Functional Programming at Facebook

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Facebook and Chat
Chat architecture
Erlang strengths
Setbacks
What has worked
Facebook
The Facebook Environment
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- The web site
  - More than 250 million active users
  - More than 3.5 billion minutes are spent on Facebook each day
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- The engineering team
  - Fast iteration: code gets out to production within a week
  - Polyglot programming: interoperability with Thrift
  - Practical: high-leverage tools win
Using FP at Facebook
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- Erlang
  - Chat backend (channel servers)
  - Chat Jabber interface (ejabberd)
  - AIM presence: a JSONP validator
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- Haskell
  - lex-pass: PHP parse transforms
  - Lambdabot
  - textbook: command line Facebook API client
  - Thrift binding
Thrift
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- An efficient, cross-language serialization and RPC framework
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  3: string blurb
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- Includes library and code generator for each language
- Servers define interfaces with an IDL
- Many supported languages

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<table>
<thead>
<tr>
<th>Language</th>
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<td>C++</td>
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Facebook Chat
Motivation

Sasha Rush wrote at 10:47pm on May 31st, 2008
deleted upon pictures request, still think we should keep the name.

Write on Sasha’s Wall

Daniel Corson wrote at 10:40pm on May 31st, 2008
did you use the ConveyTypeInference app to make that?
Write on Daniel's Wall

Daniel Corson wrote at 10:02pm on May 31st, 2008
the JulioLambdas
Write on Daniel's Wall

Sasha Rush wrote at 10:47pm on May 30th, 2008
Also we need a nerdy, groan inducing name. I'm thinking ZuckerLambda.
Write on Sasha's Wall

Sasha Rush wrote at 10:45pm on May 30th, 2008
I was just going to send you that link. Let's do it. Although maybe we should try one of
the old contests first. My practical haskell is still kind of slow.
Write on Sasha's Wall

Daniel Corson shared a link at 9:38pm on May 30th, 2008
http://www.icfpcontest.org/
Motivation
Why does Facebook need Chat?

▪ Inbox, Wall, Comments are asynchronous, slow
▪ Real-time conversation
▪ Unique advantages:
  ▪ List of friends for free
  ▪ Integrated Facebook content
  ▪ No install required
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- Apr 6, 2008: First user message sent: “msn chat?”
- Apr 23, 2008: 100% rollout (Facebook has 70M users at the time)
Chat today
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- 10+ million active channels at peak
- 1+ GB traffic at peak
- 100+ channel machines
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- Work load has increased 10x while machines not even 3x
Chat Architecture
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Architectural overview

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- Each partition served by a cluster of machines (availability)
Erlang strengths
Concurrency
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  - Chat users are independent and concurrent
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- Bonus: carries over to non-Erlang concurrent programming
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- Distributed Erlang works out-of-the-box (all nodes are trusted)
Fault Isolation
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- Bugs in the initial versions of Chat:
  - Process leaks in the Thrift bindings
  - Unintended multicasting of messages
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- (Horrible) bugs don’t kill a mostly functional system:
  - C/C++ segfault takes down the OS process and your server state
  - Erlang badmatch takes down an Erlang process
    - ... and notifies linked processes
Error logging (crash reports)
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▪ WARNING: excessive error logging can OOM the Erlang node!
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  - Pushing new functional code for Chat takes ~20 seconds
  - No state is lost
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- NOTE: we don’t use the OTP release/upgrade strategies
Monitoring and Error Recovery
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  - Organize (and control) processes
  - Systematize restarts and error recovery
- Extended supervisor with a “directory” type
  - one_for_one with string -> child pid map
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- heart: monitors and restarts the OS process
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  - “Jumps” into a passed-in function for a received message
- Perfect for a long-running, idling HTTP request handler
- But ... not compatible with gen_server:call (and gen_server:reply)
  - gen_server:call has its own receive() loop
  - hibernate() doesn’t support an explicit timeout
  - gen_hibernate: a few hours and a look at gen.erl
hipe_bifs
Cheating single assignment

- Erlang is opinionated:
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- Erlang is opinionated:
  - Destructive assignment is hard because it should be
- hipe_bifs:bytearray_*([]): manipulate references to mutable arrays (!)
  - Necessary for aggregating Chat users’ presence
  - Same in-memory format as presence servers (C++)
  - Don’t tell anyone!
Setbacks
“What’s Erlang?”
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- Lack of Erlang educational resources (at start of 2007)
  - Few industry-focused English-language resources
  - Few blogs (outside of Yariv’s and Joel Reymont’s)
  - U.S. Erlang community limited in number and visibility
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- Engineers are uncomfortable with FP
  - Universities have very conservative curricula
  - FP : academia, AI :: ‘normal programming’ : industry
  - “If you want to succeed, learn C++ and Java”, not “use the right tool for the job”
- Not similar to rest of the codebase, not hiring specifically for FP
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- (Seemingly) contrary to “move fast” value
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