Erlang

“Erlang (/ˈɜrlæŋ/ er-lang) is a general-purpose concurrent, garbage-collected programming language and runtime system.”

—Wikipedia

Learning Erlang

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Erlang specific naming requirement

- ☞ File name must match name of the module.
- ☞ Variable start with capital letter.
- ☞ Atom start with lower-case character.
- ☞ Each variable is immutable, meaning it can only be defined once.
- ☞ Execution must end with '.'

Variable

'=' symbol bind data to variable regardless of what's on which side.

```
Number = 5                  % Integer
Double = 10.0               % Double
Word = "Hello"              % Character list
List  = [1, 1, "Word"]      % List
Tuple =  {a,b,c}            % Tuple
_Foo = "foo"                % Prefix variable with _ tell compiler
                            % that we don't intend to use it.
```

Never assign variable twice.

Because it is **not possible**.

```
Number = 5.
5
Number = 6.
** exception error: no match of right hand side value 6
```

List specific function

```
[H|T] = list     %list  = [1, 1, "Word"]
H.               % [1] % Head (First position)
T.               %[1, "Word"] % Tail (The rest of the list)
[J,Y] = list     % Still works.
[J,Y|Z] = list   % Still works.
```

How to compile Erlang code?

☞ In Terminal
erlc exercise1.erl

☞ In Shell
c(exercise1).

Remember the dot '.', I'm dead serious.

Executing compiled Erlang code

- ☞ Without shell (Each -s is one statement, in this case execute then quit.)
  erl - noshell -s exercise1 helloIO -s erlang halt

- ☞ With shell
  erl
  ~ **exercise:hello().**

Finding out what is in the module

~ **exercise:module_info().**

```
[{exports,[{server,1},
           {client,1},
           {module_info,0},
           {module_info,1}]},
 {imports,[]},
 {attributes,[{vsn,[368149114189616521341851267252595821 72]}]},
 {compile,[{options,[]},
           {version,"4.9.4"},
           {time,{2014,4,19,9,6,47}},
           {source,"/Users/RobGThai/Code/erlang/message.erl"}]}]
```

Module structure

```
-module(module_name).    % Module name

-export([
        function1/0,     % declaring public function name.
        functionWithTwoPattern/2]).

function() -> "This is a method". %function implementation.
functionWithTwoPattern(Fname, Lname) ->
    io:format("Your name is ~s ~s", Fname, Lname).
```

Function overload using pattern matching

```
factorial(0) -> 1;  % If 0 was given
factorial(1) -> 1;  % If 1 was given
factorial(N) when N > 1 -> N * factorial(N-1).
% If anything more than 1 is given.
```

Notice **when N > 1** in the last function. This is called **Guard**, it is a scope for acceptable argument.

Function overload with multiple arguments

```
-export([foo/0, foo/1, foo/2]).
% Number of argument in the function must match the /X declaration.

foo() -> <...> .
foo(L) -> <...> .
foo(L, C) -> <...> .
```

Recursive function

Remember, there's **no iteration** in Erlang.

```
factorial(N) when N > 1 -> N * factorial(N-1).
```

Just like you normally would.
By the way, you probably notice by now that each function is start and end with **-> and .**

Multiple lines function

When a function does several thing, each statement before the last must be ending with `','`

```
hello(joe) ->
    io:format("Hello Joe.~n"),
    io:format("How are you?~n").
```

If expression

Similar to a function but notice the ';' at the end of the last line for each condition and the absent of it from the last condition.

```
if L =/= [] ->          % If L is not empty
    sum(L) / count(L);
true ->
    error               % Force error
end.
```

The If condition 'L =/= []' is also a **Guard**. As there is not Else in Erlang, we can add true as the last Guard to support it.

Case expression

Case use pattern to match the given tuple with the defined one.
You can also add a guard as well.

```
case Message of
    {average, L} -> average(L);
    {sum, L} when L =:= [] -> 0;     % Only when L is empty
    {sum, L} -> sum(L);
end.
```

Buildin function

```
erlang:hd          % Head
erlang:tl          % Tail
erlang:length      % Count number of item in the list
lists:sum          % Summation of all the item in the list

list:foldl         % Fold left
list:foldr         % Fold right
```

There are plenty of things available. You can use `module_info()` function to get list of the available functions.

Basic functional

```
% '<-'                    % This is called list comprehensive
% [<do> || <for each> || <only if>]
% For each X in [1,2,3], multiply X by 2.
[X*2 || X <- [1,2,3]]                    % [2, 4, 6]
% For each X in [1,2,3], if X > 2, multiply X by 2.
[X*2 || X <- [1,2,3], X > 2]             % [6]
% Using closure(annonumous function)
lists:filter(fun(X) -> (X rem 2) =:= 0 end, [1,2,3,4])      % [2, 4]
[X+Y || X <- [1,2,3], Y <- [4,5,6]]      % [5, 6, 7, 6, 7, 8, 7, 8, 9]
```

Process & Thread

```
% Run on main thread
process_loop() ->           % Run thread
    receive                 % Wait for input
        Message ->          % input
        io:format("~s~n", [Message]),          % ~s is '%s'
        process_loop()      % Keep thread alive
    end.

%Module, Function, Argument
p = spawn(M, F, A)     % Start a new thread
% Register the process_loop thread with p1
register(p1, spawn(exercise1, process_loop, [])).
% Unregister p1
unregister(p1).
```

In Erlang, everything can be convert into process using spawn.
Hence concurrency is very easy.

Threading

The `receive` Wait for input and if match proceed accordingly.

```
list_process(List) ->
    receive
        {put, Val} ->                   % put Val onto List
            NewList = [Val|List],
            list_process(NewList);

        print ->                        % print everything in the List
            io:format("~p~n",[List]),
            list_process(List);

        {Caller, pop} ->                % pop top of the List to the given Caller
            [Val | NewList] = List,
            Caller ! Val,               % Talk back to Caller
            list_process(NewList)
    end.
```

Monitoring

You can monitor the processes usage using Erlang build in function.

```
% Display Monitor
appmon:start().
```

```
% Display processes
erlang:processes().
```

You can also use `htop` via terminal to access your memory usage information.

Process Link

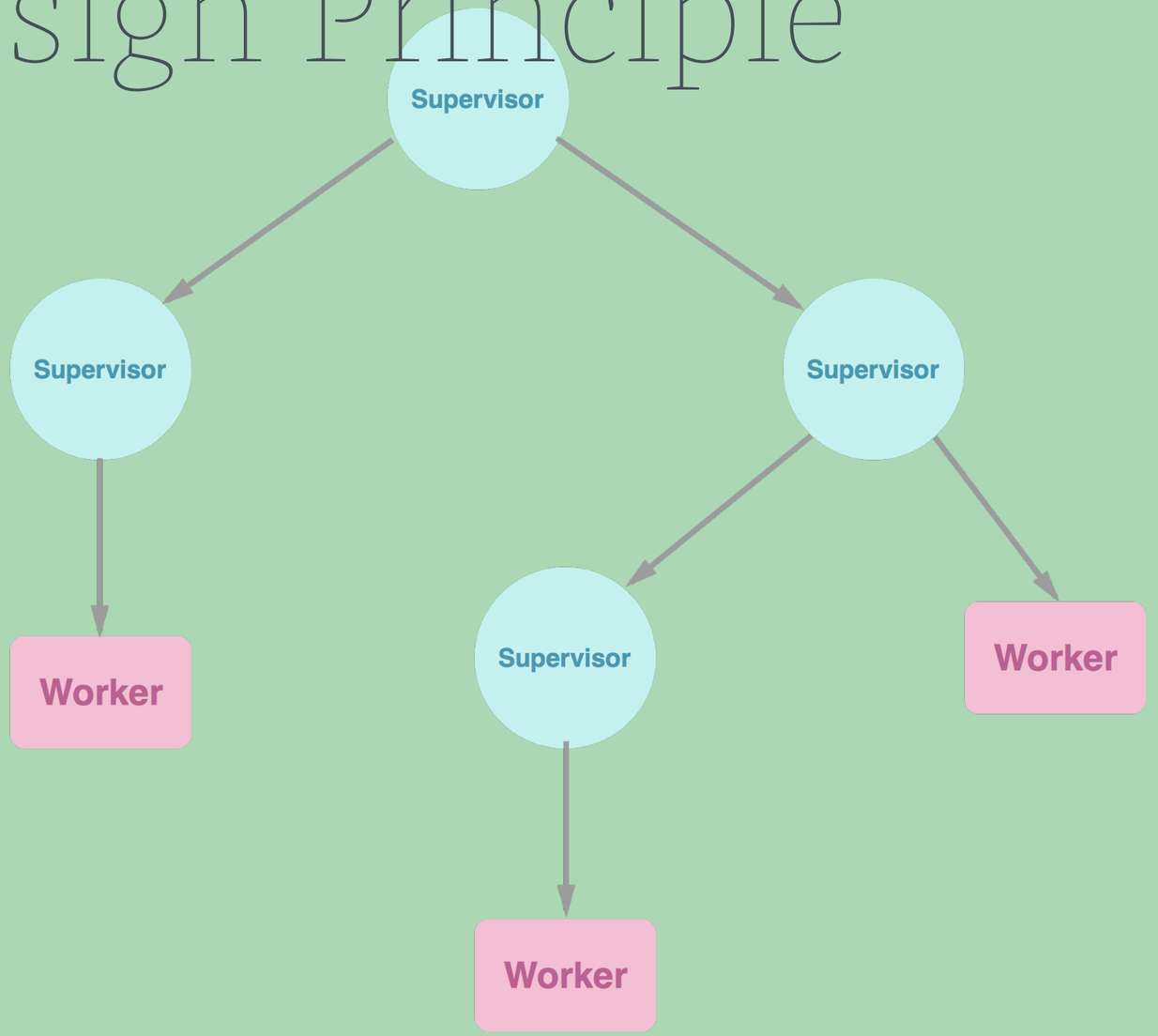
Erlang can link multiple processes together. If one of the linked process die unexpectedly, all linked processes will die together as well.

```
loop() ->
    receive
        {link, PID} ->
            link(PID),          % Link this process with the given Process ID
            loop();
        die ->
            exit("DIE")         % Force this process to die
    end.
```

Process Link (Cont.)

```
loop2() ->
    process_flag(trap_exit, true),  % Convert incoming Exit signal to message.
    receive
        {link, PID} ->
            link(PID),
            loop2();
        die ->
            exit("DIE");
        ExitMessage ->                  % The message above used here
            io:format("~p~n", [ExitMessage]),
            loop2()
    end.
```

OTP Design Principle



Behaviors

① gen_server

② gen_fsm

③ gen_event

④ supervisor

gen_server

Start server

```
% Start current module as a callback for genserver.
gen_server:start_link({local, ?SERVER}, ?MODULE, [], []).
% start_link( {<scope>, <module_name>}, <module_callback>
%     , <init argument>, <options>)

% Send message to server via gen_server
gen_server:call(genserver, hello).
% In turn, gen_server pass the Request to run on genserver
% trickering callback on genserver.
```

State tuple, a.k.a Hash

```
Request1 = #state{name = "Poohdish", age = 30}. % Create hash
Request2 = Record1#state{age = 22}. % Update age but keep name
Name = Record1#state.name.  % Access name
```

Record (Smarter State)

```
% record.hrl file contain state definition.
-record(people, {
    name = "",
    age
    }).

% Read record into shell.
> rr("record.htl").

% Remove record from shell.
> rf().

% Assign People1 to People State
People1 = #people{}.

% Assign People1 to People State
People1 = #people{}.
% Update value in People1 and give it t People2
People2 = People1#people{name = "Gof", age = 30}.
```

Rebar

“Erlang build tool that makes it easy to compile and test Erlang applications, port drivers and releases.”

—https://github.com/rebar/rebar

Rebar: Generating structure

Source code will be under **/src**

```
>rebar create-app appid=list_app
```

Rebar: Configure supervisor

```
init([]) ->
    {ok, { {one_for_one, 5, 10}, [
            {                    % This is child specs
                list_server,
                {list_server, start_link, []},
                permanent,
                brutal_kill,
                worker,
                [list_server]
            }
        ]} }.
```

Rebar: Compiling application

Complied code will be under **/ebin**

```
>rebar compile
```

Running compiled app

Loading app into Erlang

```
>erl -pa ./ebin
```

Start application

```
application:start(list_app)
```

Updating code

```
code:load_file(list_app).
```

Release app

mkdir rel in the same directory as src.

```
› rebar create-node nodeid=list_app
```

In a newly create **reltool.config** add **{lib_dir, ".."}** to the last argument for **sys**. It should look similar to this:

```
{app, list_app, [{mod_cond, app}, {incl_cond, include}, {lib_dir, ".."}]}
```

Package Erlang

Create **rebar.config** in root directory.

Add **{sub_dirs, ["rel"]}.** inside the file.

```
> rebar generate
```

File will be package under **/rel/list_app/bin** directory.

Start the app using **./list_app** inside **/bin**

Other reading

- ☞ cowboy
- ☞ basic-erlang-socket
- ☞ Bit syntax
- ☞ L 99, Ninety-Nine Lisp Problems
- ☞ `http://www.erlang.org/doc/design_principles/des_princ.html`

Thank you

Feedback & Question

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