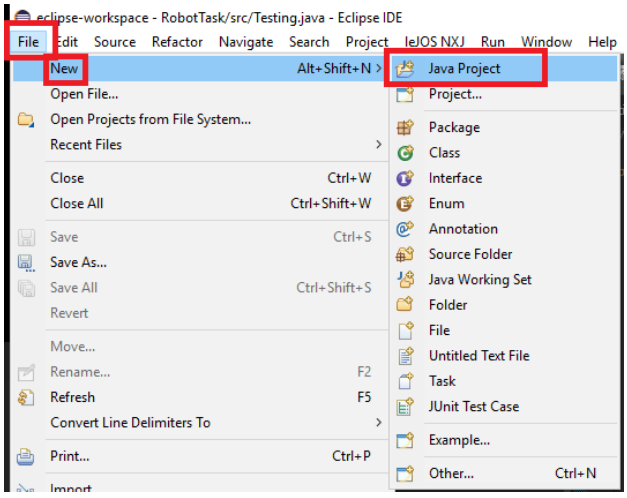
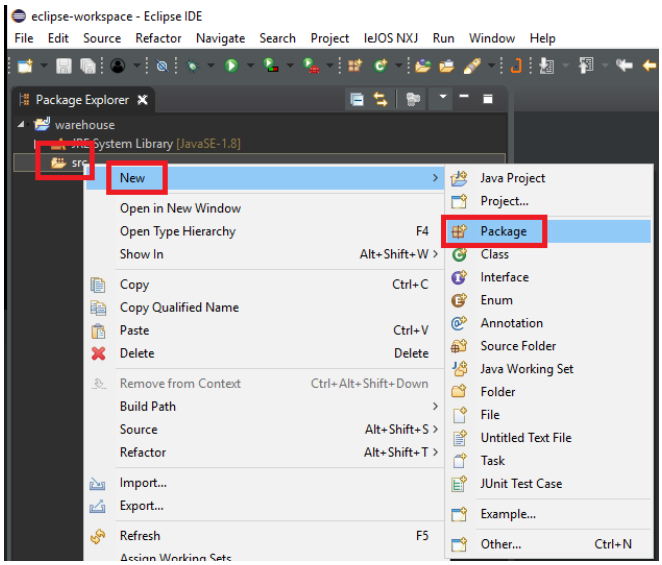
OPMS 2018 - Exercise 5
Automated high-bay warehouse

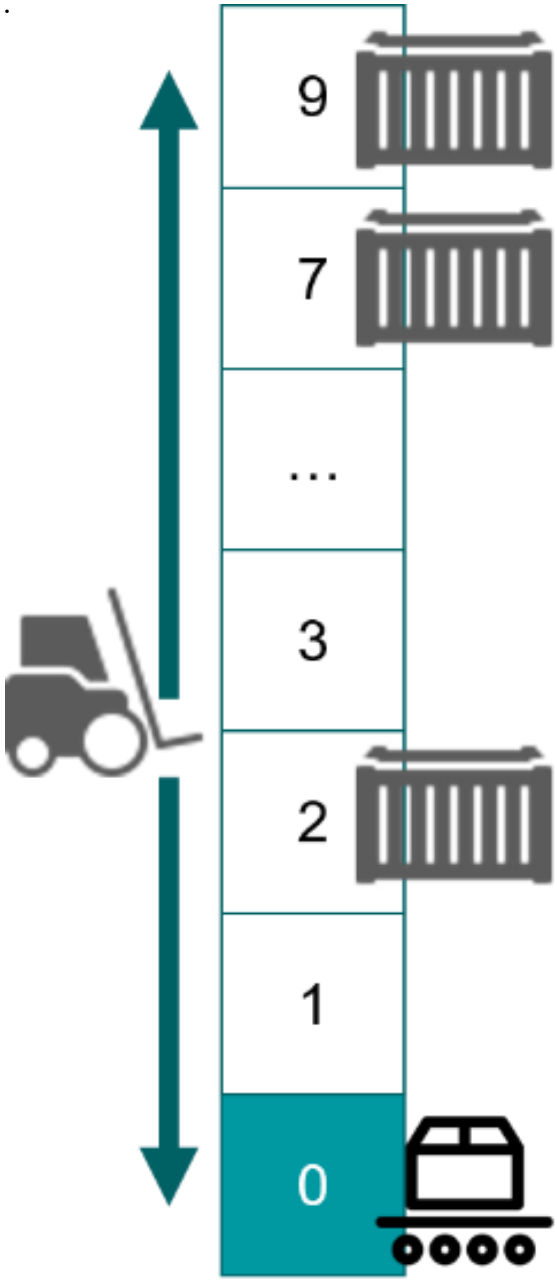
Task 0 (Setup)

- Create a new project in Eclipse and name it “Exercise5”.



- Create a package “opms.exercise5” and create all following classes inside this package.





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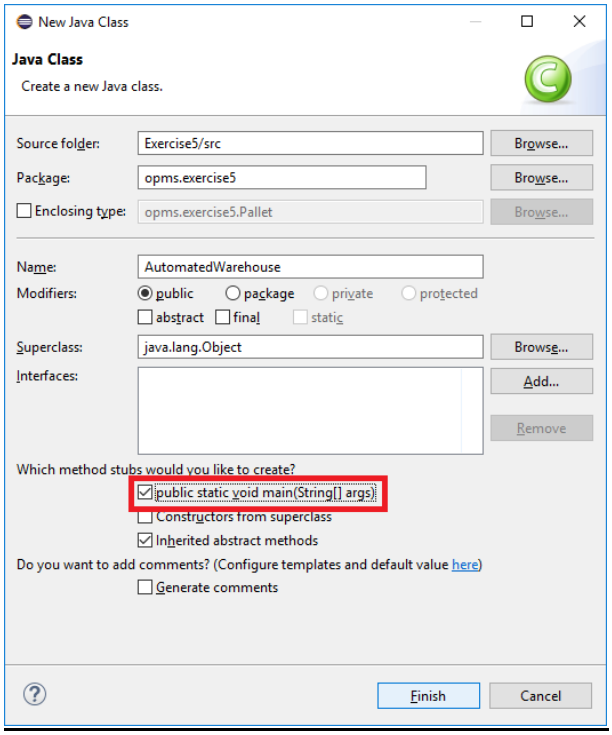
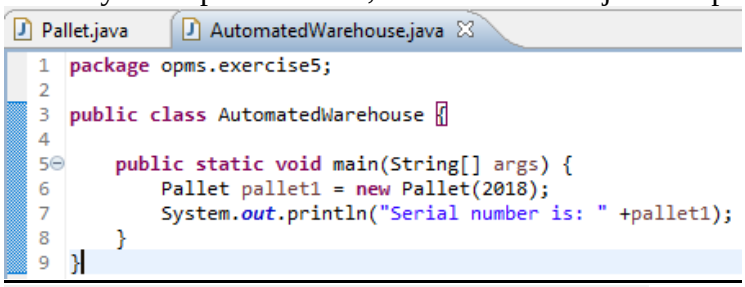
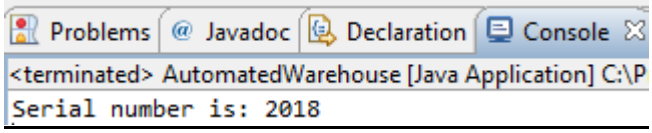
Task 1 (Pallet)

1. Create a class `Pallet`. Add a variable `private int serialNumber`.
2. Add a constructor `public Pallet(int serialNumber)` which saves the given serial number to the field `serialNumber`.
   Hint: Use `this.serialNumber = serialNumber` to set the Pallet's private field.
3. Add a method `public int getSerialNumber()` which returns the `serialNumber` field.
4. Add a method `public String toString()`, which returns the `serialNumber` as `String`.
   Hint:You can use `Integer.toString(serialNumber)` for that.
5. Create a class AutomatedWarehouse and automatically generate a main-method (see screenshot).



6. To test your implementation, create a Pallet object and print it to the console. Verify the output.





Task 2 (Conveyor Belt)

1. Create a class `ConveyorBelt`.
2. Add a field `private List<Pallet> pallets`.
   Initialize it via `new ArrayList<>()`.
   Hint: You need to import List and ArrayList from java.util. Eclipse helps you with that:

```
1  package opms.exercise5;
2
3  public class ConveyorBelt {
4      private List<Pallet> pallets = new ArrayList<>();
5  }
6
```

   Import 'List' (java.util)
   Import 'List' (com.sun.xml.internal.bind.v2.schem
   Import 'List' (java.awt)

3. Add a method `public void loadPallet(Pallet pallet)` that adds the given `Pallet` to the List `pallets`.
   Hint: You can use a list's method `add(Pallet pallet)` for that.
4. Add a method `public List<Pallet> getPallets()` that returns the list called pallets.
5. To test your implementation, go to the main method in AutomatedWarehouse and add this:
   - **a.** Create a ConveyorBelt instance and name it conveyorBelt
   - **b.** Create two more Pallets pallet2 and pallet3, with the serialNumbers 42 and 2020
   - **c.** Add all three Pallets to the conveyorBelt using the loadPallet method
   - **d.** Print all pallets via the following command:
     `System.out.println("All pallets are: " +conveyorBelt.getPallets());`

     The output should be the following:

```
Problems | @ Javadoc | Declaration | Console
<terminated> AutomatedWarehouse [Java Application] C:\Pr
Serial number is: 2018
All pallets are: [2018, 42, 2020]
```

Task 3 (Forklift)

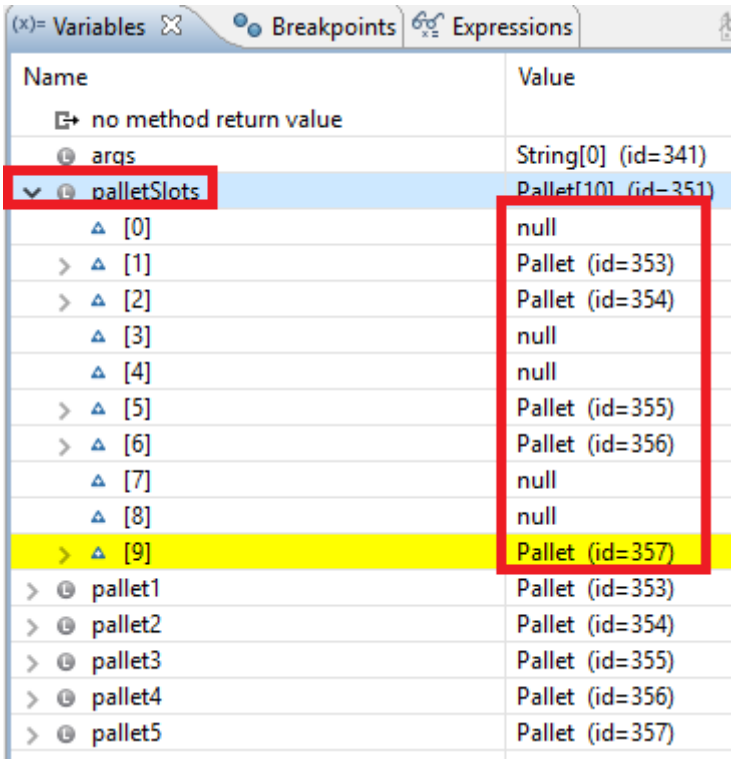
1. Create a class `Forklift`.
2. Add a field `private Pallet[] palletSlots`
   and a field `private ConveyorBelt conveyorBelt`.
3. Add a constructor `public Forklift(Pattet[] palletSlots, ConveyorBelt conveyorBelt)`, which saves both arguments to the private fields.
   Hint: As in task 1, use the keyword `this` to assign the values.

Task 4 (Automated Warehouse)

1. Navigate to the main method in AutomatedWarehouse.
2. Comment-out all code in the main method you have written so far. Code marked as a comment will not be executed. Start the Comment with `/*` and end it with `*/`

```
22      /*
23       This is a comment.
24       */
```

3. In your "empty" main method, create an Pallet[] array of size 10 and name it palletSlots.
   Hint: See slide 43 of module 4 for an example.
4. Create five Pallet objects via `new Pallet(int serialNumber)` with the serial numbers 541201, 541202, 663319, 663325 and 909042. Name them pallet1, pallet2, and so on.
5. Add these `Pallet` objects to the above created array at slots 1, 2, 5, 6 and 9. Do not assign anything to the other slots, so they will automatically contain null.
6. Also, create a `ConveyorBelt conveyorBelt = new ConveyorBelt();`
7. Finally, create a forklift instance via
   `Forklift forklift = new Forklift(palletSlots, conveyorBelt);`
8. Verify your implementation via the debugger. Add a breakpoint to where Pallet[] is created. Start the debugger and inspect your program line by line.
   When you went over `Pallet pallet5 = new Pallet(909042);` the debugger should look like this:



Task 5 (Bringing the Forklift to Life Part 1)

1. You will now enable the `Forklift` to move and shift `Pallets`.
2. Create a new Java class named `ForkliftOutOfBoundsException` that extends `Exception`.
3. Navigate to the `Forklift` class and add a field `private int position`.
4. Add a method `public void moveTo(int position) throws ForkliftOutOf-BoundsException`, which sets the private field `position` to the given value.
5. Before setting the position, check if the given position is in the `Forklift's` boundaries (0-9). If not, throw a `new ForkliftOutOfBoundsException()`.
   Hint: Use `if` to check if the given position is smaller than 0 or greater than 9.
6. We want to know if there is a `Pallet` at the forklift's current position.
   Add a method `public boolean seesPallet()` that returns `true`, if there is a `Pallet` in the `palletSlots` at the forklift's current `position`, and `false` otherwise.
   Hint: If palletSlots has `null` at the position, then there is no pallet (return false).
7. Verify your implementation: Navigate to the main method in AutomatedWarehouse and add the following:

```java
        try {
            forklift.moveTo(2);
            System.out.println("Sees pallet: " +forklift.seesPallet());
            forklift.moveTo(7);
            System.out.println("Sees pallet: " +forklift.seesPallet());
            forklift.moveTo(-11);
        } catch (ForkliftOutOfBoundsException e) {
            System.out.println("Out of bounds");
        }
```

   The output should be:

```
Problems  @ Javadoc  Declaration  Console
<terminated> AutomatedWarehouse [Java Application] C:\Pr
Sees pallet: true
Sees pallet: false
Out of bounds
```

8. When done, delete the code you added in 7, it was only for verification.

Task 6 (Bringing the Forklift to Life Part 2)

1. We want to allow the forklift to lift pallets.
   Navigate to the forklift class and add a field Pallet `private Pallet currentPallet`.
2. Add a method `public void liftPallet()` to the forklift, that
   - Assigns the `Pallet` from the `palletSlots[position]` to the private field `currentPallet`
   - And removes the just picked up `Pallet` from the `palletSlots`.
     Hint: Assign `null` to the `palletSlots[position]` to remove the pallet.
3. We want to allow the forklift to place pallets on the conveyor belt.
4. Add a method
   `public void placeOnBelt() throws ForkliftOutOfBoundsException` that
   - Moves the forklift to the conveyor belt's position (0)
     Hint: You don't need to catch the exception thrown by moveTo() here.
   - Calls `conveyorBelt.loadPallet(this.currentPallet)` to load the current pallet on the belt.
   - Sets the `currentPallet` to `null` to stop carrying it.
5. Verify your implementation by adding code to your main method in AutomatedWarehouse:

```java
        try {
            forklift.moveTo(1);
            forklift.liftPallet();
            forklift.placeOnBelt();

            forklift.moveTo(5);
            forklift.liftPallet();
            forklift.placeOnBelt();

            System.out.println("Loaded pallets: " +conveyorBelt.getPallets());
        } catch (ForkliftOutOfBoundsException e) {
            System.out.println("Out of bounds");
        }
```

   The output should look like this:

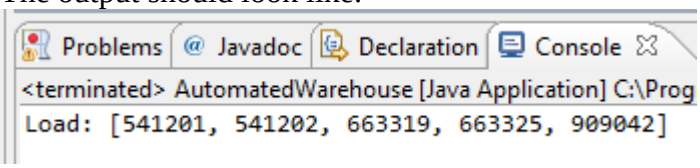
```
Problems  @ Javadoc  Declaration  Console
<terminated> AutomatedWarehouse [Java Application] C:\Pro
Loaded pallets: [541201, 663319]
```

6. When done, delete the code you added in 5, it was only for verification.

Final Task 7 (Scheduling the Forklift)

1. In the final task, you need to load all pallets on the conveyor belt. Therefore, iterate over all pallet slots via `for(int slot=1; slot<=9; slot++)` and for each slot do:
   - Use `forklift.moteTo(slot)` to move the forklift to a pallet slot
   - Check if there is a pallet at its current position using the `seesPallet()` method.
   - If `true`: Call `liftPallet()` and then place it on the belt via `placeOnBelt()`.
   - If `false`: Do nothing.
2. Hint: You need to catch any `ForkliftOutOfBoundsException`s here, so wrap your for-loop into a `try-catch`-block.
3. After the for-loop, print a list of all loaded pallets to the console.
   Hint: Call `System.out.println("Load: "+conveyorBelt.getPallets())`.
   Hint: The `conveyorBelt.getPallets()` automatically calls `pallet.toString()` for each pallet for you.

   The output should look like:

4. Verify your implementation as follows, re-run the program and inspect the output each time:
   - Changing the serial number of some pallets in the main method.
   - Add one or two additional pallets to the palletSlots array.
   - Remove some pallets from the palletSlots array.