Theory: Package

24 minutes 0 / 5 problems solved

§1. Grouping classes together

Large Java projects have a lot of classes. It's difficult to manage them if they are stored in the same directory. **Packages** provide a mechanism for grouping classes together in the same module (package). A package can contain other packages, and the whole structure resembles directories in a file system.

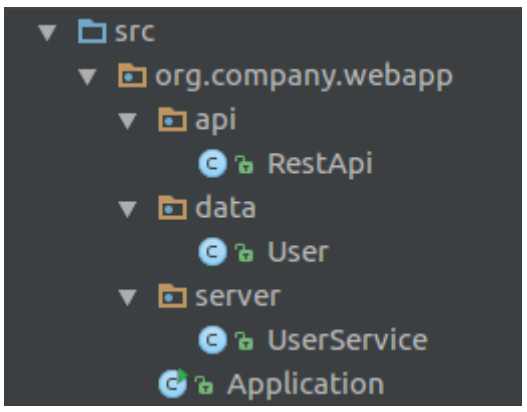
In general, packages have many advantages. They allow us to:

- group related classes together, which makes it easier to figure out where a certain class is;
- avoid the conflict of class names;
- control access to classes and members together with access modifiers (you'll learn about this in another topic).

According to the naming convention, package names are always lowercase, for example:

```
model
collection
utils
```

Here is an example project with a simple tree of packages and classes.



An example of multi-packages project structure

At the top of the tree, there is a directory `src`. This is the source root directory. In this tree, the full name of the class `User` is `org.company.webapp.data.User`.

You can output the full name using the following code:

```
System.out.println(User.class.getName()); // org.company.webapp.data.User
```

Classes declared inside a package have a special keyword `package` at the top of the file.

```
package org.company.webapp.data;

public class User {
}
```

§2. Avoiding the conflict of class names

When you use external libraries two classes may have the same name. Packages allow us to avoid the conflict of class names because the full class name includes the name of the package. So even if two classes from different packages have the same name, their full names will be different. That is, of course, if there were no conflicts between the package names.

To avoid creating packages with the same names as other public packages it is generally recommended to start your package hierarchy with the reverse domain name of your company (or another organization). For example:

Current topic:

Package Stage 6

Topic depends on:

✓ Defining classes Stage 3

Topic is required for:

Access modifiers Stage 6

Table of contents:

```
org.company
org.hyperskill
net.labs
```

§3. Importing classes

If two classes are located in the same package using one class inside the other is no problem. If it is not the case and the classes are in different packages, you need to write an import statement to use one class inside the other. The import statement is defined by the keyword `import`.

Here is an example. We have two public classes in different packages:

```
org.hyperskill.java.packages.theory.p1.A
org.hyperskill.java.packages.theory.p2.B
```

To use class `B` inside class `A` we should make an import statement.

```
package org.hyperskill.java.packages.theory.p1;  // current package


import org.hyperskill.java.packages.theory.p2.B; // it's required to make the impo
rt

public class A {

    public static void method() {

        B b = new B();

    }

}
```

> The package declaration and import statements are optional. If both of them are present, the package must come before all imports! Otherwise, we get compile-error.

It is also possible to import all classes from the package. To do this we need to write `*` in the import statement instead of a particular class name.

```

import org.hyperskill.java.packages.theory.p3.*; // import all classes from the pa
ckage
```

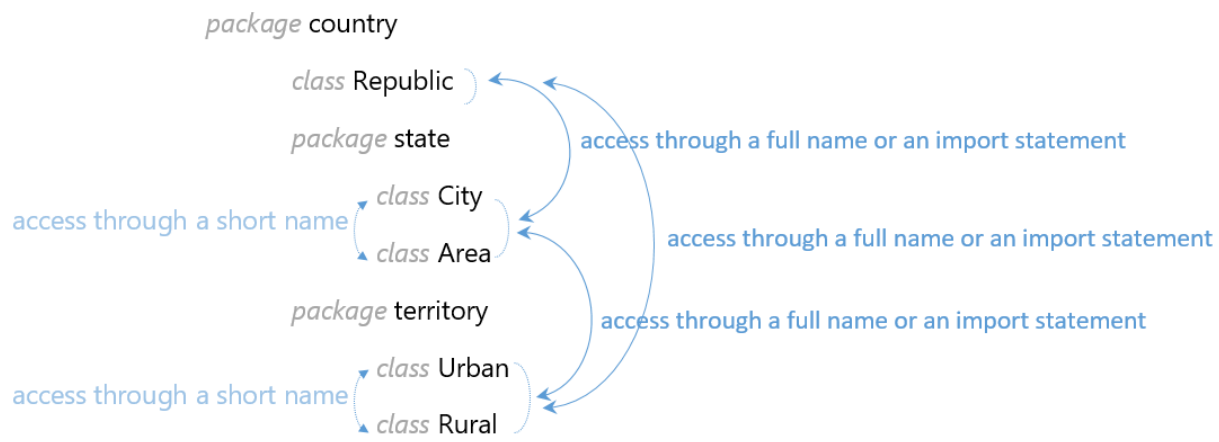
Don't do this too often. In some cases, this is considered a bad practice and can break the compatibility of your program with new versions of Java. Here is an interesting discussion about such statements.

> If two classes belong to the same package, you don't need to import them to each other.

There is a way to use a class from another package without the import statement. In this case, you should write the full class name (including full packages path) instead of the name of the class itself (short name). This is how we would use the `Scanner` without explicitly importing it first:

```
java.util.Scanner scanner = new java.util.Scanner(System.in);
java.util.Date now = new java.util.Date();
```

Let's polish the information about access to classes inside the package with the following example:



Class `City` and class `Area` are located in the same subpackage `state`, so you can use one class inside the other with a **short name**. The same thing is about class `Urban` and class `Rural` in the subpackage `territory`.

If you want to use any class of a subpackage `territory` inside the class of a subpackage `state` or vice versa, you need to write the **full name** of this class, **import the class,** or import the whole subpackage. Moreover, if you want to use classes from subpackages `state` or `territory` inside the class `Republic` from package `country` or vice versa, you also need to write a **full name** or **import the class**. This should be done even if these packages are in the same root package (here it is a package `country`).

§4. Importing standard classes

There is no difference between importing standard or custom classes.

For example, many Java developers use `java.util.Scanner` to work with the standard input/output. In their programs, they do the following import:

```
1 import java.util.Scanner;
```

After this, we can create an instance of the `Scanner` like in the examples above and use it in our programs.

Even though we would need to import most of the packages, there is a Java package that is always automatically imported. It's `java.lang`. This package contains many widely used classes, such as `String`, `System`, `Long`, `Integer`, `NullPointerException` and others.

§5. Static imports

We can also import static members (methods and fields) of a class inside another class. If we write * in the import statement, we then don't need to write the imported class name before invoking static methods or reading static fields.

Here is an example of the static import of the class `Arrays` which contains a lot of useful methods for processing arrays.

```
package org.hyperskill.java.packages.theory;


import static java.util.Arrays.*; // instead of the statement "import java.util.Ar
rays;"

public class Main {

    public static void main(String[] args) {
        int[] numbers = { 10, 4, 5, 47, 5, 12 }; // an array


        sort(numbers); // instead of writing Arrays.sort(...)



    int[] copy = copyOf(numbers, numbers.length); // instead of writing Arrays
.copyOf(...)

    }

}
```

§6. Default package

If we do not write a package statement before defining our class, it will be placed inside the **default package**. This package has a big disadvantage — classes located here can't be imported to classes located inside named packages.

The following class cannot be used in a class located inside packages since there is no package declaration.

```
// no package declaration

public class Person {
    String firstName;
    String lastName;
}
```

Do not use the **default package** for real applications. It is perfectly fine for simple, educational applications, like "Hello world", but more complex projects will be better in named packages.

§7. Summary

Packages are a very useful tool for OOP projects. Packages allow us to structure the source code better, and they make it more maintainable. That is very important for big projects that can consist of thousands of classes.

Packages are also very helpful for avoiding the conflict of class names because the full class name includes the path of the whole package. If we are careful with the naming of the package itself, there should be no conflicts!

Another thing to remember is that packages affect the visibility of classes and class members to each other. Here we should remember about imports, static members and the default package.

Creating packages even for small applications is a great practice for future grand programs!

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