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CPSC 535: Advanced Algorithms (Spring 2024)

Department of Computer Science, College of Engineering and Computer Science

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Lecture # 1 Notes

Tasks: Self-Assessment Exercise

Topic: Algorithmic Problem Solving

Definition of Algorithm:

An algorithm is a well-defined sequence of steps or procedures for solving a problem or accomplishing a task.

Characteristics of a Good Algorithm:

1. Well-Defined Instructions: Each of its steps (or phases) is precisely defined and has clear instructions.

2. Input and Output: An algorithm should have specified inputs and produce the desired output.

3. Finiteness: An algorithm should always terminate after a finite number of steps.

4. Effectiveness: It should be simple enough that each operation can be carried out in a practical amount of time.

5. Generality: The algorithm should be applicable for all problems of the desired form, not just a specific instance.

Importance of Algorithmic Problem Solving:

- Efficient algorithms can save time and resources.

- Algorithms underpin almost all computer-based applications, from searching on Google to video streaming on Netflix.

Steps in Algorithmic Problem Solving:

1. Problem Definition: Understand the problem statement. What are the given inputs? What is the desired output?

2. Algorithm Design: Break the problem down and outline the steps to get from input to output.

3. Validation: Ensure the algorithm works for all input cases, especially edge cases.

4. Analysis: Evaluate the efficiency of the algorithm. Can it be improved?

5. Implementation: Translate the algorithm into a specific programming language.

6. Testing: Once implemented, test the solution on various test cases to ensure its correctness.

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Sorting Books in a Library:

1. Problem Definition: Arrange books in alphabetical order based on author names.

2. Algorithm Design:

   - Take the first book from the unsorted pile.

   - Compare it to books on the shelf.

   - Insert the book in the correct position based on the author's name.

   - Repeat until all books are on the shelf.

3. Validation: Will this method work if two authors have the same last name? What about books that are already sorted?

4. Analysis: How long might this take with 10 books? 100? 1,000?

5. Implementation: This might involve creating a system or guideline for library assistants to follow.

6. Testing: Time how long it takes to sort a set number of books and check for any errors in the sequence.

Closing Remarks: Algorithmic problem solving is a methodical approach to addressing challenges. Whether in computing or everyday life, the fundamental principle remains understanding the problem, devising a clear plan, and executing it systematically.

Self-Assessment Test (Must submit Python File named as LibrarySortCWIDLASTNAME):

Example of naming the file: LibrarySort885xxxxxxSHAH

Due Date: Jan 24, 2024 (11:59pm)

Where to Submit: Canvas Assignment Folder

Problem Statement: A local library is trying to organize its books based on the authors' names. They are seeking a Python-based solution to automate the sorting process to ensure the books are placed in the right order on the shelves.

Task:

Implement a Python program that can take a list of books and sort them alphabetically based on their authors' names.

Requirements:

1. Define a `Book` class with two attributes: `title` and `author`.

2. Within the `Book` class, implement the `__lt__` method to make instances of the class sortable by the author's name.

3. Implement a `sort_books` function that will accept a list of `Book` objects and return the list sorted by authors' names.

4. In the `main` function, demonstrate the functionality of the sorting system using a sample list of books.

5. Print the list of books both before and after sorting to show the sorting effect.

Example: Given the following books:

- "The Old Man and the Sea" by Ernest Hemingway
- "Pride and Prejudice" by Jane Austen
- "The Great Gatsby" by F. Scott Fitzgerald
- "1984" by George Orwell
- "To Kill a Mockingbird" by Harper Lee

Your program should print:

Unsorted Books:

'The Old Man and the Sea' by Ernest Hemingway

'Pride and Prejudice' by Jane Austen

'The Great Gatsby' by F. Scott Fitzgerald

'1984' by George Orwell

'To Kill a Mockingbird' by Harper Lee

Sorted Books:

'1984' by George Orwell

'The Great Gatsby' by F. Scott Fitzgerald

'To Kill a Mockingbird' by Harper Lee

'The Old Man and the Sea' by Ernest Hemingway

'Pride and Prejudice' by Jane Austen

Note:

Pay close attention to the requirements and make sure to implement all functionalities as mentioned.
