"stack"

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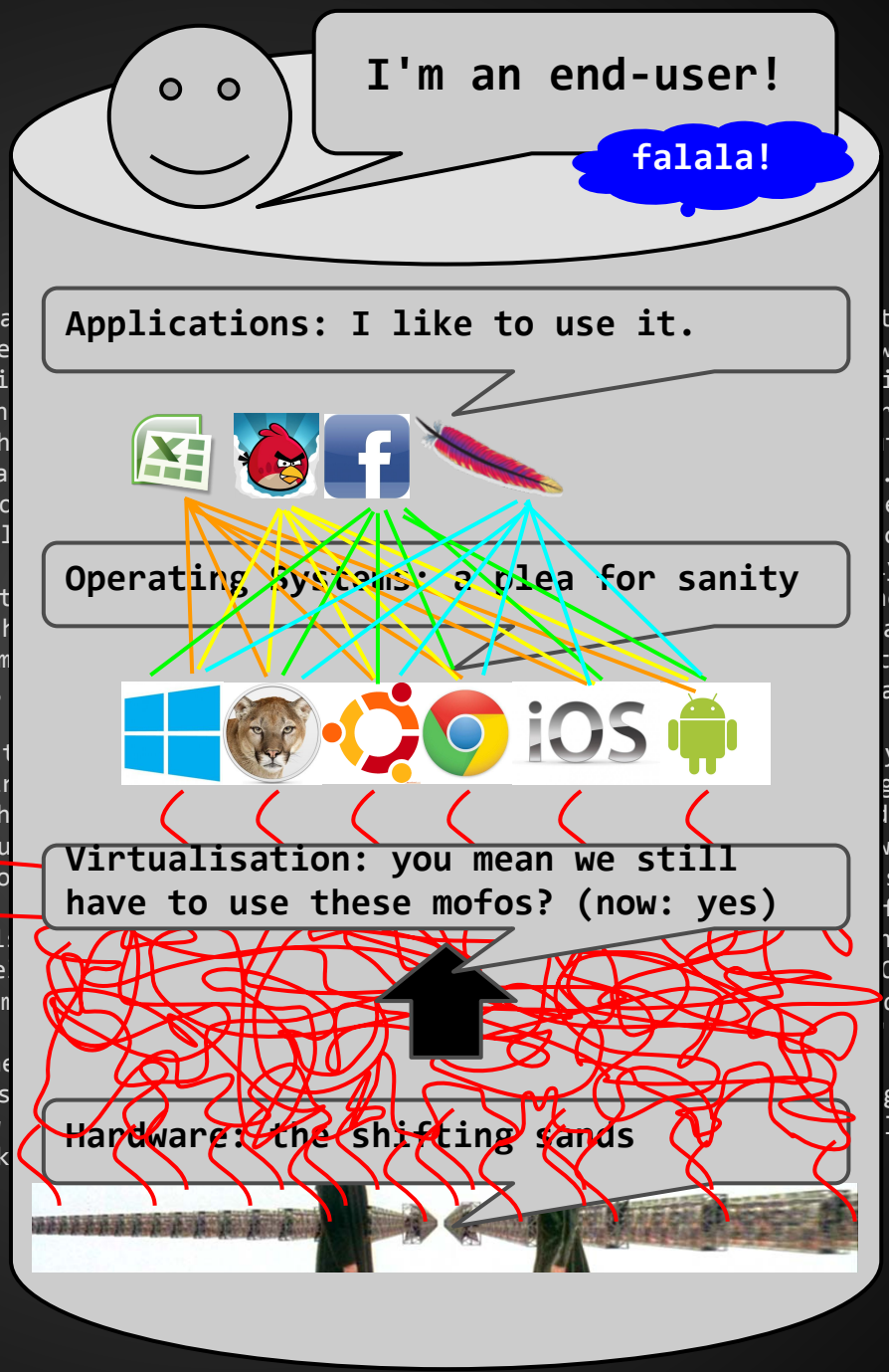

re-stack?

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Erlang/OTP?

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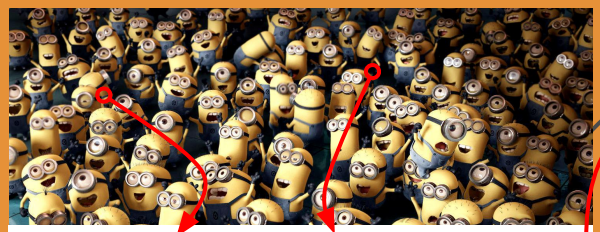
1. An Erlang **"Node a.k.a. Emulator a.k.a. VM"** runs as an **OS process**.

2. Internally it can manage '00s, '000s, or '000,000s of **Erlang processes**.



3. Erlang processes are spawned just by passing functions into **spawn()**.

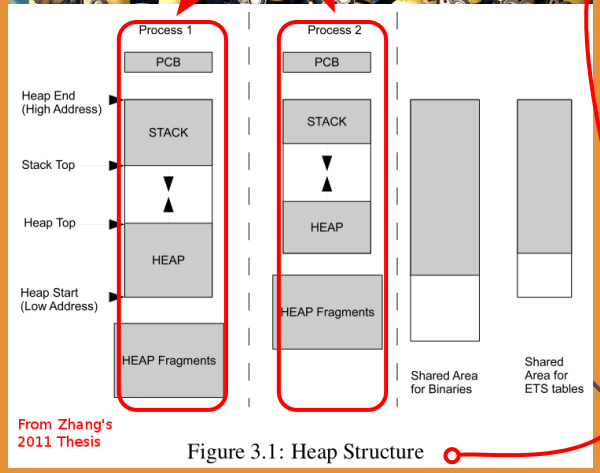
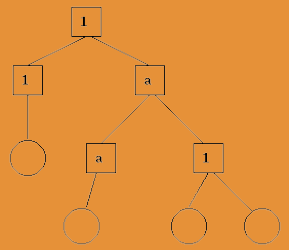


Figure 3.1: Heap Structure

4. Each Erlang process has its own **heap** and **stack** (implemented in the **OS process's heap**).

5. Erlang processes can talk to each other via **message passing** (messages are copied between Erlang processes' mailboxes).

6. Erlang processes can be organised into **supervision trees** which provide nodes with a framework for communal living and dying (very biological).



7. Architectural difference from e.g. Node.js:

Preemptive Multitasking of Erlang Processes (time sharing)

One **Scheduler** per logical core

a=>4
b=>?
c=>7
etc.
HEAP

|v|
|s|<=
|f|
|k|
|_|
STACK

An **OS Process** assigned this space...

Other OS Processes...

(RAM address space)

(logical cores)

(hardware cores)

(hardware RAM)

OS: Hardware Abstraction

Other Erlang nodes...

Other OS processes...

language layer; basic data types, and syntax - don't try to remember it right now

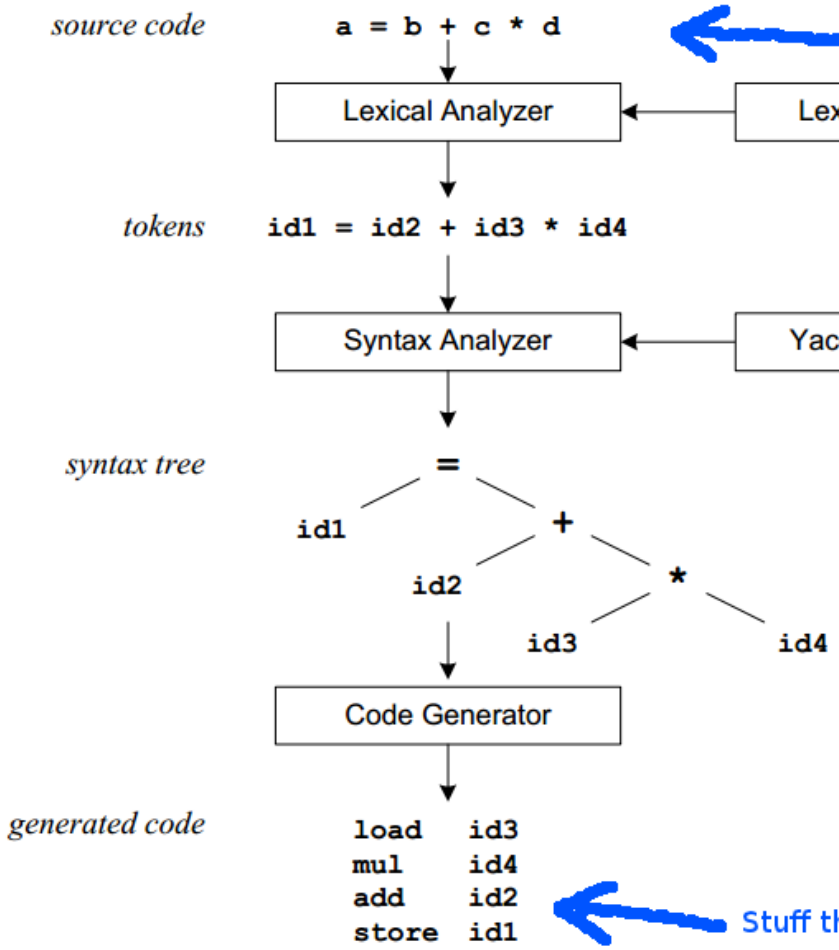
```
-module(dummy_module).
-compile(native).
-compile(export_all).

dummy_function()->
  A = lala,
  B = "lala",
  C = [$l,97,$l,$a],
  D = <<"lala">>,
  E = <<$l,$a,$l,97>>,

  F = 43794775025803947626847938 6,
  G = (3.142 + 2),          % 5.142
  H = "la" ++ [$l] ++ [97], % "lala"
  [1,2,3] == [ 1 | [2,3] ], % true

  I = {a,b,{d,e}},
  J = lists:reverse([1,2,3]), % [3,2,1]
  K = fun()->{ok,[A,B,G]} end,
  K.

% Then elsewhere, running
%   X = dummy_module:dummy_function(),
%   X().
% would return
% {ok, [lala,"lala",5.14199999... 5]}
```

```
% declares the module name
% targets MIs instead of byte codes
% declaring the interface

%function_name()->
%  VariableA = atom,
%  VariableB = "string",
%  VariableC = ditto, with less sugar,
%  VariableD = <<"binary">>,
%  VariableE = ditto, with less sugar,

%  VariableF = integer of any size,
%  Dynamic typing: floats + ints
%  Dynamic typing: strings
%  list [ head | tail ] syntax

%  VariableI = 3-tuple
%  VariableJ = module:function() call
%  VariableK = 1st-class fn, closure
%  dummy_function() can return the
closure

%  . ends dummy_function's declaration
```

POPULAR: "patten matching" basically means that you can use wild-cards in switch-cases, even for calling different branches of a function.

compilation : script, to abstract format... which goes into the module "compile"

Chart from:
http://epaperpress.com/lexandyacc/download/LexAndYaccTutorial.pdf



Stuff any programmer can write.

The tool that Eric Schmidt co-authored; now part of a pattern that OS X, Linux and Unix have in common (POSIX).

Erlang has "leex" and "yecc" which do similar work, and output "Abstract Formatted Erlang", which is fairly regular/readable, and probably a good compilation target for beginners (like me).

There's also a lower-level format called Core Erlang.

Stuff that machines are built to understand.

compilation : byte code and/or native code... what comes out of the "compile" module

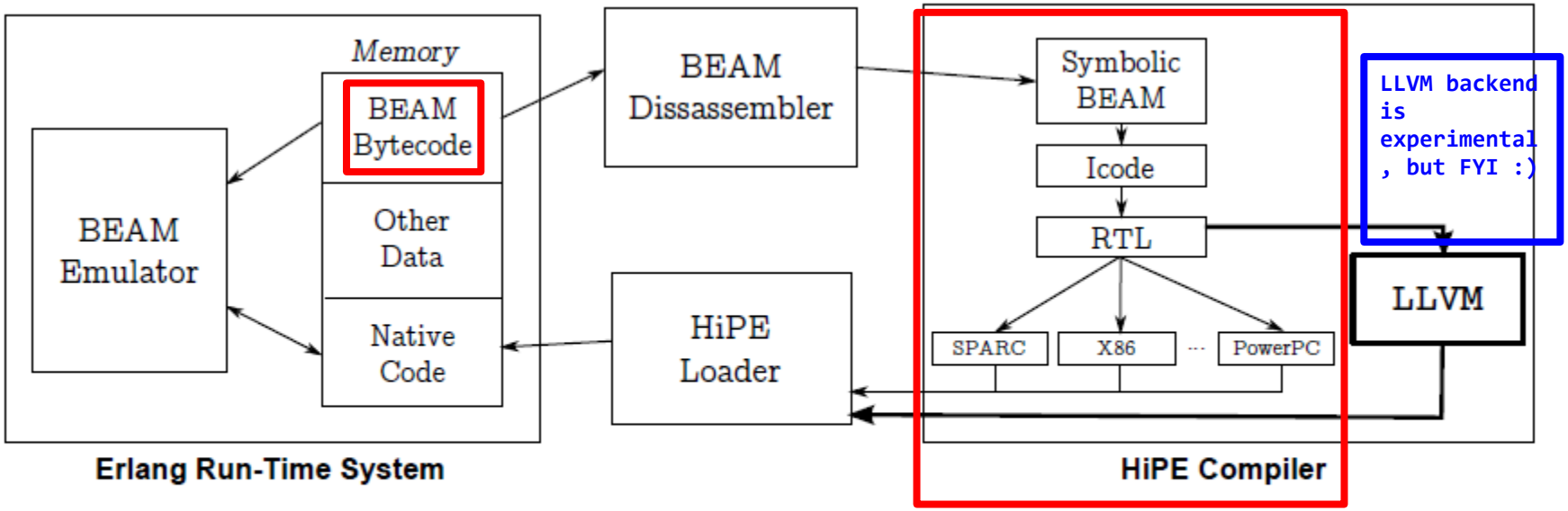


Figure 3.1: The new LLVM back end inside the Erlang/OTP system

from the thesis with the Greek cover page

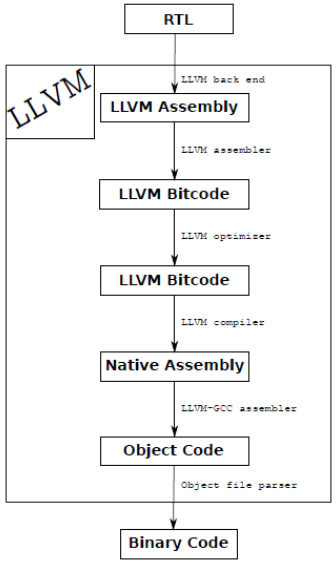


Figure 3.2: The LLVM component

Further reading (top picks):

- http://LearnYouSomeErlang.com
(easy, prosaic, illustrated intro to everything)

Search for it (or I can Dropbox the PDFs to you):

- Vorreuter's presentation on Hacking Erlang
(on compiling custom/other languages to Erlang's Abstract Format)

- Zhang's 2011 thesis: Erlang on many cores
(for a readable description of BEAM internals)

- Erl-llvm thesis with the Greek cover page
(more on lower-level & native compilation)

- A study of ETS table implementation and performance
(alternativs to Erlang's built-in in-memory key-value-store architecture/algorithms)

- Erlang-embedded whitepaper
(on getting a 3MB disk footprint, 16MB runtime)