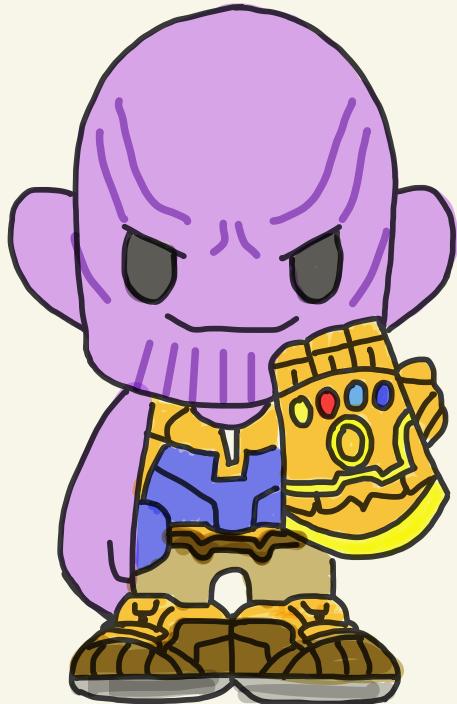


# Permissiveness for Strategy Adaptation

Highlights' 23



July 25, 2023

Ashwani Anand  
MPI-SWS

with K.Mallik (ISTA), S.P.Nayak (MPI-SWS), and A.-K.Schmuck (MPI-SWS)



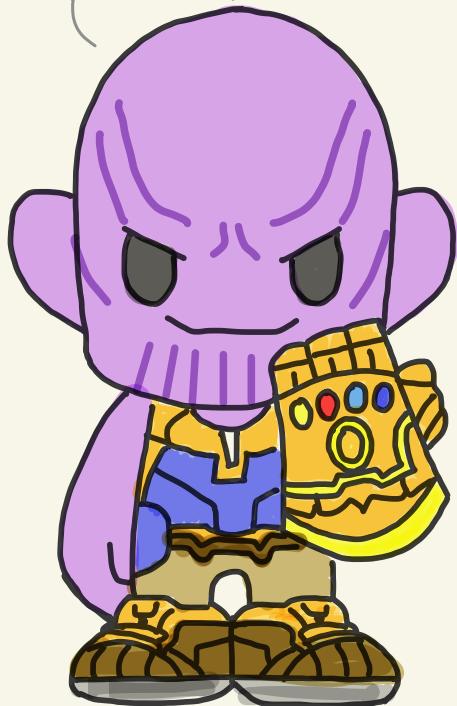
I will eliminate  
half the population



I am agile



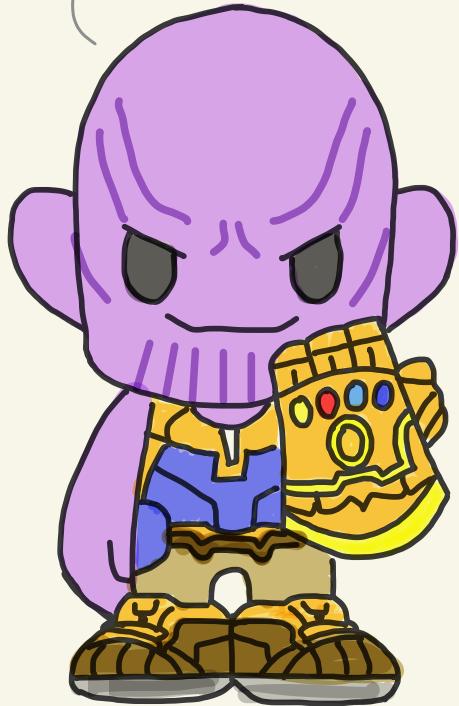
I will eliminate  
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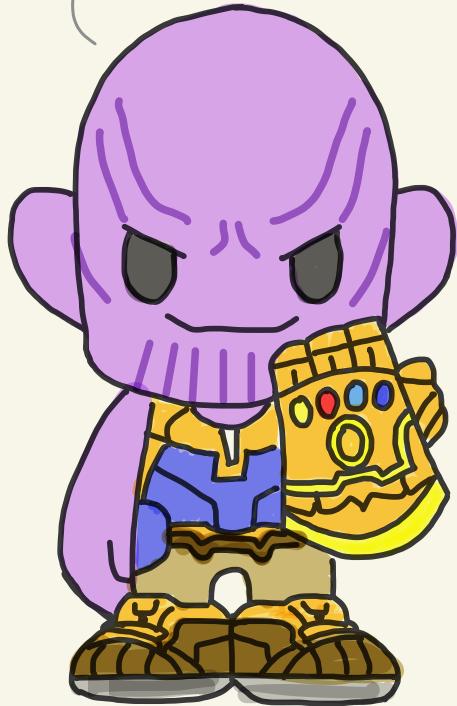
I will eliminate  
half the population



I am the  
captain



I will eliminate  
half the population



I am agile



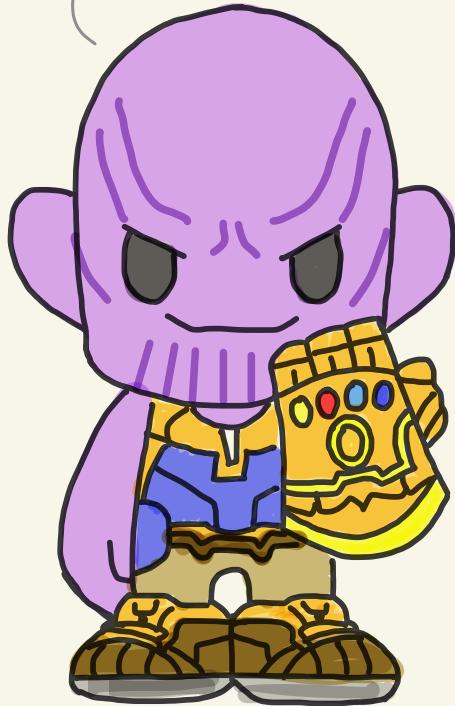
I have expensive  
toys



I am the  
captain



I will eliminate  
half the population



I am agile



I have expensive  
toys



I am the  
captain



I am a  
strategist



I will eliminate  
half the population



I am agile



I have expensive  
toys



I control thunder



I am the  
captain



I am a  
strategist



I will eliminate  
half the population



I am agile



I have expensive  
toys



I control thunder



I am the  
captain



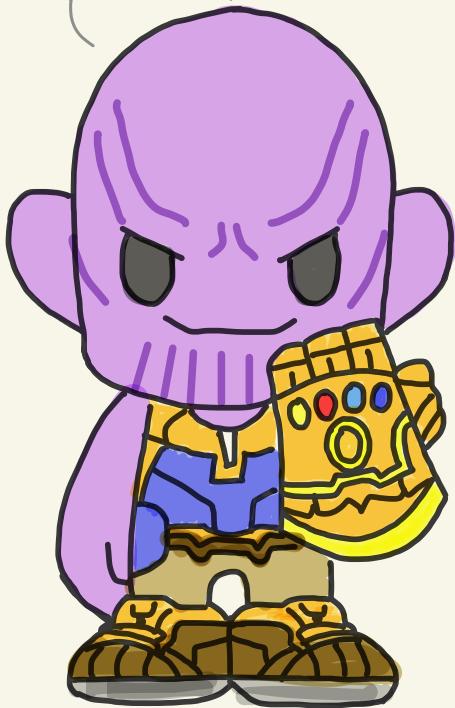
I am a  
strategist



I smash



I will eliminate  
half the population



I control thunder



I smash



I will eliminate  
half the population



Is it possible to  
satisfy the task?

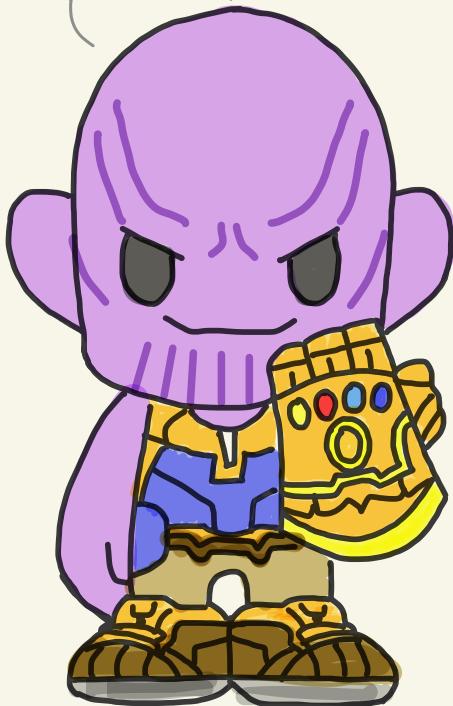
I control thunder



I smash



I will eliminate  
half the population



Is it possible to  
satisfy the task?

If yes, what should  
each agent do ?

I control thunder



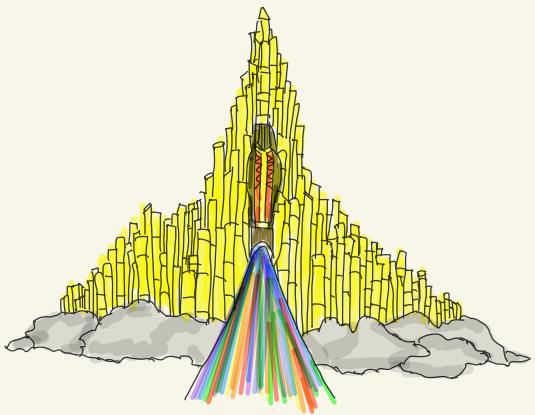
I smash



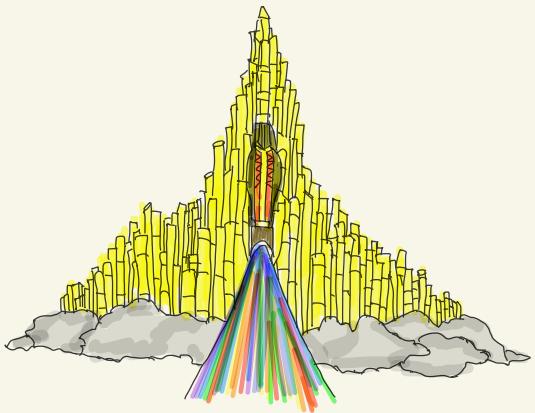
# Simpler Battle



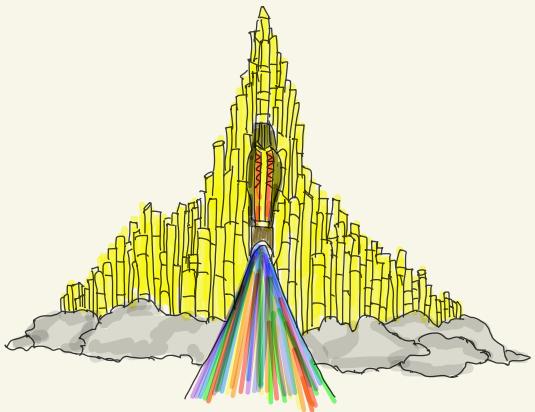
# Simpler Battle



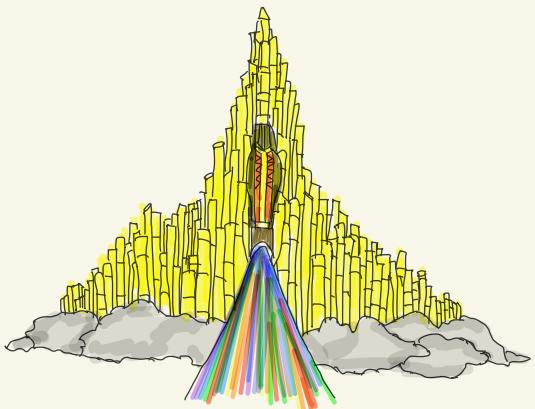
# Simpler Battle



# Simpler Battle



# Simpler Battle



I will distract  
Hela

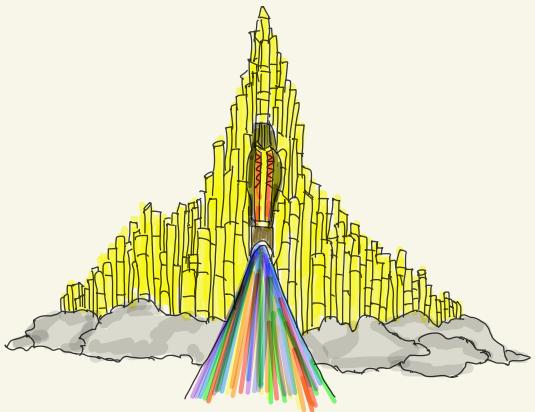


We need to  
save people  
of Asgard



I will evacuate  
people

# Simpler Battle



Each agent has individual tasks

I will distract  
Hela



We need to  
save people  
of Asgard



I will evacuate  
people

# Reactive Synthesis

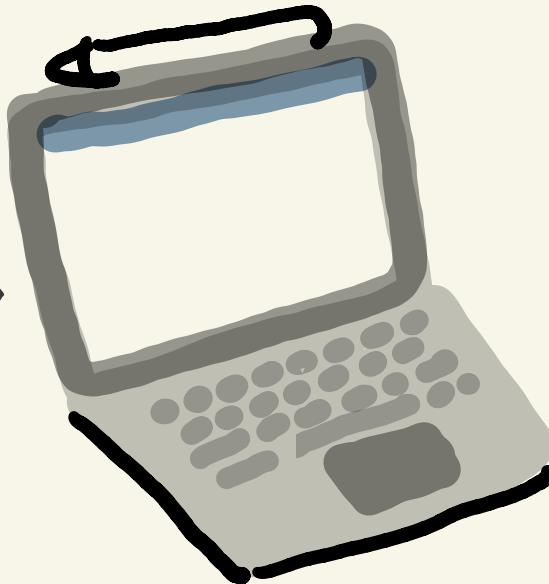
Task for an agent

Distract

Hela

# Reactive Synthesis

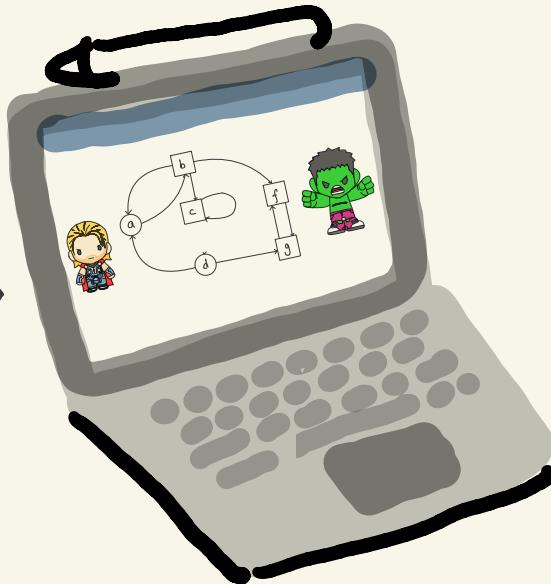
Task for an agent



# Reactive Synthesis

Task for an agent

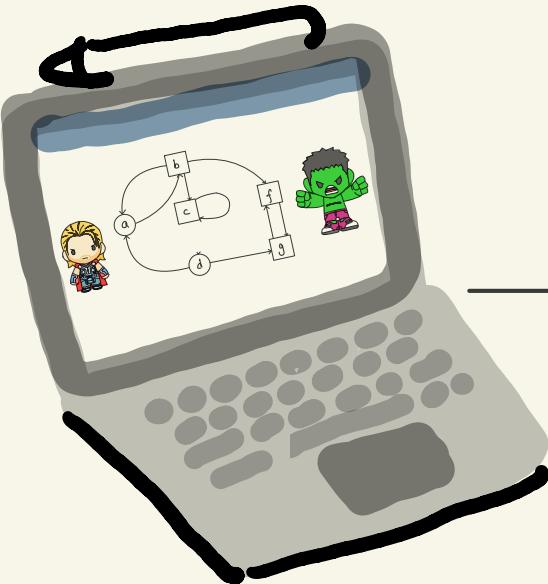
Distract  
Hela



# Reactive Synthesis

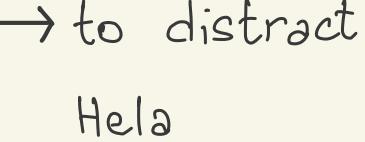
Task for an agent

Distract  
Hela



Implementation

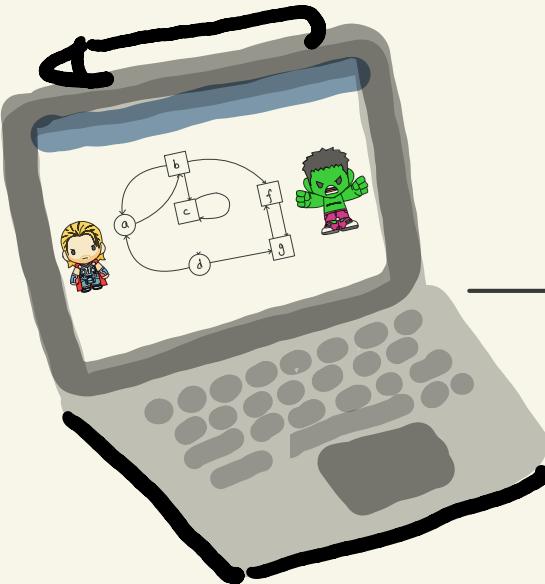
strategy  
→ to distract  
Hela



# Reactive Synthesis

Task for an agent

Distract  
Hela



Implementation

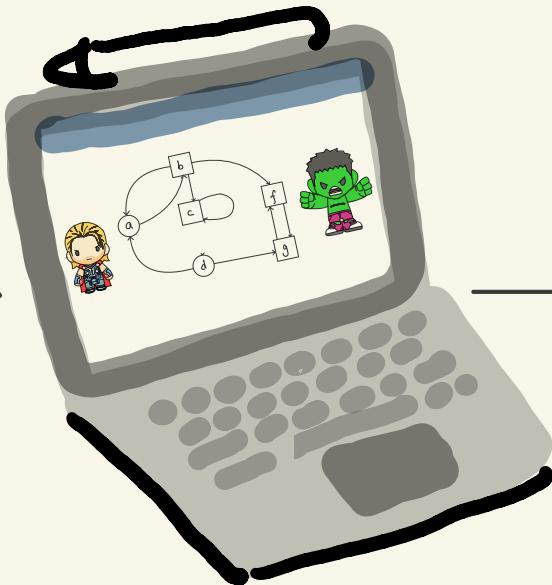
strategy  
→ to distract  
Hela

- Does not consider co-operation between agents

# Reactive Synthesis

Task for an agent

Distract  
Hela

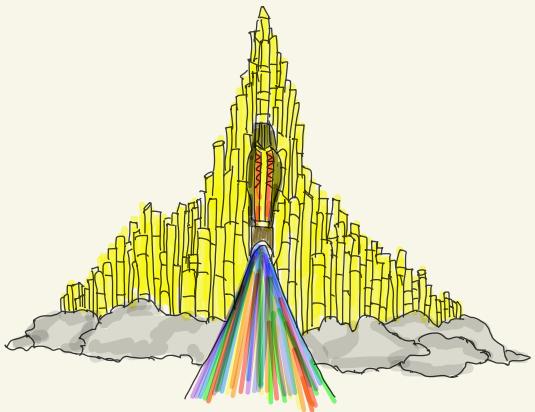


Implementation

strategy  
→ to distract  
Hela

- Does not consider co-operation between agents
- May fail to give any strategy

# Simpler Battle



Each agent has individual tasks

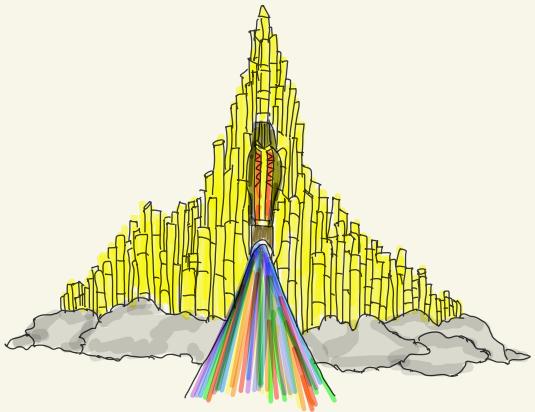
I will distract Hela



We need to save people of Asgard



# Simpler Battle



Each agent has **individual tasks**, which they might not be able to **satisfy** without co-operation.

I will distract Hela

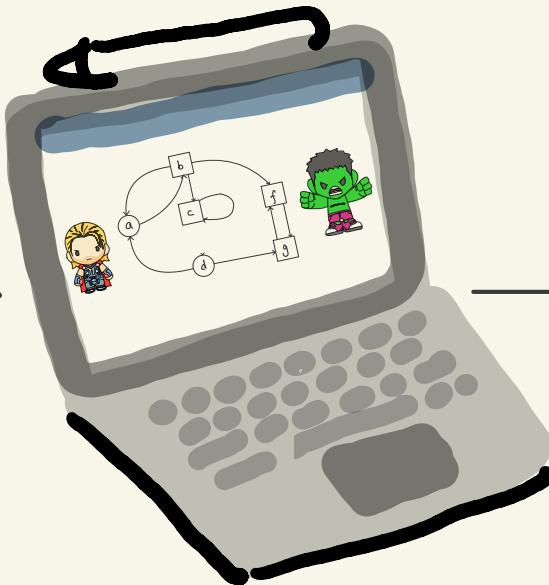
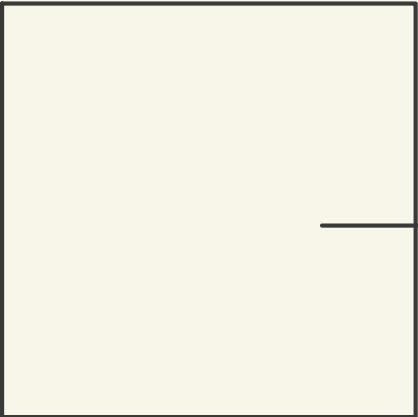


We need to save people of Asgard

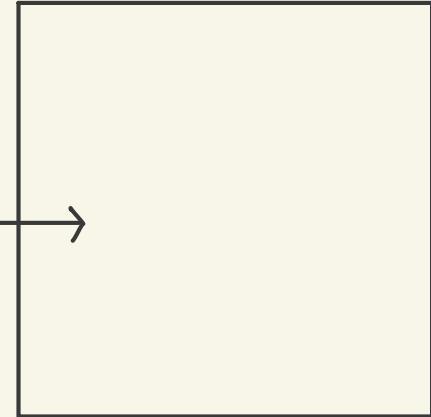


# Reactive Synthesis with Co-operation

Tasks for agents



Implementation



# Reactive Synthesis with Co-operation

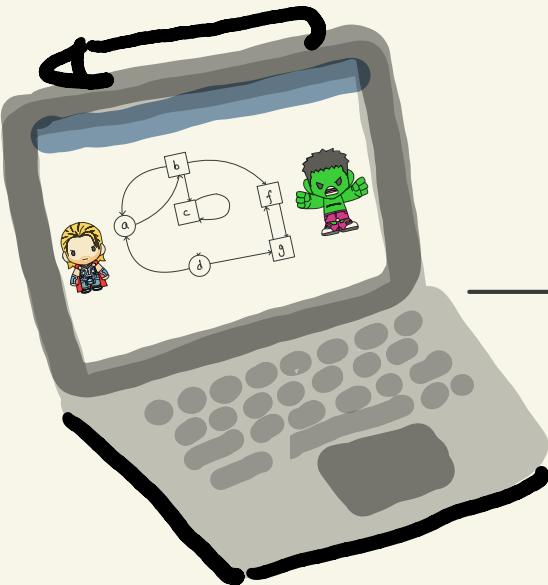
Tasks for agents

Distract

Hela

&

Evacuate  
people



Implementation

# Reactive Synthesis with Co-operation

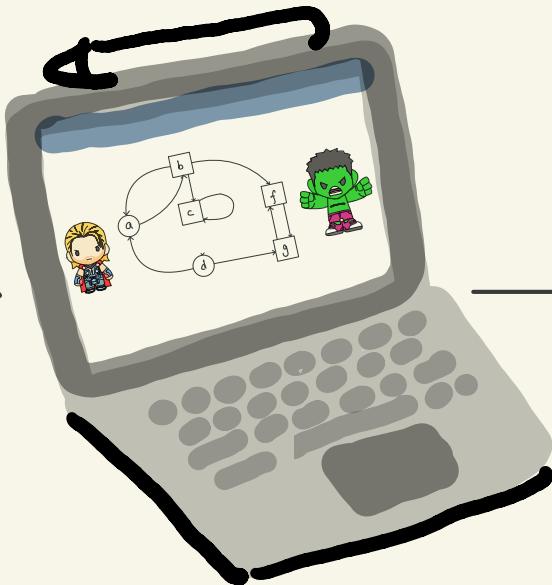
Tasks for agents

Distract

Hela

&

Evacuate  
people



Implementation

Co-operative  
strategy  
to save  
people

# Reactive Synthesis with Co-operation

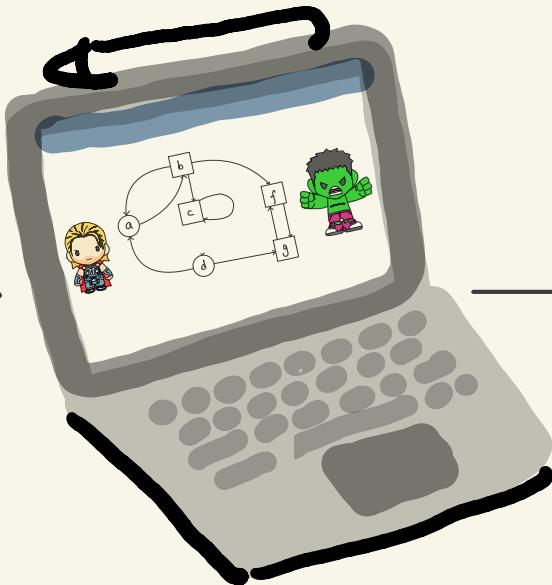
Tasks for agents

Distract

Hela

&

Evacuate  
people



Implementation

Co-operative  
strategy  
to save  
people

- ✓ Does consider co-operation between agents
- ✓ Gives a strategy which can be split

# Better, but Not Enough

## Centralized Synthesis

I can not  
share my  
task



# Better, but Not Enough

Centralized Synthesis

I can not  
share my  
task



One Strategy

I can help



# Better, but Not Enough

Centralized Synthesis

I can not  
share my  
task



One Strategy

I can help



Need to share objectives

# Better, but Not Enough

Centralized Synthesis

I can not  
share my  
task



One Strategy

I can help



Need to share objectives

Undesirable

# Better, but Not Enough

Centralized Synthesis

I can not  
share my  
task



One Strategy

I can help



Need to share objectives      Undesirable

Need to recompute strategies after every change

# Better, but Not Enough

Centralized Synthesis

I can not  
share my  
task



One Strategy

I can help



Need to share objectives      Undesirable

Need to recompute strategies after every change      Inefficient

# Our Proposal

A new negotiation framework



# Our Proposal

A new negotiation framework

- each agent shares local and non-restrictive requests



# Our Proposal

A new negotiation framework

- each agent shares local and non-restrictive requests



~ Do not let  
anyone reach Hela



# Our Proposal

A new negotiation framework

- each agent shares local and non-restrictive requests



~ Do not let  
anyone reach Hela

Keep Hela away  
from Bifrost



# Our Proposal

A new negotiation framework

- each agent shares local and non-restrictive requests



~ Do not let  
anyone reach Hela

Keep Hela away  
from Bifrost

~ Okay!



# Our Proposal

A new negotiation framework

- each agent shares local and non-restrictive requests



~ Do not let  
anyone reach Hela

Keep Hela away  
from Bifrost

~ Okay!



SMASH!! ~

# Our Proposal

A new **negotiation** framework

- each agent shares **local** and **non-restrictive requests**
- produces **guidelines** instead of single strategy



~ Do not let  
anyone reach Hela

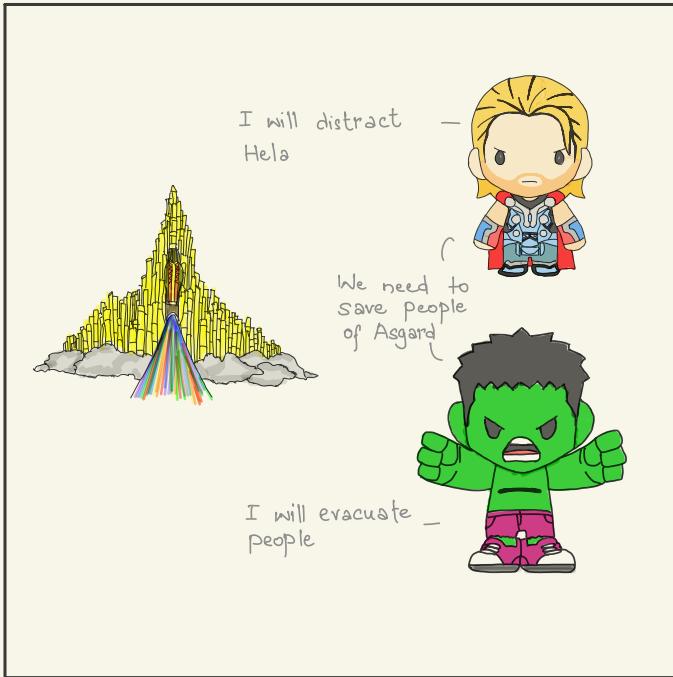
Keep Hela away  
from Bifrost

~ Okay!

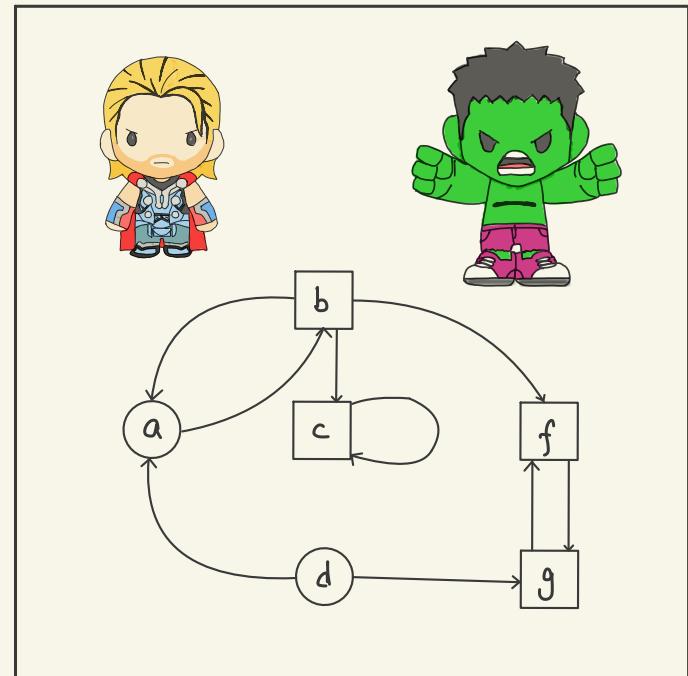
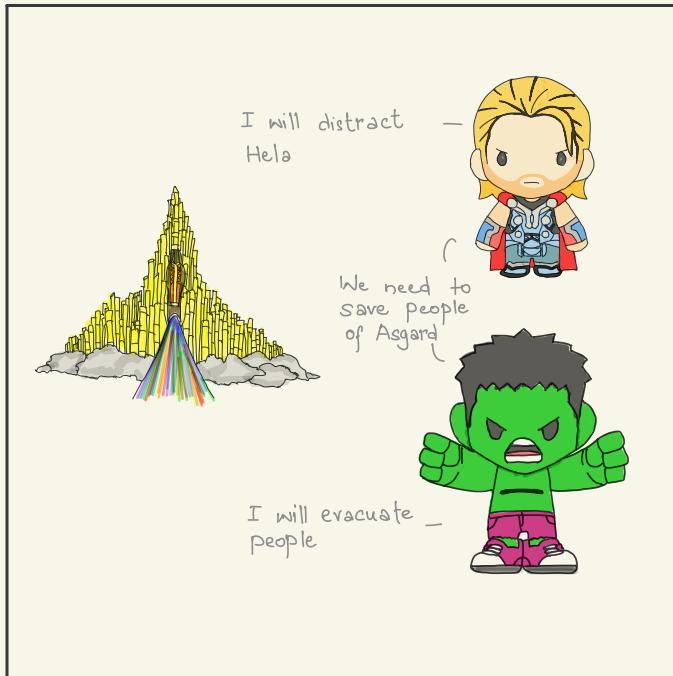


SMASH!! ~

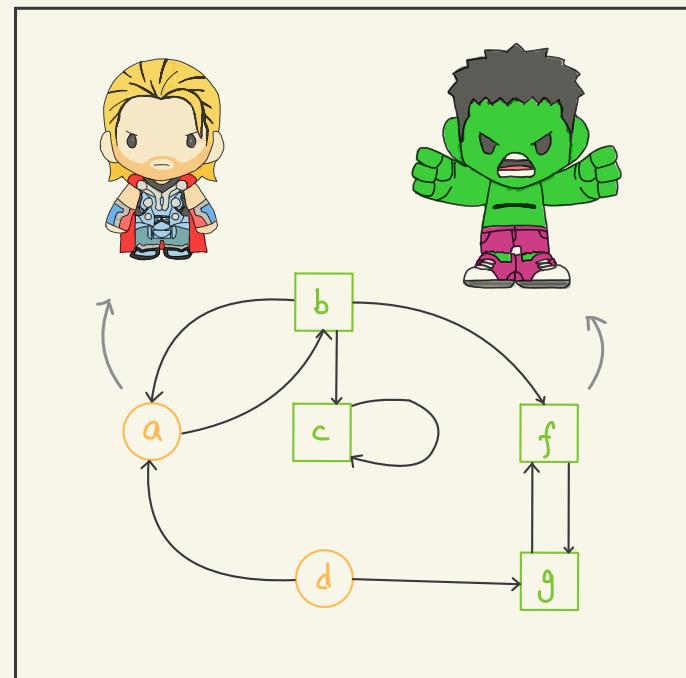
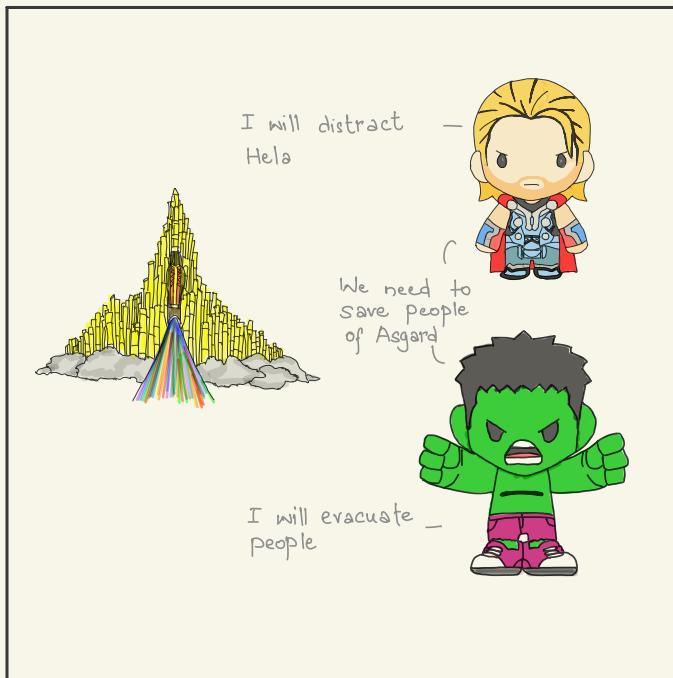
# Our Approach



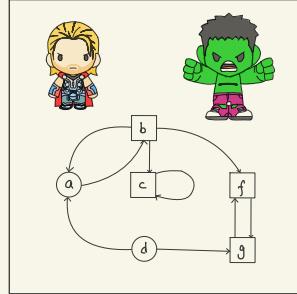
# Our Approach



# Our Approach

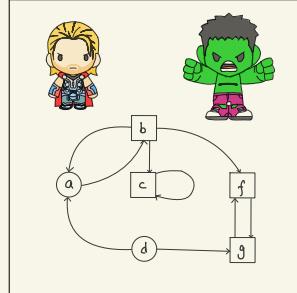


# Our Approach



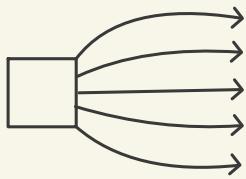
# Our Approach

Thor solves  
the game

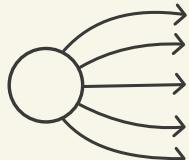


# Our Approach

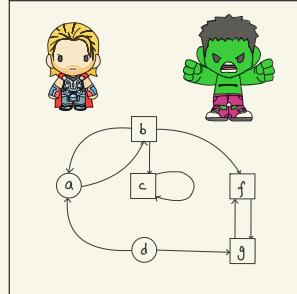
Thor solves  
the game



Request

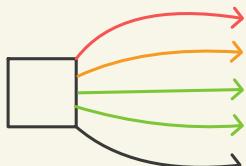


Strategy

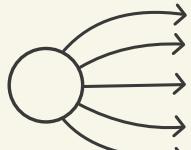


# Our Approach

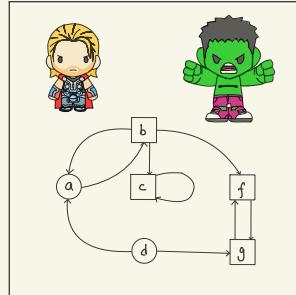
Thor solves  
the game



Request

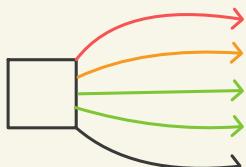


Strategy

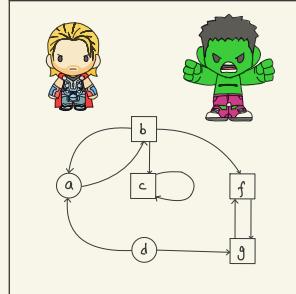


# Our Approach

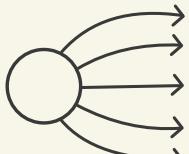
Thor solves  
the game



Request



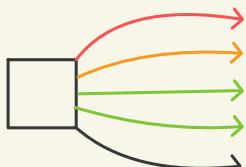
Do not smash  
Asgardians



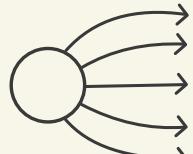
Strategy

# Our Approach

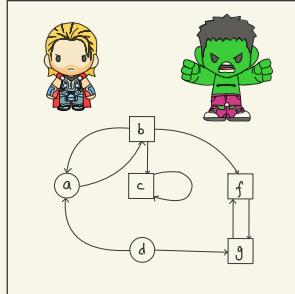
Thor solves  
the game



Request



Strategy

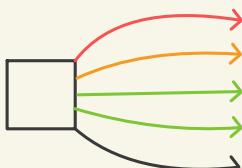


Do not smash  
Asgardians

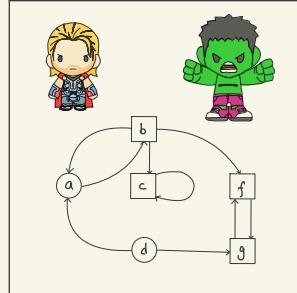
Eventually leave  
the planet

# Our Approach

Thor solves  
the game



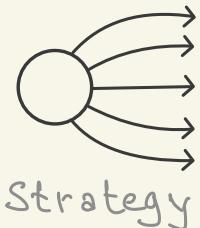
Request



Do not smash  
Asgardians

Eventually leave  
the planet

Keep fighting  
Hela's army



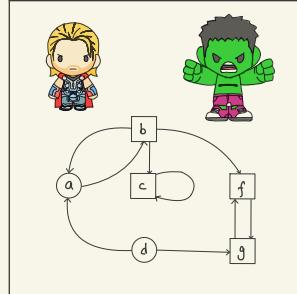
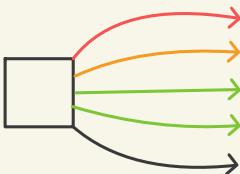
Strategy

# Our Approach

Thor solves  
the game



Request



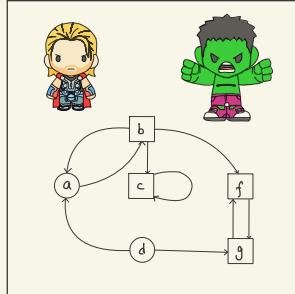
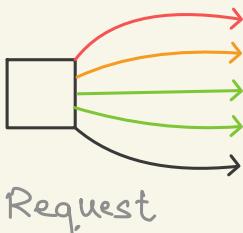
Do not smash  
Asgardians

Eventually leave  
the planet

Keep fighting  
Hela's army

# Our Approach

Thor solves  
the game

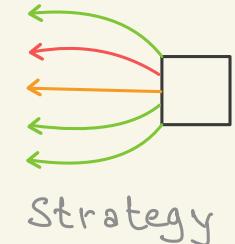
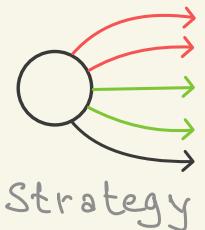
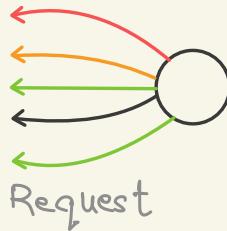


Do not smash  
Asgardians

Eventually leave  
the planet

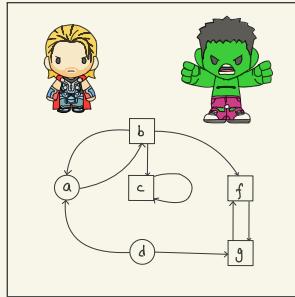
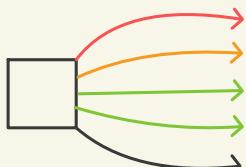
Keep fighting  
Hela's army

Hulk solves  
the game

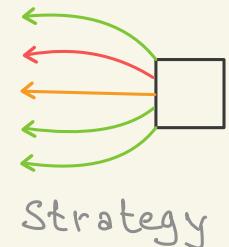
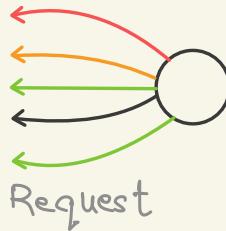


# Our Approach

Thor solves  
the game

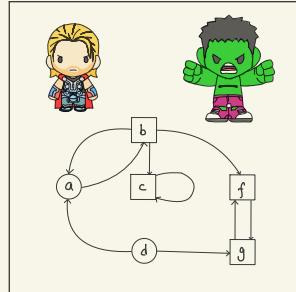
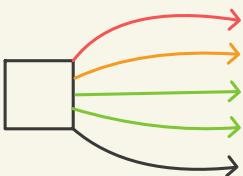


Hulk solves  
the game

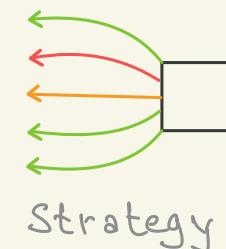
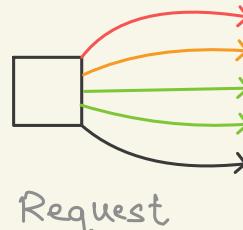
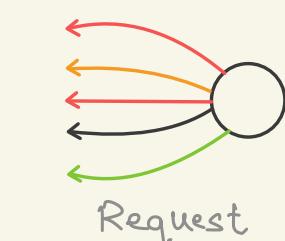
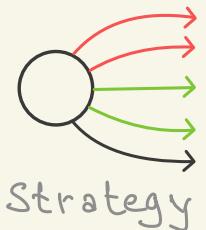
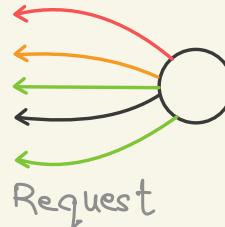


# Our Approach

Thor solves  
the game

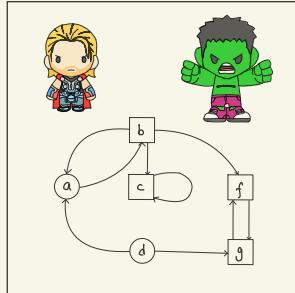
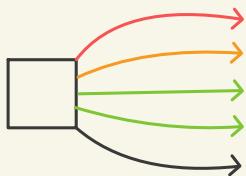


Hulk solves  
the game



# Our Approach

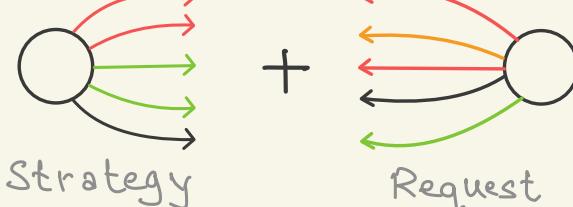
Thor solves  
the game



Hulk solves  
the game

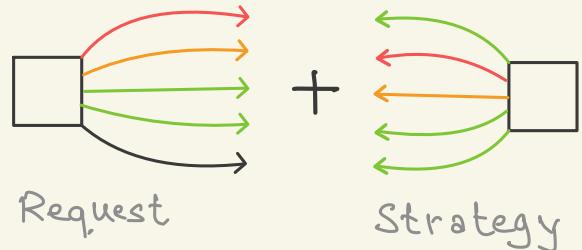


Request



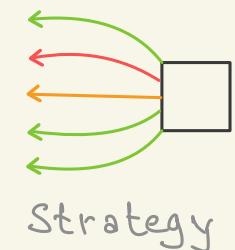
Request

+



Request

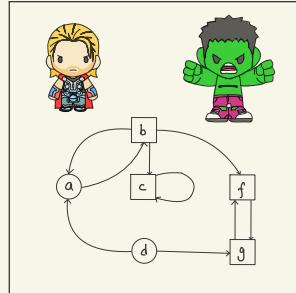
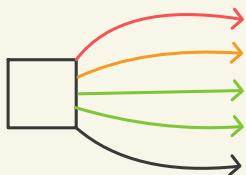
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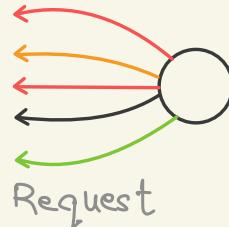
Strategy

# Our Approach

Thor solves  
the game

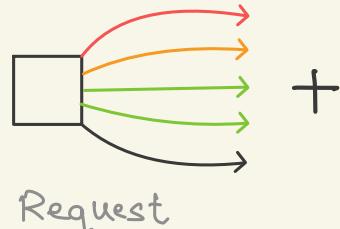
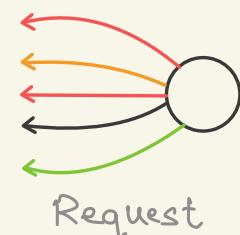


Hulk solves  
the game



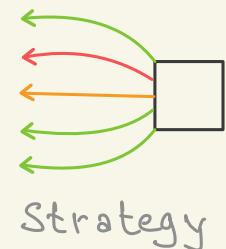
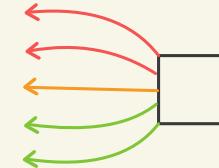
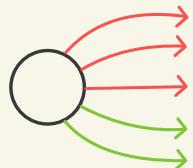
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Request



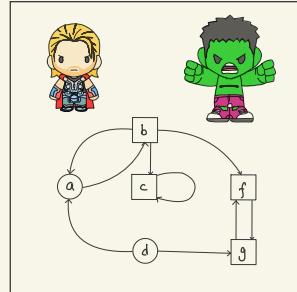
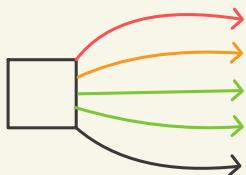
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Request

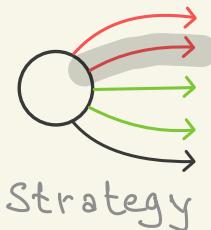
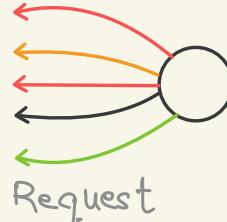


# Our Approach

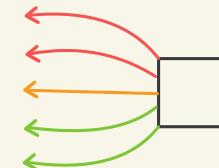
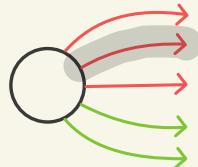
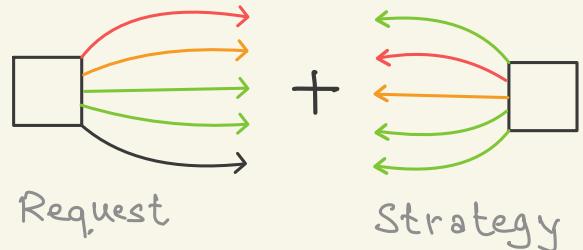
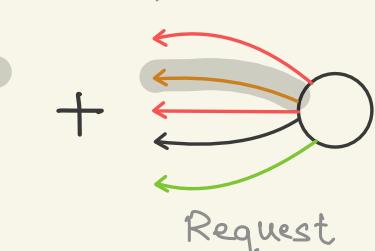
Thor solves  
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Hulk solves  
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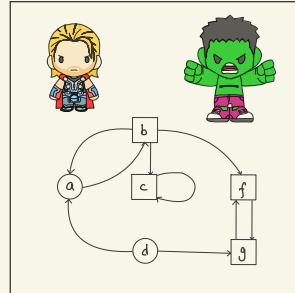
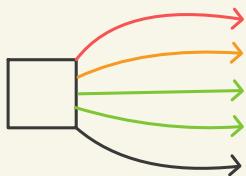


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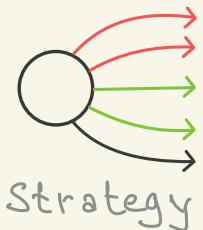
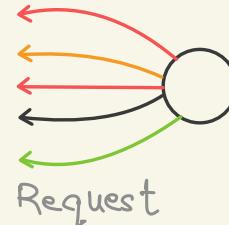


# Our Approach

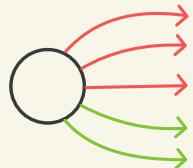
Thor solves  
the game



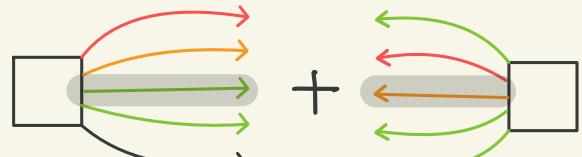
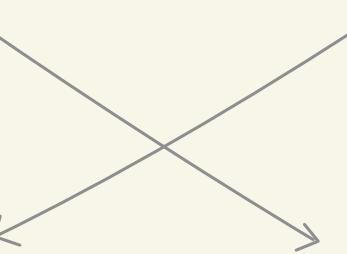
Hulk solves  
the game



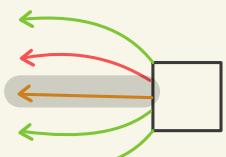
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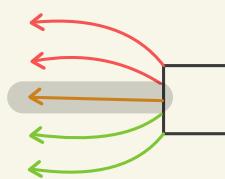
Request



+



Request



Strategy

# Summary



Novel approach for distributed synthesis

# Summary



Novel approach for distributed synthesis



Novel templates to represent requests  
and strategies

# Summary



Novel approach for distributed synthesis



Novel templates to represent requests  
and strategies



Robust to changes in scenario

# Future Work



Negotiation between multiple agents

# Future Work



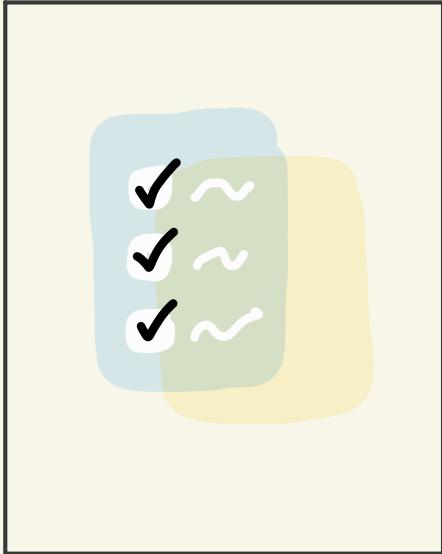
Negotiation between multiple agents



Partial observation

# Contributions

## Novel Templates



Assumptions  
on Environment

[TACAS'23]

Negotiation  
between agents

[Best Poster, HSCC'23]

Composition  
of specifications

cossy.mpi-sws.org