Knight Foundation School of Computing and Information Sciences

Course Title: Fundamentals of Modeling & Simulations **Date:** 3/5/2020

Course Number: CAP 4830

Number of Credits: 3

Subject Area: Computer Applications	**Subject Area Coordinator:** Leonardo Bobadilla **email:** bobadilla@cs.fiu.edu
Catalog Description: Introduction to discrete-event systems, a survey of modeling tools, mathematical & statistical modeling, role of random numbers, verification & validation, and applications.	
Textbook: Banks, Carson, Nelson & Nicol – Discrete-Event System Simulation, 5th Edition, Pearson, 2010, 978-0136062127	
References:	
Prerequisites Courses: STA 2023 or STA 3033 and COP 3530	
Corequisite Courses: None	

Type: Elective for CS (Applications group)

Prerequisites Topics:

1. Basic techniques of algorithm analysis and problem solving
2. Familiar with basic data structures, e.g. queues and stacks
3. Familiar with encapsulation using functions
4. Familiar with concepts of probability
5. Familiar with random variables and their distributions

Course Outcomes:

1. Be familiar with the history, advantages, and disadvantages of simulations.
2. Be familiar with a variety of simulation environments and tools.
3. Be familiar with concepts in discrete-event simulation models.
4. Be familiar with statistical models and discrete distributions.
5. Be exposed to random numbers and their generation.
6. Be exposed to input modeling and parameter estimation.
7. Be familiar with verification, validation, and documentation of simulation models.
8. Master development of simulation models to address topics in the above outcomes.

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Relationship between Course Outcomes and Program Outcomes

BS in CS: Program Outcomes	Course Outcomes
a) Demonstrate proficiency in the foundation areas of Computer Science including mathematics, discrete structures, logic and the theory of algorithms	1, 2, 3, 4, 5, 6, 7, 8
b) Demonstrate proficiency in various areas of Computer Science including data structures and algorithms, concepts of programming languages and computer systems.	3, 4, 5, 6, 7, 8
c) Demonstrate proficiency in problem solving and application of software engineering techniques	7, 8
d) Demonstrate mastery of at least one modern programming language and proficiency in at least one other.	
e) Demonstrate understanding of the social and ethical concerns of the practicing computer scientist.	
f) Demonstrate the ability to work cooperatively in teams.	
g) Demonstrate effective communication skills.	

Assessment Plan for the Course & how Data in the Course are used to assess Program Outcomes

Student and Instructor Course Outcome Surveys are administered at the conclusion of each offering, and are evaluated as described in the School's Assessment Plan: https://abet.cs.fiu.edu/csassessment/

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Outline

Topic	Number of Lecture Hours	Outcome
1. Introduction to Simulations 1.1. Brief History 1.2. Advantages & disadvantages 1.3. Components of Systems and Simulations 1.4. Steps in a simulation design	8	1
2. Simulation Environments and Tools 2.1. Spreadsheets 2.2. Software 2.3. Environments	5	2, 8
3. Concepts in Discrete-Event Simulation 3.1. Event scheduling 3.2. Event processing	5	3, 8
4. Statistical Models and Discrete Distributions 4.1. Terminology 4.2. Queueing and supply-chain systems 4.3. Reliability 4.4. Discrete distributions	5	4, 8
5. Random-Number Generation 5.1. Properties of Random numbers 5.2. Generation of pseudo-random numbers 5.3. Techniques for generation random numbers	5	5, 8
6. Input Modeling and Parameter Estimation 6.1. Data collection 6.2. Identifying distributions 6.3. Parameter estimation 6.4. Goodness-of-fit tests 6.5. Selecting input models	5	6, 8
7. Verification and Validation 7.1. Model building and V&V 7.2. Verification 7.3. Validation 7.4. Documentation	5	7, 8

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Course Outcomes Emphasized in Laboratory Projects / Assignments

Outcome	Number of Weeks
Introduction to simulations 1	2
Simulation environments and tools 2,8	2
Concepts in discrete-event simulation 3,8	2
Statistical models and discrete distributions 4,8	2
Random number generation 5,8	2
Input modeling and parameter estimation 6,8	2
Verification and validation 7,8	2

Oral and Written Communication

No significant coverage

Written Reports		Oral Presentations	
Number Required	Approx. Number of pages	Number Required	Approx. Time for each
0	0	0	0

Social and Ethical Implications of Computing Topics

No significant coverage

Topic	Class time	student performance measures

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Approximate number of credit hours devoted to fundamental CS topics

Fundamental CS Area	Core Hours	Advanced Hours
Algorithms:		
Software Design:		
Computer Organization and Architecture:		
Data Structures:		
Concepts of Programming Languages		

Theoretical Contents

Topic	Class time

Problem Analysis Experiences

Solution Design Experiences

The Coverage of Knowledge Units within Computer Science Body of Knowledge[1]

Knowledge Unit	Topic	Type	Lecture Hours

[1] See Appendix A in Computer Science Curricula 2013 at:
https://www.acm.org/binaries/content/assets/education/cs2013_web_final.pdf