Lucene Server

From Erlang to Java and Back Again

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Hello World!!
About Me
• Programmer since the age of 10
• Coded in Basic, .NET, Java, JS, ...
• Erlang programmer for the last 5 years
• Director of Engineering at Inaka
About Inaka
• We're based in Argentina
• We do Erlang consulting
• We build end-to-end applications
• We develop highly-concurrent servers for applications like Whisper or TigerText
About TigerText
• Provides secure communication for mobile devices
• Heavily used by health-care companies
• Also provides the underlying communication platform for other apps
• All servers written in Erlang


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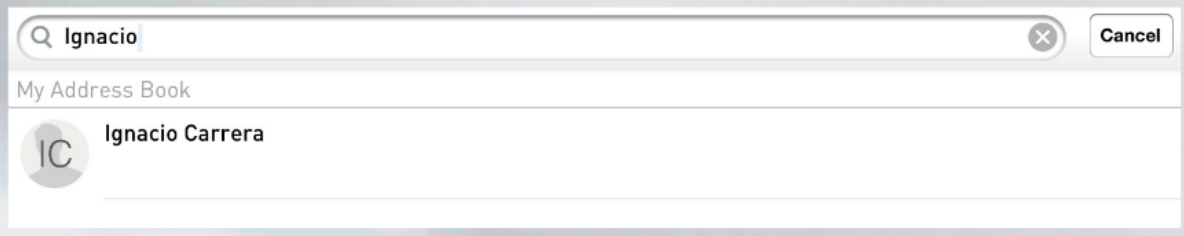
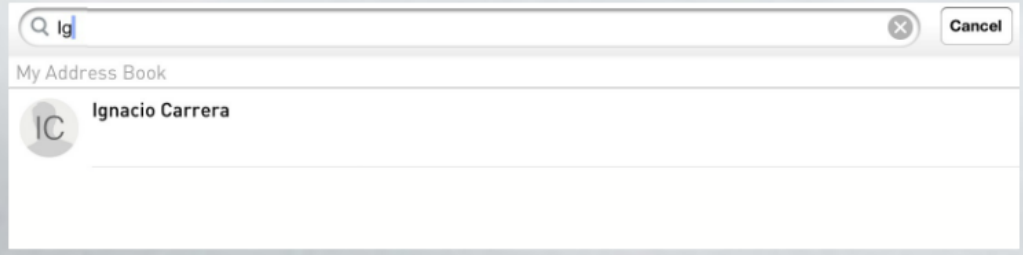
The Story

The Scenario



We had a very basic search field for users…

Functional Requests



We wanted to add the following features:

- Partial Matching
- Autocomplete
- Advanced Search (by field, location, etc.)
- Ranked Results

Technical Requests

We also wanted our solution to be:

- Implemented in Erlang
- Included in our existing servers as a rebar dependency
- Fast and scalable

Lucene Core

A high-performance, scalable, full-featured text search engine library with powerful, accurate and efficient search algorithms

...but...

It's written in JAVA

JInterface

A Java library that let's you create "nodes" in Java and provides the means to communicate them with regular Erlang nodes

…and…

It comes with Erlang!

Lucene Server

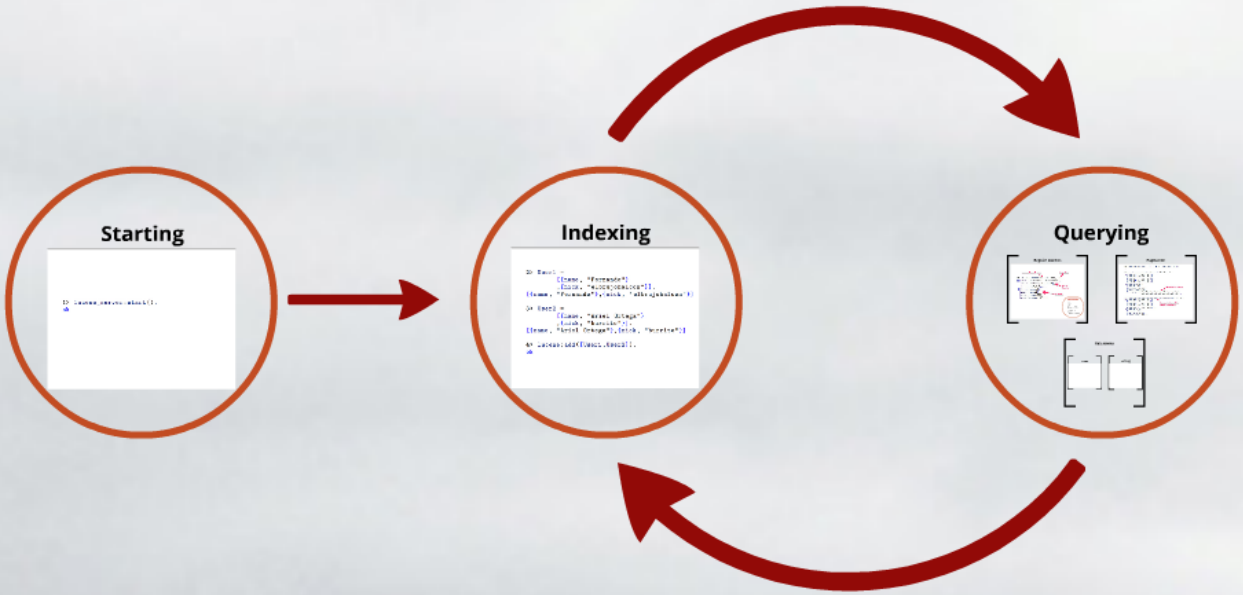
An OTP compliant application that provides indexing and querying access to a lucene backend without any JAVA knowledge requirement for its users

Lucene Server

How it works

How it's done

How it works



Starting

```
1> lucene_server:start().
ok
```

Indexing

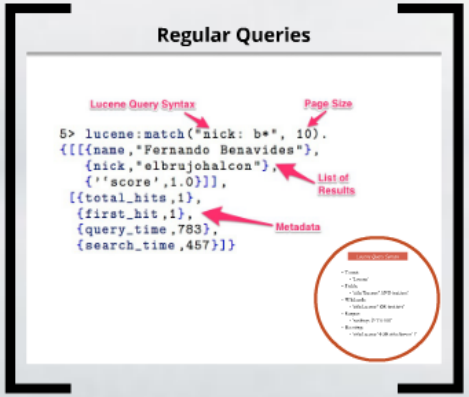
```
2> User1 =
        [{name, "Fernando"}
        ,{nick, "elbrujohalcon"}].
[{name, "Fernando"},{nick, "elbrujohalcon"}]

3> User2 =
        [{name, "Ariel Ortega"}
        ,{nick, "burrito"}].
[{name, "Ariel Ortega"},{nick, "burrito"}]

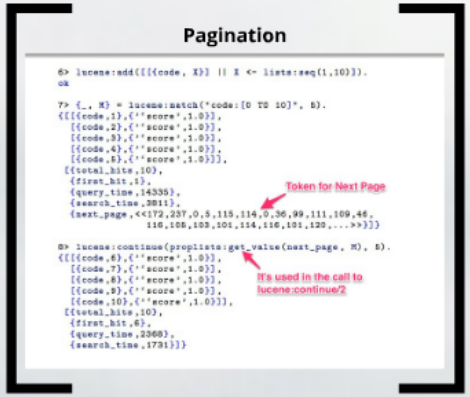
4> lucene:add([User1,User2]).
ok
```

Querying

Regular Queries



Pagination

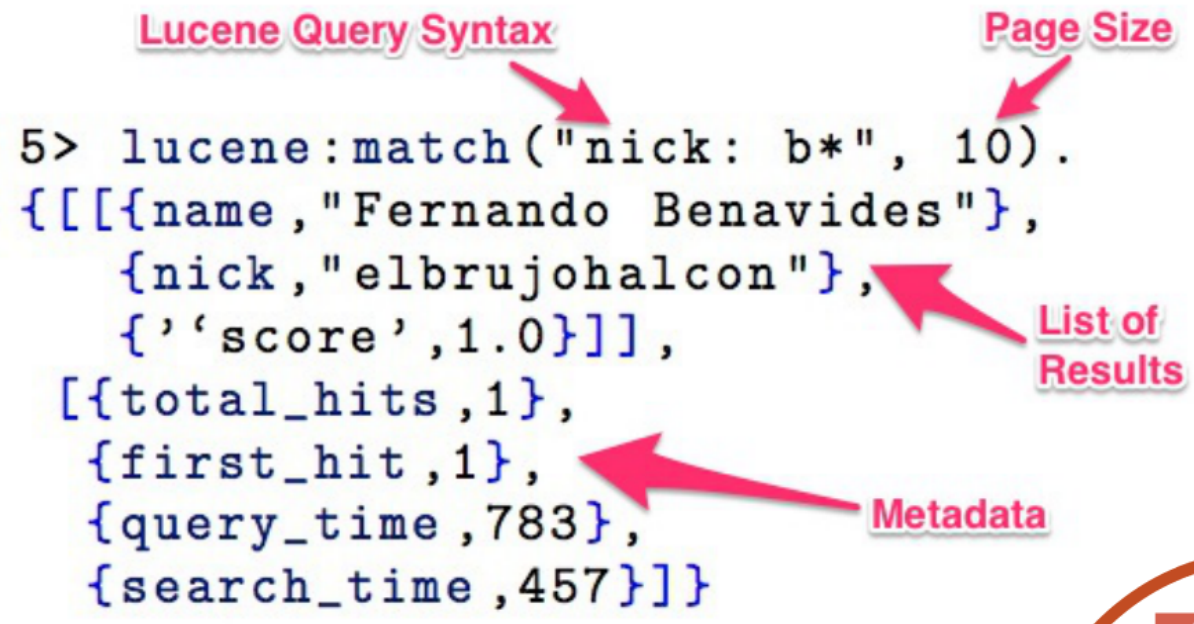


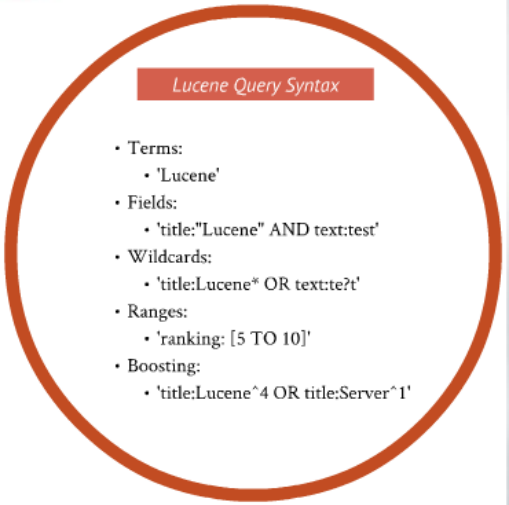
Extensions

.near

.erlang

Regular Queries





Lucene Query Syntax

- Terms:
  - 'Lucene'
- Fields:
  - 'title:"Lucene" AND text:test'
- Wildcards:
  - 'title:Lucene* OR text:te?t'
- Ranges:
  - 'ranking: [5 TO 10]'
- Boosting:
  - 'title:Lucene^4 OR title:Server^1'

Pagination

```
6> lucene:add([[{code, X}] || X <- lists:seq(1,10)]).
ok

7> {_, M} = lucene:match("code:[0 TO 10]", 5).
{[[{code,1},{''score',1.0}],
  [{code,2},{''score',1.0}],
  [{code,3},{''score',1.0}],
  [{code,4},{''score',1.0}],
  [{code,5},{''score',1.0}]],
 [{total_hits,10},
  {first_hit,1},
  {query_time,14335},
  {search_time,3811},
  {next_page,<<172,237,0,5,115,114,0,36,99,111,109,46,
               116,105,103,101,114,116,101,120,...>>}]}

8> lucene:continue(proplists:get_value(next_page, M), 5).
{[[{code,6},{''score',1.0}],
  [{code,7},{''score',1.0}],
  [{code,8},{''score',1.0}],
  [{code,9},{''score',1.0}],
  [{code,10},{''score',1.0}]],
 [{total_hits,10},
  {first_hit,6},
  {query_time,2368},
  {search_time,1731}]}
```

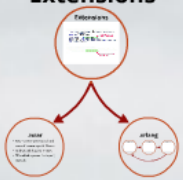
Token for Next Page

It's used in the call to lucene:continue/2

How it's done

An OTP Application

Extensions



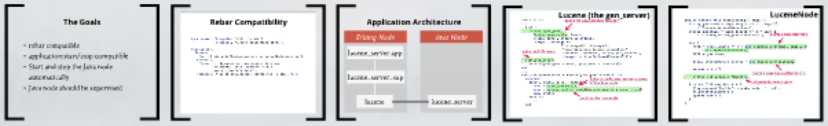
v0.1 — V1.0 — V1.1 — V2.0

A gen_server in Java

The Future

- More extensions!
- Security improvements
- Other backends? (Currently it's just in-memory)
- More users! That's YOU!!

An OTP Application



V0.1

The Goals

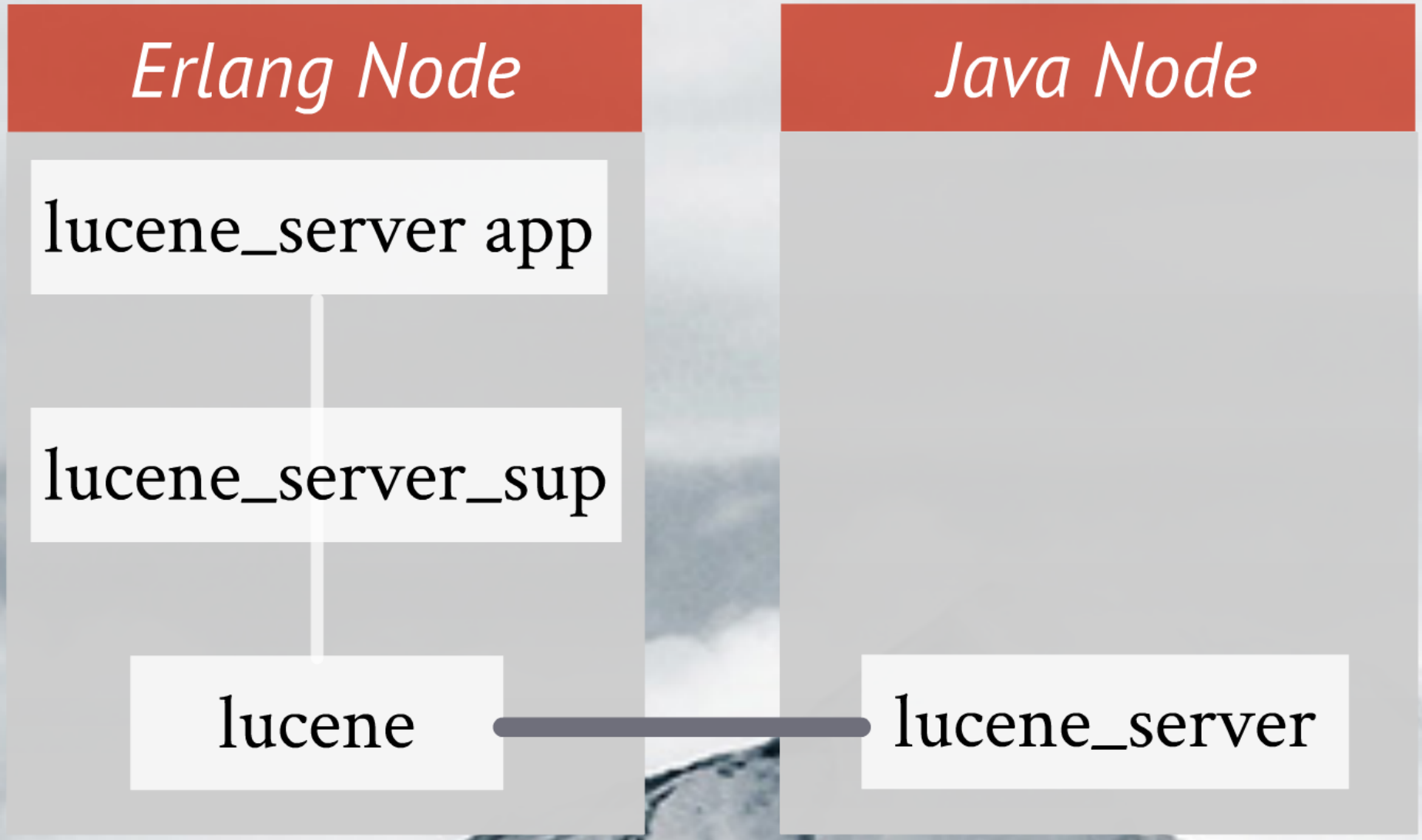
- rebar compatible
- application:start/stop compatible
- Start and stop the Java node automatically
- Java node should be supervised

Rebar Compatibility

```
{pre_hooks, [{compile, "mkdir -p bin"},
             {compile, "./copy-jinterface.sh"}]}.

{post_hooks,
  [{clean,
    "rm -rf bin priv/lucene_server.jar priv/OtpErlang.jar"},
   {compile,
    "javac -g -deprecation -sourcepath java_src
           -classpath ./bin:./priv/* -d bin
           java_src/*/*/*/*.java"},
   {compile, "jar cf priv/lucene-server.jar -C bin ."}]}.
```

Application Architecture



Lucene (the gen_server)

```
init([]) ->
...
  Port =
      erlang:open_port(
        {spawn_executable, Java},
        [{line,1000}, stderr_to_stdout,
         {args, JavaArgs ++
                ["-classpath", Classpath,
                 "com.tigertext.lucene.LuceneNode",
                 ThisNode, JavaNode, erlang:get_cookie(),
                 integer_to_list(AllowedThreads)]}]),
  wait_for_ready(
     #state{java_port = Port, java_node = JavaNode})
end.
...
wait_for_ready(State = #state{java_port = Port}) ->
  receive
    {Port, {data, {eol, "READY"}}}
      true = link(process()),
      true = erlang:monitor_node(State#state.java_node, true),
      {ok, State};
    Info ->
      ...
  end.
```

opens the Java process as a port

waits until it's ready

links to the lucene_server process in the Java node

monitors the Java node

LuceneNode

```
public static void main(String[] args) {
  String peerName = args.length >= 1 ? args[0]
      : "lucene_server@localhost";
  String nodeName = args.length >= 2 ? args[1]
      : "lucene_server_java@localhost";

  try {
    NODE = args.length >= 3 ? new OtpNode(nodeName, args[2])
        : new OtpNode(nodeName);
    PEER = peerName;

    final OtpGenServer server = new LuceneServer(NODE);

    server.start();

    System.out.println("READY");

  } catch (IOException e1) {
    jlog.severe("Couldn't create node: " + e1);
    e1.printStackTrace();
    System.exit(1);
  }
}
```

Starts a new OtpNode

Starts a new LuceneServer in it

Signals its ready state

V1.0

A gen_server in Java

Introduction

We had a process on the Java node that received messages and, for some of them, it "returned" a value.

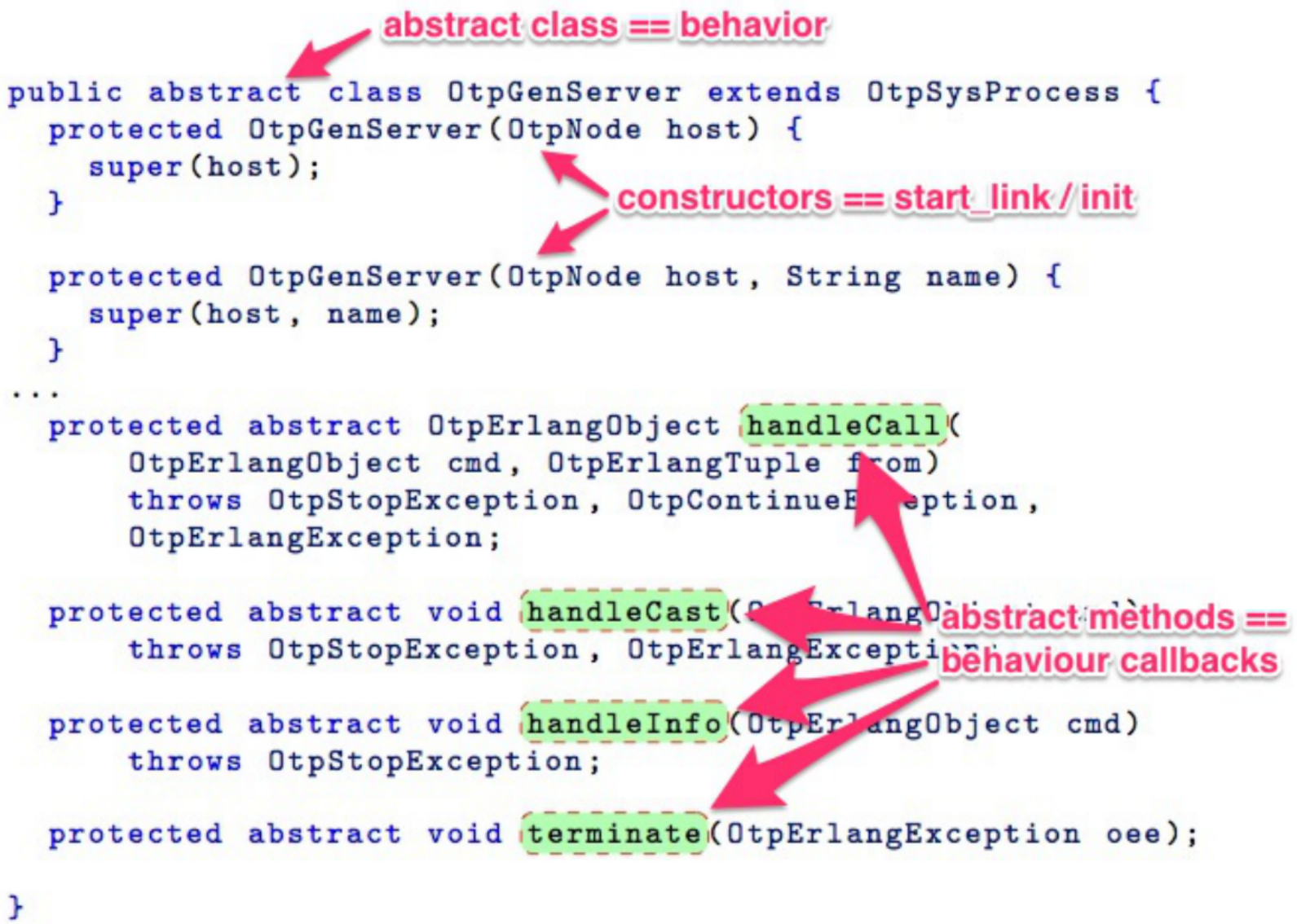
That looked a lot like a gen_server.

We also wanted all the functionality gen_server provides for its clients

code in gen.erl

```
do_call(Process, Label, Request, Timeout) ->
    try erlang:monitor(process, Process) of
        Mref ->
...
    catch
        error:_ ->
            %% Node (C/Java?) is not supporting the monitor.
            %% The other possible case -- this node is not
            %% distributed -- should have been handled earlier.
            %% Do the best possible with monitor_node/2.
            %% This code may hang indefinitely if the Process
            %% does not exist. It is only used for featureweak
            %% remote nodes.
            Node = get_node(Process),
            monitor_node(Node, true),
...
    end.
```

OtpGenServer




```
public abstract class OtpGenServer extends OtpSysProcess {
  protected OtpGenServer(OtpNode host) {
    super(host);
  }

  protected OtpGenServer(OtpNode host, String name) {
    super(host, name);
  }
...
  protected abstract OtpErlangObject handleCall(
      OtpErlangObject cmd, OtpErlangTuple from)
      throws OtpStopException, OtpContinueException,
      OtpErlangException;

  protected abstract void handleCast(OtpErlangObject cmd)
      throws OtpStopException, OtpErlangException;

  protected abstract void handleInfo(OtpErlangObject cmd)
      throws OtpStopException;

  protected abstract void terminate(OtpErlangException oee);

}
```

LuceneServer

```
protected OtpErlangObject handleCall(OtpErlangObject cmd,
    OtpErlangTuple from)
    throws OtpStopException, OtpContinueException,
    OtpErlangException {

  OtpErlangTuple cmdTuple = (OtpErlangTuple) cmd;
  OtpErlangAtom cmdName = (OtpErlangAtom) cmdTuple.elementAt(0);

  if (cmdName.atomValue().equals("pid")) {
    return super.getSelf();
  } else if (cmdName.atomValue().equals("match")) {
    String queryString =
      ((OtpErlangString) cmdTuple.elementAt(1)).stringValue();
    int pageSize =
      ((OtpErlangLong) cmdTuple.elementAt(2)).intValue();

    runMatch(queryString, pageSize, from);

    throw new OtpContinueException();

  } else
...
}
```

{pid}

{reply, self(), State}

{match, QueryString, PageSize}

{noreply, State}

JInterface-stdlib

- Open-source library
- OTP/rebar compatible
- Includes:
    - OtpSysProcess: like gen module
    - OtpGenServer: like gen_server module

Extensions

.near

- NearParserExtension is built around lucene-spatial library
- Indexes fields using n-tiers
- We added a parser for #geo{} records

V1.0

V1.1

V2.0

Extensions

.near

Special value type:
#geo{lat :: float(), lon :: float()}

parameters: lat,lon,dist (in miles)

```
9> lucene:add(
     [[{index, I},{location, lucene_utils:geo(I/2,I+1.5)}]
      || I <- lists:seq(-10,10)]).
ok

10> lucene:match("location.near:0.0,1.0,100", 3).
{[[{index,0},
   {location,{geo,-8.381903171539307e-8,1.5000000782310963}},
   {''score',-17.292743682861328}],
  [{index,-1},
   {location,{geo,-0.5000000540167093,0.500000137835741}},
   {''score',-24.45547866821289}]],
 [{total_hits,2},
  {first_hit,1},
  {query_time,1984},
  {search_time,1021}]}
```

.erlang

an Erlang function

arguments (last one is always a list of values for the chosen field)

```
11> lucene:match(
      "index.erlang:\"lists:map:[fun(X) -> X*1.0 end]\"", 3).
{[[{index,10},
   {location,{geo,4.999999953433871,11.500000152736902}},
   {''score',5.0}],
  [{index,9},
   {location,{geo,4.499999983236194,10.49999987706542}},
   {''score',4.499999523162842}],
  [{index,8},
   {location,{geo,4.000000013038516,9.499999936670065}},
   {''score',3.9999997615814213}]],
 [{total_hits,21},
  {first_hit,1},
  {query_time,2256},
  {search_time,1240},
  {next_page,<<172,237,0,5,115,114,0,36,99,111,109,46,
               116,105,103,101,114,116,101,120,...>>}]}
```

.near

Special value type:
#geo{lat :: float(), lon :: float()}

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   {''score',3.999999761581421}]],
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  {search_time,1240},
  {next_page,<<172,237,0,5,115,114,0,36,99,111,109,46,
               116,105,103,101,114,116,101,120,...>>}]}
```

Extensions

Extensions

```
public LuceneServer(DtpNode host, int allowedThreads)
    throws CorruptIndexException, LockObtainFailedException,
           IOException {
  super(host, "lucene_server");
  ...
  Extensions ext = new Extensions(',');
  ext.add("near", new NearParserExtension());
  ext.add("erlang", new ErlangParserExtension(this.translator));
  this.extensions = ext;
  ...
}

private QueryParser queryParser() {
  return new LuceneQueryParser(Version.LUCENE_36, this.analyzer,
      this.translator, this.extensions);
}
```

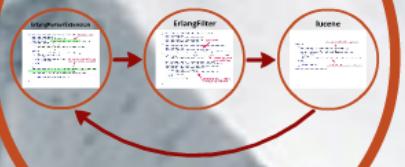
an extensions array using ',' as delimiter

is used when building query parser

.near

- NearParserExtension is built around lucene-spatial library
- Indexes fields using n-tiers
- We added a parser for #geo{} records

.erlang



Extensions

```
public LuceneServer(OtpNode host, int allowedThreads)
    throws CorruptIndexException, LockObtainFailedException,
           IOException {
  super(host, "lucene_server");
...
  Extensions ext = new Extensions('.');
  ext.add("near", new NearParserExtension());
  ext.add("erlang", new ErlangParserExtension(this.translator));
  this.extensions = ext;
...
}

private QueryParser queryParser() {
  return new LuceneQueryParser(Version.LUCENE_36, this.analyzer,
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```

an extensions array using '.' as delimiter

is used when building query parser


.near
• NearParserExtension is built around lucene-spatial library
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.erlang


ErlangParserExtension
Parses the query
Generates an ErlangFilter and uses it to filter the documents
ErlangFilter
(MFA Values)
calls the gen_server at the Erlang node
parses each result as either a double (score) or just false
lucene
exec, parse and eval the arguments
exec Mod:Fun(Arguments as Values)

ErlangParserExtension

```
public Query parse(ExtensionQuery extQuery)
  throws ParseException {
  String key = extQuery.getField();
  String[] modFun = extQuery.getRawQueryString().split(":");
  if (modFun.length < 2) {
    throw new ParseException(
        "erlang queries expect values in <mod>:<fun> or
         <mod>:<fun>:<args> format");
  } else {
    String mod = modFun[0], fun = modFun[1], args;
    if (modFun.length == 2) {
      args = "[]";
    } else if (modFun.length == 3) {
      args = modFun[2];
    } else {
...
    }
    ErlangFilter filter = new ErlangFilter(mod, fun, args, key,
        this.translator.getFieldType(key));
    ValueSource valSrc = new ErlangValueSource(filter);
    return new CustomScoreQuery(new ConstantScoreQuery(filter),
        new ValueSourceQuery(valSrc));
  }
}
```

Parses the query

Generates an ErlangFilter and uses it to filter the documents

ErlangFilter

```
public DocIdSet getDocIdSet(IndexReader reader)
  throws IOException {
  final int docBase = this.nextDocBase;
  this.nextDocBase += reader.maxDoc();
  final OtpErlangObject[] docValues;
...
  final FixedBitSet bits = new FixedBitSet(reader.maxDoc());
  OtpErlangTuple call =
    new OtpErlangTuple(new OtpErlangObject[] {
      this.mod,this.fun,this.arg, new OtpErlangList(docValues)});
...
  OtpErlangObject response = OtpGenServer.call(LuceneNode.NODE,
      "lucene", LuceneNode.PEER, call);
...
  OtpErlangList results = (OtpErlangList) response;
  for (int docid = 0; docid < docValues.length; docid++) {
    OtpErlangObject result = results.elementAt(docid);
    if (result instanceof OtpErlangDouble) {
      scores.put(docid + docBase,
          ((OtpErlangDouble) result).doubleValue());
      bits.set(docid);
    } else {
      bits.clear(docid);
    }
...
}
```

{M,F,A,Values}

calls the gen_server at the Erlang node

parses each result as either a double (score) or just false

lucene

```
Reply =
  try
    {ok, Scanned, _} = erl_scan:string(Args++"."),
    {ok, Parsed} = erl_parse:parse_exprs(Scanned),
    {value, Arguments, _} = erl_eval:exprs(Parsed, []),
    erlang:apply(
      Mod,Fun,
      Arguments ++ [[parse_value(Value) || Value <- Values]])
  catch
    _:Error ->
      {error, Error}
  end,
gen_server:reply(From, Reply)
```

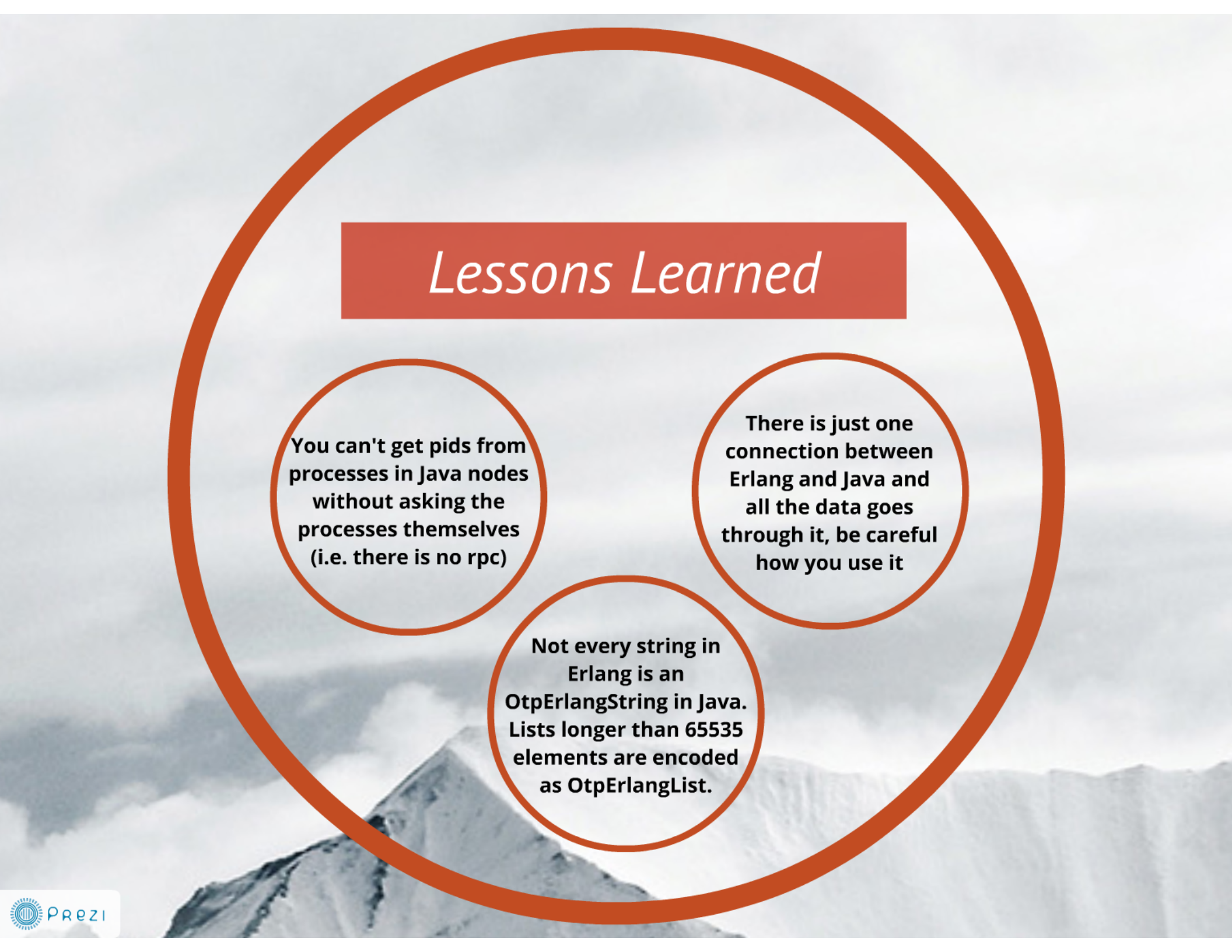
scan, parse and eval the arguments

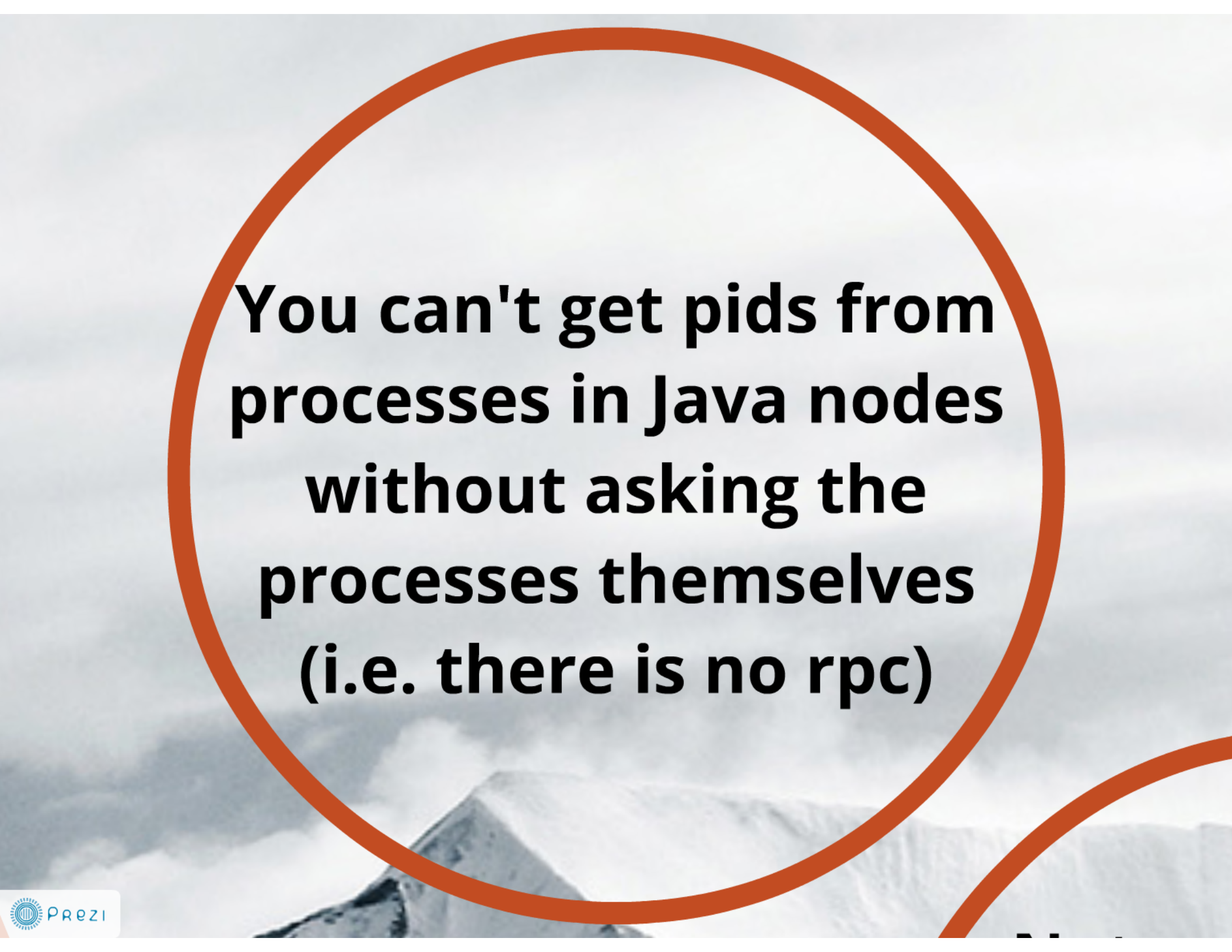
evals Mod:Fun(Arguments ++ [Values])

V2.0

The Future

- More extensions!
- Security improvements
- Other backends? (Currently it's just in-memory)
- More users! That's YOU!!


Lessons Learned
You can't get pids from processes in Java nodes without asking the processes themselves (i.e. there is no rpc)
There is just one connection between Erlang and Java and all the data goes through it, be careful how you use it
Not every string in Erlang is an OtpErlangString in Java. Lists longer than 65535 elements are encoded as OtpErlangList.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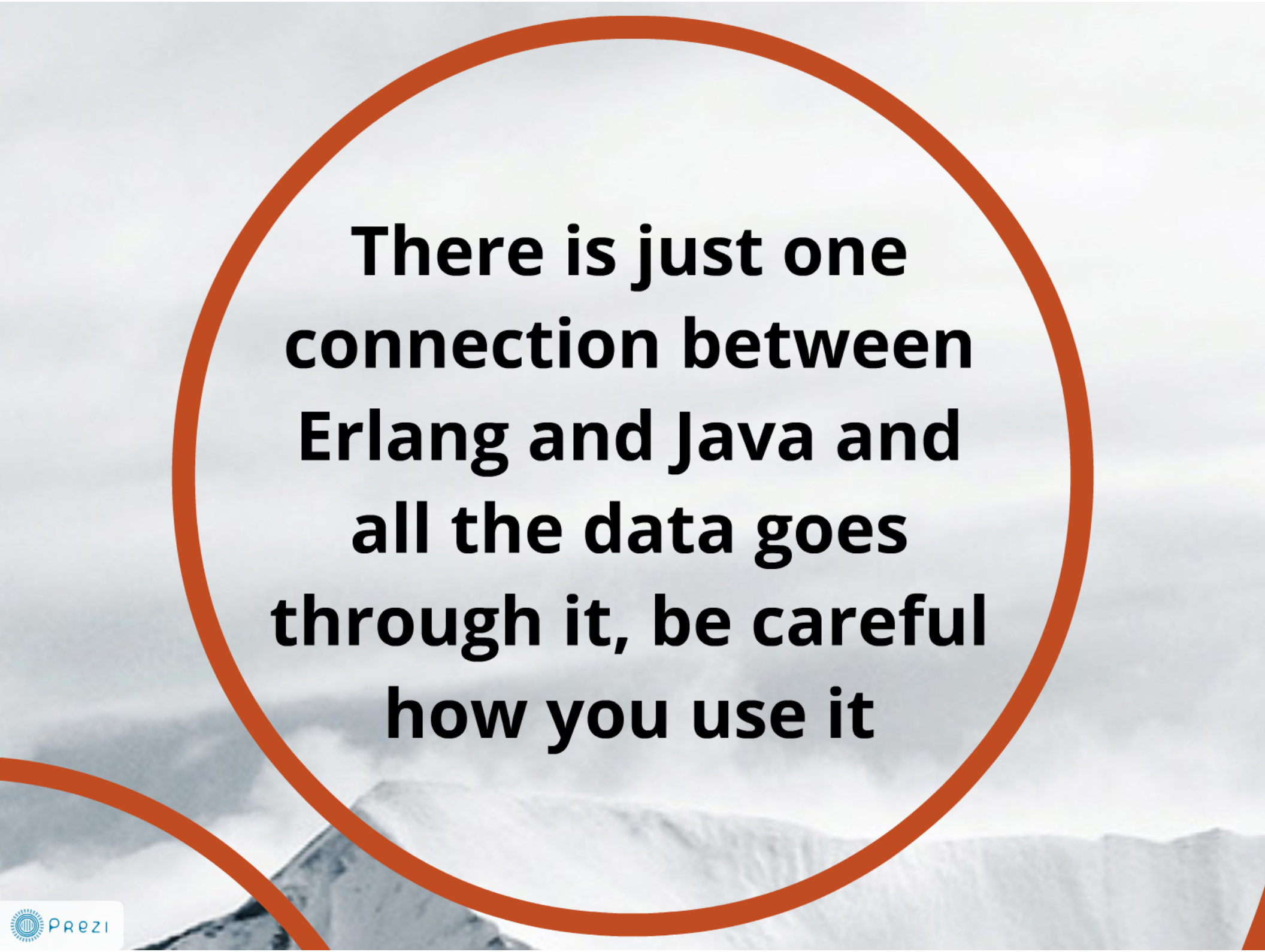
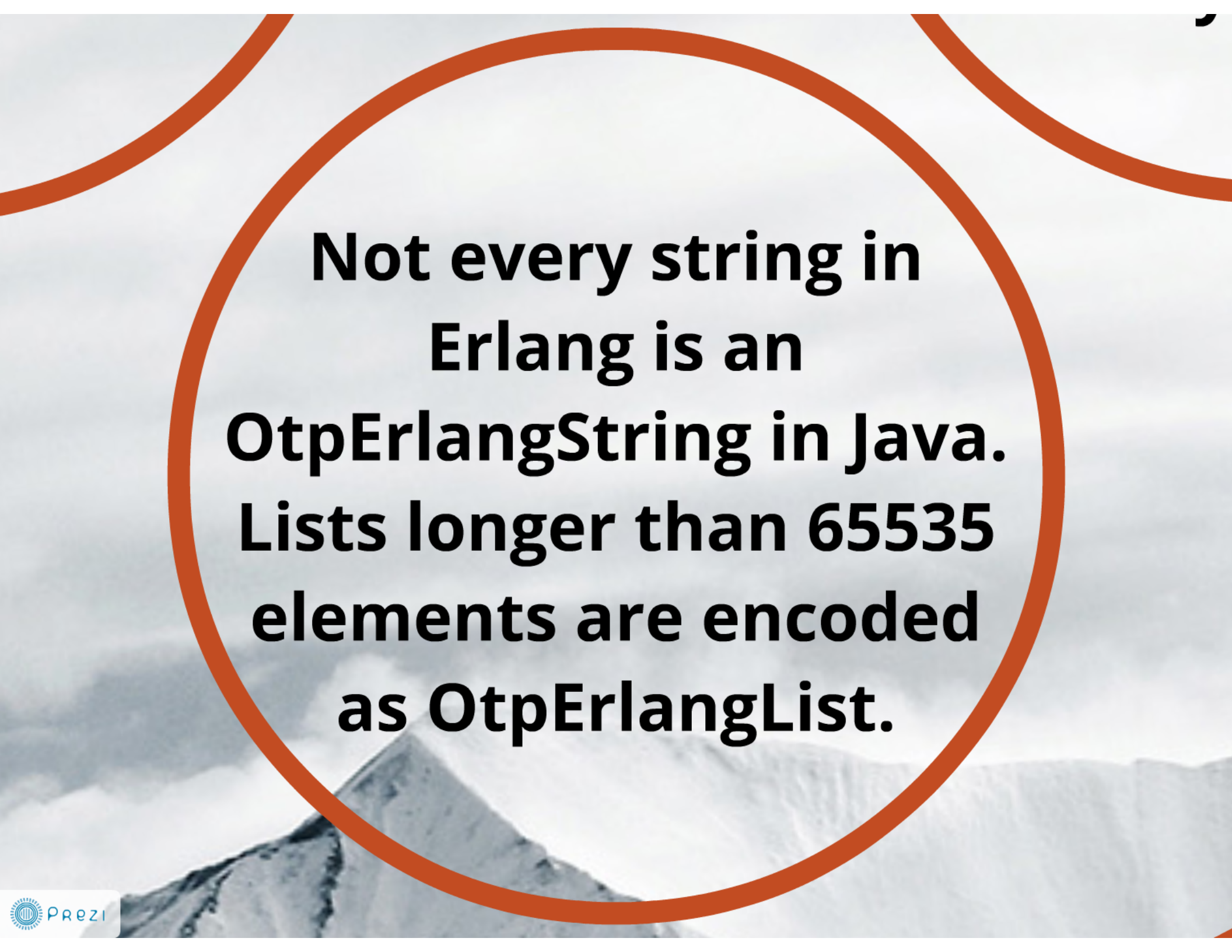

There is just one connection between Erlang and Java and all the data goes through it, be careful how you use it


Not every string in Erlang is an OtpErlangString in Java. Lists longer than 65535 elements are encoded as OtpErlangList.

Resources

- github.com/tigertext/lucene_server
- github.com/inaka/jinterface_stdlib
- lucene.apache.org/core
- about.me/elbrujohalcon
- github.com/inaka
- inaka.net
- inaka.net/blog


THANK YOU VERY MUCH!!