

# The RLAI Robotic Simulator

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# Credits

- Michael Sokolsky
- Adam White
- Anna Koop
- Thomas Degris
- Brian Tanner
- Richard Sutton
- Jason Roberts
- Chris Rayner



# Why bother with this talk?



# Recent research interests



- Taylor. *Autonomous Inter-Task Transfer in Reinforcement Learning Domains*, 2008.
- Konidaris and Barto. *Building Portable Options: Skill Transfer in Reinforcement Learning*, 2007.
- Grollman, Jenkins and Wood. *Discovering natural kinds of robot sensory experiences in unstructured environments*. 2006.
- Singh, Barto and Chentanez. *Intrinsically Motivated Reinforcement Learning*, 2005.
- Thrun and Mitchell. *Lifelong robot learning*, 1993.



# Heard in Barbados

- The “object” concept
- Intrinsic motivation
- Temporal abstraction
- Exploration
- Knowledge transfer



# “Lifelong learning”

- Emphasize learning for the long term
- Develop more autonomous agents
  - Avoid repeated “brain surgery”
  - Reduce feature engineering



# My proposal

- The RLAI Robotic Simulator
  - A flexible toolkit for building robotic environments
  - A sandbox for our ideas



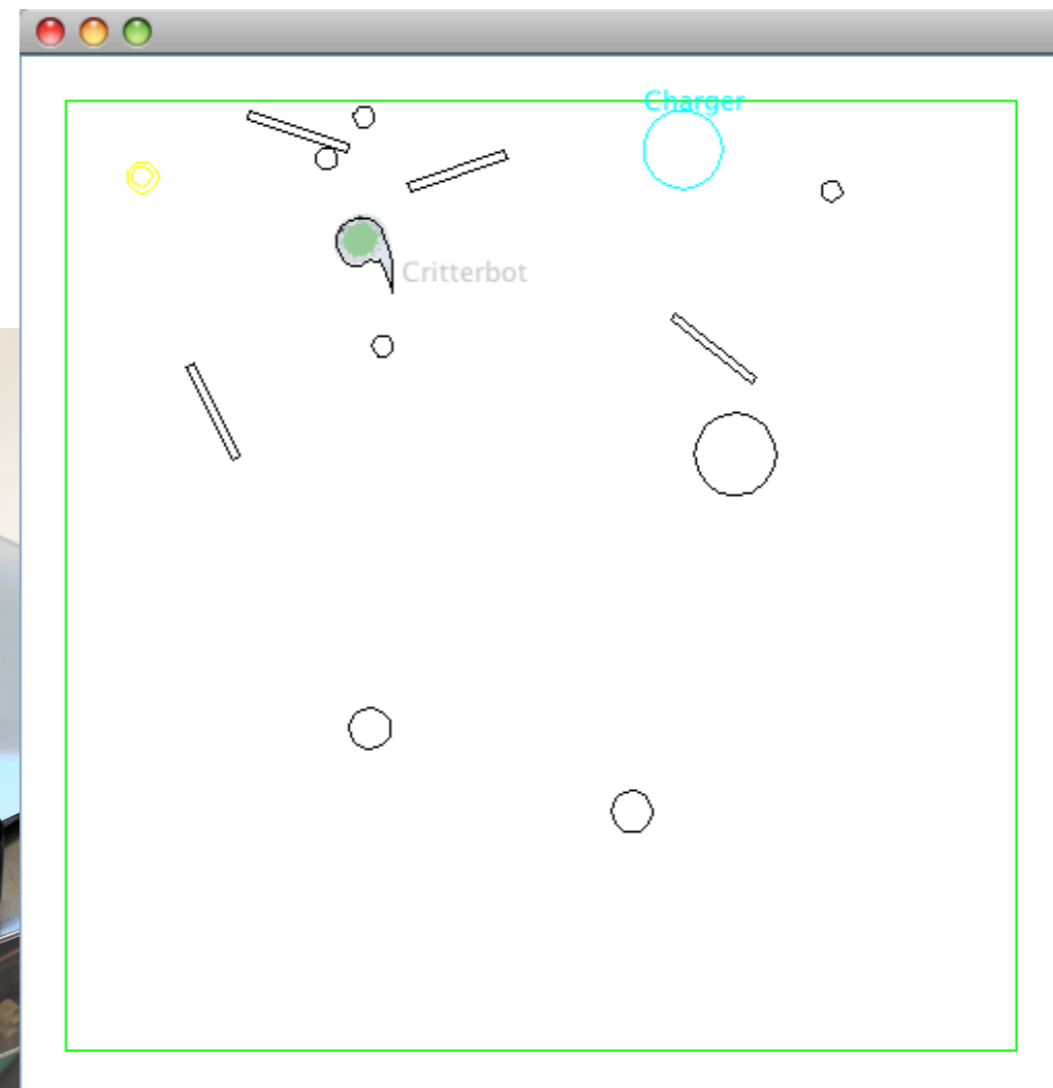
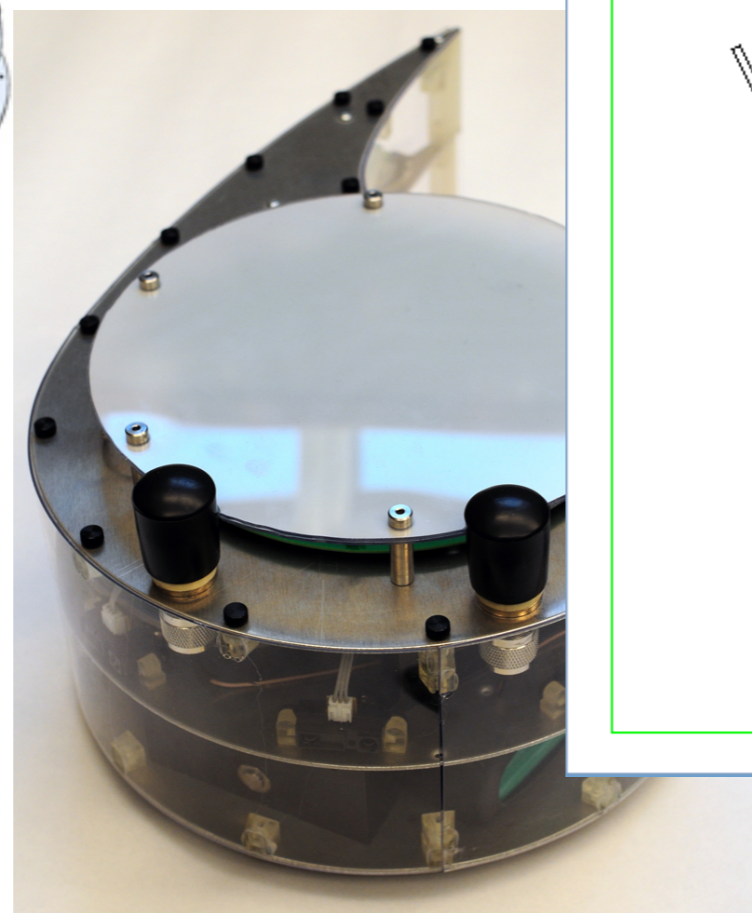
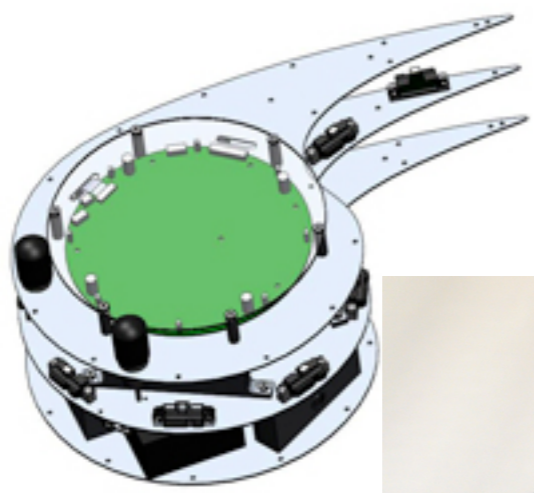
# My proposal

- The RLAI Robotic Simulator
  - A flexible toolkit for building robotic environments
  - A sandbox for our ideas
  - Geared towards the RL community

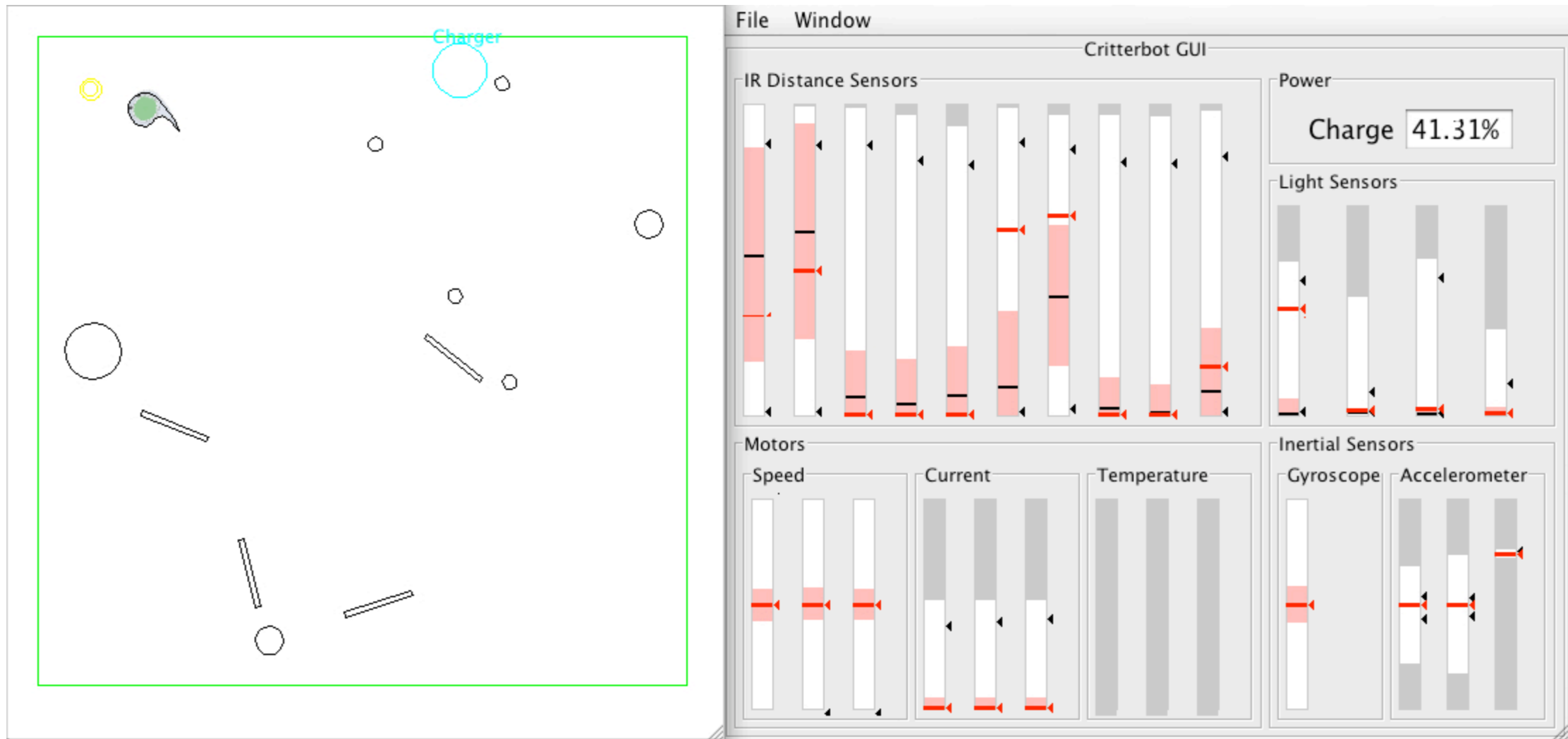




# Overview



# Visualization tools



# Basic components

- Modular framework
- Run via RL-Glue (Brian)  
or as standalone
- 100Hz simulation
- 2D continuous world
- Dynamics



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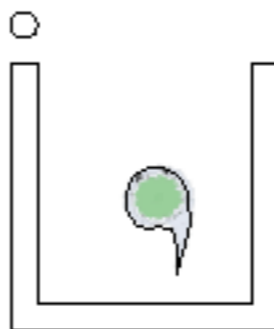


# The Critterbot Simulator

- IR Distance sensors
- Light sensors
- Batteries and chargers
- Bump sensors
- Same action space as the Critterbot



# Challenges



# Subjective observations

- Many RL tasks have been defined in objective terms
- The simulator is an opportunity to experiment with subjective data without committing to a robot
- Defining options, goals, etc. becomes much harder!



# Long time scales

- Easy to design tasks occurring at long time scales
- E.g., garbage collection task
- Experiment with options, hierarchical methods...





# Continuous spaces

- Observations and simulator state are described with continuous variables
- Implies designing methods that can go beyond discrete state spaces



# The simulator and lifelong learning

- Scalable problems, suites of problems
- Tasks can occur at many time scales: kicking a ball, keeping batteries charged, cleaning...
- Have the robot learn about its environment over long periods of time



# Concluding notes



# Why bother with this talk?



- ➔ An exciting set of RL challenges
- Geared towards the RL community
- Somewhat grounded in reality
- Compatible with RL-Glue
- A good platform for studying lifelong learning



# Links

- <http://www.cs.ualberta.ca/~sokolsky/critterbot>
  - Critterbot information
  - Simulator code
  - Simulator packages
- [mgbellemare@ualberta.ca](mailto:mgbellemare@ualberta.ca)



# Questions?



# Implemented components

- Accelerometer
- Battery / BatteryCharger
- Bump Sensors
- Critterbot Interface
- Dynamics
- Gyroscope
- Distance Sensors
- Light Sensors / Sources
- Holonomic Drive



# Software requirements

- Necessarily
  - Java 1.5
  - Unix OS
- Optionally
  - Apache ant
  - RL-Glue 3.0





# Adam White's "Bag of Tasks"

