

PG2 –SORTING, SEARCHING

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OBJECTIVES

Learn to load and parse CSV files. Implement various sorting and search algorithms. Utilize recursion to solve problems. Clone arrays into new lists.

You will be loading in a CSV file that contains unsorted data and you can store that information in a List (each item is a string). The user will be able to sort that data using the different sorting algorithms that we covered in the lecture: Bubble, Merge. Search a sorted list with a binary search algorithm.

Topics Covered

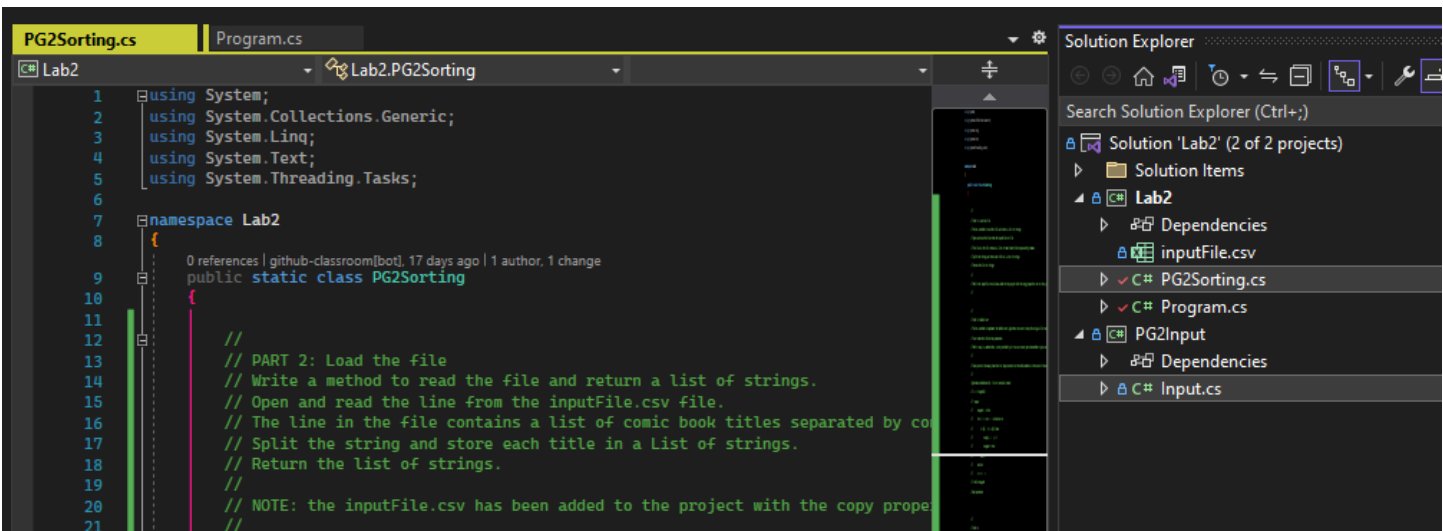
Cloning, bubble sort, merge sort, binary search, CSV, Split, File loading

Project Setup

A C# .NET Core console application has been provided for you in your **GitHub repo**. **Use the provided solution.**

NOTE: The menu code for part 1 should go into the Program.cs file. Add the methods for parts 2 - 6 to the PG2Sorting.cs file.

NOTE: PG2Input is part of Lab2.sln so you can use the Input class like you did in Lab 1.



The screenshot shows the Visual Studio IDE with the PG2Sorting.cs file open in the editor. The file contains the following code:

```
1 using System;
2 using System.Collections.Generic;
3 using System.Linq;
4 using System.Text;
5 using System.Threading.Tasks;
6
7 namespace Lab2
8 {
9     // 0 references | github-classroom[bot], 17 days ago | 1 author, 1 change
10     public static class PG2Sorting
11     {
12         //
13         // PART 2: Load the file
14         // Write a method to read the file and return a list of strings.
15         // Open and read the line from the inputFile.csv file.
16         // The line in the file contains a list of comic book titles separated by commas.
17         // Split the string and store each title in a List of strings.
18         // Return the list of strings.
19         //
20         // NOTE: the inputFile.csv has been added to the project with the copy property set to 'Copy always'
21         //
```

The Solution Explorer on the right shows the project structure for 'Lab2' (2 of 2 projects). It includes the following files:

- Solution Items
- Lab2
 - Dependencies
 - inputFile.csv
 - PG2Sorting.cs
 - Program.cs
 - PG2Input
 - Dependencies
 - Input.cs

PART A

Part A-1: The Menu

Lab Overview Video

[Part 1 Overview](#)

Show a menu to the user so they can select one of the algorithms (bubble, merge, and binary search), save a sorted list, and Exit. (Use the GetMenuChoice method you created in the first lab)

1. Bubble Sort
2. Merge Sort
3. Binary Search

4. Save
5. Exit

COMMON MISTAKES:

-3: the Exit option does not exit

Part A-2: Load the file

Lecture Videos

[Reading CSV](#)

[Reading CSV Example](#)

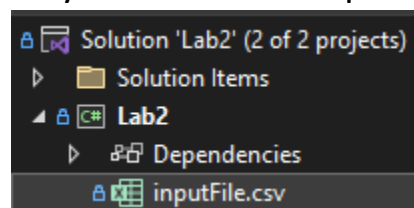
[Reading CSV Challenge](#)

Lab Overview Video

[Part 2 Overview](#)

Write a method to read the file and **return** a list of strings. Open and read the line from the **inputFile.csv** file. The line in the file contains a list of comic book titles separated by commas. Split the string and store each title in a **List of strings**.

NOTE: the inputFile.csv has been added to the project with the copy properties set so that **you do not need to add a path** to read the file. Just use the filename.



COMMON MISTAKES:

-2: you have a full or relative path to the file that is specific to your machine

-2: you are not closing the file after you read it

-2: you are not parsing the data correctly

-1: you are not cloning the original correctly. Setting List<string> list2 = list1; only points list2 to the same thing that list1 points to.

-1: not converting the array to a list.

-2: did not create a method for reading the file

PART B

Part B-1: Bubble Sort

Lecture Videos

[Bubble Sort](#)

[Swapping](#)

[Swapping Challenge](#)

[Comparing Strings](#)

[Comparing Strings Example](#)

[Comparing Strings Challenge](#)

Lab Overview Video

[Part 3 Overview](#)

Write a method to implement the [Bubble sort](#) algorithm. You want to keep the original list unsorted so make sure to clone the list inside of Bubble sort.

NOTE: **swap** is a method that is not provided by C#. You can create your own method or you can insert the swap logic inside the if. See the lectures slides for how to swap 2 items in a list.

Keep track of how many times the for loop executes for the whole method. At the end of the method, print out the number of items in the list and the number of times the algorithm had to loop.

Your code must follow the pseudocode. Turn this Wikipedia pseudocode into C#:

```
procedure bubbleSort(A : list of sortable items)
  n := length(A)
  repeat
    swapped := false
    for i := 1 to n - 1 inclusive do
      if A[i - 1] > A[i] then
        swap(A, i - 1, i)
        swapped = true
      end if
    end for
    n := n - 1
  while swapped
end procedure
```

EXAMPLE OUTPUT:

```
# of items: 84. Bubble sort loops: 3471

Bubble Sort
-----
Detective Comics           Anarky
Batman                     Arkham Man
World's Finest Comics      Azrael
```

The items on the left are the unsorted values and the items on the right are the sorted.

COMMON MISTAKES:

- 10: did not follow the pseudo-code for bubble sort
- 10: did not track the loop count and print it out.
- 1: you should print the sorted results side-by-side with the unsorted
- 5: Bubble sort can be more efficient. The inner for loop should track whether a swap happens. If the inner loop does not swap, then you can break out of the outer loop.
- 5: the bubble sort can be optimized more according to the pseudo-code. You can shorten the for loop by 1 after the for loop completes. Store the length of the list in a variable and subtract 1 from it after the for loop. This would mean 1 fewer item to compare each time you run the for loop.
- 1: in BubbleSort, you should set swapped = false right before the for loop.
- 1: the while condition in bubble sort is incorrect. You need to loop while a swap has happened.
- 2: did not create a method for Bubble sort

Part B-2: Merge Sort

Lecture Videos

[Merge Sort](#)

[Merge Sort Split Step](#)

[Merge Sort Merge Step](#)

[Split Challenge](#)

Lab Overview Video

[Part 4 Overview](#)

Write a method to implement the [Merge sort](#) algorithm. Merge sort will return a new sorted list so there is no need to clone the list that is passed in to MergeSort.

Your code must follow the pseudocode. Turn this Wikipedia pseudocode into C#:

```
function merge_sort(list m) is
    // Base case. A list of zero or one elements is sorted, by definition.
    if length of m  $\leq$  1 then
        return m

    // Recursive case. First, divide the list into equal-sized sublists
    // consisting of the first half and second half of the list.
    // This assumes lists start at index 0.
    var left := empty list
    var right := empty list
    for i = 0 to length(m) do
        if i < (length of m)/2 then
            add m[i] to left
        else
            add m[i] to right

    // Recursively sort both sublists.
    left := merge_sort(left)
    right := merge_sort(right)

    // Then merge the now-sorted sublists.
    return merge(left, right)
```

(Continued on next page)

```
function merge(left, right) is
    var result := empty list

    while left is not empty and right is not empty do
    {
        if first(left) ≤ first(right) then
            add first(left) to result
            remove first from left
        else
            add first(right) to result
            remove first from right
    }

    // Either left or right may have elements left; consume them.
    // (Only one of the following loops will actually be entered.)
    while left is not empty do
    {
        add first(left) to result
        remove first from left
    }
    while right is not empty do
    {
        add first(right) to result
        remove first from right
    }
    return result
```

EXAMPLE OUTPUT:

```
Merge Sort
-----
Detective Comics          Anarky
Batman                   Arkham Manor
World's Finest Comics     Azrael
Star-Spangled Comics     Azrael Agent of the Bat
The Brave and the Bold   Azrael volume 2
The Joker                 Batgirl
Batman Family             Batgirl volume 3
Man-Bat                   Batgirl volume 4
```

COMMON MISTAKES:

- 10: did not follow the pseudo-code for merge sort
- 2: the exit condition needs to be if the count of the list ≤ 1 .
- 2: did not write a method for Merge Sort
- 1: you should print the sorted results side-by-side with the unsorted

PART C

Part C-1: Binary Search

Lecture Videos

[Binary Search](#)

[Binary Search Algorithm](#)

Lab Overview Video

[Part 5 Overview](#)

Write a method to implement the [Binary Search](#) algorithm.

Keep track of how many times the binary search method is called when searching for a word.

In Main, clone the original list and sort the cloned list (call Sort on the list).

Loop over the sorted list and call **your** binary search method to search the sorted list for each title. Show the search title, the index and the index returned by your binary search method.

Your code must follow the pseudocode. Turn this Wikipedia pseudocode into C#:

```
// initially called with low = 0, high = N-1. A is a sorted list.
BinarySearch(A[0..N-1], searchTerm, low, high) {
    if (high < low)
        return -1 // -1 means not found
    mid = (low + high) / 2
    if (searchTerm < A[mid])
        return BinarySearch(A, searchTerm, low, mid-1)
    else if (searchTerm > A[mid])
        return BinarySearch(A, searchTerm, mid+1, high)
    else
        return mid //the searchTerm was found
}
```

Format of the output to show for each word:

[word] Index: [index] Found Index: [index returned from your binary search] Method calls: [count of method calls]

EXAMPLE OUTPUT:

Anarky	Index: 0	Found	Index: 0	Method calls: 6
Arkham Manor	Index: 1	Found	Index: 1	Method calls: 5
Azrael	Index: 2	Found	Index: 2	Method calls: 6
Azrael Agent of the Bat	Index: 3	Found	Index: 3	Method calls: 7
Azrael volume 2	Index: 4	Found	Index: 4	Method calls: 4
Batgirl	Index: 5	Found	Index: 5	Method calls: 6
Batgirl volume 3	Index: 6	Found	Index: 6	Method calls: 5
Batgirl volume 4	Index: 7	Found	Index: 7	Method calls: 6
Batman	Index: 8	Found	Index: 8	Method calls: 7

COMMON MISTAKES:

-10: did not follow the pseudo-code for binary search

-10: did not track the method calls for each word

-1: in Binary Search, you should only call the CompareTo method once and store the result instead of calling it twice.

-1: Binary Search should return the index if found or -1 if not found

-5: binary search code was not modified to work with strings and doesn't return the correct index.

-2: the binary search needs an exit condition for when $\text{min} > \text{max}$. If this condition happens, then you need to return -1 to indicate that the search item was not found. You should check the condition at the top of the binary search method.

-2: in binary search, you need to calculate the mid like this: $\text{min} + (\text{max} - \text{min}) / 2$ OR $(\text{max} + \text{min}) / 2$.

-2: when recursively calling binary search, you need to do $\text{mid} + 1$ or $\text{min} - 1$ so you are not re-evaluating the mid point again.

-2: the lab requirements for binary search were to loop over the sorted list and call your binary search for each item in the list. Print the word, the index, and the index returned from your binary search.

-2: did not write a method for Binary Search

Part C-2: NuGet & Json.NET

Lecture Videos

[NuGet](#)

NuGet is the package manager for .NET – it's a place to grab helpful code from 3rd parties. For this lab, you'll need to use NuGet to grab Json.NET.

To add a reference to Json.NET, right-click the References node under your class library project and select "Manage NuGet Packages...". Select the "Browse" link in the top-left of the page that is loaded in the IDE. Enter "Newtonsoft.Json" in the search box. Select the item in the list of search results and in the right panel of the page, select Install.

Part C-3: Save

Lecture Videos

[Serializing](#)

[Serializing Example](#)

[Serializing Challenge](#)

Lab Overview Video

[Part 6 Overview](#)

Now you have the information you need to add logic to the menu for the "Save" option. **Write a method** to serialize a sorted list to a save file.

Ask the user for the name of the save file. **Use GetString from Lab 1 to get the name of the file. If the name does not have the json extension**, add it to the file name. Look at the Path methods GetExtension, HasExtension, and ChangeExtension to make sure you get the extension set correctly.

Take a clone of the unsorted, sort using one of your sort algorithms, then save the sorted list to a json file.

You will need to **serialize** the list in JSON format. Use the **JSON.net** library.

COMMON MISTAKES:

- -2: not using GetString to get the file name from the user
- -2: not ensuring the filename has a .json extension.
- -2: not changing the extension correctly
- -4: not serializing a sorted list
- -4: not serializing in JSON format
- -2: did not write a method for saving the data

RUBRIC

FEATURE	VALUE	GRADE
PART A-1: The Menu	20	
PART A-2: Load the file	10	
PART B-1: Bubble Sort	20	
PART B-2: Merge Sort	20	
PART C-1: Binary Search	20	
PART C-2,3: Saving	10	
TOTAL	100	

PROGRAMMER'S CHALLENGE

As with every programmer's challenge, remember the following...

1. Do the rubric first. Make sure you have something to turn in for the assignment.
2. When attempting the challenge, don't break your other code.
3. You have other assignments so don't sacrifice them to work on the challenges.

Sorting Challenge

Add the ability to sort the list in the opposite direction. This is an alternating behavior such that one time, the sort is ascending. Then the next time that same sort method is selected, it sorts in descending order. It alternates between ascending and descending.

```

Batman volume 2
Batman The Dark Knight volume
Batman and Robin volume 2
Batwing
Birds of Prey volume 3
Catwoman volume 4
Detective Comics volume 2
Nightwing volume 3
Red Hood and the Outlaws
Batman Arkham Unhinged
Batman Incorporated volume 2
Talon
Legends of the Dark Knight volume 2
Batman Li'l Gotham
Batman '66
Harley Quinn
Grayson
Batman Superman
Batman Eternal
Gotham Academy
Gotham by Midnight
Arkham Manor
Batman Beyond
Red Hood Arsenal
Robin Son of Batman
We Are Robin
Batman and Robin Eternal
-----
Press any key to continue
Batman Incorporated
Batman Gotham Knights
Batman Gotham Adventures
Batman Family
Batman Eternal
Batman Confidential
Batman Beyond volume 4
Batman Beyond volume 2
Batman Beyond
Batman Arkham Unhinged
Batman and the Outsiders vo
Batman and the Outsiders
Batman and Robin volume 2
Batman and Robin Eternal
Batman and Robin
Batman Adventures volume 2
Batman 80-Page Giant
Batman '66
Batman
Batgirl volume 4
Batgirl volume 3
Batgirl
Azrael volume 2
Azrael Agent of the Bat
Azrael
Arkham Manor
Anarky

```