



**De La Salle University – Manila**  
**College of Computer Studies**



**DEPARTMENT:** Software Technology Department  
**COURSE CODE:** Algomcom  
**COURSE TITLE:** Analysis of Algorithms

**CLASS DAYS AND CLASS TIME:**

MONDAYS AND WEDNESDAYS	SECTION	ROOM
08.00 – 09.30	S17	G209
09.40 – 11.10	S18	G205
TUESDAYS AND THURSDAYS	SECTION	ROOM
13.00 – 14.30	S19	G209

**INSTRUCTORS:**

Solomon See

Consultation Hours: By Appointment

**COURSE DESCRIPTION:**

The goal of this course is to introduce various algorithm design and analysis principles and techniques applicable to different data structures, which will help computer scientists in writing correct and efficient algorithms and programs.

**LEARNING OUTCOMES (LOs)<sup>1</sup>:**

By the end of the course, the students will be able to:

- LO1: Analyze algorithms by determining algorithm's complexities, performance and resource requirements. <sup>CCT, TCPL</sup>
- LO2: Analyze the principles and techniques for different types of algorithms. <sup>CCT, TCPL</sup>
- LO3: Able to construct effective and efficient algorithms for different problems when presented during classroom activities, case scenarios and examinations using concepts learned on various principles and techniques as defined in LO2. <sup>TCPL</sup>
- LO4: Appreciate and conduct research in augmenting knowledge. <sup>RLL</sup>
- LO5: Prepare and present a well-written report according to the research paper requirement as defined in this course with proper citation and acknowledgement on prior works and not claiming as one's own. <sup>EF, SEC</sup>
- LO6: Articulate in providing and contributing constructive criticisms to peers. <sup>SEC, EF</sup>
- LO7: Extend respect on one's opinion during collaborative work, classroom discussion and research paper presentation. <sup>SEC</sup>
- LO8: Extend attentiveness and discipline in class. <sup>SEC</sup>
- LO9: Manifest intellectual honesty and punctuality in the various class activities. <sup>SEC</sup>

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<sup>1</sup> The learning outcomes are defined with the Expected Lasallian Graduate Attributes (ELGA) as instituted by the University in mind. These attributes are: Critical and Creative Thinker (CCT); Effective Communicator (EF); Reflective Lifelong Learner (RLL); Technically Proficient and Competent Professionals and Leaders (TCPL); and Service-Driven, Ethical and Socially Responsible Citizen (SEC)

**FINAL COURSE OUTPUT/PERFORMANCE TASKS:**

Throughout the course, the following are the expected performance tasks with their targeted learning outcomes (LOs) and corresponding due dates.

LEARNING OUTCOME	REQUIRED OUTPUT	TARGET DATES
LO 1, LO3, LO9	Departmental Examinations and Final Exam	1 <sup>st</sup> Departmental Exam 2 <sup>nd</sup> Departmental Exam Final Exam
	Analysis reflected in Technical Paper	Throughout the trimester
LO 2, LO3, LO4, LO5, LO6, LO7, LO8, LO9	Technical Paper Construction and Topic Research	Throughout the trimester
	Research Paper Presentation from the Mini-Symposium	TBA

**RUBRIC FOR ASSESSMENT ON THE RESEARCH PAPER COMPONENT<sup>2</sup>:**

Instruction: Yes Test: You must receive all “yeses” for your paper to be scored. Any “no” will stop the process.

Yes	No	Basic Requirements
		1. Paper typed
		2. Problem or issue is clearly stated in intro and referenced in the conclusion
		3. Correct documentation style used in text
		4. Citing evident
		5. Minimum 8 sources (and a variety of types)
		6. Works Cited/Bibliography or References accurate and correctly formatted
		7. Paper written in 3rd person; content not personal essay but non-biased research
		8. Paper meets minimum length standard (5-7 pages, excluding title and Works Cited/Bibliography or References)
		9. Evidence of consistent and conscientious editing

4—Clearly a knowledgeable, practiced, skilled pattern

3—Evidence of a developing pattern

2—Superficial, random, limited consistencies

1—Unacceptable skill application

<sup>2</sup> Rubric was adopted from: [www.christina.k12.de.us](http://www.christina.k12.de.us)

### Use of Sources and References

Skill application demonstrates use which represents →	4	3	2	1
Researched information and references are appropriately documented				
Enough outside information to clearly represent a research process				
Demonstrates use of paraphrasing, direct, and indirect quotations				
Information connects to the problem or issue being addressed				
Sources on Works Cited/Bibliography or References accurately match sources cited within the text				

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### Content/Organization

Skill application demonstrates use which represents →	4	3	2	1
Introduction is engaging and clearly defines problems and issues				
Issues and problems raised are challenging and focused				
Content connecting to problem and issues is clarifying, exploring, explaining, developing				
Text organization flows sensibly and smoothly				
Clearly outlines the formal definition of the algorithm, data structure or problem and provides clear and precise examples and figures				
Provides discussion on analysis of performance and comparison to related algorithm, data structure or problem				
Mixture of personal voice interwoven with research (commentary)				
Conclusion thoughtful, engaging, and clear				

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### Mechanics/Usage/Spelling/Format

Skill application demonstrates use which represents →	4	3	2	1
Pagination (top right following last name)				
12 point Times New Roman font and appropriate margins				
Usage/Grammar				
Correct paragraphing				
Written in formal style				

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### Information Literacy

Skill application demonstrates use which represents →	4	3	2	1
Consistent Format (APA)				
Evidence of thorough research (sources represent variety and types)				
Documentation demonstrates conscientious application of citing ethics				
Evidence of sorting and selecting appropriate material				
Evidence of importance of author's credibility and validity				
Research offers non-biased, fair research perspective from which a conclusion is drawn				
Research information goes beyond surface information				

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Total Score: \_\_\_\_/100

### RUBRIC FOR ASSESSMENT ON THE PRESENTATION COMPONENT<sup>3</sup>

Marking Scheme:

4—Clearly a knowledgeable, practiced, skilled pattern

3—Evidence of a developing pattern

2—Superficial, random, limited consistencies

1—Unacceptable skill application

The speaker(s)

Skill application demonstrates use which represents →	4	3	2	1
Showed enthusiasm in his/her facial expression and voice				
Looked prepared and credible				
Each member have an active role in the presentation				
Had convincing power				
Wore appropriate attire				

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Content/Organization

Skill application demonstrates use which represents →	4	3	2	1
Main points supported by sufficient details				
Well – prepared visuals				
Cited sources				
Discussed/presented within time limit				
Started with a bang!				
Logically organized details				
Followed the sequence to convince the audience				
Visuals and Multimedia augments presentation clarity				
Use of accurate information shared using multiple pieces of evidence (logical arguments, data or graphs)				
Audience can restate purpose of presentation				
Ended with a bang!				

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Transmission and Delivery

Skill application demonstrates use which represents →	4	3	2	1
Appropriately vary the intonation				
Conversational tone				
Controlled speed delivery				
Effective Gestures and clear language				
Avoided fillers and code-switching				

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Audience Rapport

Skill application demonstrates use which represents →	4	3	2	1
Made the audience pay attention				

<sup>3</sup> Rubric adopted from [www.christina.k12.de.us](http://www.christina.k12.de.us)

Acknowledge the presence of the audience				
Established and maintained eye contact				
Addressed possible objections				

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Total Score: \_\_\_\_/100

Comments/suggestions:

1. I enjoyed listening to the presentation because:

2. The speakers' strengths are:

3. However, I suggest that:

4. The speakers should work on the following:

#### OTHER COURSE REQUIREMENTS AND ASSESSMENTS:

Activity and Milestone
1. Topic Proposal
a. Submission of 1 <sup>st</sup> set of Review of Related Literature
b. Submission of 1 <sup>st</sup> draft of Discussion of Analysis + Revised RRL
c. Submission of 1 <sup>st</sup> draft of Discussion of Application Areas + Revised (a) and (b)
2. Submission of Initial Draft of Technical Paper
3. Submission of Revised & Final Technical Paper
4. Presentation Materials
5. Symposium Week

#### GRADING SYSTEM:

Departmental Exam	20%
Research Work (Mini-Symposium)	20%
Presentation <sup>4</sup>	10%
Written Report <sup>5</sup>	10%
Final Exam (Comprehensive)	20%
Programming Exercises	20%
Homework/Recitation	20%

Total Marks

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100%

**PASSING GRADE: 60.000%**

<sup>4</sup> See the Rubric for the Research Paper Component

<sup>5</sup> See the Rubric for the Presentation Component

**GRADING SCHEME:**

Final Grade	GPA
0 – 59	0.0
60 – 65	1.0
66 – 71	1.5
72 – 77	2.0
78 – 82	2.5
83 – 88	3.0
89 – 93	3.5
94 – 100	4.0

**LEARNING PLAN:**

TOPIC	LEARNING ACTIVITIES
Mathematical Foundations <ul style="list-style-type: none"> <li>○ Introduction</li> <li>○ Growth of Functions</li> <li>○ Summations</li> <li>○ Recurrences               <ul style="list-style-type: none"> <li>• Substitution Method</li> <li>• Iterations Method</li> <li>• Master Method</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Lecture and discussion on the basic mathematical foundation</li> <li>• Review and application of Mathematical computations learned from previous Math courses</li> </ul>
Sorting Algorithms and Search Methods <ul style="list-style-type: none"> <li>○ Review of Quadratic Time Sorting Algorithms</li> <li>○ <math>O(n \log n)</math> Sorting Algorithms</li> <li>○ Sorting in Linear Time</li> <li>○ Sorting Networks</li> <li>○ Pattern &amp;/or Substring Search</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture and discussion on the different known sorting algorithms with emphasis on the algorithm's technique and time performance.</li> <li>• In some cases, space performance is discussed to illustrate the potential trade-off when reasoning about algorithm efficiency</li> </ul>
Departmental Exam	
Analysis and Design Techniques <ul style="list-style-type: none"> <li>○ Divide and Conquer</li> <li>○ Dynamic Programming</li> <li>○ Greedy Algorithms</li> <li>○ Backtracking</li> <li>○ Approximation Algorithms</li> <li>○ Amortized Analysis (optional)</li> </ul>	<ul style="list-style-type: none"> <li>• Lecture and discussion on different algorithm analysis and design where optimization problem is being focused on.</li> <li>• Discussion also includes under what circumstances that each technique is appropriate to apply through several applications/problem solving tasks to be presented.</li> </ul>
Research (Mini-symposium)	<ul style="list-style-type: none"> <li>• Discussion and consolidation of all the basic concepts learned throughout the term in the form of presentation on different applications and techniques in problem solving.</li> </ul>

**REFERENCES:**

Cormen, T. H., Leiserson, C. E., & Rivest, R. L., Stein, C. (2009). Introduction to Algorithms. 3rd Edition. MA: The MIT Press.

Goodrich, Michael T., Tamassia, Robert. (2011). Data Structures and Algorithms in Java. Wiley.

Weiss, M. A. (2010). Data Structures and Algorithm Analysis in Java. 2nd Ed. MA: Addison Wesley.

Sedgewick, R. (2011). Algorithms, 4th Ed. MA: Addison-Wesley.

Skiena, Steven (2008). The Algorithm Design Manual. Springer.

**ONLINE RESOURCE(S):** Course Website: <http://groups.yahoo.com/group/BorgzAlgomcom>

**CLASS POLICIES:****Policies and Requirements for Research Paper:****GENERAL GUIDELINES:**

1. The objective of the Research Symposium is to expose students to other problems beyond what were/will be covered in the lecture class.
2. Each group can consist of 4 students (maximum) and a minimum of 2 students.
3. The target audience are students enrolled in ALGOCOM
4. Venue is TBA (Usually, the ISR is our venue)
5. The date(s) of Research Symposium will be announced. Normally, the schedule of the Research Symposium is done 2 weeks before the end of the term.
6. Research Symposium Topics may fall under three (3) major categories:
  - a. [NP \(non-deterministic polynomial time\) problems](#)
  - b. [Advanced Data Structures/ Abstract Data Types](#)
  - c. [Advanced Algorithms](#)
7. Students can propose topics (advanced algorithms or advanced data structures) from your thesis.
8. Paper Format, kindly see [Paper Format](#) document (see Paper Format for ACM Word Template For SIG site)

**PAPER FORMAT FOR NP-RELATED PROBLEMS:**

Title

Authors

I. Abstract

II. Introduction

III. Formal Definition of the Problem

IV. Brute-Force Solution

V. Fastest Known Solution and/or approximation Algorithm

VI. Applications (to real-world scenarios or computer science applications)

VII. Conclusion

## VIII. References

### **PAPER FORMAT FOR ADVANCED DATA STRUCTURES/ABSTRACT DATA TYPES**

Title

Authors

- I. Abstract
- II. Introduction
- III. Formal Definition of the ADT
  1. Properties/Characteristics
  2. Operations
- IV. Analysis and Comparison to related ADT
- V. Applications
- VI. Conclusion
- VII. References

### **PAPER FORMAT FOR ADVANCED ALGORITHMS**

Title

Authors

- I. Abstract
- II. Introduction
- III. Formal Definition of the Algorithm
- IV. Analysis and Comparison of the Algorithm to related Algorithms
- V. Applications
- VI. Conclusion
- VII. References

**SAMPLE TOPICS FOR MINI-SYMPOSIUM ARE PROVIDED BELOW, HOWEVER YOU ARE NOT LIMITED TO THESE.**

### **TOPICS UNDER NP PROBLEMS**

Google: NP Problems Compendium for topics

Website: <http://www.nada.kth.se/~viggo/problemlist/compendium.html>

Some topics include:

- a. Minimum Rectangle Cover
- b. Minimum Flow-Shop Scheduling
- c. Minimum k-Chinese Postman Problem
- d. Minimum Graph Coloring
- e. Minimum Multiprocessor Scheduling with Speed Factors
- f. Minimum Graph Motion Planning
- g. Minimum Steiner Trees
- h. K-Nearest Neighbor Algorithm

### **TOPICS UNDER ADVANCED DATA STRUCTURES/ ABSTRACT DATA TYPES**

Some topics include:

- a. TRIES
- b. kd-Trees



- c. Fibonacci Heaps
- d. Binomial Heaps
- e. Threaded B-Trees
- f. Link Cut Trees
- g. Red Black Trees
- h. Quadtrees

#### **TOPICS UNDER ADVANCED ALGORITHMS**

Topics that may be investigated:

- a. Application of approximation algorithms
  - i. hill climbing theory
  - ii. simulated annealing
- b. Hidden Markov Model
- c. Generalized LR Parsing
- d. Compression/Decompression standards
- e. Emerging audio standard (Post-MP3 standards)
- f. Encryption/Decryption standards
- g. Kalman Filter
- h. Application of Belief Networks (e.g. Bayesian Network)
- i. Application of Neural Networks
- j. Application of Self-Organizing Maps
- k. <http://www.nist.gov/dads>