ГЕНЕТИЧНИ КЛАСОВЕ

ЛЕКЦИОНЕН КУРС "ПРОГРАМИРАНЕ НА JAVA"

Distributed @learning center

СТРУКТУРА НА ЛЕКЦИЯТА

- Общ стек
- Клас Object
- Класове-обвивки
- Смесени стекове
- Генетични класове
- Примери

ПРОБЛЕМ: СТЕК ЗА ЕЛЕМЕНТИ ОТ РАЗЛИЧЕН ТИП

- За char-елементи (сегашен вариант)

Stack.java

```
class Stack {
   private char[] stackElements;
   private int top;
      ...
   public void push(char x) {
      top++; stackElements[top] = x;
   }
   ...
```

Как да реализираме генерализация ?

- За int-елементи
- За времена: клас 'Time'

→ 3 (обобщ. n) класа с общ код в по-голямата си част

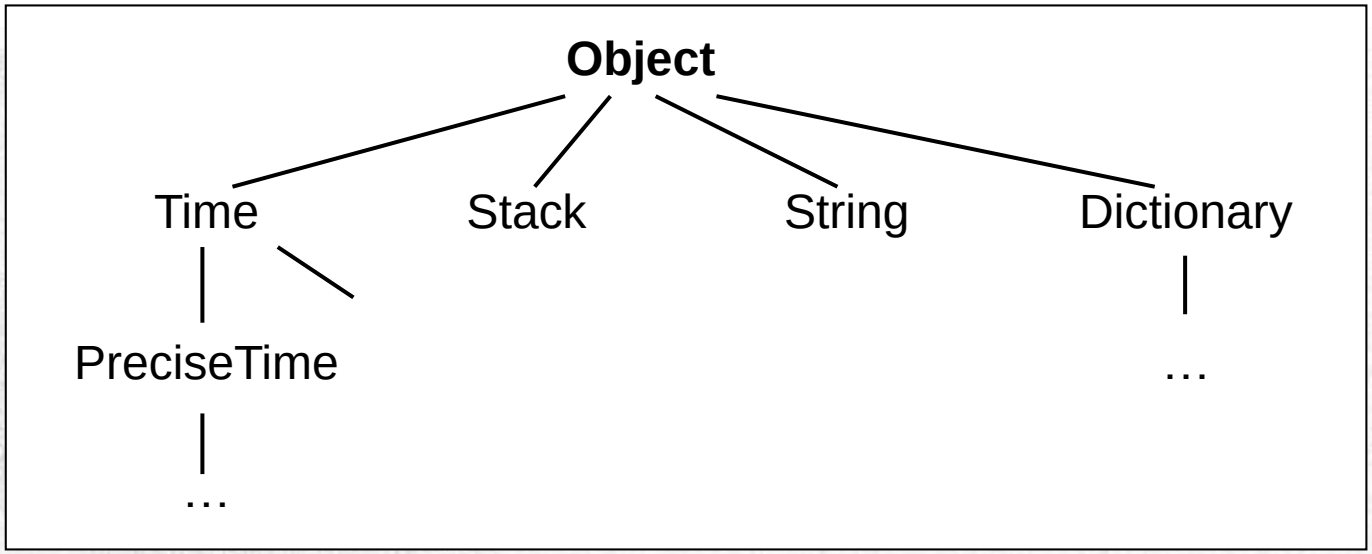
Съществува ли елегантно решение ?

ОБЩ СТЕК: ТИП НА ЕЛЕМЕНТИТЕ 'OBJECT'

StackForChar.java

```
class Stack {
   private Object [] stackElements;
   private int top;

   public Stack(int n) {
      stackElements = new Object[n];
      top = -1;
   }

   public void push(Object x) {
      top++;
      stackElements[top] = x;
   }
   ...
}
```

ПОВТОРЕНИЕ: ПРАВИЛА ЗА СЪВМЕСТИМОСТ В ЙЕРАРХИЯТА НА КЛАСОВЕТЕ



Обектите на един подклас могат да стоят там, където се допускат обекти на суперкласа.

```
Time t;
t = new PreciseTime(12, 10, 1);
t.printTime();
```

ОБЩ СТЕК:ИЗПОЛЗВАНЕ ПРИ 'TIME'

```
class Stack {
    private Object [] stackElements;
    private int top;

    public Stack(int n) {
        stackElements = new Object[n];
        top = -1;
    }

    public void push(Object x) {
        top++; stackElements[top] = x;
    }
    ...
}
```

Какво става при `timeStack.push(t1)`?

```
Time t1 = new Time(8, 30);
Stack timeStack = new Stack(10);
timeStack.push(t1.copy());
t1.addMinutes(10);
timeStack.push(t1.copy());
t1.addMinutes(30);
timeStack.push(t1.copy());
```

индиректно:
class Time extends Object

ОБЩ СТЕК: ИЗПОЛЗВАНЕ ПРИ 'CHAR'

```
class Stack {
     private Object [] stackElements;
     private int top;

     public Stack(int n) {
          stackElements = new Object[n];
          top = -1;
     }

     public void push(Object x) {
          top++; stackElements[top] = x;
     }
     ...
}
```


```
char ch = 'A';
Stack s = new Stack(10);
s.push(ch);
```

Очаква обект или подклас

```
Stackchar.java:52: Incompatible type for method.
Can't convert char to java.lang.Object.
```

WRAPPER-КЛАСОВЕ

Прост тип → клас

прост Тур ‘опакован' в клас

byte	Byte
short	Short
int	Integer
long	Long
double	Double
float	Float
boolean	Boolean
char	Character
void	Void

в java.lang

За всички подкласове на java.lang.Object
→ могат да стоят там, където е разрешено Object.

WRAPPER-CLASS ‚CHARACTER‘

java.lang
Class Character

java.lang.Object
  java.lang.Character
All Implemented Interfaces:
Comparable, Serializable

---

public final class **Character**
extends Object
implements Serializable, Comparable
The `Character` class wraps a value of the primitive type `char` in an object. An object of type `Character` contains a single field whose type is `char`.

In addition, this class provides several methods for determining a character's category (lowercase letter, digit, etc.) and for converting characters from uppercase to lowercase and vice versa.

Character information is based on the Unicode Standard, version 3.0.

The methods and data of class `Character` are ... his file specifies various properties including name and general...

The file and its description are available from...

- http://www.unicode.org

Since:
1.0
See Also:
Serialized Form

Field Summary

static byte	**COMBINING SPACING** ...
static byte	**CONNECTOR PUNCTUA** ...
static byte	**CONTROL** General ...
static byte	**CURRENCY SYMBOL**
static byte	**DASH PUNCTUATION**
static byte	**DECIMAL DIGIT NUMB** ...
static byte	**DIRECTIONALITY ARABI** ...
static byte	**DIRECTIONALITY BOUNDARY NEUTRAL** Weak bidirectional character type "BN" in the Unicode specification.
static byte	**DIRECTIONALITY COMMON NUMBER SEPARATOR** Weak bidirectional character type "CS" in the Unicode specification.
static byte	**DIRECTIONALITY EUROPEAN NUMBER** Weak bidirectional character type "EN" in the Unicode specification.
static byte	**DIRECTIONALITY EUROPEAN NUMBER SEPARATOR** Weak bidirectional character type "ES" in the Unicode specification.
static byte	**DIRECTIONALITY EUROPEAN NUMBER TERMINATOR** Weak bidirectional character type "ET" in the Unicode specification.
	...

The Character class wraps a value of the primitive type char in an object. An object of type Character contains a single field whose type is char.
In addition, this class provides several methods for determining a characters's category (lowercase letter, digit, etc.) and for converting characters from uppercase to lowercase and vice versa.

Constructor Summary

`Character(char value)`	Constructs a newly allocated Char…

Method Summary

char	`charValue()` Returns the value of this `Character` object.
int	`compareTo(Character …` …Characte…
int	`compareTo(Object o)` Compares…
static int	`digit(char ch, int radix)` Returns…
boolean	`equals(Object obj)` Compares this ob…
static char	`forDigit(int digit, int radix)` Determines the character representation for a specific digit in the specified radix.
static byte	`getDirectionality(char ch)` Returns the Unicode directionality property for the given character.
static int	`getNumericValue(…`
static int	`getType(char ch)`
int	`hashCode()` Returns …
static boolean	`isDefined(char ch)`
static boolean	`isDigit(char ch)` Determines if the specified character is a digit.
static boolean	`isIdentifierIgnorable(char …`
static boolean	`isISOControl(char ch)` De…
static boolean	`isJavaIdentifierPart(char ch…`
static boolean	`isJavaIdentifierStart(char …`
static boolean	`isJavaLetter(char ch)` **Deprecated.** *Replaced by isJavaIdentifierStart(char).*
static boolean	`isJavaLetterOrDigit(char…`
static boolean	`isLetter(char ch)` Deter…
static boolean	`isLetterOrDigit(char ch)`
static boolean	`isLowerCase(char ch)` Determines if the specified character is a lowercase character.
static boolean	`isMirrored(char ch)`
static boolean	`isSpace(char ch)` D…
static boolean	`isSpaceChar(char ch)`
static boolean	`isTitleCase(char ch)`
	…

public Character(char value)
Constructs a newly allocated Character object that represents the specified char value.

public char charValue()
Returns the value of this Character object.

public static int getNumericValue(char ch)
Returns the int value that the specified Unicode character represents.

public static boolean isDigit(char ch)
Determines if the specified character is a digit.

public static boolean isLetter(char ch)
Determines if the specified character is a letter.

public static boolean isLowerCase(char ch)
Determines if the specified character is a lowercase character.

ОБЩ СТЕК: ИЗПОЛЗВАНЕ НА WRAPPER-КЛАС 'CHARACTER'

```
class Stack {
     private Object [] stackElements;
     private int top;

     public Stack(int n) {
          stackElements = new Object[n];
          top = -1;
     }

     public void push(Object x) {
          top++; stackElements[top] = x;
     }

     public Object top() {…}
     ...
}
```

```
Character ch;
Stack s = new Stack(10);
ch = new Character(Keyboard.readChar());
s.push(ch);
ch = (Character)s.top();
char c = ch.charValue();
```

Typ 'char'

'Character'

'char'

СЪВМЕСТИМОСТ И TYP-CAST

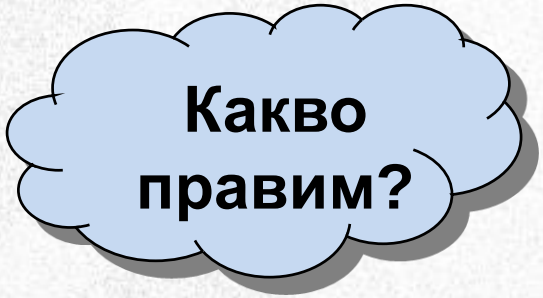
```
class Stack {
    private Object [] stackElements;
    private int top;

    public Stack(int n) {
        stackElements = new Object[n];
        top = -1;
    }

    public void push(Object x) {
        top++; stackElements[top] = x;
    }

     public Object top() {…}
    ...
}
```

```
Character ch;
Stack s = new Sta      );
ch = new Cha      cter(Keyboard.readChar());
s.push(ch);
ch = (Character)s.top();
char c = ch.charValue();
```

Правило за съвместимост: обектите на един подклас могат да стоят там, където са допустими обекти на суперкласа.

Обратна посока (суперклас → подклас): Typ-Cast на 'Object' към 'Character'

ПРЕДПОЛОЖЕНИЕ: JAVA-API БЕЗ WRAPPER-КЛАСОВЕ



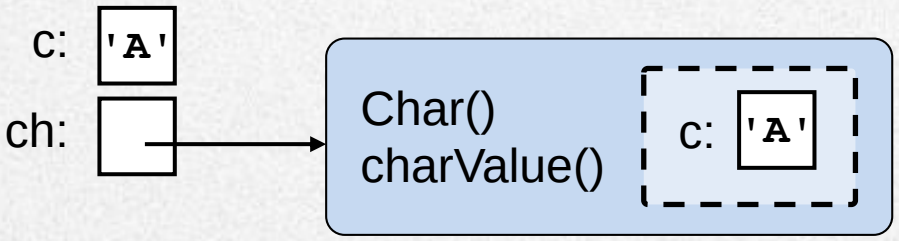
➔ Сами реализираме

WRAPPER 'CHAR' ЗА 'CHAR': САМОРЕАЛИЗАЦИЯ

StackForChar.java

```
class Char {
   private char c;
   public Char(char ch) {
      c = ch;
   }
   public char charValue() {
      return c;
   }
}
```

```
Char ch;
ch = new Char('A');
char c = ch.charValue();
```



WRAPPER-CLASS ‚CHARACTER‘

java.lang
Class Character

java.lang.Object
  java.lang.Character
All Implemented Interfaces:
Comparable, Serializable

public final class **Character**
extends Object
implements Serializable, Comparable
The Character class wraps a value of the primitiv

In addition, this class provides several methods for d

Character information is based on the Unicode Stand

The methods and data of class Character are defi
various properties including name and general categ

The file and its description are available from the Ur

- http://www.unicode.org

Since:
1.0
See Also:
Serialized Form

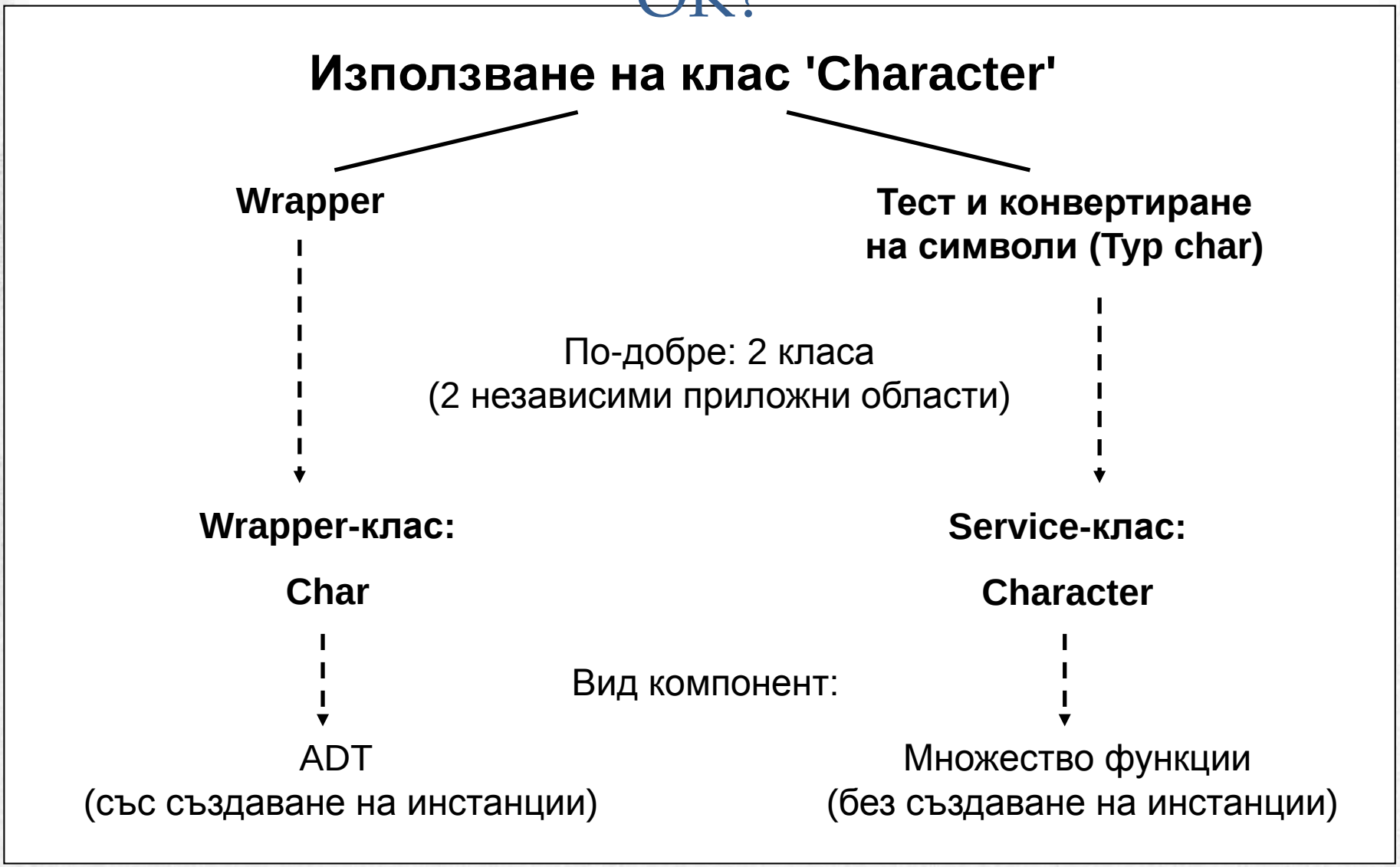
- The Character class wraps a value of the primitive type char in an object. An object of type Character contains a single field whose type is char.
- In addition, this class provides several methods for determining a characters's category (lowercase letter, digit, etc.) and for converting characters from uppercase to lowercase and vice versa.

Field Summary

static byte	COMBINING_SPACING_MARK	General category "Mc" in the Unicode specification.
static byte	CONNECTOR_PUNCTUATION	General category "Pc" in the Unicode specification.
static byte	CONTROL	General category "Cc" in the Unicode specification.
static byte	CURRENCY_SYMBOL	General category "Sc" in the Unicode specification.
static byte	DASH_PUNCTUATION	General category "Pd" in the Unicode sp
static byte	DECIMAL_DIGIT_NUMBER	General category "Nd" in the U
static byte	DIRECTIONALITY_ARABIC_NUMBER	Weak bidire
static byte	DIRECTIONALITY_BOUNDARY_NEUTRAL	Weak bidi
static byte	DIRECTIONALITY_COMMON_NUMBER_SEPARATOR	W
static byte	DIRECTIONALITY_EUROPEAN_NUMBER	Weak bidirectional charact
static byte	DIRECTIONALITY_EUROPEAN_NUMBER_SEPARATOR	Weak bidirectional character type "ES" in the Unicode specification.
static byte	DIRECTIONALITY_EUROPEAN_NUMBER_TERMINATOR	Weak bidirectional character type "ET" in the Unicode specification.
	...	

Логическата структура OK?

JAVA-API: ЛОГИЧЕСКАТА СТРУКТУРА ОК?



ИЗПОЛЗВАНЕ НА 'CHARACTER'

Използване на клас 'Character'

Wrapper

Създаване на инстанции

```
ch = new Character('A');

char c = ch.charValue();
```

Методи на инстанции

Тест и конвертиране за символи (Тур char)

без създаване на инстанции

```
Character.isLetter('A');

Character.isDigit(c);
```

Методи на класове

ВИНАГИ “ЧИСТИ" STACKS: ЕДИН И СЪЩ БАЗОВ ТИП (НАПР. CHARACTER)?

Общ стек: тип на елементите 'Object'

StackForChar.java

```
class Stack {
   private Object [] stackElements;
   private int top;

   public Stack(int n) {
      stackElements = new Object[n];
      top = -1;
   }
   ...
}
```

До сега: Stacks от Time, Character, …

"СМЕСЕНИ" СТЕКОВЕ ВЪЗМОЖНИ

```
class Stack {
   private Object [] stackElements;
   private int top;

   public Stack(int n) {
      stackElements = new Object[n];
      top = -1;
   }
   ...
}
```

```
Stack mixedStack = new Stack(10);

mixedStack.push(new Char('A'));
mixedStack.push(new Time(8,30));
mixedStack.push(new Integer(20));
```

БИ БИЛО ДОБРЕ, АКО ИМА ТИП-ПАРАМЕТРИ … (1)

Вместо:

```
class Stack {
    private Object [] stackElements;
    private int top;

    public Stack(int n) {
        stackElements = new  Object [n];
        top = -1;
    }

    public void push(Object x) {
        top++; stackElements[top] = x;
    }

    public Object top() {
        . . .
    }
  . . .
}
```

БИ БИЛО ДОБРЕ, АКО ИМА ТИП-ПАРАМЕТРИ … (2)

сега:

```
class Stack  <T> {
    private T [] stackElements;
    private int top;

    public Stack(int n) {
        stackElements = new  T [n];
        top = -1;
    }

    public void push(T x) {
        top++; stackElements[top] = x;
    }

    public T top() {
       . . .
    }
  . . .
}
```

Т.е. произволен, но твърдо определен тип

… С АКТУАЛИЗИРАНЕ ПОСРЕДСТВОМ ТИП-АРГУМЕНТИ

```
Stack <Time> tStack;
Stack <Character> chStack;

tStack = new Stack <Time> ();
chStack = new Stack <Character> ();

tStack.push(new Time(1,20));
chStack.push(new Character('A'));
chStack.push(new Time(7,10));
```

Грешка на типа: компилаторът очаква параметър от тип ‘Character’

С това: не са разрешени „смесени“ стекове

ГЕНЕТИЧНИ КЛАСОВЕ: ДЕКЛАРАЦИЯ

```
class Pair <T> {
    private T first;
    private T second;

    public Pair(T fst, T scd) {
        first = fst;
        second = scd;
    }

    public T getFirst() {
      return first;
    }

    public T getSecond() {
      return second;
    }
  }
```

Променлива на тип

BuildPairs.java

T: произволен,
но определен тип Typ

С това няма смесени двойки:
напр. (Integer, String)

от Java 2
(Version 1.5)

ГЕНЕТИЧЕН ТИП: ПРОМЕНЛИВИТЕ НА ТИПОВЕ СЕ АКТУАЛИЗИРАТ

BuildPairs.java

```
class BuildPairs {

  public static void main (String[] args) {
    Pair<Integer> pi;
    Pair<String>  ps;
    Integer i, j;

    i = new Integer(99);
    j = new Integer(100);
    pi = new Pair<Integer> (i, j);
    ps = new Pair<String> ("Hallo", "World");

    System.out.println(ps.getFirst() + " "
           + ps.getSecond());
    System.out.println(pi.getFirst().intValue()
           + " " + pi.getSecond().intValue());
  }
}
```

Генетичен тип

Аргумент-тип

ГЕНЕТИЧЕН ТИП: ИЗПОЛЗВАНЕ КАТО НОРМАЛЕН ТИП

BuildPairs.java

```
class BuildPairs {

  public static void main (String[] args) {
    Pair<Integer> pi;
    Pair<String>  ps;
    Integer i, j;

    i = new Integer(99);
    j = new Integer(100);
    pi = new Pair<Integer> (i, j);
    ps = new Pair<String> ("Hello", "World");

    System.out.println(ps.getFirst() + " "
           + ps.getSecond());
    System.out.println(pi.getFirst().intValue()
           + " " + pi.getSecond().intValue());
  }
}
```

Задаване на променливи

Извикване на конструктор

Извикване на метод

```
% java BuildPairs

Hello World
99 100
```

TYPBOUNDS: ОГРАНИЧЕНИЕ НА ТИП-АРГУМЕНТИ

BuildPairsBounds.java

```
class PairNumber <T extends Number> {
  private T first;
  private T second;

  PairNumber(T fst, T scd) {
     first = fst;
     second = scd;
  }

  public T getFirst() {
    return first;
  }

  public T getSecond() {
    return second;
  }

  public double add () {
    return first.doubleValue() + second.doubleValue();
  }
}
```

Тип-аргументът трябва да бъде изведен от Number:
Integer, Double …
(Wrapper-класове, които представят числа)

TYPBOUNDS: ОГРАНИЧЕНИЕ НА ТИП-АРГУМЕНТИ

BuildPairsBounds.java

```
class BuildPairsBounds {

  public static void main (String[] args) {
    PairNumber<Integer> pi;
//  PairNumber<String>  ps;
    Integer i, j;

    i = new Integer(99);
    j = new Integer(100);
    pi = new PairNumber<Integer> (i, j);

    System.out.println(pi.getFirst().intValue()
            + " " + pi.getSecond().intValue() + " "
            + pi.add());
  }
}
```

Integer изведен от Number

грешка!

```
% java BuildPairsBounds

99 100 199.0
```

БЛАГОДАРЯ ЗА ВНИМАНИЕТО!

КРАЙ “ГЕНЕТИЧНИ КЛАСОВЕ”

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