Mutual Goal Agreement for Multi-Agent Systems

Under Adverse Conditions

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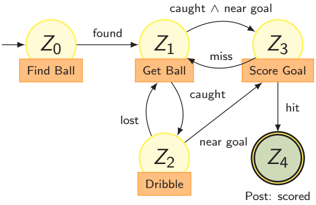
Team Behavior Modelling



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- Each state requires the Agent to execute a certain behaviour.

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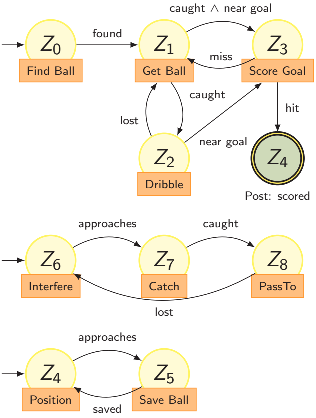

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- Each state requires the Agent to execute a certain behaviour.
- Multiple agents ⇒ mutiple state machines.

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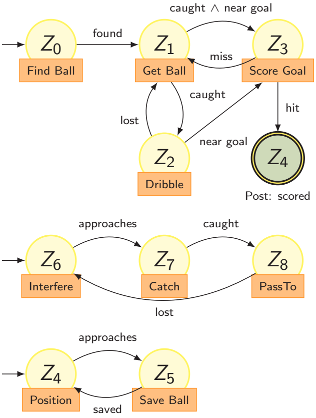
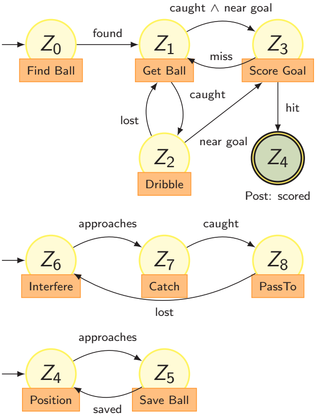


Overall Questions:

- How to coordinate transitions?
- How to assign agents to the state machines?

Assignment



Assignment of robots to the statemachines (SM)

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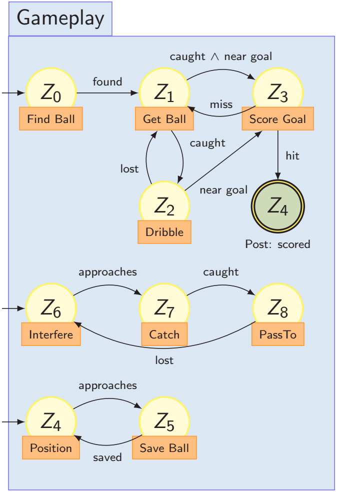

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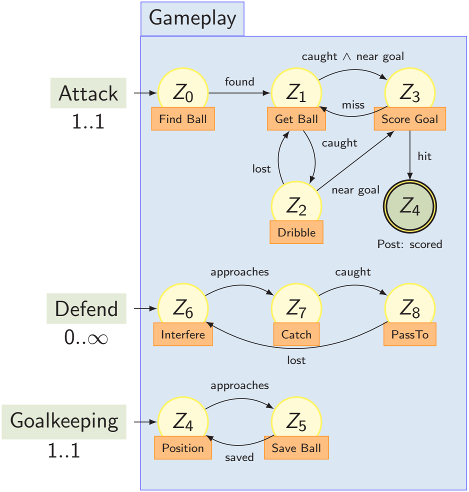

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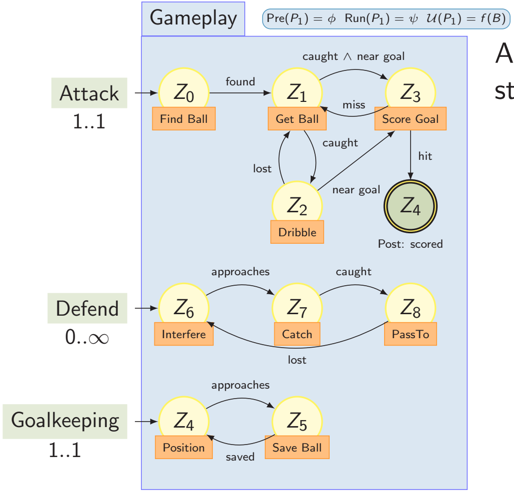

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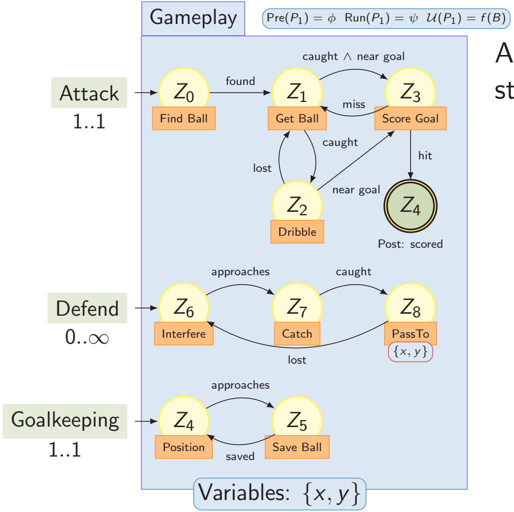
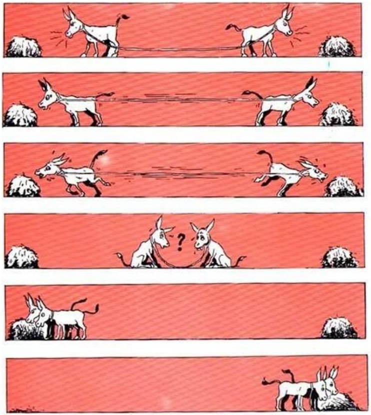


Assignment of robots to the statemachines (SM)

- Annotation of each SM with a *Task* and a *Cardinality*,
- Plans have a *Precondition*, *Runtimecondition*, and a *Utility Function*.
- Plan variables can be queried.

Why do we need agreement on mutual goals?



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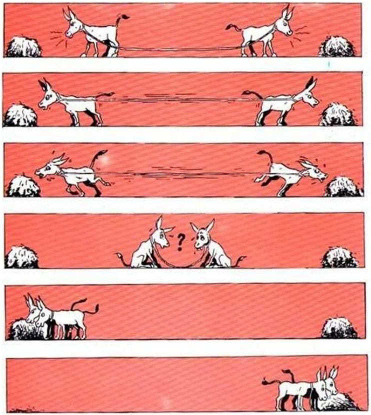

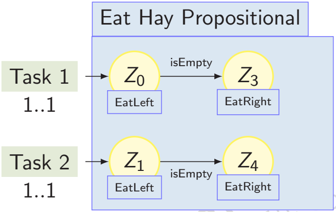

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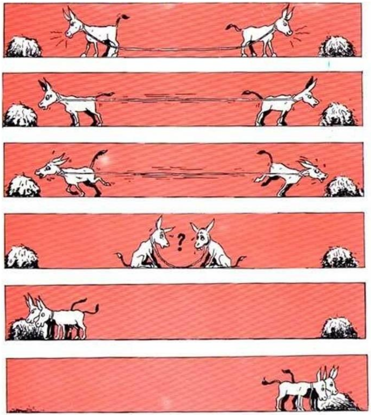

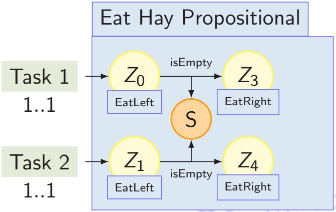

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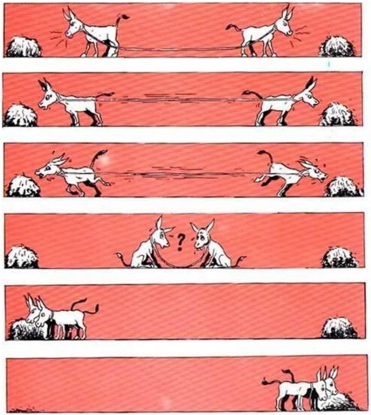

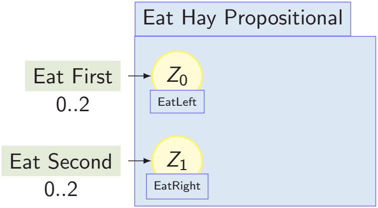

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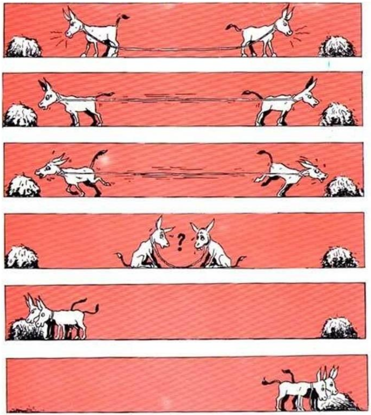

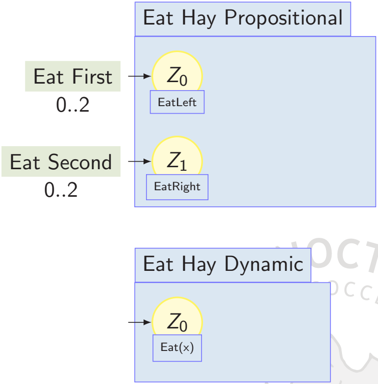

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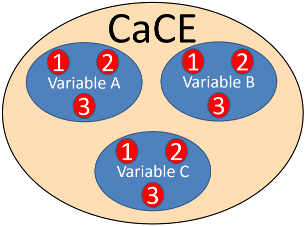
We need a agreement for variable values.

Carpe Noctem Consensus Engine

CaCE

CaCE Overview



What is CaCE?

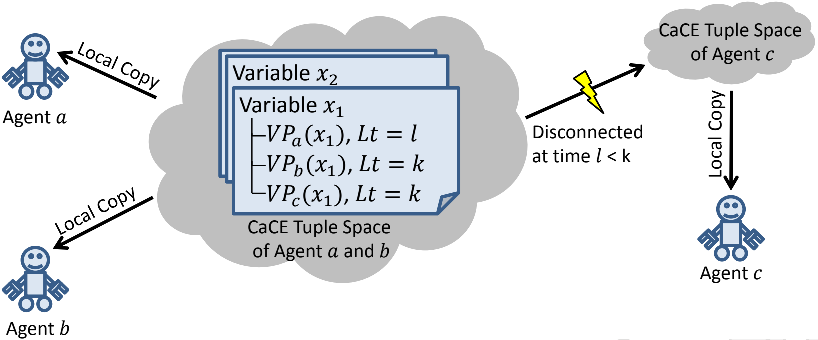
- A distributed tuple space with replication
- An approach to achieve coordination for ALICA variables

Requirements:

- Communication is transient and unreliable
- Conflicts can occur, but we have to deal with them
- Support of persistency and complex datatypes

DISTRIBUTED SYSTEMS

Data Distribution in CaCE



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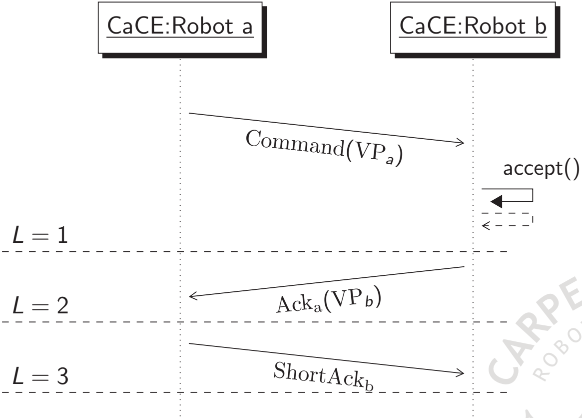
- Value Decission Strategy
  - ⇒ Determine the current value from the known proposals

CaCE Consistency Levels



Acceptance Strategy: Believe Ordering

A conflict resolution strategy is a function C, which decides for the highest ranked input belief for a Variable x:

$$\begin{aligned} \mathrm{VP}_a(x) &= C(\mathrm{VP}_a(x), \mathrm{VP}_b(x), ..., \mathrm{VP}_n(x)) \\ &= \max(\mathrm{VP}(x) \in <_o) \end{aligned}$$

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Example

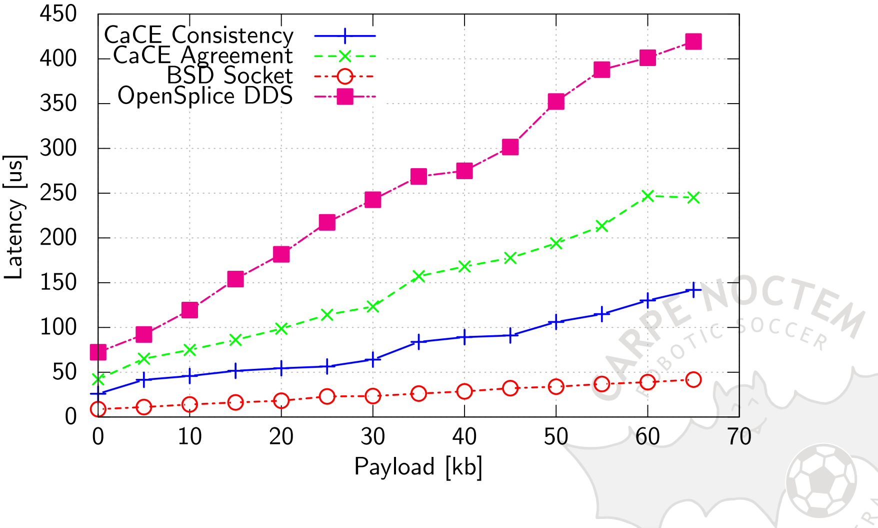
The default conflict resolution order beliefs by the Lamport time $<_{Lt} = \{(\mathrm{VP}_1(x), \mathrm{VP}_2(x)) \mid Lt(\mathrm{VP}_1(x)) < Lt(\mathrm{VP}_2(x))\}$

Value Decission

Most Common Decission Strategies

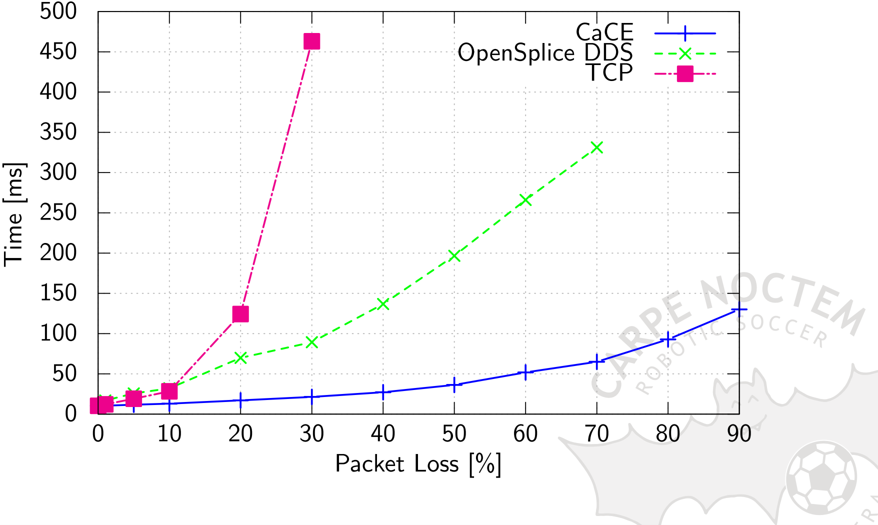
- Most recent proposal
- Majority voting
- Full agreement

Latency


CaCE Consistency
CaCE Agreement
BSD Socket
OpenSplice DDS
Latency [us]
Payload [kb]
0
50
100
150
200
250
300
350
400
450
0
10
20
30
40
50
60
70
CARPE NOCTEM
ROBOTIC SOCCER

DISTRIBUTED SYSTEMS

Transmission Time



Thank you for your attention