Spring 2019

COSC 302

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Course in a nutshell

In 101 course you learned that CS is about solving problems. There is a question here; “Is every problem solvable?” Basically, what is a “problem”? What is a “solution”? We will discuss these questions here in this course.

Within this course an “algorithm” is what is considered as a solution to the problem. You should already know what an algorithm is from 101 course because you already have solved problems by giving algorithms and implementing them in Python. Some techniques to devising an algorithm will be introduced here. There are not too many (only divide and conquer, greedy algorithm, dynamic programming, and the use of some data structures) and they might not be applicable to your problem in hand.

This course does not teach you these techniques only to help you devise an algorithm for your problem. You will rely mostly on your intelligence to solve your problems and maybe utilize one of these techniques. This course teaches you these techniques to show you that you may solve a problem with two different algorithms one of which is way better than the other.

Hold on! What does “better” mean here? Yes, this is another thing you are expected to learn in this course. There are not too many criteria to define what is a better algorithm. While we mention them all, we limit ourselves to just two criteria! Correctness and time complexity. A better algorithm, for now, is an algorithm which correctly solves the problem faster. Predicting how fast an algorithm is, together with proving the correctness of the algorithm, is what we call analyzing an algorithm. This requires some math which you learned in 290 course.

To teach analyzing algorithms we need to have some sample algorithms in hand to analyze and if possible make them better perhaps using the aforementioned techniques. By deploying some well known interesting problems and some solutions to them, this course also aims at introducing some algorithms which every
computer scientist should know. Among these problems there are some which you cannot give an efficient solution to them but an inefficient (will be defined) one. If you do, you will become famous for the history. They are called NP-complete problems. Just remember their name!

In summary, it is expected that by the end of this semester you get to know some well known algorithms, some techniques to devising algorithms (and some data structures), understand what is a better algorithm and how to analyze algorithms (mathematically prove the correctness and time/space complexity of the algorithm), find out if there is an efficient solution (or a solution at all) for your problem, and bottomline learn how to devise a better algorithms.

Prerequisites: COSC 290

Instructor

Hiva Samadian
313 McGregory Hall
x7946
hsamadian@colgate.edu

Office hours:
Tuesdays 11:10-12:40, and 13:00-14:00
Wednesdays 16:00-17:30

TAs

For lab section A: William (Liam) Caracciolo ’19, lcaracciolo@colgate.edu
For lab section B: Jake French ’19, jfrench@colgate.edu

Office and office hours:
Liam: Tuesday 11:30 to 12:30 and Wednesday 4:15 to 6:15
Jake: Tuesday 2:30 to 4:00 and Wednesday 4:45 to 6:15
Location for both: department's lounge

Organization

Lecture Meeting Times and place: TR 9:55–11:10 AM, McGregory 315
Lab Meeting Times and place:
Section A: Thursdays 1:20–3:10 PM, McGregory 315
Section B: Thursdays 3:20–5:10 PM, McGregory 315
**Moodle**

Check the Moodle page of the course frequently as all lecture slides, assignments, announcements and updates will be posted on Moodle. You will submit your assignments, take the quizzes, and see your grades on Moodle. You can also communicate with the class through the forum of the course’s Moodle page.

For your labs you have to check the Moodle of your lab for the problem sets and submit your solutions and see your lab grades in there.

**Textbooks**


*Note:* I call the "Introduction to Algorithms" book the "1st" book, and "Algorithms" the "2nd" book. Thus, in the schedule table in the syllabus "2. Ch0" means chapter 0 of the 2nd book. Books can be found in bookstore.

**Course work and relative course policies**

This course (lecture + lab) count for a total of 1.25 credits. Therefore, you are expected to spend around 12.5 hours/week on this course. The course work has been designed to take this much of time. However, based on your background you may need less or more time. So, expect that you spend more time than just 12.5 hours. The course work comprises the following components. Each component has a specific purpose addressed below. Non of the following components alone is enough for learning this course. It is important that you understand the role of each of the components.
• **Reading:**

Purposes: (1) This is where you start with and for the first time learn about the new concepts. (2) To help you discover your questions and feed the Q/A segment of the class (3) To help the instructor better address the students’ questions in the lecture.

Task: Complete the assigned reading (see the schedule) and submit the list of your question(s), that you get from your reading, to Moodle due 8:00 AM before the class. It is OK if your submission does not include any question. That means you have understood the reading material, and you are able to answer questions that you may be asked in class. You may be asked to answer your own question after it was explained in the lecture.

Grading the task: Reading task worth %20 of your final grade. Half of it is the Q/A grade and the other half is the Quizzes grade. Your Q/A grade is calculated as follows: No submission or empty file submission gets 0/3. If you submit a file asserting that you have no question, then you may be asked to answer questions in class. In this case you get up to 3 point based on your answer to the questions. If at least one valid question is submitted you will get 3/3. Basically any question is valid (and will be discussed in some point) except for a not specific question asked in the general format “I did not understand X, can you explain?”. In such cases you need to describe your thought about X and express the exact thing that makes it vague for you. A not valid question (in the format above) will be voided and if it causes your submission to turn to an empty one, then it gets 0/3. We have 28 classes during the semester. So you may get maximum 28x3=84 points; that is 16 points is given to everyone by default. You do not lose Q/A point for excused absence as long as you submit your reading questions. There would be several in class pop quizzes which assess just the quality of your Reading task.

• **Class:**

Purpose: The sole purpose of the class is to complete your reading task. It is assumed that you may have questions from your readings. Class is an opportunity to get the answer of your questions and make sure you grasped a through understanding of the concepts.
Class activities to achieve this purpose is divided in two main segments: (one) reviewing the reading material through lecturing the slides addressing your questions, and (two) discussing your questions and their answers (Q/A segment).

Tasks: You are expected to come to the class and to actively participate in class activities, including asking and answering questions. Students may be called on in class.

Grading the task: While it is not required to attend in the class to pass the course, attendance will hold %5 of your final grade. Each unexcused absence will affect the participation component of the grade by %20 of the attendance grade. Attendance will be taken occasionally. Unexcused absence will also affect the Reading grade as explained above.

- **Lab:**

Purpose: To complete this course, you must sign up for a 2-hour weekly lab section. While classes are centered around reviewing the concepts of the reading materials, labs pursue different purposes. They are interactive problem solving workshops. You learn the concepts in class and solve problems in lab. Lab has its own activities, schedule, and Moodle page.

Tasks: Solving lab problems, checking your solutions with TA, submitting correct solutions neatly on time on Moodle of the lab, presenting your assigned problem in the lab, and grading other students’ presentation are the Lab tasks. With the exception of the first week of the semester, each week on Thursday before noon a problem set will be posted on Moodle of your lab section to be worked on in your next Thursday’s lab (In the first week, in addition to Thursday, a problem set is posted on Monday for the lab of the first week). Solving the lab problems which is posted on Thursday noon, and submitting it on Moodle of the lab is due the next Thursday before the lab starts. Your lab (in the afternoon) starts with randomly assigning each student a single problem among the problems posted at noon to be presented in the next lab. Then each student will present his/her solution to a single problem which was assigned to him/her last week to be presented in this week’s lab. Students will grade each other’s work based on their understanding. You have to attend in the office hours of the TA of your section to check and discuss your solution with him even if you think your solution is correct. And if needed, get help before you submit each lab’s solution. There might be group presentations which will be announced in Moodle. You are expected to attend in the labs.
Grading the task: Lab is graded independent from the class. Your lab grade does not affect your main course grade. Your lab grade is calculated with the approach described below:

Your lab grade is the average of grades of individual labs. For each lab, submitting your solution worth 30 points, presenting your work 60 points from which 30 points is given by your classmates and the other 30 points by me, and 10 points is allocated to the quality of your assessment (how you grade others). Here is how these points are given:

**Submission points (out of 30):** The problem assigned to you and your solution to it have to be typed. If problems other than your assigned one is required to be solved and submitted, they are not required for you to be typed. You may scan your handwriting.
- 5 points for submitting it
- 5 points for submitting before the deadline (before the lab starts)
- 5 point for typing the problem that is assigned to you
- up to 5 points for writing neatly
- up to 10 points for solving all required problems

**Presentation points (out of 60):** The quality of your presentation is assessed by your peer students based on three criteria; your mastery on the topic, how clear is your explanation, and how much they understood the solution you present to the problem. They give numbers 1 to 5 to each question. The average of an individual’s grades to these three questions multiply by 30 is the grade of that individual to you. The average of the grades of all students will be your presentation grade given by students. I give a grade out of 30 with the same criteria which would likely be close to the grade you get from students. If your solution is wrong, I will check the TA’s attendance list before give you a grade. It will help you to get a higher grade if you have attended the TA’s office hours.

**Assessment points (out of 10):** Moodle Workshop tool, which we are using to implement our lab, generates a grade for your assessment based on how far is the grade you gave to each of the three questions for each other student. This auto generated grade is your assessment grade unless if I override it by a different grade. I will override the auto generated grade if a student breaks any of the following rules in grading others:
- If a student’s solution is wrong you must give 1-3 out of 5 (not less than 1 not more than 3) to all three questions for that student based on the magni-
tude of the error of the solution and the quality of the presentation. If you do not, I subtract 5 points from the auto generated grade for your assessment. You are responsible to verify if the solution is wrong or not. The lab discussion on each presentation will help you to verify this. You may ask questions if you are not sure. You are responsible to make sure that you learn the RIGHT answer to each problem that is presented.

• If you give 30 to a student, that means you are approving that you have understood that solution thoroughly. I randomly ask questions about the solutions that are given 30. If you are asked a question and you fail to answer, it indicates that your assessment to that solution was not accurate (forgetting details will be OK). In this case also I will subtract 5 points from your auto generated point for your assessment.

• You must grade others during the lab. If you do not give grade to anyone, Moodle will not grade your assessment. In this case I will give 0 to your assessment. If you fail to grade ALL other students, you will still be graded by Moodle and I don’t subtract points from your grade for this reason. But try to grade everyone since grading everyone, in most cases, increases your assessment grade.

Attendance in labs are not required. That means attendance is not graded. However, an absence in a lab causes you lose 70 points for the presentation and assessment of that lab. If you are excused, you may be given a chance to present your work in the following labs (if there is time in those labs) to get grade for your presentation.

You see your grades in Moodle as two components only. One out of 90 and one out of 10 under names Submission and Assessment respectfully. The assessment part is clear. It is the %10 described above. The grade named as Submission in Moodle is initially only the 30 points given to your presentation by students which I override it by adding the other two components (30 points for your submission and 30 points my grade to your presentation). That is why you may see in some parts of Moodle that your grade is out of 40 while your total grade is more than 40 (out of 100). Your grade has been taken care of carefully so that Moodle calculates the right grade for you out of 100. You can always check the feedback in grades part to see the details on the components of your grade or overrides.
• **Homework assignments:**

Purpose: Solving both small and bigger problems independently and individually

Task: There are bi-weekly homework assignments (six assignments in total) which I upload on Moodle every other Sunday and have to be solved and submitted on Moodle due on Sunday 11:55 PM of the second week after they are uploaded.

Grading the task: Each assignment worth %10 of your final grade; %60 total. Late homework may turned in after the stated deadline with a penalty of 20% per day. Some assignments might be graded partially that is I will choose randomly one or more problems from the given problems of the assignment and grade only those problems for all students.

• **Final exam:**

There will be an in class final exam for the course during the university-schedule exam time. Any topic discussed throughout the semester might come in the final exam.

**Grading breakdown**

• Homework assignments %60
• Final exam 15%
• Reading (Quizzes) %10
• Reading (Q/A) %10
• Attendance %5

Letter grade assignments are as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>F</td>
<td>&lt; 60</td>
</tr>
<tr>
<td>D-</td>
<td>60-62</td>
</tr>
<tr>
<td>D</td>
<td>63-66</td>
</tr>
<tr>
<td>D+</td>
<td>67-69</td>
</tr>
<tr>
<td>C-</td>
<td>70-72</td>
</tr>
<tr>
<td>C</td>
<td>73-76</td>
</tr>
<tr>
<td>C+</td>
<td>77-79</td>
</tr>
<tr>
<td>B-</td>
<td>80-82</td>
</tr>
<tr>
<td>B</td>
<td>83-86</td>
</tr>
<tr>
<td>B+</td>
<td>87-89</td>
</tr>
<tr>
<td>A-</td>
<td>90-92</td>
</tr>
<tr>
<td>A</td>
<td>93-99</td>
</tr>
<tr>
<td>A+</td>
<td>≥ 100</td>
</tr>
</tbody>
</table>
Classroom etiquette

You are expected to practice common courtesy with regard to all course interactions. Cell phones must be off before class begins. Laptops must be off or closed unless a classroom activity requires their use. If you have a special need or reason why you need to use a laptop, please come see me to discuss how we can come up with a workable arrangement.

If you are using a laptop or other device in violation of this policy, I will first email you a warning. On the second infraction I will reduce 2% of your overall grade. Each subsequent violation will result in a doubling of the grade reduction amount (i.e., 4% on the third infraction, 8% on the fourth, etc.).

Why ban laptops and other devices in a computer science class unless their use is necessary? For starters, see these articles:

- Ill Communication: Technology, distraction & student performance
- The Pen Is Mightier Than the Keyboard: Advantages of Longhand Over Laptop Note Taking
- Laptop multitasking hinders classroom learning for both users and nearby peers

Academic honesty and collaboration

You are expected to abide by Colgate’s academic honor code. Communication (i.e., discussing the problem and possible solutions) while working on assignments is fine, but the work you submit must be your own. Roughly speaking, it is okay to share ideas but it is not okay to share any artifacts (code, write-up, etc.).

Changes:

While this syllabus and its schedule is intended to be the static plan for the entire semester, things might happen to enforce adjustment or improvement. Any change will be posted in Moodle, and if necessary, will be discussed in the class.
Schedule and readings

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic*</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction</td>
<td>1. Ch1&amp;2, 2. Ch0</td>
</tr>
<tr>
<td>2</td>
<td>Growth of function and asymptotic analysis</td>
<td>1. Ch3</td>
</tr>
<tr>
<td>3</td>
<td>Algorithms with numbers</td>
<td>2. Ch1</td>
</tr>
<tr>
<td>4</td>
<td>Divide-and-conquer, recurrence</td>
<td>2. Ch2, 1. Ch4</td>
</tr>
<tr>
<td>5</td>
<td>Sorting algorithms</td>
<td>1. Ch6&amp;7</td>
</tr>
<tr>
<td>6</td>
<td>Using data structures</td>
<td>1. Ch10&amp;12</td>
</tr>
<tr>
<td>7</td>
<td>Graphs1</td>
<td>2. Ch3, 1. Ch22</td>
</tr>
<tr>
<td>8</td>
<td>Graphs2</td>
<td>2. Ch4</td>
</tr>
<tr>
<td>9</td>
<td>Greedy algorithms</td>
<td>2. Ch5</td>
</tr>
<tr>
<td>10</td>
<td>Dynamic Programming 1</td>
<td>1. Ch 15, 2. Ch 6</td>
</tr>
<tr>
<td>11</td>
<td>Dynamic Programming 2</td>
<td>2. Ch 6</td>
</tr>
<tr>
<td>12</td>
<td>NP complete problems</td>
<td>1. Ch 34</td>
</tr>
<tr>
<td>13</td>
<td>NP complete problems</td>
<td>2. Ch 8</td>
</tr>
<tr>
<td>14</td>
<td>Halting problem, Review</td>
<td>-</td>
</tr>
</tbody>
</table>

* Variety of algorithms will be discussed under each topic.
Appendix

Unexpected Circumstances

If unexpected circumstances arise that could impact your involvement in the course (inability to attend class, complete the homework on time, etc.), please let your instructor know as soon as possible so that we may design appropriate accommodations. Usually these accommodations will be made in consultation with your Administrative Dean.

Additionally, any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact their Administrative Dean for support. Furthermore, please notify your instructor if you are comfortable in doing so, so we may provide any resources available.

Academic Support and Disabilities Services

(Lynn Waldman, Director)

If you feel you may need an accommodation based on the impact of a disability, you should contact your instructor privately to discuss your specific needs. If you have not already done so, please contact Lynn Waldman, Director of Academic Support and Disability Services at 315-228-7375 in the Center for Learning, Teaching, and Research. Reasonable and appropriate accommodations for students with disabilities are determined on a case-by-case basis to ensure that members of the community with disabilities have access to Colgate’s programs and services. She also assists students in identifying and managing the factors that may interfere with learning and in developing strategies to enhance learning.

NASC Liaison Group

NASC liaisons are a group of natural science and mathematics faculty members dedicated to providing science-interested students from underrepresented groups with mentorship, motivation, and individualized support as they navigate their paths in the sciences at Colgate. NASC liaisons do not replace the role of an academic advisor or offer formal academic advising. Rather a NASC liaison may meet one-on-one with a student to give
another perspective on their academic plan; give tips on effective studying; or introduce a student to upper-class peers, alumni, or other faculty members that might be able to help them. The roles of NASC liaisons will depend on students’ needs, and we encourage students to reach out for mentorship and moral support. To find out more about the group or to contact a member, visit the NASC division webpage. Computer Science Prof. Fourquet is a member of this group.

Information Technology

The Information Technology Service Desk is located on the third floor of Case-Geyer Library and provides services to all students across campus. The help desk consultants assist with problems concerning email, Portal, Moodle, and problems with your personal laptops. Talk to your instructor if problems with your personal computer are effecting your ability to get your work done.

Counseling Center

College life can sometimes get bumpy; if you are experiencing emotional or personal difficulties, the Counseling Center offers completely confidential and highly professional services.

Administrative Deans

Each student is assigned an Administrative Dean who can advise you regarding personal and/or academic matters. Administrative deans often assist students to understand policies and procedures, navigate personal challenges, work with faculty, and engage with parents.