Miami Dade College

Course Description

CAI4830C | Simulation for Applied Artificial Intelligence | 3.00 credits

Students will learn how to choose the right constructs of the modeling language to create a representation of a real-world system that is suitable for risk-free dynamic experiments. In addition, the students will learn how to build and deploy simulation models using the three major paradigms in simulation modeling for AI: agent-based, system dynamics, and discrete-event. Pre/Corequisite: CAI4505C.

Course Competencies

Competency 1: The student will demonstrate an understanding of simulation modeling by:

1. Differentiating between analytical and simulation modeling
2. Applying analytical models using queuing theory and the Pollaczek–Khinchine formula
3. Using simulation to improve an analytical queuing theory model
4. Identifying the advantages of simulation modeling and its applications

Competency 2: The student will demonstrate an understanding of System Dynamics, Discrete Event, and Agent-Based Simulation in AI by:

1. Exploring Stock and Flow, Feedback, and Causal Loop diagrams
2. Exploring Use case for events and event type
3. Exploring condition-triggered events
4. Designing and drawing state charts and state transitions: triggers, guards, and actions
5. Identifying and prioritizing essential system features
6. Identifying relationships, space, events, and agent behaviors
7. Building and running system dynamics, discrete static or dynamic events, and agent-based simulations using modern software
8. Building and running multi-method simulations using modern software
9. Analyzing the resulting data of an experiment and communicating the results effectively to decision-makers

Competency 3: The student will demonstrate an understanding of randomness and optimization in simulation models by:

1. Incorporating randomness into a model by using probability distribution functions and custom (empirical) distributions
2. Analyzing trajectory depending on sources of internal randomness in process, agent-based, and system dynamics models
3. Using Random number generators and seeds to create reproducible and unique experiments
4. Using optimization software with simulation software to perform efficient search

Competency 4: The student will demonstrate an understanding of interactive model design by:
Building data exchange interfaces to the external world

1. Using graphics tools to design 2D and 3D front ends for models
2. Including various UI controls (buttons, sliders, text inputs, etc.) into the model front end
3. Differentiating between virtual and real-time (time, date, and calendar) as it applies to the model

Competency 5: The student will demonstrate an understanding of the fundamentals of digital twins concept by:

1. Differentiating the three levels of the digital twin: the master, the shadow, and the twin
2. Describe the benefits of using Digital twins in different use cases

Learning Outcomes:

- Communicate effectively using listening, speaking, reading, and writing skills
- Use quantitative analytical skills to evaluate and process numerical data
- Solve problems using critical and creative thinking and scientific reasoning
- Formulate strategies to locate, evaluate, and apply information
- Use computer and emerging technologies effectively