Knight Foundation School of Computing and Information Sciences

Course Title: Systems Programming **Date:** 11/22/2024

Course Number: COP 4338

Number of Credits: 3

Subject Area: Programming
Catalog Description: Programming in C and advanced programming in Unix environments, including multiprocessing and multithreading. This course will have additional fees.
Textbook: *System Programming with C and Unix* (Adam Hoover), Pearson, Dec-2009 ISBN: 9780136067122.
References:
Prerequisites Courses: None
Corequisites Courses: *COP-3530*

Type: Required for CS Major

Prerequisites Topics:

- Significant programming experience in a modern programming language
- From COP3337: Master arrays and multidimensional arrays

Course Outcomes:

The following outcomes must be addressed solely in a Unix environment:

1. **Define** C basic types.
2. **Manipulate** data in C programs using arrays.
3. **Apply** pointers to manage memory in C.
4. **Develop** programs in Unix using utilities such as makefiles, gcc, and gdb.
5. **Implement** standard Input / Output operations in C programs.
6. **Explain** the structure of process address space, including Data, Heap, Code, and Stack segments.
7. **Apply** techniques for dynamic memory management in C programming.
8. **Develop** multithreaded programs while ensuring proper synchronization techniques are applied.
9. **Design** program solutions that apply C programming features to solve complex problems.

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Association between Student Outcomes and Course Outcomes

BS in Computing: Student Outcomes	Course Outcomes
1) Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.	9
2) Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.	
3) Communicate effectively in a variety of professional contexts.	
4) Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles.	
5) Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.	

Program Specific Student Outcomes

6) Apply computer science theory and software development fundamentals to produce computing-based solutions. [CS]	1 – 9
6) Apply security principles and practices to maintain operations in the presence of risks and threats. [CY]	
6) Apply theory, techniques, and tools throughout the data science lifecycle and employ the resulting knowledge to satisfy stakeholders' needs. [DS]	
6) Use systemic approaches to select, develop, apply, integrate, and administer secure computing technologies to accomplish user goals. [IT]	

Assessment Plan for the Course and how Data in the Course are used to assess Student 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.cis.fiu.edu/

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Outline

Topic	Number of Lecture Hours	Outcome

• **C**
  ○ Basic types
  ○ Type conversions and casting
  ○ Pointers and Arrays
  ○ Standard I/O
	6	1, 2, 3, & 5

• ***NIX**
  ○ Basic command line interface
  ○ Makefiles and gdb
	2	4

• **File I/O**
  ○ Parsing
  ○ Formatted I/O for file data
	2	5

• **Process Address Spaces**
  ○ Memory segments
  ○ Static vs dynamic segments
  ○ Segment scopes
	2	6

• **Concurrency**
  ○ Multiprocessing and IPC
  ○ Multithreading and synchronization
	5	8

• **Dynamic memory management**
  ○ Pointers
  ○ Memory allocation and deallocation
	3	2 & 7

• **Optional topics**
  ○ Sorting
  ○ Memory allocator
  ○ Socket programming
  ○ System calls
  ○ Parallel programming
	5	

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Course Outcomes Emphasized in Laboratory Projects / Assignments

Course Outcome	Number of Weeks
1, 2, 3 & 4	2
1 & 5	2
5 & 7	3
6 & 7	3
8	2

Oral and Written Communication:
None

Social and Ethical Implications of Computing Topics:
None

Approximate number of credit hours devoted to fundamental CS topics

Topic	Core Hours	Advanced Hours
Algorithms:		0.5
Software Design:		1.5
Computer Organization and Architecture:		0.5
Data Structures:		1
Concepts of Programming Languages:		1.0

Theoretical Contents: None

Problem Analysis Experiences

6 Programming Assignments

Solution Design Experiences

6 Programming Assignments

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

Knowledge Unit	Topic	Lecture Hours
OS 3	Concurrency (multiprocessing and multithreading)	5
OS 5	Memory management	5
OS 8	File systems and I/O	2
PF 3	Fundamental data structures	1

[1]See https://csed.acm.org/wp-content/uploads/2023/03/Version-Beta-v2.pdf for a description of Computer Science Knowledge units