Sofia University
Department of Mathematics and Informatics

Course : OO Programming with C#.NET

Date: November 6, 2019

Student Name:

Lab No. 5

Submit the all C# .NET files developed to solve the problems listed below. Use comments and Modified-Hungarian notation.

Problem No. 1

Use the **`class Invoice`** provided in the attached file **`ex09_03.rar`** to create an **`array`** of **`Invoice`** objects. Use the **sample data** shown below to initialize the elements of that array. **`class Invoice`** includes **four properties**- a **`PartNumber`** (type **`int`**), a **`PartDescription`** (type **`string`**), a **`Quantity`** of the item being purchased (type **`int`**) and a **`Price`** (type **`decimal`**).

Write a console application that performs the following **queries** on the array of **`Invoice`** objects and **displays the results**:

a) Use LINQ to **`sort`** the **`Invoice`** objects by **`PartDescription.`**

b) Use LINQ to **`sort`** the **`Invoice`** objects by **`Price`**.

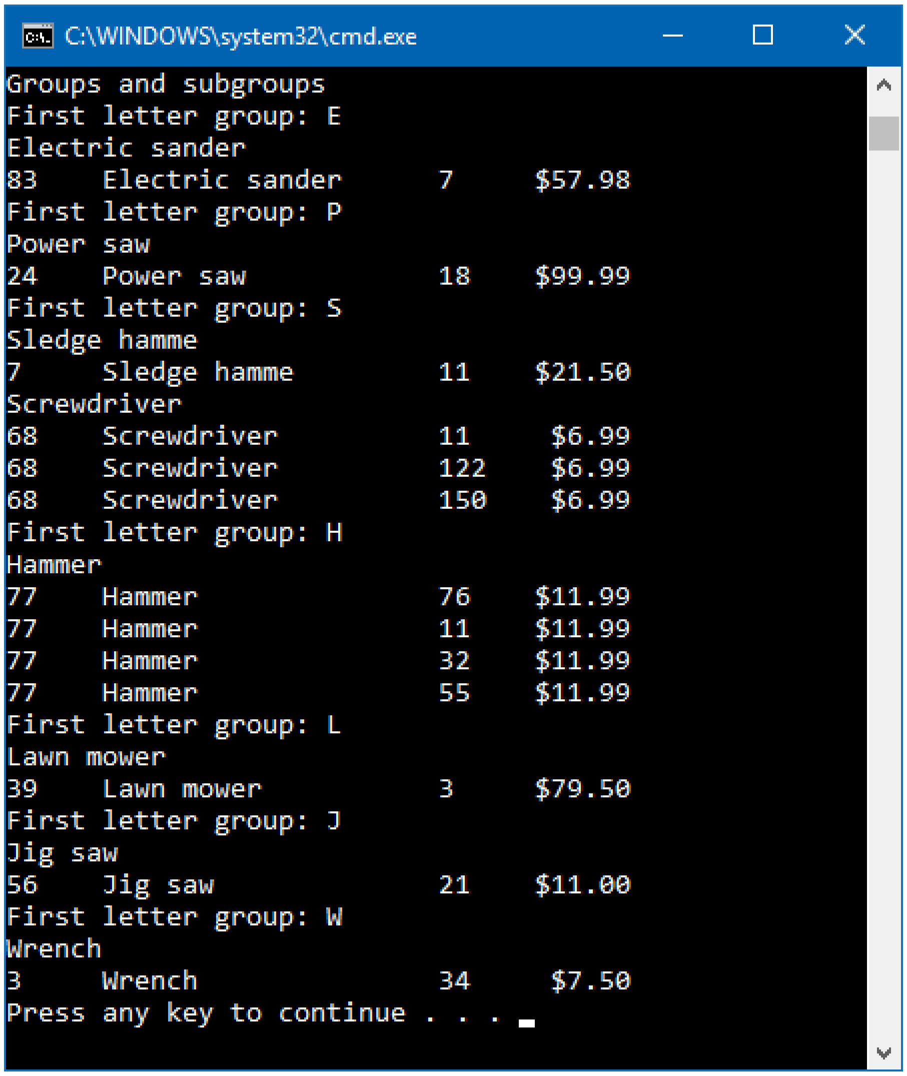
c) Use LINQ to **`select`** the **`PartDescription`** and **`Quantity`** and **`sort`** the results by **`Quantity`**.

d) Use LINQ to **`select`** from each **`Invoice`** the **`PartDescription`** and the value of the **`Invoice`** (i.e., **`Quantity * Price`**). Name the calculated column **`InvoiceTotal.`** **Order the results** by **`Invoice`** value. [***Hint***: Use **`let`** to store the result **`of Quantity * Price`** in a **new range variable `total.`**]

e) Using the results of the LINQ query in *Part d*, select the **`InvoiceTotals`** in the range **`$200 to $500`**.

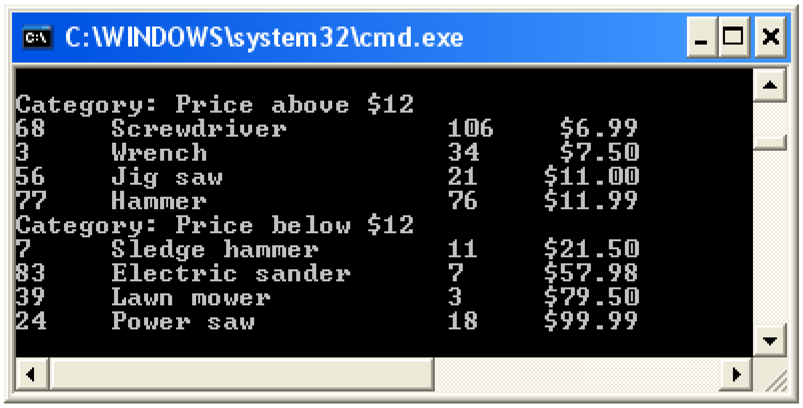
f) **Group invoices in two groups**- invoices with Unit **`price`** below **`$12`** and invoices with unit **`price`** above of equal to **`$12`**. Display details about invoices in each group **sorted in ascending order of the price**

g) Group invoices in subgroups, where the outer subgroup is defined by the first letter in the part description and the inner group comprises the invoice details of invoices whose part description starts with the corresponding first letter.



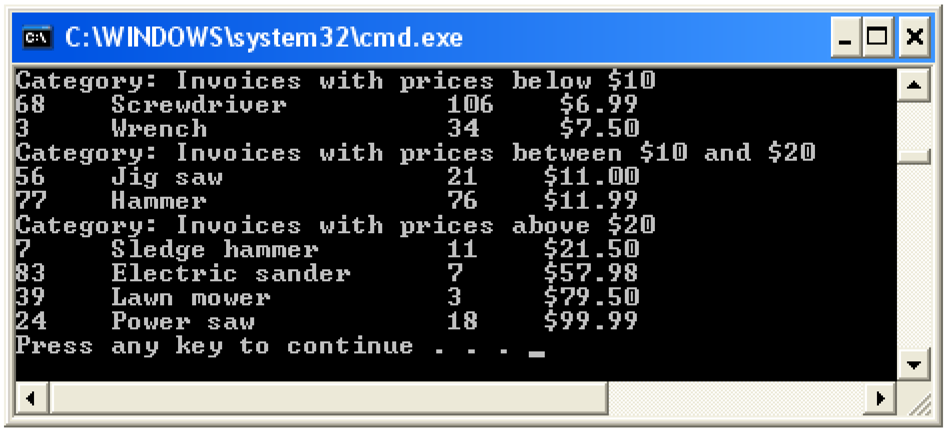
```
Groups and subgroups
First letter group: E
Electric sander
83      Electric sander      7      $57.98
First letter group: P
Power saw
24      Power saw            18     $99.99
First letter group: S
Sledge hamme
7       Sledge hamme         11     $21.50
Screwdriver
68      Screwdriver          11      $6.99
68      Screwdriver          122     $6.99
68      Screwdriver          150     $6.99
First letter group: H
Hammer
77      Hammer               76     $11.99
77      Hammer               11     $11.99
77      Hammer               32     $11.99
77      Hammer               55     $11.99
First letter group: L
Lawn mower
39      Lawn mower           3      $79.50
First letter group: J
Jig saw
56      Jig saw              21     $11.00
First letter group: W
Wrench
3       Wrench               34      $7.50
Press any key to continue . . .
```

h)



```
Category: Price above $12
68      Screwdriver         106     $6.99
3       Wrench              34      $7.50
56      Jig saw             21     $11.00
77      Hammer              76     $11.99
Category: Price below $12
7       Sledge hammer       11     $21.50
83      Electric sander     7      $57.98
39      Lawn mower          3      $79.50
24      Power saw           18     $99.99
```

i) **Group invoices in three groups**- invoices with Unit `price` below `$10,` invoices with unit price between `$10` and `$20` and invoices with unit price above of equal to `$20`. **Display details** about invoices in each group **sorted in ascending order of the price**



```
Category: Invoices with prices below $10
68     Screwdriver             106     $6.99
3      Wrench                  34      $7.50
Category: Invoices with prices between $10 and $20
56     Jig saw                 21     $11.00
77     Hammer                  76     $11.99
Category: Invoices with prices above $20
7      Sledge hammer           11     $21.50
83     Electric sander         7      $57.98
39     Lawn mower              3      $79.50
24     Power saw               18     $99.99
Press any key to continue . . .
```

<u>Note</u>: The LINQ queries (a- g) should be returned by static methods in class Invoice, where each such method takes an array of Invoice instances as an argument. The Console application calls these methods and displays the returned LINQ queries using a generic static method.

- **Write also the versions of LINQ making use of methods and Lambda expressions.**
- **Write versions of generic static method in the Console application making use of the Parallel.For , Parallel.ForEach from TPL and the ForAll() from PLINQ to display the results of the LINQ queries (a- e)**
- **Compare the time used to execute the LINQ queries with each one of these methods making use of an instance of class StopWatch.**

Sample data

Part number	Part description	Quantity	Price
83	Electric sander	7	57.98
24	Power saw	18	99.99
7	Sledge hammer	11	21.50
77	Hammer	76	11.99
39	Lawn mower	3	79.50
68	Screwdriver	106	6.99
56	Jig saw	21	11.00
3	Wrench	34	7.50

<u>Problem No. 1b</u>

Consider the following array

```
City[] cities =
       {
        new City(){ContinentName ="Europe", CountryName="Germany", CityName="Berlin" },
        new City(){ContinentName ="Europe", CountryName="Germany", CityName="Frankfurt" },
        new City(){ContinentName ="Europe", CountryName="France", CityName="Paris" },
        new City(){ContinentName ="Europe", CountryName="France", CityName="Marseille" },
        new City(){ContinentName ="Asia", CountryName="Japan", CityName="Tokyo" },
           new City(){ContinentName ="Asia", CountryName="Korea", CityName="Seul" }

            };
```

`Write LINQ statements to group the array element by ContinentName and subgroup of CountryName per continent with a list of cities per country.`

Problem No. 2

Write a console application that **inputs a sentence** from the user (*assume no punctuation*), then **determines** and **displays** the ***nonduplicate*** **words** in ***alphabetical*** **order**.
Treat **uppercase** and **lowercase** letters the same.
[***Hint***: You can use **`string`** method **`Split`** with no arguments, as in **`sentence.Split(),`** to break a sentence into an **`array`** of **`strings`** containing the individual words. By default, **`Split`** uses **`spaces`** as delimiters. Use string method **`ToLower`** in the **`select`** and **`orderby`** clauses of your LINQ query to obtain the **`lowercase`** version of each word.]

Problem No. 3a

Write a console application that inserts **30** **`random`** letters into a **`List< char >.`** **Perform** the following queries on the **`List`** and **display** your results:
[*Hint:* **`Strings`** can be indexed like arrays to access a character at a specific index.]

a) Use LINQ to **`sort`** the **`List`** in **`ascending`** order.
b) Use LINQ to **`sort`** the List in **`descending`** order.
c) **`Display`** the **`List`** in ascending order with **`duplicates`** removed

Problem No. 3b

A strong brand, hot IPO (*Initial Public Offering marks the start of a company's publicly traded life*) and an intense engineering culture help make search advertising company Google a dream employer for a lot of people. Now, a new aptitude test Google is circulating purports to find the best and brightest. Alan Eustace, vice president of engineering and research for Mountain View, Calif.-based Google, published an aptitude test for "uber-geeks."
The 21 GLAT questions include engineering brain-twisters such as, "Consider a function which, for a given whole number n, returns the number of ones required when writing out all numbers between 0 and n. For example, f(13)=6. Notice that f(1)=1. What is the next largest n such that f(n)=n?"
Write a console application to solve this problem.

Hint. Use the ToCharArray() method of convert the string representation of an integer into an array of chars and apply LINQ to solve the problem

Problem No. 4a

Using a random generator create an array of integers of 100 elements that take random values in the range [20, 50]. **Write a Console application that uses LINQ grouping** to partition the array of numbers by their remainder when divided by 8. Display the total numbers in each group, as well as , the numbers that constitute that group

Problem No. 4b

Given a List of strings ("blueberry", "chimpanzee", "abacus", "banana", "apple", "cheese") write a **Console application that uses LINQ grouping** to partition the list of strings in groups of their first letter. Display the total of strings in each group, a title for each group , as well as , the strings that constitute each group
Example:
Words that start with the letter 'b':
blueberry banana
Words that start with the letter 'c':
chimpanzee cheese

Problem No. 5a

Run the Task Manager and open the Performance Wizard to view CPU usage on your computer. Run the attached C# project **MultMatricesInTPL**. Experiment increasing the number of columns and rows in the matrices. The larger the matrices, the greater the performance difference between the parallel and sequential versions of the computation. When the matrix is small, the sequential version will run faster because of the overhead in setting up the parallel loop

Problem No. 5b

Write a Console application to **multiply a matrix by a row** using parallel For. Compare the execution of a sequential and a parallel execution of the task.

Problem No. 5c

Run the attached project **ReturnAverageTPL**. Modify its code so that the parallel **For** returns the average value of all the sums generated inside the loop.

Problem No. 6

Given

```
var customers new[] {
         new { ID = 1,  FirstName = "Sandeep"  , LastName = "Ramani" },
         new { ID = 2,  FirstName = "Dharmik"  , LastName = "Chotaliya" },
         new { ID = 3,  FirstName = "Nisar"    ,  LastName = "Kalia" } ,
         new { ID = 4,  FirstName = "Ravi"     , LastName = "Mapara" } ,
         new { ID = 5,  FirstName = "Hardik"   , LastName = "Mistry" }
         new { ID = 6,  FirstName = "Sandy"    , LastName = "Ramani" },
         new { ID = 7,  FirstName = "Jigar"    , LastName = "Shah" },
         new { ID = 8,  FirstName = "Kaushal"  , LastName = "Parik" } ,
         new { ID = 9,  FirstName = "Abhishek" , LastName = "Swarnker" } ,
         new { ID = 10, FirstName = "Sanket"   , LastName = "Patel" }
         new { ID = 11, FirstName = "Dinesh"   , LastName = "Prajapati" },
         new { ID = 12, FirstName = "Jayesh"   , LastName = "Patel" },
         new { ID = 13, FirstName = "Nimesh"   , LastName = "Mishra" } ,
         new { ID = 14, FirstName = "Shiva"    , LastName = "Reddy" } ,
         new { ID = 15, FirstName = "Jasmin"   , LastName = "Malviya" }
         new { ID = 16, FirstName = "Haresh"   , LastName = "Bhanderi" },
         new { ID = 17, FirstName = "Ankit"    , LastName = "Ramani" },
         new { ID = 18, FirstName = "Sanket"   , LastName = "Shah" } ,
         new { ID = 19, FirstName = "Amit"     , LastName = "Shah" } ,
         new { ID = 20, FirstName = "Nilesh"   , LastName = "Soni" }       };
```

a) Write a PLINQ query to select the customers with IDs in the range between 5 and 15, while preserving the order of the IDs in the output

b) Write a PLINQ query to select the customers with distinct LastName

c) Write a PLINQ query to select the customer ID, and the FirstName and LastName concatenated by a comma and a space between them

Use Parallel.ForEach and ParallelQuery ForAll methods to output the results