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A Hybrid Architecture For a Middle-Size RoboCup Team

Vision: “ By the year 2050, develop a team of fully autonomous humanoid robots that can win against the human world soccer champion team.”

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Summary

- Introduction
- RoboCup Domain
- Architecture
- Current Status
- Conclusions

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Introduction

- Robotics and AI widely used today
- While Robotics provides the means to interact with the world, AI decides how to use those means

- Mechanics, vision, low-level control have improved much.
- High-level control, AI (applied to robots) have a long way ahead

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Introduction

- Most robots use reactive systems to make decisions
- Reactive systems are limited
- Deliberative systems are more powerful, flexible, and handle incomplete world information in a better way, but are slow

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RoboCup Domain

- RoboCup Middle-Size League

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RoboCup Domain

- Fast-changing domain
- Incomplete and wrong information
- Technical problems and limitations

This makes the middle-size league a very interesting and challenging domain for AI!

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Architecture

- Goal: intelligent high level control, complex and smart behaviours, cooperation, machine learning, planning
- Problem: speeeeeeed...
- How to have a powerful deliberative system, and make sure decisions are made in real-time?

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Architecture

- Solution: hybrid architecture
- The deliberative system makes intelligent and complex decisions
- The reactive systems makes not so good decisions, but guarantees a real-time decision (it's always better than doing nothing)

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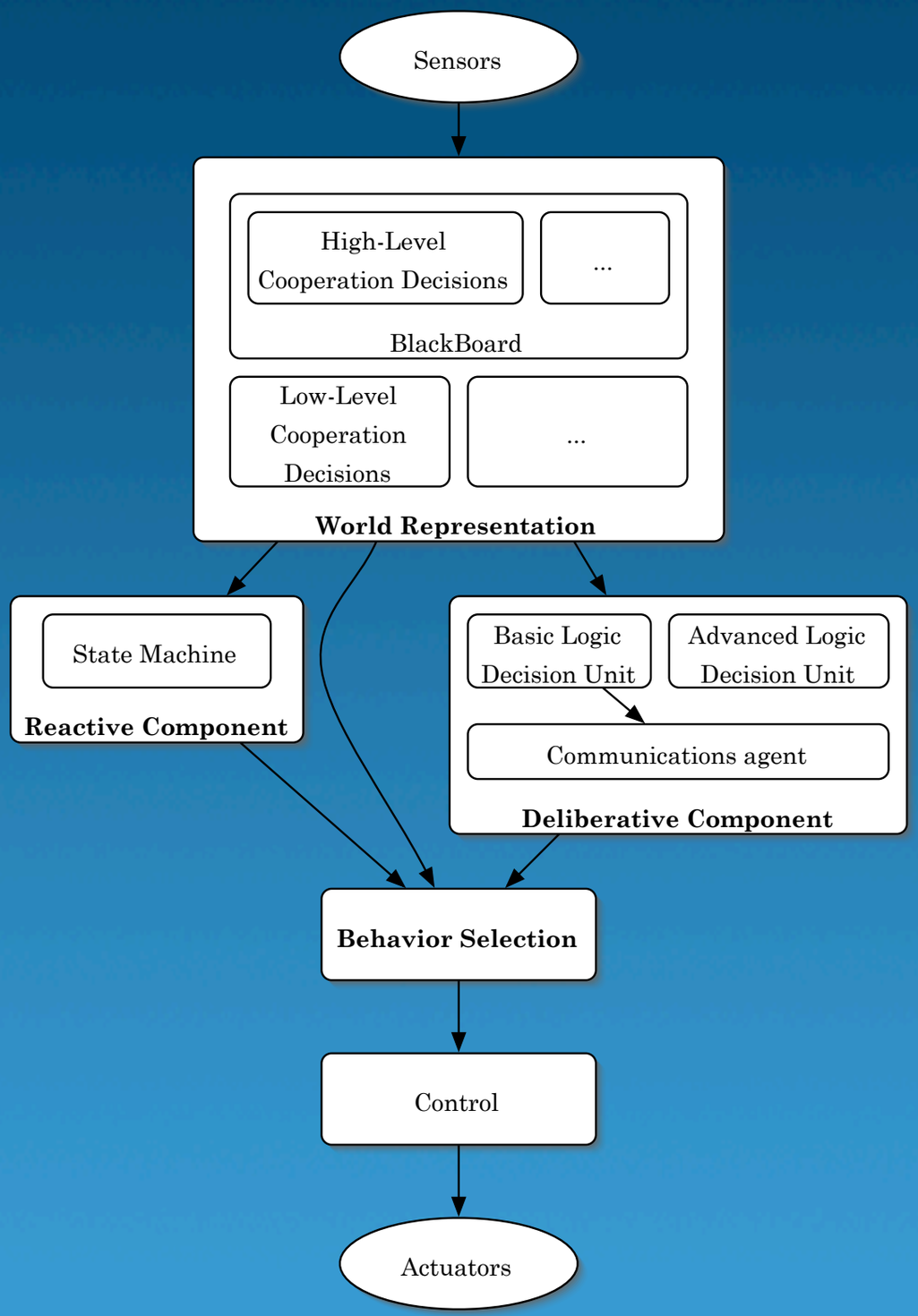
Architecture



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Current Status

- Development is not easy
- More time lost solving hardware problems than writing and tuning new code
- Solution: using a hardware simulator

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Current Status

- Basic Logic Decision Unit - experimental version working
- In a short time and no more than one page of code, the state machine behaviour was reproduced, with a few extras

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Current Status

```
basicBehaviour( goHome, Home ) :-
        gameRunning( 1 ),
        inside_goal,
        home( Home ).

basicBehaviour( goHome, Home ) :-
        gameRunning( 1 ),
        get_state( St ),
        St = goHome,
        \+ state_finished( goHome ),
        home( Home ).
```

```
basicBehaviour( score, 0 ) :-
        gameRunning(1),
        \+ state_finished( score ),
        vision_seeball,
        has_ball,
        near_goal.

has_ball :-
        vision_ball_dist( Dist ),
        Dist < 0.38,
        vision_ball_angle( Angle ),
        Angle > -20,
        Angle < 20.
```

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Current Status

Average from 10 samples of each robot (under simulation)

Decision System	Ball Losses	Path Length	Time	Ball Out
Logic	0.8	9.28 m	30.5 s	20 %
State machine	0.7	9.40 m	33 s	10 %

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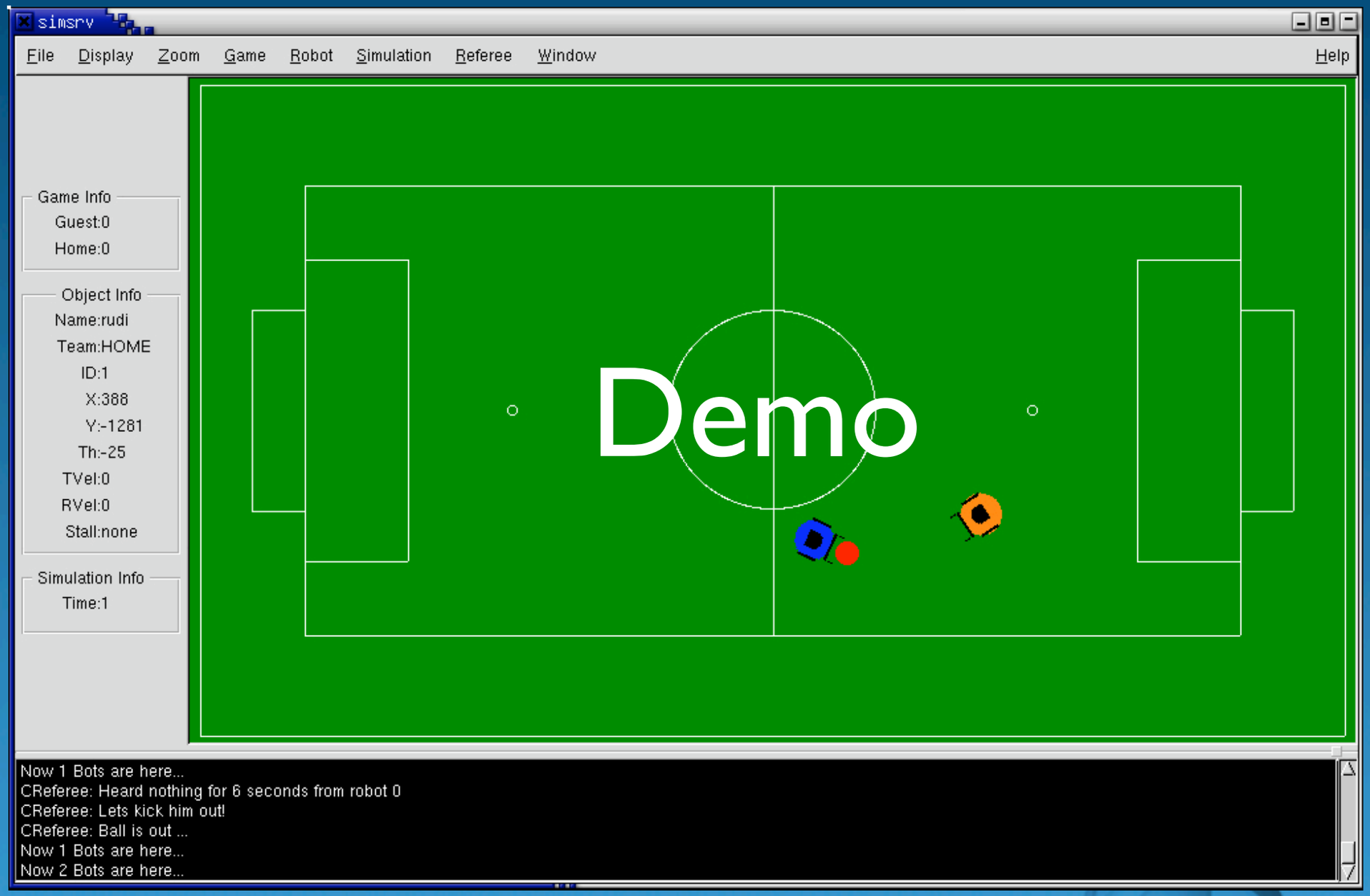
Current Status



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Conclusion

- The simulator is an essential tool for quick development and testing
- Basic Logic Decision Unit:
  - Very fast decisions
  - Easy behaviour modifications (no *sparghetti* code)
  - Robot scores in less time, because the system is not event-driven

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The End

Q&A

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