

Encapsulation

Benefits of Encapsulation



SoftUni Team
Technical Trainers



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Software University

<https://softuni.bg>

- Encapsulation
- Access Modifiers
- State Validation
- Mutable and Immutable Objects

sli.do

#csharp-advanced



Encapsulation

Hiding Implementation

Encapsulation

- Process of wrapping code and data together into a **single unit**
- Flexibility and extensibility of the code
- Reduces **complexity**
- Structural changes remain **local**
- Allows **validation** and **data binding**



Encapsulation – Example

- Fields should be **private**

Person

-name: string

-age: int

- == private

+Person(string name, int age)

+Name: string

+Age: int

+ == public

- Properties should be **public**



Keyword This

- Reference to the **current object**
- Refers to the **current instance** of the class
- Can be passed as a **parameter to other methods**
- Can be **returned** from method
- Can invoke **current class methods**






Visibility of Class Members

Access Modifiers

Private Access Modifier

- It's the main way to perform encapsulation and hide data from the outside world




```
private string name;  
Person (string name) {  
    this.name = name;  
}
```

- The default field and method modifier is **private**
- Avoid declaring private classes and interfaces
 - accessible only within the declared class itself

Public Access Modifier

- The most **permissive** access level
- There are **no restrictions** on accessing public members




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

- To access class directly from a namespace use the **using** keyword to include the namespace

Internal Access Modifier

- **Internal** is the **default** class access modifier



```
class Person {  
    internal string Name { get; set; }  
    internal int Age { get; set; }  
}
```

- Accessible to any other class in the same project

```
Team rm = new Team("Real");  
rm.Name = "Real Madrid";
```

Problem: Sort People by Name and Age

- Create a read-only class **Person**
- Read and sort people by first name and age

Person
<pre>+FirstName:string +LastName:string +Age:int +ToString():string</pre>



Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1497#0>

Solution: Sort People by Name and Age (1)

```
public class Person {  
    // TODO: Add a constructor  
    public string FirstName { get; private set; }  
    public string LastName { get; private set; }  
    public int Age { get; private set; }  
    public override string ToString() {  
        return $"{FirstName} {LastName} is {Age} years old.";  
    }  
}
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1497#0>

Solution: Sort People by Name and Age (2)

```
var lines = int.Parse(Console.ReadLine());
var people = new List<Person>();
for (int i = 0; i < lines; i++) {
    var cmdArgs = Console.ReadLine().Split();
    // Create variables for constructor parameters
    // Initialize a Person
    // Add it to the list
}
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1497#0>

Solution: Sort People by Name and Age (3)

//continued from previous slide

```
var sorted = people.OrderBy(p => p.FirstName)
    .ThenBy(p => p.Age).ToList();
```

```
Console.WriteLine(string.Join(
    Environment.NewLine, sorted));
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1497#0>

Problem: Salary Increase

- Expand **Person** with **salary**
- Add getter for **salary**
- Add a method, which updates **salary** with a given percent
- Persons younger than 30 get half of the normal increase

Person

+FirstName: string

+Age: int

+Salary: decimal

+IncreaseSalary(decimal): void

+ToString(): string

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1497#1>

Solution: Salary Increase

```
public decimal Salary { get; private set; }  
public void IncreaseSalary(decimal percentage)  
{  
    if (this.Age >= 30)  
        this.Salary += this.Salary * percentage / 100;  
    else  
        this.Salary += this.Salary * percentage / 200;  
}
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1497#1>



Validation

- Setters are a good place for simple **data validation**

```
public decimal Salary {  
    get { return this.salary; }  
    set {  
        if (value < 650)  
            throw new ArgumentException("...");  
        this.salary = value; }  
}
```

Throw exceptions

- Callers of your methods should take care of **handling** exceptions

- Constructors use **private setters** with validation logic

```
public Person(string firstName, string lastName,  
              int age, decimal salary) {  
    this.FirstName = firstName;  
    this.LastName = lastName;  
    this.Age = age;  
    this.Salary = salary;  
}
```

Validation happens
inside the setter

- Guarantee **valid state** of the object after its creation

Problem: Validate Data

- Expand **Person** with validation for every field
- Names must be at least 3 symbols
- Age cannot be zero or negative
- Salary cannot be less than 650

Person

```
-firstName: string  
-lastName: string  
-age: int  
-salary: decimal
```

```
+Person()  
+FirstName  
+LastName  
+Age  
+Salary
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1497#2>

Solution: Validate Data

```
public int Age
{
    get => this.age;
    private set {
        if (age < 1)
            throw new ArgumentException("...");
        this.age = value; }
}

// TODO: Add validation for the rest
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1497#2>

Mutable vs Immutable Objects

- Mutable Objects

- Mutable == changeable
- Use the same memory location
- **StringBuilder**
- **List**

- Immutable Objects

- Immutable == unchangeable (read-only)
- Create new memory every time they're modified
- **string**
- **Tuples**



Mutable Fields

- **Private mutable** fields are still **not encapsulated**



```
class Team
{
    private List<Person> players;
    public List<Person> Players {
        get { return this.players; } }
}
```

- In this case you can **access** the field methods through the **getter**

Immutable Fields

- You can use **ICollection** to encapsulate collections



```
public class Team
{
    private List<Person> players;
    public ICollection<Person> Players {
        get { return this.players.AsReadOnly(); } }
    public void AddPlayer(Person player)
        => this.players.Add(player); // mutable now
}
```

Problem: Team

- Team have two squads
 - First team & Reserve team
- Read persons from console and add them to team
- If they are younger than 40, they go to first squad
- Print both squad sizes

Team
<pre>-name : string -firstTeam: List<Person> -reserveTeam: List<Person></pre>
<pre>+Team(string name) +Name: string +FirstTeam: ReadOnlyList<Person> +ReserveTeam: ReadOnlyList<Person> +AddPlayer(Person person)</pre>

Check your solution here: <https://judge.softuni.bg/Contests/1497/Encapsulation-Lab>

Solution: Team (1)

```
private string name;  
private List<Person> firstTeam;  
private List<Person> reserveTeam;  
  
public Team(string name) {  
    this.name = name;  
    this.firstTeam = new List<Person>();  
    this.reserveTeam = new List<Person>(); }  
  
// continues on the next slide
```

Check your solution here: <https://judge.softuni.bg/Contests/1497/Encapsulation-Lab>

Solution: Team (2)

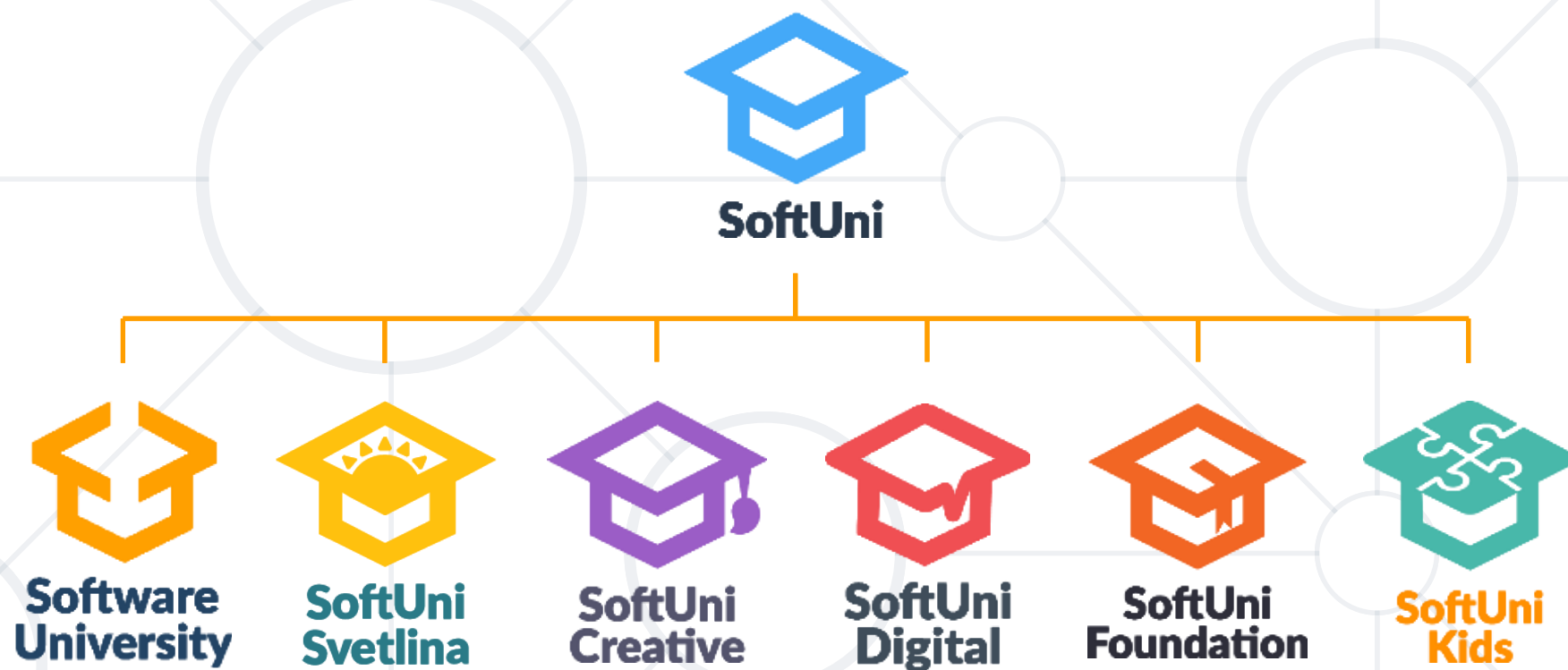
```
public IReadOnlyCollection<Person> FirstTeam {  
    get { return this.firstTeam.AsReadOnly(); }  
}  
  
// TODO: Implement reserve team getter  
  
public void AddPlayer(Person player) {  
    if (player.Age < 40)  
        firstTeam.Add(player);  
    else  
        reserveTeam.Add(player); }  
}
```

Check your solution here: <https://judge.softuni.bg/Contests/1497/Encapsulation-Lab>

- Encapsulation:
 - Hides **implementation**
 - Reduces **complexity**
 - Ensures that structural changes remain local
- **Mutable** and **Immutable** objects



Questions?



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