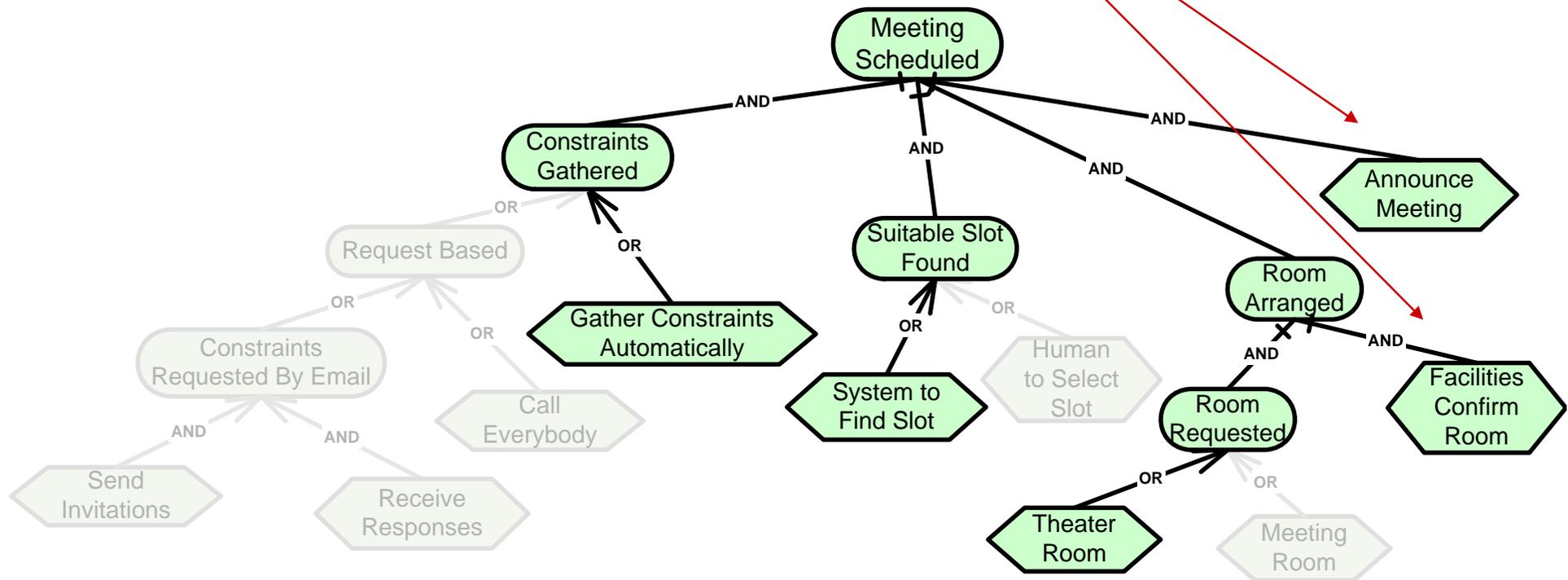
Which one happens first?



[Gather Constraints Automatically, System to Find a Slot, Theater Room (requested),  
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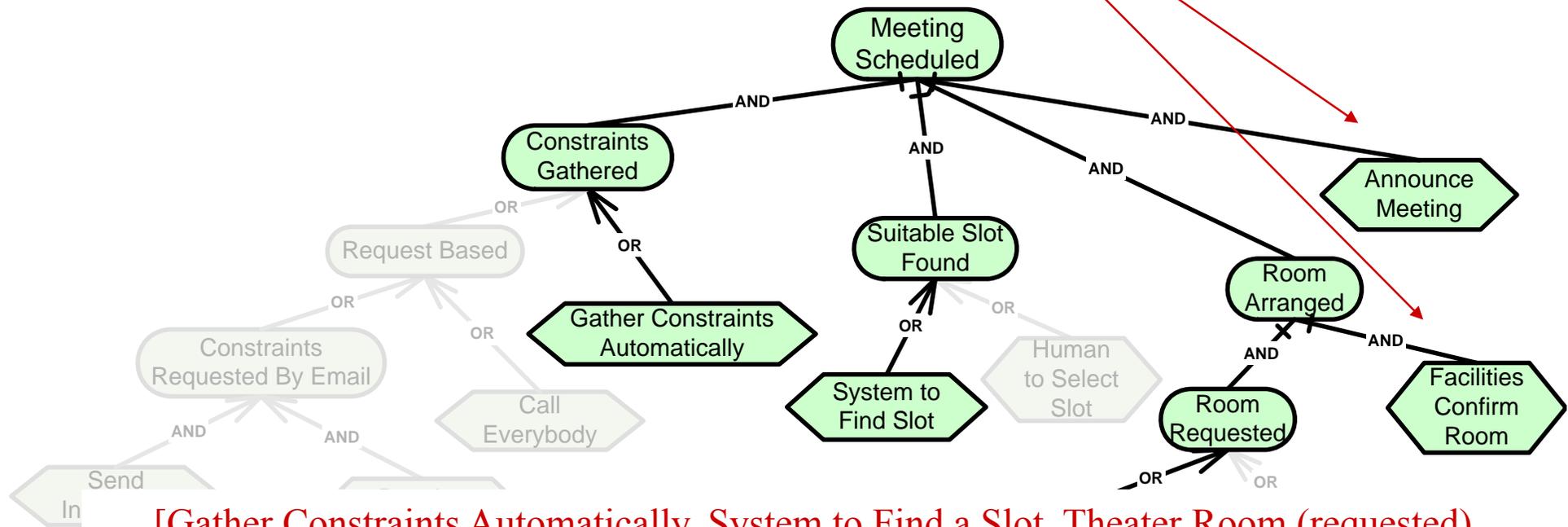
Which one happens first?



[Gather Constraints Automatically, System to Find a Slot, Theater Room (requested),  
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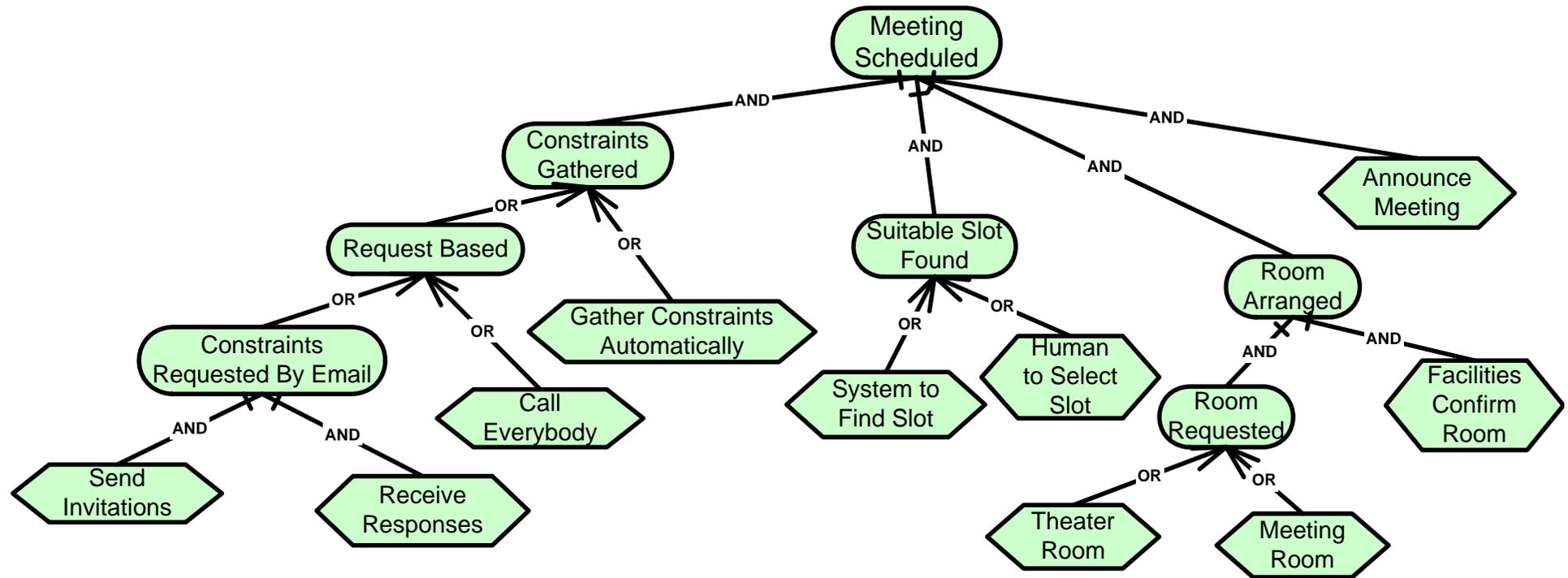


[Gather Constraints Automatically, System to Find a Slot, Theater Room (requested),  
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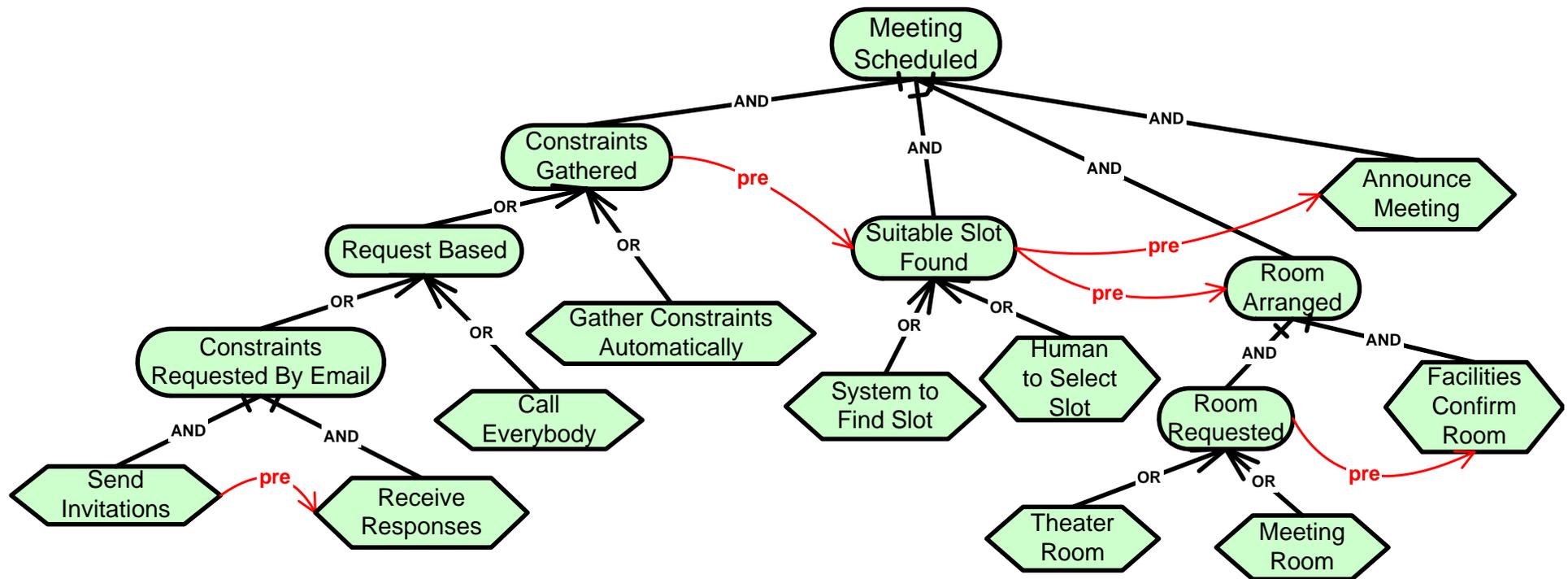
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[Gather Constraints Automatically, System to Find a Slot, Theater Room (requested),  
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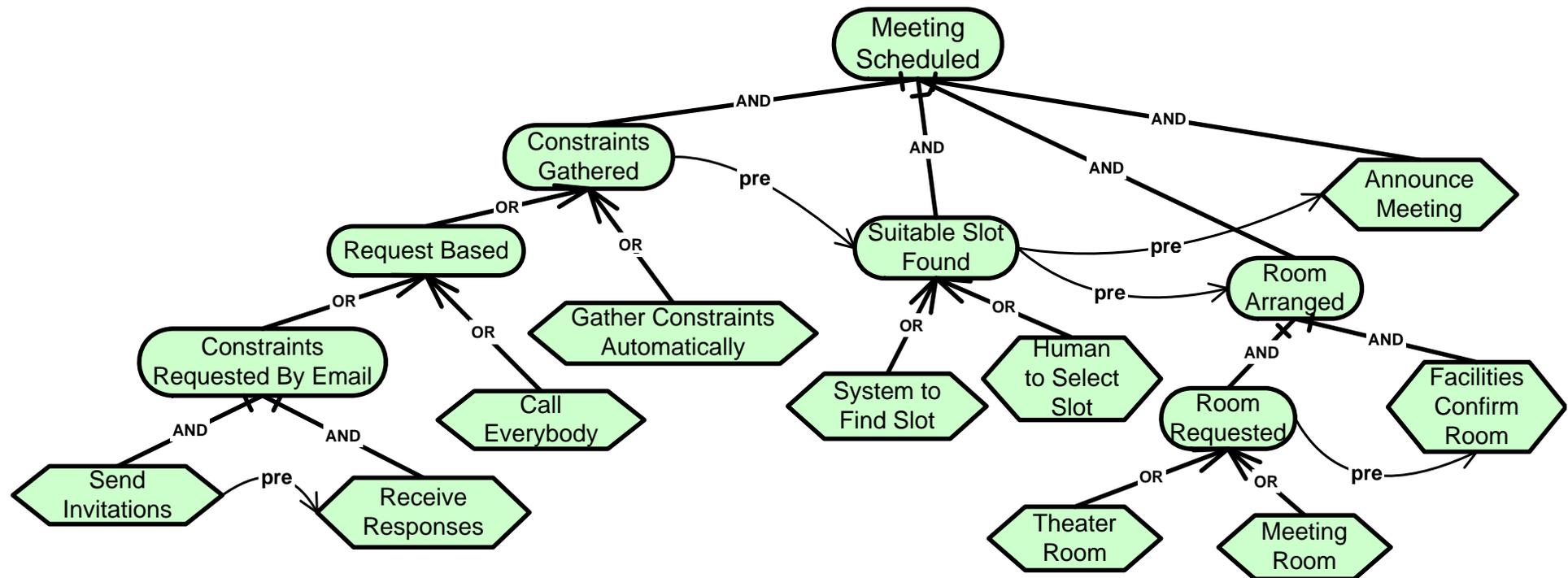
# Temporally Extended Goal Models



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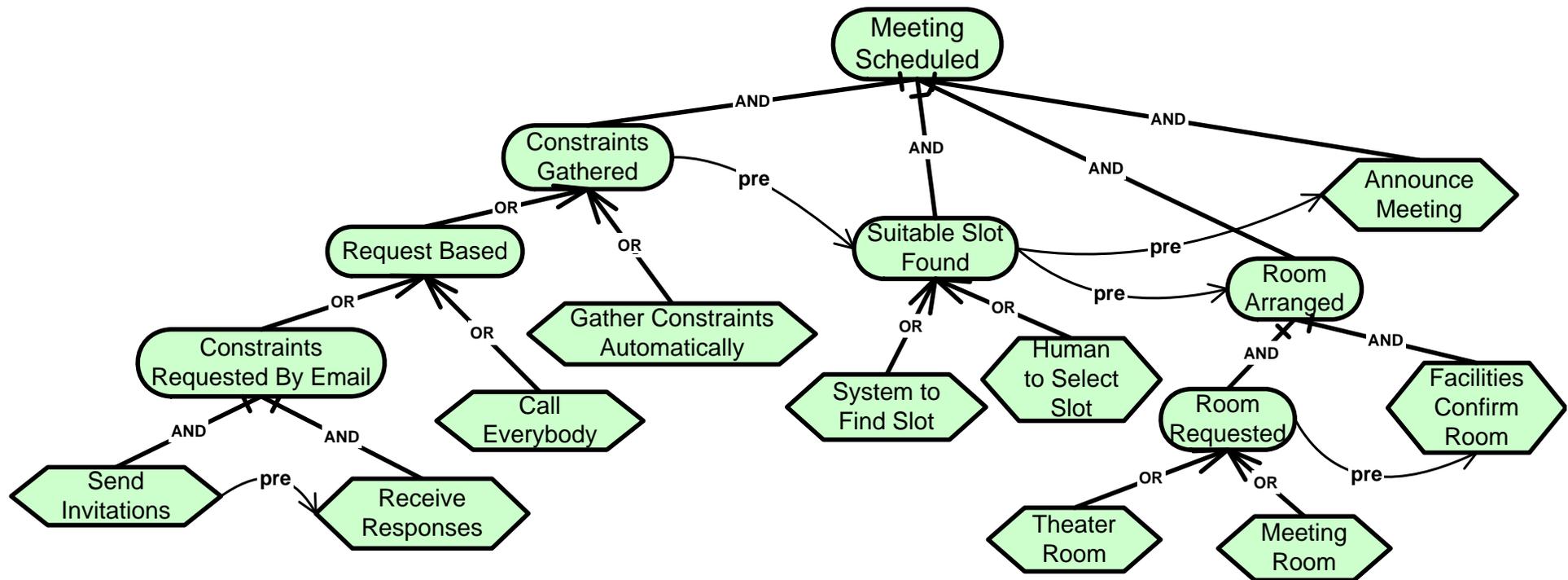
# Temporally Extended Goal Models



[Gather Constraints Automatically, System to Find a Slot, Theater Room (requested), Announce Meeting, Facilities Confirm Room]

[Receive Responses, Send Invitations, Human to Select Slot, Facilities Confirm Room, Theater Room (request), Announce Meeting]

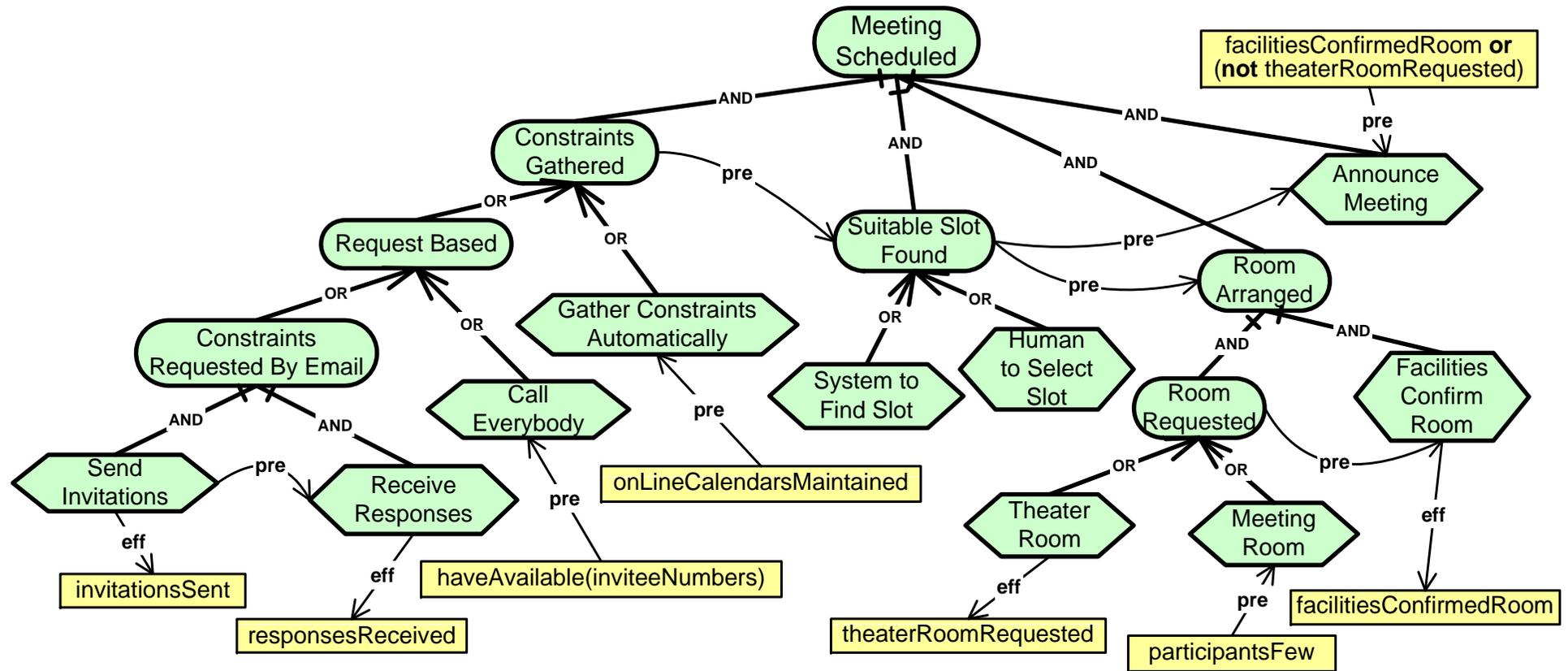
# Temporally Extended Goal Models



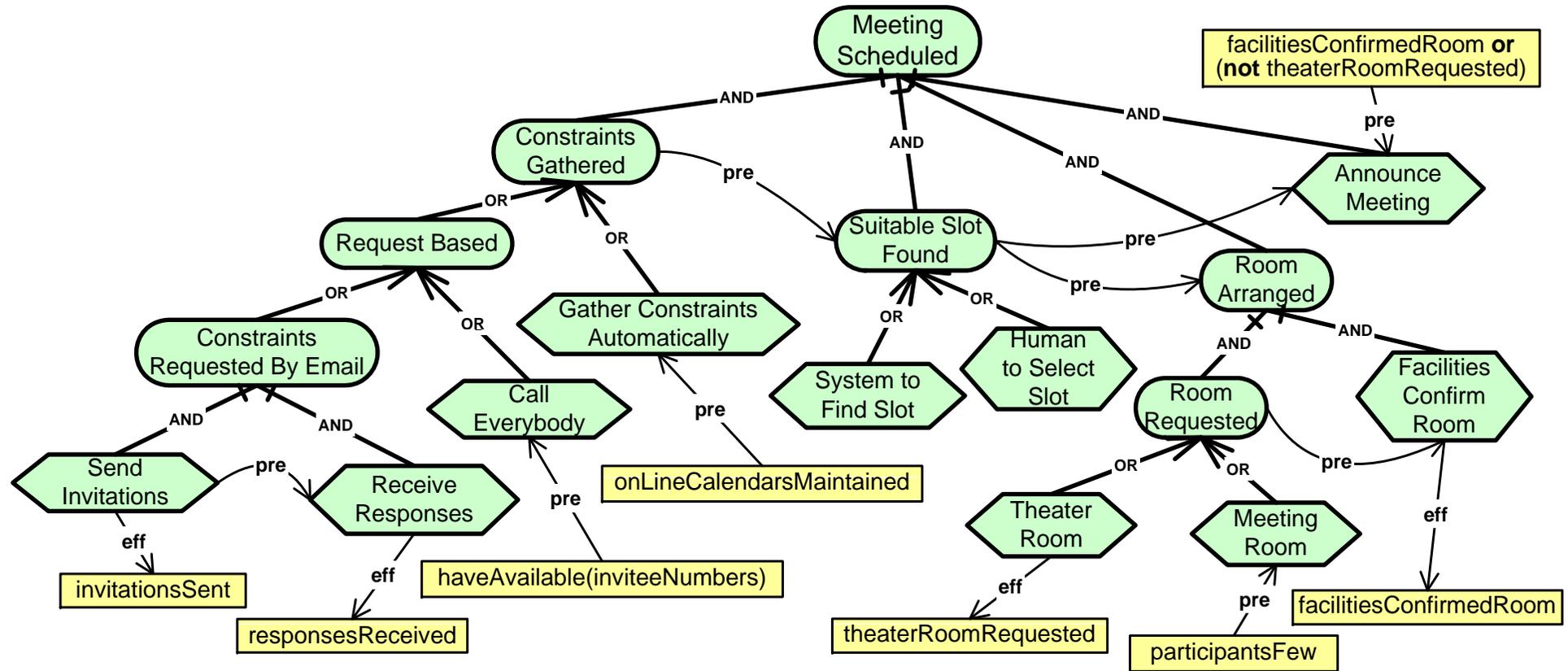
[Gather Constraints Automatically, System to Find a Slot, Theater Room (requested), Announce Meeting, Facilities Confirm Room]

[~~Receive Responses~~, ~~Send Invitations~~, Human to Select Slot, ~~Facilities Confirm Room~~, ~~Theater Room (request)~~, Announce Meeting]

# Representing State with Domain Predicates

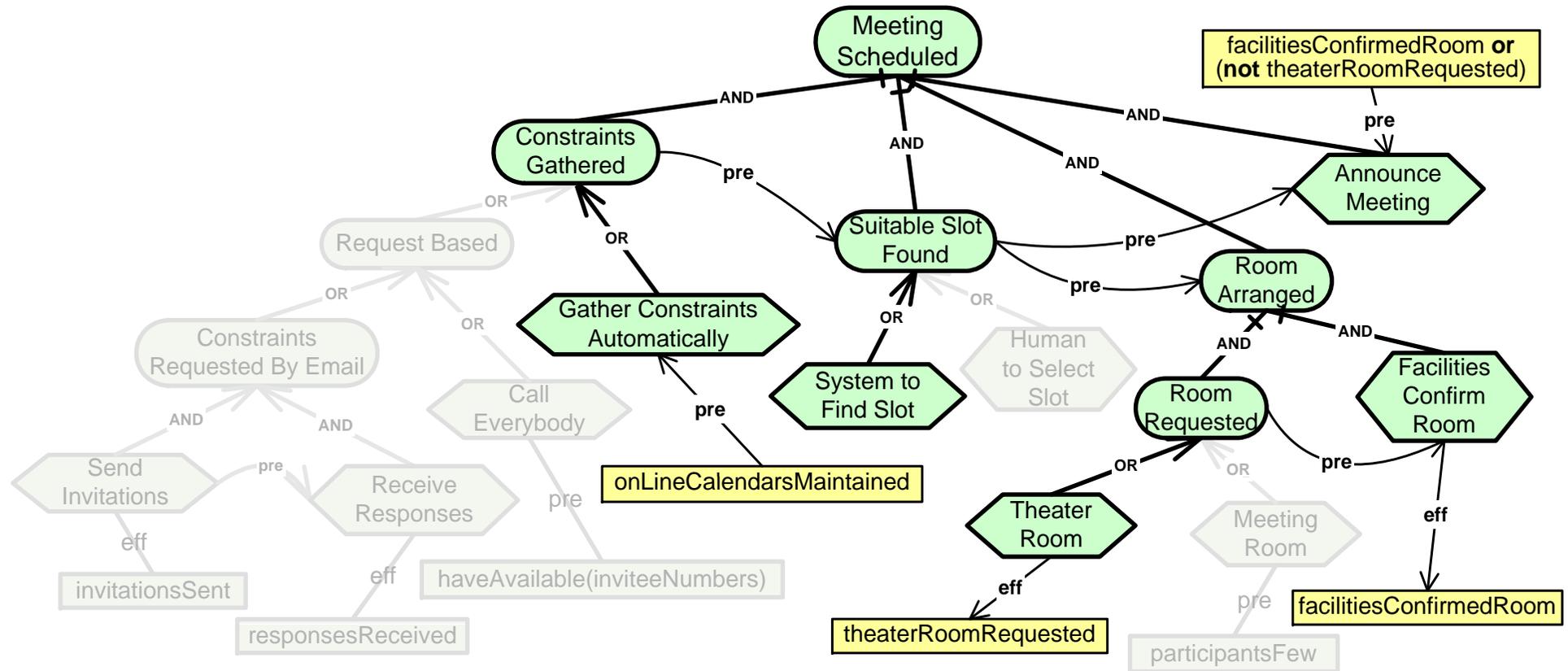


# Leveraging Temporal Variability: *Preferences*



$$(\diamond \text{ callEverybody}) \times 0.4 + (\neg \text{ announceMeeting} \cup \text{ facilitiesConfirmRoom}) \times 0.6$$

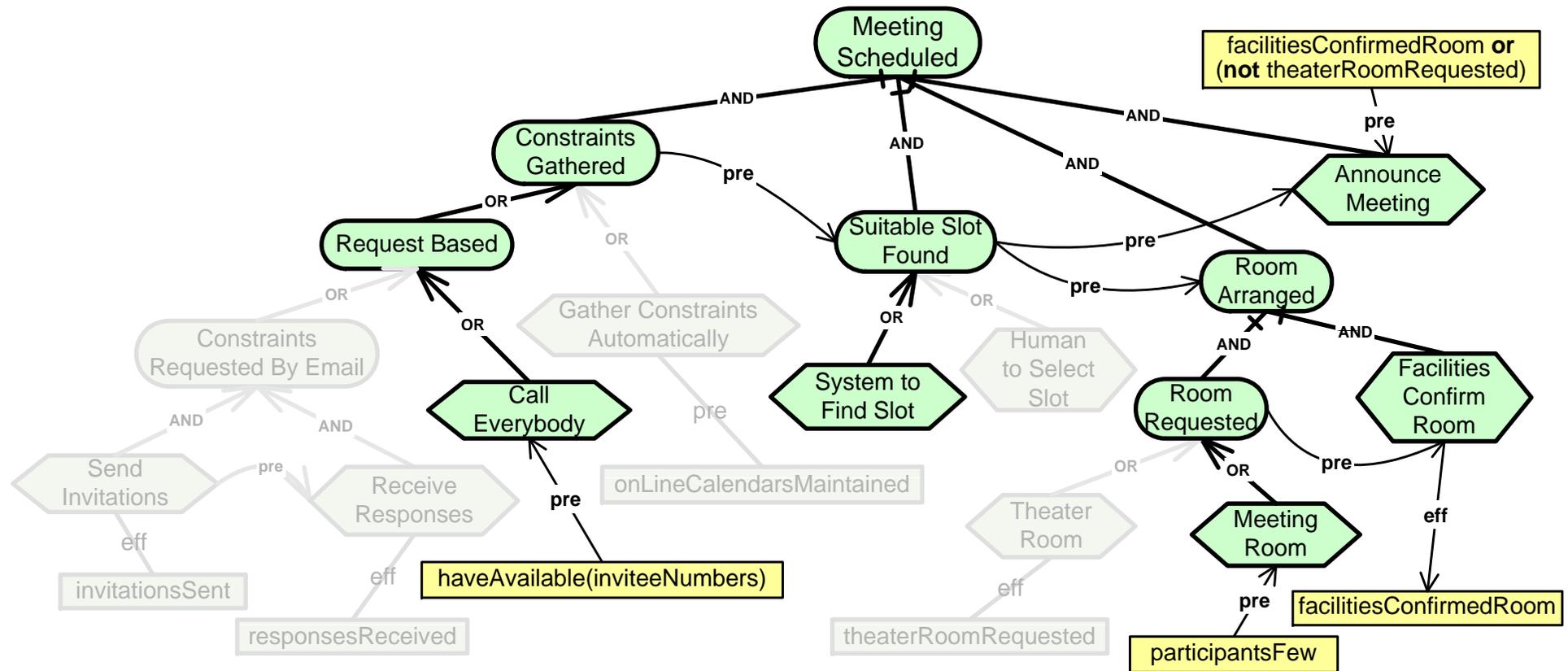
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$$(\diamond \text{ callEverybody}) \times 0.4 + (\neg \text{ announceMeeting } \cup \text{ facilitiesConfirmRoom}) \times 0.6$$

\* [Gather Constraints Automatically, System to Find a Slot, Theater Room (requested), Announce Meeting, Facilities Confirm Room]  $\rightarrow$  **0.6**

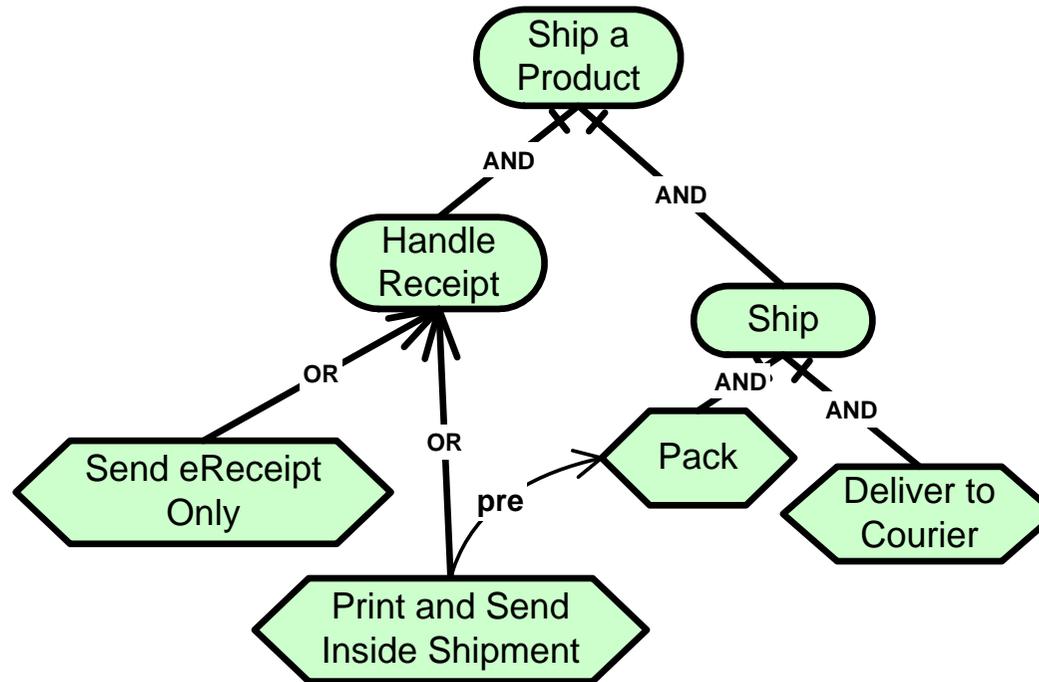
# Leveraging Temporal Variability: *Preferences*



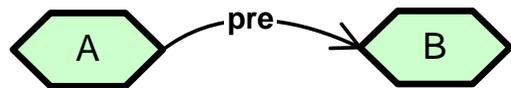
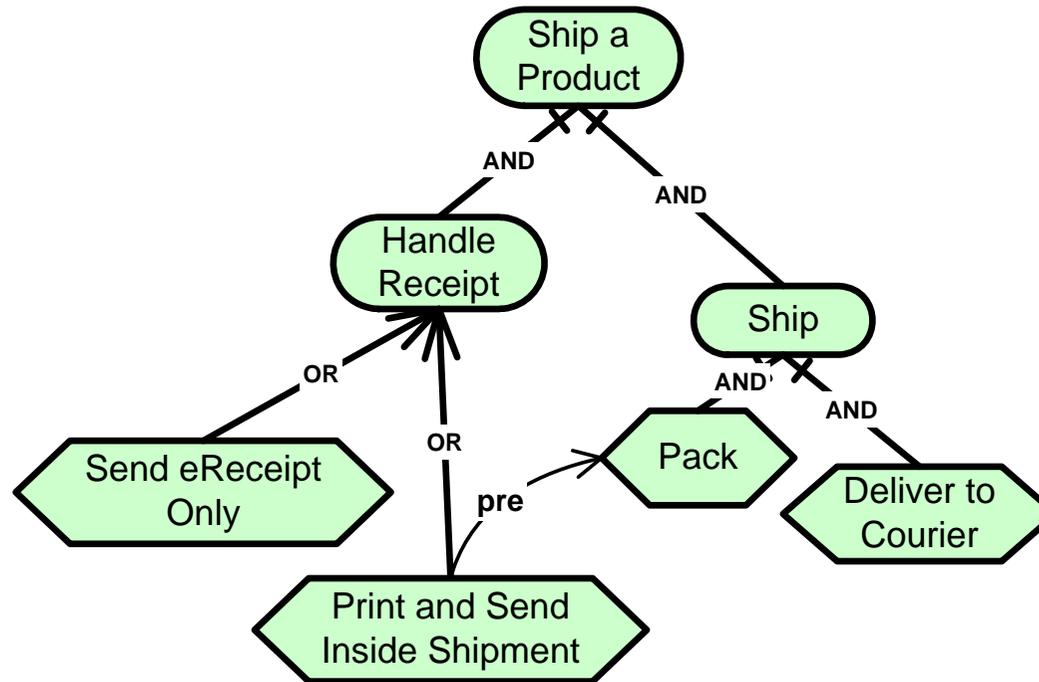
$$(\diamond \text{callEverybody}) \times 0.4 + (\neg \text{announceMeeting} \cup \text{facilitiesConfirmRoom}) \times 0.6$$

\* [Call Everybody, System to Find a Slot, Meeting Room (requested), Facilities Confirm Room, Announce Meeting]  $\rightarrow$  **0.4**

# Visual Temporal Constraints: Caveats



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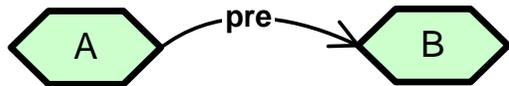
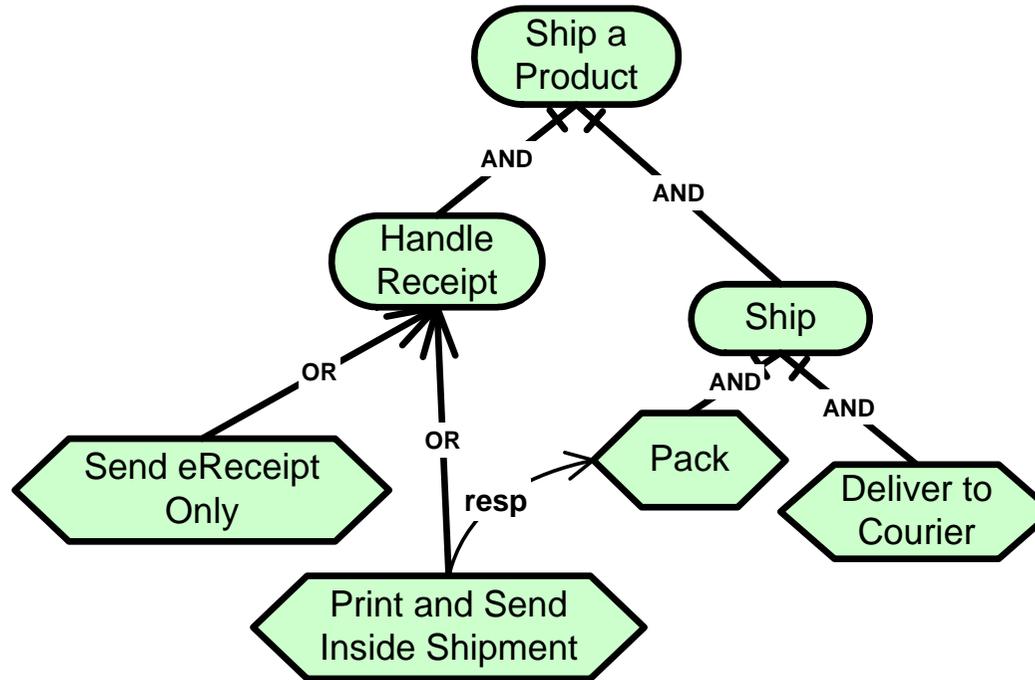


**Precedence:** if **B** then **A** must have preceded (if **not B** we don't care)  
 $\neg A U ( B \text{ or } \square \neg A)$



**Response:** if **A** then **B** must follow (if **not A** we don't care)  
 $\square(A \Rightarrow \diamond B)$

# Visual Temporal Constraints: Caveats

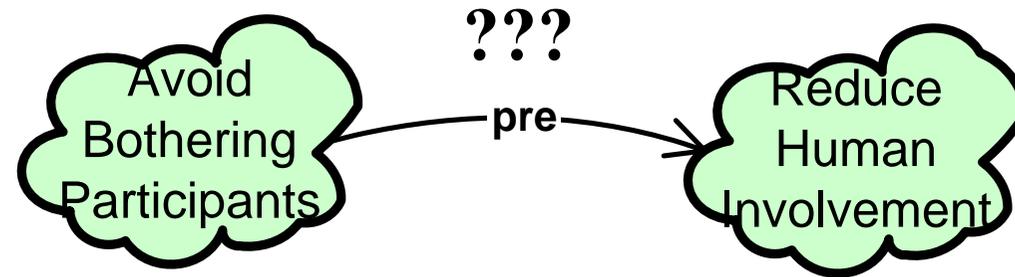


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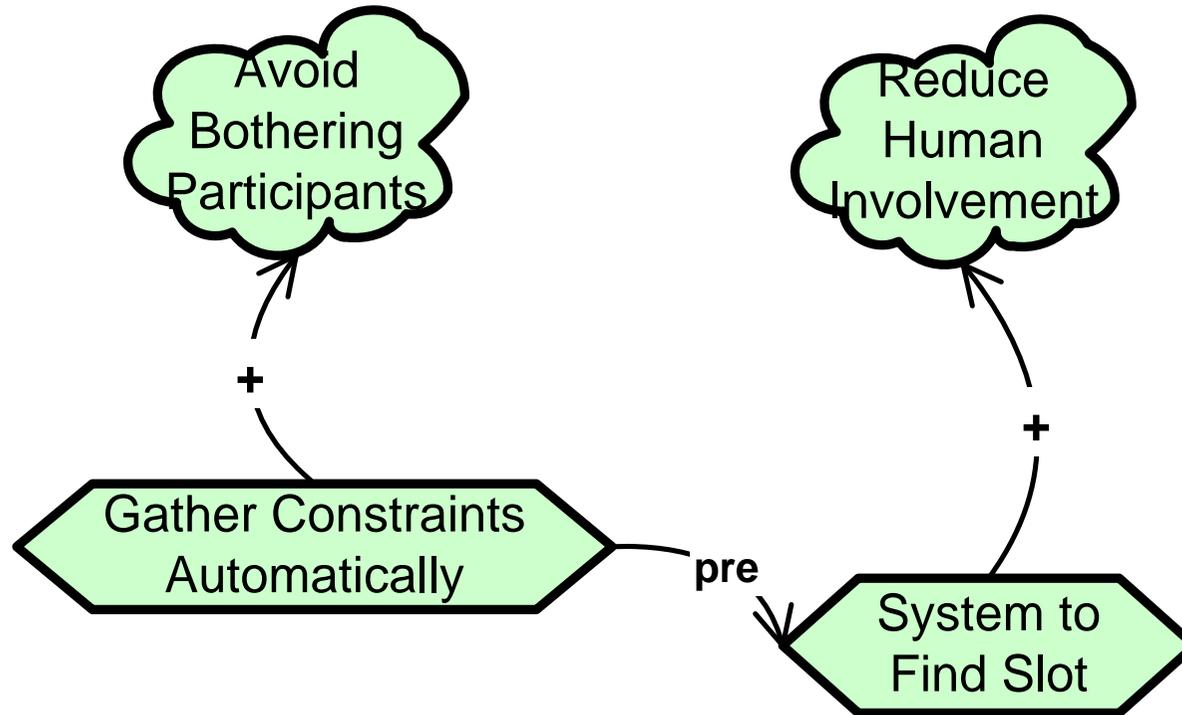


**Response:** if **A** then **B** must follow (if **not A** we don't care)  
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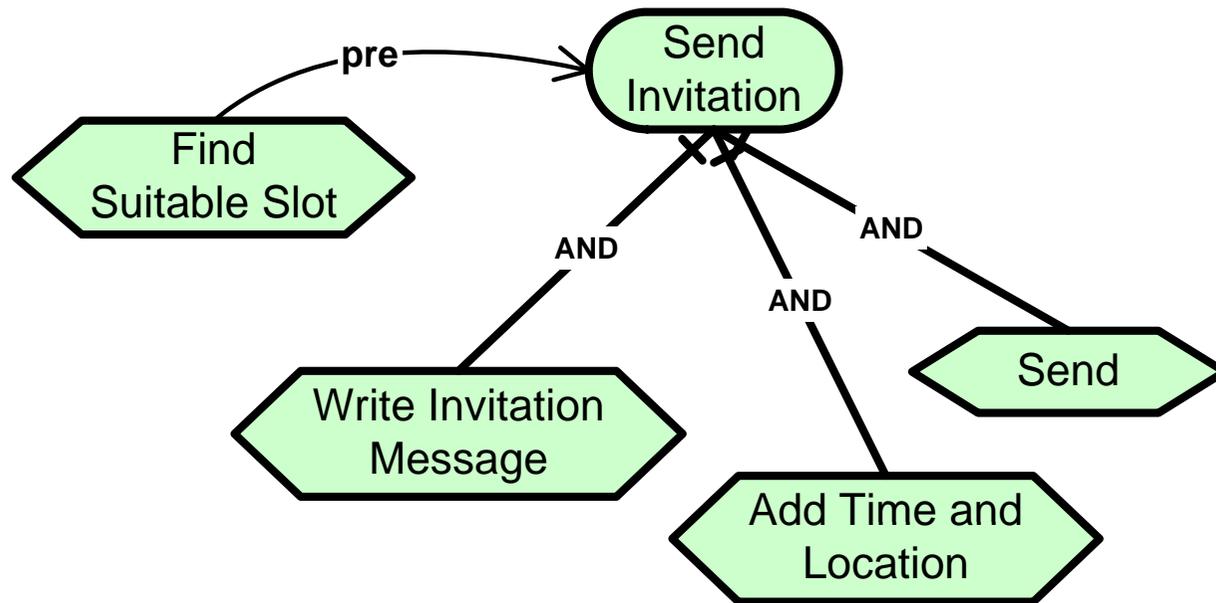
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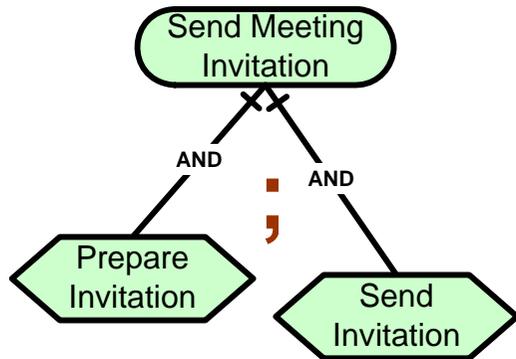


Can't we write the invitation message before we have found a suitable slot?

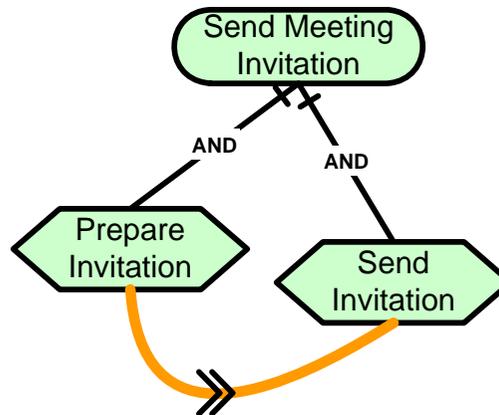
# Goal Models and Satisfaction Ordering

- Supported since KAOS (LTL).
  - Not widely accepted approach for modeling ordering *within* semi-formal goal models (e.g.  $i^*$ ).
- Researchers add their own visual constraints
  - To prepare for formalization (Golog, SMV, PDDL).
  - Biased towards formal language of choice.

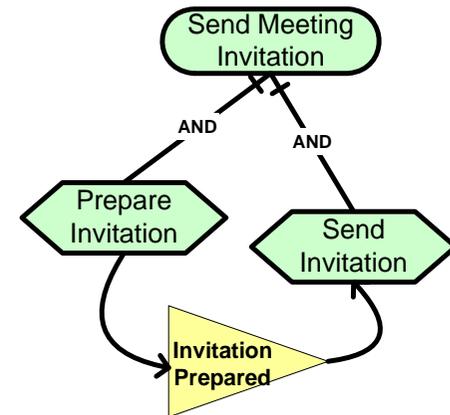
# Adding Ordering Information to Goal Models



Lapouchnian, Wang,  
Lesperance et al. (Golog)  
– CAiSE06, AOIS01

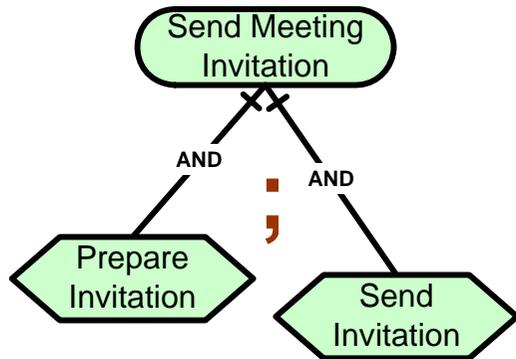


**Formal Tropos.** Fuxman, Liu,  
Pistore, Roveri, Mylopoulos et  
al. (SMV) – RE03

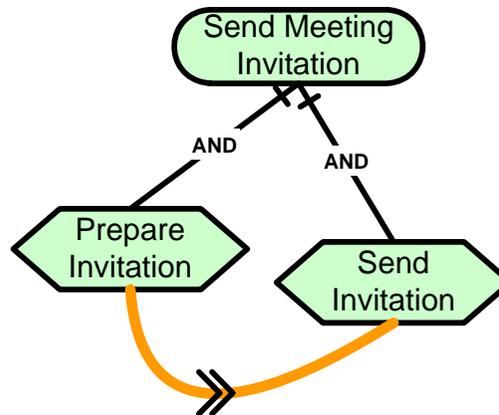


**Snet.** Gans,  
Lakemayer, Jarke,  
Vits et al. (Golog)  
– CAiSE02

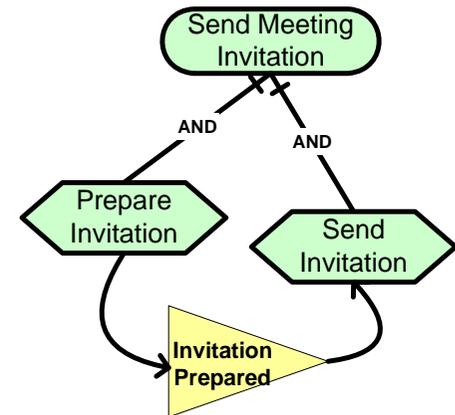
# Adding Ordering Information to Goal Models



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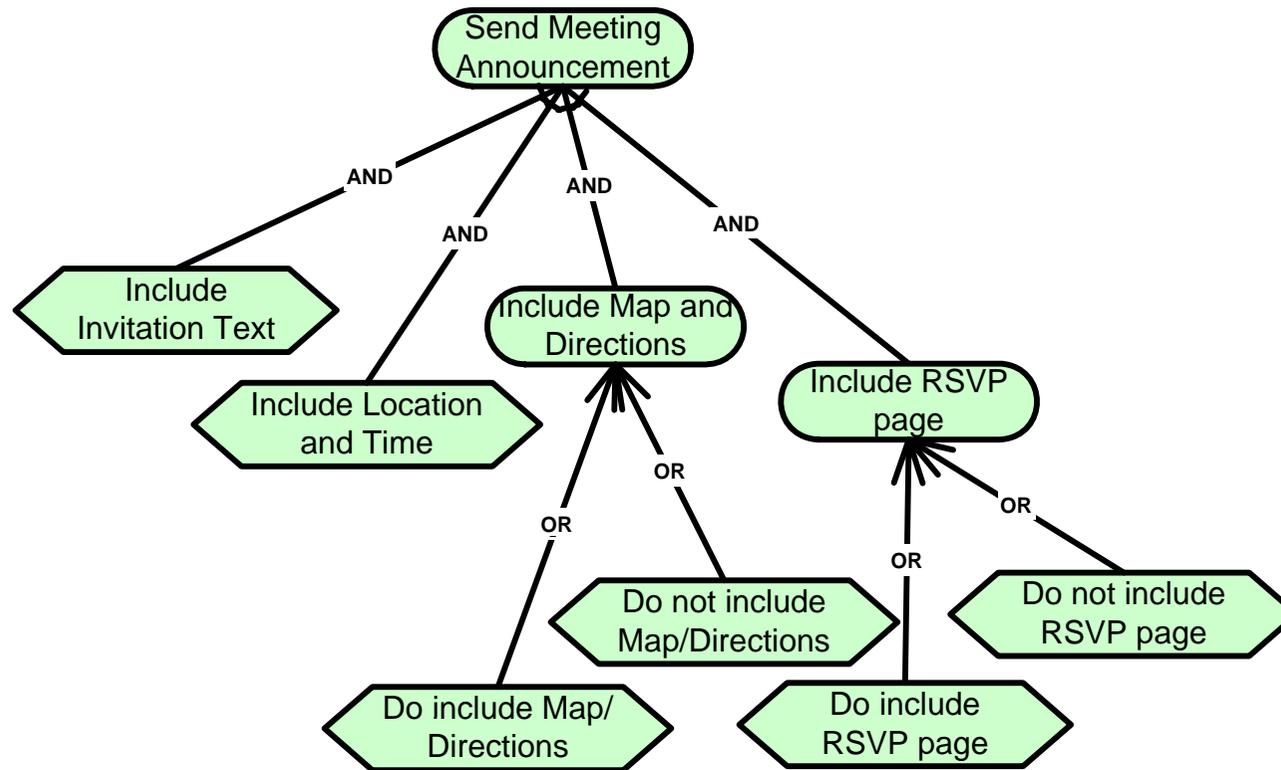


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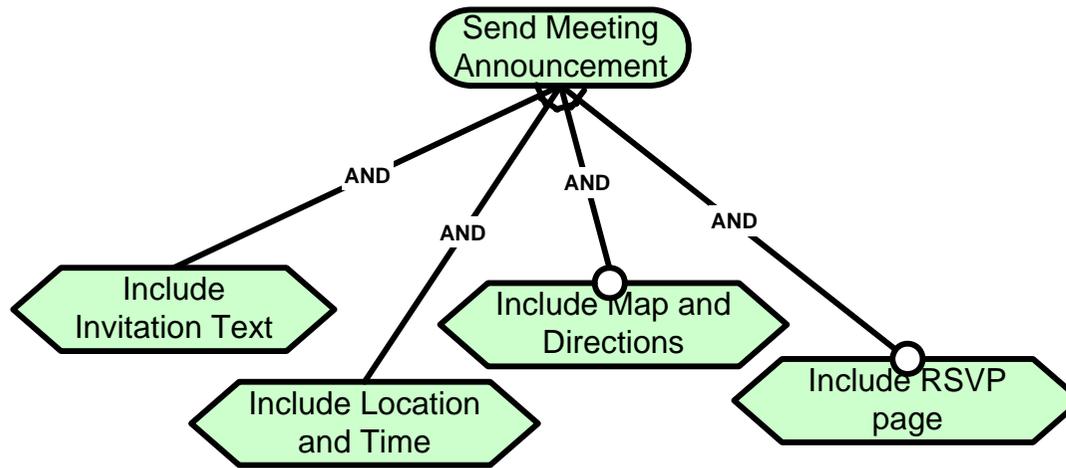
# Summary

- Enabling the Ordering Aspect of Goal Models
  - Forces a different “reading” of the models
  - Space of alternatives explodes
- Visual Constraint Elements
  - Many people have attempted it for preparing analysis.
  - May have a visual value.
  - Interesting ramifications.
- Future Work:
  - Empirical Investigation on Comprehensibility of such interventions.

# Side note: Optional Goals

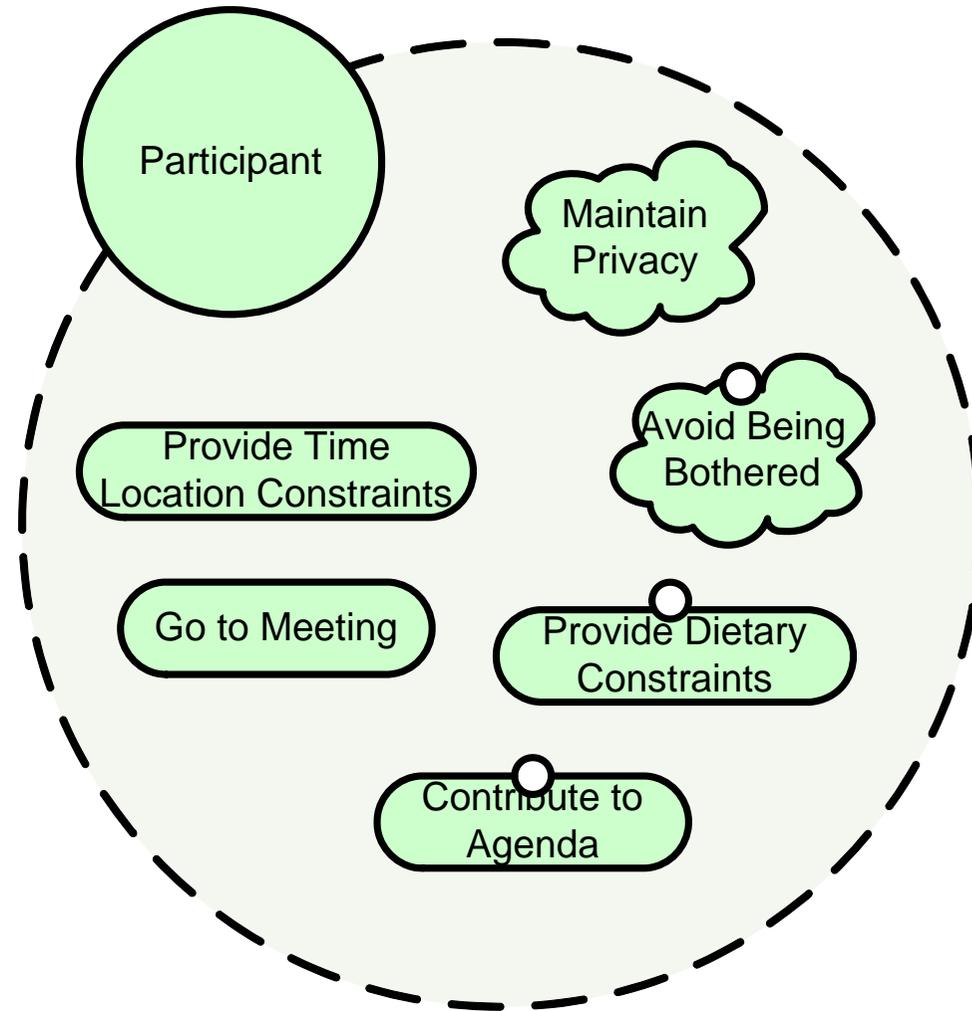


# Side note: Optional Goals



# Optional Roots Goals?

## Optional Soft-goals?



# Thank you!

(questions?)