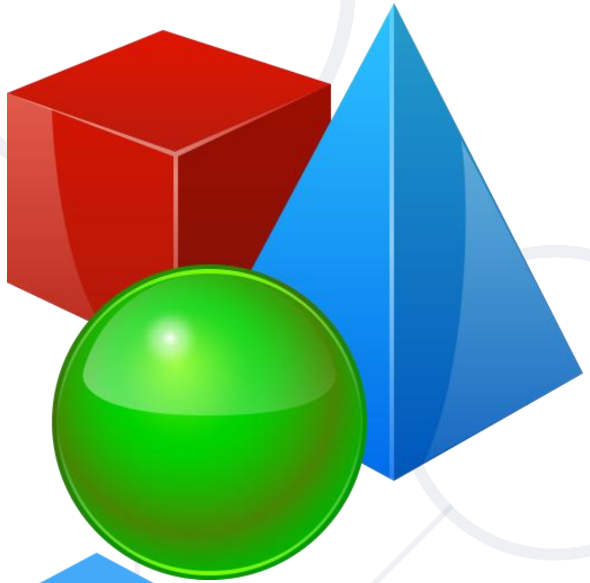
# Objects and Classes

Using Objects and Classes

Defining Simple Classes



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## Table of Contents

## Objects and Classes

What is an Object? What is a Class?

## Classes

- In programming, **classes** provide the structure for **objects**
  - Act as **templates** for **objects** of the same type
- Classes define
  - **Properties** (data), e.g., **Name**, **Age**
  - **Behaviors** (actions), e.g., **`Bark()`**
- One class may have many instances (objects)
  - Sample class: **Dog**
  - Sample objects: **`sparky`**, **`rufus`**

## Classes – Example

```
class Dog
{
      public string Name { get; set; }
      public string Breed { get; set; }
      public int Age { get; set; }

      public void Bark()
      {
            Console.WriteLine("Bark!");
      }
}
```

Name

Properties

Method

## Objects

- An **object** holds a set of named values
  - Creating a **Dog** object

| Dog |
|---|
| Name = "Sparky" |
| Breed = "Corgi" |
| Age = 3 |

Object name

Object properties

Create a **new** object of type Dog

```
var puppy = new Dog
        ("Sparky", "Corgi", 3);
Console.WriteLine(puppy);
```

The **new** operator creates a new object

```
var puppy = new Dog {Name = "Sparky", Breed = "Corgi", Age = 3 };
```

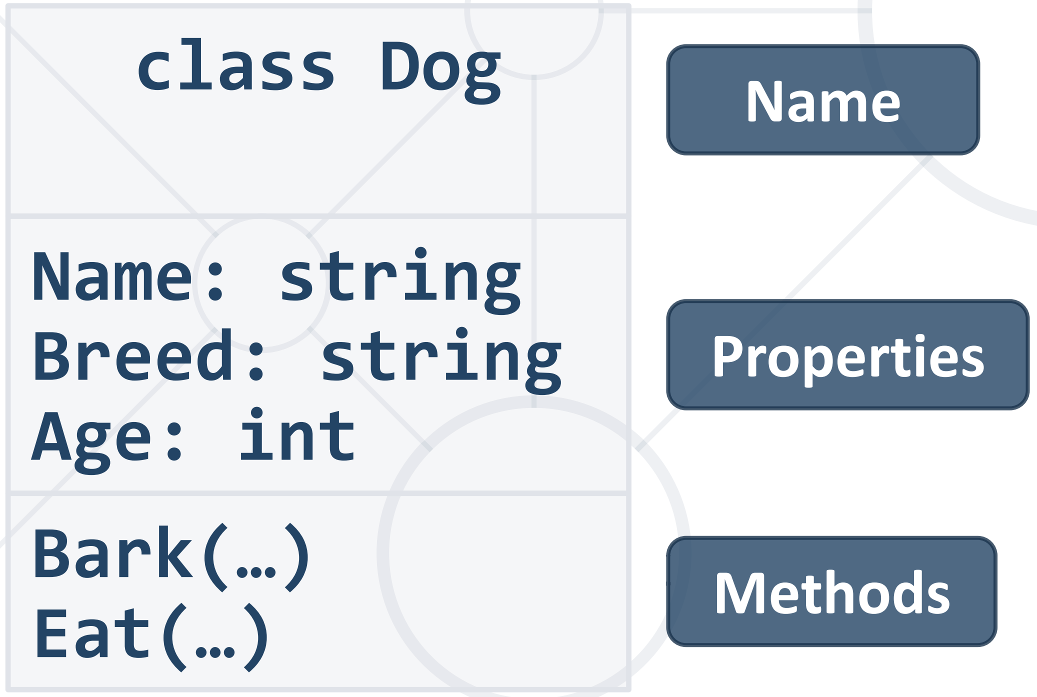
## Objects – Instances of Classes

- Creating the object of a defined class is called **instantiation**
- The **instance** is the object itself, which is created runtime
- All instances have common **behaviour**

```
Dod sparky = new Dog("Sparky", "Corgi", 5);
Dog rufus = new Dog("Rufus", "Shepherd", 3);
Dog allie = new Dog("Allie", "Husky", 2);
```

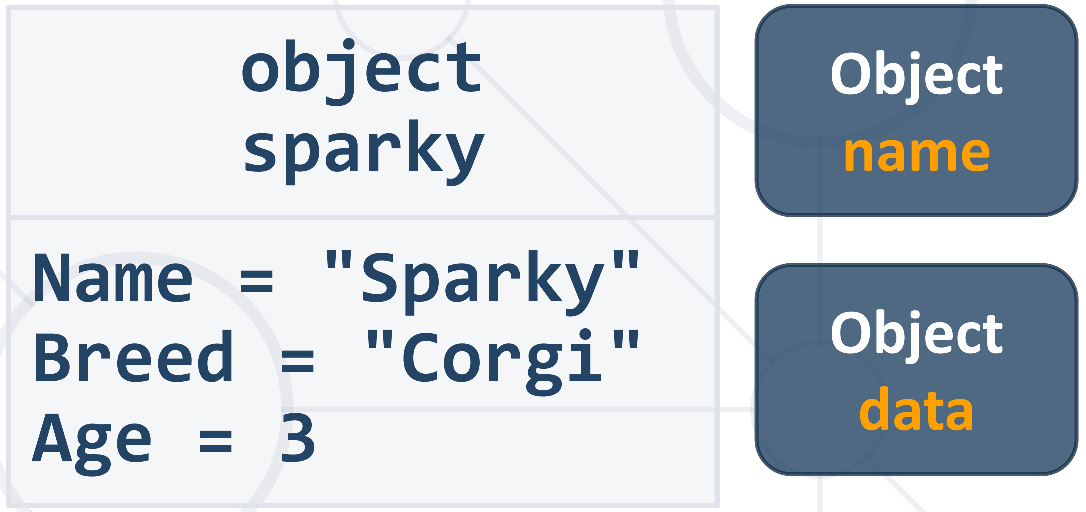
## Classes vs Objects

- Classes provide **structure** for creating objects

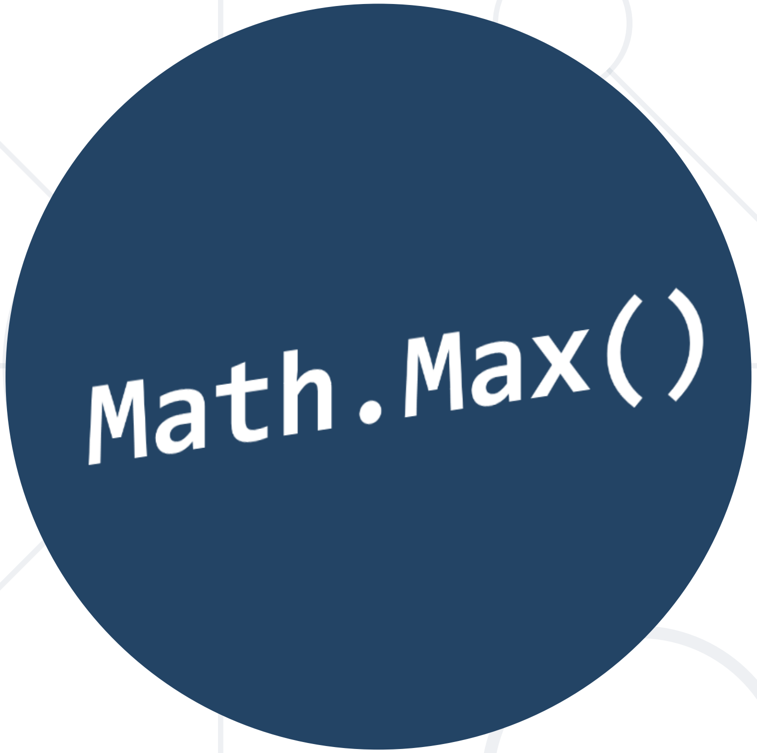


```
class Dog

Name: string
Breed: string
Age: int

Bark(…)
Eat(…)
```

- An object is a single instance of a class



```
object
sparky

Name  = "Sparky"
Breed = "Corgi"
Age  = 3
```



# Using the Built-in API Classes

Math, Random, BigInteger, ...

## Built-in API Classes in .NET Core

- .NET Core provides thousands of ready-to-use classes
  - Packaged into namespaces like `System`, `System.Text`, `System.Collections`, `System.Linq`, `System.Net`, etc.
- Using static .NET class members

```
double cosine = Math.Cos(Math.PI);
```

- Using non-static .NET classes

```
Random rnd = new Random();
int randomNumber = rnd.Next(1, 99);
```

## Problem: Randomize Words

- You are given a list of words
  - Randomize their order and print each word at a separate line

```
a b
```

```
b
a
```

```
PHP Java C#
```

```
Java
PHP
C#
```

**Note: The output is a sample. It should always be different!**

Check your solution here: https://alpha.judge.softuni.org/contests/objects-and-classes-lab/1214/practice#1

## Solution: Randomize Words

```
string[] words = Console.ReadLine().Split(' ');
Random rnd = new Random();
for (int pos1 = 0; pos1 < words.Length; pos1++)
{
   int pos2 = rnd.Next(words.Length);
   // TODO: Swap words[pos1] with words[pos2]
}
Console.WriteLine(string.Join(Environment.NewLine, words));
```

Check your solution here: https://alpha.judge.softuni.org/contests/objects-and-classes-lab/1214/practice#1

## Problem: Big Factorial

- Calculate **n!** (**n** factorial) for very big **n** (e.g. 1000)

5 $\rightarrow$ 120

10 $\rightarrow$ 3628800

12 $\rightarrow$ 479001600

50 $\rightarrow$ 30414093201713378043612608166064768844377641568
960512000000000000

88 $\rightarrow$ 185482642257398439114796845645546284380220968
949399346684421580986889562184028199319100141244
804501828416633516851200000000000000000000

Check your solution here: https://alpha.judge.softuni.org/contests/objects-and-classes-lab/1214/practice#2

# Solution: Big Factorial

```
using System.Numerics;


int n = int.Parse(Console.ReadLine());
BigInteger f = 1;
for (int i = 2; i <= n; i++)
   f *= i;
Console.WriteLine(f);
```

Use the .NET API class `System.Numerics` `.BigInteger`

N!

Check your solution here: https://alpha.judge.softuni.org/contests/objects-and-classes-lab/1214/practice#2

## Creating Custom Classes

Defining Classes

## Defining Simple Classes

- Specification of a given type of objects from the real-world
- Classes provide structure for describing and creating objects

Keyword

Class name

```
class Dice
{
    …
}
```

Class body

## Naming Classes

- Use **PascalCase** naming
- Use descriptive nouns
- Avoid abbreviations (except widely known, e.g., URL, HTTP, etc.)

✓

```
class Dice { … }
class BankAccount { … }
class IntegerCalculator { … }
```

✗

```
class TPMF { … }
class bankaccount { … }
class intcalc { … }
```

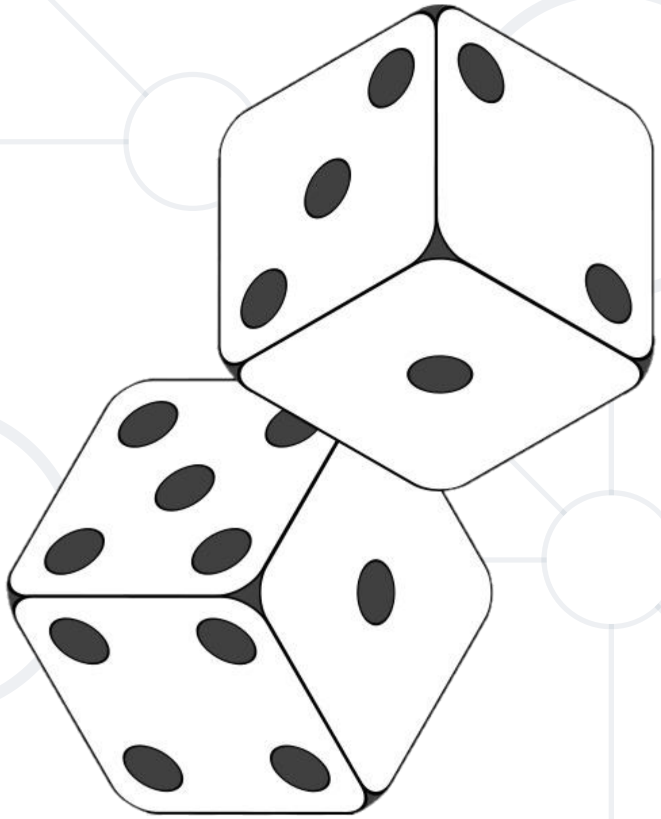
## Class Members

- Class is made up of **state** and **behaviour**
- Properties **store state**
- Methods **describe behaviour**

```
class Dice
{
  public int Sides { get; set; }
  public string Type { get; set; }
  public void Roll() { }
}
```

Properties

Method



# Creating an Object

- A class can have **many instances** (objects)

```
class Program
{
  public static void Main()
  {
    Dice diceD6 = new Dice();
    Dice diceD8 = new Dice();
  }
}
```

Use the **new** keyword

## Properties

- Describe the characteristics of a given class

```
class Student
{
  public string FirstName { get; set; }
  public string LastName { get; set; }
  public int Age { get; set; }
}
```

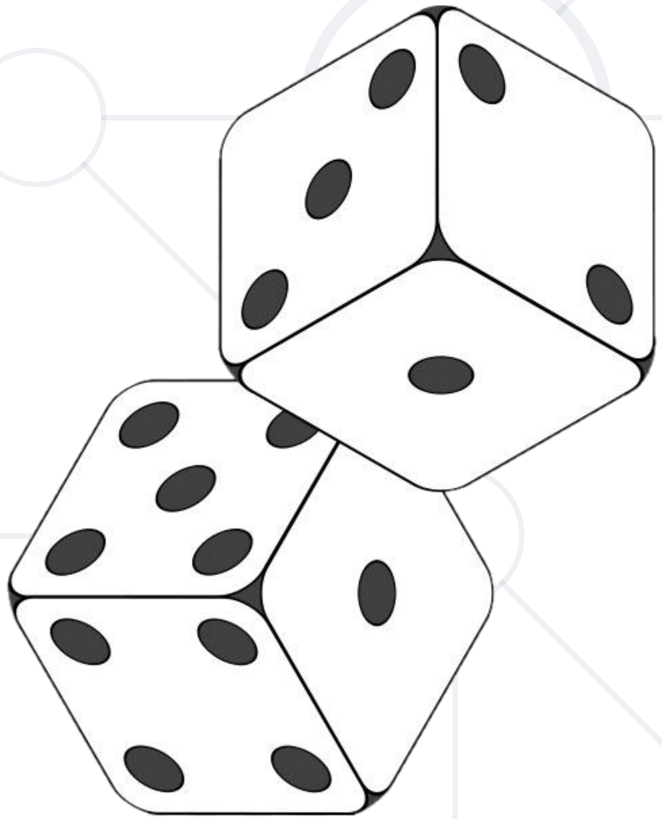
The getter provides access to the field

The setter provides field change

## Methods

- Store **executable code** (algorithm)

```
class Dice
{
  public int Sides { get; set; }
  public int Roll()
  {
    Random rnd = new Random();
    return rnd.Next(1, Sides + 1);
  }
}
```



## Constructors

- Special methods, executed during object creation

```
class Dice
{
    public int Sides { get; set; }
    public Dice()
    {
        this.Sides = 6;
    }
}
```

**Constructor name is the same as the name of the class**

**Overloading default constructor**

## Constructors

- You can have multiple constructors in the same class

```
class Dice
{
  public Dice() { }
  public Dice(int sides)
  {
    this.Sides = sides;
  }
  p int Sides { get; set; }
}
```

```
class Program
{
 public static void Main()
 {
    Dice dice1 = new Dice();
    Dice dice2 = new Dice(7);
  }
}
```

## Class Operations

- Classes can define **data** (state) and **operations** (actions)

```
class Rectangle
{
   public int Top { get; set; }
   public int Left { get; set; }
   public int Width { get; set; }
   public int Height { get; set; }

  int CalcArea()
  {
    return Width * Height;
  }
```

Classes may hold data (**properties**)

Classes may hold operations (**methods**)

# Class Operations

```
public int Bottom
{
  get
  {
    return Top + Height;
  }
}
```

Calculated property

```
public int Right
{
  get
  {
    return Left + Width;
  }
}
```

Calculated property

```
public bool IsInside(Rectangle r)
{
   return (r.Left <= Left) && (r.Right >= Right) &&
       (r.Top <= Top) && (r.Bottom >= Bottom);
}
```

Boolean method

## Summary

- Objects
  - Holds a set of named values
  - Instance of a class
- Classes define templates for object
  - Methods
  - Constructors
  - Properties