Erlang Solutions Ltd.

Basic Erlang

© 1999-2012 Erlang Solutions Ltd.

Overview: basic Erlang I

- Basic Erlang I
  - Data Types
  - Variables
  - Complex Data Structures
  - Pattern Matching
- Basic Erlang II
- Basic Erlang III

© 1999-2012 Erlang Solutions Ltd.

Data Types: integers

```
0
10
100000000
-234
16#AB10F
2#1010
$a
$A
$\n
```

- **B#Val** is used to store numbers in base **B**
- **$Char** is used for ascii values
  - $A is equivalent to 65
- Large integers are converted to bignums
- Max size depends on physical constraints:
  - RAM
  - Paging memory

© 1999-2012 Erlang Solutions Ltd.

Data Types: floats

```
17.368
-56.654
12.34E-10
```

- Not efficiently implemented
- Stored as a double
  - 64-bit representation
- Follows the IEEE 754 standard

© 1999-2012 Erlang Solutions Ltd.

Data Types: atoms

```
january
fooBar
alfa21
start_with_lower_case
node@ramone
true
false

'January'
'a space'
'Anything inside quotes{}#@ \n
\012'
'node@ramone.erlang.org'
```

- Atoms are constant literals
- Start with a lower case letter or are encapsulated by ' '
- Any character code is allowed within an atom if using ' '
- Letters, integers and _ are allowed if the atom starts with a lower case letter

© 1999-2012 Erlang Solutions Ltd.

Data Types: booleans

```
true
false
1 == 2
1 /= 2
1 == 1.0
1 =:= 1
1 =/= 1.0
1 < 2
a > z
less < more
is_boolean(9+6)
is_boolean(true)
not((1 < 3) and (2 == 2))
not((1 < 3) or (2 == 2))
not((1 < 3) xor (2 == 2))
```

- No separate type for booleans: atoms **true** and **false** are used instead.
- Operators (and, andalso, or, orelse, xor, not) accept **true** and **false** as if they actually were boolean types.

© 1999-2012 Erlang Solutions Ltd.

Data Types: tuples

```
{123, bcd}
{123, def, abc}
{abc, {def, 123}, ghi}
{}
{person, 'Joe', 'Armstrong'}
{person, 'Mike', 'Williams'}
```

- Tuples are used to denote data-types with a fixed number of items
- Tuples of any size are allowed
- Contain valid Erlang expressions

Data Types: lists

```
[1, 2, 3, 4, 5, 6, 7, eight, nine]
```

- Lists are written beginning with a [and ending with a]
- Elements are separated by commas
- Used to store a variable number of items
- Lists are dynamically sized
- Strings in Erlang are lists of ASCII values

Data Types: lists

```
[january, february, march]
[123, def, abc]
[a,[b,[c,d,e],f],g]
[]
[{person, 'Joe', 'Armstrong'},
 {person, 'Robert', 'Virding'},
 {person, 'Mike', 'Williams'}]
[72,101,108,108,111,32,87,111,114,108,100]
[$H,$e,$l,$l,$o,$ ,$W,$o,$r,$l,$d]
"Hello World"
```

Data Types: lists

```
List = [Element | List] or
       []
```

- A recursive list definition consists of a head and a tail
- Lists whose last tail term is [] are called:
  - **proper** lists or
  - **well formed** lists
- The tail can be any valid Erlang data type
- Most Erlang programs manipulate proper lists

Data Types: lists

```
[one, two, three, four]
[one, two, three, four | []]
[one, two|[three, four]]
[one, two|[three|[four|[]]]]
[one|[two|[three|[four|[]]]]]
```

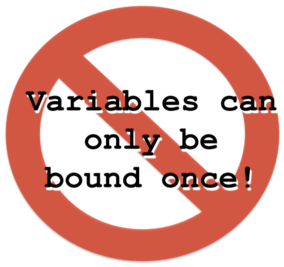
Variables

```
A_long_variable_name
Flag
Name2
DbgFlag


_a_do_not_care_variable
_
```

- Variables can start with an uppercase letter or _
- They may not contain any 'funny characters'
- _ alone is a don't care variable
  - Its values are ignored and never bound

Variables



- Variables are used to store values of data structures
- The value of a variable can not be changed once it has been bound
- There is no need to declare them. Just use them!
- Erlang does not have a static type system
- Types are determined at run time

© 1999-2012 Erlang Solutions Ltd.

Complex Data Structures

```
[{{person, "Joe", "Armstrong"},
  [{telephone_number, [3,5,9,7]},
   {shoe_size, 42},
   {pets, [{cat, tubby}, {cat, tiger}]},
   {children, [{thomas, 5}, {claire, 1}]}]
 },
 {{person, "Mike", "Williams"},
  [{shoe_size, 41},
   {likes, [boats, beer]}]
 }
].
```

© 1999-2012 Erlang Solutions Ltd.

Complex Data Structures

- Arbitrary complex data structures can be created by nesting other data structures
- Data structures may contain bound variables
- Data structures are created by writing them down
- No explicit memory allocation or deallocation is needed
  - Allocated automatically
  - Deallocated by the **garbage collector** when no longer referenced.

© 1999-2012 Erlang Solutions Ltd.

Pattern Matching

```
Pattern = Expression
```

- Pattern matching is used for:
  - Assigning values to variables
  - Controlling the execution flow of programs (if, case, function heads)
  - Extracting values from compound data types
  - The pattern can contain variables which are bound when the matching succeeds
  - The expression may not contain unbound variables

© 1999-2012 Erlang Solutions Ltd.

Pattern Matching: assigning

A = 10
Succeeds, binds **A** to **10**

{B, C, D} = {10, foo, bar}
Succeeds, binds **B** to **10**, **C** to **foo** and **D** to **bar**.

{E, E, foo} = {abc, abc, foo}
Succeeds, binds **E** to **abc**.

[H|T] = [1,2,3]
Succeeds, binds **H** to **1**, **T** to **[2,3]**.

© 1999-2012 Erlang Solutions Ltd.

Pattern Matching: assigning

A match must either succeed or fail

`{A, A, B} = {abc, def, 123}`
– fails

`[A,B,C,D] = [1,2,3]`
– fails

`[A,B|C] = [1,2,3,4,5,6,7]`
– succeeds, A = 1, B =2, C = [3,4,5,6,7]

`[H|T] = []`
– fails

© 1999-2012 Erlang Solutions Ltd.

Pattern Matching: extraction

{A, _, [B|_], {B}} = {abc, 23, [22, x], {22}}
– Succeeds, `A = abc, B = 22`

C = 10,
{C, C, 13, D, _} = {10, 10, 13, 12, 15}
– Succeeds, `D = 12, C = 10`

Var = {person, 'Francesco', 'Cesarini'},
{person, Name, Surname} = Var
– Succeeds, `Name = 'Francesco', Surname = 'Cesarini'`

[Element|Tail] = [1,2,3,4]
– Succeeds, `Element = 1, Tail = [2,3,4]`

Summary: basic Erlang I

- Basic Erlang I
  - Data Types
  - Variables
  - Complex Data Structures
  - Pattern Matching
- Basic Erlang II
- Basic Erlang III

Overview: basic Erlang II

- Basic Erlang I
- Basic Erlang II
  - Function Calls
  - Modules
- Basic Erlang III

Functions: calls

```
module:function(Arg1, Arg2, ..., ArgN)
   function(Arg1, Arg2, ..., ArgN)
```

- Erlang programs consist of functions that call each other
- Functions are defined within modules
- Function names and module names must be atoms
- The **arity** of a function is its number of arguments.

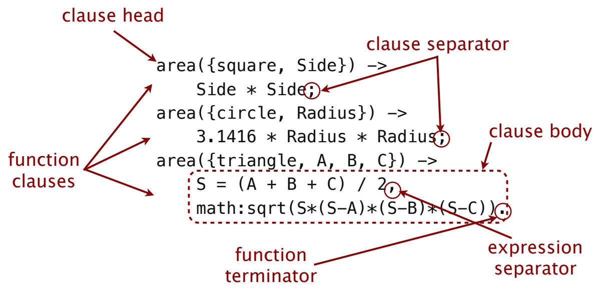
Functions: syntax

```
circumference(R) ->
    2 * math:pi() * R.


product(X, Y) -> X * Y.

product(X, Y, Z) -> X * Y * Z.
```

Functions: syntax



```
area({square, Side}) ->
    Side * Side;
area({circle, Radius}) ->
    3.1416 * Radius * Radius;
area({triangle, A, B, C}) ->
    S = (A + B + C) / 2,
    math:sqrt(S*(S-A)*(S-B)*(S-C)).
```

Functions: syntax

```
Func(Pattern1, Pattern2, ...) ->
    <expression 1>,
    <expression 2>,
    ...
    <expression n>;
Func(Pattern1, Pattern2, ...) ->
    <expression 1>,
    <expression 2>,
    ...
    <expression n>;
...
Func(Pattern1, Pattern2, ...) ->
    <expression 1>,
    <expression 2>,
    ...
    <expression n>.
```

- A function is defined as a collection of clauses
- Variables are pattern matched in the function clause head
- If pattern matching fails on a clause, the next one is tested
- The first clause matched is used
- The last expression executed in the clause body is returned

© 1999-2012 Erlang Solutions Ltd.

Functions: examples

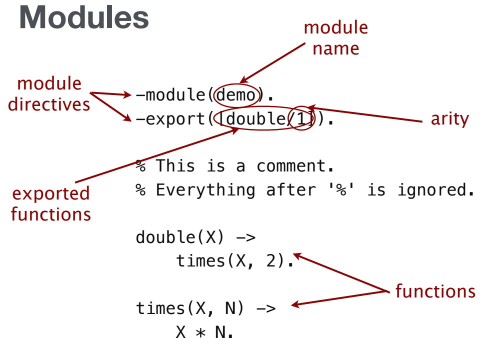
```
factorial(0) -> 1;
factorial(N) ->
    N * factorial(N-1).


> factorial(3).
    (matches N = 3 in clause 2)
    == 3 * factorial(3-1)
    (matches clause 2)
    == 3 * 2 * factorial(2-1)
    (matches clause 2)
    == 3 * 2 * 1 * factorial(1-1)
    (matches clause 1)
    == 3 * 2 * 1 * 1
    == 6
```

- Pattern matching occurs in the function head
  - Unbound variables get bound after a successful pattern match
- Variables are local to each clause
- Variables are allocated and deallocated automatically

© 1999-2012 Erlang Solutions Ltd.

Modules



```
-module(demo).
-export([double/1]).

% This is a comment.
% Everything after '%' is ignored.

double(X) ->
    times(X, 2).

times(X, N) ->
    X * N.
```

© 1999-2012 Erlang Solutions Ltd.

Modules

- Modules are stored in files with the **.erl** suffix
- The module and file names must be the same
  - You store the module **foo** in **foo.erl**
- Modules are named with the **-module(Name).** directive
- Exported functions can be called from outside the module

© 1999-2012 Erlang Solutions Ltd.

Modules

- Use **-export([Function/Arity, Function/Arity, ...])**
- Local functions may only be called within the module
- Prefix function calls with the module name when making a call from outside the module
  - **Module:Fun(Args)**
  - This is a **fully qualified call**

© 1999-2012 Erlang Solutions Ltd.

Summary: basic Erlang II

- Basic Erlang I
- Basic Erlang II
  - Function Calls
  - Modules
- Basic Erlang III

© 1999-2012 Erlang Solutions Ltd.

Overview: basic Erlang III

- Basic Erlang I
- Basic Erlang II
- Basic Erlang II
  - Starting the System
  - Shell Commands
  - Editors

Starting the System

- Start the Erlang system by typing **erl** in the unix shell, or double-clicking the Erlang icon in Windows. An Erlang shell will be started.
- 1>, 2>, ... are the shell prompts
- The shell is an Erlang process that sits in a read-eval-print loop
- It reads valid Erlang expressions typed in by the user followed by a full stop and evaluates them
- **c(Module).** compiles the file **Module.erl** and loads the module in the shell.

The Erlang Shell

```
$ erl
Erlang R14B01 (erts-5.8.1) [source] [smp:4:4] [rq:4]
[async-threads:0] [hipe] [kernel-poll:false]

Eshell V5.8.2  (abort with ^G)
1> c(demo).
{ok,demo}
2> demo:double(25).
50
3> demo:times(4,3).
** exited: {undef,{demo,times,[4,3]}}
4> 10 + 25.
35
5>
```

Shell Commands

help()
prints out list of shell commands available

h()
History. Prints the last 20 commands

b()
Shows all variable bindings

f() - f(X)
Forgets all variable bindings. **f(X)** only forgets the variable **X**. These can **only** be used in the shell

Shell Commands

e(N)
Evaluates the **N**th command in history

e(-1)
Evaluates the previous command

CTRL + (n, p, f, b, y, a, e, ...)
Use the keys **CTRL + (n, p, f, b, y, a, e, ...)** to move around in the shell and edit content as you would in Emacs.

Editors

Emacs	Vim
ErlIDE	gedit
TextMate	Notepad++
SciTE	And more...

Summary: basic Erlang III

- Basic Erlang I
- Basic Erlang II
- Basic Erlang III
  - Starting the System
  - Shell Commands
  - Editors

© 1999-2012 Erlang Solutions Ltd.