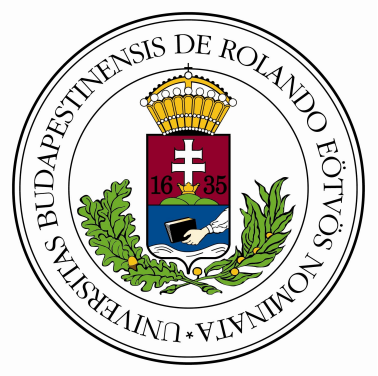
Programozási nyelvek – Java

Műveletek



Kozsik Tamás

ELTE Eötvös Loránd Tudományegyetem

Outline

Racionális számok

```
package numbers;
public class Rational {

    private int numerator, denominator;
    /* class invariant: denominator > 0 */

    public Rational( int numerator, int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }

}
```

Getter-setter

```
package numbers;
public class Rational {
    private int numerator, denominator;

    public Rational( int numerator, int denominator ){ ... }

    public void setDenominator( int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.denominator = denominator;
    }

    public int getDenominator(){ return denominator; }

    ...
}
```

Tervezett használat

```
import numbers.Rational;
public class Main {
    public static void main( String[] args ){
        Rational p = new Rational(1,3);
        Rational q = new Rational(1,2);
        p.multiplyWith(q);
        println(p);              // 1/6
        println(q);              // 1/2
    }
    private static void println( Rational r ){
        System.out.println( r.getNumerator() + "/" +
                            r.getDenominator() );
    }
}
```

Aritmetika

```
package numbers;
public class Rational {
    private int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    public int getNumerator(){ return numerator; }
    public int getDenominator(){ return denominator; }
    public void setNumerator( int numerator ){ ... }
    public void setDenominator( int denominator ){ ... }

    public void multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
    }
    ...
}
```

Dokumentációs megjegyzéssel

```
package numbers;
public class Rational {
    ...
    /**
    *  Set {@code this} to {@code this} * {@code that}.
    *  @param that Non-null reference to a rational number,
    *              it will not be changed in the method.
    *  @throws NullPointerException When {@code that} is null.
    */
    public void multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
    }
    ...
}
```

Műveletek sorozása

```
package numbers;
public class Rational {
    ...
    public Rational multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
        return this;
    }
    ...
}
```

```
Rational p = new Rational(1,3);
Rational q = new Rational(1,2);
p.multiplyWith(q).multiplyWith(q).divideBy(q);
println(p);
```

Outline

Több metódus ugyanazzal a névvel

```
public class Rational {
    ...
    public void multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
    }

    public void multiplyWith( int that ){
        this.numerator *= that;
    }
}
```

```
Rational p = new Rational(1,3), q = new Rational(1,2);
p.multiplyWith(q);
p.multiplyWith(2);
```

Trükkös szabályok: „jobban illeszkedő”

```
static void m( long n ){ ... }
static void m( float n ){ ... }
public static void main( String[] args ){
    m(3);
}
```

Egyformán illeszkedő

```
static void m( long n, float m ){ ... }
static void m( float m, long n ){ ... }
public static void main( String[] args ){
    m(4,2);
}
```

```
Foo.java:5: error: reference to m is ambiguous
        m(4,2);
        ^
  both method m(long,float) in Foo
   and method m(float,long) in Foo match
1 error
```

Több konstruktor ugyanabban az osztályban

```
public class Rational {
    ...
    public Rational( int numerator, int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }

    public Rational( int value ){
        numerator = value;
        denominator = 1;
    }
}
```

```
Rational p = new Rational(1,3), q = new Rational(3);
```

Túlterhelés (overloading)

- Több metódus ugyanazzal a névvel, több konstruktor

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- Több metódus ugyanazzal a névvel, több konstruktor
- Formális paraméterek eltérnek
  - Paraméterek száma
  - Paraméterek deklarált típusa

Túlterhelés (overloading)

- Több metódus ugyanazzal a névvel, több konstruktor
- Formális paraméterek eltérnek
  - Paraméterek száma
  - Paraméterek deklarált típusa
- Híváskor a fordító eldönti, melyiket kell hívni
  - Az aktuális paraméterek száma,
  - illetve deklarált típusa alapján

Túlterhelés (overloading)

- Több metódus ugyanazzal a névvel, több konstruktor
- Formális paraméterek eltérnek
  - Paraméterek száma
  - Paraméterek deklarált típusa
- Híváskor a fordító eldönti, melyiket kell hívni
  - Az aktuális paraméterek száma,
  - illetve deklarált típusa alapján
- Fordítási hiba, ha:
  - Egyik sem felel meg a hívásnak
  - Ha több is egyformán megfelel

Jó ez így?

```
public class Rational {
    ...

    public void multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
    }

    public Rational multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
        return this;
    }
    ...
}
```

Jogos túlterhelés

```
public class Rational {
    ...
    public void set( int numerator, int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }

    public void set( Rational that ){
        if( that == null ) throw new IllegalArgumentException();
        this.numerator = that.numerator;
        this.denominator = that.denominator;
    }
    ...
}
```

Alapértelmezett érték?

```
public class Rational {
    ...
    public void set( int numerator, int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }
    public void set( int value ){
        set(value,1);
    }
    public void set(){
        set(0);
    }
    ...
}
```

Alapértelmezett érték – a Java ezt nem engedi

```
public class Rational {
    ...
    public Rational( int numerator = 0, int denominator = 1 ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }

    public void set( int numerator = 0, int denominator = 1 ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }
    ...
}
```

Konstruktorok egymást hívhatják

```
public class Rational {
    ...
    public Rational( int numerator, int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }
    public Rational( int value ){
        this(value,1);              // legelső utasítás kell legyen
    }
    public Rational(){
        this(0);
    }
    ...
}
```

Konstruktor(ok) helyett gyártóművelet(ek)

factory method, pl. `new Rational(0)` helyett `Rational.zero()`

```
public class Rational {
    ...
    private Rational( int numerator, int denominator ){
        this.numerator = numerator;
        this.denominator = denominator;
    }
    public static Rational make( int numerator, int denominator ){
        return new Rational(numerator,denominator);
    }
    public static Rational valueOf( int val ){return make(val,1);}
    public static Rational oneOver( int den ){return make(1,den);}
    public static Rational zero(){ return make(0,1); }
}
```

Outline

Egy másfajta megközelítés

```
package numbers;
public class Rational {
    ...
    public void multiplyWith( Rational that ){ ... }
    public Rational times( Rational that ){ ... }
}
```

```
Rational p = new Rational(1,3);
Rational q = new Rational(1,2);
p.multiplyWith(q);
println(p);              // 1/6
Rational r = p.times(q);
println(r);              // 1/12
println(p);              // 1/6
```

Megvalósítások

```
package numbers;
public class Rational {
    private int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    ...
    public Rational times( Rational that ){
        return new Rational( this.numerator * that.numerator,
                             this.denominator * that.denominator );
    }
    public void multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
    }
}
```

Megvalósítások

```
package numbers;
public class Rational {
    private int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    ...
    public Rational times( Rational that ){
        return new Rational( this.numerator * that.numerator,
                             this.denominator * that.denominator );
    }
    public Rational multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
        return this;
    }
}
```

Operátor túlterhelés nincs a Javában

```
package numbers;
public class Rational {
    private int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    ...
    public Rational operator*( Rational that ){
        return new Rational( this.numerator * that.numerator,
                             this.denominator * that.denominator );
    }
    public Rational operator*=( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
        return this;
    }
}
```

Sosem módosuló belső állapot

```
package numbers;
public class Rational {
    private int numerator, denominator;
    public Rational( int numerator, int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }
    public int getNumerator(){ return numerator; }
    public int getDenominator(){ return denominator; }
    public Rational times( Rational that ){ ... }
    public Rational  plus( Rational that ){ ... }
    ...
}
```

Módosíthatatlan mezőkkel

```
package numbers;
public class Rational {
    private final int numerator, denominator;
    public Rational( int numerator, int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        this.numerator = numerator;
        this.denominator = denominator;
    }
    public int getNumerator(){ return numerator; }
    public int getDenominator(){ return denominator; }
    public Rational times( Rational that ){ ... }
    public Rational  plus( Rational that ){ ... }
    ...
}
```

Outline

Globális konstans

```
public static final int WIDTH = 80;
```

- Osztályszintű mező
- Picit olyan, mint a C-ben egy #define
- Hasonló a C-beli const-hoz is (de nem pont ugyanaz)
- Konvenció: végig nagy betűvel írjuk a nevét

Módosíthatatlan mező

- Például `WIDTH` globális konstans
- Vagy `Rational` két mezője
- Ha egyszer értéket kapott, nem adhatunk új értéket neki
- Inicializáció során értéket kell kapjon
  - „Üres konstans'' (blank final)!

```
public class Rational {
    private final int numerator, denominator;
    public Rational( int numerator, int denominator ){
        this.numerator = numerator;
        this.denominator = denominator;
    }
...
```

Módosíthatatlan lokális változó

```
public class Rational {
    ...
    public void simplify(){
        final int gcd = gcd(numerator, denominator);
        numerator /= gcd;
        denominator /= gcd;
    }
    ...
}
```

Módosíthatatlan formális paraméter

Hibás

```
static java.math.BigInteger factorial( final int n ){
    assert n > 0;
    java.math.BigInteger result = java.math.BigInteger.ONE;
    while( n > 1 ){
        result = result.multiply(java.math.BigInteger.valueOf(n));
        --n;
    }
    return result;
}
```

Módosíthatatlan formális paraméter

Helyes

```
static java.math.BigInteger factorial( final int n ){
    assert n > 0;
    java.math.BigInteger result = java.math.BigInteger.ONE;
    for( int i=n; i>1; --i ){
        result = result.multiply(java.math.BigInteger.valueOf(i));
    }
    return result;
}
```

Mutable versus Immutable

Módosítható belső állapot

```
public class Rational {
    private int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    public int getNumerator(){ return numerator; }     ...
    public void setNumerator( int numerator ){ ... }   ...
    public void multiplyWith( Rational that ){ ... }
```

Módosíthatatlan belső állapot

```
public class Rational {
    private final int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    public int getNumerator(){ return numerator; }
    public int getDenominator(){ return denominator; }
    public Rational times( Rational that ){ ... }
```

Más elnevezési konvenció

```
public class Rational {
    private final int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    public int numerator(){ return numerator; }
    public int denominator(){ return denominator; }
    public Rational times( Rational that ){ ... }
}
```

```
System.out.println( p.numerator() + "/" + p.denominator() );
```

Más elnevezési konvenció + mutable + túlterhelés

```
public class Rational {

    private int numerator, denominator;

    public int numerator(){ return numerator; }
    public void numerator( int numerator ){
        this.numerator = numerator;
    }

    ...
}
```

```
p.numerator(3);
System.out.println( p.numerator() );
```

Nyilvános módosíthatatlan belső állapot

```
public class Rational {
    public final int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    public Rational times( Rational that ){ ... }
    ...
}
```

Érzékeny a reprezentációváltoztatásra!

Reprezentációváltás

```
public class Rational {
    private final int[] data;
    public Rational( int numerator, int denominator ){
        if( denominator <= 0 ) throw new IllegalArgumentException();
        data = new int[]{ numerator, denominator };
    }
    public int numerator(){ return data[0]; }
    public int denominator(){ return data[1]; }
    public Rational times( Rational that ){ ... }
}
```

Kitérő

```
int[] t = new int[3];
t = new int[4];

int[] s = {1,2,3};
s = {1,2,3,4};  // fordítási hiba
s = new int[]{1,2,3,4};
```

final referencia

```
final Rational p = new Rational(1,2);
p.setNumerator(3);
p = new Rational(1,4); // fordítási hiba
```

final referencia

```
final Rational p = new Rational(1,2);
p.setNumerator(3);
p = new Rational(1,4); // fordítási hiba

final int[] data = new int[2];
data[0] = 3;
data[1] = 4;
data = new int[3]; // fordítási hiba
```

Karaktersorozatok ábrázolása

- `java.lang.String`: módosíthatatlan (immutable)

```
String fourtytwo = "42";
String twentyfour = fourtytwo.reverse();
String twentyfourhundredfourtytwo = twentyfour + fourtytwo;
```

Karaktersorozatok ábrázolása

- `java.lang.String`: módosíthatatlan (immutable)

```
String fourtytwo = "42";
String twentyfour = fourtytwo.reverse();
String twentyfourhundredfourtytwo = twentyfour + fourtytwo;
```

- `java.lang.StringBuilder` és `java.lang.StringBuffer`: módosítható

```
StringBuilder sb = new StringBuilder("");
for( char c = 'a'; c <= 'z'; ++c ){
   sb.append(c).append(',');
}
sb.deleteCharAt(sb.length()-1);    // remove last comma
String letters = sb.toString();
```

Karaktersorozatok ábrázolása

- java.lang.String: módosíthatatlan (immutable)

```
String fourtytwo = "42";
String twentyfour = fourtytwo.reverse();
String twentyfourhundredfourtytwo = twentyfour + fourtytwo;
```

- java.lang.StringBuilder és java.lang.StringBuffer: módosítható

```
StringBuilder sb = new StringBuilder("");
for( char c = 'a'; c <= 'z'; ++c ){
   sb.append(c).append(',');
}
sb.deleteCharAt(sb.length()-1);    // remove last comma
String letters = sb.toString();
```

- char[]: módosítható

Hatékonyságbeli kérdés

```
StringBuilder sb = new StringBuilder("");
for( char c = 'a'; c <= 'z'; ++c ){
   sb.append(c).append(',');
}
sb.deleteCharAt(sb.length()-1);
String letters = sb.toString();
```

```
String letters = "";
for( char c = 'a'; c <= 'z'; ++c ){
   letters += (c + ",");
}
letters = letters.substring(0,letters.length()-1);
```

Outline

Osztályszintű metódus (függvény)

```
public class Rational {
    private final int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    public int numerator(){ return numerator; }
    public int denominator(){ return denominator; }

    public static Rational times( Rational left, Rational right ){
        return new Rational( left.numerator * right.numerator,
                             left.denominator * right.denominator );
    }
}
```

```
Rational p = new Rational(1,3), q = new Rational(1,2);
Rational r = Rational.times(p,q);
```

Osztályszintű metódus (eljárás)

```
public class Rational {
    private int numerator, denominator;
    public Rational( int numerator, int denominator ){ ... }
    public int getNumerator(){ return numerator; }
    public void setNumerator( int numerator ){ ... }
    ...
    public static void multiplyLeftWithRight( Rational left,
                                              Rational right ){
        left.numerator *= right.numerator;
        left.denominator *= right.denominator;
    }
}
```

```
Rational p = new Rational(1,3), q = new Rational(1,2);
Rational.multiplyLeftWithRight(p,q);
```

Outline

Paraméterátadási technikák

- Szövegszerű helyettesítés
- Érték szerinti
- Érték-eredmény szerinti
- Eredmény szerinti
- Cím szerinti
- Megosztás szerinti
- Név szerinti
- Igény szerinti

Paraméterátadás Javában

Érték szerinti (call-by-value)

primitív típusú paraméterre

```
public void setNumerator( int numerator ){
    this.numerator = numerator;
}
```

Megosztás szerinti (call-by-sharing)

referencia típusú paraméterre (a referenciát érték szerint adjuk át)

```
public static void multiplyLeftWithRight( Rational left,
                                          Rational right ){
    left.numerator *= right.numerator;
    left.denominator *= right.denominator;
}
```

Érték szerinti (call-by-value)

```
public void setNumerator( int numerator ){
    this.numerator = numerator;
    numerator = 0;
}
```

```
Rational p = new Rational(1,3);
int two = 2;
p.setNumerator(two);
println(p);
System.out.println(two);
```

Megosztás szerinti (call-by-sharing)

```
public static void multiplyLeftWithRight( Rational left,
                                          Rational right ){
    left.numerator *= right.numerator;
    left.denominator *= right.denominator;
    left = new Rational(9,7);
}
```

```
Rational p = new Rational(1,3), q = new Rational(1,2);
Rational.multiplyLeftWithRight(p,q);
println(p);
```

Változó számú paraméter

```
static int sum( int[] nums ){
    int s = 0;
    for( int n: nums ){ s += n; }
    return s;
}
                          sum( new int[]{1,2,3,4,5,6} )
```

Változó számú paraméter

```
static int sum( int[] nums ){
    int s = 0;
    for( int n: nums ){ s += n; }
    return s;
}
```

```
sum( new int[]{1,2,3,4,5,6} )
```

```
static int sum( int... nums ){
    int s = 0;
    for( int n: nums ){ s += n; }
    return s;
}
```

```
sum(1,2,3,4,5,6)
```

Outline

Íme egy jól kinéző osztálydefiníció...

```
package numbers;
public class Rational {
    ...
    public void multiplyWith( Rational that ){
        this.numerator *= that.numerator;
        this.denominator *= that.denominator;
    }
    public void divideBy( Rational that ){
        if( that.numerator == 0 )
            throw new ArithmeticException("Division by zero!");
        this.numerator *= that.denominator;
        this.denominator *= that.numerator;
    }
}
```

És ha a paraméterek nem diszjunktak?

```
package numbers;
public class Rational {
    ...
    public void divideBy( Rational that ){
        if( that.numerator == 0 )
            throw new ArithmeticException("Division by zero!");
        this.numerator *= that.denominator;
        this.denominator *= that.numerator;
    }
}
```

```
Rational p = new Rational(1,2);
p.divideBy(p);
```

Belső állapot kiszivárgása

```
public class Rational {
    private int[] data;
    ...
    public int getNumerator(){ return data[0]; }
    public int getDenominator(){ return data[1]; }
    public void set( int[] data ){
        if( data == null || data.length != 2 || data[1] <= 0 )
            throw new IllegalArgumentException();
        this.data = data;
    }
}
```

```
int[] cheat = {3,4};
Rational p = new Rational(1,2);  p.set(cheat);
cheat[1] = 0;        // p.getDenominator() == 0   :-(
```

Belső állapot kiszivárgása ügyetlen konstruálás miatt

```
public class Rational {
    private final int[] data;
    public int getNumerator(){ return data[0]; }
    public int getDenominator(){ return data[1]; }
    public Rational( int[] data ){
        if( data == null || data.length != 2 || data[1] <= 0 )
            throw new IllegalArgumentException();
        this.data = data;
    }
}
```

```
int[] cheat = {3,4};
Rational p = new Rational(cheat);
cheat[1] = 0;       // p.getDenominator() == 0   :-(
```

Belső állapot kiszivárgása getteren keresztül

```
public class Rational {
    private final int[] data;
    ...
    public int getNumerator(){ return data[0]; }
    public int getDenominator(){ return data[1]; }
    public int[] get(){ return data; }
}
```

```
Rational p = new Rational(1,2);
int[] cheat = p.get();
cheat[1] = 0;        // p.getDenominator() == 0   :-(
```

Defenzív másolás

```
public class Rational {
    private final int[] data;
    public Rational( int[] data ){
        if( data == null || data.length != 2 || data[1] <= 0 )
            throw new IllegalArgumentException();
        this.data = new int[]{ data[0], data[1] };
    }
    public void set( int[] data ){ /* hasonlóan */ }
    public int[] get(){
        return new int[]{ data[0], data[1] };
    }
}
```

Módosíthatatlan objektumokat nem kell másolni

```
public class Person {
    private String name;
    private int age;
    public Person( String name, int age ){
        if( name == null || name.trim().isEmpty() || age < 0 )
            throw new IllegalArgumentException();
        this.name = name;
        this.age = age;
    }
    public String getName(){ return name; }
    public int getAge(){ return age; }
    public void setName( String name ){ ... this.name = name; }
    public void setAge( int age ){ ... this.age = age; }
}
```

Tömbelemek között is lehet aliasing

```
Rational rats[2]; // fordítási hiba

Rational rats[] = new Rational[2]; // = {null,null};

Rational[] rats = new Rational[2]; // gyakoribb
rats[0] = new Rational(1,2);
rats[1] = rats[0];
rats[1].setDenominator(3);
System.out.println(rats[0].getDenominator());
```

- módosítható versus módosíthatatlan

Ugyanaz az objektum többször is lehet a tömbben

```
/**
    ...
    PRE: rats != null
    ...
*/
public static void increaseAllByOne( Rational[] rats ){
    for( Rational p: rats ){
        p.setNumerator( p.getNumerator() + p.getDenominator() );
    }
}
```

Dokumentálva

```
/**
    ...
    PRE: rats != null and (i!=j => rats[i] != rats[j])
    ...
*/
public static void increaseAllByOne( Rational[] rats ){
    for( Rational p: rats ){
        p.setNumerator( p.getNumerator() + p.getDenominator() );
    }
}
```

Tömbök tömbje

- Javában nincs többdimenziós tömb (sor- vagy oszlopfolytonos)
- Tömbök tömbje (referenciák tömbje)

```
int[][] matrix = {{1,0,0},{0,1,0},{0,0,1}};

int[][] matrix = new int[3][3];
for( int i=0; i<matrix.length; ++i ) matrix[i][i] = 1;

int[][] matrix = new int[5][];
for( int i=0; i<matrix.length; ++i ) matrix[i] = new int[i];
```

Ismét aliasing – bug-gyanús

```
Rational[][] matrix = { {new Rational(1,2), new Rational(1,2)},
                        {new Rational(1,2), new Rational(1,2)},
                        {new Rational(1,2), new Rational(1,2)} };
```

```
Rational half = new Rational(1,2);
Rational[] halves = {half, half};
Rational[][] matrix = {halves, halves, halves};
```

Outline

Lambda-kifejezések

```
int[] nats = {0, 1, 2, 3, 4, 5, 6};
```

```
int[] nats = new int[1000];
for( int i=0; i<nats.length; ++i ) nats[i] = i;
```

```
int[] nats = new int[1000];
java.util.Arrays.setAll(nats, i->i);

java.util.Arrays.setAll(nats, i->(int)(100*Math.random()));
```

Több paraméterrel

```
public static void main( String[] args ){
    java.util.Arrays.sort(args);
    java.util.Arrays.sort( args, (s,z) -> s.length()-z.length() );
}
```

Lehetőségek

```
i -> i

(int i) -> i+1

(int n, String s) -> {  StringBuilder sb = new StringBuilder();
                        for( int i=1; i<=n; ++i ) sb.append(s);
                        return sb.toString();
                     }
```

Funkcionális programozás

```
int[] nums = new int[1000];
java.util.Arrays.setAll(nums, i->(int)(100*Math.random()));

java.util.Arrays.stream(nums)
                .filter( i -> i%2 == 0 )
                .map( i -> i/2 )
                .limit(10)
                .forEach( i -> System.out.println(i) )
```

Részleges alkalmazás

```
java.util.Arrays.stream(nums)
                .forEach( i -> System.out.println(i) )
```

```
java.util.Arrays.stream(nums)
                .forEach( System.out::println )
```