

The logo of the University of Skövde is centered in the background. It features a shield with a lion, a star, and a tree, surrounded by a laurel wreath. Below the shield is the year '1977'.

**More expressions, functions and recursion**

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Expressions: conditionals

```
if (logicalExpr) { statement } else { statement }
```

```
if (x < 0) -x else x // absolute
```

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~~Expressions~~ Statements: loops

```
while (logicalExpr) { statement }
```

```
var i, sum = 0
```

```
while (i < 10) {
```

```
    sum += i
```

```
    i += 1
```

```
}
```

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~~Expressions~~ Statements: loops

```
do { statement } while (logicalExpr)
```

```
var i, sum = 0
```

```
do {
```

```
    sum += i
```

```
    i += 1
```

```
} while (i < 10)
```

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~~Expressions~~ Statements: loops

```
for (generator) { statement }
```

```
var sum = 0
```

```
for (i <- 0 to 10)
```

```
    sum += i    // sum = 55
```

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## ~~Expressions~~ Statements: loops

```
for (generator[; definition|filter|generator]*) { statement }
```

```
for (
```

```
    i <- 0 to 10;
```

```
    j <- i to 10
```

```
){
```

```
    print(i + " ")
```

```
    if (j == 10) println
```

```
}
```

```
0 0 0 0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1 1
2 2 2 2 2 2 2 2
3 3 3 3 3 3 3
4 4 4 4 4 4
5 5 5 5 5
6 6 6 6 6
7 7 7 7
8 8 8
9 9
10
```

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## ~~Expressions~~ Statements: loops

```
for (generator[; definition|filter|generator]*) { statement }
```

```
for (  
    i <- 0 to 10;  
    if (i % 2 == 0);  
    j <- i to 10  
) {  
    print(i + " ")  
    if (j == 10) println  
}
```

```
0 0 0 0 0 0 0 0 0 0 0  
2 2 2 2 2 2 2 2 2  
4 4 4 4 4 4 4  
6 6 6 6 6  
8 8 8  
10
```

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~~Expressions~~ Statements: loops

```
for (generator[; definition|filter|generator]*) { statement }
```

```
for (  
    i <- 0 to 10;  
    x = i * i;  
    if x % 3 == 0  
) print(x + " ")  
// = 0 9 36 81
```

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## Expressions ~~Statements~~: loops

```
for (generator[; definition|filter|generator]*) { statement }
```

```
for (
```

```
    i <- 0 to 10;
```

```
    x = i * i;
```

```
    if x % 3 == 0
```

```
) yield x
```

```
// = Vector(0, 9, 36, 81)
```

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## Functions

```
def sum(a: Int, b: Int): Int = a + b
```

```
sum(2, 3)    // = 5
```

```
val a = sum _
```

```
a(2, 3)      // = 5
```

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## Functions as literals

```
val sum: (Int, Int) => Int = (a: Int, b: Int) => a + b
```

```
sum(2, 3)    // = 5
```

```
val a = sum
```

```
a(2, 3)      // = 5
```

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## Functions as literals (type inference)

```
val sum: (Int, Int) => Int = (a, b) => a + b
```

```
sum(2, 3)    // = 5
```

```
val a = sum
```

```
a(2, 3)      // = 5
```

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## Functions as literals

```
val sum = (a: Int, b: Int) => a + b
```

```
sum(2, 3)    // = 5
```

```
val a = sum
```

```
a(2, 3)      // = 5
```

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## Functions

```
def sum(a: Int, b: Int = 3): Int = a + b
```

```
sum(2)      // = 5
```

```
sum(2, 4)   // = 6
```



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## Functions

```
def sum(ns: Int*): Int = ns.sum
```

```
sum(2)           // = 2
```

```
sum(2, 4)        // = 6
```

```
sum(2, 4, 3, 7)  // = 16
```

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## Recursive functions

```
def sum(x: Int): Int =  
  if (x <= 0) 0  
  else x + sum(x - 1)
```

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## Recursive functions

## Substitution model

```
def sum(x: Int): Int = sum(3)
  if (x <= 0) 0
  else x + sum(x - 1)
```

$\text{sum}(3)$   
 $= 3 + \text{sum}(2)$   
 $= 2 + \text{sum}(1)$   
 $= 1 + \text{sum}(0)$   
 $= 0$

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## Recursive functions

```
def isPrime(x: Int): Boolean = {  
  def check(div: Int): Boolean =  
    if (div > x/2) true  
    else (x % div != 0) && check(div + 1)  
  check(2)  
}
```

```
isPrime(7) // = true
```

```
isPrime(21) // = false
```

## Tail-recursive functions

```
def sum(x: Int): Int = {  
  def loop(n: Int, acum: Int): Int =  
    if (n <= 0) acum  
    else loop(n - 1, acum + n)  
  loop(x, 1)  
}
```

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## Tail-recursive functions

```
@tailrec
```

```
def sum(x: Int): Int = {  
    def loop(n: Int, acum: Int): Int =  
        if (n <= 0) acum  
        else loop(n - 1, acum + n)  
    loop(x, 1)  
}
```

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