



On a Philosophy of Agent-based Modeling

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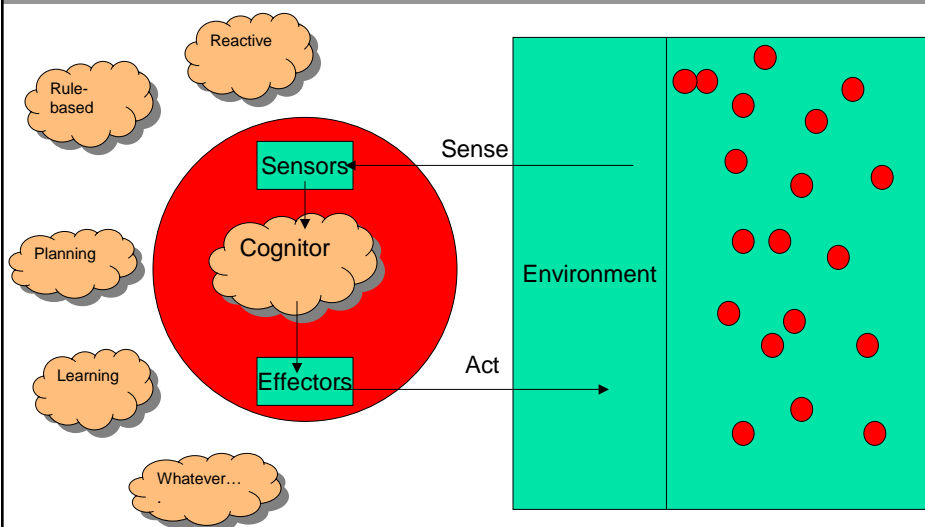
- Time for a movie!

Observations



- Simulation used as evaluation mechanism
- One replicate per scenario
- Large number of scenarios
- Scenarios automatically generated?
- Fitness metric "easily" determined
- Scenario evaluation done quickly
- Evaluations done sequentially?
- Learning mechanism present

The term "Agent"



ABM – “Typical” Characteristics



Agent modeling is bottom-up . . .

- Agents are Heterogeneous
- Agents are “individuals”
- Agents operate on “local” information
- Interactions are nonlinear
- Emergence happens....
- Use focused on “intangibles”

Agent-based Models



- Pythagoras – www.projectalbert.org
- Socrates - www.projectalbert.org
- Mana - www.projectalbert.org
- PAX - www.projectalbert.org
- Einstein -http://www.cna.org/isaac/einstein_splash.htm
- SEAS - <http://www.teamseas.com/>
- SEAS – the other SEAS
<http://www.mgmt.purdue.edu/centers/perc/html/index.htm>

Agent-based Modeling Frameworks



- Repast - <http://repast.sourceforge.net/>
- Mason- <http://cs.gmu.edu/~eclab/projects/mason/>
- Netlogo - <http://ccl.northwestern.edu/netlogo/>
- Swarm - http://www.swarm.org/wiki/Main_Page
- SimKit - <http://diana.cs.nps.navy.mil/Simkit/>

Suggestions for a Possible Philosophy



- Accept differing, complementary roles
 - Exploratory – insight, learning focus
 - Analytical - decision focus
- Keep options open, i.e., multiple, competing models, ABM or ~ABM – no model is an island
- Develop a shared modeling language, independent of implementation
- More education on ABMs
- Institute a Lessons Learned/Mailing list/Wiki/ Shared Models for ABMs
- May be some time before we get SASO modeling “right”, but we should learn by doing

Some Resources



- MWS On-line, www.projectalbert.org/researchdoc.html
- NPS Seed Lab,
<http://diana.gl.nps.navy.mil/~susan/SeedLab/index.html>
- Adamatzky, A, and Komosinski, M. (eds), Artificial Life Models in Software, 2005
- Epstein, J. M., "Remarks on the Foundations of Agent-Based Generative Social Science", CSED Working Paper No. 41, July 2005
- Grimm, V., and Railsback, S. F., Individual-based Modeling and Ecology, 2005
- Luna, F. and Stefanson, B., Economic Simulations in Swarm: Agent-Based Modeling and Object Oriented Programming, 2000
- Epstein, J. M., and Axtell, R., Growing Artificial Societies: Social Science from the Bottom Up
- Russell, S., and Norvig, P., Artificial Intelligence, 2nd Edition, 2003
- Wooldridge, M., An Introduction to Multitagent Systems, 2001

Summary



- Agent-based modeling:
 - Requires different perspective
 - Still modeling

Questions?



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BACKUP



Challenges



- Dealing with uncertainty
 - Parameter - #'s things, pk's
 - Structural – c2 network, unit
 - Model – attrition, sensors, cognition
 - Systemic – interaction of some or all of above
- Large dimensional spaces
 - Sampling
 - Importance, intro of bias (e.g., priors)
 - Analyzing
 - Visually/algorithmically