

Teaching the Lab-intensive Simulation Course with Simio

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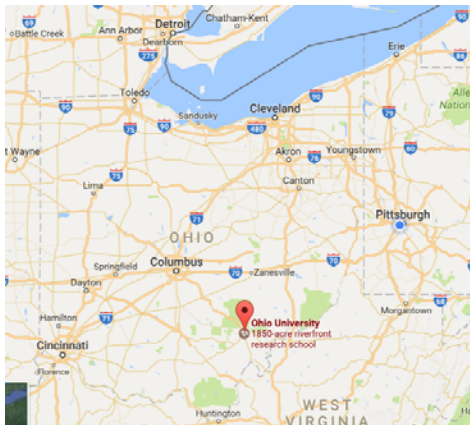


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RUSS COLLEGE OF ENGINEERING AND TECHNOLOGY

Where is Athens?



RUSS COLLEGE OF ENGINEERING AND TECHNOLOGY

Ohio University Introduction



- Ohio University is a large, primarily residential, public research university in Athens, Ohio, United States. One of America's oldest universities, the second oldest in Ohio, it was chartered in 1787 and approved in 1804, opening for students in 1809. As of 2014, the Athens campus had 23,300 students; the other five campuses had approximately 10,000, and eLearning 5,900. [Wikipedia]



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Ohio University



- Russ College of Engineering and Technology
 - Russ Prize (given by National Academy of Engineering)
 - Major engineering departments
 - ~1700 undergraduates
 - \$100 mil Russ Endowment
- ISE Department
 - 12 faculty
 - 100 undergraduates
 - BS, MS programs
 - PhD Program integrated with ME

Personal Introduction



- PhD, ISE, University of Southern California
- MS CS, USC; BS ME, MS ISE, Former Yugoslavia
- 22 years faculty at Ohio University
 - Simulation, Lean Manufacturing, CIM, Intelligent Systems, Geometric Modeling, Advanced Simulation
- Research/Teaching Assistant, PostDoc, USC
- 11 years academic experience in Former Yugoslavia (assistant, lecturer)

Simulation Experience



- Started with Siman/Cinema in late 1980s
 - Did few projects
- Studied other software in UK
 - SeeWhy, Witness, Genetik
- Graduate work at USC
 - Independent consulting job – Elevator model
- Applied simulation in elective production control course
- Started teaching simulation in 2001

Simulation Courses



- Ise4130 – Industrial Computer Simulation
 - Required for BS
 - Optional for MS/PhD
- Ise4310 – Introduction to Systems Engineering
 - Elective BS/MS/PhD
- Ise7330 – Advanced Computer Simulation
 - Graduate level course

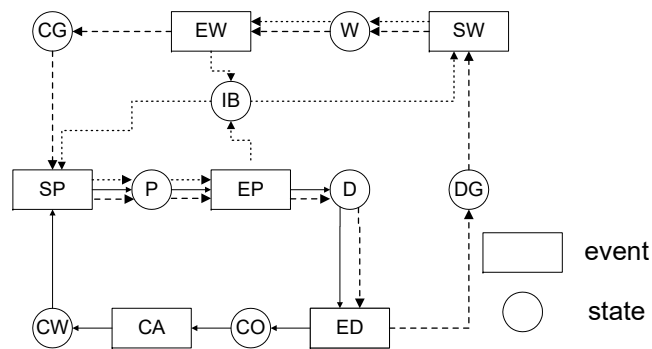
Required Simulation Course

- Teaching from 2001
- Prereq: Statistics, probability and programming
- 2 hour lecture/2 hour lab
- Arena until 2011
- Simio 2011, Arena/Simio 2011-15
- Simio 2016-

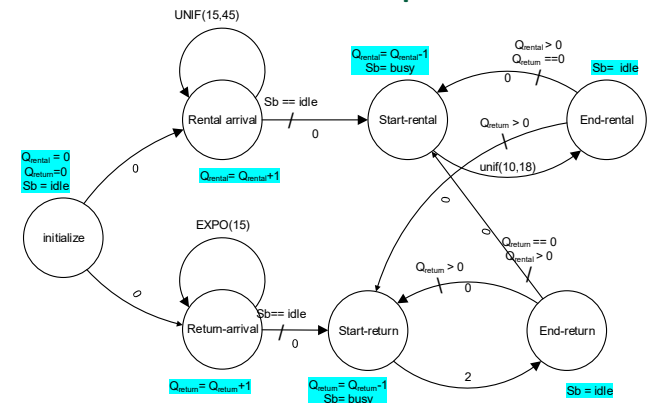
The Course Focus

- Simulation as a modeling tool
- Lectures explain principles
 - Basics of queuing theory
 - Performance measures
 - Entity life cycle diagram
 - Event graphs
 - Principles of Simio software
- Labs introduce modeling and software
- Weekly projects

Entity Life Cycle Diagram



Event Graph



Lab Sessions

- Two hours lab every week
- Each student has a seat in computer classroom
- Step by step instructions
 - Similar to simbits
- Start from basics
- Introduce new concepts in each lab
- Students make 2-3 models in each lab
- **Learning by doing**

Summary of Lab Sessions

- Introduction to Simio
- Random Number Generation, Running Simio
- Simple Models in Simio
- Simio Fixed Objects
- Statistics and SMORE plots
- Resources, Workstations
- Simulation Models and Task Sequences
- Transfer Logic, Vehicles, Conveyors
- Solving Problems in Simio (combiner, separator, schedules)
- Process Logic Examples, Logic on Entity State
- Sequences and Model Data
- Debugging and Verification of Simulation Models
- Simio Experiments and OptQuest

Example of Lab Instructions

- Step-by-step
- Snippets of the model
- Sequence of model building
- Explanations

ISS 4130/5130 Lab 7 11

4. Create Rate Table

- Select the Data tab
- Click on **New Facility** and create a new one. Name it *****AccommodationTable** and give it data shown below:

Starting Offset	Ending Offset	Rate (events per hour)
Day 1, 0:00:00	Day 1, 0:00:00	10
Day 1, 0:00:00	Day 1, 0:30:00	40
Day 1, 0:30:00	Day 1, 0:45:00	20
Day 1, 0:45:00	Day 1, 0:50:00	27
Day 1, 0:50:00	Day 1, 0:55:00	10
Day 1, 0:55:00	Day 1, 0:58:00	4

5. Edit Model Parts

- Select **ModelEntity** from the Navigation panel (on the right), and then select the **Definitions** tab
- Click **Properties** on the left
- Click **Standard Property** drop down list and select **Expression** to add a new Expression Property. Name the property *****TimeConsumption** and give it default value = 0
- Now, insert a distribution for the Expression you just created. To do this, go back to the Model by clicking on it in the Navigation panel.

6. Edit Model objects

- Select *****Customer** in Facility area and under General Properties there should be a *****NameTransaction** input. It should read: **RandomProcess(7,0,2,2,0,3,0,72,4,0,87,5,0,9,6,1,0)**

7. Edit Modules

- Select *****Customer** and edit Properties
 - Change Entity Type to *****Customer**. Then change Arrival Mode to **Time Varying Arrival Rate**, so that you can reference the rate table we just created. Select the Rate Table you just created from the drop down list. Change Entities per Arrival to: **RandomProcess(0.7, 2, 0.92, 3, 1.0)**
 - Select *****Resource** and edit Properties
 - Change the Initial Capacity to be 4. Set the Processing Time to: **RandomProcess(0.7, 2, 0.92, 3, 1.0)**
 - Edit the Secondary Resources by expanding the tree titled "Resources for Processing". Object Type should read **Resource** and Object List Name should be *****Follower**

*****Note:** If you **add_obj** find "Resource for Processing" item, then uncheck "Show Commonly Used Properties Only" at the top of the property window!

ResourceType refers to Entity object, rate refers to variable names in the model, Rate refers to child items, business object properties, Entity refers to job participation input table

Projects

- Weekly individual projects (9 total)
- Content similar to lab sessions
 - **Students have assignments on content that they practiced in the classroom**
- Final project
 - Team work (3-4 students)
 - Real world problems
 - From companies in neighboring areas
 - Six to eight weeks

Sample Final Projects



- Distribution center (Simio competition)
- Car light Assembly cell
- Specialty Clinic at NCH
- Stretch-wrap Packaging system
- Progressive care unit in Hospital
- Emergency Department
- Students occasionally use simulation in senior design projects
 - Warehouse model

Student feedback



- I liked the lab time and the professor's commitment to his students.
- The activities were interesting.
- The instructor makes this course fun and makes you want to do well
- The labs and projects were interesting, I feel that the projects really developed my simulation skills
- This course was up there as one of my favorites for the semester. Dr. Sormaz is a great teacher and willing to help and explain thoroughly any questions that come along. He also presents his class in an upbeat way to keep us engaged during lecture.
- i <3 simulation

Simio Competitions



- Participant in five competitions
 - Fall 14/15, Spring 15/16, Fall 16/17, Spring 16/17 – two teams
- Evaluator in Spring 14/15

Other Simulation Courses



- Ise4310 – Intro to Systems Engineering
 - System dynamics course (use Vensim)
 - Focus is on understanding business structure and behavior
- Ise7330 – Advanced Computer Simulation
 - Advanced topics from Banks/Carson book
 - Random number generation
 - Simulation implementation
 - Decision making based on simulation results

Research and Graduate Work

- Dynamic routing and dispatching
 - Simulation as verification tool
- Simulation model translation
 - Arena -> Simio and back
- Hierarchical modeling of warehouse operations
 - Inspired by last year project
- Modeling crowd management
 - Sport, cultural events
 - Disasters (natural and human caused)

New Directions

- Planning and Scheduling with Simio
- Using portal to teach simulation experimentation
- Custom built objects (hospital)

