Defining Classes

Classes, Fields, Constructors, Properties, Methods

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#csharp-advanced

Abstract Data Type

Hide Details from the Client

Abstract Data Type

- Data type whose **representation** is **hidden** from the client

```
string ADT – indexed sequence of
chars:
string()
int Length()
char CharAt(int index)
bool IsEmpty()
// many others…
```

ADTs are defined by their **usage**

Abstract Data Type (2)

- You **don't need** to know the **implementation** to use an ADT

```
Dog:
        Dog()
 string Name()
   void Bark()
   void Sleep()
```

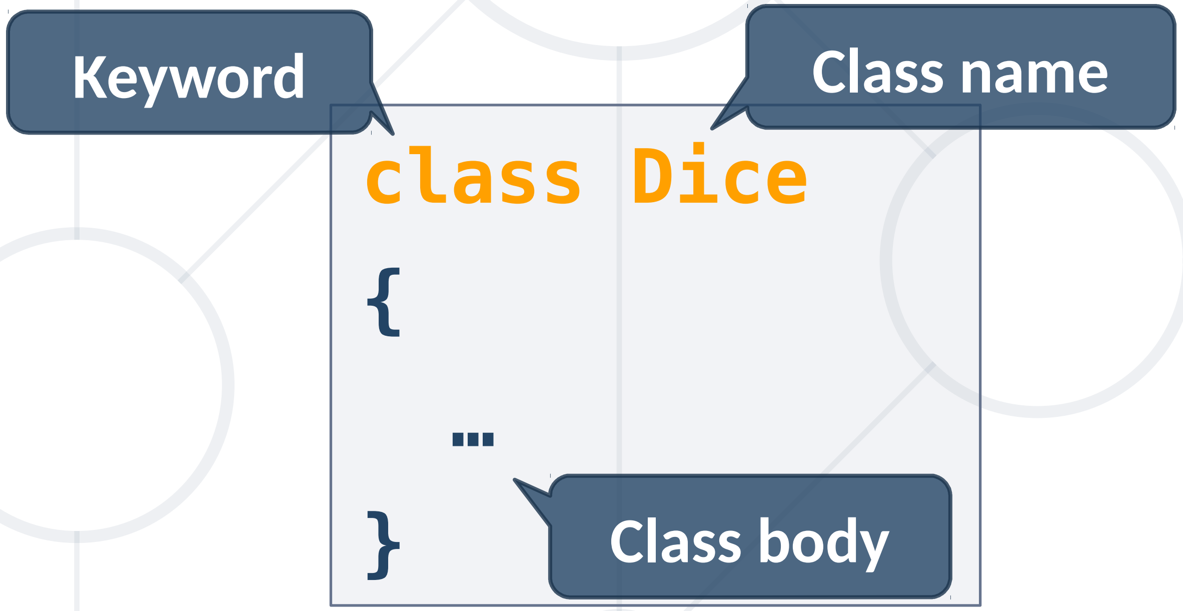
```
Computer:
        Computer()
   void TurnOn()
   void TurnOff()
 string Spec()
```

Defining Classes

Creating Class for an ADT

Defining Simple Classes

- Class is a **concrete implementation** of an ADT
- Classes provide **structure** for **describing** and **creating** objects



```
class Dice
{
    …
}
```

Naming Classes

- Name classes with nouns using **PascalCasing**
- Use **descriptive nouns**
- **Avoid abbreviations** (except widely known, e.g. URL, HTTP, etc.)

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

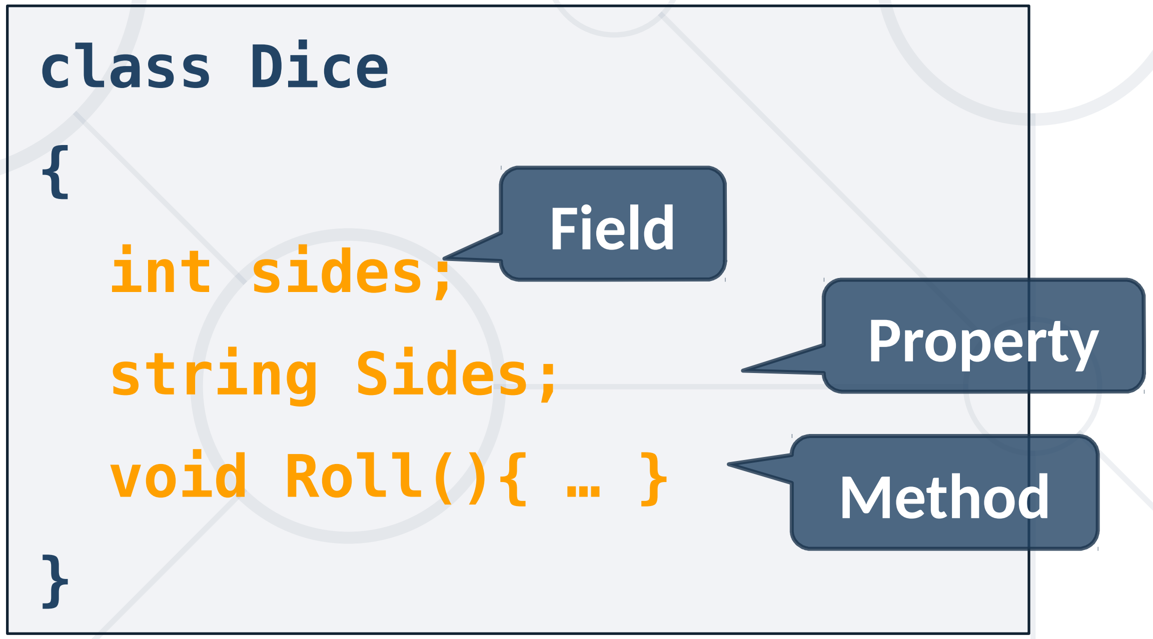
✓

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

✗

Class Members

- Members are **declared** in the class and they have certain accessibility, which can be specified
- They can be:
  - Fields
  - Properties
  - Methods, etc.



```
class Dice
{
  int sides;
  string Sides;
  void Roll(){ … }
}
```

Creating an Object

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

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

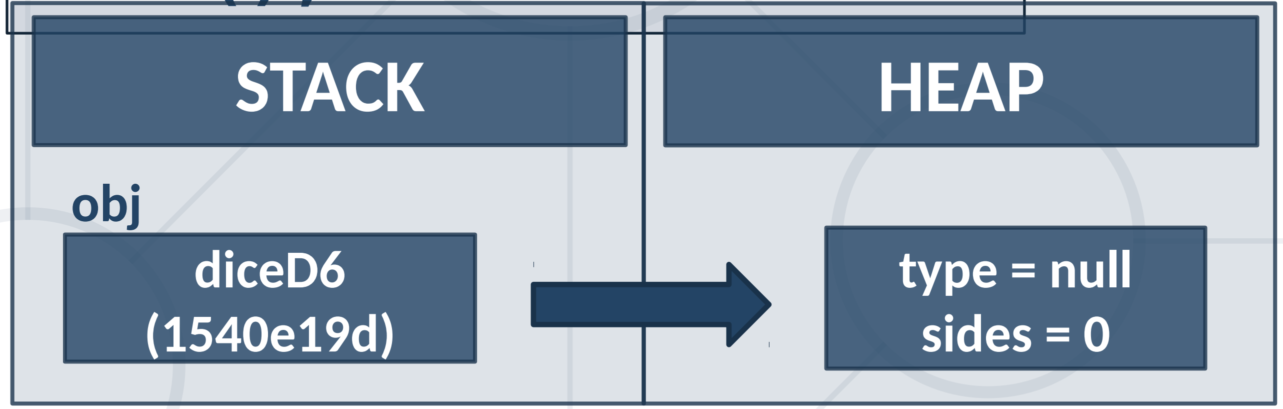
Use the **new** keyword

A variable stores a **reference**

Object Reference

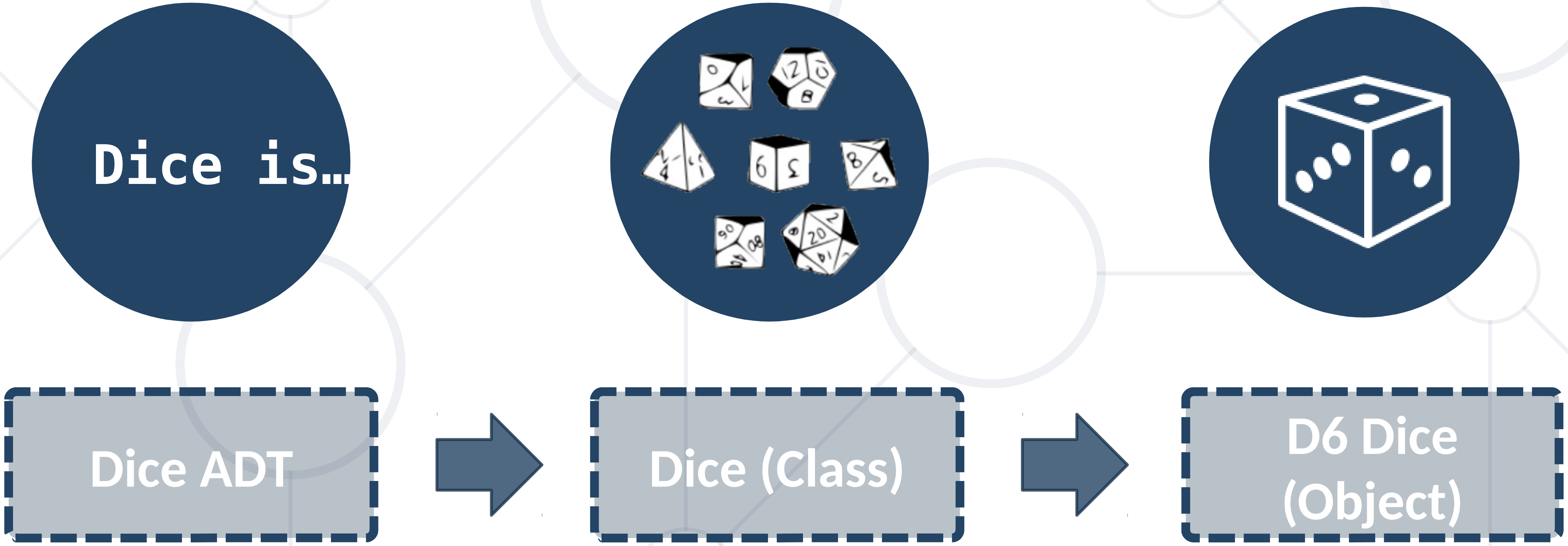
- Declaring a variable creates a **reference** in the stack
- The **new** keyword allocates memory on the heap

```
Dice diceD6 = new
Dice();
```



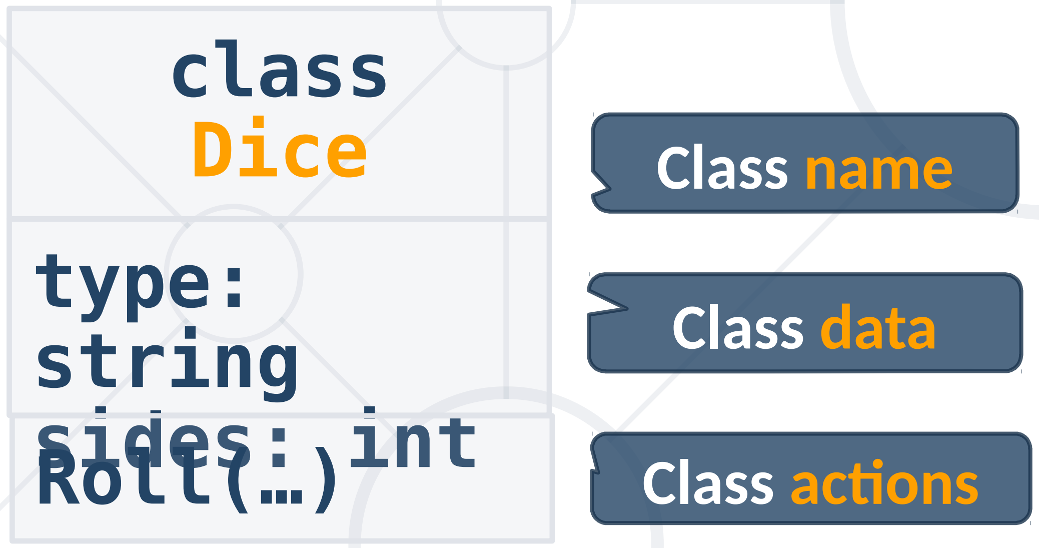
Classes vs. Objects

- Classes provide **structure** for describing and creating objects
- An **object** is a **single instance of a class**

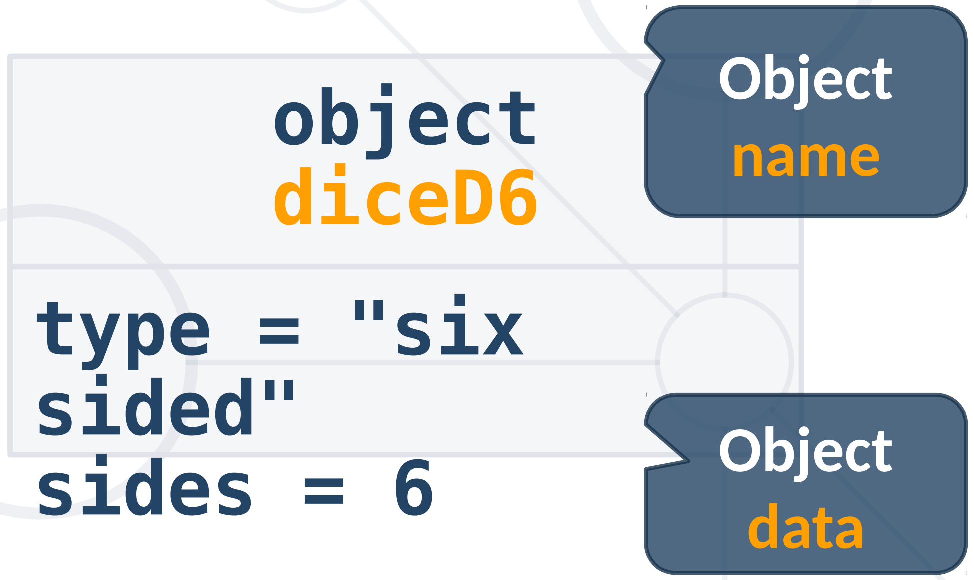


Classes vs. Objects

- Classes provide structure for creating objects
- An object is a single instance of a class



```
class
Dice
type: string
sides: int
Roll(…)
```



```
object
diceD6
type = "six sided"
sides = 6
```

Class Data

Storing Data Inside a Class

Fields and Modifiers

- Class fields have type and name
- Modifiers define accessibility

Class modifier

Fields should always be private

Fields can be of any type

```
public class Dice
{
  private string type;
  private int sides;
  private int[] rollFre-
quency;
  private Person owner;
  public void Roll () { … }
}
```

Properties

- Used to create **accessors** and **mutators** (**getters** and **setters**)

```
public class Dice
{
  private int sides;
  public int Sides
  {
    public get { return
this.sides; }
    public set { this.sides = value;
}
  }
}
```

The field is hidden

The getter provides access to the field

The setter provides field change

Problem: Car

- Create a class **Car**

```
Car
-make:string
-model:string
-year:int
(no actions)
```

```
private string make;
private string model;
private int year
public string Make
{
  get { return this.make; }
  set { this.make = value; }
}
// TODO: Balance and Year Getter &
Setter
```

Methods

Defining a Class Behaviour

Methods

- Store **executable code** (an algorithm)

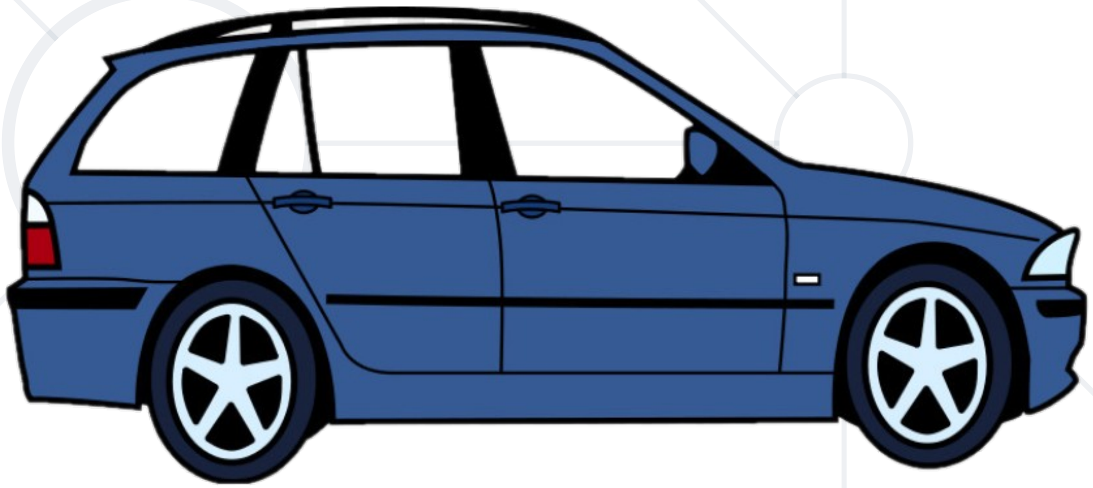
```
public class Dice
{
   private int sides;
   private Random rnd = new Random();
   public int Roll() {
      int rollResult = rnd.Next(1, this.sides +
1);
      return rollResult;
   }
}
```

this points to the current instance

Problem: Car Extension

- Create a class **Car**

```
Car
-make:string
-model:string
-year:int
-fuelQuantity:double
-fuelConsumption:double
+Drive(double distance):void
+WhoAmI():string
```



Solution: Car Extension

```
// TODO: Get the other fields from previous prob-
lem
private double fuelQuantity;
private double fuelConsumption;
// TODO: Get the other properties from previous
problem
public double FuelQuantity {
  get { return this.fuelQuantity; }
  set { this.fuelQuantity = value; }}
public double FuelConsumption {
  get { return this.fuelConsumption; }
  set { this.fuelConsumption = value; }}
```

Check your solution here: https://judge.softuni.bg/Contests/1478/Defining-Classes-Lab

Solution: Car Extension (2)

```
public void Drive(double distance)
{
    bool canContinue = this.FuelQuantity – (distance *
                 this.FuelConsumption) >= 0;
    if(canContionue)
        this.FuelQuantity -= distance * this.FuelConsumption;
    else
        Console.WriteLine("Not enough fuel to perform this
trip!");
}
```

Check your solution here: https://judge.softuni.bg/Contests/1478/Defining-Classes-Lab

Solution: Car Extension (3)

```
public string WhoAmI()
{
    StringBuilder sb = new StringBuilder();
    sb.AppendLine($"Make: {this.Make}");
    sb.AppendLine($"Model: {this.Model}");
    sb.AppendLine($"Year: {this.Year}");
    sb.Append($"Fuel: 
{this.FuelQuantity:F2}L");
    return sb.ToString();
}
```

Check your solution here: https://judge.softuni.bg/Contests/1478/Defining-Classes-Lab

Constructors

Object Initialization

Constructors

- When a constructor is invoked, it creates an instance of its class and usually initializes its members
- Classes in C# are instantiated with the **keyword new**

```
public class Dice
{
  public Dice() {
}
}
```

```
public class StartUp
{
  static void Main()
{
  var dice = new
Dice()
}
```

Object Initial State

- Constructors **set object's initial state**

```
public class Dice
{
  int sides;
  int[] rollFrequency;
  public Dice(int sides) {
    this.sides = sides;
    this.rollFrequency = new
int[sides];
  }
}
```

Always ensure **correct state**

Multiple Constructors

- You can have multiple constructors in the same class

```java
public class Dice
{
  private int sides;
  public Dice() { }
  public Dice(int sides)
  {
    this.sides = sides;
  }
}
```

Constructor without parameters

Constructor with parameters

Constructor Chaining

- Constructors can call each other

```
public class Person {
  private string name;
  private int age;
  public Person() {
    this.age = 18;
  }
  public Person(string name) :
this()
  {
    this.name = name;
  }
}
```

Calls default constructor

Problem: Car Constructors

- Extend the previous problem and **create 3 constructors**
- Default values are:
  - Make – VW
  - Model – Golf
  - Year – 2025
  - FuelQuantity = 200
  - FuelConsumption = 10

```
Car
---------------------------------------------
+Car()
+Car(string make, string
model, int year)
+Car(string make, string
model, int year, double
fuelQuantity, double
fuelConsumption)
```

Solution: Car Constructors

```
public Car() {
  this.Make = "VW";
  this.Model = "Golf";
  this.Year = 2025;
  this.FuelQuantity = 200;
  this.FuelConsumption = 10;}
  public Car(string make, string model, int year) : this()
{
      this.Make = make;
      this.Model = model;
      this.Year = year;}
```

Check your solution here: https://judge.softuni.bg/Contests/1478/Defining-Classes-Lab

Problem: Car Constructors(2)

```
public Car(string make, string model, int 
year,
double fuelQuantity, double fuelConsumption)
    : this(make, model, year)
{
    this.FuelQuantity = fuelQuantity;
    this.FuelConsumption = fuelConsumption;
}
```

Check your solution here: https://judge.softuni.bg/Contests/1478/Defining-Classes-Lab

Problem: Car Engine And Tires

- Create the two classes and extend the Car class

Engine
-horsePower:int -cubicCapacity:double
+Engine(int horsePower, double cubicCapacity)

Tire
-year:int -pressure:double
+Engine(int year, double pressure)

Car
+Car(string make, string model, int year, double fuelQuantity, double fuelConsumption, Engine engine, Tire[] tires)

Solution: Car Engine And Tires

```
private int horsePower;
private double cubicCapacity;
public Engine(int horsePower, double cubicCapac-
ity){
    this.HorsePower = horsePower;
    this.CubicCapacity = cubicCapacity;}
public int HorsePower {
    get { return this.horsePower; }
    set { this.horsePower = value; } }
public double CubicCapacity{
    get { return this.cubicCapacity; }
    set { this.cubicCapacity = value; }}
```

Check your solution here: https://judge.softuni.bg/Contests/1478/Defining-Classes-Lab

Solution: Car Engine And Tires(2)

```
private int year;
private double pressure;
public Tire(int year, double pressure){
    this.Year = year;
    this.Pressure = pressure;}
public int Year{
    get { return this.year; }
    set { this.year = value; }}
public double Pressure{
    get { return this.pressure; }
    set { this.pressure = value; }}
```

Check your solution here: https://judge.softuni.bg/Contests/1478/Defining-Classes-Lab

Solution: Car Engine And Tires(3)

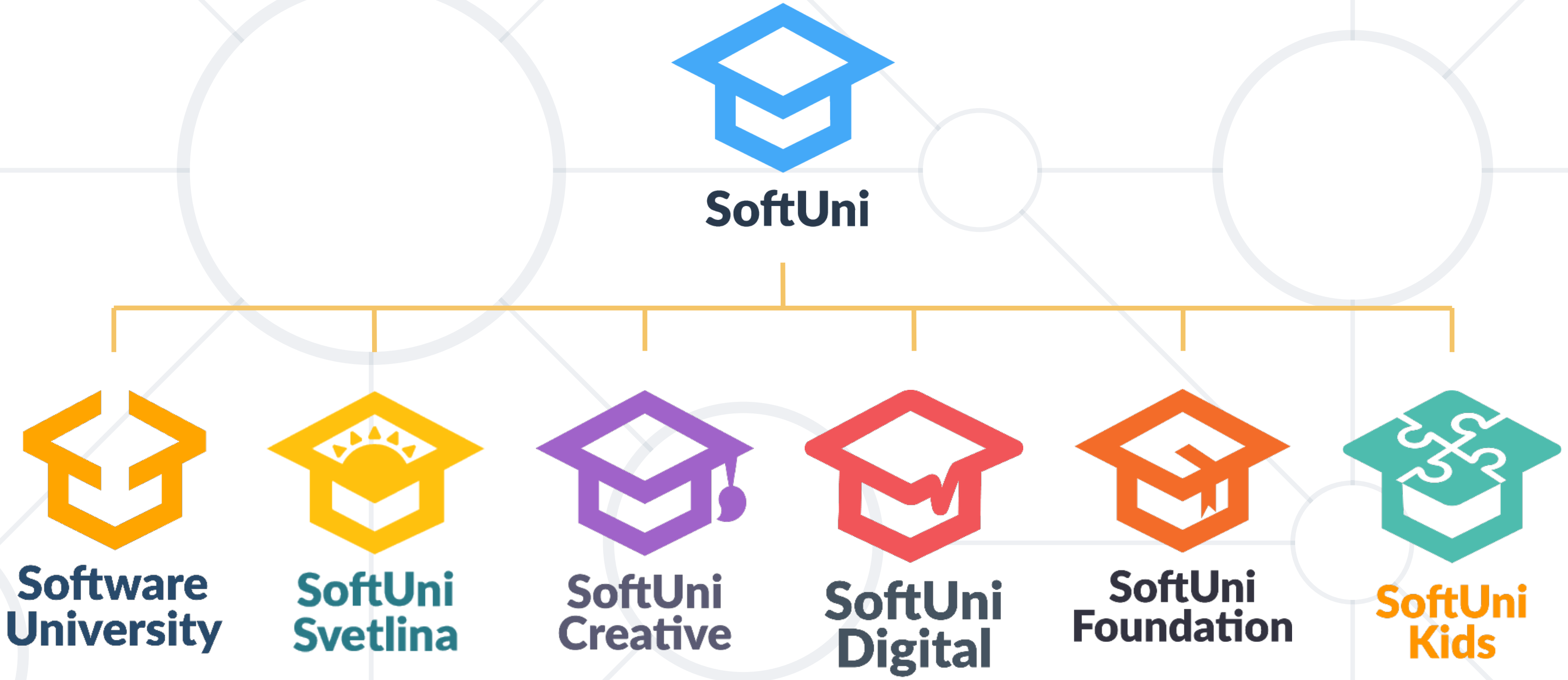
```
public Car(string make, string model, int year,
double fuelQuantity, double fuelConsumption, Engine en-
gine,
Tire[] tires)
    : this(make, model, year, fuelQuantity, fuelCon-
sumption)
{
    this.Engine = engine;
    this.Tires = tires;
}
```

Check your solution here: https://judge.softuni.bg/Contests/1478/Defining-Classes-Lab

Summary

- Classes define **structure** for objects
- Objects are **instances of a class**
- Classes define **fields**, **methods**, **constructors** and other members
- Constructors:
  - **Invoked** when creating **new instances**
  - **Initialize** the **object's state**

Questions?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