CloudSim

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Introduction
Introduction

OSRF
To support the development, distribution, and adoption of open source software for use in robotics research, education, and product development.

Hugo Boyer
Senior software engineer

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Senior software engineer

Brian Gerkey
Chief executive officer

Steffi Paepcke
UX

Brant Revill
Web
Introduction
Introduction
Introduction
Introduction
Introduction
DARPA Robotics Challenge
DARPA Robotics Challenge

Disaster

Response
DARPA Robotics Challenge

<table>
<thead>
<tr>
<th>Track A</th>
<th>Phase 1</th>
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<tbody>
<tr>
<td>≤ 5 Teams</td>
<td>≤ $3M each</td>
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<table>
<thead>
<tr>
<th>Track B</th>
<th>Phase 1</th>
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<tbody>
<tr>
<td>≤ 12 Teams</td>
<td>≤ $375k each</td>
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<table>
<thead>
<tr>
<th>Track C</th>
<th>Phase 1</th>
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<tbody>
<tr>
<td>≤ 100 Teams</td>
<td>No funding</td>
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<table>
<thead>
<tr>
<th>Track D</th>
<th>Phase 1</th>
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<tbody>
<tr>
<td>m Teams</td>
<td>No funding</td>
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<table>
<thead>
<tr>
<th>Phases</th>
<th>Phase 2</th>
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<tbody>
<tr>
<td>Virtual Disaster Response Challenge</td>
<td>Disaster Response Challenge 1</td>
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<table>
<thead>
<tr>
<th>Phases</th>
<th>Phase 2</th>
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<tbody>
<tr>
<td>≤ 8 Teams</td>
<td>≤ $1M each</td>
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<tr>
<th>Phases</th>
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<td>≤ 6 Teams</td>
<td>≤ $750k each</td>
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<table>
<thead>
<tr>
<th>Phases</th>
<th>Phase 2</th>
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<tbody>
<tr>
<td>1 Team</td>
<td>$2M Prize</td>
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Open Source Robotics Foundation
DARPA Robotics Challenge
DARPA Robotics Challenge
Map-reduce the best robotics teams in the world

Map: simulated arenas vs
• Operator skills
• Cutting edge software

Reduce: best score of
• Time
• Task completion
• Bandwidth utilization

15 tasks, 3 days.

theroboticschallenge.org
CloudSim: design and overview

Configuration
• Network routes
• Software, simulation configurations
• Security

Private instant network
Evolution
CloudSim evolution

September 2012 (2012-09)

Brian's prototype:
- Amazon gpu machine
- OpenID authentication
- Python thread that bring up a machine, setup ROS, X and Gazebo

December 2012

Version 1.0
- New front end
- push notifications (polling)
- REST API
- Redis backend
CloudSim evolution

February 2013

Constellations
- chaining VPNs does not scale
- virtual lans (AWS VPC)
- Constellation plugin (single thread):
  - launch, terminate
  - start task, stop task

Development slows down
- 20 min
CloudSim evolution

February 2013
CloudSim evolution

Issues:
- not getting full 10 gbs bandwidth
- some strange behavior
- capacity
- jitter
CloudSim evolution

SoftLayer

Pros
- up to date performance
  - NVIDIA K10 processor
  - 2x Intel Xeon-SandyBridge E5-2690-OctoCore [2.9GHz] CPU
- no hypervisor
- single tenancy

Cons
- monthly instead of hourly
- inflexible network topology and FW
- 1h provisioning [with bugs]
Status
Status

CloudSim architecture
• Thin web client
• Web server to process requests
• Daemon to launch cloud machines
• Simulation machines
Limitations
Limitations

Latency
• Some extra ms. are required to reach the machines on the cloud
• The latency is not fixed and depends on the geographic location of user/provider

Cost
• Pay on demand
  Amazon $2.10/h
  SoftLayer $1200.00/month
• Are we ready to pay for CPU cycles?

Small range of GPU-based providers
• A wider selection of providers would reduce costs
• Mitigated by demand for game streaming
Benefits
CloudSim benefits

ROS in a box
• curated selection of:
  hardware
  software (Groovy Precise Gazebo)
  networking and routing
  robotics (controllers, sensors)
  simulation worlds

Concurrent by design
• 1 or 100 machines, same time
• Open and extensible

Low barrier to entry
• Thin client
• Platform for sharing
Future possibilities
Future possibilities

Research and industrial
• Store of simulation experiments
• [Automatic] [parallel] Testing
• Design optimization

Education
• Competition in the classroom
• Share simulations, data, benchmarks

Other future lines
• Launch other open source robotics software
• Connect to data sets

Expansion
• Deploy to real robots

Dream big
Conclusion
Conclusion

Motivated by specific requirements of the DARPA Robotics Challenge
Contribute to the success of Gazebo
Enables new workflows in robotics simulations
Makes ROS and Gazebo more accessible
Open Source, BSD license

CloudSim could be to ROS/Gazebo what Android is to Linux

http://gazebosim.org/wiki/CloudSim