



# Argumentation-based Methodology for Goal-oriented Requirements Language (GRL)

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SEPIDEH GHANAVATI

MARC VAN ZEE

FLORIS BEX



# RationalGRL Framework

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- A tool-supported approach that:
  - maps argument diagrams to GRL and
  - helps developing GRL models by allowing for better representation of the stakeholders' arguments and discussions.
- Arguments are integrated in goal models via argument schemes.
- RationalGRL combines GRL with Practical Reasoning Argumentation Scheme (PRAS)

$$\textit{RationalGRL} = \textit{GRL} + \textit{PRAS}$$



# Related Work

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- Jureta et al. propose:
  - “*Goal Argumentation Method (GAM)*” to guide argumentation and justification of modeling choices during the construction of goal models.
- GAM includes:
  - A mechanism to translate formal argument models to goal models.
    - RationalGRL framework is an instantiation and implementation of part of the GAM.
- Difference between our approach and GAM is:
  - RationalGRL integrates arguments and goal models using argument schemes and it is applied to GRL. Also, GRL is the input to the framework.
  - GAM instead uses structured argumentation and it is applied to  $i^*$ .



# Practical Reasoning Argumentation Scheme (PRAS)

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- PRAS aims at reasoning about goals and actions.
- PRAS follows the basic argument schemes as:

*We have goal G; Doing action A realize goal G; Which promote value V;*

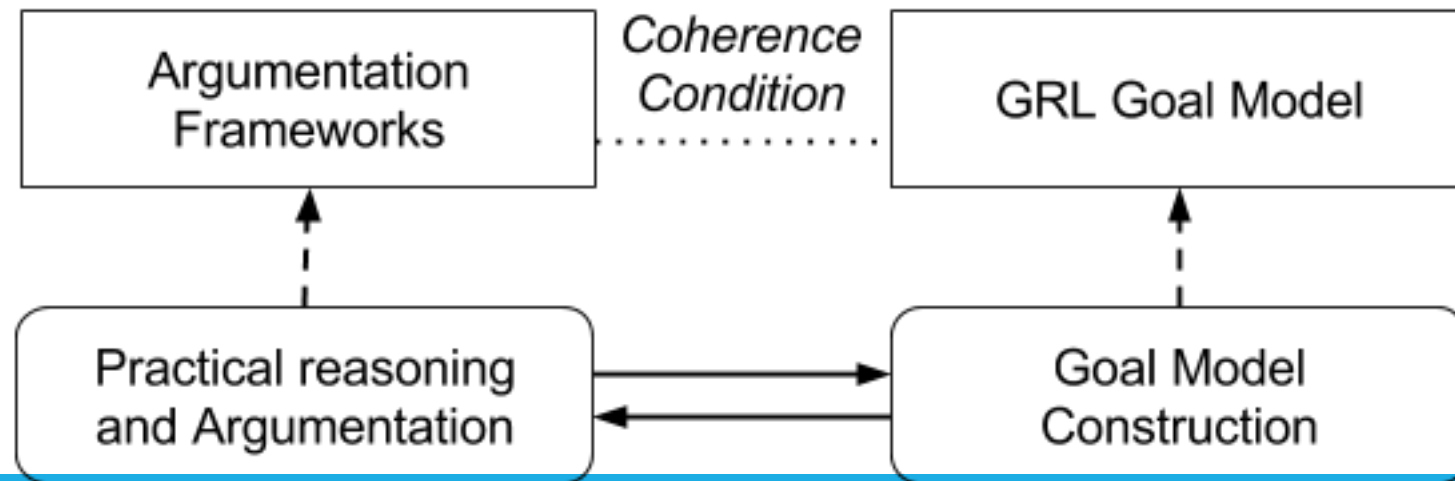
*Therefore, We should perform action A.*

- PRAS also includes a set of Critical Questions
  - Criticize practical arguments for acceptance or rejection.
- Examples are:
  - Will the action satisfies the desired goal?
  - Are there alternative ways of realizing the same goal?



# RationalGRL Framework

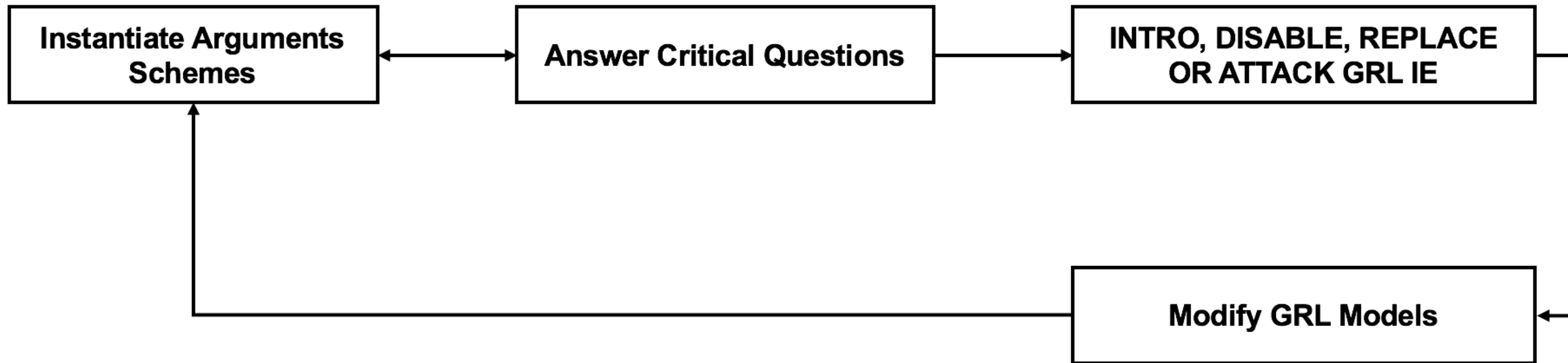
- RationalGRL integrate GRL with underlying discussions and arguments of the stakeholders during the analysis phase. → GRL with PRAS
- Argumentation framework is developed based on:
  - The analysis of critical questions, practical reasoning and discussions of the stakeholders.



# RationalGRL Methodology I

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The methodology starts with a GRL model that is derived from stakeholder's functional and non-functional requirements.



# RationalGRL Methodology II

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- Instantiate Argument Schemes (AS)
  - There are 14 argument schemes.
  - Example: “Goal G contributes to softgoal S”.
  - An argument is for or against part of a goal model.
- Answer Critical Questions (CQs)
  - Critical questions can attack the argument.
  - Each argument scheme has one or more critical questions.
  - Examples: “Does the goal contributes to the softgoal?”
  - CQ can instantiate a new argument scheme.



# Argument Schemes and Critical Questions

Argument scheme		Critical Questions		Effect
AS0	Actor $a$ is relevant	CQ0	Is the actor relevant?	DISABLE
AS1	Actor $a$ has resource $R$	CQ1	Is the resource available?	DISABLE
AS2	Actor $a$ can perform task $T$	CQ2	Is the task possible?	DISABLE
AS3	Actor $a$ has goal $G$	CQ3	Is the goal a legitimate goal?	DISABLE
LE	AS4 Actor $a$ has softgoal $S$	CQ4	Is the softgoal a legitimate softgoal?	DISABLE
LE	AS5 Goal $G$ decomposes into tasks $T_1, \dots, T_n$	CQ5a	Does the goal decompose into the tasks?	DISABLE
CE		CQ5b	Does the goal decompose into any other tasks?	REPLA
LE	AS6 Task $T$ contributes to softgoal $S$	CQ6a	Does the task contribute to the softgoal?	DISABLE
		CQ6b	Are there alternative ways of contributing to the same softgoal?	INTRO
		CQ6c	Does the task have a side effect which contribute negatively to some other softgoal?	INTRO
		CQ6d	Does the task contribute to some other softgoal?	INTRO
LE	AS7 Goal $G$ contributes to softgoal $S$	CQ7a	Does the goal contribute to the softgoal?	DISABLE
		CQ7b	Does the goal contribute to some other softgoal?	INTRO
LE	AS8 Resource $R$ contributes to task $T$	CQ8	Is the resource required in order to perform the task?	DISABLE
	AS9 Actor $a$ depends on actor $b$	CQ9	Does the actor depend on any actors?	INTRO
CE	AS10 Task $T_1$ decomposes into tasks $T_2, \dots, T_n$	CQ10a	Does the task decompose into other tasks?	REPLA
CE		CQ10b	Is the decomposition type correct? (AND/OR/XOR)	REPLA
LE	AS11 Task $T$ contributes negatively to softgoal $S$	CQ11	Does the task contribute negatively to the softgoal?	DISABLE
LE	AS12 Element $IE$ is relevant	CQ12	Is the element relevant/useful?	DISABLE
CE	AS13 Element $IE$ has name $n$	CQ13	Is the name clear/unambiguous?	REPLA
K	-	Att	Generic counterargument	ATTAC





# RationalGRL Methodology III

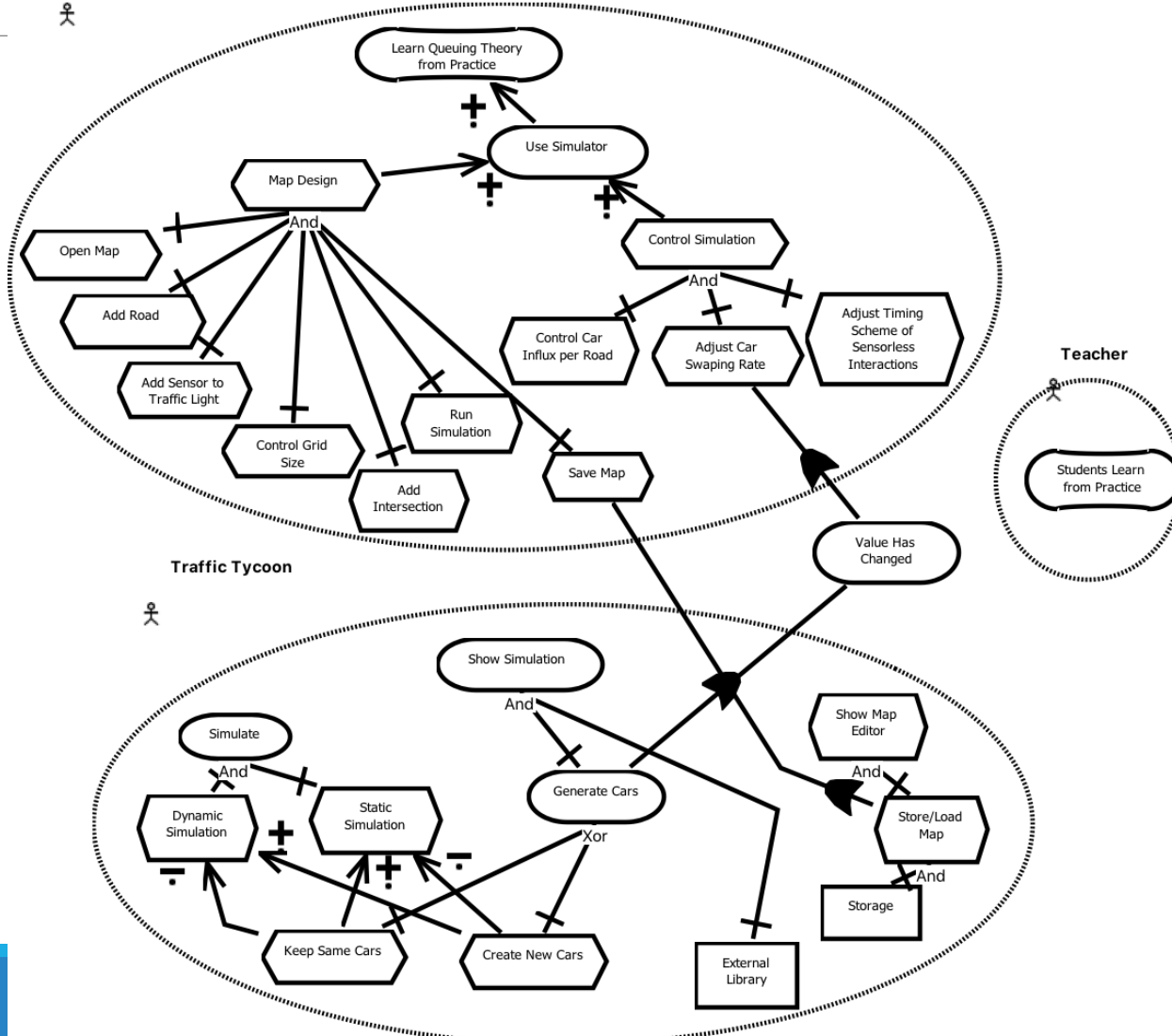
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- Decide on Intentional Elements (IE) and their Relationships
  - Answering CQ can result in one of the four cases:
    - **INTRO**: The argument scheme of the CQ does not get attacked and instead it creates a new argument.
    - **DISABLE**: The IE or the relationship related to the AS needs to be disabled or removed.
    - **REPLACE**: Introduces a new argument and attack the original argument at the same time.
    - **ATTACK**: A generic counterargument which attacks any argument with another argument.
- Modify GRL Models
  - Based on the result of the step above, the GRL model gets modified.
  - An IE or relationship can be introduced, disabled, replaced or attacked by another one.



# Traffic Simulator Example I

Student  
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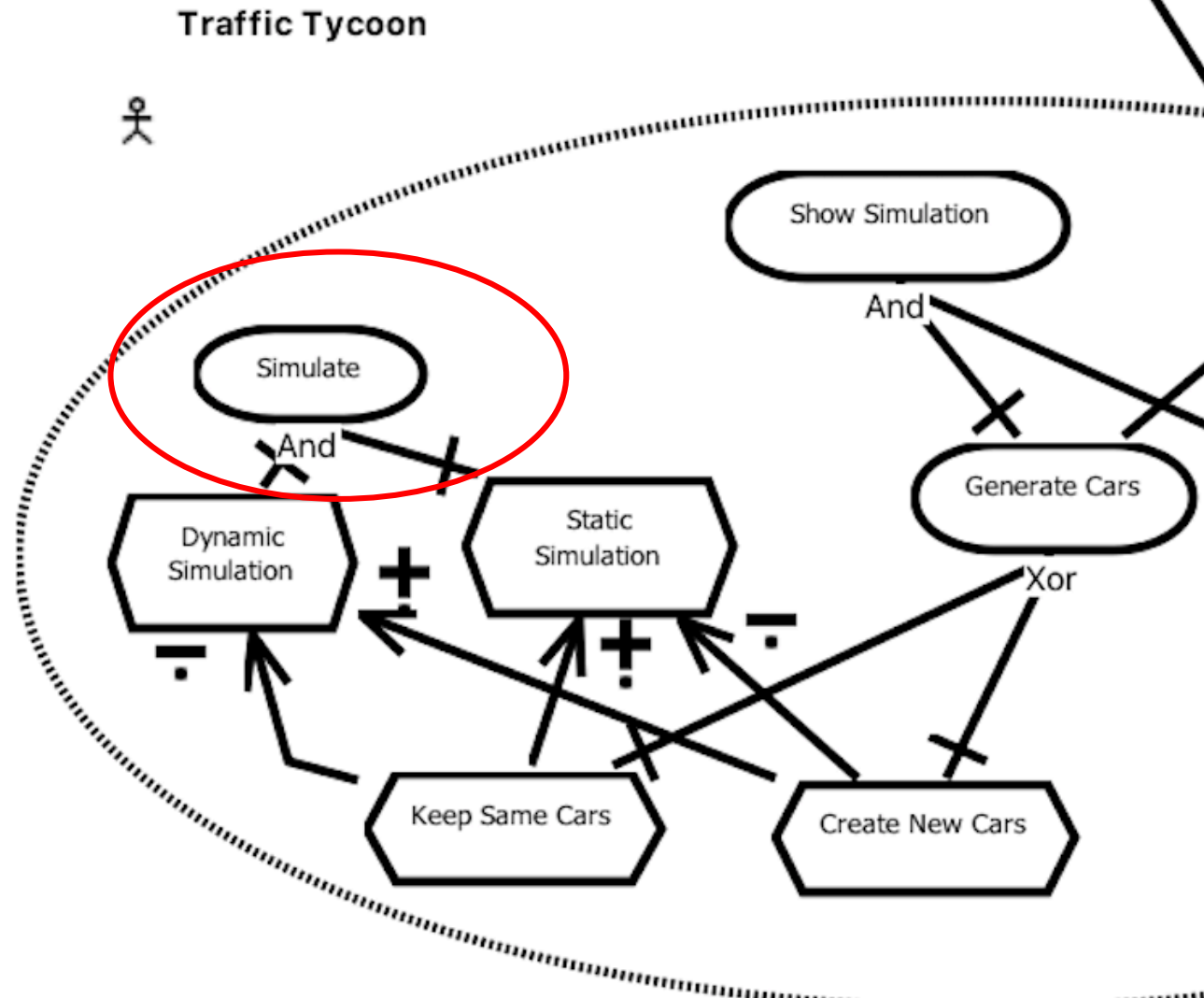
# Critical Questions Example for Traffic Simulator

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- Why does actor *Teacher* have only a single softgoal *Students learn from practice*?
  - Why is this, for instance, not connected to any of the elements of *Student*?
- What does *Adjust timing schemes of sensorless interactions* mean?
- Why does task *Keep same cars* contribute positively to *Static simulation* and negatively to *Dynamic simulation*?
- How does the *Student* control the *Traffic Tycoon*?
- Why does *Map design* have so many decompositions into other tasks?



# Traffic Simulator Example II



# Traffic Simulator Example III

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- Critical Question 1 (CQ1):
  - Does *Simulate* AND-decompose into any tasks?
  - Answer: Yes → namely tasks *Dynamic simulation* and *Static simulation*.
  - → Two argument schemes.
- Two argument schemes:
  - Actor *Traffic Tycoon* has task *Dynamic simulation*.
  - Actor *Traffic Tycoon* has task *Static simulation*.
- GRL model → Goal *Simulate* → AND-Decomposed to Tasks *Dynamic simulation* and *Static simulation*.



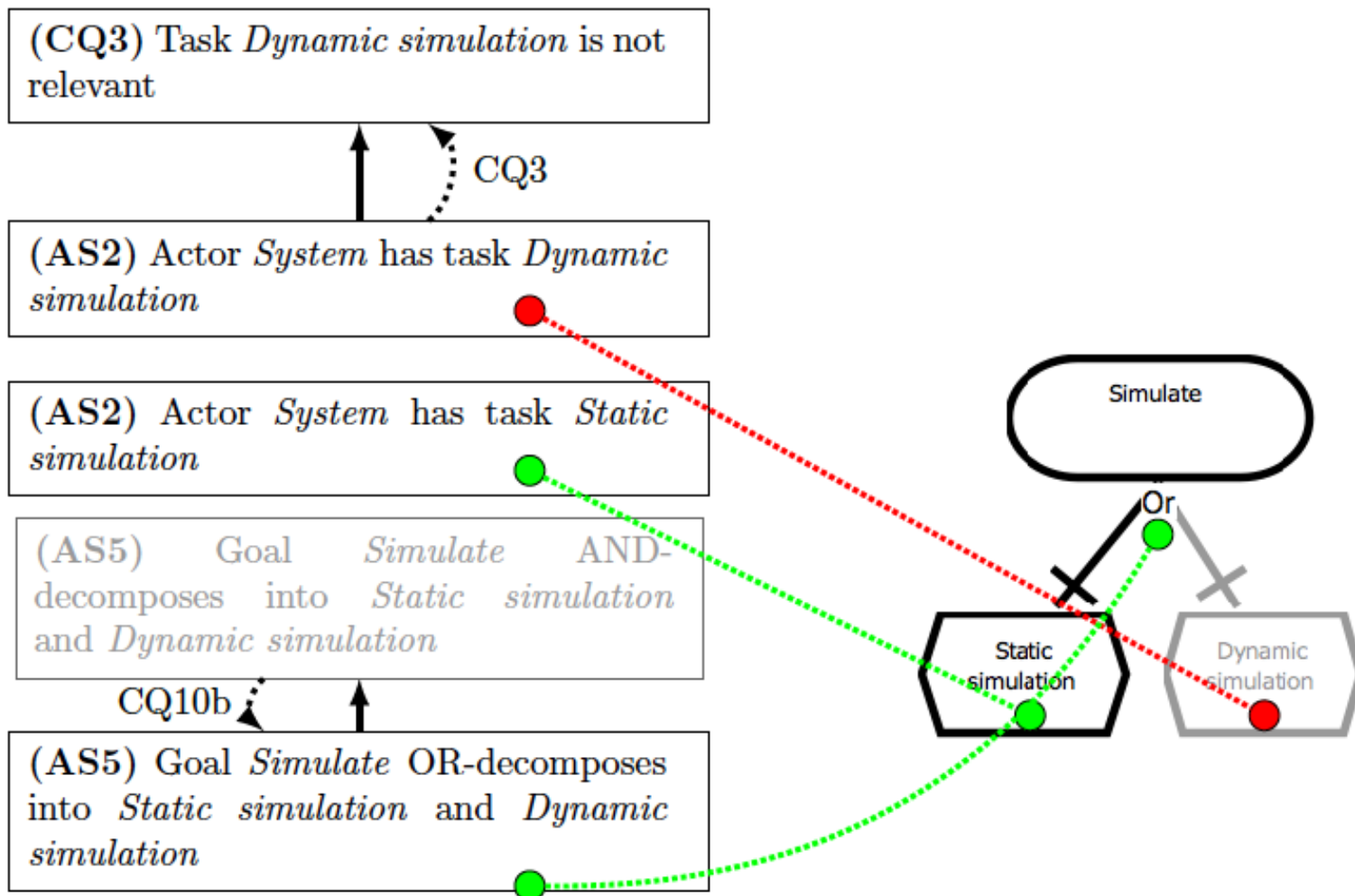
# Traffic Simulator Example IV

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- Critical Question 2 (CQ2):
  - Is task *Dynamic simulation* relevant?
  - Answer: No, it is not relevant! → *The requirements specification explicitly states dynamic simulations are not required.*
- GRL model:
  - The corresponding GRL IE is *disabled*.
  - The decomposition is changed from *AND* to *OR*, since it turned out not both tasks can be implemented together.



# Traffic Simulator Example IV



# Conclusion

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- Proposed RationalGRL framework which
  - Integrates argumentation techniques from AI with goal modeling GRL.
  - Helps documenting stakeholders' discussions about GRL models.
- Provided the list of argument schemes and relevant critical questions.
- Illustrated the framework's steps through an example.





# Future Work

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- Extend argumentation framework by performing an empirical studies so that we can capture more AS that are relevant to GRL.
- Develop a tool-support that can also be integrated with GRL tool-support, jUCMNav, to help analyzing the AS and CQs.
- Provide better mapping between PRAS and GRL.
- Evaluate our work with more rigorous case studies.



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**Thanks!**  
**Any Questions?**

