The MITRE Elastic Goal-Directed Simulation Framework (MEG)

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18 June 2013 OSDC Workshop Edinburgh, UK



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The MITRE Elastic Goal-Directed Simulation Framework (MEG)

- Middleware framework to supplement existing simulation applications
- Provides access to three capabilities:
 - Cloud-based or grid-based computing resources
 - Advanced Design of Experiments (DOE) methodologies
 - Robust data processing and visualization tools

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The MITRE Elastic Goal-Directed Simulation Framework (MEG)

- Run experiments on multiple grids
- Simulation Adaption:
 - Command line input
 - No hard coded paths



The MITRE Elastic Goal-Directed Simulation Framework (MEG) is first and foremost an engineering activity – our goal is to develop a practical, useful tool.





The MEG Vision

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Log into framework web site

Stage files

Specify the Design of Experiments (DOE)

View status of available clusters/grids

Select target cluster/grid

Submit DOE for running

Files transferred to target cluster As jobs complete...

Output data is returned DOE Mgr determines next jobs Vis Mgr is updated Automated Goal-Directed Replication Management Framework





Design Principles

- Learn by Doing Give users access early and often. Don't design in a vacuum
- Provide Transparency Let end users see the reason for faults
- Support Various Modeling Languages Don't force the users to change, adapt to their needs
- Provide a Low Barrier for Entry Require the minimum amount of effort for end users to integrate
- A Good Idea Applies to Itself Use simulation-based optimization to identify the optimal configuration for MEG installations

MITRF

MEG Architecture

GUI Services

- ZK GUI Toolkit
- TOMCAT web server
- Wizard utility
- Persistent workspace

Scheduler Services

- Distributed Resource Management by Gridway
- User does not need to specify grid

DOE Services

 Parameter sweep, user specified input, Monte Carlo, multiple types of Genetic Algorithms

Data and Visualization Services

- Output directory is monitored for changes by the MITRE Data Gin
- Data is synchronized to the database
- Can be visualized in "fast time"

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- Approach to running simulations on the MEG
- Demo



Involves two MITRE Innovation Program (MIP) research projects

- Financial Modeling & Simulation Execution Environment
 - Rajani Shenoy, Matthew McMahon, Jenny McFarland, Ernie Page
- Computational Steering for Interactive Modeling and Simulation
 - Carlos Ramos, Matthew McMahon, Thom DeCarlo III





Cont's Heterogeneous Feedback Model

- Distinct input parameters
- Two output files
- Single Market Model
- Trader behavior is based on a reaction to information
- Script for statistical analysis of model output
 - Written in R



Ghoulmie, Cont, and Nadal. 'Heterogeneity and feedback in an agent-based market model,' J. Phys.: Condens. Matter 17 (2005) S1259–S1268.







MEG Implementation Steps

- Convert to headless
 - 7 parameters converted to command line input
- Change file paths
- Convert R script to Python
 - Run after each experiment
- Create the Input Files
 - Configuration file
 - Condor submit file
 - Run script
- Upload and Run
 - Upload the model and the script to the HIVE
 - Upload input files to the web interface





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<pre># Run the jar file java -jar /projects/MEG/test/HFCont.jar MEG-X MEG-DEPTH MEG-NTRADERS MEG-NEWSVARD 0 500 5 true > output.txt python /projects/MEG/test/FinancialStats.py > financial_stats.out # Echo inputs and outputs into a file to feed into DataGin if desired # Echo MEG-X MEG-Y MEG-Z \$fSum \$fProduct \$MEGExecutionId \$jobUid >output.\$jobUid.txt chgrp MEG /projects/MEG/test p pice* \$00T_DIR_withJob/params.csw p pice* \$00T_DIR_withJob/params.csw p stats* \$00T_DIR_withJob/stats.csw m -rf *.csw m -rf financial_stats.out ##Return sum and product in multi-objective format echo \$jobUid </pre>	19	fi	
<pre># Run the jar file java -jar /projects/MEG/test/HFCont.jar MEG-X MEG-DEPTH MEG-NTRADERS MEG-NEWSVARD 0 500 5 true > output.txt python /projects/MEG/test/FinancialStats.py > financial_stats.out # Echo inputs and outputs into a file to feed into DataGin if desired # Echo MEG-X MEG-Y MEG-Z SfSum %fProduct %MEGExecutionId %jobUid >output.%jobUid.txt chgrp MEG /projects/MEG/test p param* %OUT_DIR_withJob/params.csv p price* %OUT_DIR_withJob/price_and_volume.csv p stats* %OUT_DIR_withJob/stats.csv m -rf financial_stats.out # #Return sum and product in multi-objective format echo %jobUid ##Return sum and product in multi-objective format # Comparam # Co</pre>	20		
<pre>java -jar /projects/MEG/test/HFCont.jar MEG-X MEG-DEPTH MEG-NTRADERS MEG-NEWSVARD 0 500 5 true > output.txt python /projects/MEG/test/FinancialStats.py > financial_stats.out</pre>	21	# Run the jar file	
<pre>python /projects/MEG/test/FinancialStats.py > financial_stats.out f = f Echo inputs and outputs into a file to feed into DataGin if desired fecho MEG-X MEG-Y MEG-2 \$fSum \$fProduct \$MEGExecutionId \$jobUid >output.\$jobUid.txt chgrp MEG /projects/MEG/test cp param* \$OUT_DIR_withJob/params.csv cp price* \$OUT_DIR_withJob/price_and_volume.csv cp stats* \$OUT_DIR_withJob/stats.csv rm -rf .csv rm -rf financial_stats.out f#Return sum and product in multi-objective format echo \$jobUid </pre>	22	java -jar /projects/MEG/test/HFCont.jar MEG-X MEG-DEPTH MEG-NTRADERS MEG-NEWSVARD 0 500 5 true > output.txt	
<pre>python /projects/MEG/test/FinancialStats.py > financial_stats.out F# Echo inputs and outputs into a file to feed into DataGin if desired fecho MEG-X MEG-Y MEG-Z \$fSum \$fFroduct \$MEGExecutionId \$jobUid >output.\$jobUid.txt chgrp MEG /projects/MEG/test g cp param* \$00T_DIR_withJob/params.csv g cp price* \$00T_DIR_withJob/pice_and_volume.csv g cp price* \$00T_DIR_withJob/stats.csv g cp stats* \$00T_DIR_withJob/stats.csv fm -rf *.csv fm -rf financial_stats.out f#Return sum and product in multi-objective format echo \$jobUid </pre>	23		
<pre>25 26 [# Echo inputs and outputs into a file to feed into DataGin if desired 27 #echo MEG-X MEG-Y MEG-Z \$fSum \$fProduct \$MEGExecutionId \$jobUid >output.\$jobUid.txt 28 ohgrp MEG /projecta/MEG/test 29 op param* \$00T DIR_withJob/params.csv 30 op price* \$00T DIR_withJob/price_and_volume.csv 31 op stats* \$00T DIR_withJob/stats.csv 32 rm -rf *.csv 33 rm -rf output.txt 34 rm -rf financial_stats.out 35 36 ##Return sum and product in multi-objective format 37 echo \$jobUid 38 38 38 38 38 38 38 38 38 38 38 38 38</pre>	24	python /projects/MEG/test/FinancialStats.py > financial_stats.out	
<pre>26 # Echo inputs and outputs into a file to feed into DataGin if desired 27 #echo MEG-X MEG-Y MEG-Z \$fSum \$fProduct \$MEGExecutionId \$jobUid >output.\$jobUid.txt 28 chgrp MEG /projects/MEG/test 29 cp param* §OUT_DIR_withJob/params.csv 30 cp price* \$OUT_DIR_withJob/price_and_volume.csv 31 cp stats* \$OUT_DIR_withJob/stats.csv 32 Tm -rf *.csv 33 Tm -rf output.txt 34 Tm -rf financial_stats.out 35 36 ##Return sum and product in multi-objective format 37 echo \$jobUid 38 38 38 38 38 38 38 38 38 38 38 38 38</pre>	25		
<pre>27 *#echo MEG-X MEG-Z \$fSum \$fProduct \$MEGExecutionId \$jobUid >output.\$jobUid.txt 28 chgrp MEG /projects/MEG/test 29 cp param* \$OUT_DIR_withJob/params.csv 30 cp price* \$OUT_DIR_withJob/price_and_volume.csv 31 cp stats* \$OUT_DIR_withJob/stats.csv 32 rm -rf *.csv 33 rm -rf output.txt 34 rm -rf financial_stats.out 35 4#Return sum and product in multi-objective format 36 echo \$jobUid 38 38 38 38 38 38 38 38 38 38 38 38 38</pre>	26	□ # Echo inputs and outputs into a file to feed into DataGin if desired	
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<pre>30</pre>	29	cp param* SOUT_DIR_withJob/params.csv	
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	37	echo \$Johora	
	38		





"Fast-Time" Visualization

- Qlikview connected to the Data Gin
- Micro-Maps format
- Interactive visualization tool that allows results to be seen as experiments are completed







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