Exercises about classes

- Solve them in Visual Studio.

Exercise 12.01: Animal farm

- The namespace of your project is “Animals”.
- You have a class “TestDog” that contains the Main().
    - This tests the class “Dog”.
        - Create 2 or more instances of a dog.
        - Test the full functionality of a dog using those instances.
- Create an extra class with the name “Dog”.
    - You can decide where.
- The class “Dog” has 4 variables with corresponding properties. These properties are no automatic properties and do have gets and sets.
    - Age (of the dog).
    - Breed / Kind (of the dog).
    - Colour (of the dog).
    - Name (of the dog).
- The class “Dog” has multiple constructors. You have to use the properties in the constructors. Do not use the variables.
    - One with no parameters.
    - One with only the name of the dog.
    - One with all four parameters / properties / variables.
- The class has extra methods.
    - Bark.
    - Sit.
    - Eat.

Notes

        - These methods just show something on the console, so you are able to test the methods.
- There is also 1 property that counts the number of dogs.
    - This is a static property.
    - Make sure that all the constructors call the routine where you add 1 to that property.
    - The property that counts the number of dogs is a property that has a read only behaviour. Only the get is implemented.
- In the test routines, all properties and methods must be tested on get and set.
    - Getting the value and setting the value.
    - There is one exception, the number of dogs.

Variant 1

- The same exercise, but with automatic properties.
    - See slide 12 from Part 05 – C# Class Fields and Properties.

Notes

Exercise 12.02: The old and wise

- The namespace of your project is “Classroom”.
- You have a class “Person”.
    - The person has a first name, last name and a birthdate.
        - These are all properties with get and set.
    - The person has 1 constructor, that has 3 parameters.
        - The first name, the last name and the birthdate.
    - The person has also dynamic properties “AgeInYears” and “AgeInDays”. In a previous example, you have already calculated the age in days and years.
        - See slide 11 from C# Class Fields and Properties – Part 05.
- This must give back, whatever I try with the objects of type Person, a correct result.
- You also create a test routine that proves that it works.

Exercise 12.03: Tik and Tok from the Masked Singer

- Create a class “Chicken”.
- This class has one property (get and set).
    - The number of eggs that chicken can lay in one day.
    - This number is 0, 1 or 2.
    - When a negative number is tried to set to that property, the number becomes 0.
    - When a number higher than 2 is tried to set to that property, the number becomes 2.
- Add a constructor to it, no parameters.
    - By default, a chicken can lay 1 egg.
- Add a method that shows the number of eggs that a chicken can lay.
    - Just information on the console is good enough.

Notes

....

....

....

....

....

....

....

Notes

Exercise 12.04: In Flatland a rectangle is a line

- Create a class "Rectangle".
  - A rectangle has a width and a height.
  - Both values must be positive (zero or larger).
  - When a negative number is given to that property, you change it to the default 1.
  - I need 2 constructors.
    - One without parameters, both width and height become 1 as default.
    - One with 2 parameters, the width and the height.
  - I need 2 dynamic properties.
    - One that gives the circumference / perimeter.
      - The sum of the length of all sides.
    - One that gives the area.
- Write also a test class that proves that the functionality works.

Exercise 12.05: Give me a point, … give me a line

Part 1

- Create a class that defines a point.
- Put this class in the namespace “Mathematics”.
- The point has 2 coordinates.
    - An x (type double).
    - An y (type double).
- The constructor of a point puts randomly a number to the “x-coordinate” and also randomly a number to the “y-coordinate”.
    - Round the numbers to 6 digits after the decimal symbol.
        - So 12,123456 is a correct coordinate.
- You have also for x and y properties with a get and a set.
- Write a test program that checks if this works fine.

Part 2

- Create a class that defines a line.
    - The code must be in a different file in your project.
- Put this class also in the namespace “Mathematics”.
- A line has 2 points.
    - A start point (a property of the class line).
    - An end point (a property of the class line).
    - Start point and end point must be different.
- Create a constructor that makes sure that you have a line with a different start point and end point.
    - So you have randomly 2 different points.
    - Make sure that they are different, if not, repeat to create randomly a point until it is different than the first one you created.
- Create a dynamic property that returns the length of the line.

Notes

....

....

....

....

....

....

....

Notes

....

....

....

....

....

....

....

- ○ See below for the calculation.
- Write a test program that checks if this works fine.

How to calculate the length of a line?

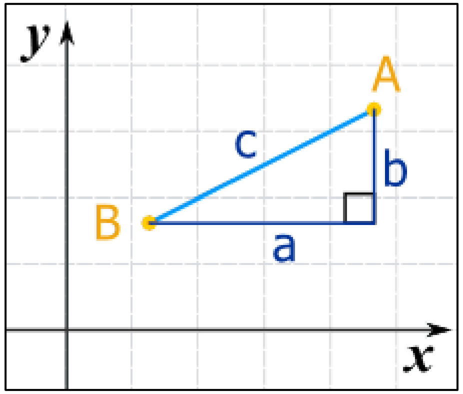
- If point 1 has coordinates x1 and y1.
- If point 2 has coordinates x2 and y2.
- The length is the square root of the squared difference of the x-coordinates and the squared difference of the y-coordinates.
  - ○ This is Pythagoras ($a^2 + b^2 = c^2$).

$$Length = \sqrt{(x2 - x1)^2 + (y2 - y1)^2}$$

Example

- If point 1 has coordinates 1 and 4.
- If point 2 has coordinates 5 and 1.

$$5 \; = \; Length = \sqrt{(5-1)^2 + (1-4)^2}$$



Exercise 12.06: The Body Mass Index (BMI)

Variant 1

- Create a class that defines a Body Mass Index.
- Put this class in the namespace “Health”.
- The class has 2 variables.
  - A mass (type double).
  - A length (type double).
- You have also for mass and length the needed properties with a get and a set.
  - Give the properties good names.
    - "BodyMass" and "BodyLength".
  - Negative values and zero must be set to the default values.
    - Default value for mass is 75.
    - Default value for length is 175.
- One constructor has two parameters that sets the two properties.
  - Don’t set the variables, set the properties.
- Another constructor has no parameters, but sets the two properties by default.
  - The mass becomes 75 (in kilogram).
  - The length becomes 175 (in centimeter).
  - Don’t set the variables, set the properties.
- Create a dynamic property that gives you the calculated BMI.
  - This is how you calculate it.
  - Don’t add the test that length can’t be zero.
    - It is not possible to have a length of zero.

$$\frac{mass\ property}{\frac{length\ property}{100}\ x\ \frac{length\ property}{100}}$$

Notes

Notes

....

....

....

....

....

....

....

Variant 2

- The disadvantage of the exercise above is that every time you use the BMI dynamic property, the calculation is done.
- Change the class so that the calculation is done, when you change the mass or the length property.
- The disavandage of the solution of variant 1 is that you can execute the calculation, but that you don't need the result.

Unstanding the concept of the two variants are important.

When do you do the calculation?

- *The moment you need the result?*
- *The moment one of the ingredients change?*

Exercise 12.07: Special number

- Create a class that defines a SpecialNumber.
- Put this class in the namespace “Mathematics”.
- The class has 1 variable.
  - A number (type BigInteger).
    - This is part of the namespace System.Numerics.
- You have also for the number the needed properties with a get and a set.
  - Give the property a good name.
    - "BigNumber".
  - Negative values must be set to the default values.
    - Default value for BigNumber is 0.
- One constructor has one parameters that sets the property.
  - Don’t set the variable, set the property.
- Another constructor has no parameters, but sets the property by default.
  - The BigNumber becomes 0.
- Create a dynamic property "SumSmallerThan".
  - Sum all the numbers that are between 0 and BigNumber.
    - Borders excluded.
    - When the number is 0, the result is 0.
    - When the number is 1, the result is 0.
    - When the number is 2, the result is 1.
    - When the number is 3, the result is 3 (2 + 1).
    - When the number is 5, the result is 10 (4 + 3 + 2 + 1).
- Create a method "Distance" that receives a BigInteger "givenNumber" and returns a BigInteger.
  - Distance is calculated in this way.
    - Take the absolute value of "givenNumber".
      - Negative values becomes positive.
    - Add all numbers between the absolute value of "givenNumber" and the property "BigNumber".

Notes

Notes

....

....

....

....

....

....

....

            - Borders are excluded.
    - When BigNumber is 7 and givenNumber is 15:
        - Result is 77 (8 + 9 + 10 + 11 + 12 + 13 + 14).
    - When BigNumber is 7 and givenNumber is 2:
        - Result is 18 (3 + 4 + 5 + 6).
    - When BigNumber is 4 and givenNumber is -8:
        - Result is 18 (5 + 6 + 7).
- Create a method "Distance" that receives a SpecialNumber and returns a BigInteger.
    - Distance is calculated the same way, but you take the BigNumber of the received SpecialNumber to calculate with.

Notes

....

....

....

....

....

....

....

Class Exercises in framework Karel the Robot

Solve them in Visual Studio.

Example 09999-e Karel the Robot.zip contains all demos given during the courses.

You can adapt, extend the existing code by solving those exercises. Create a new GitHub repository to save your progress. Make me contributor if it, when you want me to evaluate the exercises.

Exercise 12.08:

-