Encapsulation

What is Encapsulation, Benefits, Implementation in Java

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Questions

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#JavaFundamentals

Encapsulation

Hiding Implementation

Encapsulation

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- Process of **wrapping** code and data together into a single **unit**
- Objects fields **must be private**

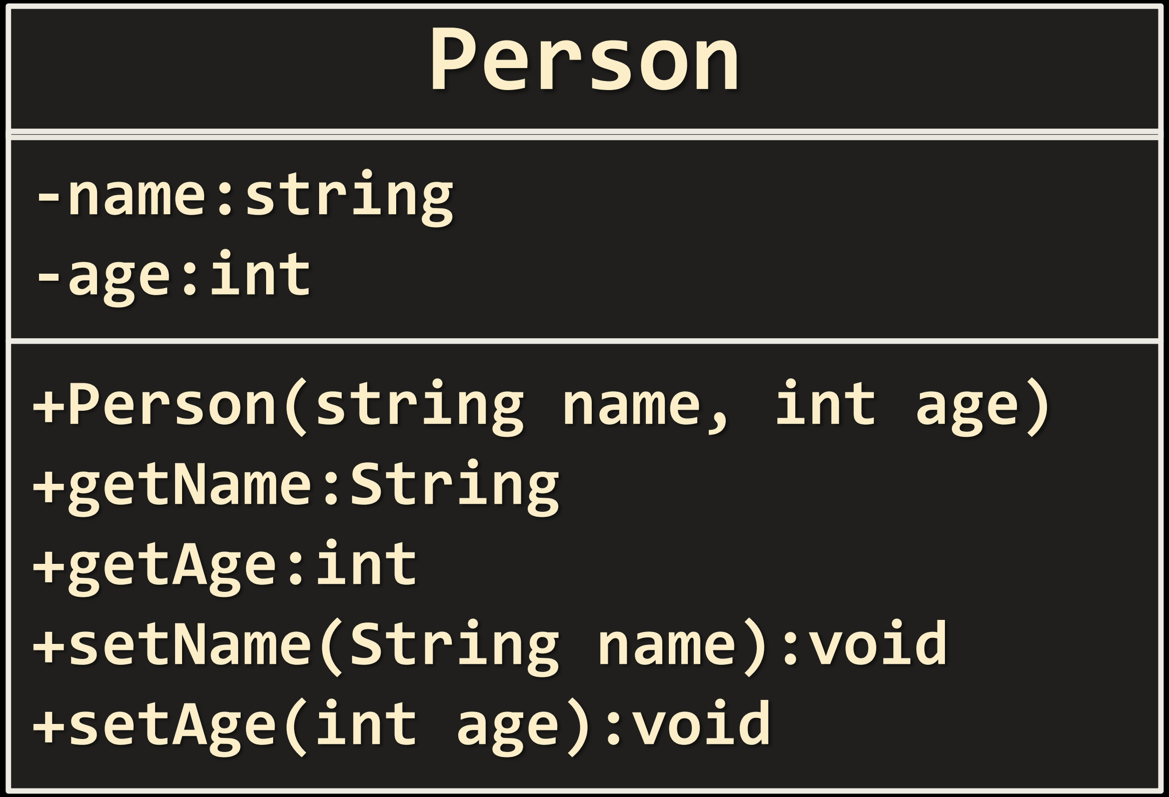
```
class Person {
  private int age;
}
```

- Use **getters** and **setters** for data access

```
class Person {
  public int getAge()
  public void setAge()
}
```

Encapsulation – Example

Fields should be **private**



Person

-name:string
-age:int

+Person(string name, int age)
+getName:String
+getAge:int
+setName(String name):void
+setAge(int age):void

Keyword this

- **this** is reference to the **current object**
- **this** can refer current class instance variable

```
public Person(String name) {
  this.name = name;
}
```

- **this** can invoke current class method

```
public String fullName() {
  return this.getFirstName() + " " + this.getLastName()
}
```

Keyword this (2)

- this can invoke current class constructor

```
public Person(String name) {
  this.firstName = name;
}
```

```
public Person (String name, Integer age) {
  this(name);
  this.age = age;
}
```

Keyword this (3)

- **this** can be passed like an argument in method or constructor

```
public Person getInstance() {
  return this;
}
```

- **this** can be returned from method

Access Modifiers

Visibility of Class Members

Private

- Object hides data from the outside world

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

- Classes and interfaces **cannot** be private
- Data can be **accessed only within the declared class** itself

Protected

- Grants **access to subclasses** in other package

```
class Team {
  protected String getName ()
  protected void setName (String name)
}
```

- **Protected** modifier cannot be applied to class and interfaces
- Prevents a **nonrelated** class from trying to use it

Default

- Do not explicitly declare an access modifier

```
class Team {
  String getName ()
  void setName (String name)
}
```

- Available to any other class in the same package

```
Team real = new Team("Real");
real.setName("Real Madrid");
System.out.println(real.getName()); // Real Madrid
```

Public

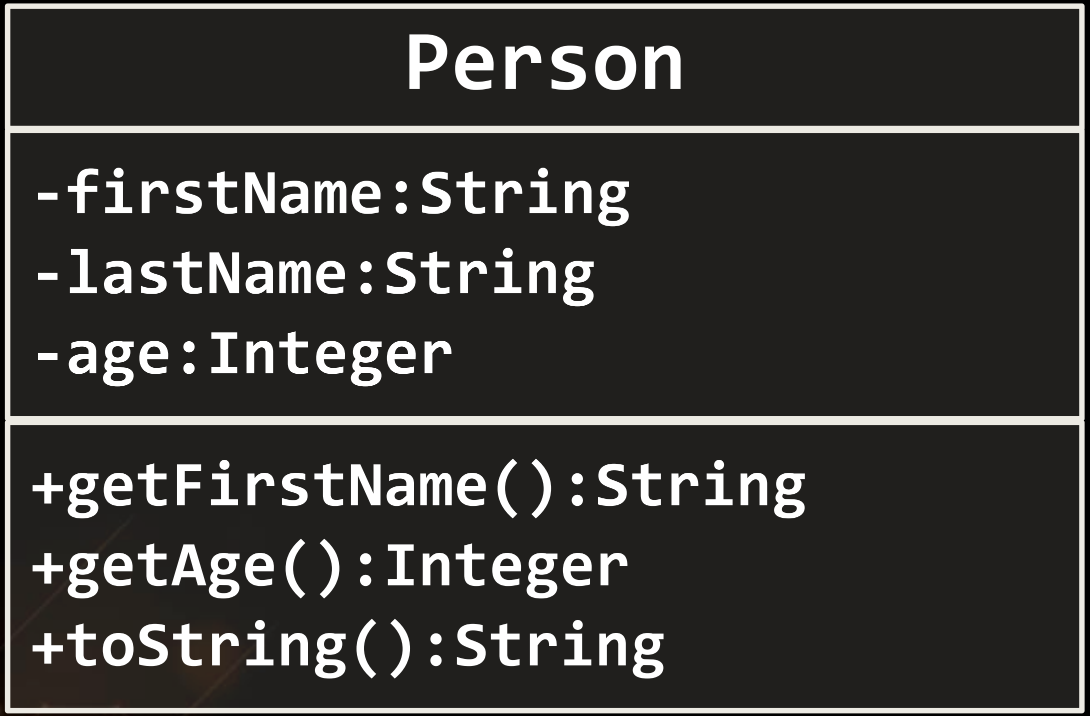
- Grants access to **any class** belonging to the **Java Universe**

```
public class Team {
  public String getName ()
  public void setName (String name)
}
```

- Import a package if you need to use a class
- The `main()` method of an application has to be public

Problem: Sort Persons by Name and Age

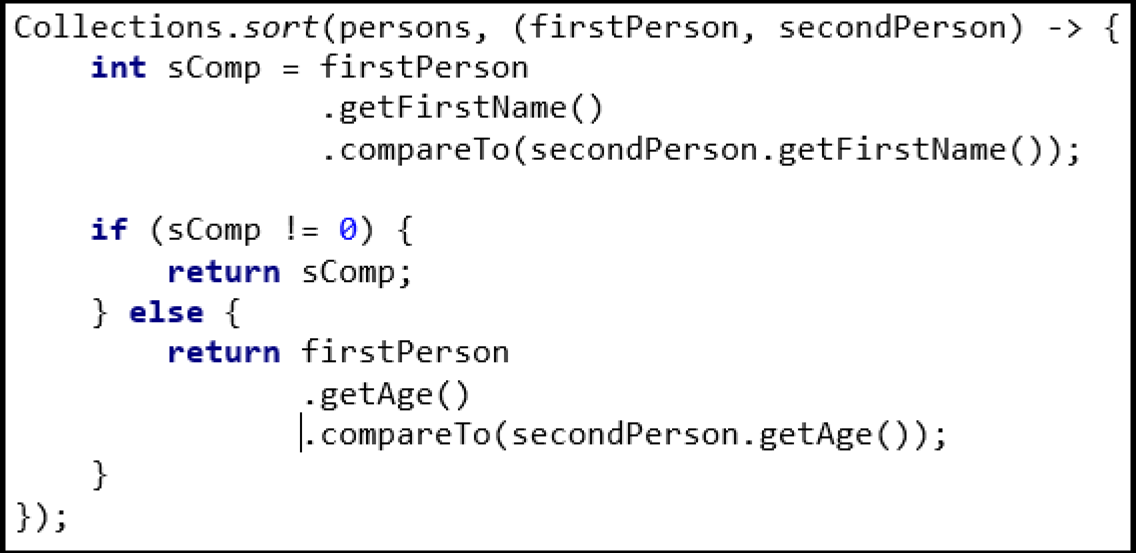
- Create a class **Person**



Person

-firstName:String
-lastName:String
-age:Integer

+getFirstName():String
+getAge():Integer
+toString():String



```
Collections.sort(persons, (firstPerson, secondPerson) -> {
    int sComp = firstPerson
                .getFirstName()
                .compareTo(secondPerson.getFirstName());

    if (sComp != 0) {
        return sComp;
    } else {
        return firstPerson
               .getAge()
               .compareTo(secondPerson.getAge());
    }
});
```

Solution: Getters and Setters

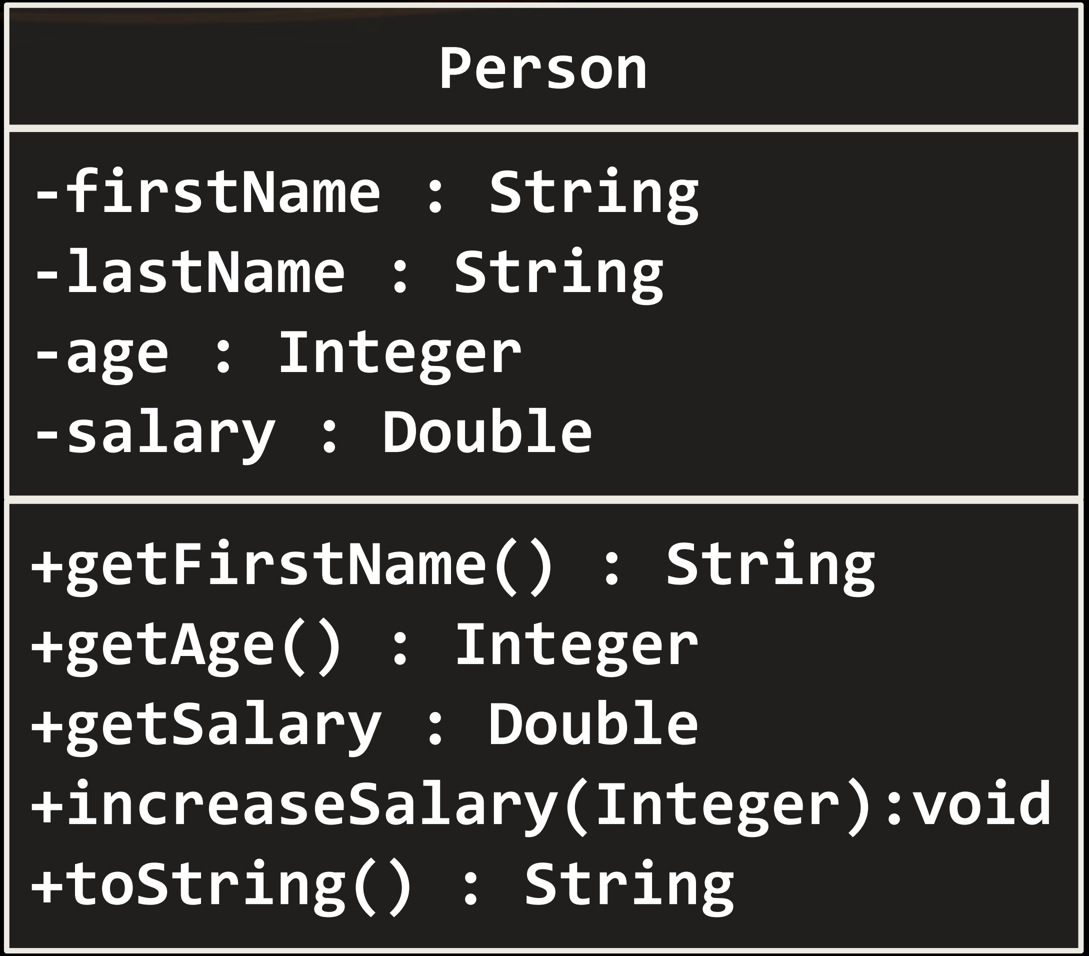
```java
public class Person {
  private String firstName;
  private String lastName;
  private Integer age;
  public String getFirstName() { // TODO: }
  public Integer getAge() { return age; }

  @Override
  public String toString() { // TODO: }
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/475#0

Problem: Salary Increase

- Implement Salary
- Add:
  - getter for salary
  - increaseSalary by percentage
- Persons younger than 30 get only half of the increase



```
Person

-firstName : String
-lastName : String
-age : Integer
-salary : Double

+getFirstName() : String
+getAge() : Integer
+getSalary : Double
+increaseSalary(Integer):void
+toString() : String
```

Solution: Getters and Setters

- Expand Person from previous task

```
public class Person {
  private Double salary;
  public String getSalary() { return this.salary; }
  public void increaseSalary(Integer 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.bg/Contests/Practice/Index/475#0

Exercises in Class

Implement Getters and Setters

Encapsulation in Java

Validation

- **Data validation** happens in **setters**

```
private void setSalary(Double salary) {
  if (salary < 460) {
    throw new IllegalArgumentException("Message");
  }

  this.salary = salary;
}
```

It is better to throw an exception, than to printing on the Console

- Printing with **System.out couples** your class
- **Client** can **handle** class exceptions

Validation (2)

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

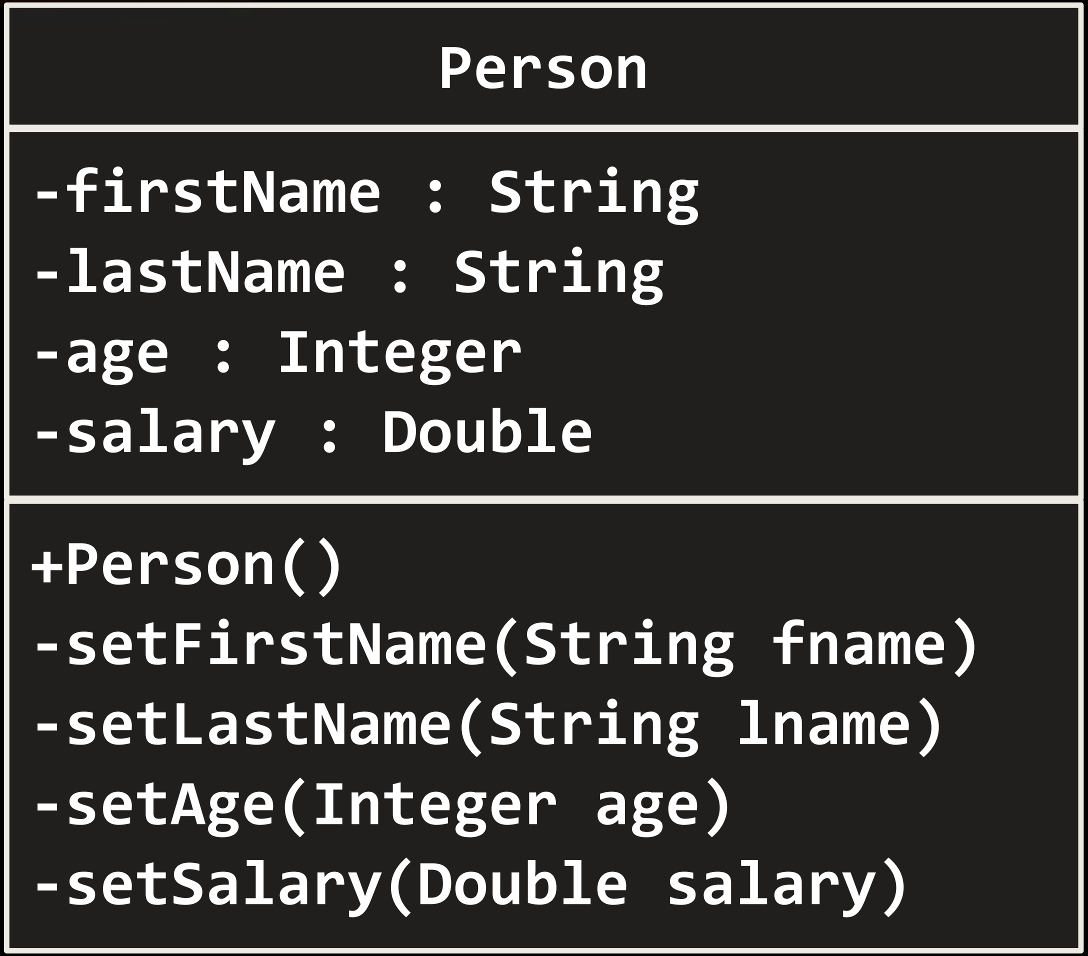
```java
public Person(String firstName, String lastName,
              Integer age, Double salary) {
  setFirstName(firstName);
  setLastName(lastName);
  setAge(age);
  setSalary(salary);
}
```

Validation should be in the setter

- Guarantees **valid state** of object in its creation
- Guarantees **valid state** for public setters

Problem: Validate Data

- Expand **Person** with validation for every field
- **Names** should be at least 3 symbols
- **Age** cannot be **zero or negative**
- **Salary** cannot be **less than 460**



```
Person
-firstName : String
-lastName : String
-age : Integer
-salary : Double
+Person()
-setFirstName(String fname)
-setLastName(String lname)
-setAge(Integer age)
-setSalary(Double salary)
```

Solution: Validate Data

```
// TODO: Add validation for firstName
// TODO: Add validation for lastName
private void setAge(Integer age) {
  if (age < 1) {
    throw new IllegalArgumentException(
      "Age cannot be zero or negative integer");
  }
  this.age = age;
}
// TODO: Add validation for salary
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/475#0

Immutable Objects

- Immutable == value **cannot** be changed

```
String myString = new String("old String");
System.out.println(myString);
myString.replaceAll("old", "new");
System.out.println(myString);
```

```
old String
old String
```

Mutable Objects

- You can **change state** of objects by their **reference**

```
Point myPoint = new Point(0, 0);
myPoint.setLocation(1.0, 0.0);
System.out.println(myPoint);
```

```
java.awt.Point[1.0, 0.0]
```

Mutable Fields

- private mutable fields are still don’t encapsulated

```
class Team {
  private String name;
  private List<Person> players;

  public List<Person> getPlayers() {
    return this.players;
  }
}
```

- In this case **getter is setter too**

Mutable Fields (2)

- For securing our collection we can return Collections.unmodifiableList()

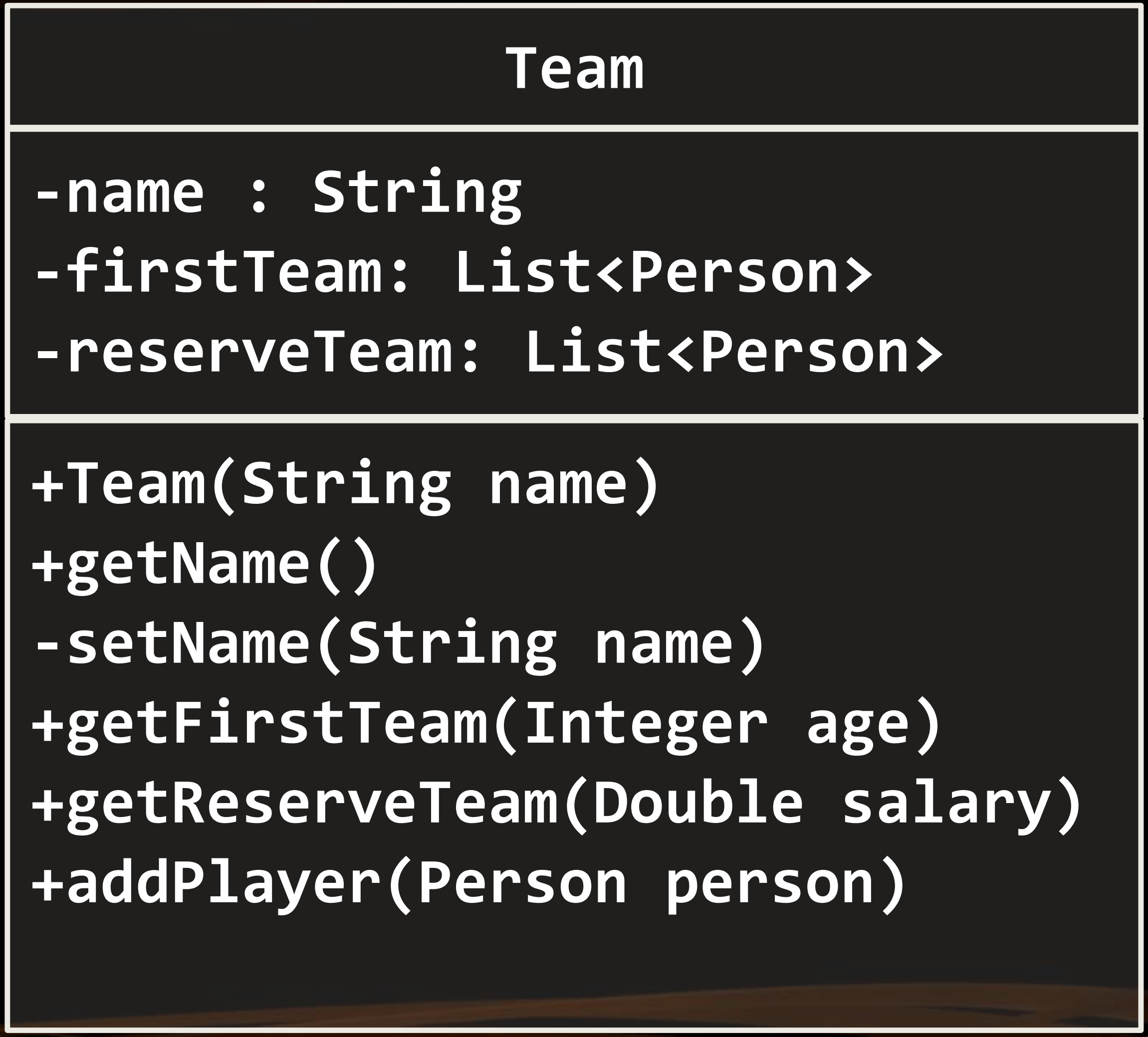
```
class Team {
  private List<Person> players;
  public addPlayer(Person person) {
    this.players.add(person);
  }
  public List<Person> getPlayers() {
    return Collections.unmodifiableList(players);
  }
}
```

Add new methods for functionality over list

Returns a **safe** collections

Problem: First and Reserve Team

- Expand your project with class **Team**
- Team have two squads **first team** and **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
-name : String
-firstTeam: List<Person>
-reserveTeam: List<Person>
+Team(String name)
+getName()
-setName(String name)
+getFirstTeam(Integer age)
+getReserveTeam(Double salary)
+addPlayer(Person person)
```

Solution: Validate Data

```java
private List<Person> firstTeam;
private List<Person> reserveTeam;

public addPlayer(Person person) {
  if (person.getAge() < 40) {
    firstTeam.add(person);
  } else {
    reserveTeam.add(person);
  } }
public List<Person> getPlayers() {
  return Collections.unmodifiableList(firstTeam);
}
//TODO: add getter for reserve team
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/475#0

Keyword final

- final class can't be extended

```
public class Animal {}
public final class Mammal extends Animal {}
public class Cat extends Mammal {}
```

- final method can't be overridden

```
public class Animal {
  public final move(Point point) }
public class Mammal extends Animal {
  @override
  public move() }
```

Keyword final (2)

- **final variable** value can't be changed once it is set

```
Private final String name;
Private final List<Person> firstTeam;

public Team (String name) {
  this.name = name;
  this.firstTeam = new ArrayList<Person> ();
}
public doSomething() {
  this.name = "";
  this.firstTeam = new Arraylist<Person>();
  this.firstTeam.add(Person person)
}
```

Compile time error

Encapsulation – Benefits

- Reduces complexity
- Structural changes remain **local**
- Allows **validations** and **data binding**

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Exercises in Class

Validations, Mutable and Immutable Objects

Summary

- **Encapsulation** hides implementation
- **Access modifiers**
- **Encapsulation** reduces complexity
- Ensures that **structural changes** remain **local**
- **Mutable objects**
- **Immutable objects**

Encapsulation

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