Victoria University
of Wellington, New Zealand
Te Whare Wananga o te
Upoko o te Ika a Maui
Aotearoa

SWEN221:
Software Development

21: Java8: More powerful interfaces!

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Default methods

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- Static methods:
  - Works exactly as normal static methods, Convenient to return "predefined" implementations of an interface
- Default methods:
  - A "default" implementation for a method, very similar to an implemented method in an abstract class.

Combining implementations!

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  default void move(Map map){/*...*/}
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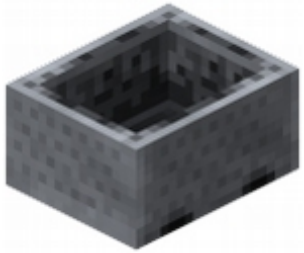
```



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interface MinecartChest extends Chest,Minecart{
  static MinecartChest factory(Point p){









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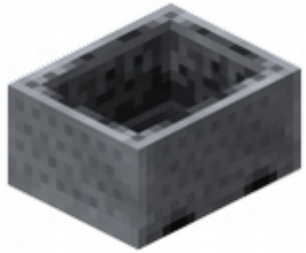

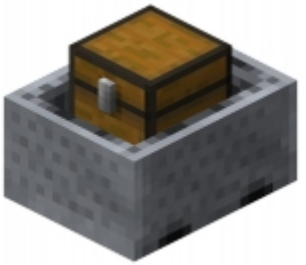

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interface MinecartChest extends Chest,Minecart{
  static MinecartChest factory(Point p){
    return new MinecartChest(){
      Point position=p;
      List<Item> items=new ArrayList<>();
      public List<Item> get() {return items;}
      public Point getPosition() {return this.position;}
      public void setPosition(Point val){this.position=val;}
};  }  }
```

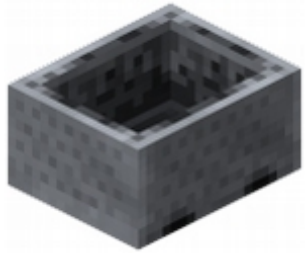

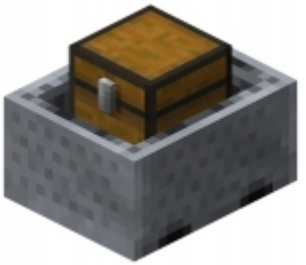

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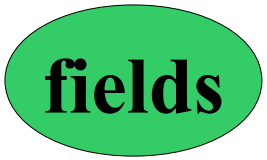

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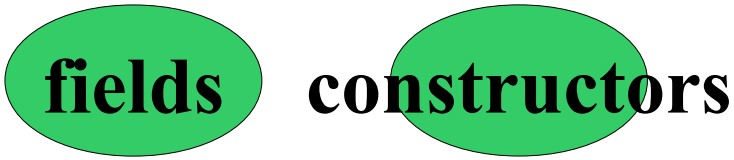

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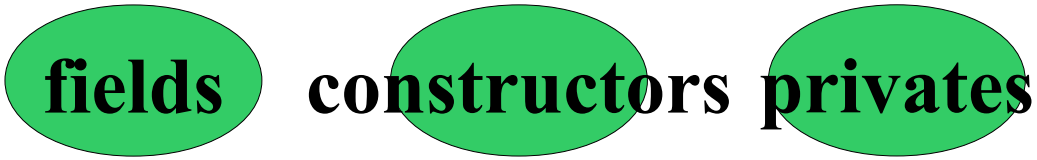

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Lambdas

- Convenient syntax for anonymous nested classes

Old and new

Comparators using long syntax for anonimus classes

```
Collections.sort(ls,new Comparator<String>(){
  public int compare(String s1, String s2) {
    return s1.compareToIgnoreCase(s2);
    }});
```

- Convenient syntax for anonymous nested classes

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Comparators using short syntax for anonimus classes

```
Collections.sort(ls,(s1,s2)->s1.compareToIgnoreCase(s2));
```

- Convenient syntax for anonymous nested classes

Extensive use for event handler

```
SwingUtilities.invokeLater(new Runnable() {
  public void run() {
    MiniGui g = new MiniGui();
    ...
    JButton b = new JButton("------Bar------");
    b.addActionListener(new ActionListener() {
      public void actionPerformed(ActionEvent e) {
        System.out.println("Button pressed");
      }});
    ...}});
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    ...}});
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Before and after

```
SwingUtilities.invokeLater(()->{
  MiniGui g = new MiniGui();
  ...
  JButton b = new JButton("------Bar------");
  b.addActionListener(e->System.out.println("Button pressed"));
  ...});
```

Alternatives for syntax

```
p-> p.getAge()

(p1,p2)-> p1.getAge()>p2.getAge()

()-> System.currentTimeMillis()

(customer,product)-> {
  if(customer.getAge()<25 && product.hasAlcohol()){
    return “Please, show me your id!”
    }
  return “Do you need a receipt?”
  }

p-> p.getAge()
==
(Person p)-> p.getAge()
==
p->{return p.getAge();}
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More alternative syntax :-(

```
String::length                          // instance method
System::currentTimeMillis               // static method
List<String>::size                      // explicit type arguments for generic
type
List::size                              // inferred type arguments for generic
type
int[]::clone
T::fieldName
System.out::println
"abc"::length
foo[x]::bar
(test ? list.replaceAll(String::trim) : list) :: iterator
super::toString
String::valueOf                         // overload resolution needed
Arrays::sort                            // type arguments inferred from context
Arrays::<String>sort                    // explicit type arguments
ArrayList<String>::new                  // constructor for parameterized type
ArrayList::new                          // inferred type arguments for generic
class
Foo::<Integer>new                       // explicit type arguments for generic
constructor
Bar<String>::<Integer>new               // generic class, generic constructor
Outer.Inner::new                        // inner class constructor
int[]::new                              // array creation
```

https://docs.oracle.com/javase/specs/jls/se8/html/jls-15.html#jls-15.13-500

Guided exercise

- In this code there is a lot of repetition!
- Use lambdas and factorize the code!

```
public static int reduceSum(List<Integer> list){
  assert !list.isEmpty();//or if(list.isEmpty()){throw...}
  int res=list.get(0);
  for(int i=1;i<list.size();i++){res=res + list.get(i);}
  return res;
  }
public static int reduceMul(List<Integer> list){
  assert !list.isEmpty();//or if(list.isEmpty()){throw...}
  int res=list.get(0);
  for(int i=1;i<list.size();i++){res=res * list.get(i);}
  return res;
  }
```

Guided exercise

- Can we write Reduce.of(list, lambda)?

```
public static void main(String[] arg){
  List<Integer> list = Arrays.asList(1,2,3,4,5,6,7,3);

  System.out.println(Reduce.of(list,(a,b)->a+b));

  System.out.println(Reduce.of(list,(a,b)->a*b));

  System.out.println(Reduce.of(list,(a,b)->
    {if(a>b){return a;} return b;}));

  }
```

Guided exercise

- Can we write Reduce.of(list, lambda)?

```
public interface Reduce<T> {
  T apply(T e1, T e2);
  public static <T> T of(List<T> list,Reduce<T> fun){
    assert !list.isEmpty();//or if(..){throw..}
    T res=list.get(0);
    for(int i=1;i<list.size();i++){
      res= fun.apply (res, list.get(i));
    }
    return res;
  }
//compare it with the specific code of before:
//assert !list.isEmpty();
//int res=list.get(0);
//for(int i=1;i<list.size();i++){res=res + list.get(i);}
//return res;
```

Syntax and types

- Can use short syntax to implement any ***Functional Interface:***
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- Examples (Java before 8):

  Comparable<T>, Comparator<T>, Runnable, Callable<V>,AutoCloseable

- In Java8, > 40 different functional interfaces:
  - no need to memorize them all!

https://docs.oracle.com/javase/8/docs/api/java/util/function/package-summary.htm

New functional interfaces in Java8

Main Java 8 functional interface:

- `Function<T,R>`
- A function from
  - type T (parameter)
  - to type R (return type)

- Some composition behaviour provided!

Function in Java8 `java.util.function`

```
interface Function<T, R> {

  R apply(T t);//method still to define, often using the new syntax

  static <T>
  Function<T, T> identity(){return t -> t;}

  default <V>
  Function<V, R>compose(Function<? super V, ? extends T> before){
        return (V v) -> this.apply(before.apply(v));
    }

  default <V>
  Function<T, V> andThen(Function<? super R, ? extends V> after){
        return (T t) -> after.apply(this.apply(t));
    }
}
```

- Minimal code, but not "simple"

Function in Java8 java.util.function

```
Function<Integer,Integer>multiply2=x->x*2;

Function<Integer,Integer>add2=x->x+2;

System.out.println(
  multiply2.andThen(add2).apply(1));//(1*2)+2=4

System.out.println(
  add2.andThen(multiply2).apply(1));//(1+2)*2=6

System.out.println(
  multiply2.andThen(multiply2).apply(1));//1*2*2=4

System.out.println(
  add2.compose(multiply2).apply(1));//(1*2)+2=4
  //==multiply2.andThen(add2)
```

- Simple when sub/super types are not involved

New functional interfaces in Java8

We have seen: `Function`

Now: `Consumer<T>`

- A kind of function that eats up a value.

- Has `accept` method returning void
- Has an `andThen` method to compose `Consumers`:
  values `accepted` by a composed consumer are accepted by both consumers

New functional interfaces in Java8

We have seen: `Function,Consumer`

Now: `Supplier<T>`

- A kind of function that takes no arguments.
- Has a `get` method returning a value of type `T`
- Very useful, similar to factory pattern

New functional interfaces in Java8

We have seen: `Function,Consumer,Supplier`

Now: `Predicate<T>`

- A kind of function that takes 1 argument

- Has a `test` method returning a boolean
- Has `and, or, negate` methods allowing to compose `Predicates`.