Fields, Indexed Tokens, And You

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Why Are We Here?

- Supercharged searches!
- I want you to turn this...

This search has completed and has returned 42 results by scanning 166,579 events in 6.198 seconds.

...into this!

This search has completed and has returned 42 results by scanning 58 events in 0.42 seconds.

...this is bad:

5 of 171,000 events matched
Who’s That Guy?

- Professional Services Consultant II, Certified Architect II, Splunk Trustee x3
- Seven years at EMEA Splunk Partner
- Heavy Splunker since 2012

- Get in touch with me: martin.mueller@consist.de
- Give karma at Splunk Answers: martin_mueller
- Join us on Slack: splunk-usergroups.signup.team
Session Objectives

- Understand how Splunk turns a logfile into indexed tokens
- Learn how your searches make good use of indexed tokens (or not)

Topics in detail:
  - Breakers & Segmentation
  - Lispy
  - Fields
Breakers & Segmentation

How Does Splunk Break Events Into Indexed Tokens?
How Splunk Chops Up An Event

- Read in a line of data, apply segmentation, store tokens in TSIDX files
- Minor breakers: / : = @ . - $ # % \ _
- Major breakers: \r\n\s\t [] <> () {} | ! ; , ‘ ” etc.
- Can be configured in segmenters.conf – but very rarely should!

127.0.0.1 - mm [24/Jun/2016:18:11:03.404 +0200]
Inspect a TSIDX file

127.0.0.1 - mm [24/Jul/2016:18:11:03.404 +0200]

bin> splunk cmd walklex ..\var\lib\splunk\conf2016_segmentation\db\hot_v1_1\1466784663-1466784663-15369347184008592423.tsidx ""

my needle:
10 1 127.0.0.1
11 1 18
12 1 2016
13 1 24
14 1 24/jun/2016:18:11:03.404
15 1 404
16 1 0200
17 1 03
18 1 1
19 1 11
20 1 127

Each token is a pointer to the raw event
Room For Optimization

- Look for high-cardinality groups of tokens you don‘t search for
- Common offender: Textual timestamp representations:
  24/jun/2016:18:11:03.404
- You don‘t filter for „events from June“ by searching for jun
- Segmenters.conf lets you filter out unwanted parts of your events
- Beware: Easy to break stuff, hard to define filters in some cases
Lispy

How Does Splunk Find Events Matching Your Search?
Lispy??

- Lispy expressions are predicates Splunk uses to locate events
- Awesome for debugging and performance tuning

- Square brackets, prefix notation for operators? That’s lispy.
- Search for `splunk.conf 2018 - Orlando, FL and you get` [ AND 2018 conf fl orlando splunk ]
- All events matching the predicate are scanned
Since 6.2, lispy is by default only visible in `search.log`

Enable the old-fashioned header in `limits.conf`:

```
[search_info] infocslog_level=DEBUG
```

This search has completed and has returned 2 results by scanning 292 events in 0.915 seconds.

The following messages were returned by the search subsystem:

```
Configuration initialization for C:\dev\splunk\etc took 59ms when dispatching a search (search ID: 1467571813.23)
```

```
base lispy: [ AND 2016 conf fl orlando splunk ]
```

```
search context. user="admin", app="search", ds path=pathname="C:\dev\splunk\etc"
```

Check lispy efficiency by comparing `eventCount/scanCount`
How To Find Naughty Searches?

Find start and end events for searches

```
index=_audit search_id TERM(action=search) (info=granted OR info=completed)
| transaction search_id Group by search ID
  | startswith=(info=granted) endswith=(info=completed)
| eval lispy_efficiency = event_count / scan_count
| where scan_count > 100 AND total_run_time > 5
  AND lispy_efficiency < 0.5
| table _time total_run_time event_count scan_count
  lispy_efficiency user savedsearch_name search
```

▶ Adjust thresholds as needed
▶ Finds some false positives, e.g. itself 😊
▶ Stats? Sure:

```
index=_audit search_id TERM(action=search) (info=granted OR info=completed)
| stats first(_time) as _time first(total_run_time) as total_run_time first(event_count) as event_count first(scan_count) as scan_count first(user) as user first(savedsearch_name) as savedsearch_name first(search) as search by search_id
| eval lispy_efficiency = event_count / scan_count
| where lispy_efficiency < 0.5 AND total_run_time > 5 AND scan_count > 100
```
Every breaker is a major breaker

Remove duplicates, sort alphabetically

Some additional optimizations

127.0.0.1 becomes [ AND 0 1 127 ]

Load all events off disk that contain all three tokens – scanCount

Filter for 127.0.0.1 in the raw event – eventCount

This search has completed and has returned 9,450 results by scanning 21,804 events in 5.284 seconds.
<table>
<thead>
<tr>
<th>Search</th>
<th>Lispy</th>
</tr>
</thead>
<tbody>
<tr>
<td>foo bar <em>(implicit AND)</em></td>
<td>[ AND bar foo ]</td>
</tr>
<tr>
<td>foo OR bar</td>
<td>[ OR bar foo ]</td>
</tr>
<tr>
<td>(a AND b) OR (c AND d)</td>
<td>[ OR [ AND a b ] [ AND c d ] ]</td>
</tr>
<tr>
<td>(a OR b) AND (c OR d)</td>
<td>[ AND [ OR a b ] [ OR c d ] ]</td>
</tr>
</tbody>
</table>
NOT Can Be Tricky

- NOT bad works as expected: [ NOT bad ]
- Load all events that don't have that token

- How do you translate NOT 127.0.0.1?
- [ NOT [ AND 0 1 127 ] ]?
- That would rule out 127.0.1.1!
- The sad reality: [ AND ]
- Same story with NOT "foo bar"
Wildcards

- Filter for partial matches of indexed tokens
- Imagine indexed tokens are stored as a tree, where each node contains a list of events
- Beware of wildcards at the beginning!

<table>
<thead>
<tr>
<th>Search</th>
<th>Lispy</th>
</tr>
</thead>
<tbody>
<tr>
<td>foo*</td>
<td>[ AND foo* ]</td>
</tr>
<tr>
<td>f*o</td>
<td>[ AND f*o ]</td>
</tr>
<tr>
<td>*foo</td>
<td>[ AND ]</td>
</tr>
</tbody>
</table>
Wildcards Can Be Tricky

- Wildcards in combination with breakers lead to unexpected results

- Hello W*rld gives you [ AND hello w*rld ] – great!
- Hello*World gives you [ AND hello*world ] – oops!
- There is no indexed token matching this lispy!
Wildcards Can Be Really Tricky

- Wildcards in combination with breakers lead to unexpected results

- Say your events contain `java.lang.NullPointerException`

- Indexed tokens: `java lang NullPointerException`  
  `java.lang.NullPointerException`

- `java*Exception / [ AND java*Exception ]` – great!

- `java.lang.*Exception / [ AND java lang ]` – fine!

- `java.lang*Exception / [ AND java lang*Exception ]` – oops!

- In short: Be very very careful around wildcards
TERM()

- Force lispy to use a complex token, ignore breakers
  - `TERM(127.0.0.1)` becomes `[ AND 127.0.0.1 ]`
- Allows leading wildcards, `TERM(*foo)` becomes `[ AND *foo ]`
- Enables inexact `tstats` queries \o/
  | `tstats count where index=_* TERM(*bucketMover)`
- Can be used with fields: `component=TERM(*bucketMover)`

- Beware: Crawling the index for leading wildcards is IO-intensive
- Related: `CASE(FoO)` produces case-sensitive lispy expressions
Fields

Unprecedented
Search-time Fields

- Field values are extracted from the raw event while the search runs
- Default assumption: Field values are whole indexed tokens
- `exception=java.lang.NullPointerException` becomes
  
  `[ AND java lang NullPointerExcepcion ]`

- Actual field extractions and post-filtering happens after loading raw events
- Pro: Flexibility, scoping, mostly decent performance
- Con: Terrible performance in some cases, partial tokens pitfall
Index-time Fields

- **Default fields**: host, source, timestartpos, etc.
- **Custom fields in** transforms.conf (WRITE_META=true)
- **Pro**: Search performance
- **Con**: Flexibility, lack of sourcetype namespace
- **Con if over-used**: Indexing overhead, disk space

**Search for** `sourcetype=foo timestartpos>0 [ AND sourcetype::foo [ GT timestartpos 0 ] ]`
Define Custom Index-time Fields

- transforms.conf: REGEX, FORMAT, WRITE_META
- props.conf: TRANSFORMS-class = stanza
- fields.conf: [fieldname] INDEXED = true

- ...fields.conf?
- Tells the search that a field is expected as an indexed field (lispy : :)
- Not scoped to a props.conf stanza such as sourcetype!
- Trying to work around fields.conf with field aliases is futile
- Use field::value in search to explicitly access indexed field
Calculated Fields

- Call an eval expression at search time: `[stanza] EVAL-answer=42`
- Field values don’t have to be indexed tokens, hard to filter in lispy
  - `answer=42` becomes `[ OR 42 sourcetype:::stanza ]`
- Scan all events for the field value plus all events for that stanza
- Common use case: CIM normalization, e.g. Bluecoat TA:
  - `EVAL-dest=coalesce(dest_ip, dest_host)`
- No pre-search optimization
- Use sparingly when searching by a field
Comparisons

- Access logs, search for server errors: \texttt{status}>=500
- What indexed token to scan for? None - [ AND ]

- Can be solved with a lookup of known server error codes (CIM App)
- Can be solved with an indexed field

- Non-solution: \texttt{status}=5*, [ AND 5* ]
- Too many events have a 5* token somewhere
Remember **NOT**? Tricky...

- **NOT bad** worked well: [ NOT bad ]
- What about **NOT field=bad**?
- Index-time? No problem: [ NOT field::bad ]
- Search time? [ NOT bad ]?

- That would rule out events like this:
  field=good otherfield=bad!
- Instead, Splunk has to scan all the events
Value Uniqueness

- 2016-09-28 12:34:56.789 uid=2016 syscall=2
- Search for uid=2016, get [ AND 2016 ]
- Token is not very unique, scans all events from that year
- Common offenders: Small integers, true, yes, ERROR, etc.

- Can be solved with an indexed field
- Can sometimes be solved with TERM(uid=2016)
- Beware of uid="2016" – major breakers break TERM()
Fields From Partial Tokens

- Any financial services people? – DE44500105175407324931
- Extract fields: (?<country>[A-Z][A-Z]) (?<check>\d\d)...
- Search for country=DE, get lispy [ AND DE ] – oops!
- Can be fixed by fields.conf (but beware of scoping!)
  [country] INDEXED_VALUE = <VALUE>*

- Search for check=44 – fixing in fields.conf gets ugly
  [check] INDEXED_VALUE = *<VALUE>*
  [check] INDEXED_VALUE = false
What About Accelerations?

- Accelerated Datamodels and Reports get filled by frequent searches
- Users of accelerations get a large performance boost regardless of their lispy efficiency – good!

- However!
- The frequent summarizing searches should be well-optimized
- Rule of thumb: The more often something will run for a long time into the future, the more time you should spend on optimizations
1. Love thy Job Inspector
2. Start to think of lispy when writing searches
3. Level 2: Think in lispy
4. Carefully consider opportunities for index-time fields
5. Give extra scrutiny to…
   • Searches using wildcards
   • Small numbers
   • Filtering through \texttt{NOT} – especially for fields
   • Calculated fields
   • These: \texttt{5 of 171,700 events matched}
Thank You

Don't forget to rate this session in the .conf2017 mobile app.