@drkrab

Erjang — a JVM-based Erlang VM
A Journey into Erlang Land

Kresten Krab Thorup
Trifork CTO

software pilots
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The Desert of Java

Java was designed
in the client-server age

Synchronous coordination prevailed

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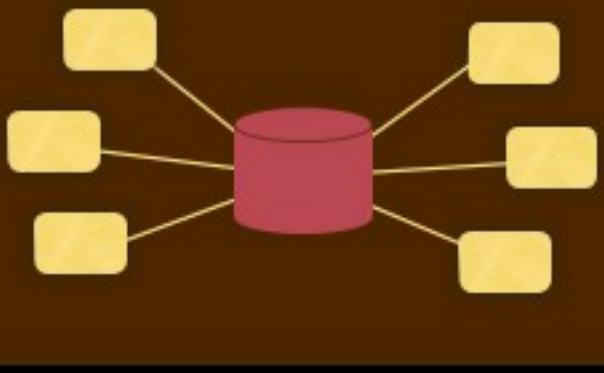

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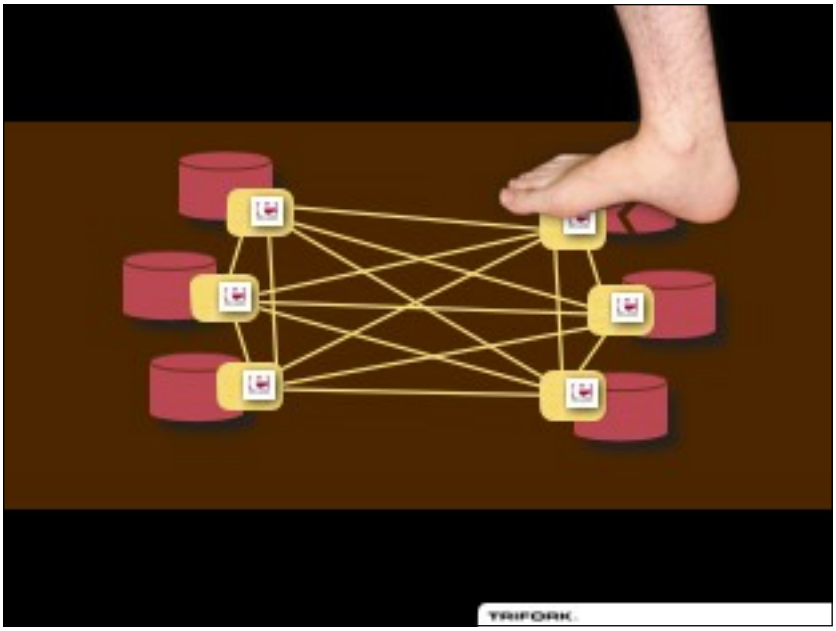

Erlang's raison d'être

Build reliable systems
in the presence of errors

⇒ Isolation + Concurrency

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process modeling

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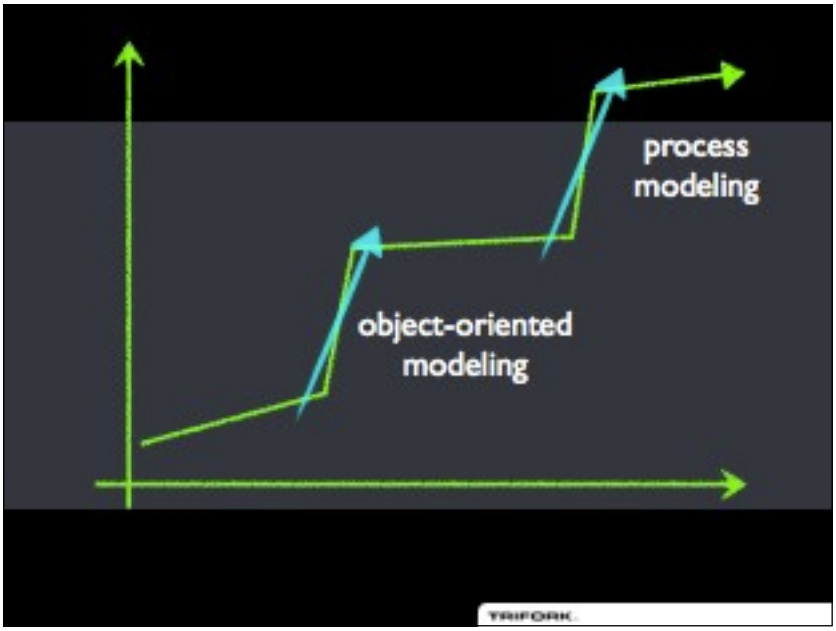
process
modeling
object-oriented
modeling
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1UP
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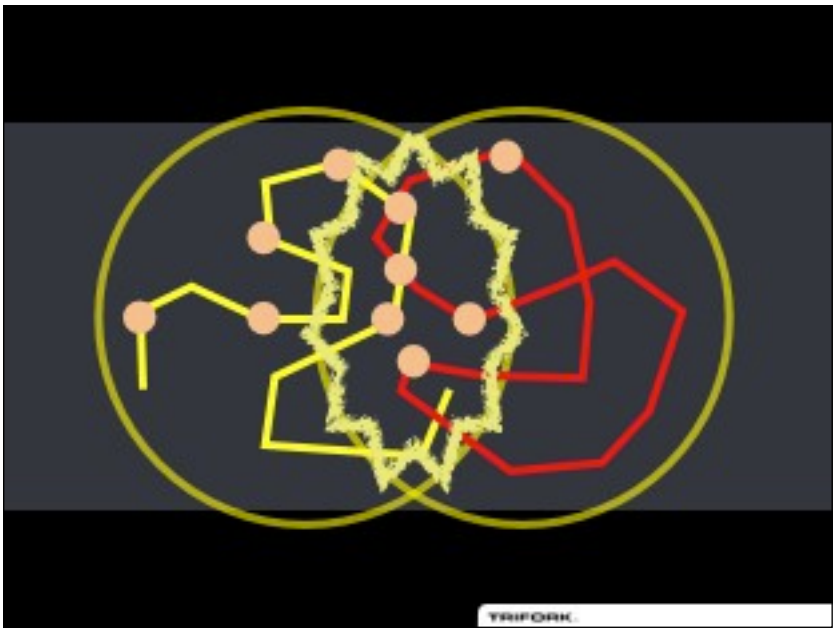
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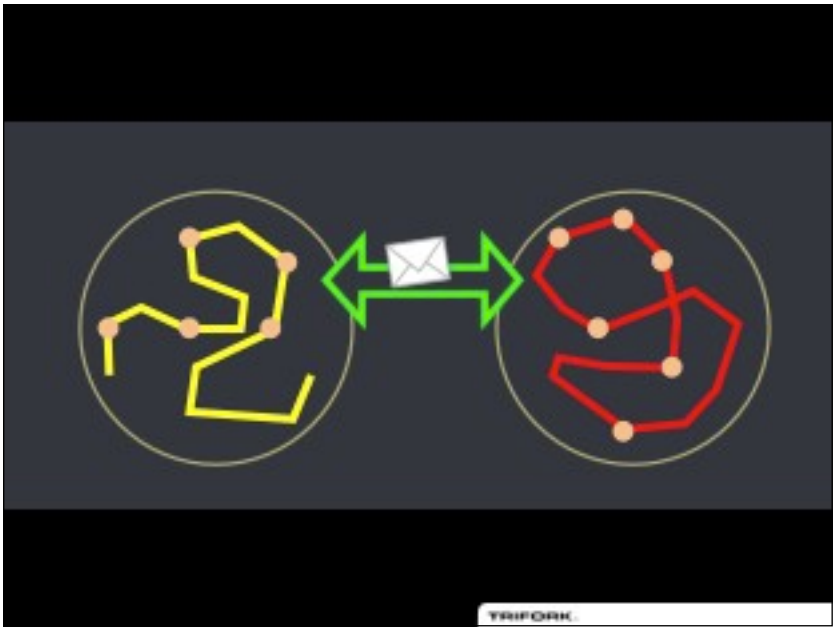
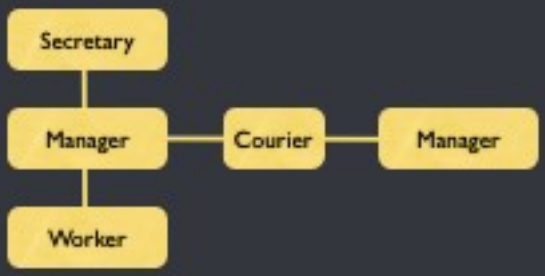


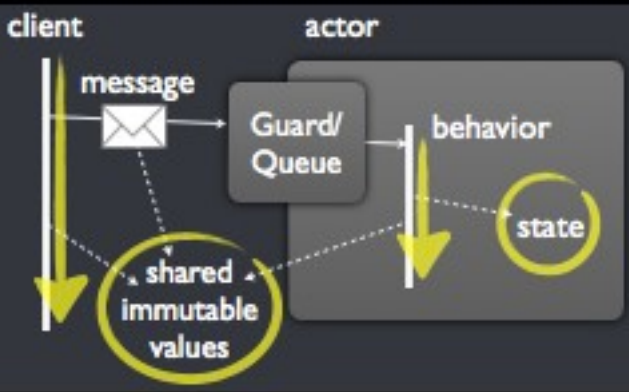
Anthropomorphic Programming

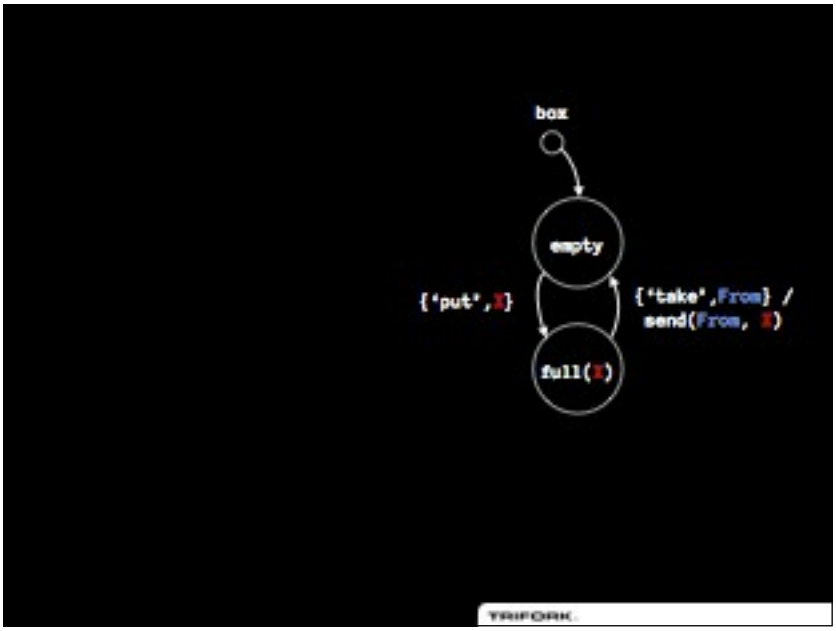


Morven Gentleman, SP&E 1981; Thomas & Barry ICT 2004

Hierachical Organizations

Process Aggregation

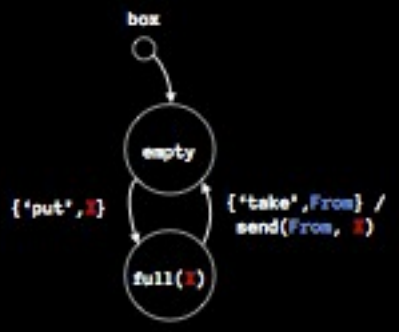





```
box() → empty().

empty() →
  receive
    {'put', X} →
        full(X)
  end.

full(X) →
  receive
    {'take', From} →
        From ! X,
        empty()
  end.
```

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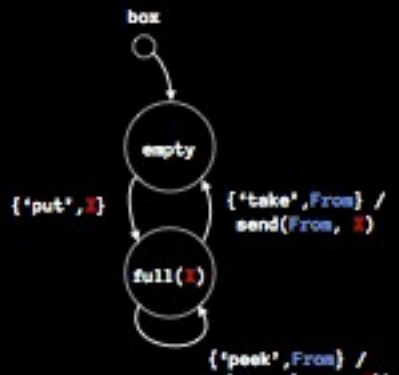

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        From ! X,
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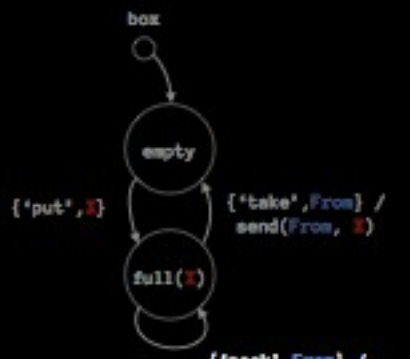
   {'peek', From} →
        From ! {'ok', X},
        full(X)
  end.
```

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        From ! {'ok', X},
        full(X)
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```

```
Box = spawn(box),

Box ! {'put', 27},

Box ! {'take', self()},
receive
  Value → print(Value)
end
```



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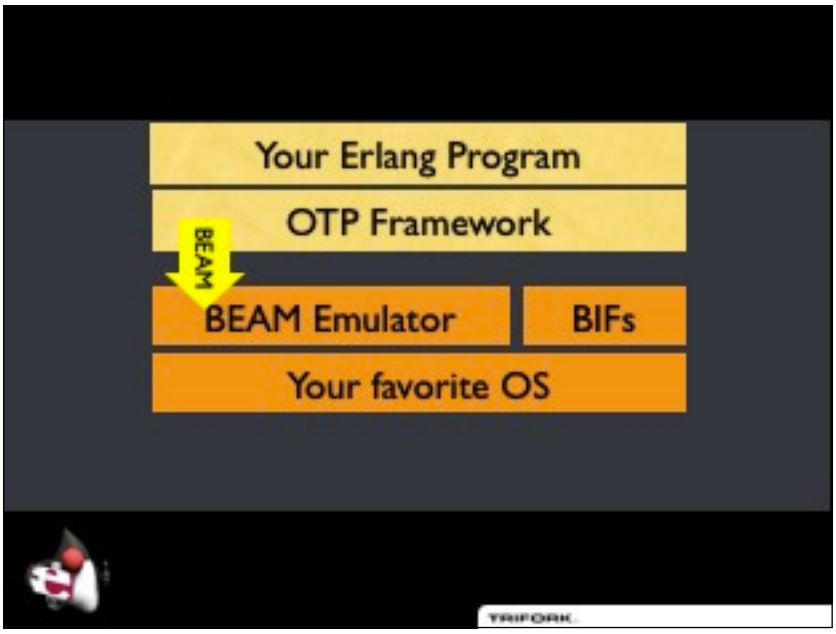
Your Erlang Program
OTP Framework
BEAM
BEAM Emulator
BIFs
Your favorite OS
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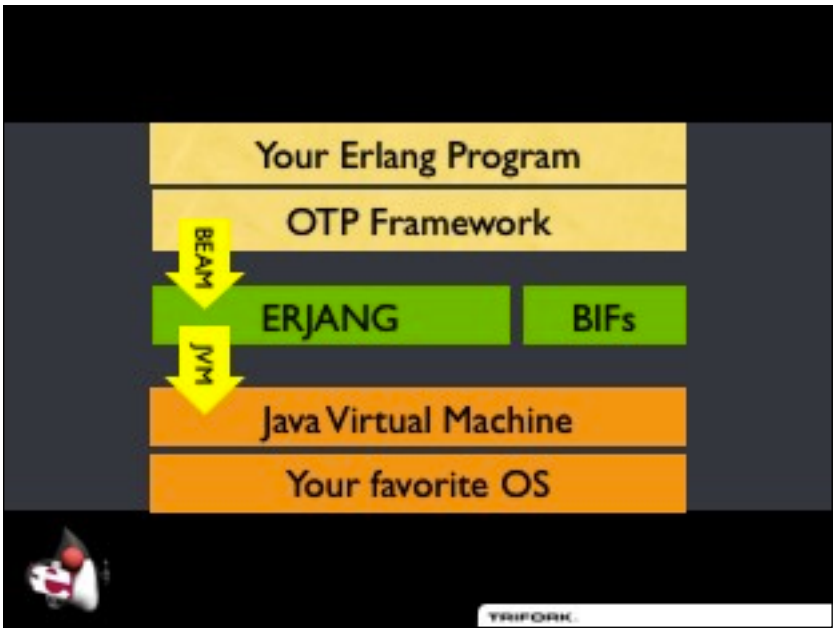
Your Erlang Program
OTP Framework
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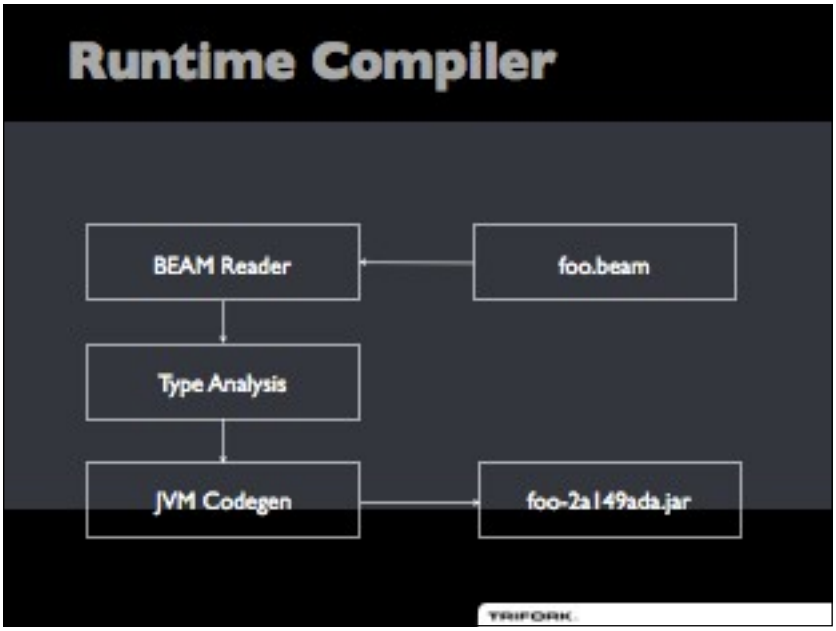
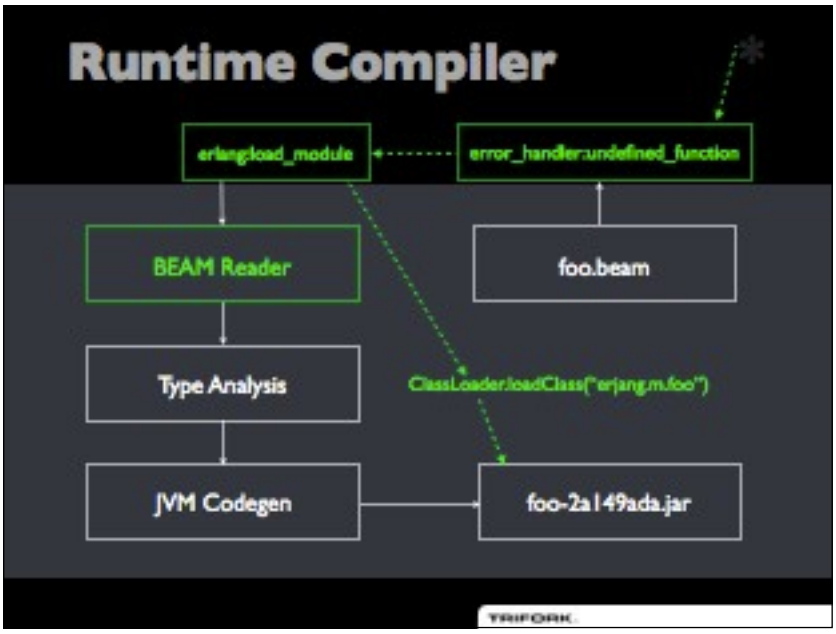
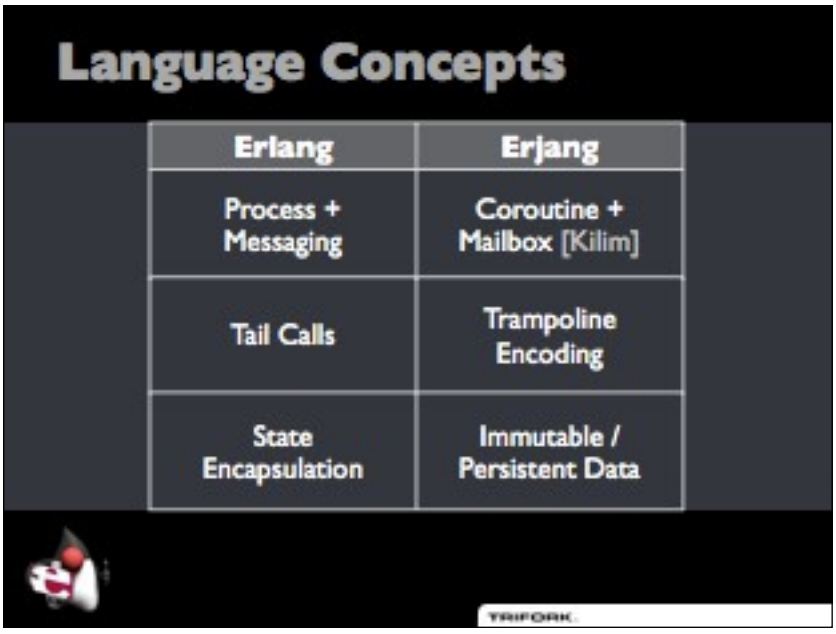
BIFs
JVM
Java Virtual Machine
Your favorite OS
TRIFORK


Runtime Compiler
BEAM Reader
foo.beam
Type Analysis
JVM Codegen
foo-2a149ada.jar
TRIFORK


Runtime Compiler
erlang:load_module
error_handler:undefined_function
BEAM Reader
foo.beam
Type Analysis
ClassLoader.loadClass("erjang.m.foo")
JVM Codegen
foo-2a149ada.jar
TRIFORK


Language Concepts
Erlang
Erjang
Process + Messaging
Coroutine + Mailbox [Kilim]
Tail Calls
Trampoline Encoding
State Encapsulation
Immutable / Persistent Data
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Tail Calls

```
-module(bar).

bat([H | T], T2) ->
  bat(T, foo(H, T2));

bat([], T2) -> T2.

foo(H, T) ->
  lists:reverse(H ++ T).
```

The BEAM Code

```
{function, bat, {nargs,2}}.
{label,264}.
  {test,is_nonempty_list,{else,265},[{x,0}]}.
  {get_list,{x,0},{x,0},{y,0}}.
  {call,2,foo}.
  {move,{x,0},{x,1}}.
  {move,{y,0},{x,0}}.
  {call_last,2,bat,1}.
{label,265}.
  {test,is_nil,{else,263},[{x,0}]}.
  {move,{x,1},{x,0}}.
  return.
{label,263}.
  {func_info,{atom,appmon_bar},{atom,bat},2}.
```


```
public static EObject
    bat___2(EProc eproc, EObject arg1, EObject arg2)
{
   ECons cons; ENil nil;
  tail:
    if((cons = arg1.test_nonempty_list()) != null) {
      // extract list
      EObject hd = cons.head();
      EObject tl = cons.tail();
      // call foo/2
      EObject tmp = foo___2(eproc, hd, arg2);
      // self-tail recursion
      arg1 = tl;
      arg2 = tmp;
      goto tail;
    } else if ((nil = arg1.test_nil()) != null) {
      return arg2;
    }
   throw ERT.badyc_info(am_bar, am_bat, 2);
}
```

Erlang ⇒ JVM

```
-module(bar).

bat([H | T], T2) ->
  bat(T, foo(H, T2));

bat([], T2) -> T2.
```

```
foo(H, T) ->
  lists:reverse(H ++ T).
```


```
foo(H, T) ->
  lists:reverse(H ++ T).
```

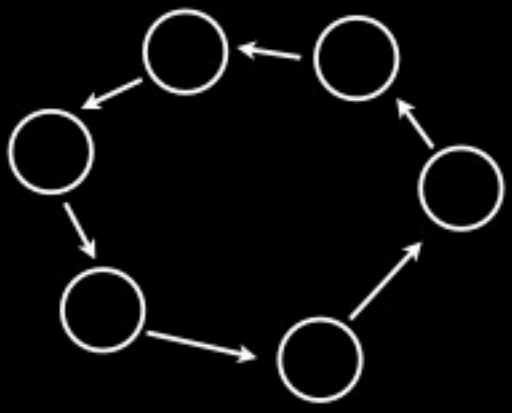
```
public static EObject
    foo__2(EProc p, EObject H, EObject T)
{
    EObject r = foo__2$body(p,H,T);
    while (r == TAIL_MARKER) {
       r = p.tail.go();
    }
    return r;
}
```


```
foo(H, T) ->
  lists:reverse(H ++ T).
```

```
public static
    EObject foo__2$body(EProc p, EObject H, EObject T)
{
    // Tmp = erlang:'++'(H,T)
    EObject tmp = erlang_append__2.invoke(p,H,T);

    // return lists:reverse(Tmp)
    p.tail = lists__reverse_1;
    p.arg1 = tmp;
    return TAIL_MARKER;
}
```

The ring!



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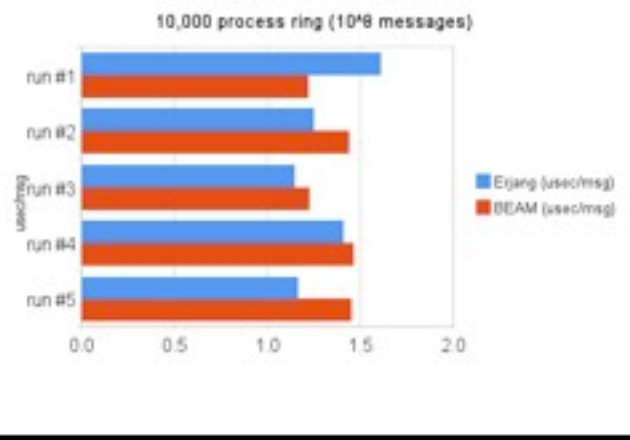

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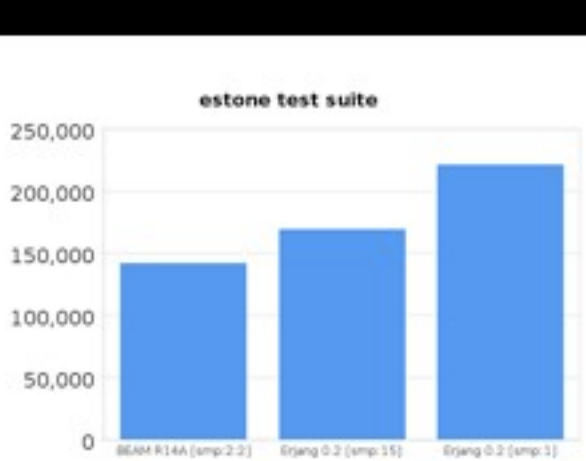

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Interfacing to Java

- Erlang's primitive operations "BIFs" are implemented in Java
- @BIF annotation makes a static-public method available from Erlang.
- Erlang port concept for "drivers"

Example BIF

```
// foo:bar(...) native Bodyction

package erjang.m.foo;
class foo extends ENative {

  @BIF public static
  EObject bar(EProc proc, EObject arg1, arg2, ...)  {


  }
}
```

Example BIF

```
@BIF public static EObject
spawn_link(EProc proc, EObject mod, EObject fun, EObject args)
     throws Pausable {
        EAtom m = mod.testAtom();
        EAtom f = fun.testAtom();
        ESeq  a = args.testSeq();

        if (m==null||f==null||a==null)
                throw ERT.badarg(mod, fun, args);

        EProc p2 = new EProc(proc.group_leader(), m, f, a);
        p2.link_to(proc);
        ERT.run(p2);

        return p2.self_handle();
}
```

Interfacing to Java

```
demo() ->
    Map = 'java.util.HashMap':new(),
    Map:put('x', "4"),
    Map:put(1, 'foo'),
    print(Map).

print([]) -> ok;
print([{Key,Val}|Tail]) ->
    io:format("key=~p, value=~p~n",
                    [Key,Val]),
    print(Tail).
```

Interfacing to Java

```
java.util.Map      [{Key,Value}, ...]
                 | fun(Key) -> Value
java.util.List     [Elem0, Elem1, ...]
Object[]           [Elem0, Elem1, ...]
“foo”              “foo” (a.k.a. [97,98,99] )
java.lang.Runnable fun() -> value

fun(Op,Parms,Args) -> interface
```

"The world *is* concurrent. ... I could not drive my car on the highway if I did not intuitively understand the notion of concurrency..." —Joe Armstrong

http://www.youtube.com/watch?v=N0OUqYZMEZk

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