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Tracking Logs at Zillow with Lookups & JIRA

Seth Thomas, Jon Wentworth

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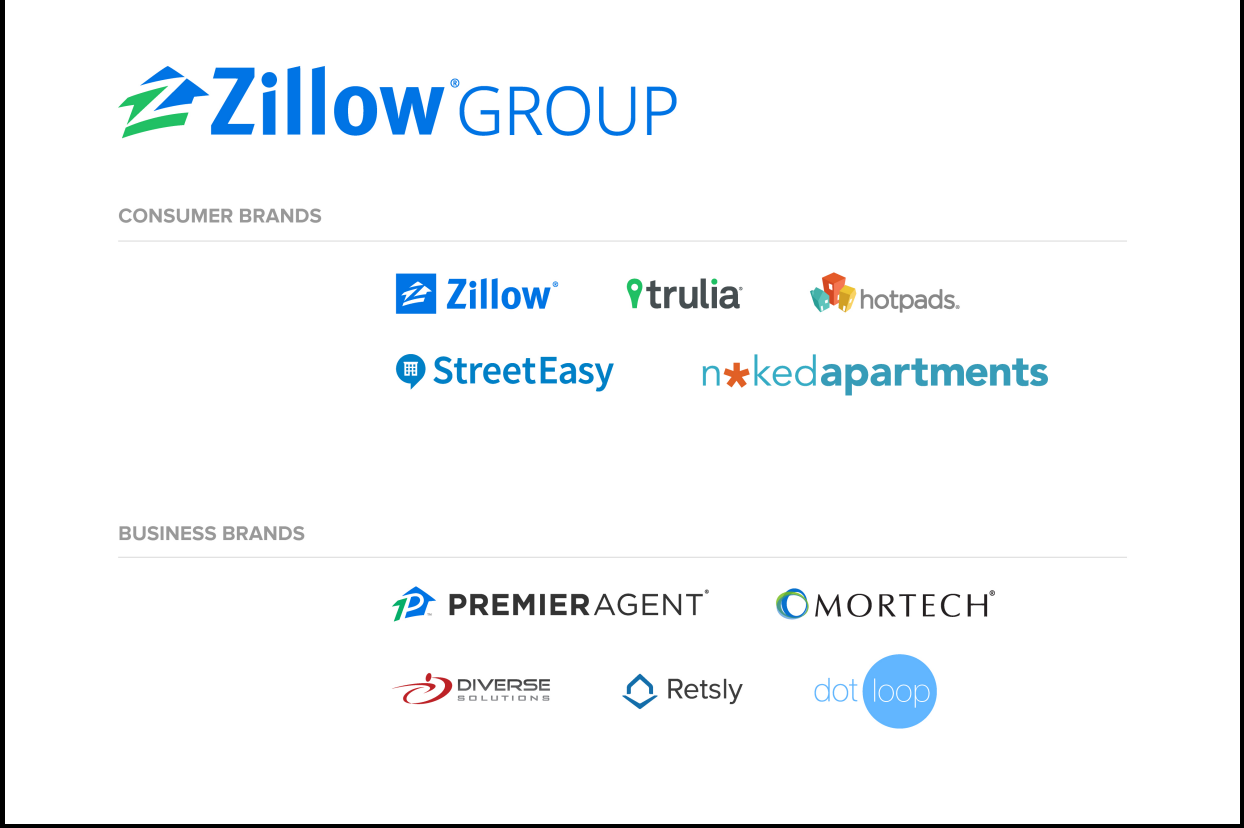
What is Zillow?

About Zillow

- Zillow Group operates the largest real estate network on the web.
- Zillow Group Rentals is the largest rental network on the web, composed of the millions of rental shoppers on Zillow, Trulia, HotPads and MyNewPlace.
- 4 out of 5 U.S. homes have been viewed on Zillow.
- Zillow Group captured nearly two-thirds of the total market share for the online real estate category.
- Zillow has data on more than 110 million U.S. homes, with Zestimates and Rent Zestimates on more than 100 million U.S. homes.
- More than 70 million homes on Zillow have been updated by our community of users.
- 166 million average monthly unique users visited Zillow Group brands' mobile apps and websites
- mobile apps and websites reached an all-time high of nearly 180 million unique users
- More than 36 million rental visitors come to Zillow Group's rental sites and apps each month



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Zillow Group Splunk

How does Zillow use Splunk?

- Operations Center & Systems Engineering
- Customer Service
- Product & Engineering Teams
- Performance Team
- SEO Team
- Native Mobile Apps (iOS, Android) with MiNT

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Our Problem

Our services can produce a lot of errors, which do we care about, how do we track them, what are the metrics, how well is the process working?

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Evolution of Error Event Tracking

Top 10 – quantifies noise

Leaderboard – shows movement between 2 periods

Assigning Identity – is there a JIRA ticket

- Creates an Error Dictionary
- Assigns accountability
- Provides context upon regression
- Maps to all environments (prod & pre-prod)
- Allows for quality gates between code promotions

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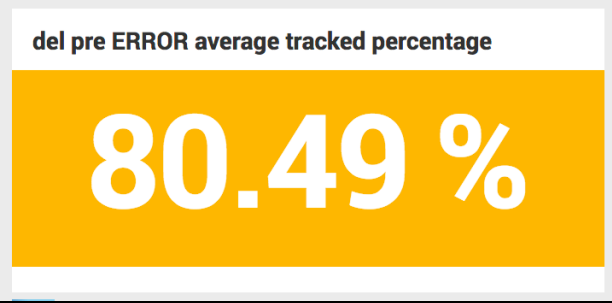
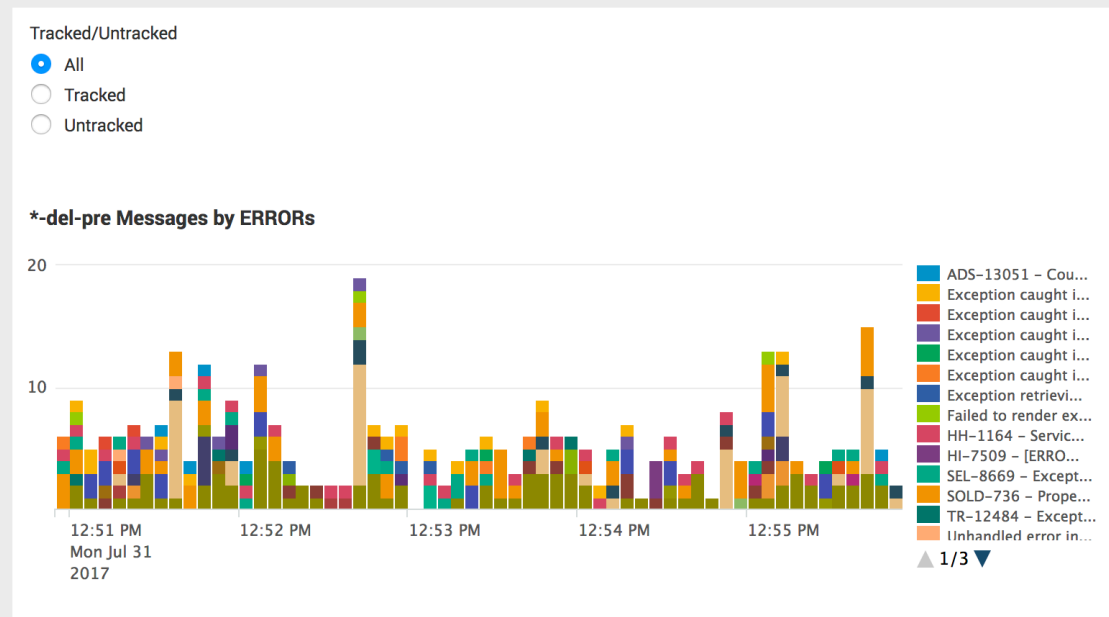
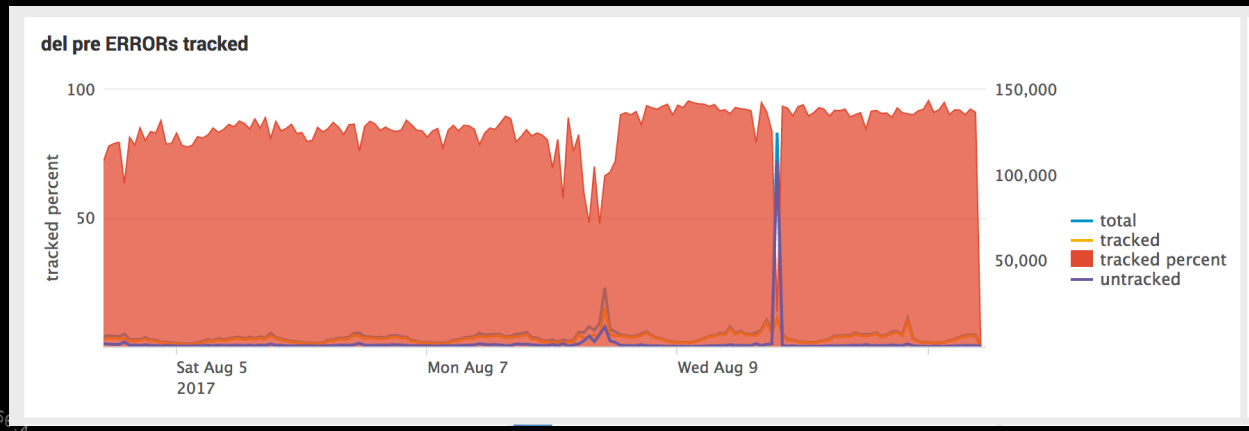
Tracking Progress with Metrics

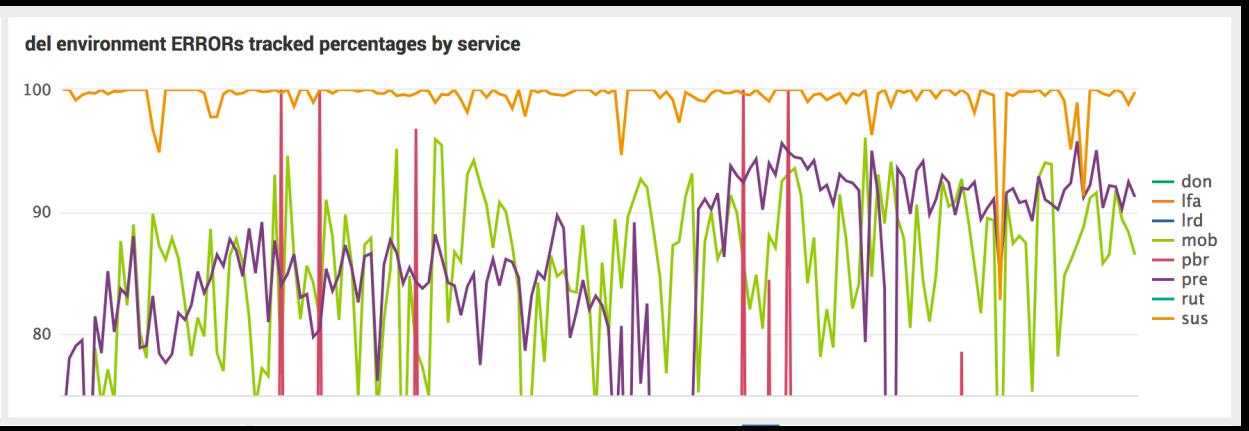
ERROR % bug Tracking

Defined Goal 80%









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Implementation Logistics

- This is a simple project IF you have the required rights and permissions.
  - JIRA requires access to API
  - Splunk access to Transforms and Apps
- No cost, doesn't index data, only populates a lookup.csv

- Who benefits? – Everyone!
  - ERROR messages are assigned to teams, tracked and triaged
  - Alarms triggered for new ERROR events
  - Regressions are caught early

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ZOC

Zillow Operations Center responsibilities

- Monitor Site Health
  - Routine Eyes on Glass
  - Code Deployments
  - Outages
- Protect and Defend
  - Site Error Rates
  - Log Level Rates
  - Perception of Unhealthiness

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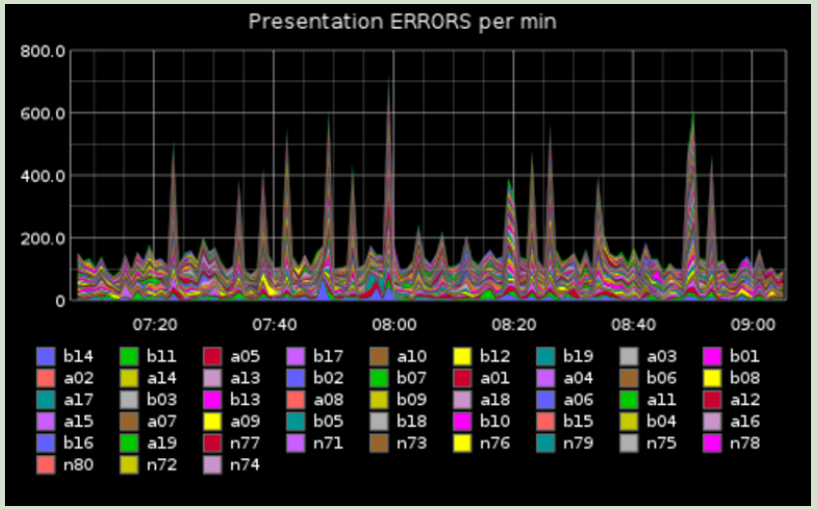
ZOC

Our traditional tools before Splunk

terminal	Graphite	log rollups

```
'2017-04-03T15:48:55.511889Z' '[hi_api.controllers.api.collections_controller] _update_collection_order_and_details called with
 user_id: 56451544, collection_id: 2285921'
'2017-04-03T15:48:55.598456Z' '[elasticsearch] HEAD /hi_search/image/9523396527 [status:404 request:0.002s]'
'2017-04-03T15:48:55.598825Z' '[boto3.resources.action] Calling sqs:send_message with {u\'QueueUrl\': \'https://us-west-2.queue
.amazonaws.com/150122898372/HI_prod_ElasticSearchBoard\', \'MessageBody\': \'{"id": 2285921, "time": 1491234535.598739}\'}'
'2017-04-03T15:48:55.600975Z' '[botocore.vendored.requests.packages.urllib3.connectionpool] Resetting dropped connection: us-we
st-2.queue.amazonaws.com'
'2017-04-03T15:48:57.204575Z' '[boto3.resources.action] Calling sqs:send_message with {u\'QueueUrl\': \'https://us-west-2.queue
.amazonaws.com/150122898372/HI_prod_EmailSubscribe\', \'MessageBody\': \'{"job_data": {"email_address": null, "user_id": 564515
44, "subscription_ids": [42, 41], "is_buzz_check": true}}\'}'
'2017-04-03T15:48:57.206735Z' '[botocore.vendored.requests.packages.urllib3.connectionpool] Resetting dropped connection: us-we
st-2.queue.amazonaws.com'
'2017-04-03T15:49:01.082308Z' '[hi_api.controllers.api.collections_controller] post called with user_id 76897548, collection_id
 None, image_id None'
'2017-04-03T15:49:01.082560Z' '[hi_api.controllers.api.collections_controller] _create_collection called with user_id: 76897548
'
'2017-04-03T15:49:01.105946Z' '[hi_api.controllers.api.collections_controller] Missing user from pogo! Requested: 1, Returned:
0, Missing: [76897548]'
'2017-04-03T15:49:01.123261Z' '[hi_api.controllers.api.collections_controller] Missing user from pogo! Requested: 1, Returned:
0, Missing: [76897548]'
'2017-04-03T15:49:01.125609Z' '[hi_api.controllers.api.collections_controller] Missing user from pogo! Requested: 1, Returned:
0, Missing: [76897548]'
'2017-04-03T15:49:01.125813Z' '[hi_api.lib.application_common] data not found in pogo using empty data with zuid 76897548'
'2017-04-03T15:49:01.322873Z' '[hi_api.controllers.api.collections_controller] post called with user_id 76897548, collection_id
 3137238, image_id 9499223622'
'2017-04-03T15:49:01.325298Z' '[hi_api.controllers.api.collections_controller] _save_image_to_collection called with user_id: 7
6897548, collection_id: 3137238, image_id: 9499223622'
'2017-04-03T15:49:01.332170Z' '[hi.db.image] There is no row for image_id = 9499223622'
'2017-04-03T15:49:01.660312Z' '[hi_api.controllers.api.images_v2] Missing user from pogo! Requested: 262, Returned: 261, Missin
g: [37361976]'
'2017-04-03T15:49:04.132177Z' '[boto3.resources.action] Calling sqs:send_message with {u\'QueueUrl\': \'https://us-west-2.queue
.amazonaws.com/150122898372/HI_prod_EmailSubscribe\', \'MessageBody\': \'{"job_data": {"email_address": null, "user_id": 581368
50, "subscription_ids": [42, 41], "is_buzz_check": true}}\'}'
'2017-04-03T15:49:04.155737Z' '[boto3.resources.action] Calling sqs:send_message with {u\'QueueUrl\': \'https://us-west-2.queue
.amazonaws.com/150122898372/HI_prod_UserSavedSearch\', \'MessageBody\': \'{"job_data": {"update_time": 1491234544.155594, "emai
l_frequency_id": 4, "user_id": 58136850, "subscription_type_id": 1, "search_object": {"room_type_id": 34, "style_id": null, "ta
g_ids": [], "grade_id": null, "color": null, "text": null, "tag_count": 0}}}\'}'
'2017-04-03T15:49:04.157989Z' '[botocore.vendored.requests.packages.urllib3.connectionpool] Resetting dropped connection: us-we
st-2.queue.amazonaws.com'
```



lyn-del-pre-errors Error Counters

1386647	Info
681216	Warn
53541	Errors
0	Fatals

lyn-del-pre-errors Errors

17539	web.service.homedetail.PropertyLinkFactoryImpl AddressObject is null for zpid #
4202	[I/O dispatcher #]service.account.FutureLoginImpl
1802	web.ZillowEngine org.apache.hivemind.ApplicationRuntimeException: Proxied content call returned an internal server error.####activationPath=/contacts/AddContactStatusUpdate.htm##Path=/contacts/AddContactStatusUpdate.htm##Content-Length=###
1032	web.ZillowEngine java.lang.RuntimeException: com.google.common.util.concurrent.UncheckedExecutionException: com.zillow.service.asset.StaticsAssetFetchException: Exception retrieving from http://zgm-frontend-prod.s#-website-us-west-#.amazonaws.com/calculator/payment/hdp/app.config.json - Error: Read
1006	web.pages.search.SearchDispatcher
887	database.utils.PropertySetter Property 'valueByCode' threw exception; nested exception is java.lang.IllegalArgumentException: No enumeration element for type:Type ID:# Base:Enum elements:Baseboard(#,#),Forced air(#,#),Geothermal(#,#),Heat pump(#,#),Radiant(#,#),Stove(#,#),Wall(#,#),Other(#,#), code:
871	web.ZillowEngine java.lang.RuntimeException: com.google.common.util.concurrent.UncheckedExecutionException: com.zillow.service.asset.StaticsAssetFetchException: Exception retrieving from http://zgm-frontend-prod.s#-website-us-west-#.amazonaws.com/after-bal-contact/app.config.json - Error: Read timed
827	service.asset.StaticsAssetFetcher Exception retrieving from http://zgm-frontend-prod.s#-website-us-west-#.amazonaws.com/calculator/payment/hdp/app.config.json - Error: Read timed out
771	web.pages.personalization.api.PersonalizationJsonResponsePage Error getting personalization data
767	web.components.homedetail.facts.CompareWithPublicFacts Could not get detailed propertyInformation from property database for id: #
758	database.utils.PropertySetter Property 'valueByCode' threw exception; nested exception is java.lang.IllegalArgumentException: No enumeration element for type:Type ID:# Base:Enum elements:Brick(#,#),Cement / Concrete(#,#),Composition(#,#),Metal(#,#),Shingle(#,#),Stone(#,#),Stucco(#,#),Vinyl(#,#),Wood
749	service.asset.StaticsAssetFetcher Exception retrieving from http://zgm-frontend-prod.s#-website-us-west-#.amazonaws.com/after-bal-contact/app.config.json - Error: Read timed out
744	service.asset.StaticsAssetFetcher Exception retrieving from http://zgm-frontend-prod.s#-website-us-west-#.amazonaws.com/calculator/payment/hdp-summary/app.config.json - Error: Read timed out
707	service.asset.StaticsAssetFetcher Exception retrieving from http://zgm-frontend-prod.s#-website-us-west-#.amazonaws.com/calculator/affordability/hdp/app.config.json - Error: Read timed out
706	database.utils.PropertySetter Property 'valueByCode' threw exception; nested exception is java.lang.IllegalArgumentException: No enumeration element for type:Type ID:# Base:Enum elements:Carport(#,#),Garage - Attached(#,#),Garage - Detached(#,#),Off-street(#,#),On-street(#,#),None(#,#), code:#skippi
684	database.utils.PropertySetter Property 'valueByCode' threw exception; nested exception is java.lang.IllegalArgumentException: No enumeration element for type:Type ID:# Base:Enum elements:Coal(#,#),Electric(#,#),Gas(#,#),Oil(#,#),Propane / Butane(#,#),Solar(#,#),Wood / Pellet(#,#),Other(#,#),None(#,#
599	service.account.FutureLoginImpl
515	service.imaging.ImagingServiceImpl Exception invoking image conversion service
515	service.imaging.ImagingServiceImpl ERROR upload to CLOUD
510	service.imaging.ImagingServiceImpl Error Converting ImageId #// Returned # for addImageWorkitemStream but: HTTP/#.# # Not Implemented
507	web.ZillowEngine java.lang.NullPointerException####activationPath=/search/Unsubscribed.htm##Path=/search/Unsubscribed.htm##
481	web.pages.search.GetResults Unhandled error in pageBeginRender:
480	web.ZillowEngine java.lang.NullPointerException####activationPath=/profile##Path=/profile/Eric-Buersken/##
467	service.user.auth.ExternalAccountProviderWrapper AUTH: Failed to reload login session: ResponseImpl{code=#, host did not accept the connection within timeout of # ms'}
457	web.components.profiles.reviews.ReviewListJSON error retrieving data from review-display api
453	web.ZillowEngine java.lang.RuntimeException: Encoded url identifier has no valid type: AjaxRender.htm####activationPath=/url-shortener/AjaxRender.htm##Param:
426	web.service.homedetail.logic.contact.PropertyContactRecipientLogicImpl Couldn't find posting contact emails in the database for property: #

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ZOC

Limitations

- Graphs only show basic volume trends
- Strong cmd line foo to tail logs meaningfully
- Log rollups lack time dimension

Is that error new? Intro'd with release? Regression?

Who owns that?

What just happened?

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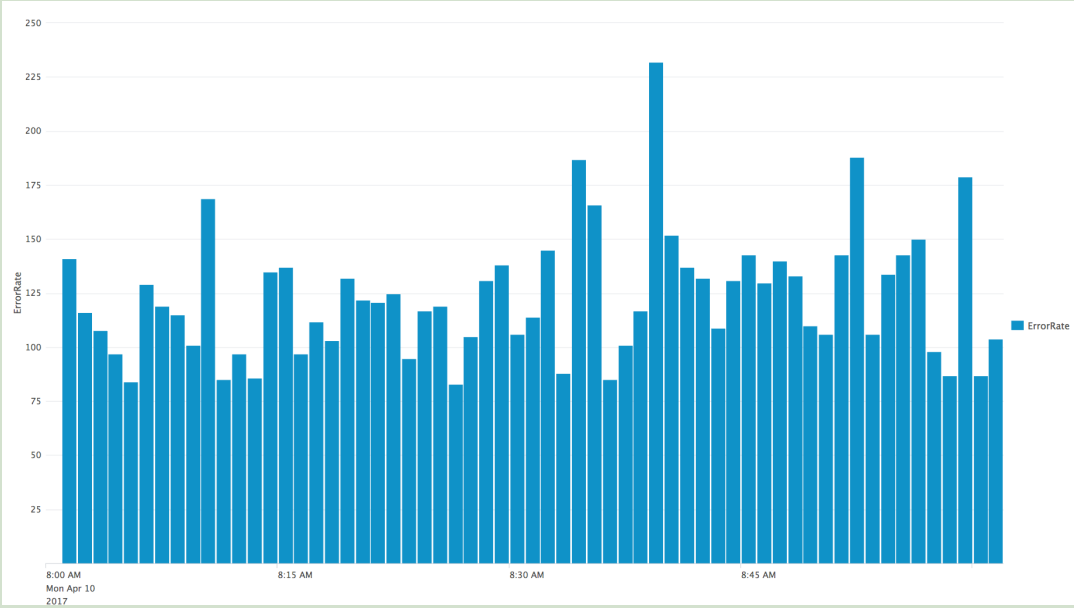
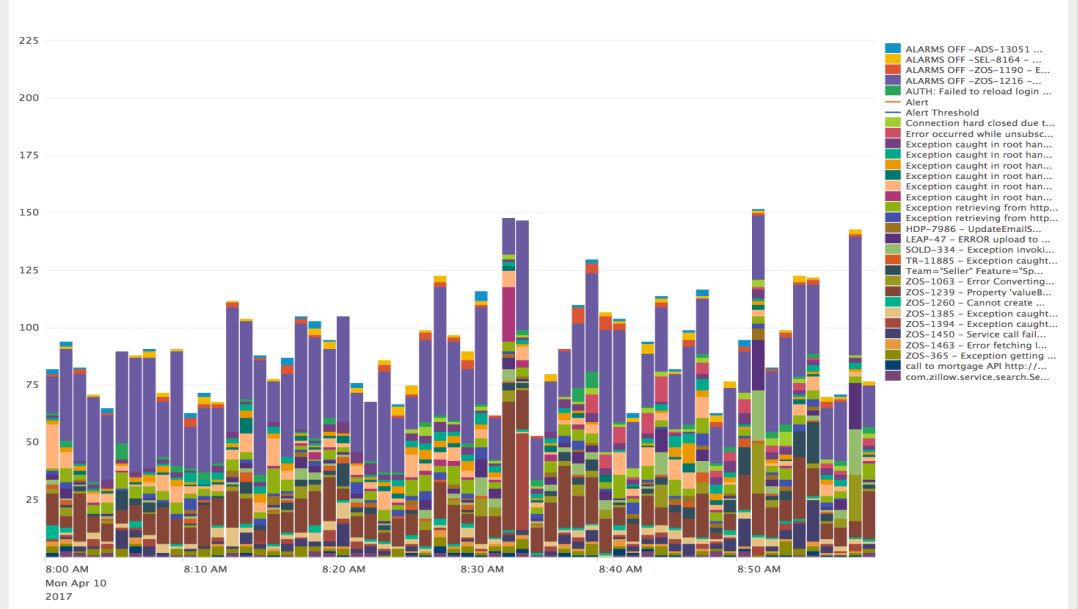
Needed a solution

to turn this	into this… automatically
	

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Lexicon

Java service error log

- 2017-07-12T18:14:50.205813+00:00 WARN [com.zillow.web.pages.myzillow.SavedSearchEdit] no saved search available for XXXXXXXXXX
- 2017-07-12T18:14:50.661995+00:00 ERROR [com.zillow.db.InnerPool] Connection hard closed due to exception:java.sql.SQLException: Invalid state, the Connection object is closed. src:{ call dbo.XXXXXXXXXX(XXXXXXXXXX) } on jdbc:jtds:sqlserver://XXXXXXXXXX
- 2017-07-12T18:14:50.662739+00:00 ERROR [org.springframework.transaction.support.TransactionTemplate] Application exception overridden by rollback exception

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Lexicon

Java service error log

- Timestamp
- Severity level
- Class – hierarchical code template
- Message – verbose return

- 2017-07-12T18:14:50.205813+00:00 WARN [com.zillow.web.pages.myzillow.SavedSearchEdit] no saved search available for XXXXXXXXXX
- 2017-07-12T18:14:50.661995+00:00 ERROR [com.zillow.db.InnerPool] Connection hard closed due to exception:java.sql.SQLException: Invalid state, the Connection object is closed. src:{ call dbo.XXXXXXXXXX(XXXXXXXXXX) } on jdbc:jtds:sqlserver://XXXXXXXXXX
- 2017-07-12T18:14:50.662739+00:00 ERROR [org.springframework.transaction.support.TransactionTemplate] Application exception overridden by rollback exception

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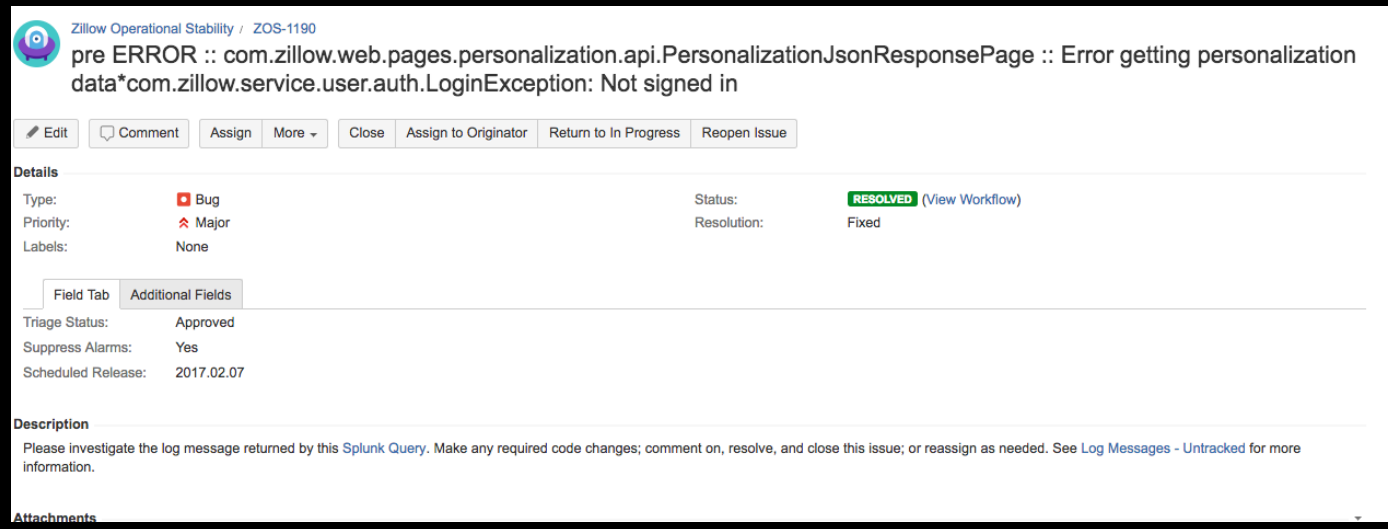
Lexicon

JIRA

A commercial issue tracking product, developed by Atlassian.

- **JIRA is a component of Zillow's code development tool suite**
  - Provides bug tracking, issue tracking, and project management functions.



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Lexicon

jirarest

Add-on used to query JIRA's API

| jirarest jqlsearch "LogTrackingEnabled=Yes"

→ **Using https://github.com/firebus/splunk-jira** ←

Version 2.1 handles auto-pagination for production-scale Jira implementations, jirarest command

Not using official Splunk version https://splunkbase.splunk.com/app/1438/

Provides only jira command to live query JIRA REST API. Deprecated jirarest commands.

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Lexicon

lookup

| lookup <lookup-table-name> <lookup-field1> AS <event-field1>, <lookup-field2> AS <event-field2> OUTPUTNEW <lookup-destfield1> AS <event-destfield1>, <lookup-destfield2> AS <event-destfield2>

| lookup update=true MyLookup msg, cls, java_svc OUTPUT bug java_svc cls lvl msg Priority

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Lexicon

cluster

For rollups, regex has it’s limitations…

rex field=msg mode=sed "s/\S+@\S+.\w+/*@*.*x/g" | rex field=msg mode=sed "s/token = \S+\w+/token = */g" | rex field=msg mode=sed "s/screenname=.+\w+/screenname=*/g" | rex field=msg mode=sed "s/(?s)(.{200}).+/\1*/g" | rex field=msg mode=sed "s/\d+/*/g" | rex field=msg mode=sed "s/\"/ /g" | rex field=msg mode=sed "s/zws-id=[^&].+\w+/zws-id=*/g”

→ | eval msg=substr(msg,1,200)

| cluster t=0.8 labelonly=t field=msg

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Lexicon

cluster

```
<base_search> lvl=ERROR
| eval msg=substr(msg,1,200)
| cluster t=0.8 labelonly=t field=msg
| top limit=0 msg cluster_label
| where count > 60
| sort cluster_label
```

Last 15 minutes

✓ 3,809 events (7/18/17 10:54:37.000 AM to 7/18/17 11:09:37.000 AM) No Event Sampling Job Verbose Mode

Events (3,809) | Patterns | Statistics (8) | Visualization

100 Per Page Format Preview

msg	cluster_label	count	percent
AddressObject is null for zpid 2093526210	2	84	2.205303
AddressObject is null for zpid 79905228	2	64	1.680231
Asset not found at http://zgm-frontend-prod.s3-website-us-west-2.amazonaws.com/calculator/payment/hdp-summary/app.config.json	28	122	3.202940
Unhandled exception from call. : hdpHomeValues com.zillow.pogo.client.impl.IOExceptionUnrecoverable: Request to <http://pogo-collator.del.zillow.local> failed for query: <return{bedrooms,zestimate,pri	91	116	3.045419
Unhandled exception from call. : recentlySoldComps com.zillow.pogo.client.impl.IOExceptionUnrecoverable: Request to <http://pogo-collator.del.zillow.local> failed for query: <return{videoIds,zestimate	91	72	1.890260
Unhandled exception from call. : forSaleComps com.zillow.pogo.client.impl.IOExceptionUnrecoverable: Request to <http://pogo-	91	68	1.785245

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Step by Step

1. Create and fill fields in JIRA tickets
1. Search JIRA with jirarest to populate lookup file
1. Enable wildcard searching - transforms.conf
1. Create searches against fields using lookups
1. Enhance with evals and conditionals

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Step by Step

1. Create and fill fields in JIRA tickets

- LogTrackingEnabled
- LogTrackingMessage
- LogTrackingClass
- LogTrackingLevel
- LogTrackingService

LogTrackingEnabled	☑ Yes
LogTrackingMessage	no saved search available for *
LogTrackingService	pre
LogTrackingClass	com.zillow.web.pages.myzillow.SavedSearchEdit
LogTrackingLevel	WARN

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Step by Step

2. Search JIRA with jirarest to populate lookup file

```
| jirarest jqlsearch "LogTrackingEnabled=Yes"
| eval bug=Key
| eval msg=LogTrackingMessage
| eval cls=LogTrackingClass
| eval lvl=LogTrackingLevel
| eval java_svc=LogTrackingService
| table bug msg cls lvl java_svc "Suppress Alarms"
| fillnull value="NULL"
| outputlookup MyLookup.csv
```

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Step by Step

2. Search JIRA with jirarest to populate lookup file

```
| jirarest jqlsearch "LogTrackingEnabled=Yes"
| eval bug=Key
| eval msg=LogTrackingMessage
| eval cls=LogTrackingClass
| eval lvl=LogTrackingLevel
| eval lava_svc=LogTrackingService
| table bug msg cls lvl java_svc "Suppress Alarms"
| fillnull value="NULL"
```

Last 15 minutes

✓ 674 events (7/18/17 9:25:11.000 AM to 7/18/17 9:40:11.000 AM) No Event Sampling

Job Verbose M

Events (674) Patterns Statistics (674) Visualization

100 Per Page Format Preview

Prev 1 2 3 4 5 6 7

bug	msg	cls	lvl	java_svc	Suppress Alarms
ZPID-8656	Connection hard closed due to exception:java.sql.SQLException: Procedure or function 'PropertyLatLongUserMrg*' expects parameter *@*.*x was not supplied. src:{call dbo.PropertyLatLongUserMrg*(?, ?, *	com.zillow.db.InnerPool	ERROR		NULL
ZPID-8655	org.springframework.jdbc.BadSqlGrammarException: CallableStatementCallback; bad SQL grammar []; nested exception is java.sql.SQLException: Procedure or function 'PropertyLatLongUserMrg*' expects para*	com.zillow.web.pages.ajax.property.AddProperty	ERROR		NULL
ZPID-7038	java.lang.NoSuchFieldException: ZillowCSskipping property initialization for:dataSourceType	com.zillow.database.utils.PropertySetter	ERROR		NULL
ZPID-6653	OCP operation took*	com.zillow.service.overlapped.OverlappedCallManager	WARN		NULL
ZOS-1712	Unhandled error in pageBeginRender*com.zillow.pogo.client.impl.IOExceptionUnrecoverable*Request to*http*//pogo-collator.del.zillow.local*failed for query*	com.zillow.web.pages.search.GetResults	ERROR		NULL
ZOS-1711	Unhandled exception from call*com.zillow.pogo.client.impl.IOExceptionUnrecoverable*Request to*http*//collator-pog.del.zillow.local*failed for query*	com.zillow.service.overlapped.OverlappedCallManager	ERROR		NULL
ZOS-1710	Unhandled exception from call*com.zillow.pogo.client.impl.IOExceptionUnrecoverable*Request to *http*//pogo-collator.del.zillow.local*	com.zillow.service.overlapped.OverlappedCallManager	ERROR		NULL
ZOS-1709	Exception caught in root handler* java.lang.NullPointerException*Request received at Fri Jul * PDT *Method*GET* activationPath*/ui/ClientProfile.htm*Path*/ui/ClientProfile.htm*Memory* Free*983MB* Total*2437MB* Max*2534MB*java.lang.NullPointerException*	com.zillow.web.ZillowEngine	ERROR		Yes

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Step by Step

2. Search JIRA with jirarest to populate lookup file

```
| jirarest jqlsearch "LogTrackingEnabled=Yes"
| eval bug=Key
| eval msg=LogTrackingMessage
| eval cls=LogTrackingClass
| eval lvl=LogTrackingLevel
| eval java_svc=LogTrackingService
| table bug msg cls lvl java_svc "Suppress Alarms"
| fillnull value="NULL"
| outputlookup MyLookup.csv
```

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Step by Step

3. Enable wildcard searching - transforms.conf

```
[MyLookup]
filename = MyLookup.csv
case_sensitive_match=false
match_type = WILDCARD(msg)
```

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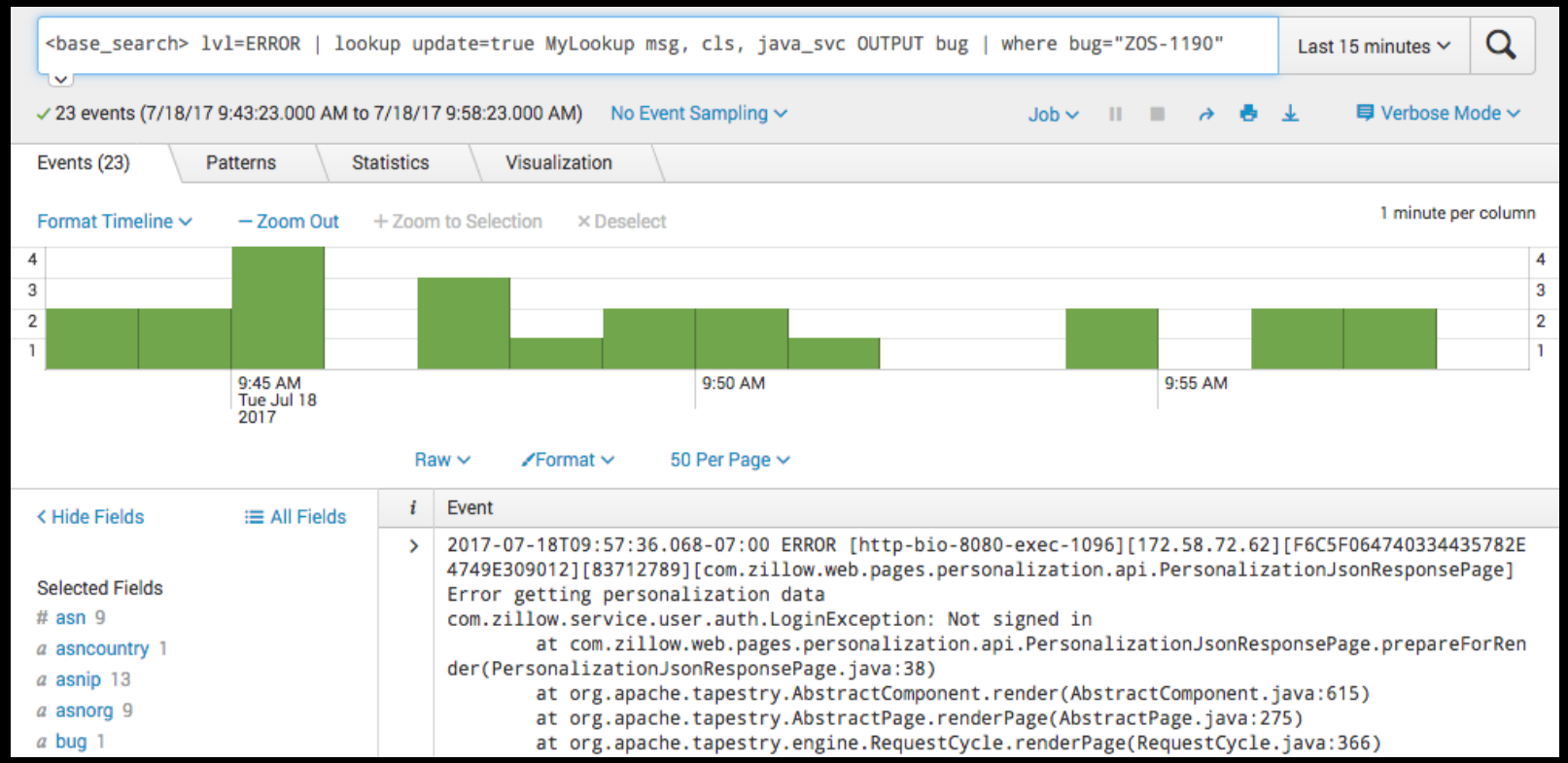
Step by Step

4. Create searches against fields using lookups

<base_search> lvl=ERROR | lookup update=true MyLookup msg, cls, java_svc OUTPUT bug | where bug="ZOS-1190"



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Step by Step

4. Create searches against fields using lookups

<base_search> lvl=ERROR | lookup update=true MyLookup msg, cls, java_svc OUTPUT bug | where bug="ZOS-1190"

bug	lvl	msg	cls	java_svc
ZOS-1190	ERROR	Error getting personalization data*com.zillow.service.user.auth.LoginException: Not signed in*	com.zillow.web.pages.personalization.api.PersonalizationJsonResponsePage	pre

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Step by Step

4. Create searches against fields using lookups

<base_search> lvl=ERROR | lookup update=true MyLookup msg, cls, java_svc OUTPUT bug | where bug="ZOS-1190"

2017-07-18T09:57:36.068-07:00 ERROR [http-bio-8080-exec-1096][172.58.72.62][F6C5F064740334435782E4749E309012][83712789][com.zillow.web.pages.personalization.api.PersonalizationJsonResponsePage] Error getting personalization data com.zillow.service.user.auth.LoginException: Not signed in
at com.zillow.web.pages.personalization.api.PersonalizationJsonResponsePage.prepareForRender(PersonalizationJsonResponsePage.java:38)

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Step by Step

5. Enhance with evals and conditionals

```
<base_search> lvl=ERROR
| lookup update=true MyLookup msg, cls, java_svc OUTPUT bug "Suppress Alarms”
| eval msg=substr(msg,1,200)
| cluster t=0.8 labelonly=t field=msg
| eval cluster_by = if(isnotnull(bug), bug, cluster_label)
| eventstats first(bug) as bug, first(msg) as msg by cluster_by
| eval bug = if(like('Suppress Alarms',"Yes"), "ALARMS OFF -".bug, bug)
| eval bug = if(isnotnull(bug), bug." - ".msg, msg)
| timechart count by bug usenull=f useother=f
...
```

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Step by Step

5. Enhance with evals and conditionals (cont.)

```
...
| eval alert=300 | rename alert AS "Alert Threshold"
| appendcols [ search index="_internal" sourcetype="scheduler" thread_id="AlertNotifier*" NOT
(alert_actions="summary_index" OR alert_actions="")
| where like(savedsearch_name,"%Error Rate Threshold Exceeded%")
| timechart count(savedsearch_name) AS Alert
| fields Alert | eval Alert= Alert * 350 ]
```

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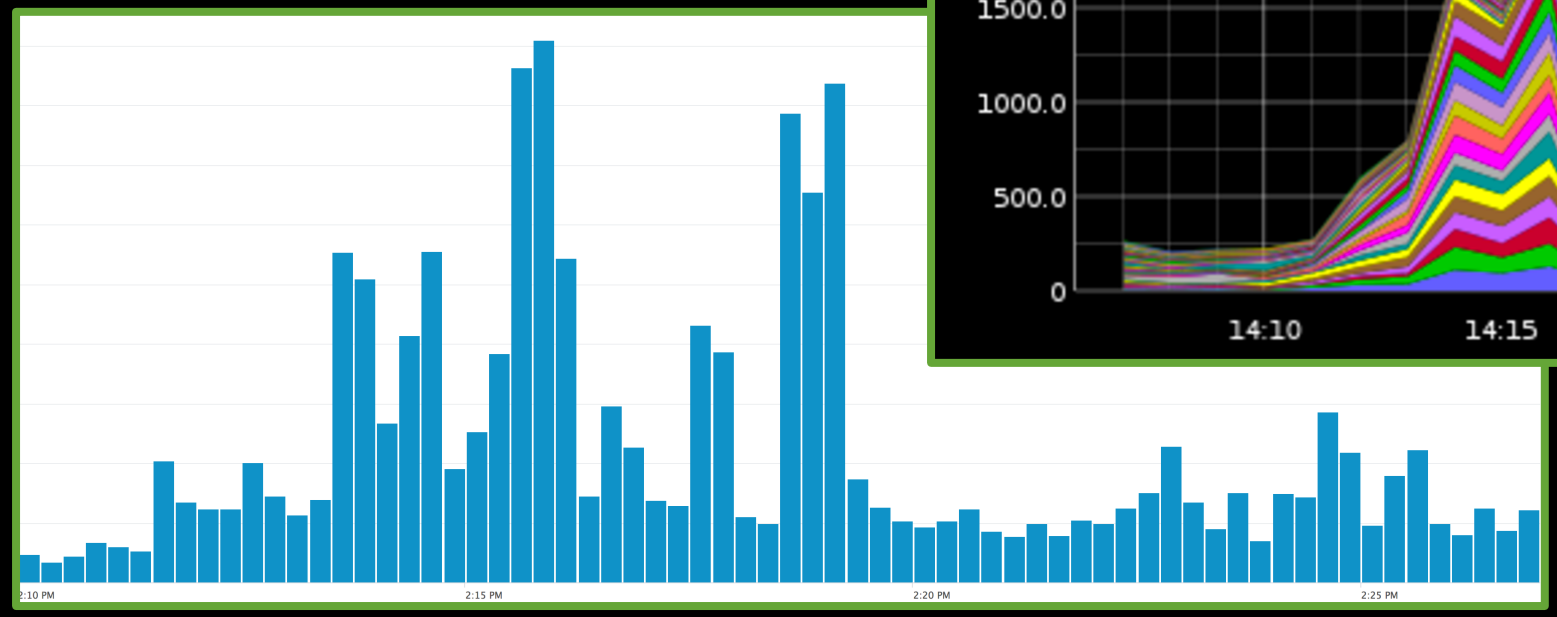
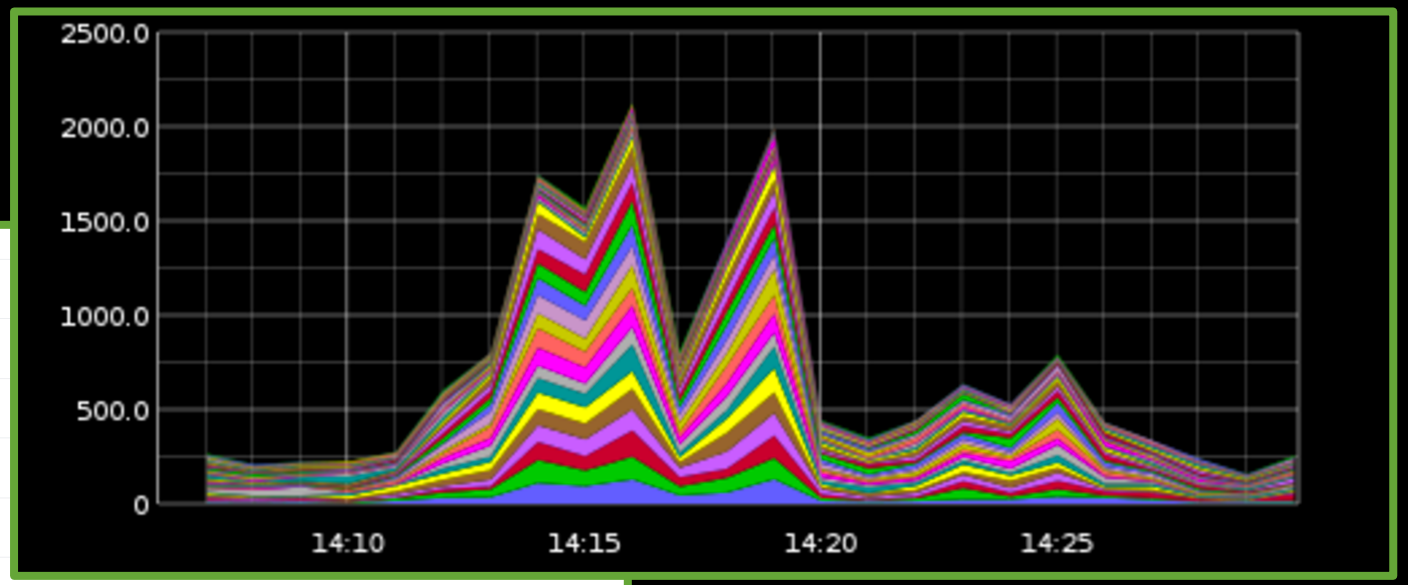
To turn this…





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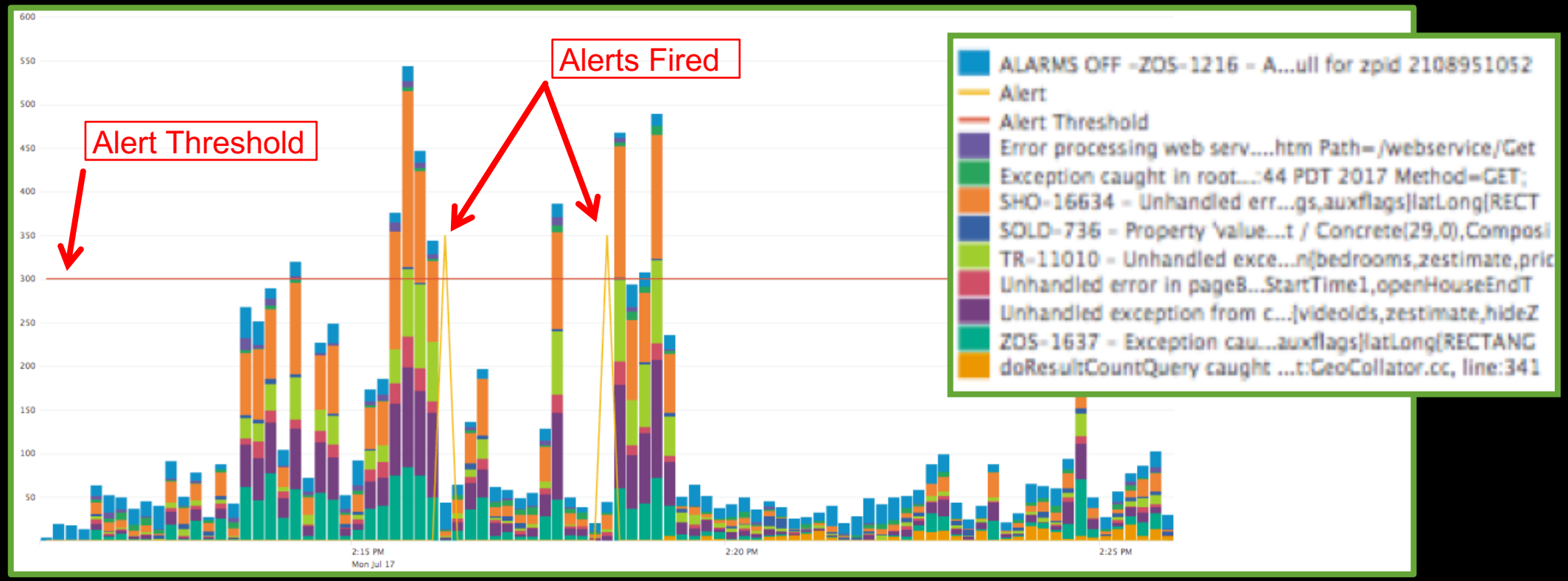
...into this



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and this…

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and this…

_time	Top 10 Errors	Msg Count	Total Count
Wed Jul 19 22:15:00 2017	Minor - https://zbrt.atl.zillow.net/browse/PERS-5522	16596	38286
	Connection hard closed due to exception:java.sql.SQLException: The tar	7536	
	Unable to obtain pooled connection for bean 'SubscriptionReadonly': Ti	4372	
	Minor - https://zbrt.atl.zillow.net/browse/ZOS-1564	3913	
	Unable to obtain pooled connection for bean 'SubscriptionReadonly': Ne	3913	
	Major - https://zbrt.atl.zillow.net/browse/ADS-13199	494	
	Error getting latest ordinal	291	
	org.springframework.jdbc.CannotGetJdbcCon	205	
	Exception caught in root handler: org.springframework.jdbc.CannotGetJd	155	
	Exception caught in root handler: org.springframework.dao.TransientDat	139	
	Unable to obtain pooled connection for bean 'Subscription': Login time	139	
	java.sql.SQLException: Login timed out. connecting to: jdbc:jtds:sqlse		
Wed Jul 19 22:14:00 2017	Minor - https://zbrt.atl.zillow.net/browse/PERS-5522	18946	37852
	Connection hard closed due to exception:java.sql.SQLException: The tar	7869	
	Unable to obtain pooled connection for bean 'Subscription': Login time	4226	
	java.sql.SQLException: Login timed out. connecting to: jdbc:jtds:sqlse	4226	
	Major - https://zbrt.atl.zillow.net/browse/ADS-13199	579	

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Recap

1. **Create and fill fields in JIRA tickets**
   - Manual or semi-automated
2. **Search JIRA with jirarest to populate lookup file**
   - Saved Search (/10min)
3. **Enable wildcard searching - transforms.conf**
   - One-time configuration
4. **Create searches against fields using lookups**
   - Dashboards, alerts, leaderboards, etc.
5. **Enhance with evals and conditionals**
   - Many, many possibilities

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Thank You

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