Informatik II
Tutorial 7
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Overview

- Debriefing Exercise 6
- Briefing Exercise 7
Can be instantiated:
Non-abstract classes (D, E, F)
U6.A1 – Classes and interfaces

Type casts

- Static (*implicit cast*):
  only subclasses to parent classes

- Dynamic (*explicit cast*):
  \( T \ t = (T)\ obj; \)
  valid, if the actual object pointed to by reference \( \text{obj} \) is of type \( T \) (including all children of \( T \))

```java
public static void d3()
{
    B b = new D();
    A a = (A) b;
    C c = (C) b; //cross-cast!
    D d = (D) b;
    E e = (E) b;
}
```
Interfaces vs. Abstract Class: why Interfaces?

- Functionality is an important point in the program
  what is done where and who has access?

- Interfaces represent exactly this concept:
  It is guaranteed, what is done exactly and the interface defines it (who and where). The implementation (how) is completely irrelevant.

Reminder of abstraction in your program:
- Use a class when the relationship "is-a" can be applied to your object
- Each attribute of a class is justifiable because your object "has-a" propriety
- An interface comes in handy because your object "behaves-as-a"
Solution U6.A2 – IStack expanded

```java
public interface IStack {
    public void push(int number);
}

public class ListStack implements IStack {

    public void push(int number) {
        list = new List(number, list);
        size += 1;
    }
}

public class StackFactory {

    public static IStack create() {
        return new ListStack();
        //return new u6a5.ChunkedStack();
    }
}

@Test public void push() {
    IStack stack = StackFactory.create();
    ...
}
```
package u6a3;

/**
 * abstract class for geometric objects
 */
public abstract class GeometricObject implements Comparable {
    public abstract int area();

    public boolean smallerThan(Comparable rhs) {
        GeometricObject other = (GeometricObject) rhs;
        return this.area() < other.area();
    }
}
U6.A3 Extending the GeometricObject class

```java
public class Rectangle extends GeometricObject {
    private int a;
    private int b;

    public String toString()
    {
        return String.format("Rectangle(%d,%d)", a, b);
    }

    public int area()
    {
        return a * b;
    }

    public Rectangle(int base, int height)
    {
        this.a = base;
        this.b = height;
    }
}

public class Triangle extends GeometricObject {
    private int base;
    private int height;

    public String toString()
    {
        return String.format("Triangle(%d,%d)", base, height);
    }

    public int area()
    {
        return base * height / 2;
    }

    public Triangle(int base, int height)
    {
        this.base = base;
        this.height = height;
    }
}
```
U6.A3 Sorting a GenericList

```java
private GenericList insertSorted(GenericList list, Object value) {
    if (list == null) return new GenericList(value, null);

    Comparable lhs = (Comparable) value;
    Comparable rhs = (Comparable) list.value;
    if (lhs.smallerThan(rhs)) return new GenericList(value, list);

    list.next = insertSorted(list.next, value);
    return list;
}
```

Generic objects compared through interfaces

```java
public GenericList sort(GenericList list) {
    if (list == null) return null;
    return insertSorted(sort(list.next), list.value);
}
```

Similar to previous assignment
Overview

- Debriefing Exercise 6
- Briefing Exercise 7
Java Generics

- Generics allow parameterization of types
  - Input to formal parameters are values (e.g. f(int a))
  - Input to type parameters are types e.g. ArrayList<T>

- Reuse the same code for different input types
- Same algorithm
  - E.g. sorting Integers, Floats, Students etc.

- Stronger type checks at compile time
  - Compile-time errors are easier to fix than run-time errors
  - No need to typecast

- Code is easier to maintain and read
Generics

- Collection of Java Generics (generic class)

```java
class MyPair<T>{
    public T first, second;
}
```

- An object pair of type MyPair<Float> contains two Float references: `pair.first` and `pair.second`

- An object pair of type MyPair<Integer> contains two Integer references: `pair.first` and `pair.second`
Generics

- All classes inherit from Object (abstract base class)
- Cast when extended from container (here List)

```java
MyType Elem = (MyType) Kollektion.getNext();
```

such casts can lead to runtime ClassCastException

Better way:

```java
Object obj = Kollektion.getNext();
if( obj instanceof MyType )
doSomething( (MyType)obj );
```
U07.A01

- ArrayList and Generics
  - Each group consists of multiple students:
    ```java
    ArrayList<Student> group
    ```
  - There are multiple groups of students:
    ```java
    ArrayList<ArrayList<Student>> groups;
    ```

a) Implement factory method
b) Implement filterRaw (without generics: ArrayList)
c) Implement filterGeneric (using Generics: ArrayList<Student>)
U07.A01 Generics

- **FilterFactory** and (empty) IFilter implementation
  - Input: `ArrayList` of groups, that are actually `ArrayList` of `Student`.
  - Output: `ArrayList` of `Student` obtaining the Testat.

- Implementation of **filterRaw**
  - No Generics: `ArrayList` as raw type (compiler warnings)
  - Filter out all students who do not have enough points for the Testat... when taking them out first from `ArrayList`, then cast to `Student`

- Implementation of **filterGeneric**
  - `ArrayList<T>` indicates what is stored inside it
  - Type checking when adding elements to the list `ArrayList<T>` directly provides objects of the correct type (no casting required)
U7.A2 Tic-Tac-Toe

- Draw game tree given the following game state

- Mark all situations (starting from the bottom) with \{-1, 0, 1\} depending on the possible outcome of the game

- What is the optimal move?
Reminder: Binary Trees

- Each node contains pointers to:
  - Left successor
  - Right successor
  - (Parent)

- Recursive traversal:
  - Preorder: W-L-R
  - Inorder: L-W-R
  - Postorder: L-R-W
Tree traversal:


Inorder: A, B, C, D, E, F, G, H, I

Postorder: A, C, E, D, B, H, I, G, F
Binary Search Tree

- Structure:
  - The nodes contain data elements, or pointers to data elements (record)
  - Each node also has a key attribute (key)
  - The set of key attributes is totally ordered \((a \leq b)\)
  - Search is done by key comparison

- For every node with key attribute \(s\), we have:
  - All keys in the left subtree are smaller than \(s\)
  - All keys in the right subtree are greater than \(s\)

- The subtrees are also binary search trees

What happens if there are multiple objects with the same key?
U7.A3 Binary Search Trees

a) Delete elements 15, 12, 20

a) Implement IBinarySearchTreeUtils<T> and UtilsFactory.create

height
isLeaf
hasOneChild
preOrder
inOrder
postOrder
insert
find
remove
U7.A4 Reversi

- Game


- Ongoing series until the end of the semester

- Tournament at the end!

- Cool prizes!
Cool prizes?
U7.A4 Reversi

a) Reversi framework
   - Setup the framework
   - Play a game against your team mate (or yourself)
   - Take snapshot

b) Implement a Random Player
   - 2 strategies
     1. Find a random move. If valid accept, otherwise?
     2. Find all possible moves. Choose one at random.
How to do it?

```java
public interface ReversiPlayer {
    void initialize(int myColor, long timeLimit);
    Coordinates nextMove(GameBoard gb);
}
```

```java
public abstract class PlayerBase implements ReversiPlayer {
    private int m_color = 0;
    private long m_timeout = 0;
    protected final int getColor() { return m_color; }
    protected final long getTimout() { return m_timeout; }
    ...
    protected abstract void foo();
}
```

```java
public class RandomPlayer extends PlayerBase {
    protected void foo() {
    ...
    }
}
```
U7.A4 Reversi Questions

- Check the documentation

- E-mail me first!

- Reversi Coordinator
  - Alexander Viand: alexander.viand@inf.ethz.ch
Have Fun!
Tree traversal...

```java
preOrder(node) {
    print(node)
    if left != null then preOrder(left)
    if right != null then preOrder(right)
}
```

- Pre-Order (root, left, right)  
  8, 3, 1, 6, 4, 7, 10, 14, 13

- In-Order (left, root, right)

- Post-Order (left, right, root)
Tree traversal...

```javascript
inOrder(node) {
  if left != null then inOrder(left)
  print(node)
  if right != null then inOrder(right)
}
```

- **Pre-Order (root, left, right)**
  
  8, 3, 1, 6, 4, 7, 10, 14, 13

- **In-Order (left, root, right)**
  
  1, 3, 4, 6, 7, 8, 10, 13, 14

- **Post-Order (left, right, root)**
Tree traversal...

```
postOrder(node) {
    if left != null then postOrder(left)
    if right != null then postOrder(right)
    print(node)
}
```

- **Pre-Order (root, left, right)**: 8, 3, 1, 6, 4, 7, 10, 14, 13
- **In-Order (left, root, right)**: 1, 3, 4, 6, 7, 8, 10, 13, 14
- **Post-Order (left, right, root)**: 1, 4, 7, 6, 3, 13, 14, 10, 8