

Computer Science I

COP 3502 – Introduction



Computer Science Department
University of Central Florida

COP 3502 – Computer Science I



Computer Science 1: Introduction

- How is COP3502 different than COP 3223?
 - COP 3223 teaches how to program in C
 - Language basics, variable declarations, conditional expressions, if statements, loops, functions, arrays, structures, etc.
 - This will not be covered in this class
 - You will need to freshen up on your C very quickly
 - If you need help, but a good C-language book or find a quality reference online
 - With respect to the C language, we will cover:
 - Pointers, 2D arrays, and linked lists



Computer Science 1: Introduction

- The goals of Computer Science I:
 - Improve knowledge of standard data structures and abstract data types
 - Improve knowledge of standard algorithms used to solve several classical problems
 - Cover some mathematical concepts that are useful for the analysis of algorithms
 - Analyze the efficiency of solutions to problems



Computer Science 1: Introduction

- The goals of Computer Science I:
 - In COP 3223, we only cared if we found a solution to the problem at hand
 - Didn't really pay attention to the efficiency of the answer
 - For this class:
 - We learn standard ways to solve problems
 - And how to analyze the efficiency of those solutions
 - Finally, we simply expand upon our knowledge of our use of the C programming language



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- Example Problem:
 - We will now go over two solutions to a problem
 - The first is a straightforward solution that a COP 3223 student should be able to come up with
 - Doesn't care about efficiency
 - The second solution is one that a COP 3502 student should be able to come up with after some thought
 - Cares about efficiency

- Hopefully this example will illustrate part of the goal of this course



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- Max Number of 1's:
 - You are given an $n \times n$ integer array
 - Say, for example, a 100×100 sized array
 - Each row is filled with several 1's followed by all 0's
 - Example:
 - Row 1 may have 38 1's followed by 62 0's
 - Row 2 may have 73 1's followed by 27 0's
 - You get the idea
 - The goal of the problem is to identify the row that has the maximum number of 1's.



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- Max Number of 1's:
 - Straightforward COP 3223 style solution:
 - Make a variable called MaxOnes and set equal to 0
 - For each row do the following:
 - Start from the beginning of the row on the left side
 - Scan left to right, counting the number of 1's until the first zero is encountered
 - If the number of 1's is greater than the value stored in MaxOnes, update MaxOnes with the number of 1's seen on this row
 - Clearly, this works
 - But let's see how long this algorithm will take



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- Max Number of 1's:
 - Analysis of Straightforward Solution:
 - Basically we iterate through each square that contains a 1, as well as the first 0 in each row
 - If all cells were 0, we would only “visit” one cell per row, resulting in n visited cells
 - However, if all cells were 1's, we would “visit” all of the cells (n^2 total)
 - So in the worst case, the number of simple steps the algorithm takes would be approximately n^2
 - This makes the running time of this algorithm $O(n^2)$
 - The meaning of this Big-O will be discussed later in the semester



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- Max Number of 1's:
 - Analysis of Straightforward Solution:
 - There seems to be extra work done here
 - Once we know that a row has 12 1's, for example, it seems pointless to start checking at the beginning of the next row
 - Why not just start at column 12
 - If it's a 0, then that row can't be the winner
 - If it is a 1, then clearly there is no point in going back, on that row, and checking the previous 11 squares
 - This idea leads to a more efficient algorithm



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- Max Number of 1's:
 - More Efficient COP 3502 style algorithm:
 1. Initialize the current row and current column to 0
 2. While the current row is less than n (or before the last row)
 - a. While the cell at the current row and column is 1
 - Increment the current column
 - b. Increment the current row
 3. The current column index represents the maximum number of 1's seen
 4. Now let's trace through a couple of examples



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- Max Number of 1's:
 - Example 1:

1	1	0	0	0	0
0	0	0	0	0	0
1	1	1	0	0	0
1	1	1	0	0	0
1	1	1	1	1	0
1	1	1	1	0	0



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- Max Number of 1's:
 - Example 2:

0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
1	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0
1	1	1	1	0	0	0	0
1	1	1	1	1	1	0	0
1	1	1	1	1	1	1	0
1	1	1	1	1	1	1	1



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- Max Number of 1's:
 - Analysis of Better Solution:
 - How many steps will this algorithm take, in terms of n ?
 - Each “step” taken by the algorithm either goes to the right or down in the table.
 - There are a maximum of $n-1$ steps to the right
 - And a maximum of $n-1$ steps down that could be taken
 - Thus the maximum number of “steps” that can be done during this algorithm is approximately $2n$
 - And this is the worst case
 - So the running time of this algorithm is $O(n)$
 - An improvement of the previous algorithm
 - Input size of 100 for n
 - n^2 would be 10,000 steps and $2n$ would be 200 steps



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- Implementing an Algorithm in C:
 - In this class, you will have an opportunity to improve upon your ability to write programs that implement an algorithm you have learned
 - You must know the syntax of C in order to properly and effectively do this
 - There's no set way to create code to implement an algorithm
 - But this example shows some steps you can take in doing so



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- Implementing an Algorithm in C:
 - Here are some issues to think about:
 1. What data structures are going to be used?
 2. What functions are going to be used?
 3. What run-time errors should we protect against?
 4. What atypical cases may we have to deal with?
 5. What is an efficient way to execute the steps in the algorithm?



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- Maximum Number of 1's
 - This was a creative exercise
 - Much of what you learn in class will not be
 - We have many set algorithms and data structures that you will study
 - Occasionally you will have to come up with new ideas like this one
 - Mostly, however, you will simply have to apply the data structures and algorithms shown in class fairly directly to solve the given problems



CS1 - Introduction

**Are
You
Excited?**

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