COMP 5327: Advanced Algorithms
Spring 2019
Course Syllabus

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Introduction to the Course

About the Instructor

Instructor Name: Dr. Bhanukiran Gurijala
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Virtual Office Hours: Monday: 10 am – 12 pm; Tuesday: 3 – 5 pm; Thursday: 3 – 5 pm
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Prerequisites/ Corequisites

None

Statement on Course Materials

Some of the writings, lectures, films, or presentations in this course may include material that conflicts with the core beliefs of some students. Please review the syllabus carefully to see if the course is one that you are committed to taking. If you have a concern, please discuss it with the instructor at your earliest convenience.

Course Description

This course focuses on the advanced design and analysis of algorithms. Several algorithm design and analysis techniques will be discussed in detail which include solutions to practical problems in graph theory, networks, optimization via divide and conquer algorithms, dynamic programming algorithms and greedy algorithms. Complexity theory, distributed algorithms, and encryption algorithms will be examined.

Instructional Contact Hours/Credits

Lecture - 45 Clock Hours / 3 Semester Credits

Virtual Office Hours

This is an online course. Instructor can be contacted via email and phone calls. Phone calls will be accepted during office hours, and other times by appointment.

Please post your questions of general interest in the **Course Q and A forum**. Even if you don't have any questions of your own right now, check to see what may have been posted by others. If you know the answer to a question, feel free to post a reply. The instructor will be moderating and responding to the questions regularly. Please use email for private correspondence.

Course Materials

Textbook

- "Introduction to The Design and Analysis of Algorithms" by Anany Levitin. ISBN-13: 978-0-13-231681-1 (Required Textbook)

Library Resources

Since this course includes course activities that require students to gather information using library resources, students are expected to know how to use the library's resources including the available databases, periodicals, and journals. If you are not familiar with using the library, please visit the library's website for more detailed information: http://www.na.edu/library/

Technical Requirements

To access this course, students will need access to the Internet and a supported Web browser (Internet Explorer, Firefox, Safari or Chrome). For detailed hardware and software requirements, please visit the following website: http://www.na.edu/nau-distance-education/

Course Technologies

This course requires a webcam and a built-in microphone to attend web conferences. This course requires assignments to be submitted in Microsoft Office or Adobe Acrobat (pdf) file formats. Assignments created using other applications, such as Google Documents, Microsoft Works or WordPerfect, are not acceptable.

Course Format

This is a fully online course. In order to complete this course successfully students need access to a computer and the Internet on a daily basis. This course is both synchronous, (through webinars) and asynchronous (discussion board, group work, etc.) All instructions are contained in this syllabus and in the NAUmoodle course management system.

This course will be delivered entirely online through NAU Moodle course management system at Office 365 Portal named NAU Moodle. Students can get access through Office 365 portal with their NAU accounts provided by IT department. For login issues and account problems with NAU Moodle, please contact with Distance Education Support via one of the following methods:

- Visit Room 732
- Call 832-464-8691
- Email moodle@na.edu
- Visit http://www.na.edu/nau-distance-education/

For hardware and software problems other than NAU Moodle system, please contact with IT Department via one of the following methods:

- Visit Room 820
- Call 832-230-5541
- Email support@na.edu

Learning Outcomes

Program-Level Outcomes (PLO)

MS in CS - Program Learning Outcomes (PLO)	Assessment
1. Demonstrate advanced skills of computing theory and algorithms.	A
2. Develop sophisticated knowledge of operating systems and hardware.	
3. Apply advanced practices of software design and development cycle.	
4. Acquire advanced skills of computer networks	
5. Analyzing data using advanced computing tools.	
6. Engaging and applying secure practices in various digital environments.	
7. Demonstrate communication skills to convey technical information accurately and effectively.	
Key: I=Introduced; E=Emphasized; U=Utilized; A=Comprehensive Assessment	

Course-Level Outcomes

Students will be able to:

Course-Level Outcomes (CLO)	Meets PLO
1. <u>Discuss</u> complexity theory in the terms of Big Oh, Big Theta and Omega.	1

2. Apply and compare sorting and searching algorithms.	1
3. Be familiar with various algorithm designs such as divide and conquer, dynamic programming, greedy algorithms, recursion, trees, networks and deep learning.	1
4. Apply distributed algorithms, and encryption algorithms.	1

Grading

Grading Table

The following table summarizes the requirements and grading of the assignments in this course. The specific instructions for each activity are included in the appropriate forum, assignment, or quiz on the course NAUmoodle website.

Assignment	Quantity	Points	Maximum Total
Discussion Forum	8	2	16
Bi-Weekly Assignments (At least two will be Library Research Assignments)	7	4	28
Webinar Participation	7	1	7
Quizzes	12	2	24
Final Project	1	25	25
		Course Total:	100/100

Grade Distribution

Percentage Achieved	Course Grade
96 – 100	A
91 – 95	A-
86 – 90	B+

81 – 85	B
76 – 80	B-
71 – 75	C+
66 – 70	C
Below 66	F

Time Requirements:

The activities in this course are based on a 15-week instruction schedule. Course topics will be demonstrated and discussed online; however, additional time outside of class is required to achieve learning objectives. Students are expected to spend approximately 6 hours a week, on average, completing class activities such as assignments and projects. This meets the Federal Government's expectation of 2 hours of homework for each hour of lecture. The average time commitment range calculation for this course (3 Semester Credit Hour) is shown in the following table:

Class Activities	Weekly Minimum Expected Average Time
Discussion Forum Postings	0.5 hour
Assignments	6 hours
Webinar Participation	0.5 hour
Multimedia Presentations	0.5 hour
Readings	2.5 hours
Weekly Total	**10 clock-hours**
Total Term Expectation:	**10 x 15 = 150 clock hours**

Late Submissions

Technology issues cannot be used as a reason for late assignments. You must have back-up plans for technology issues, such as technical problems with your computer, Internet server provider problems, etc.

Late submissions will not be accepted for this course.

Assignment Guidelines

Discussion Forums

Students should participate in discussion forums and complete discussion activities with correct English usage, accurate spelling, and standard grammar. Students are expected to post a response to the discussion questions early in the week and maintain a thread of discussions throughout the week as they respond to their classmates.

Points will be given for:
- Following the timeline and quantity of posts to discussion questions
- Offering ideas or resources and inviting a review of them based on readings
- Articulating, explaining and supporting positions on ideas
- Exploring and supporting issues by adding explanations and examples
- Reflecting on and re-evaluating personal opinions based on readings
- Offering a review, challenging, discussing and expanding ideas of others
- Negotiating interpretations, definitions, and meanings
- Responding to at least two other students' responses

Students' work on discussion forum will be graded on two parts:

Rubric	Score 0%	Score 50%	Score 75%	Score 100%
Discussion Posting	Did not participate in discussion	Poorly developed, does not add to the discussion	Developing ideas	Well-developed ideas
Discussion responses to other students	Did not interact with any students	Interacts once with other students	Interacts twice with other students	Interacts at least three times with other students

Bi-Weekly Assignments

The purpose of this assignment is to encourage students to read, comprehend, and analyze the course materials. At least two of the assignments will be library research assignments.

Rubric for Bi-Weekly Assignments:

Rubric	Score 0%	Score 50%	Score 75%	Score 100%
Organization	No organization is evident	Some organization and clarity is	Writing is generally clear and consistent	Well-developed ideas, clear writing, logical

		evident		and consistent
Depth of Concepts	Demonstrates only minimal understanding	Demonstrates some understanding of the core concepts	Demonstrates understanding of most of the core concepts	Demonstrates understanding of all core concepts
Literature and References	No references	Some references cited, citations are incomplete	Citations are adequate	Through list of references with complete citations

Webinars

The instructor will be conducting 30 to 90 minutes' webinar sessions every other week. The webinars will include lecturing, reviewing course requirements, and answering any questions students may have. **Participation is optional but will be graded.** To get the full credit from the webinars:

1. Join the webinar, and type in your full name into chat box, **OR**
2. Watch the recorded session on the course page and submit a summary of the webinar, a synopsis, in 100-150 words.

The first webinar will be held on Wednesday January 16, 2019, at 1 pm.

Webinar Schedule:
Webinar links will be posted on course website. Make sure that you installed Gotomeeting software/app to participate in the webinar sessions. Please refer to our technical support website to get more technical information: http://www.na.edu/nau-distance-education/video-tutorials/

Webinar	Date	Time
Session 1	Wednesday January 16, 2019	1:00 pm
Session 2	Wednesday January 30, 2019	1:00 pm
Session 3	Wednesday February 13, 2019	1:00 pm
Session 4	Wednesday February 27, 2019	1:00 pm
Session 5	Wednesday March 20, 2019	1:00 pm
Session 6	Wednesday April 03, 2019	1:00 pm

Session 7	Wednesday April 17, 2019	1:00 pm

Library Research Assignment

Main purpose of the library research assignments is to develop our students' library research skills, their academic writing skills, and to help our students gain confidence and facility in using library research tools.

Our library website: http://www.na.edu/library

Project

Students are required to complete a project. Details will be provided during the semester. The main work will be solving challenging algorithmic questions.

Rubric	Score 25%	Score 50%	Score 75%	Score 100%
Implementing Correct and Efficient Algorithms	Student solves more than 25% of the provided questions	Student solves more than 50% of the provided questions	Student solves more than 75% of the provided questions	Student solves more than 90% of the provided questions

Quizzes

There will be 12 multiple choice quizzes during the semester available on NAUmoodle.

Students Rights and Responsibilities

Students are responsible for:
- reading any assigned reading as stated in the weekly blocks of the course page
- reviewing the web-page resources posted in the NAU Moodle course site for each week
- reading all discussion postings in the weekly blocks as assigned
- posting weekly discussion postings as assigned
- assuring that their computer/device is compatible and working to engage

effectively in this online course
- uploading assignments before or on the assigned due date/time

Students can expect:
- the instructor will return email and phone communications within 24 hours unless otherwise announced in the course page.
- discussion participation will be responded to/graded after 5 days of the due date
- Bi-Weekly assignments will be graded after 7 days of the due date.
- Quizzes will be graded automatically
- Final project will be graded after 7 days of the due date.

Academic Honesty

Each student assumes the responsibilities of being a member of the NAU academic community. All acts of plagiarism are not tolerated including: cheating, claiming one's work as their own, fabrication and helping one to commit any of these acts. Any violations of academic honesty will receive strict disciplinary action, which can include suspension and even expulsion from NAU.

ADA Statement

When possible, and in accordance with 504/ADA guidelines, we will attempt to provide reasonable academic accommodations to students who request and require them. Please call North American University at (832) 230-5555 for more assistance.

Course Schedule

All assignments are due by 11:55 p.m. Sunday at the end of the week in which they are assigned.

Week	Topics / Activities	Assignments	Readings	Course Level Outcomes
Week 1	o Overview of the Course o Review of the Syllabus o Review Course NAU Moodle site	Discussion 1: Introduce yourself	Chapter 1	1

	o Course Procedures o Content o Introduction - Algorithm Basics o Webinar 1 (Link will be published on NAU Moodle)	Synopsis 1 (Summarize Webinar 1 and submit it on NAU Moodle)		

Week 2	o Introduction
	
	   - Algorithm Basics
	
	   - Data Structures
		Quiz 1
		
		Homework 1 (NAU Moodle)
			Chapter 2	1

Week 3	o Fundamentals of the Analysis of Algorithm Efficiency o Asymptotic Notations and Basic Efficiency Classes o Webinar 2	Quiz 2 Discussion 2 Synopsis 2	Chapter 3	1

Week 4	o Brute Force and Exhaustive Search
	
	   - Basic Concepts
	
	   - Selection Sort
	
	   - Bubble Sort
	
	   - Depth-First Search
	
	   - Breadth-First Search
		Quiz 3
		
		Homework 2
			Chapter 4	1, 2

Week 5	o Decrease-and-Conquer - Insertion Sort - Topological Sort - Generate Combinatorial Objects - Constant Size Decrease - Variable Size Decrease o Webinar 3	Quiz 4 Discussion 3 Synopsis 3	Chapter 5	1, 2
Week 6	o Divide and Conquer -Merge sort -Quicksort -Binary Tree Traversals -Multiplication of Large Integers	Quiz 5 Homework 3	Chapter 6	1, 3
Week 7	o Transform and Conquer -Fundamentals -Presorting -Balanced Search Trees -Heaps and Heapsort -Binary Exponentiation -Problem Reduction o Webinar 4	Quiz 6 Discussion 4 Synopsis 4	Chapter 7	1, 3
Week 8	o Space and Time Trade-offs -Sorting by Counting -Input Enhancement in String	Quiz 7	Chapter 8	1, 2, 3

	Matching
	
	   -Hashing
	
	   -B-Trees
		Homework 4		

Week 9	o Dynamic Programming
	
	   - Basics
	
	   - Knapsack Problem
	
	   - Binary Search Trees
	
	   - Warshall's Algorithm
	
	   - Floyd's Algorithm
	
	o Webinar 5
		Quiz 8
		
		Discussion 5
		
		Synopsis 5
		
		FINAL PROJECT
			Chapter 9	1, 2, 3

Week 10	o Greedy Techniques
	
	   - Prim's Algorithm
	
	   - Kruskal's Algorithm
	
	   - Dijkstra's Algorithm
		Quiz 9
		
		Homework 5
			Chapter 10	1, 2, 3

Week 11	o Iterative Improvement
	
	   -Maximum-Flow Problem
	
	   -Maximum Matching in Bipartite Graphs
	
	   -Stable Marriage Problem
	
	o Webinar 6
		Quiz 10
		
		Discussion 6
		
		Synopsis 6
			Chapter 11	1, 2, 3

Week 12	o Limitations of Algorithm Power
	
	   - Lower-Bound Arguments
	
	   - Decision Trees
		Quiz 11
		
		Homework 6
			Chapter 12	1, 2, 3, 4

	- P, NP, and NP-Complete Problems			
Week 13	o Coping with the Limitations of Algorithm Power - Backtracking - Branch-and-Bound - Approximation Algorithms for NP-Hard Problems o Webinar 7	Discussion 7 Synopsis 7	Chapter 16 – Material will be provided	1, 3
Week 14	o Cryptography - Introduction - Terminology - Encryption - Transposition Ciphers	Quiz 12 Discussion 8 Homework 7		1, 4
Week 15	o Cryptography - Substitution Ciphers - Block Ciphers - Public Encryption and RSA	Complete Online Course Evaluation Survey		1, 4

Syllabus subject to change

This syllabus may change as needed to support the student learning outcomes for this course.