

# ELK Stack





Somkiat Puisungnoen

Somkiat Puisungnoen

Update Info 1 View Activity Log 10+ ...

Timeline About Friends 3,138 Photos More

When did you work at Opendream? X

... 22 Pending Items

Intro

Software Craftsmanship

Software Practitioner at สยามชัมนาณกิจ พ.ศ. 2556

Agile Practitioner and Technical at SPRINT3r

Post Photo/Video Live Video Life Event

What's on your mind?

Public Post

Somkiat Puisungnoen 15 mins · Bangkok · ⚙️

Java and Bigdata



Page

Messages

Notifications 3

Insights

Publishing Tools

Settings

Help ▾



somkiat.cc

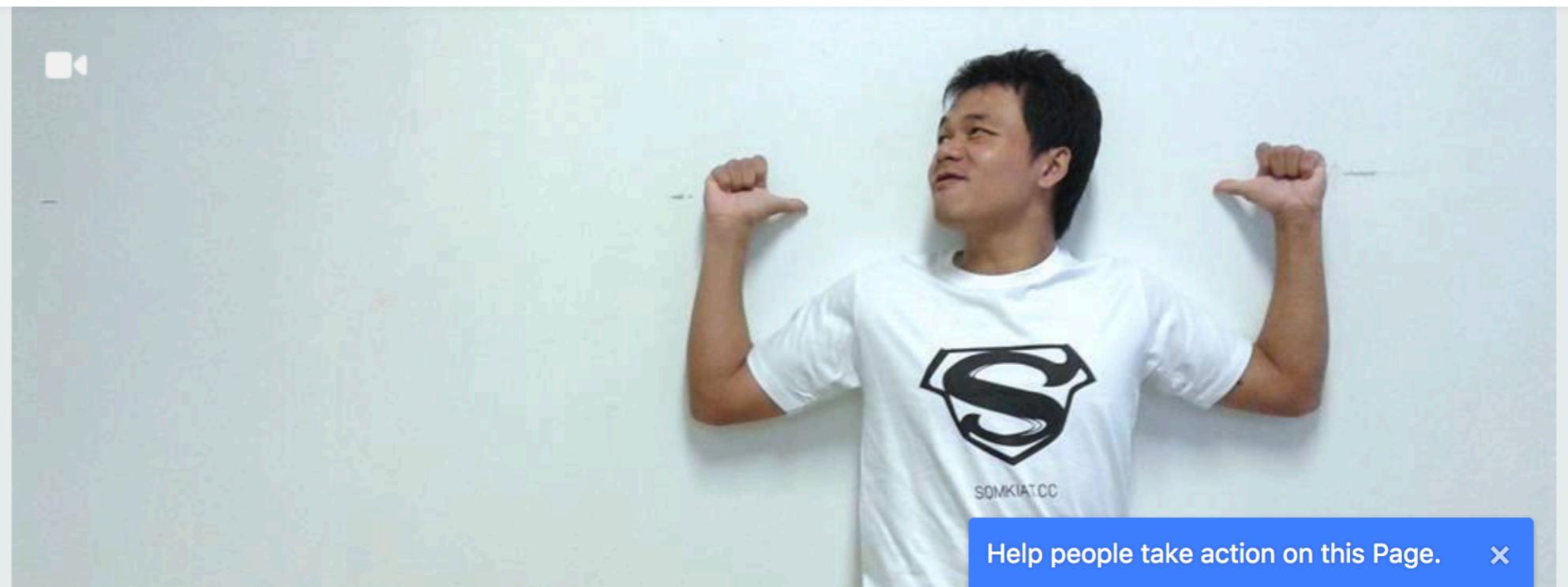
@somkiat.cc

Home

Posts

Videos

Photos



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**[https://github.com/up1/course\\_elk](https://github.com/up1/course_elk)**



# Agenda

- ELK stack
- Introduction to Elasticsearch
- CRUD (Create, Read, Update, Delete)
- Search DSL (Domain Specific Language)
- Analyzer
- Mapping
- Aggregation



# Agenda

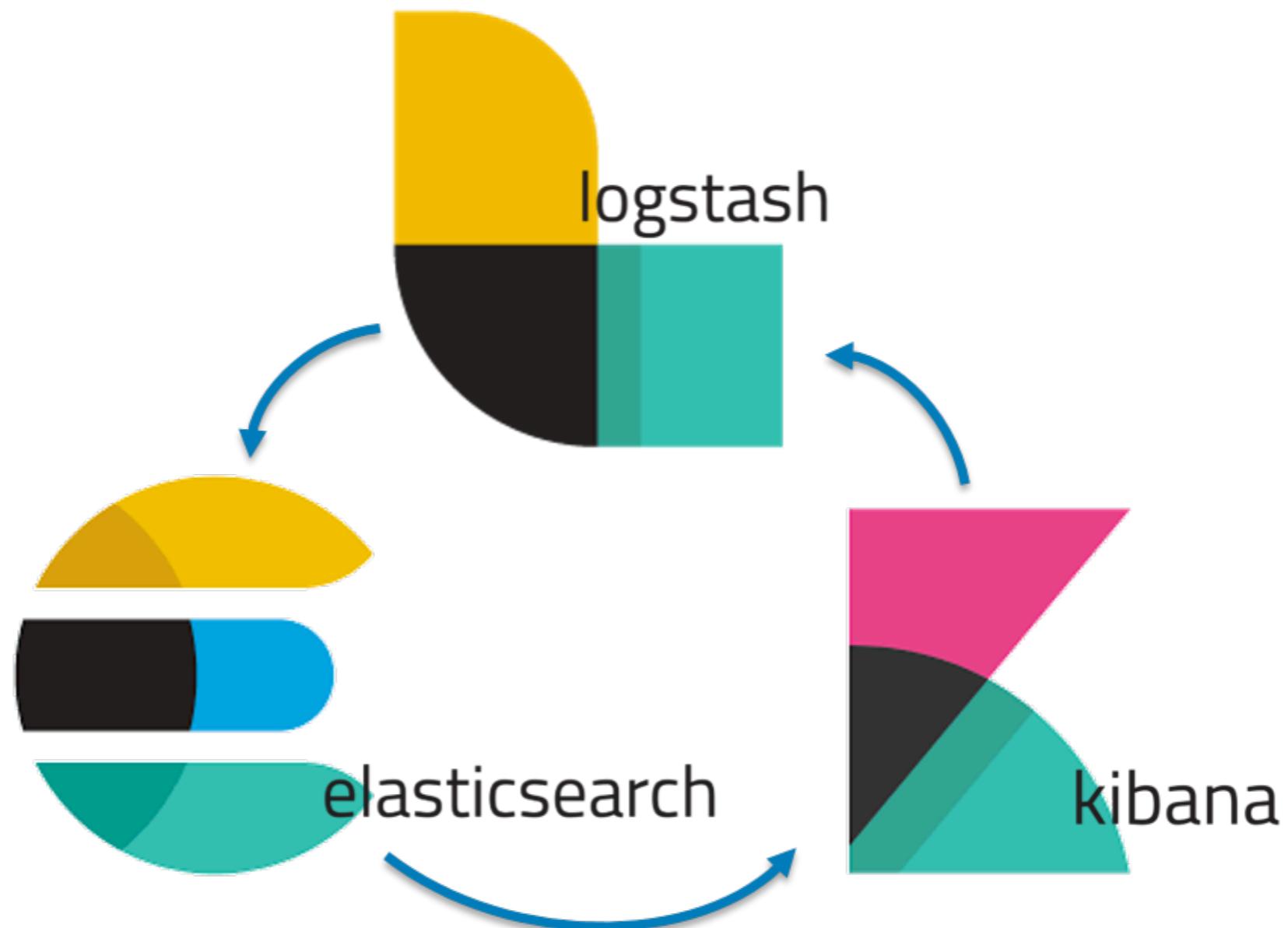
- Working with Kibana
- Useful features
  - Auto-suggestion
  - ngram algorithm
- Clustering management
- Design for scaling
- Working with Logstash



# Agenda

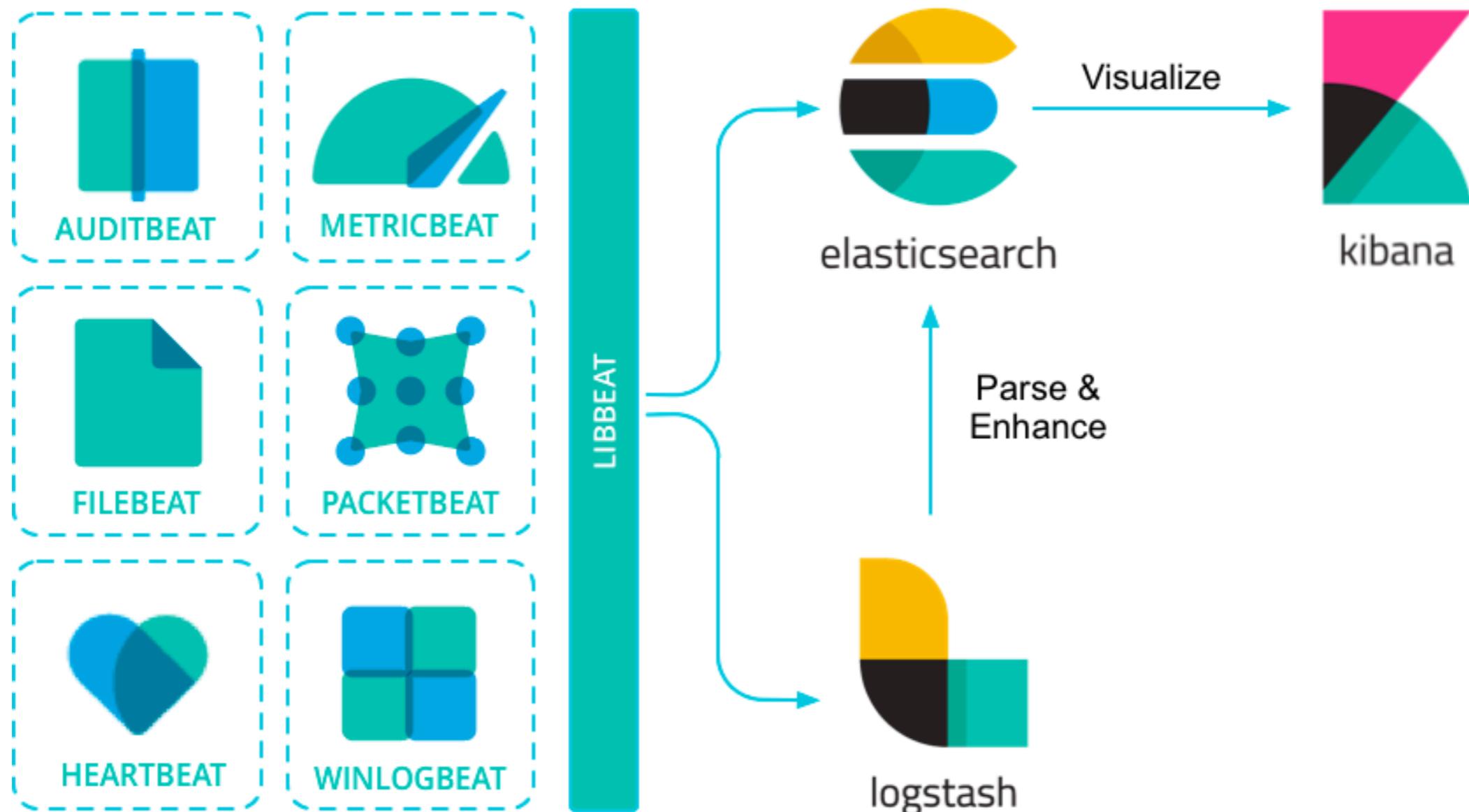
- Working with Prometheus
- Working with Grafana
- Workshop







# Beat



<https://www.elastic.co/guide/en/beats/libbeat/current/index.html>



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# Beat

Purpose	Library
Audit data	Auditbeat
Log files	Filebeat
Cloud data	Functionbeat
Availability	Heartbeat
Metrics	Metricbeat
Network traffic	Packetbeat
Windows event logs	Winlogbeat

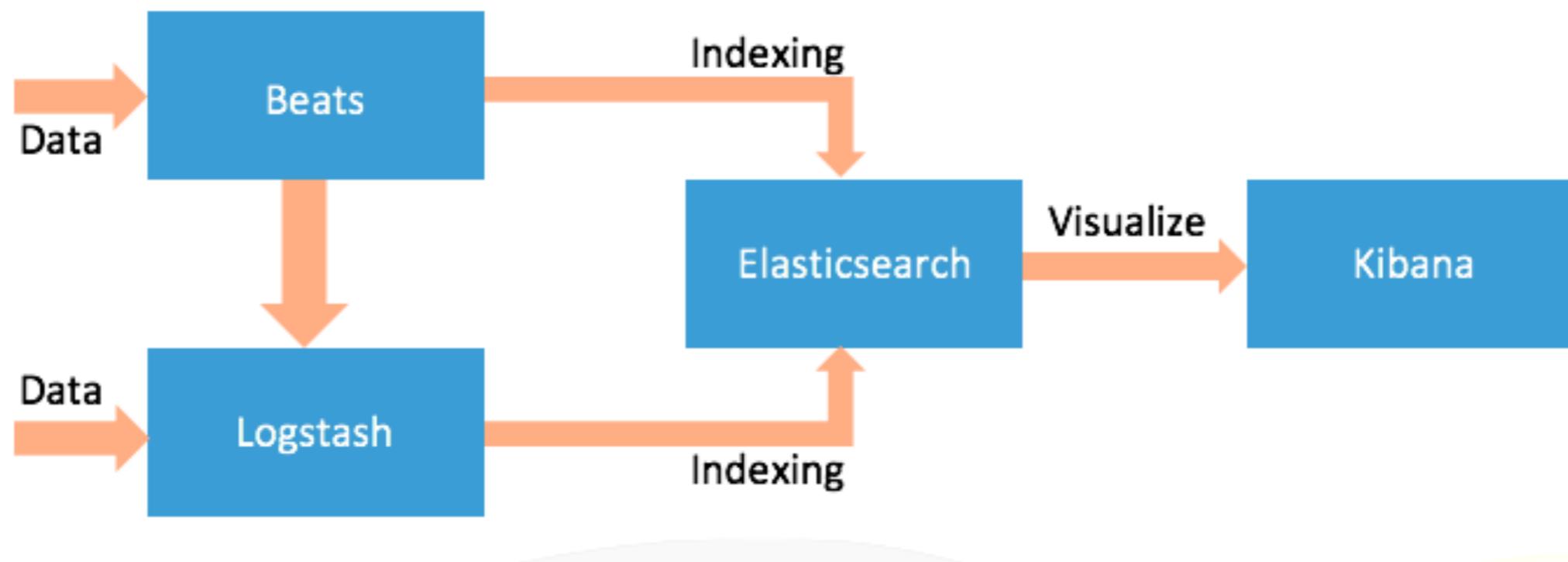
<https://www.elastic.co/guide/en/beats/libbeat/current/beats-reference.html>



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# ELK stack



# Elasticsearch ?



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# Elasticsearch

Search  
Analytic  
Real-time  
Distributed  
Scalability



# Distributed Search Engine

Open Source  
Document-based  
Based on **Apache Lucene**  
JSON over HTTP



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# Distributed Search Engine



Compass



elasticsearch



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# Apache Lucene

The screenshot shows the official Apache Lucene website. At the top, there's a navigation bar with a search bar containing "Search with Apache So" and a dropdown menu "select provider". Below the search bar are three tabs: "CORE (JAVA)", "SOLR", and "PYLUCENE". A large green banner in the center features the text "Ultra-fast Search Library and Server" and the Apache Lucene logo. To the right of the banner is the Solr logo. Below the banner, a dark grey box contains the text "Apache Lucene and Solr set the standard for search and indexing performance". The main content area has a light grey background. On the left, the text "Welcome to Apache Lucene" is displayed above a list of project components. On the right, there are two "DOWNLOAD" buttons: one for "Apache Lucene 7.5.0" in green and another for "Apache Solr 7.5.0" in orange. At the bottom right of this section is the word "Projects".

Ultra-fast Search Library and Server

Apache Lucene and Solr set the standard for search and indexing performance

## Welcome to Apache Lucene

The Apache Lucene™ project develops open-source search software, including:

- [Lucene Core](#), our flagship sub-project, provides Java-based indexing and search technology, as well as spellchecking, hit highlighting and advanced analysis/tokenization capabilities.
- [Solr™](#) is a high performance search server built using Lucene Core, with XML/HTTP and JSON/Python/Ruby APIs, hit highlighting, faceted search, caching, replication, and a web admin interface.
- [PyLucene](#) is a Python port of the Core project.

[DOWNLOAD](#)

Apache Lucene 7.5.0

[DOWNLOAD](#)

Apache Solr 7.5.0

Projects

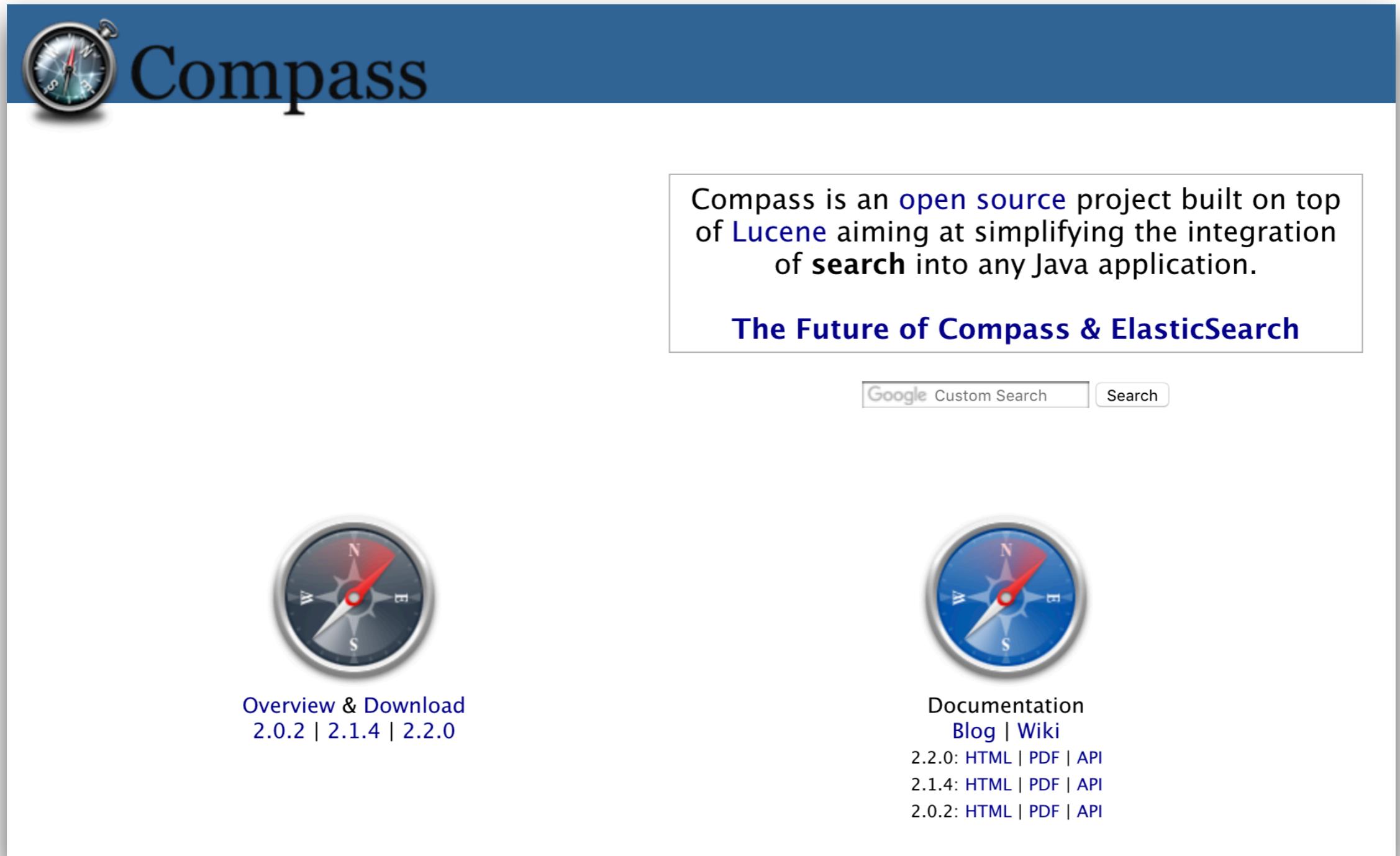
<http://lucene.apache.org/>



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# Compass



The screenshot shows the official website for the Compass project. At the top left is a compass icon. To its right, the word "Compass" is written in a large, serif font. Below this, a box contains a paragraph about the project and a link to a blog post. At the bottom, there are two columns: one for "Overview & Download" and one for "Documentation". Both columns feature a compass icon and links to various versions of the software.

Compass is an [open source](#) project built on top of [Lucene](#) aiming at simplifying the integration of [search](#) into any Java application.

[The Future of Compass & ElasticSearch](#)

[Google Custom Search](#) [Search](#)

[Overview & Download](#)  
2.0.2 | 2.1.4 | 2.2.0

[Documentation](#)  
[Blog](#) | [Wiki](#)  
2.2.0: [HTML](#) | [PDF](#) | [API](#)  
2.1.4: [HTML](#) | [PDF](#) | [API](#)  
2.0.2: [HTML](#) | [PDF](#) | [API](#)

<http://www.compass-project.org/>



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# Document based

## JSON (JavaScript Object Notation)

## Dynamic Schema (Schema-less)

## Some relationship (nested, parent/child)



# StackOverflow Question

```
{  
  "items": [  
    {  
      "owner": {  
        "reputation": 13,  
        "user_id": 9796344,  
        "user_type": "registered",  
        "profile_image": "",  
        "display_name": "Cherry",  
        "link": "https://stackoverflow.com/users/9796344/cherry"  
      },  
      "score": 0,  
      "last_activity_date": 1528986761,  
      "creation_date": 1528986761,  
      "post_type": "question",  
      "post_id": 50859951,  
      "link": "https://stackoverflow.com/q/50859951"  
    }  
  ],  
  "has_more": false,  
  "quota_max": 10000,  
  "quota_remaining": 9986  
}
```

<https://api.stackexchange.com/docs/posts-by-ids>



# Ranking from DB Engine (2018)

350 systems in ranking, June 2019

Rank			DBMS	Database Model	Score		
Jun 2019	May 2019	Jun 2018			Jun 2019	May 2019	Jun 2018
1.	1.	1.	Oracle	Relational, Multi-model	1299.21	+13.67	-12.04
2.	2.	2.	MySQL	Relational, Multi-model	1223.63	+4.67	-10.06
3.	3.	3.	Microsoft SQL Server	Relational, Multi-model	1087.76	+15.57	+0.03
4.	4.	4.	PostgreSQL	Relational, Multi-model	476.62	-2.27	+65.95
5.	5.	5.	MongoDB	Document	403.90	-4.17	+60.12
6.	6.	6.	IBM Db2	Relational, Multi-model	172.20	-2.24	-13.44
7.	7.	8.	Elasticsearch	Search engine, Multi-model	148.82	+0.20	+17.78
8.	8.	7.	Redis	Key-value, Multi-model	146.13	-2.28	+9.83
9.	9.	9.	Microsoft Access	Relational	141.01	-2.77	+10.02
10.	10.	10.	Cassandra	Wide column	125.18	-0.54	+5.97

<https://db-engines.com/en/ranking>



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# Use cases

Security/log analytics  
Marketing  
Operations  
Searching data



# Let's start



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# Installation

## Elasticsearch

## Kibana



# Install Elasticsearch



# Elasticsearch

Required Java 8  
JDK and Open JDK  
Need \$JAVA\_HOME



# JAVA\_HOME

\$echo %JAVA\_HOME% //For Windows

\$echo \$JAVA\_HOME // for Linux/Mac



# Start Elasticsearch

./bin/elasticsearch

```
[0g8-71W] loaded module [reindex]
[0g8-71W] loaded module [repository-url]
[0g8-71W] loaded module [transport-netty4]
[0g8-71W] loaded module [tribe]
[0g8-71W] no plugins loaded
[0g8-71W] using discovery type [zen]
initialized
[0g8-71W] starting ...
[0g8-71W] publish_address {127.0.0.1:9300},
[0g8-71W] recovered [0] indices into cluster_state
transport] [0g8-71W] publish_address {127.0.0.1:9200},
```



# Configuration files

`elasticsearch.yml`

`jvm.options`

`log4j2.properties`

Default : `$ES_HOME/config`

Custom config path : `$ES_PATH_CONF`



# Default of Memory

1 GB !!! (Java need more memory)

```
 ] [DW5j42N] JVM arguments [-Xms1g, -Xmx1g, -  
ction=75, -XX:+UseCMSInitiatingOccupancyOnly, -XX:  
Dfile.encoding=UTF-8, -Djna.nosys=true, -XX:-Omit  
.netty.noKeySetOptimization=true, -Dio.netty.recy  
led=false, -Dlog4j2.disable.jmx=true, -Djava.io.t  
T/elasticsearch.G4kbTLZn, -XX:+HeapDumpOnOutOfMem  
s_err_pid%p.log, -Xlog:gc*,gc+age=trace,safepoint  
ize=64m, -Djava.locale.providers=COMPAT, -XX:UseA
```



# Config of JVM

`$ES_HOME/config/jvm.options`

```
# Xms represents the initial size of total heap space  
# Xmx represents the maximum size of total heap space  
  
-Xms1g  
-Xmx1g
```



# Default plugins

```
[o.e.p.PluginsService      ] [DW5j42N] loaded module [aggs-matrix-stats]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [analysis-common]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [ingest-common]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [lang-expression]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [lang-mustache]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [lang-painless]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [mapper-extras]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [parent-join]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [percolator]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [rank-eval]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [reindex]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [repository-url]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [transport-netty4]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [tribe]
```



# Install X-Pack by default

```
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-core]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-deprecation]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-graph]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-logstash]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-ml]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-monitoring]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-rollup]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-security]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-sql]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-upgrade]
[o.e.p.PluginsService      ] [DW5j42N] loaded module [x-pack-watcher]
[o.e.p.PluginsService      ] [DW5j42N] no plugins loaded
```

<https://www.elastic.co/guide/en/elasticsearch/reference/current/installing-xpack-es.html>



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# X-Pack ?

Elastic Stack Extension  
Security  
Monitoring  
Alerting  
Reporting  
Machine Learning



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# Licence

	FREE OPEN SOURCE	BASIC	GOLD	PLATINUM
Elasticsearch	<a href="#">Download</a>		<a href="#">Request Info</a>	<a href="#">Request Info</a>
✓ Scalability & Resiliency	✓	✓	✓	✓
✓ Query & Analytics	✓	✓	✓	✓
✓ Data Enrichment	✓	✓	✓	✓
✓ Management & Tooling	✓	✓	✓	✓
✓ Security			✓	✓
✓ Alerting			✓	✓
✓ Machine Learning				✓
Kibana				
✓ Explore & Visualize	✓	✓	✓	✓
✓ Stack Management & Tooling	✓	✓	✓	✓
✓ Stack Monitoring		✓	✓	✓

<https://www.elastic.co/subscriptions>



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# Hello Elasticsearch

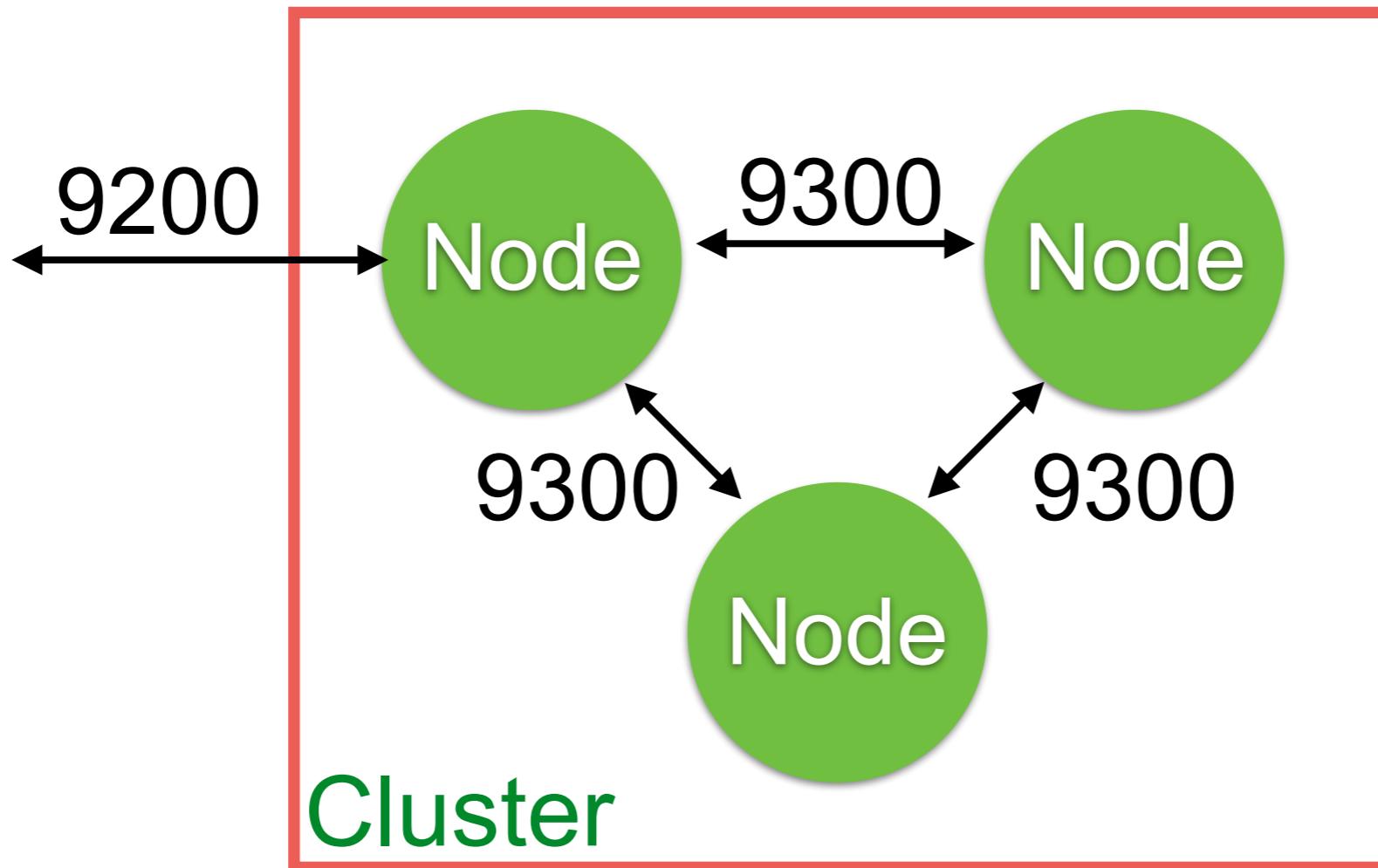
<http://localhost:9200/>

```
{  
    name: "Somkiats-MacBook-Pro",  
    cluster_name: "elasticsearch",  
    cluster_uuid: "gglAIg0NRHyn4AefFR6law",  
    - version: {  
        number: "7.1.1",  
        build_flavor: "default",  
        build_type: "tar",  
        build_hash: "7a013de",  
        build_date: "2019-05-23T14:04:00.380842Z",  
        build_snapshot: false,  
        lucene_version: "8.0.0",  
        minimum_wire_compatibility_version: "6.8.0",  
        minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
    tagline: "You Know, for Search"  
}
```



# Ports of Elasticsearch

RESTful API with JSON Over HTTP (9200)  
Java API (9300)



# Name of node and cluster

```
{  
  name: "Somkiats-MacBook-Pro",  
  cluster_name: "elasticsearch",  
  cluster_uuid: "gglAIg0NRHyn4AefFR61aw",  
  - version: {  
      number: "7.1.1",  
      build_flavor: "default",  
      build_type: "tar",  
      build_hash: "7a013de",  
      build_date: "2019-05-23T14:04:00.380842Z",  
      build_snapshot: false,  
      lucene_version: "8.0.0",  
      minimum_wire_compatibility_version: "6.8.0",  
      minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
  tagline: "You Know, for Search"  
}
```



# Name of node and cluster

\$ES\_HOME/config/elasticsearch.yml

```
# ----- Cluster -----  
#  
# Use a descriptive name for your cluster:  
#  
cluster.name: my-application  
#  
# ----- Node -----  
#  
# Use a descriptive name for the node:  
#  
node.name: node-1  
#  
# Add custom attributes to the node:  
#  
#node.attr.rack: r1  
#
```



# Change in Elasticsearch 7.x

Default name = Hostname

<https://www.elastic.co/guide/en/elasticsearch/reference/master/breaking-changes-7.0.html>



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# Try to change and restart !!!



```
{  
  name: "Somkiats-MacBook-Pro",  
  cluster_name: "elasticsearch",  
  cluster_uuid: "gglAIg0NRHyn4AefFR61aw",  
  - version: {  
      number: "7.1.1",  
      build_flavor: "default",  
      build_type: "tar",  
      build_hash: "7a013de",  
      build_date: "2019-05-23T14:04:00.380842Z",  
      build_snapshot: false,  
      lucene_version: "8.0.0",  
      minimum_wire_compatibility_version: "6.8.0",  
      minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
  tagline: "You Know, for Search"  
}
```



# Compatibility of DSL and Index



```
{  
  name: "Somkiats-MacBook-Pro",  
  cluster_name: "elasticsearch",  
  cluster_uuid: "gglAIg0NRHyn4AefFR61aw",  
  - version: {  
      number: "7.1.1",  
      build_flavor: "default",  
      build_type: "tar",  
      build_hash: "7a013de",  
      build_date: "2019-05-23T14:04:00.380842Z",  
      build_snapshot: false,  
      lucene_version: "8.0.0",  
      minimum_wire_compatibility_version: "6.8.0",  
      minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
  tagline: "You Know, for Search"  
}
```

DSL version

Index version



```
{  
  name: "Somkiats-MacBook-Pro",  
  cluster_name: "elasticsearch",  
  cluster_uuid: "gglAIg0NRHyn4AefFR61aw",  
  - version: {  
      number: "7.1.1",  
      build_flavor: "default",  
      build_type: "tar",  
      build_hash: "7a013de",  
      build_date: "2019-05-23T14:04:00.380842Z",  
      build_snapshot: false,  
      lucene_version: "8.0.0",  
      minimum_wire_compatibility_version: "6.8.0",  
      minimum_index_compatibility_version: "6.0.0-beta1"  
    },  
  tagline: "You Know, for Search"  
}
```

Index version



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# Health of cluster

[http://localhost:9200/\\_cluster/health](http://localhost:9200/_cluster/health)

```
{  
  "cluster_name": "elasticsearch",  
  "status": "green",  
  "timed_out": false,  
  "number_of_nodes": 1,  
  "number_of_data_nodes": 1,  
  "active_primary_shards": 0,  
  "active_shards": 0,  
  "relocating_shards": 0,  
  "initializing_shards": 0,  
  "unassigned_shards": 0,  
  "delayed_unassigned_shards": 0,  
  "number_of_pending_tasks": 0,  
  "number_of_in_flight_fetch": 0,  
  "task_max_waiting_in_queue_millis": 0,  
  "active_shards_percent_as_number": 100.0  
}
```



# Health of cluster

Status	Meaning
Green	All shards are allocated
Yellow	Primary shard is allocated, but replicas are not
Red	Shard not allocated in the cluster



# cat APIs

`http://localhost:9200/_cat`

```
=^.^=
/_cat/allocation
/_cat/shards
/_cat/shards/{index}
/_cat/master
/_cat/nodes
/_cat/tasks
/_cat/indices
/_cat/indices/{index}
/_cat/segments
/_cat/segments/{index}
/_cat/count
/_cat/count/{index}
/_cat/recovery
/_cat/recovery/{index}
/_cat/health
/_cat/pending_tasks
/_cat/aliases
/_cat/aliases/{alias}
```

<https://www.elastic.co/guide/en/elasticsearch/reference/current/cat.html>



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# cat APIs

`http://localhost:9200/_cat/nodes?v`

ip	heap.percent	ram.percent	cpu	load_1m	load_5m	load_15m	node.role	master	name
127.0.0.1	20	100	7	1.98			mdi	*	DW5j42N



# Install Kibana



# Start Kibana

```
[status][plugin:xpack_main@6.4.2] Status changed from yellow to green - Ready
[status][plugin:searchprofiler@6.4.2] Status changed from yellow to green - Ready
[status][plugin:ml@6.4.2] Status changed from yellow to green - Ready
[status][plugin:tilemap@6.4.2] Status changed from yellow to green - Ready
[status][plugin:watcher@6.4.2] Status changed from yellow to green - Ready
[status][plugin:index_management@6.4.2] Status changed from yellow to green - Ready

[status][plugin:graph@6.4.2] Status changed from yellow to green - Ready
[status][plugin:grokdebugger@6.4.2] Status changed from yellow to green - Ready
[status][plugin:logstash@6.4.2] Status changed from yellow to green - Ready
[status][plugin:reporting@6.4.2] Status changed from yellow to green - Ready
[kibana-monitoring][monitoring-ui] Starting monitoring stats collection
[status][plugin:security@6.4.2] Status changed from yellow to green - Ready
[license][xpack] Imported license information from Elasticsearch for the [monitor]
tatus: active
[listening][server][http] Server running at http://localhost:5601
```



# Hello Kibana

<http://localhost:5601/>

The image shows the Kibana landing page. On the left is a vertical sidebar with icons for Kibana, APM, Metrics, Security, Visualize, Discover, and Admin. The main content area has two main sections: "Add Data to Kibana" and "Visualize and Explore Data".

**Add Data to Kibana:**

- APM:** APM automatically collects in-depth performance metrics and errors from inside your applications. [Add APM](#)
- Logging:** Ingest logs from popular data sources and easily visualize in preconfigured dashboards. [Add log data](#)
- Metrics:** Collect metrics from the operating system and services running on your servers. [Add metric data](#)
- Security analytics:** Centralize security events for interactive investigation in ready-to-go visualizations. [Add security events](#)

Data already in Elasticsearch? [Set up index patterns](#)

**Visualize and Explore Data:**

- Dashboard:** Display and share a collection of visualizations and saved searches.
- Timelion:** Use an expression language to analyze time series data.
- Discover:** Interactively explore your data by querying and filtering raw documents.
- Visualize:** Create visualizations and aggregate data stores in your

**Manage and Administer the Elastic Stack:**

- Console:** Skip cURL and use this JSON interface to work with your data directly.
- Index Patterns:** Manage the index patterns that help retrieve your data from Elasticsearch.
- Saved Objects:** Import, export, and manage your saved searches,



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# Using Dev Tools

The screenshot shows the Kibana interface with a sidebar on the left and a main content area on the right.

**Left Sidebar:**

- Kibana logo
- Discover
- Visualize
- Dashboard
- Timelion
- APM
- Dev Tools** (highlighted with a red box)
- Monitoring
- Management

**Main Content Area:**

## Dev Tools

### Welcome to Console

#### Quick intro to the UI

The Console UI is split into two panes: an editor pane (left) and a response pane (right). Use the editor to type requests and submit them in the response pane on the right side.

Console understands requests in a compact format, similar to cURL:

```
1 # index a doc
2 PUT index/type/1
3 {
4   "body": "here"
5 }
6
7 # and get it ...
8 GET index/type/1
```

While typing a request, Console will make suggestions which you can then accept by hitting Enter/Tab. These suggestions are made based on types.

#### A few quick tips, while I have your attention

- Submit requests to ES using the green triangle button.
- Use the wrench menu for other useful things.
- You can paste requests in cURL format and they will be translated to the Console syntax.
- You can resize the editor and output panes by dragging the separator between them.
- Study the keyboard shortcuts under the Help button. Good stuff in there!

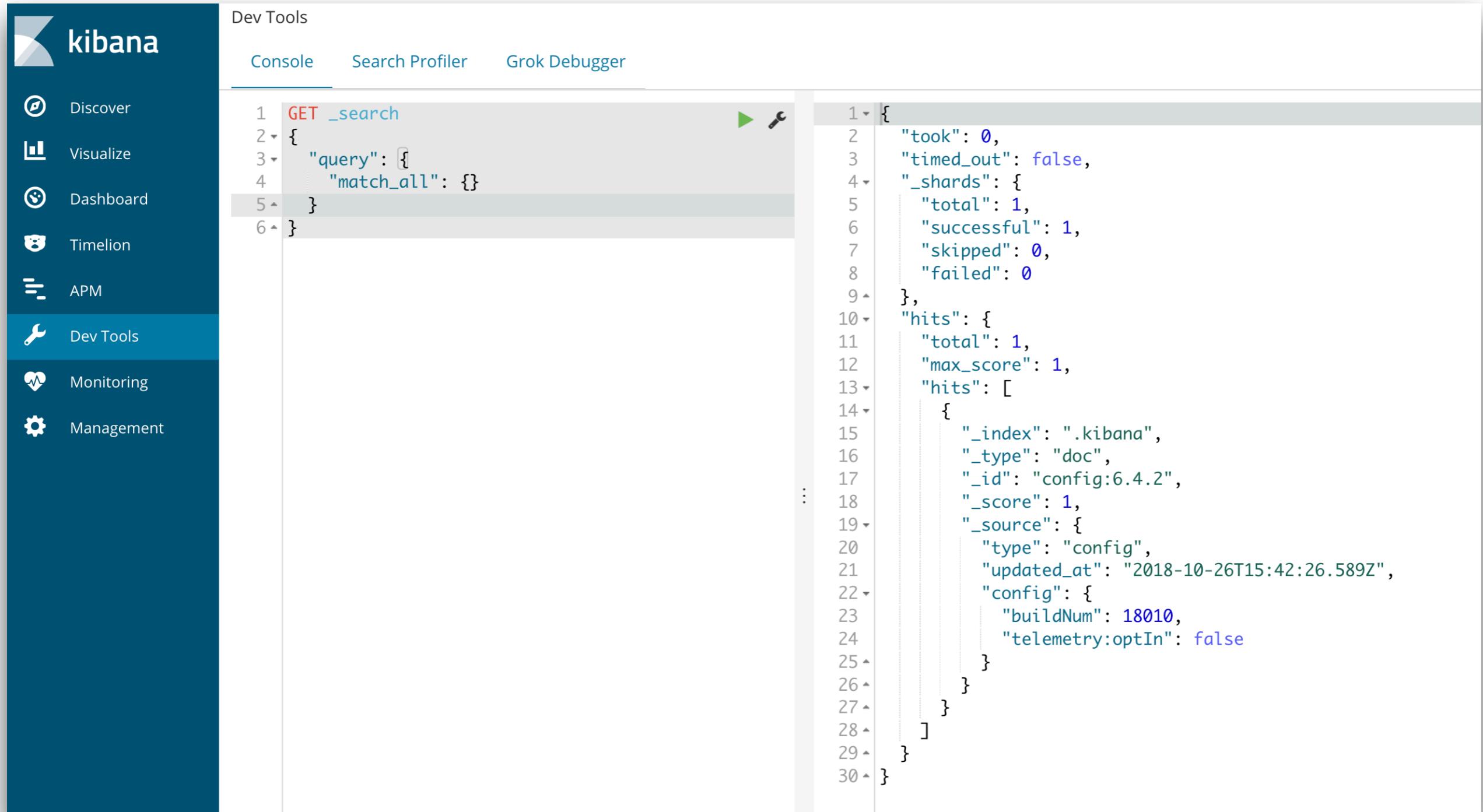
[Get to work](#)



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# Ready to start



The screenshot shows the Kibana Dev Tools interface. On the left is a sidebar with icons for Discover, Visualize, Dashboard, Timelion, APM, Dev Tools (which is selected), Monitoring, and Management. The main area is titled "Dev Tools" and contains three tabs: Console, Search Profiler, and Grok Debugger. The "Console" tab is active, displaying a code editor with a GET \_search request and its JSON response. The request is:1 GET \_search
2 {
3 "query": {
4 "match\_all": {}
5 }
6 }The response is:1 {
2 "took": 0,
3 "timed\_out": false,
4 "\_shards": {
5 "total": 1,
6 "successful": 1,
7 "skipped": 0,
8 "failed": 0
9 },
10 "hits": {
11 "total": 1,
12 "max\_score": 1,
13 "hits": [
14 {
15 "\_index": ".kibana",
16 "\_type": "doc",
17 "\_id": "config:6.4.2",
18 "\_score": 1,
19 "\_source": {
20 "type": "config",
21 "updated\_at": "2018-10-26T15:42:26.589Z",
22 "config": {
23 "buildNum": 18010,
24 "telemetry:optIn": false
25 }
26 }
27 }
28 ]
29 }
30 }



# Elasticsearch architecture



# Basic concepts

Cluster

Node

Shard

Replica

Gateway

Index

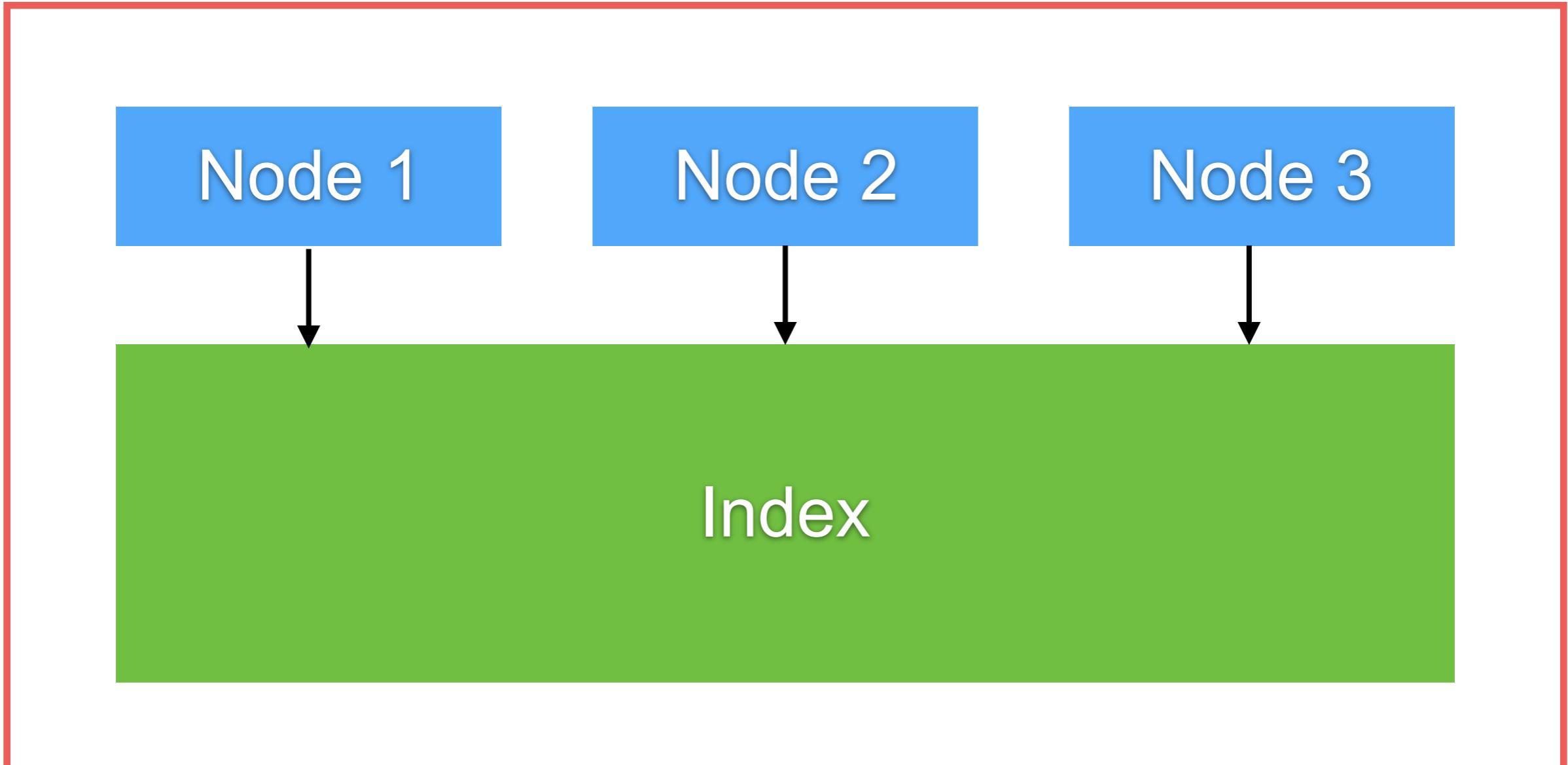
Document

Type

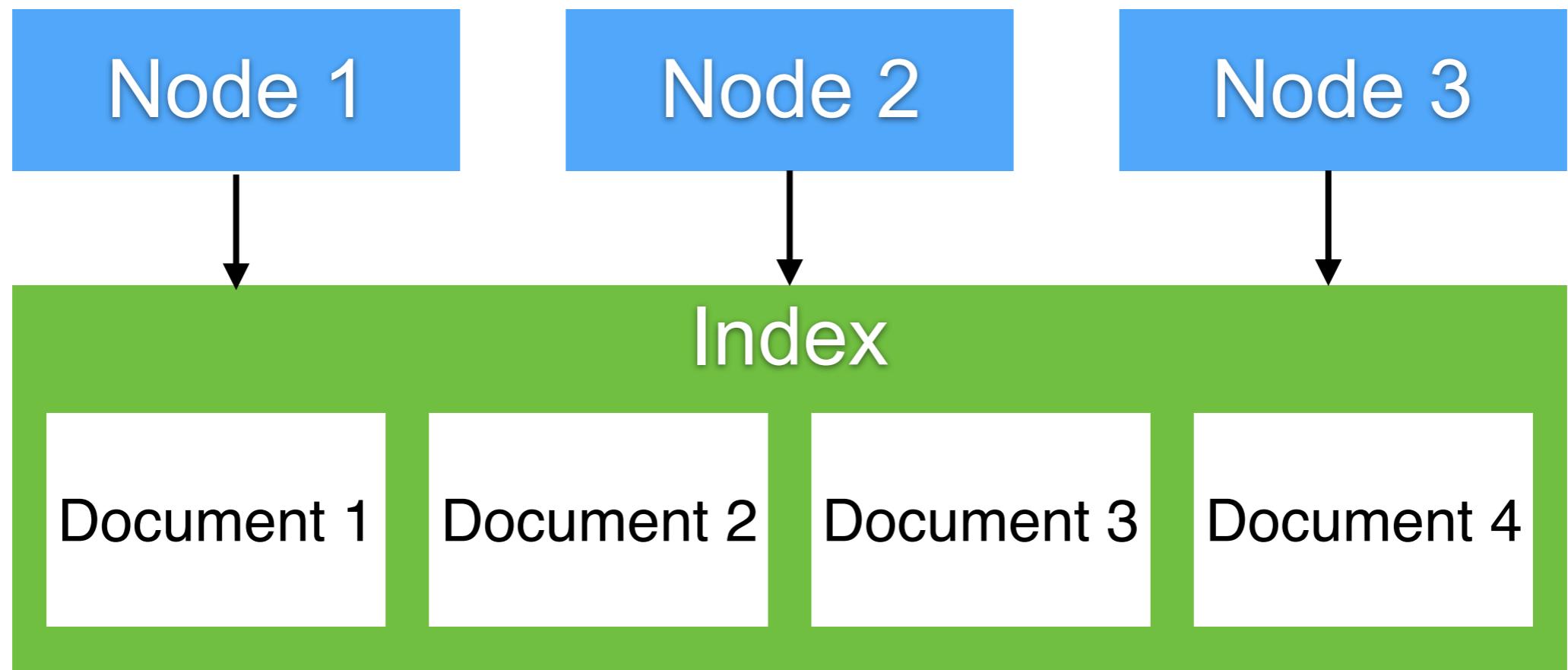
Mapping



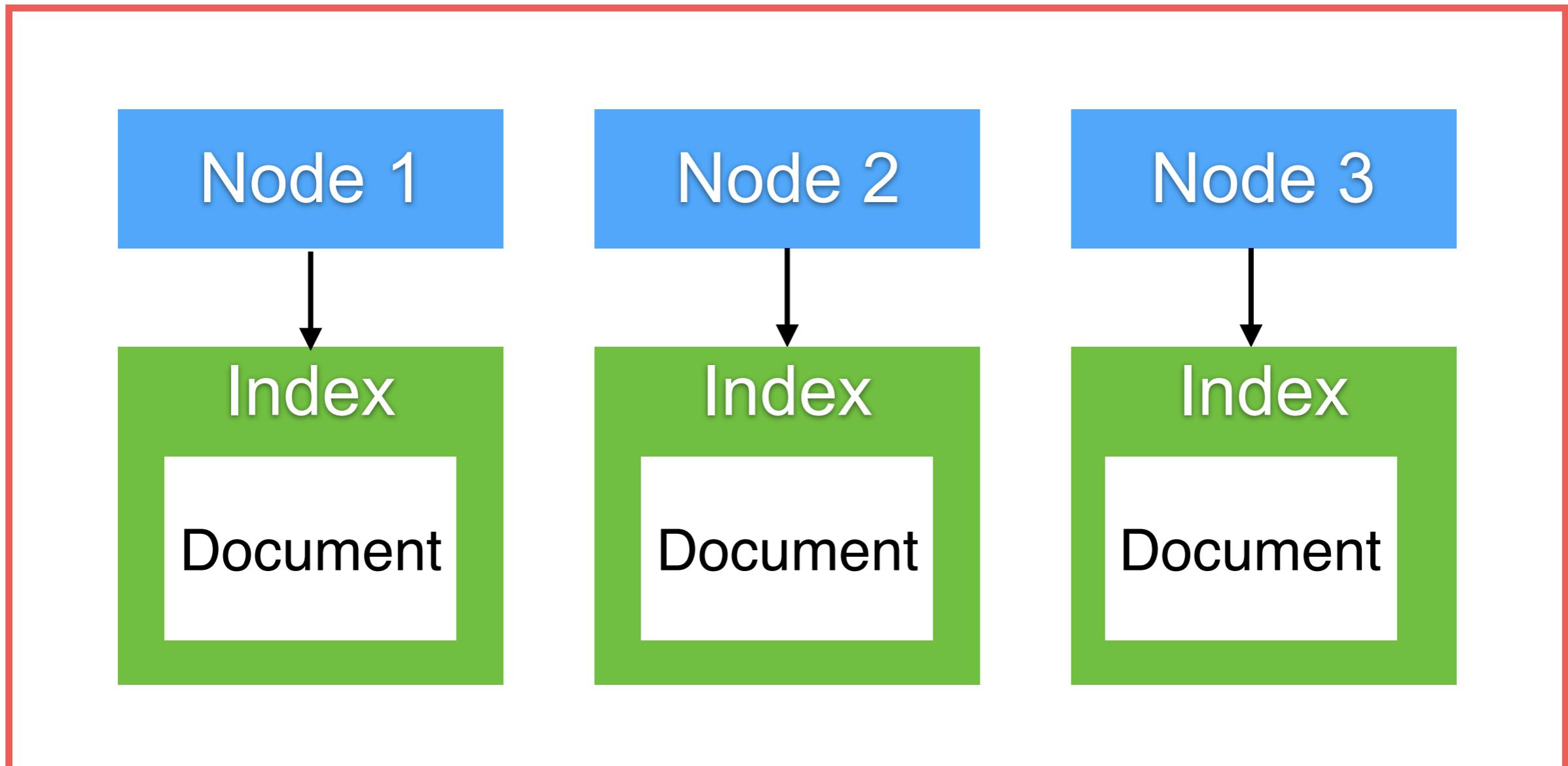
# Cluster



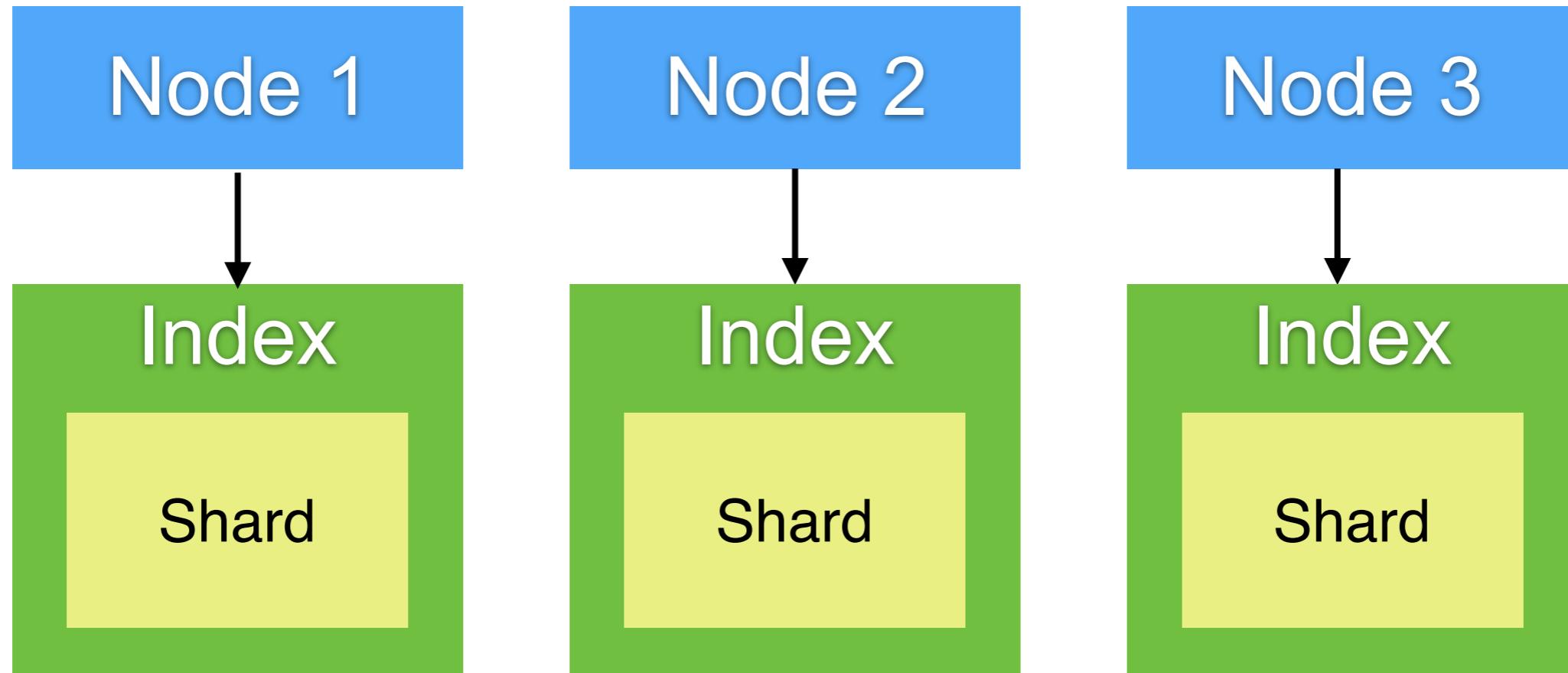
# Documents !!



# Distributed database



# Design for scale (Shard)



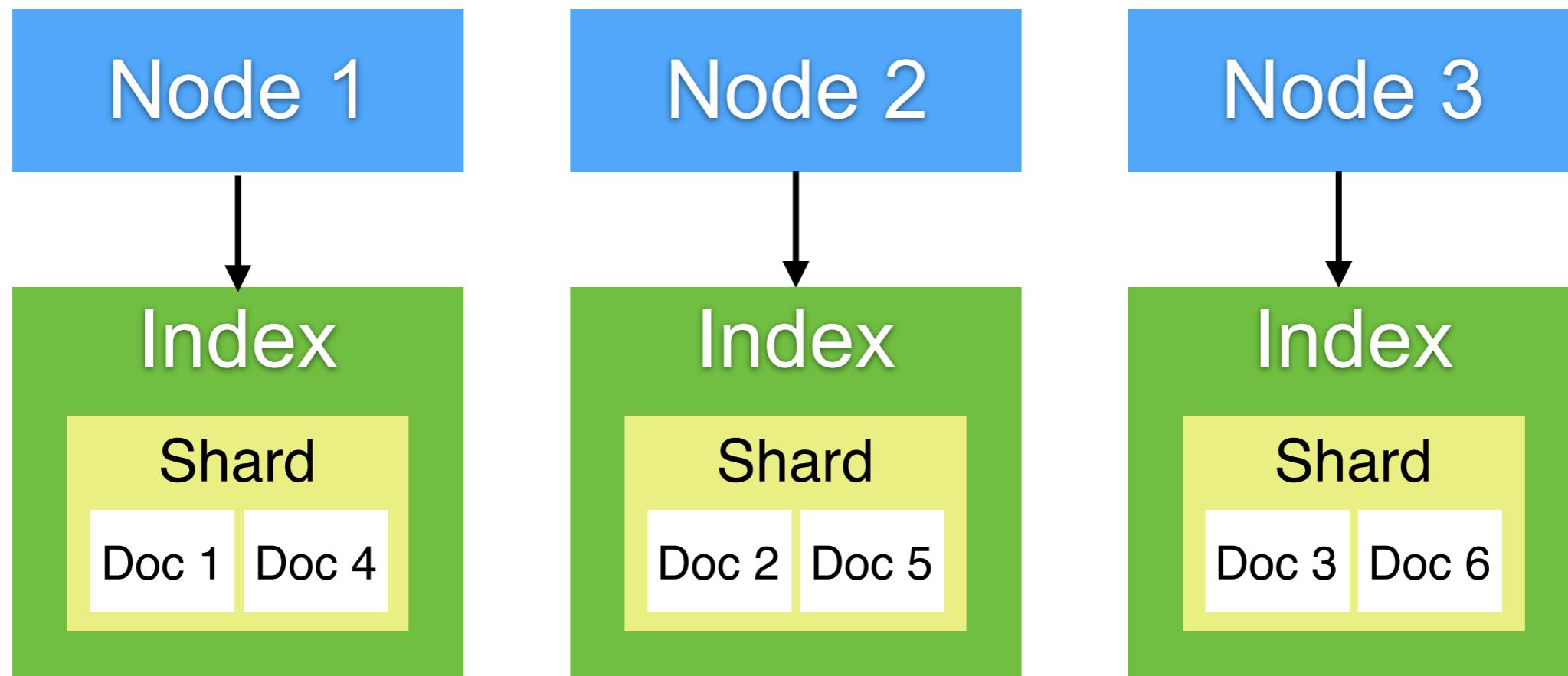
# Index is split into shards

Each shard may be on a different node in cluster

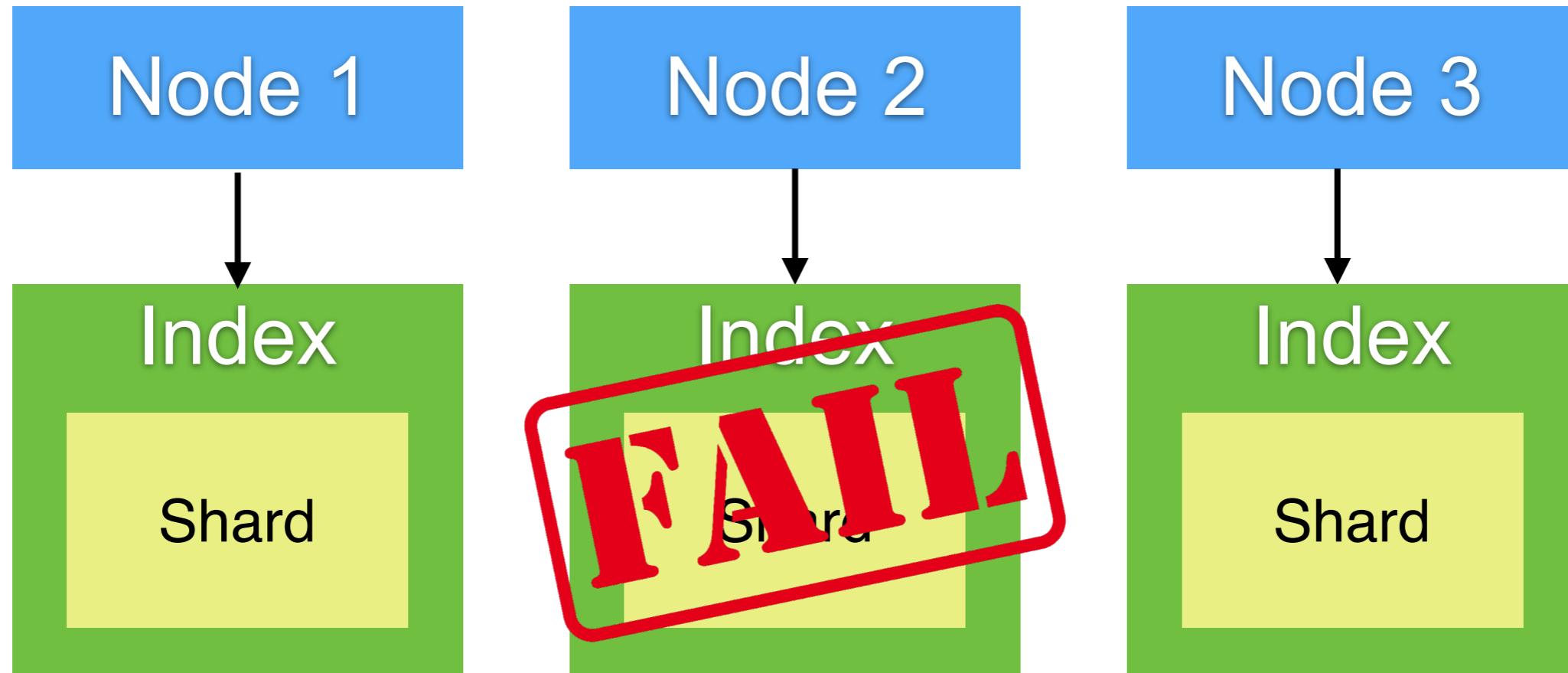
Every shard is a self-contained *Lucene index*



# Documents are hashed



# Design for fail (Replica)



# Replica = copy of shards

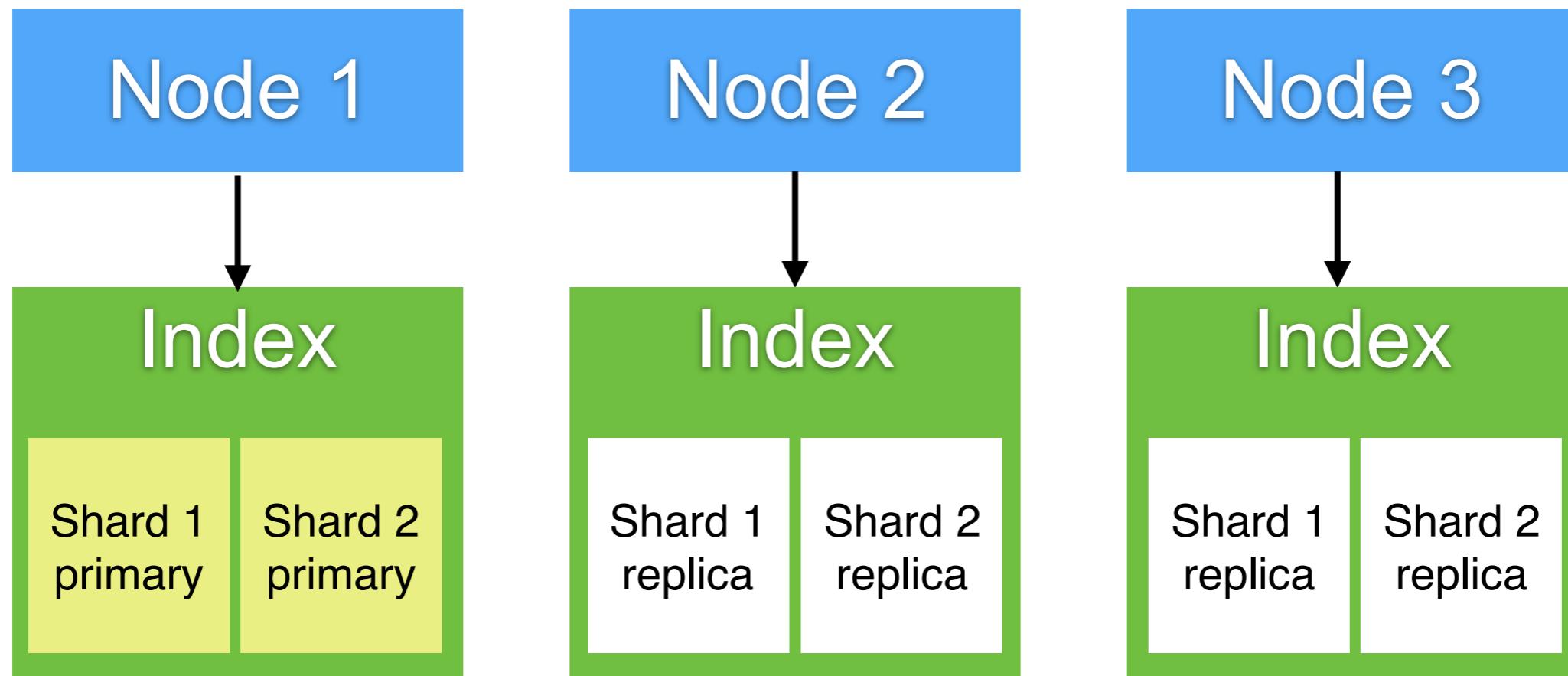
1 replica = 1 Primary + 1 Replica

2 replicas = 1 Primary + 2 Replicas

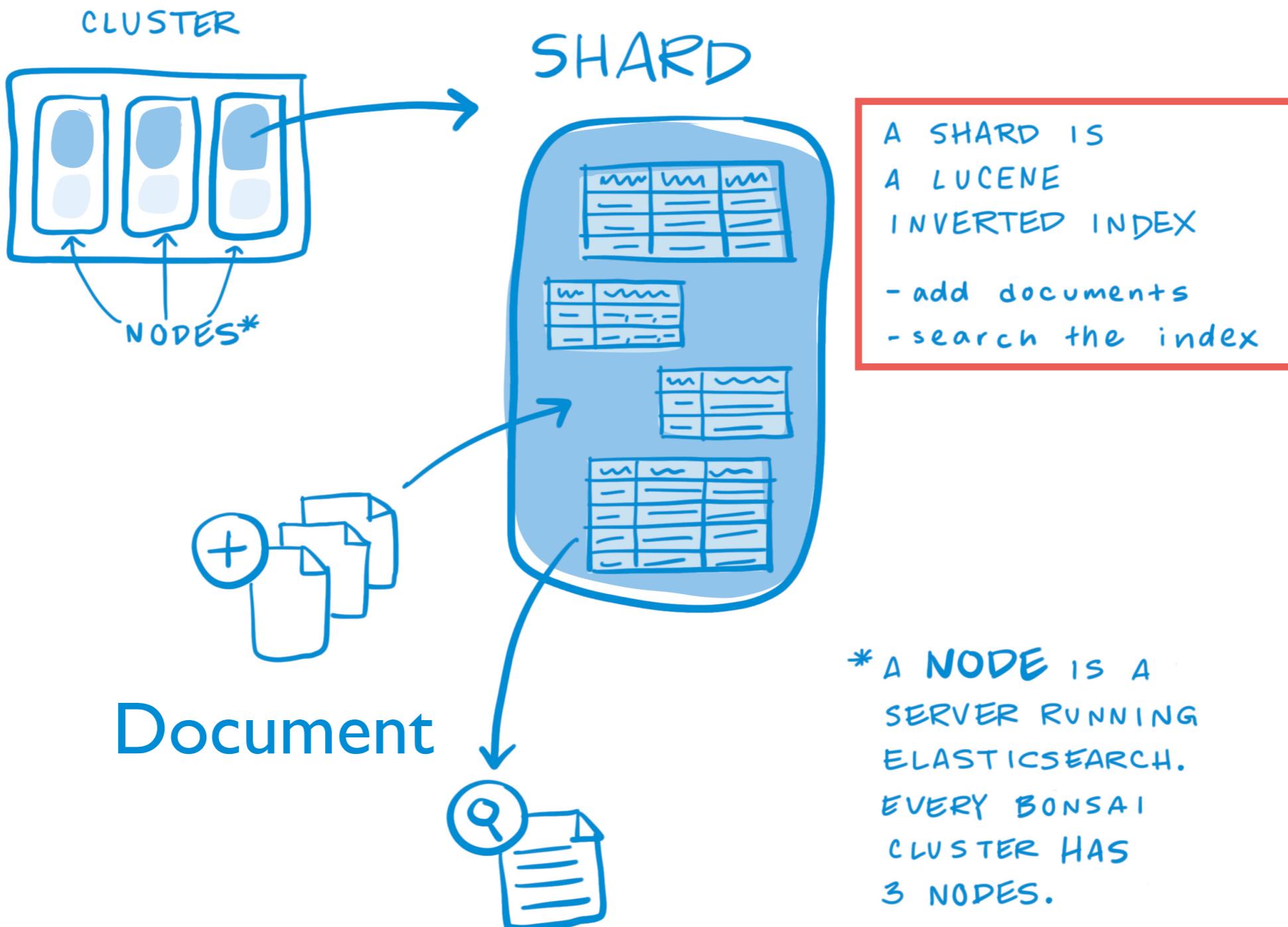
3 replicas = 1 Primary + 3 Replicas



# Replica = 2



# Basic concepts

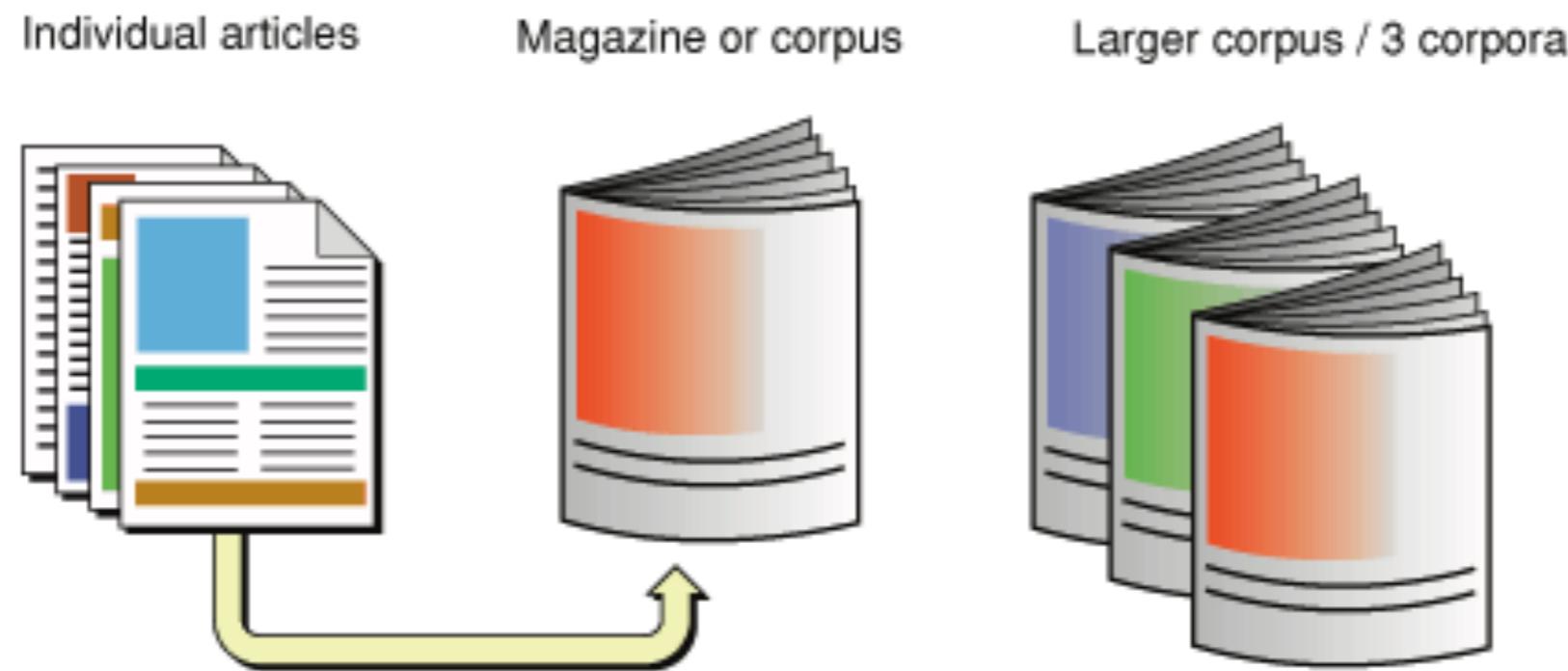


# Inverted Index



# Inverted Index

Corpus is a collection of documents



[https://developer.apple.com/library/archive/documentation/UserExperience/Conceptual/SearchKitConcepts/searchKit\\_basics/searchKit\\_basics.html#/apple\\_ref/doc/uid/TP40002843-TPXREF101](https://developer.apple.com/library/archive/documentation/UserExperience/Conceptual/SearchKitConcepts/searchKit_basics/searchKit_basics.html#/apple_ref/doc/uid/TP40002843-TPXREF101)

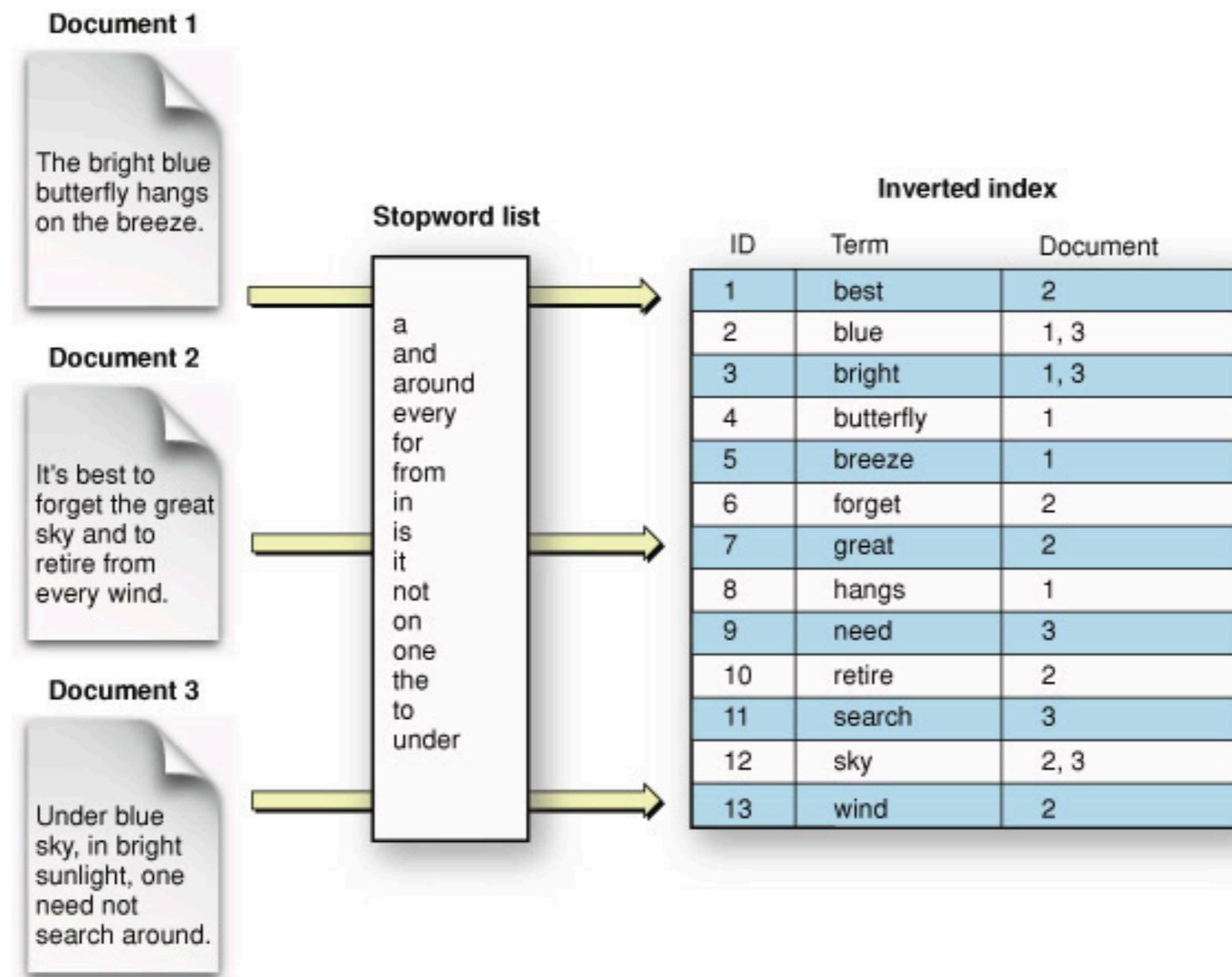


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# Inverted Index

Try to construct index



# Apache Lucene

Elasticsearch

Apache Lucene

JVM

<https://lucene.apache.org/>



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# Basic concept

Apache Lucene writes all the information to a structure called “**Inverted Index**”



# Basic concept

Document  
Field  
Term  
Token



# Example

Document no.	Data
1	Elasticsearch Server
2	Mastering Elasticsearch Second Edition
3	Apache Solr Cookbook Third Edition



# Token

Token	Document no.
Elasticsearch	1
Elasticsearch	2
Server	1
Mastering	2
Second	2
Edition	2
Edition	3
Apache	3
Solr	3
Cookbook	3
Third	3



# Term

Token	Count	Document no.
elasticsearch	2	1,2
server	1	1
mastering	1	2
second	1	2
edition	2	2,3
apache	1	3
solr	1	3
cookbook	1	3
third	1	3



# Lucene inverted index

Token	Count	Document no.
elasticsearch	2	1,2
server	1	1
mastering	1	2
second	1	2
edition	2	2,3
apache	1	3
solr	1	3
cookbook	1	3
third	1	3



# Lucene inverted index

Write-once and read-many-times structure

Called “**Segment**”

Can't be delete (just marked to deleted)



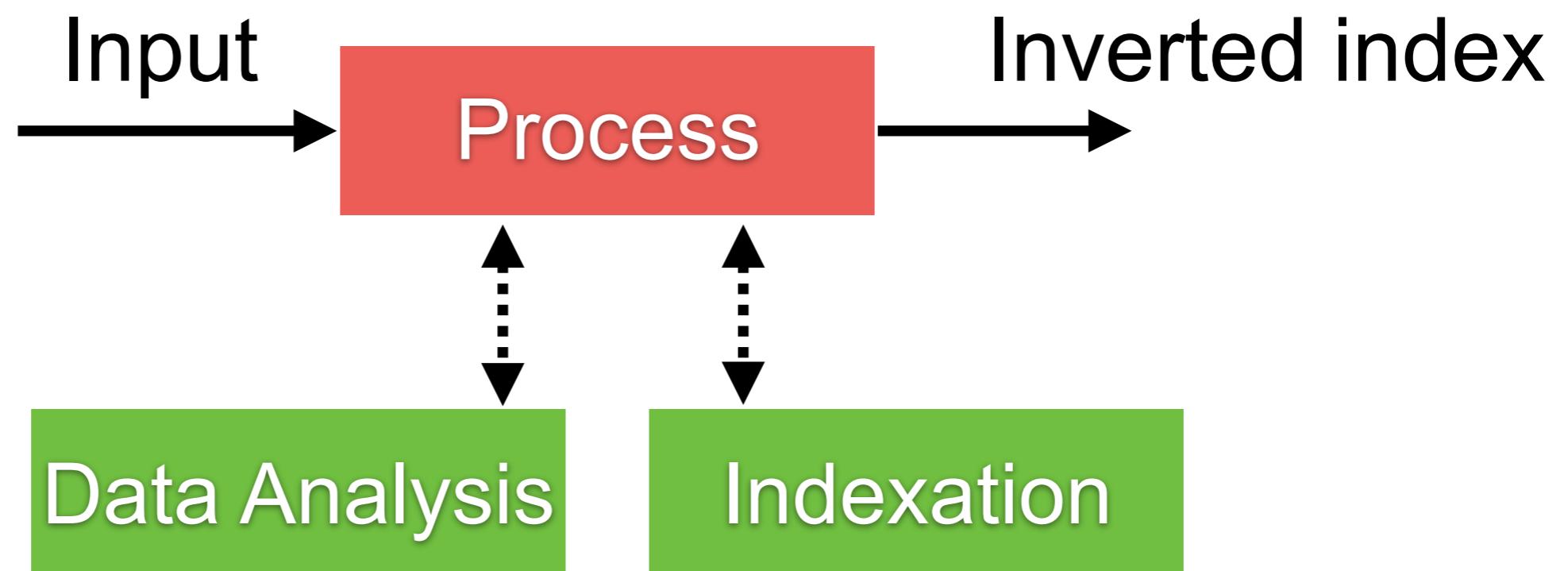
# Input data analysis

Write-once and read-many-times structure

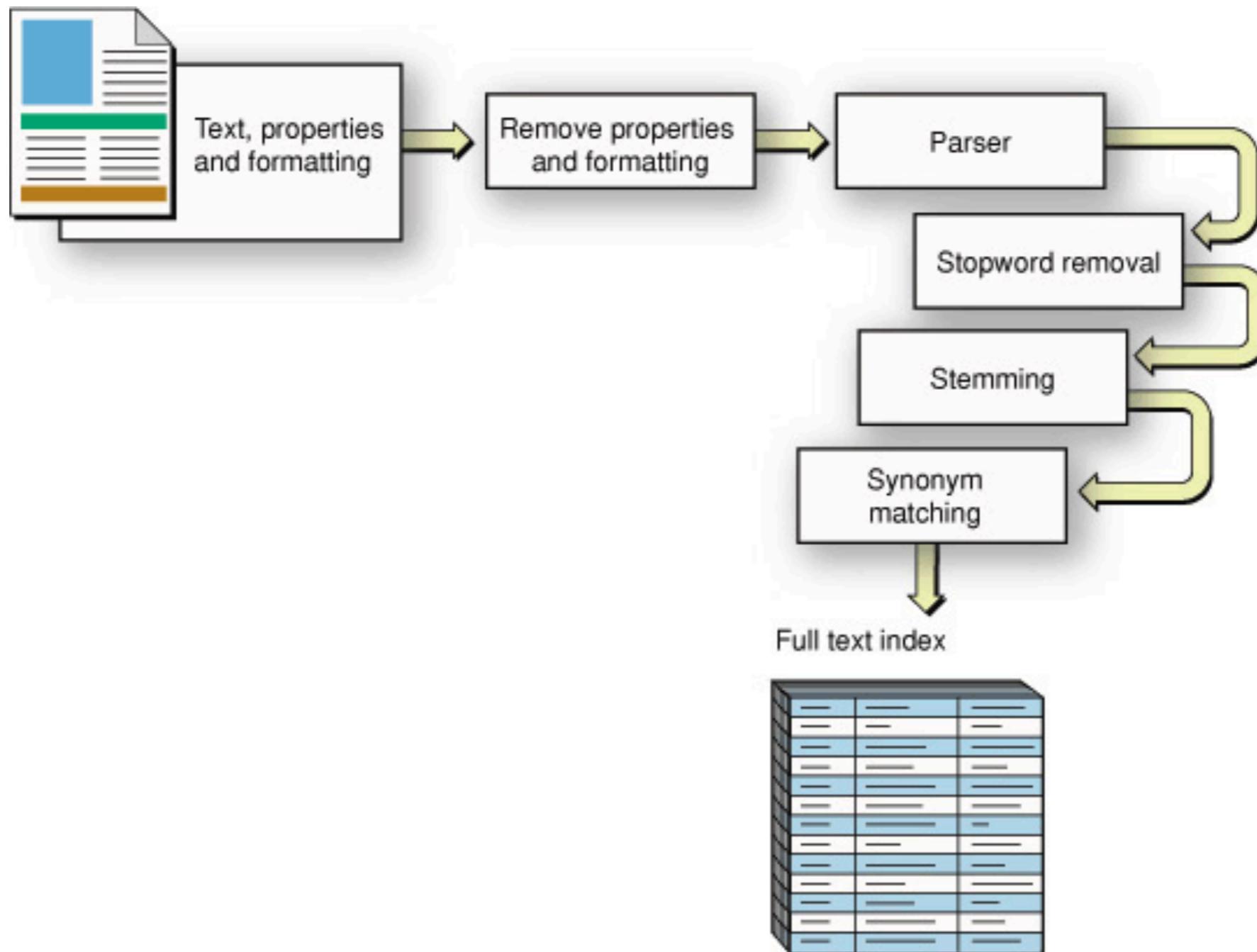


# Input data analysis

Write-once and read-many-times structure



# Process ?



# **CRUD with Elasticsearch**

**02-crud/book\_document.json**



# CRUD with Elasticsearch

Create document

Read document

Update document

Delete document



# Compare with RDBMS

Database

Table

Row

Column

Index

Type\*

Document

Field

\* Only 1 type per index



# Create a document

PUT /store/book/1

```
{  
  "title": "Elasticsearch: The Definitive Guide",  
  "author_name": [  
    "Clinton Gormley",  
    "Zachary Tong"  
,  
  "tag": [  
    "search",  
    "computer"  
,  
  "isbn-13": "978-1449358549",  
  "isbn-10": "1449358543",  
  "price": 44.3,  
  "page": 724,  
}
```



# Create document

PUT **/store/book/1**

Index name

Type name

Document ID



# 1 Type per Index

## Removal of mapping types



**IMPORTANT**

Indices created in Elasticsearch 6.0.0 or later may only contain a single [mapping type](#). Indices created in 5.x with multiple mapping types will continue to function as before in Elasticsearch 6.x. Mapping types will be completely removed in Elasticsearch 7.0.0.

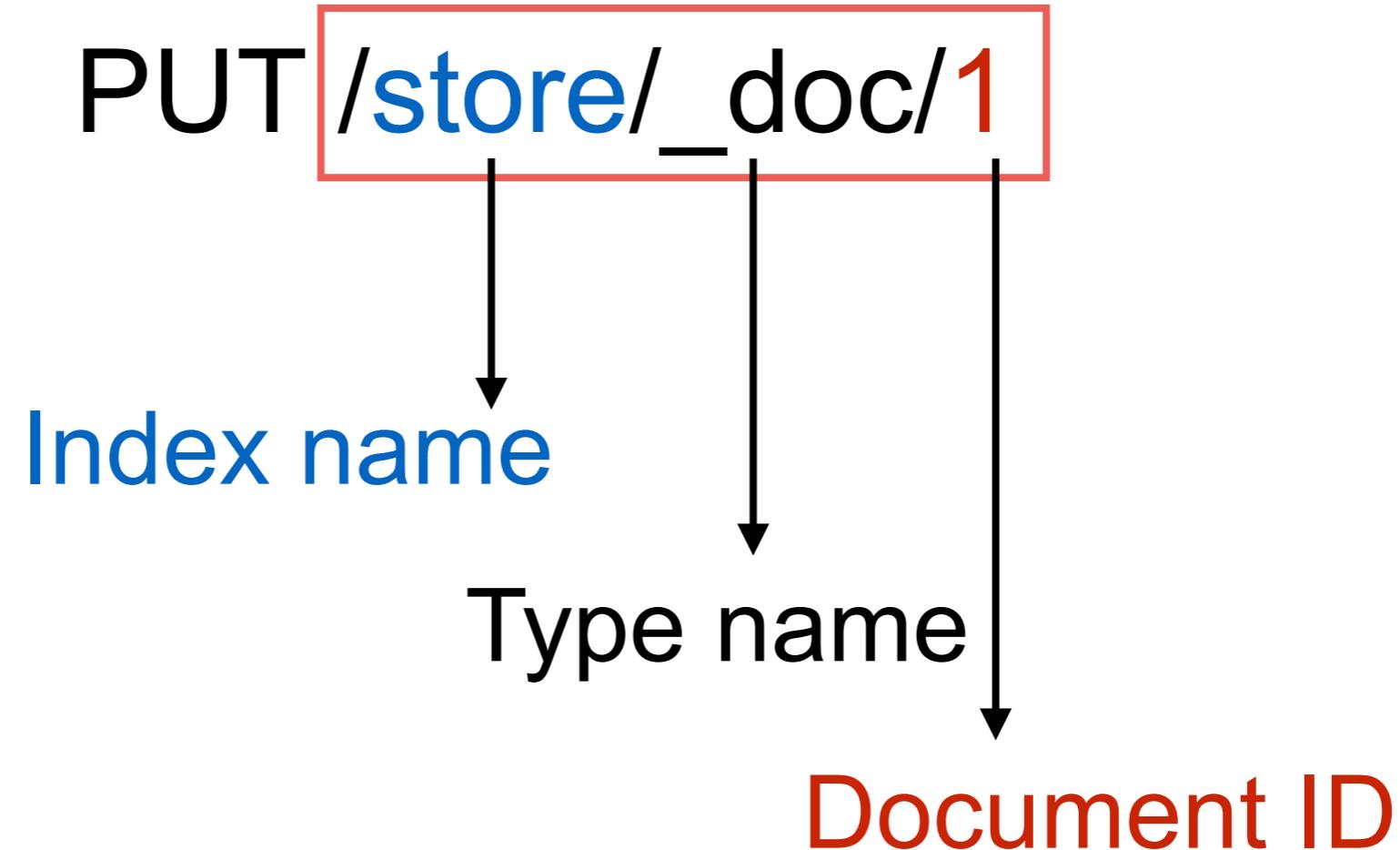
<https://www.elastic.co/guide/en/elasticsearch/reference/6.5/removal-of-types.html>



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# Create document (1 type)



# Change in Elasticsearch 7.x

## # of shard of index change from 5 to 1

```
#! Deprecation: the default number of shards will change  
from [5] to [1] in 7.0.0; if you wish to continue using  
the default of [5] shards, you must manage this on the  
create index request or with an index template
```

```
{  
  "_index": "store1",  
  "_type": "book",  
  "_id": "2",  
  "_version": 1,  
  "result": "created",  
  "_shards": {  
    "total": 5,  
    "successful": 5,  
    "failed": 0  
  }  
}
```



# Read document

GET /store/book/1

```
{  
  "_index": "store",  
  "_type": "book",  
  "_id": "1",  
  "_version": 1,  
  "found": true,  
  "_source": {  
    "title": "Elasticsearch: The Definitive Guide",  
    "author_name": [  
      "Clinton Gormley",  
      "Zachary Tong"  
    ],  
    "tag": [  
      "search",  
      "computer"  
    ]  
  }  
}
```

Information of document



# Update document

Whole document  
Partial document



# Update whole document

PUT /store/\_doc/123

```
{  
  "title": "Update",  
  "author_name": [  
    "user1",  
    "user2"  
  ],  
  "tag": [  
    "update",  
    "book"  
  ]  
}
```



# Update partial document

POST /store/\_update/123

```
{  
  "doc": {  
    "title": "partial update",  
    "tag": [  
      "test",  
      "computer"  
    ],  
    "views": 0  
  }  
}
```



# Delete document

**DELETE /store/\_doc/1**

```
{  
  "_index": "store",  
  "_type": "book",  
  "_id": "1",  
  "_version": 2,  
  "result": "deleted",  
  "_shards": {  
    "total": 2,  
    "successful": 1,  
    "failed": 0  
  },  
  "_seq_no": 1,  
  "_primary_term": 1  
}
```



# More features

Update by query

Delete by query

Partial update document



# Routing

<https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping-routing-field.html#>

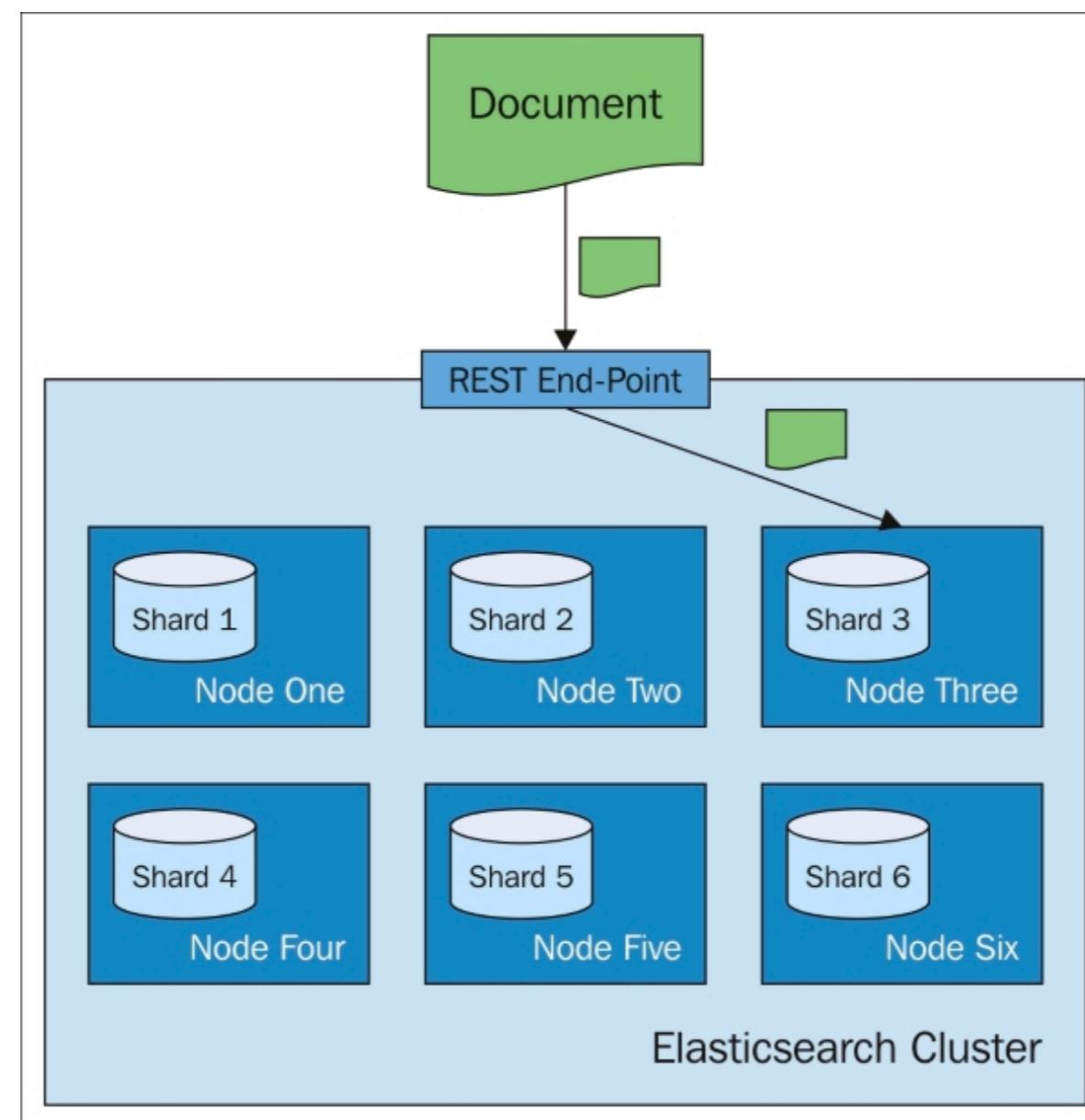


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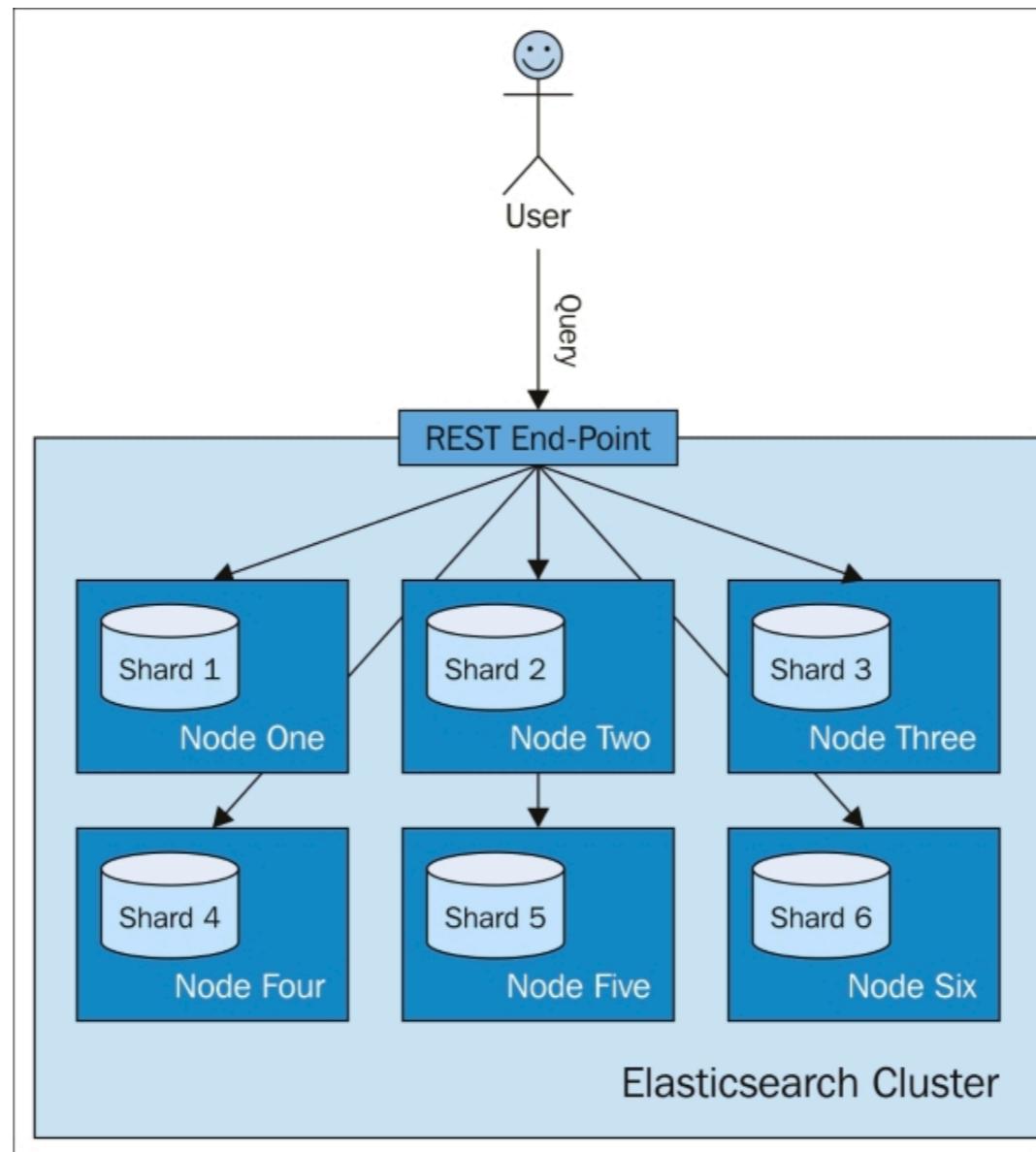
# Default indexing

ES calculate the hash value of the doc id



# Default searching/query

Query all the shards to get data  
(depend on search type)



# Custom routing

Routing field  
Routing to index partition



# Routing field

```
shard_num =  
hash(_routing) % num_primary_shards
```



# Routing to index partition

```
shard_num  
=  
(hash(_routing) + hash(_id)) % routing_partition_size)  
%
```

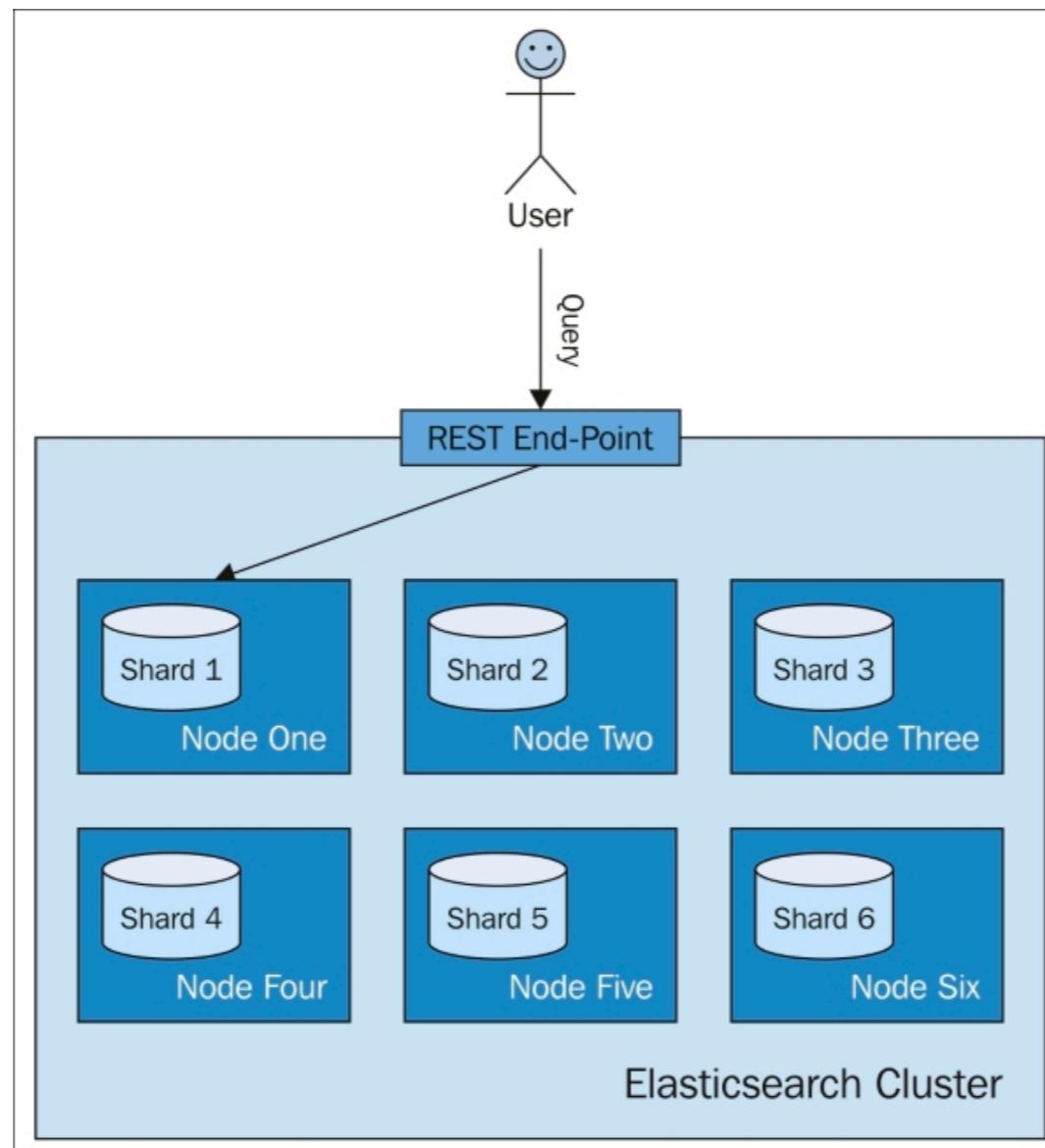
num\_primary\_shards

*routing\_partition\_size = 1 (default)*



# Custom routing

ES will send our query to a single shard



# Bulk API

03-bulk/book\_bulk.json

<https://www.elastic.co/guide/en/elasticsearch/reference/current/docs-bulk.html>



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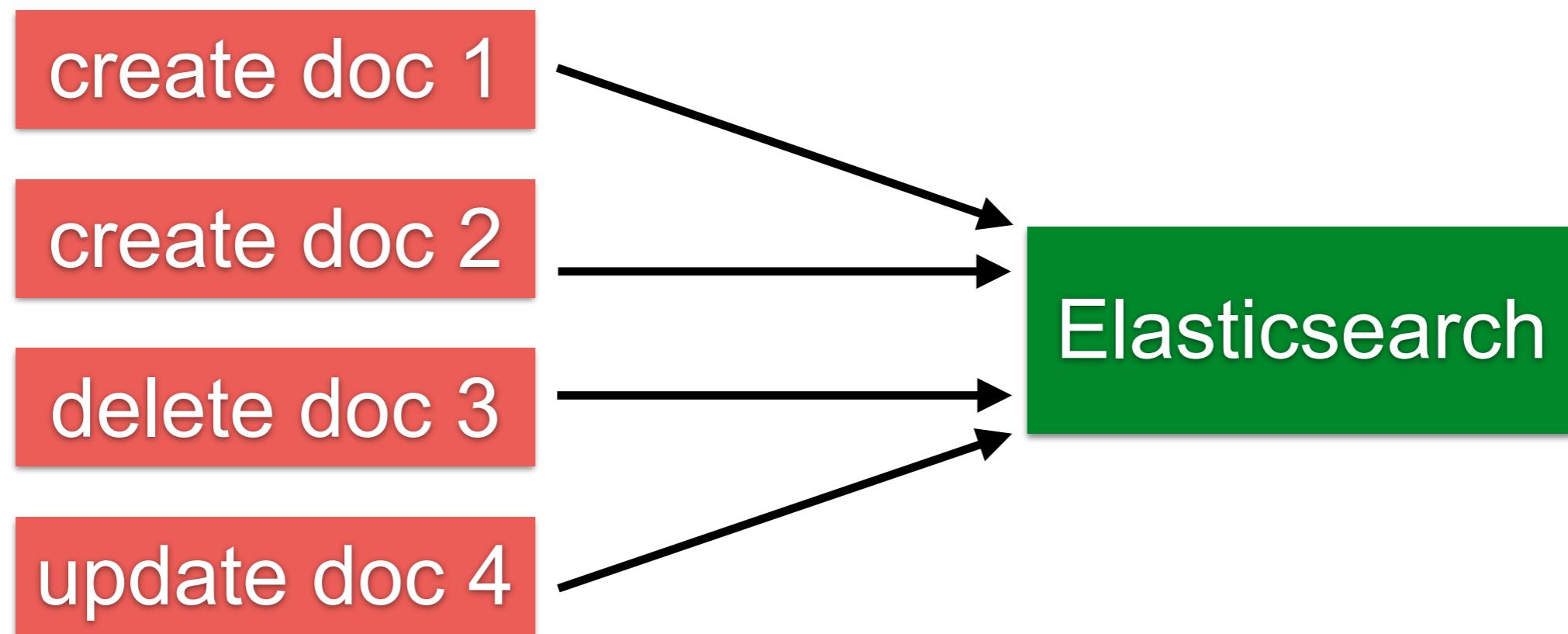
# Bulk API

Perform many index/delete operation in single API call

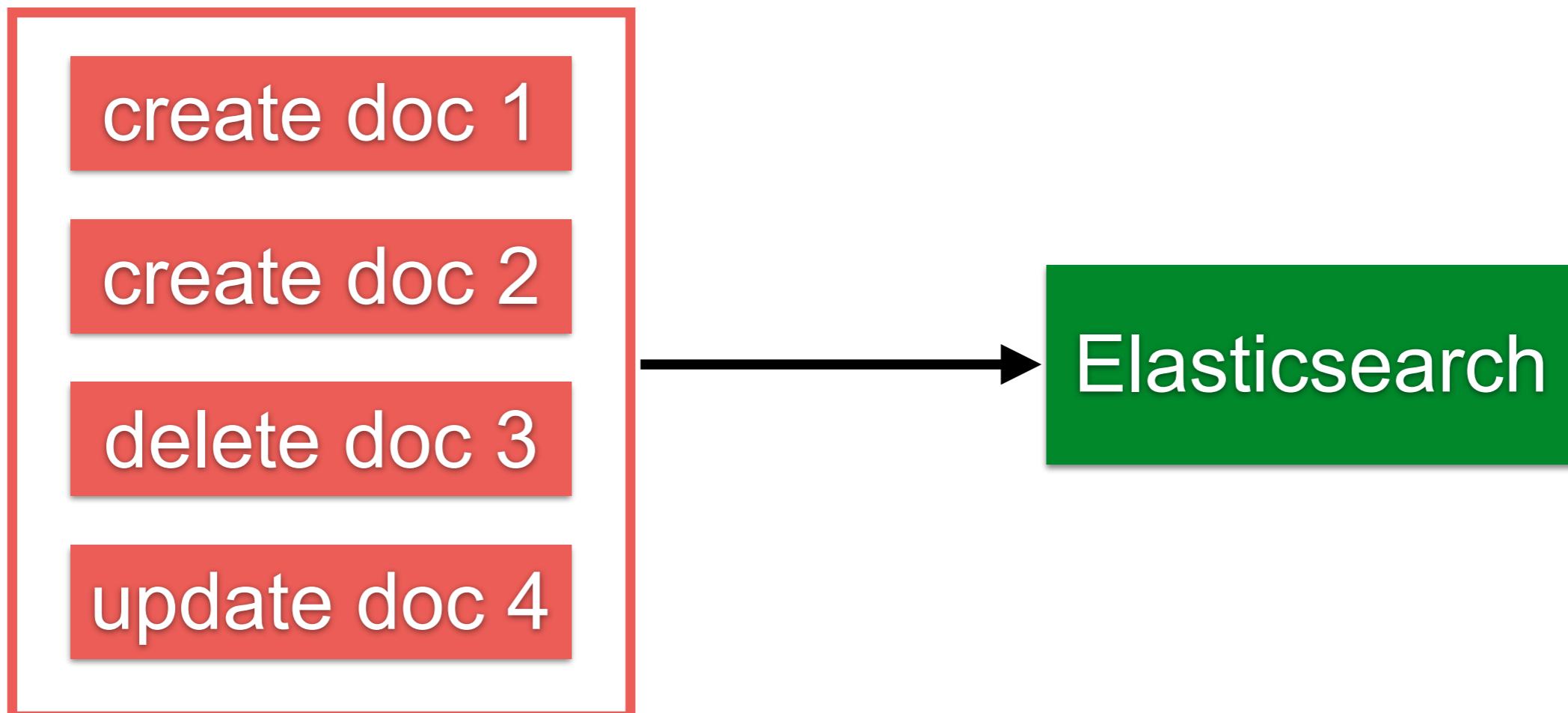
Increase indexing speed



# Without Bulk API



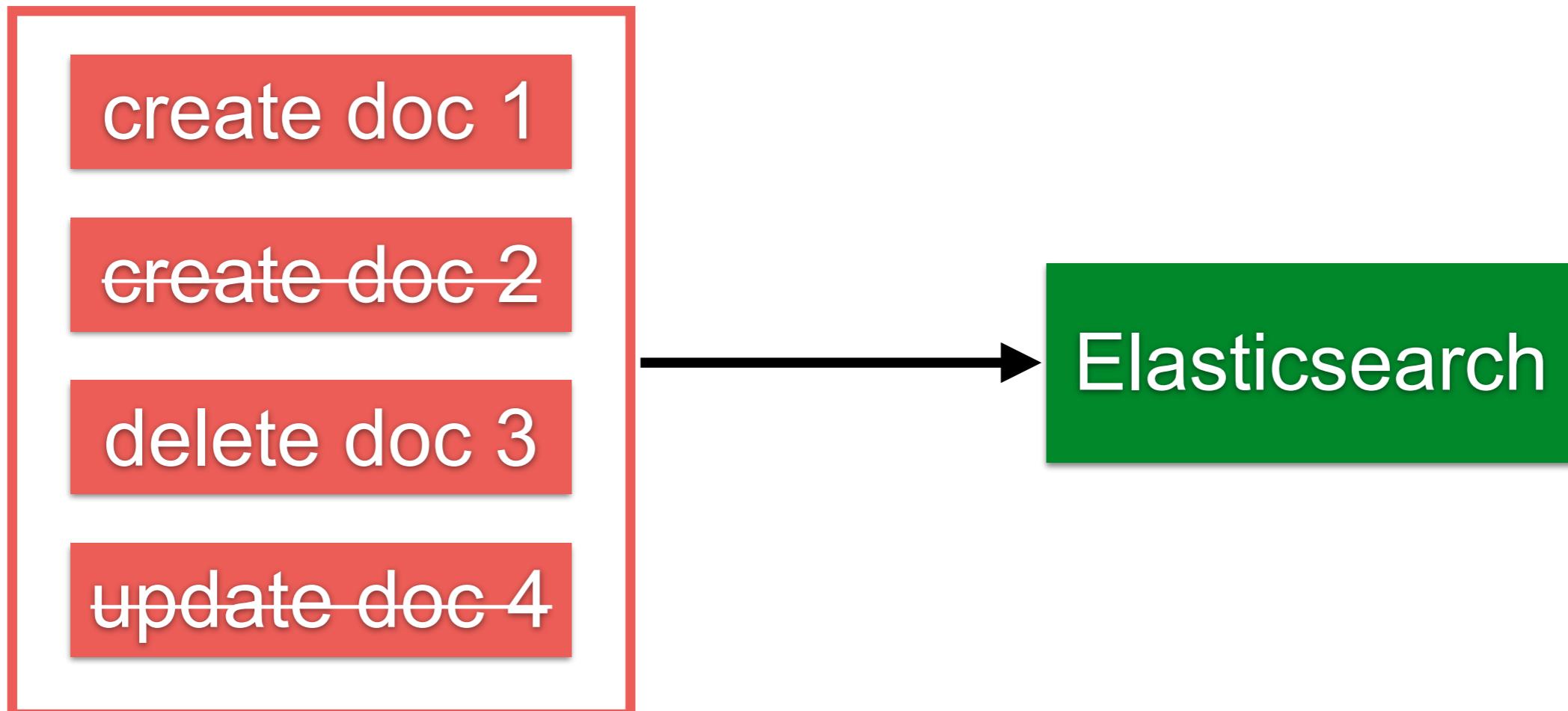
# With Bulk API



Store in memory 5-15 MB



# No transaction in bulk api



# Create a document

**POST /store/book/\_bulk**

```
{"create": {"_id": "1001"}  
{"title": "new book 1000", "description": "my new book"}}
```



# Response from Bulk API

```
{  
  "took": 89,  
  "errors": false,  
  "items": [  
    {  
      "create": {  
        "_index": "store",  
        "_type": "book",  
        "_id": "1001",  
        "_version": 1,  
        "result": "created",  
        "_shards": {  
          "total": 2,  
          "successful": 1,  
          "failed": 0  
        },  
        "_seq_no": 0,  
        "_primary_term": 1,  
        "status": 201  
      }  
    }  
  ]  
}
```

Time in milliseconds

HTTP Status 201 = Created



# Searching / Query

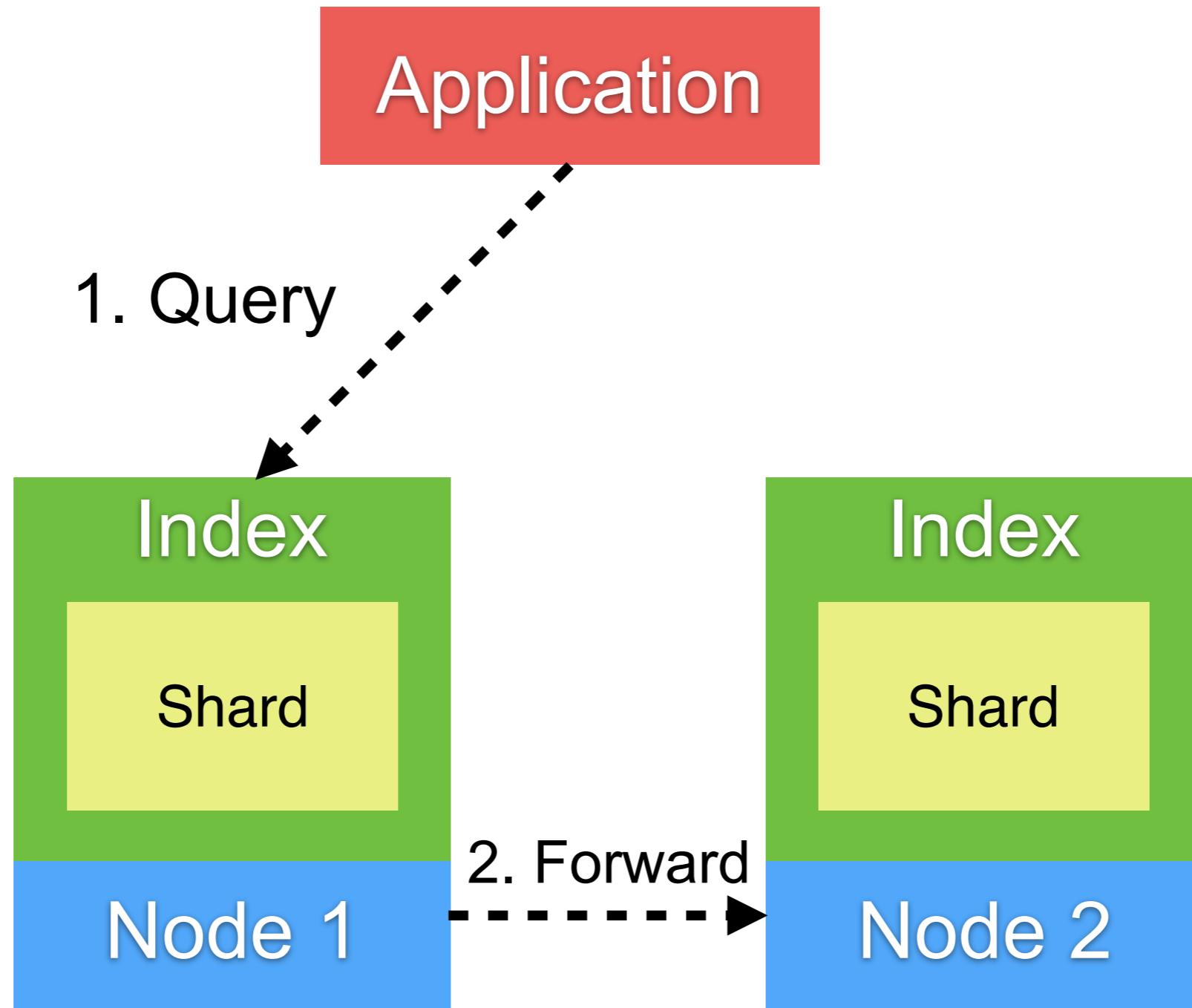


# Searching

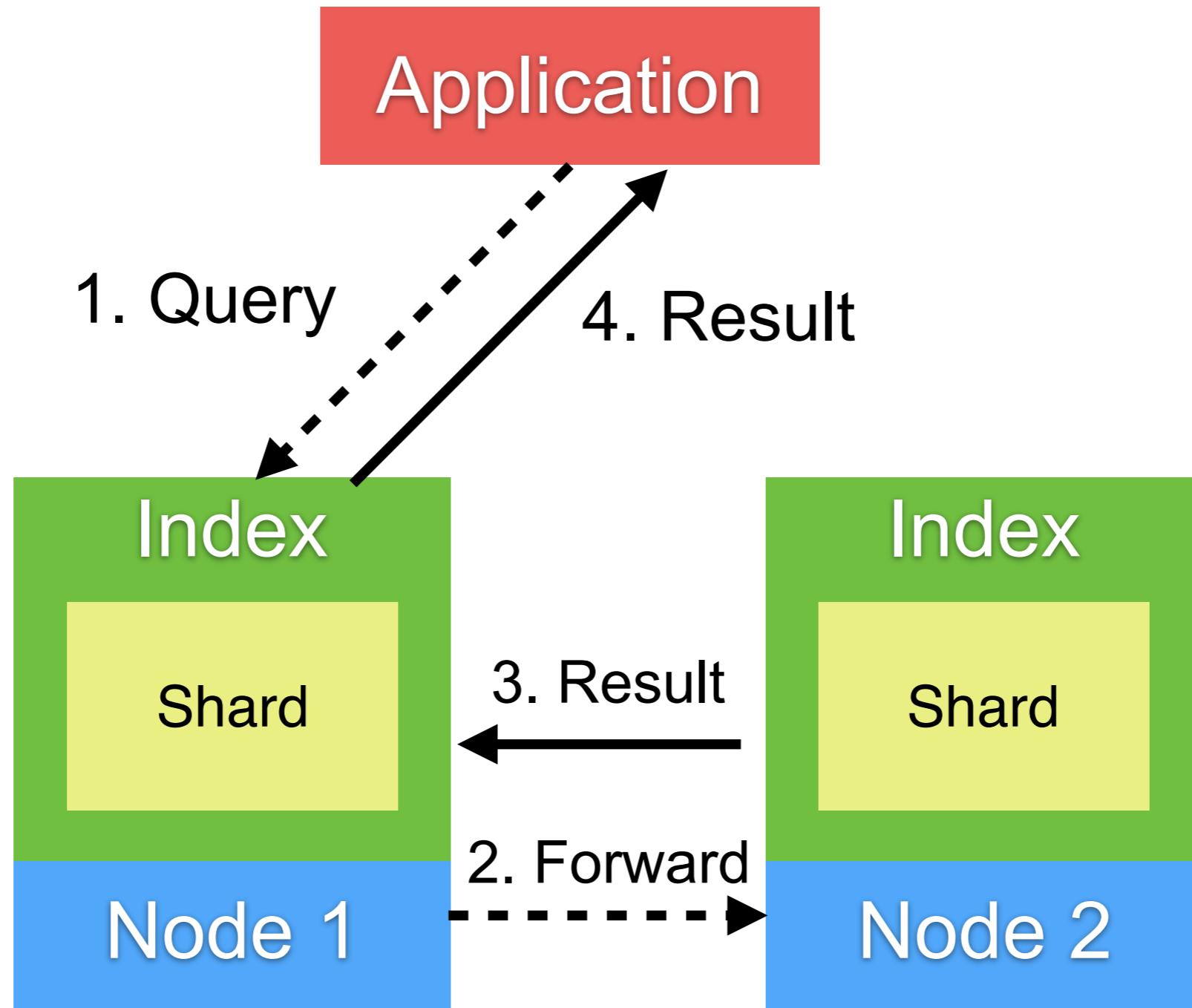
Scattering phase  
Gathering phase



# Scattering phase



# Gathering phase



# Query DSL

04-search/book\_search.json



# Query DSL

**Domain Specific Language for query data**  
**Flexible query language**  
**Based on JSON format**

<https://www.elastic.co/guide/en/elasticsearch/reference/current/query-dsl.html>

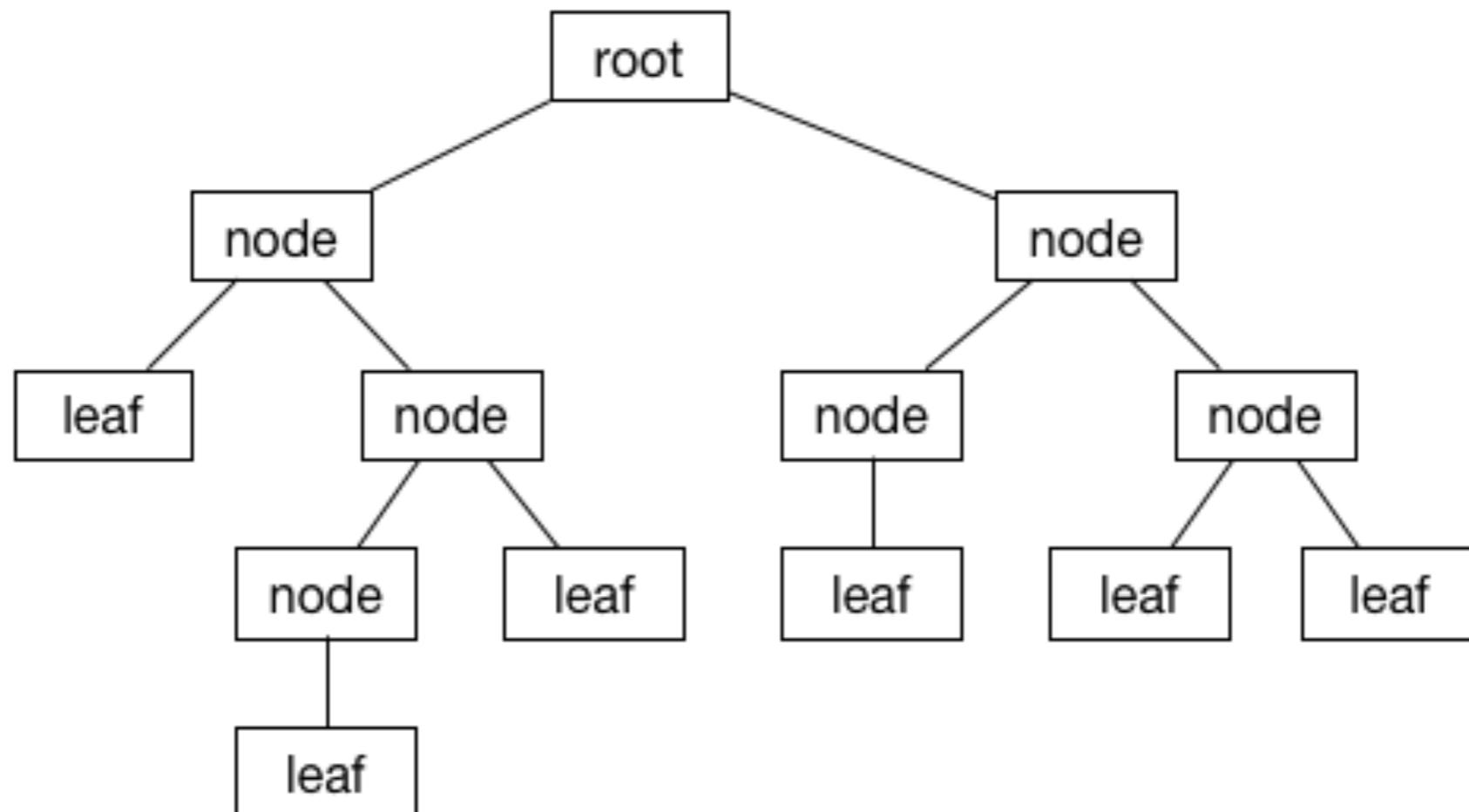


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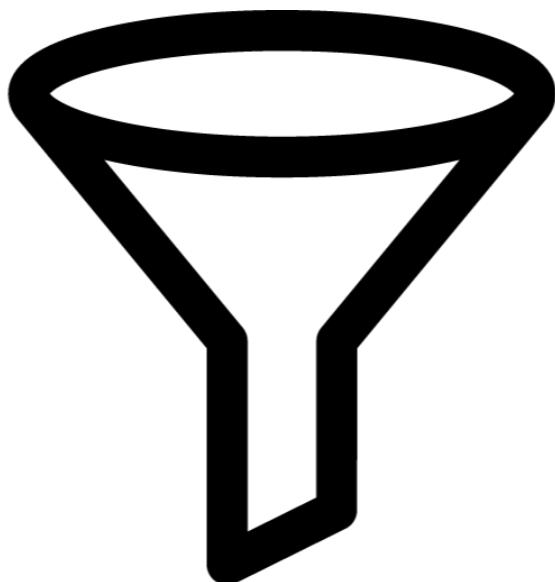
# Query DSL

1. Leaf query clause
2. Compound query clause



# Query DSL

Query (unstructured data)  
Filter (structured data)



Query



# Query DSL

Query	Filter
Relevance	Boolean, yes/no
Full text search	Exact values
Not cached	Cached
Slower	Faster

***Filter first, then query remaining documents***



# Query DSL

Full text query  
Term level query  
Compound query  
Joining query  
Geo query  
Specialized query  
Span query



# Leaf query clause

GET /store/book/\_search

```
{  
  "query": {  
    "match_all": {}  
  }  
}
```



# Compound query clause

GET /store/book/\_search

```
{  
  "query": {  
    "bool": {  
      "must": [{}],  
      "should": [{}],  
      "must_not": [{}]  
    }  
  }  
}
```



# \_all field is disabled (ES 6.0+)

## \_all field



**WARNING**

Deprecated in 6.0.0.

`_all` may no longer be enabled for indices created in 6.0+, use a custom field and the mapping `copy_to` parameter

Space issue  
Analyzer issue  
Highlighting issue

<https://www.elastic.co/guide/en/elasticsearch/reference/6.5/mapping-all-field.html>



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# Workshop

amazon

All ▾ elasticsearch

New to Amazon? Click here to learn more

Deliver to Thailand

Departments ▾ Your Amazon.com Today's Deals Gift Cards Sell

EN ▾ Hello. Sign in Account & Lists ▾ Orders Cart 0

1-16 of 119 results for "elasticsearch"

Show results for

Books

- Computers & Technology
- Data Processing
- Web Development & Design
- Online Internet Searching
- Databases & Big Data
- ▼ See more

Kindle Store

- Computers & Technology
- Business Software
- Search Engines
- Application Development
- Computer Databases
- ▼ See more
- ▼ See All 8 Departments

Refine by

Book Language

- English

Book Format

- Paperback

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Previous Page 1 2 3 ... 8 Next Page



# Query

amazon

All ▾ elasticsearch

Departments ▾ Your Amazon.com Today's Deals Gift Cards Sell

New to Amazon? EN Hello. Sign in Account Lists Orders Cart

Sort by Featured

## Filter

**Books**

- Computers & Technology
- Data Processing
- Web Development & Design
- Online Internet Searching
- Databases & Big Data
- ▼ See more

**Kindle Store**

- Computers & Technology
- Business Software
- Search Engines
- Application Development
- Computer Databases
- ▼ See more
- ▼ See All 8 Departments

Refine by

**Book Language**

- English

**Book Format**

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**Paging**

Previous Page 1 2 3 ... 8 Next Page

## Sorting

**SQL Server 2017 Administrator's Guide**

By Waheed Ahmad and Imanuele Pollicino

SQL Server 2017 Administrators Guide

★★★★★ 3 prime

**PostgreSQL 9.6 High Performance**

By Waheed Ahmad, Gregory Smith

PostgreSQL 9.6 High Performance: Optimize your PostgreSQL database

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# Aggregation API

05-aggregation/book\_aggregation.json

<https://www.elastic.co/guide/en/elasticsearch/reference/current/search-aggregations.html>



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```
SELECT count(1), sum(price)  
FROM some_table  
GROUP BY some_column
```



# Aggregation Types

Bucketing  
Metric  
Matrix  
Pipeline



# Structure

```
"aggregations" : {  
    "<aggregation_name>" : {  
        "<aggregation_type>" : {  
            <aggregation_body>  
        }  
        [ , "meta" : { [ <meta_data_body> ] } ]?  
        [ , "aggregations" : { [ <sub_aggregation> ]+ } ]?  
    }  
    [ , "<aggregation_name_2>" : { ... } ]*  
}
```



# Count by category

GET /store/\_search

```
{  
  "aggs": {  
    "all_book_title": {  
      "terms": {  
        "field": "category.keyword"  
      }  
    }  
  }  
}
```



# Count by category

GET /store/\_search

```
{  
  "aggs": {  
    "all_book_title": {  
      "terms": {  
        "field": "category.keyword"  
      }  
    }  
  }  
}
```



# Count by category

GET /store/\_search

```
{  
  "aggs": {  
    "all_book_title": {  
      "terms": { Aggregation type  
        "field": "category.keyword"  
      }  
    }  
  }  
}
```



# Result of aggregation

```
{  
  "hits": {  
    "total": 5,  
    "max_score": 1,  
    "hits": [  
      {  
        "_source": {  
          "title": "The Logstash Book"  
        }  
      },  
      {  
        "_source": {  
          "title": "Elasticsearch Server: Second Edition"  
        }  
      }  
    ]  
  }  
}
```

Search result



# Result of aggregation

```
"aggregations": {  
    "all_book_title": {  
        "doc_count_error_upper_bound": 0,  
        "sum_other_doc_count": 0,  
        "buckets": [          Aggregation result  
            {  
                "key": "Computer & Technology",  
                "doc_count": 5  
            },  
            {  
                "key": "Online Searching",  
                "doc_count": 3  
            },  
            {  
                "key": "Java Programming",  
                "doc_count": 2  
            }  
        ]  
    }  
}
```



# Show only aggregation result

GET /store/\_search

```
{  
  "size": 0, Set search result size = 0  
  "aggs": {  
    "all_book_title": {  
      "terms": {  
        "field": "category.keyword"  
      }  
    }  
  }  
}
```



# Range of price

GET /store/\_search

```
{  
  "size": 0,  
  "aggs": {  
    "price_range": {  
      "range": {  
        "field": "price",  
        "ranges": [  
          { "from": 0, "to": 10 },  
          { "from": 11, "to": 20 },  
          { "from": 21, "to": 50 }  
        ]  
      }  
    }  
  }  
}
```



# Result of aggregation

```
"buckets": [
  {
    "key": "0.0-10.0",
    "from": 0,
    "to": 10,
    "doc_count": 1
  },
  {
    "key": "11.0-20.0",
    "from": 11,
    "to": 20,
    "doc_count": 0
  },
  {
    "key": "21.0-50.0",
    "from": 21,
    "to": 50,
    "doc_count": 3
  }
]
```



# Range of price and ordering

GET /store/\_search

```
{  
  "size": 0,  
  "aggs": {  
    "price_range": {  
      "range": {  
        "field": "price",  
        "ranges": [  
          { "from": 0, "to": 10 },  
          { "from": 11, "to": 20 },  
          { "from": 21, "to": 50 }  
        ]  
      }  
    }  
  }  
}
```



# Workshop aggregation with car

05-aggregation/car.json



# Try by yourself

Best seller by color

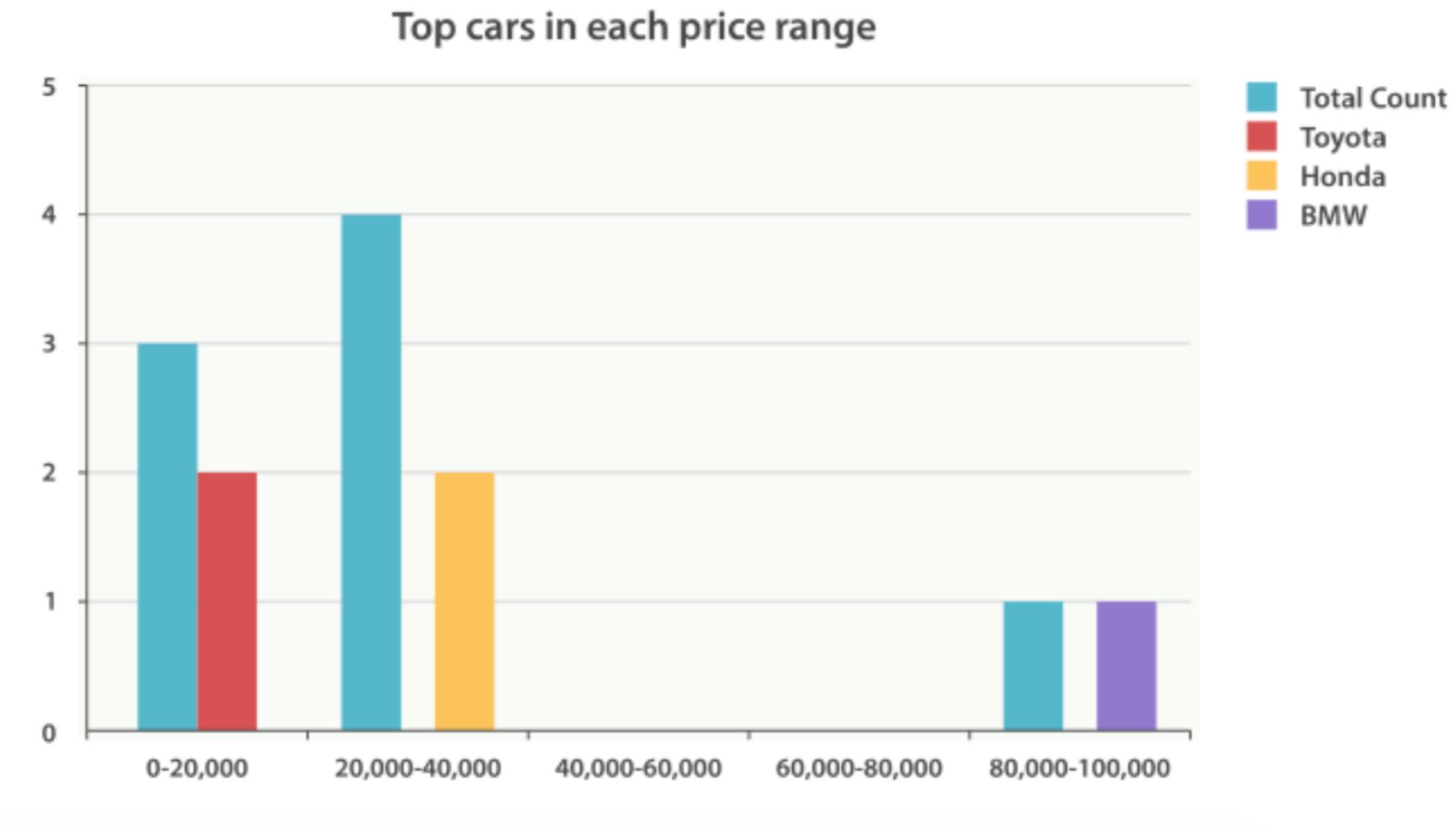
Statistic of best seller by color

Detail of car in each color

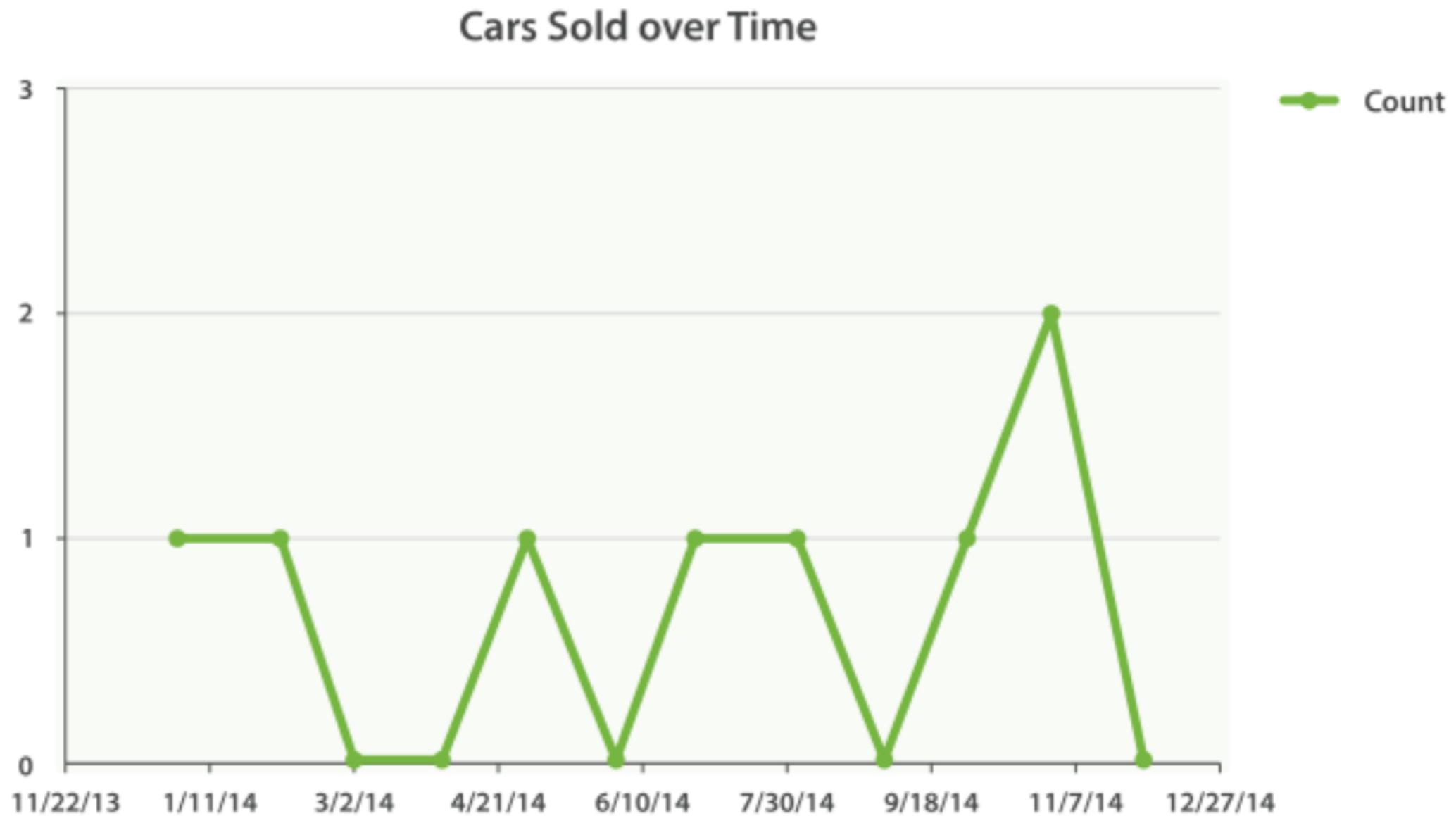
Min/max of price by make



# Top cars in each price range ?



# Cars sold over Time ?



# Mapping

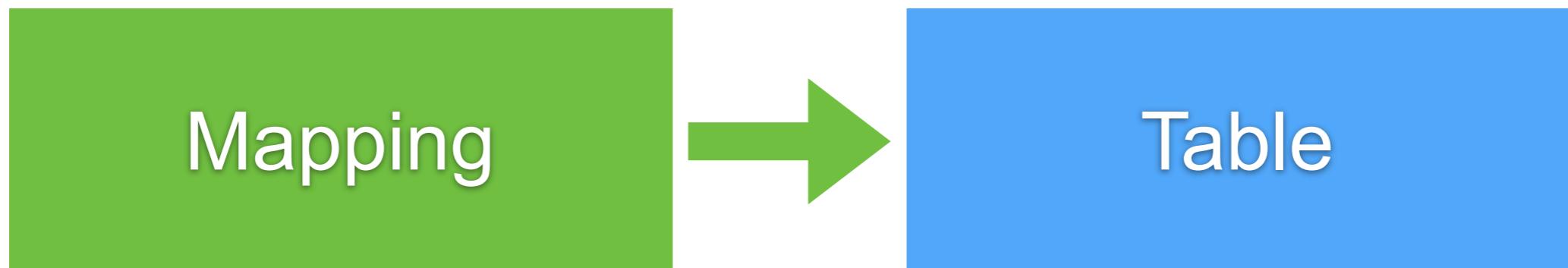
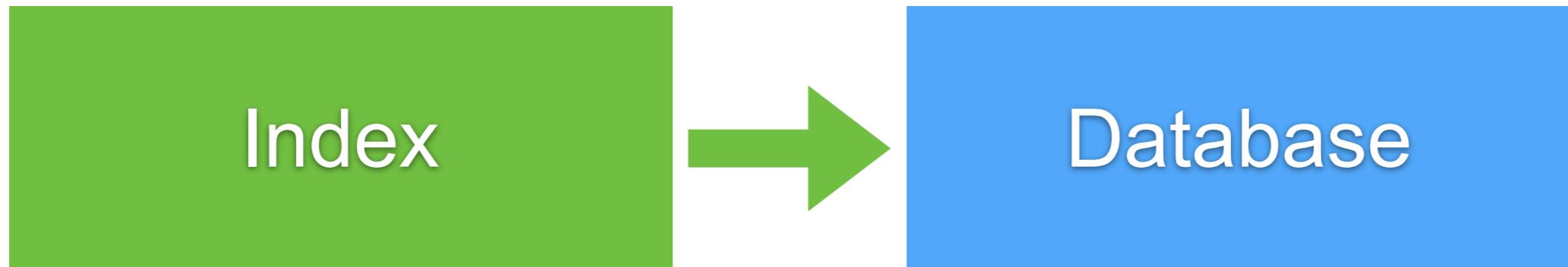
<https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping.html>



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# Explicit Mapping



# Mapping type

Meta-fields

Field or properties



# Meta-field

Metadata of document  
`_index, _type, _id, _source`



# Field or properties

List of fields or properties of document



# Mapping/Schema of document

GET /store/\_mapping/book

```
"mappings": {  
    "book": {  
        "properties": {  
            "author name": {  
                "type": "text",  
                "fields": {  
                    "keyword": {  
                        "type": "keyword",  
                        "ignore_above": 256  
                    }  
                }  
            }  
        }  
    }  
}
```



# Mapping/Schema of document

GET /store/\_mapping/book

```
"mappings": {  
    "book": {  
        "page": {  
            "type": "long"  
        },  
        "price": {  
            "type": "float"  
        },  
        "published_date": {  
            "type": "date"  
        }  
    }  
}
```



# Field Datatypes

Core

Complex

Geo

Specialized



# Field Datatypes

<b>text</b>	<b>date</b>
<b>keyword</b>	<b>ip</b>
<b>long</b>	<b>boolean</b>
<b>double</b>	<b>completion</b>
<b>geo_point</b>	<b>geo_shape</b>
<b>array</b>	<b>object</b>
<b>nested</b>	<b>binary</b>

<https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping-types.html>



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# Field Datatypes

<b>text</b>	<b>date</b>
<b>keyword</b>	<b>ip</b>
<b>long</b>	<b>boolean</b>
<b>double</b>	<b>completion</b>
<b>geo_point</b>	<b>geo_shape</b>
<b>array</b>	<b>object</b>
<b>nested</b>	<b>binary</b>

<https://www.elastic.co/guide/en/elasticsearch/reference/current/mapping-types.html>



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# Array

No data type **array** in Elasticsearch

["name", "title"]	array of string
[1, 2, 3]	array of integer
[ {"name": "up1", "age": 30} ]	array of object



# Mapping configuration

Maximum number of fields = 1,000

Maximum depth of fields = 20

Maximum depth of nested fields = 50



# Dynamic/Explicit mapping

Fields and mapping types not need to defined before being used



# Mapping

## Explicit mapping

Quick data insertion

## Manual mapping

Better search Results

Increased performance

Concerned of the field types



# Custom Mapping in ES 7

Don't specify the type name !!

```
PUT project/_mapping
{
  "properties": {
    "user_id": {
      "type": "keyword"
    },
    "image_name": {
      "type": "keyword"
    }
  }
}
```



# Analyzer

## 07-analyzer

<https://www.elastic.co/guide/en/elasticsearch/reference/current/analysis.html>

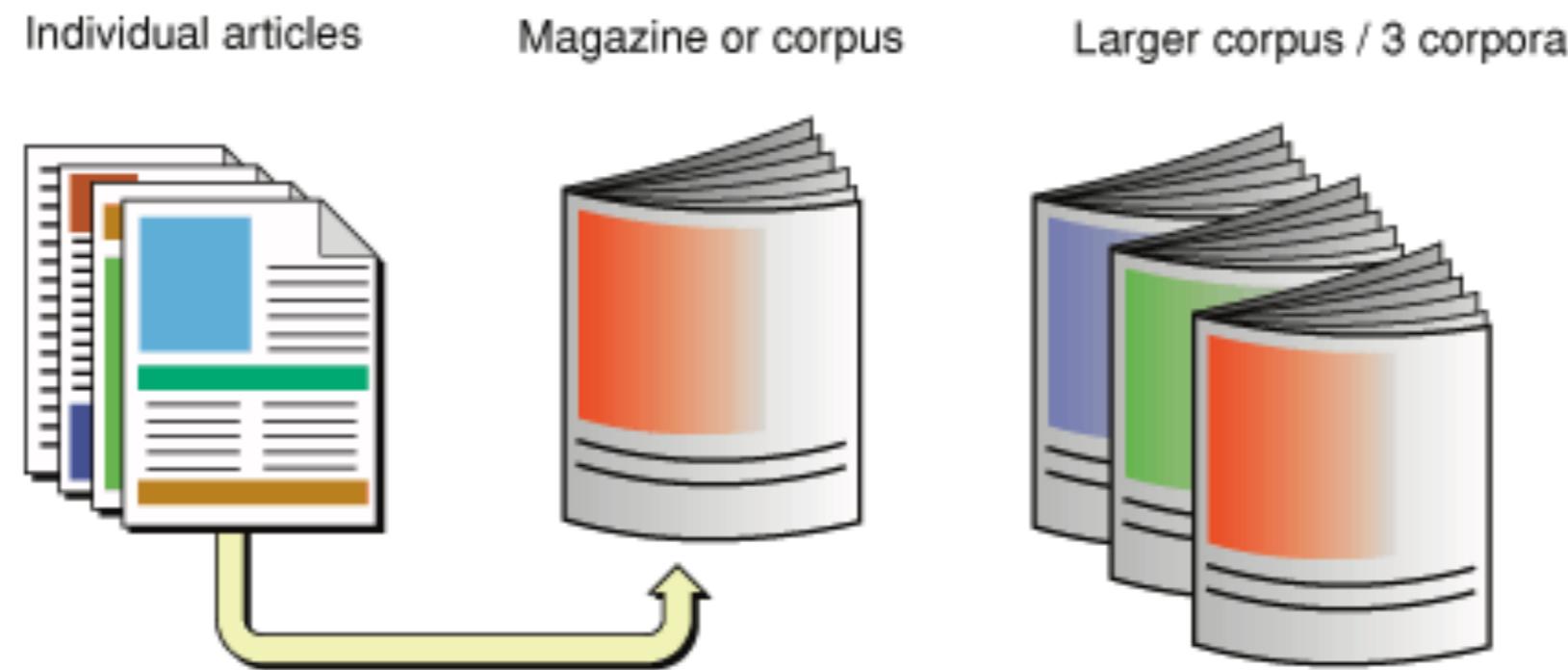


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# Inverted Index

Corpus is a collection of documents



[https://developer.apple.com/library/archive/documentation/UserExperience/Conceptual/SearchKitConcepts/searchKit\\_basics/searchKit\\_basics.html#/apple\\_ref/doc/uid/TP40002843-TPXREF101](https://developer.apple.com/library/archive/documentation/UserExperience/Conceptual/SearchKitConcepts/searchKit_basics/searchKit_basics.html#/apple_ref/doc/uid/TP40002843-TPXREF101)

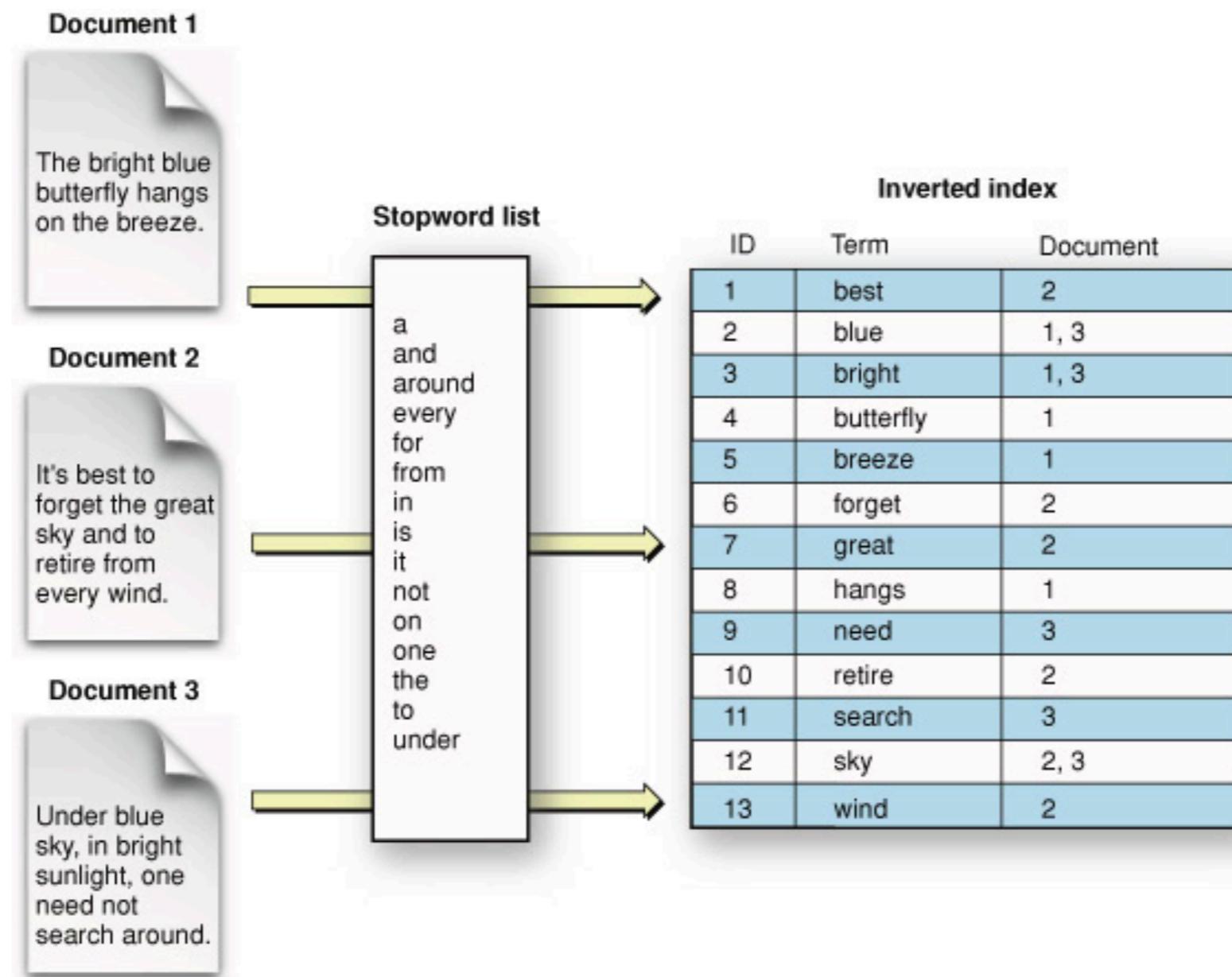


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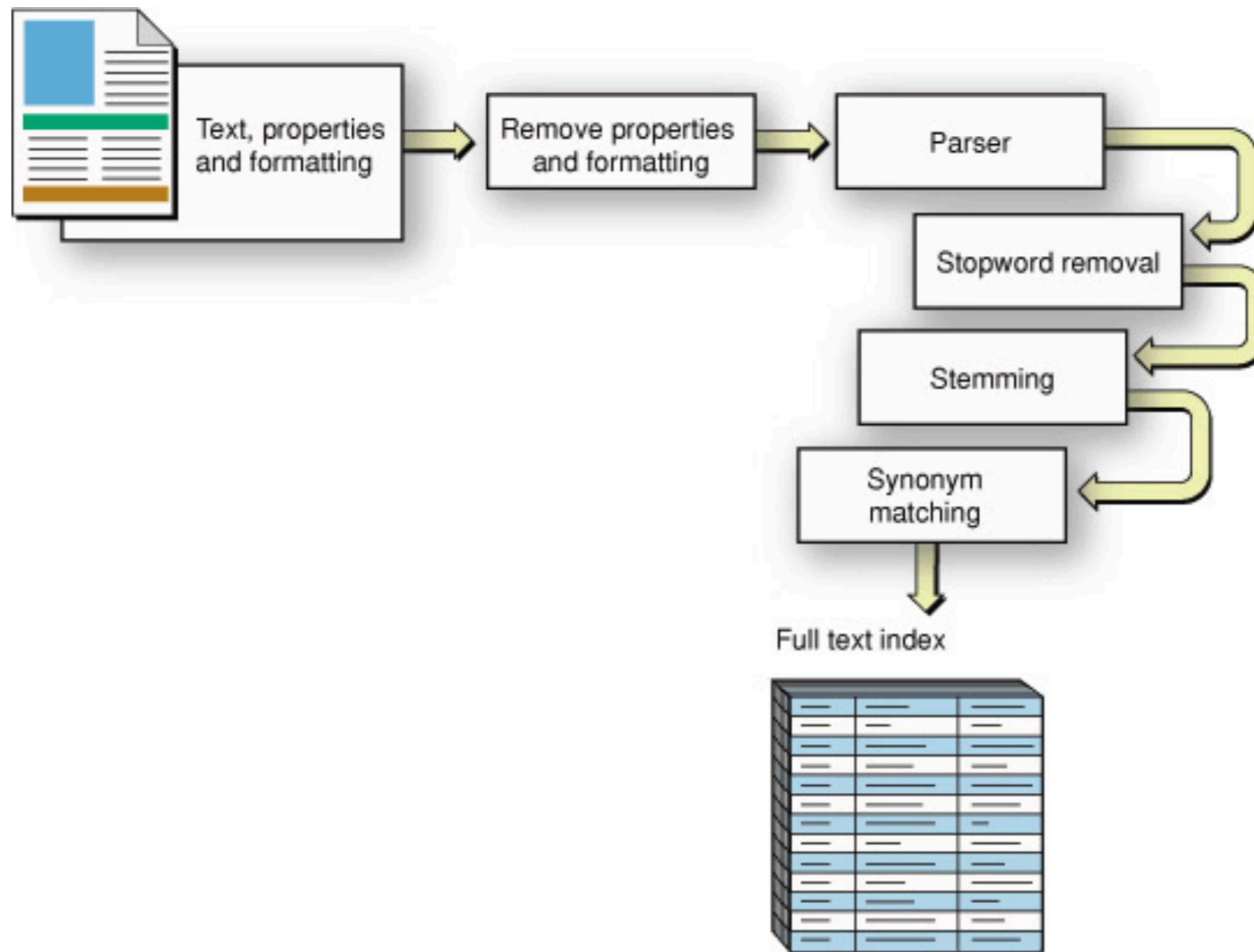
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# Inverted Index

Try to construct index



# Text extraction



# Analyzer in ES

Analyzer  
Tokenizer  
Filter



# Testing analyzer !!

Very important



# Testing analyzer !!

```
POST _analyze
{
  "analyzer": "whitespace",
  "text":      "The quick brown fox."
}
```



# Default analyzer !!

```
POST _analyze
{
    "text": "The quick brown fox."
}
```



# Thai analyzer !!

```
POST _analyze
{
  "analyzer": "thai",
  "text":      "สวัสดีประเทศไทย"
}
```



# Tokenizer and filter

```
POST _analyze
{
  "tokenizer": "standard",
  "filter": [ "lowercase", "asciifolding" ],
  "text":      "Is this déjà vu?"
}
```



# Analyze by index

```
POST my_index/_analyze
{
  "analyzer": "your_analyzer",
  "text":      "your text"
}
```



# Analyze by field

```
POST my_index/_analyze
{
  "field": "my_text",
  "text": "your text"
}
```



# Working with Suggester

<https://www.elastic.co/guide/en/elasticsearch/reference/current/search-suggesters.html>



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# Suggesters in ES

Term  
Phrase  
Completion  
Context



# Basic knowledge

N-gram tokenizer  
Edge-ngram tokenizer

<https://www.elastic.co/guide/en/elasticsearch/reference/7.1/analysis-ngram-tokenizer.html>



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# N-Gram

Terms as a sequence of n words

search

Unigram	s,e,a,r,c,h
Bigram	se, ea, ar,rc, ch
Trigram	sea, ear, arc, rch
4-gram	sear, earc, arch
5-gram	searc, earch



# Workshop

## ngram/ngram.json



# More tools



# Elasticsearch Head

 **ElasticSearch Head**  
offered by travistx

★★★★★ (75) · [Developer Tools](#) · 45,312 users

[OVERVIEW](#) · [REVIEWS](#) · [SUPPORT](#) · [RELATED](#)

**ElasticSearch** http://192.168.7.8:9200/ · [Connect](#) · Rick · cluster health: yellow (6, 18)

Overview · Browser · Structured Query · Any Request · Info · Status · Nodes Stats · Cluster Nodes · Cluster State · Cluster Health

Cluster Overview · New Index

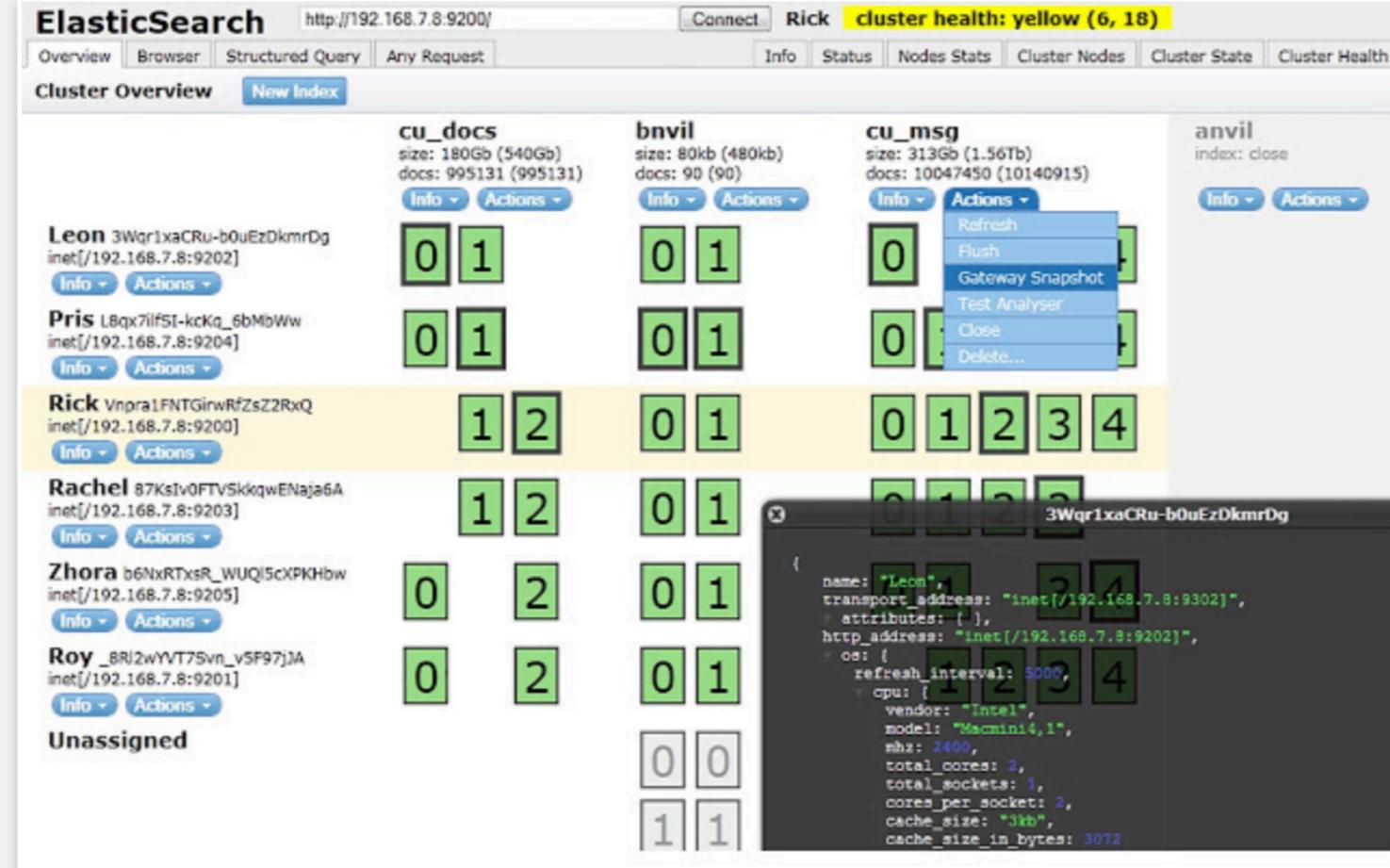
	cu_docs	bnvil	cu_msg	anvil
Leon	size: 180Gb (540Gb) docs: 995131 (995131)	size: 80kb (480kb) docs: 90 (90)	size: 313Gb (1.56Tb) docs: 10047450 (10140915)	index: close
Pris	Info · Actions	Info · Actions	Info · Actions · Refresh Flush Gateway Snapshot Test Analyser Close Delete...	Info · Actions
Rick	1 2	0 1	0 1 2 3 4	3Wqr1xaCRu-b0uEzDkmrDg
Rachel	1 2	0 1	0 1 2 3 4	3Wqr1xaCRu-b0uEzDkmrDg
Zhora	0 2	0 1	0 1 2 3 4	3Wqr1xaCRu-b0uEzDkmrDg
Roy	0 2	0 1	0 1 2 3 4	3Wqr1xaCRu-b0uEzDkmrDg
Unassigned	0 0	0 0	0 1 2 3 4	3Wqr1xaCRu-b0uEzDkmrDg

Compatible with your device

**ElasticSearch Head**  
Chrome Extension containing the excellent Elasticsearch Head application.

[Website](#) · [Report Abuse](#)

**Additional Information**  
Version: 0.1.3 · Updated: December 4, 2017 · Size: 434KiB · Language: English (United States)



<https://github.com/mobz/elasticsearch-head>



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# Elasticsearch Dump



<https://github.com/taskrabbit/elasticsearch-dump>



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# Geo Location

08-geo-location/sample\_geo.json



# Geo Location Type

Geo-point  
Geo-shape



# Geo-point

Must pre-define in mapping of index

```
PUT /my_map
{
  "mappings": {
    "city": {
      "properties": {
        "name": {
          "type": "text"
        },
        "location": {
          "type": "geo_point"
        }
      }
    }
  }
}
```



# Geo-point Format

Geo-point as object

Geo-point as string

Geo-point as array

Geo-point as geohash

<https://www.elastic.co/guide/en/elasticsearch/reference/current/geo-point.html>



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# Geo-point Format

Type	Format
Object	lat = lon =
String	lat, lon
Array	[lon, lat] <b>** GeoJSON **</b>

<https://en.wikipedia.org/wiki/GeoJSON>



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# Geohash converter

## Geohash Converter

Simple and fast conversion from geohash to latitude/longitude and from latitude/longitude to geohash.

GeoHash

Lat, Lng

Precision

<http://geohash.co/>



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# Geo-point query

Geo-bounding-box

Geo-distance

Geo-polygon

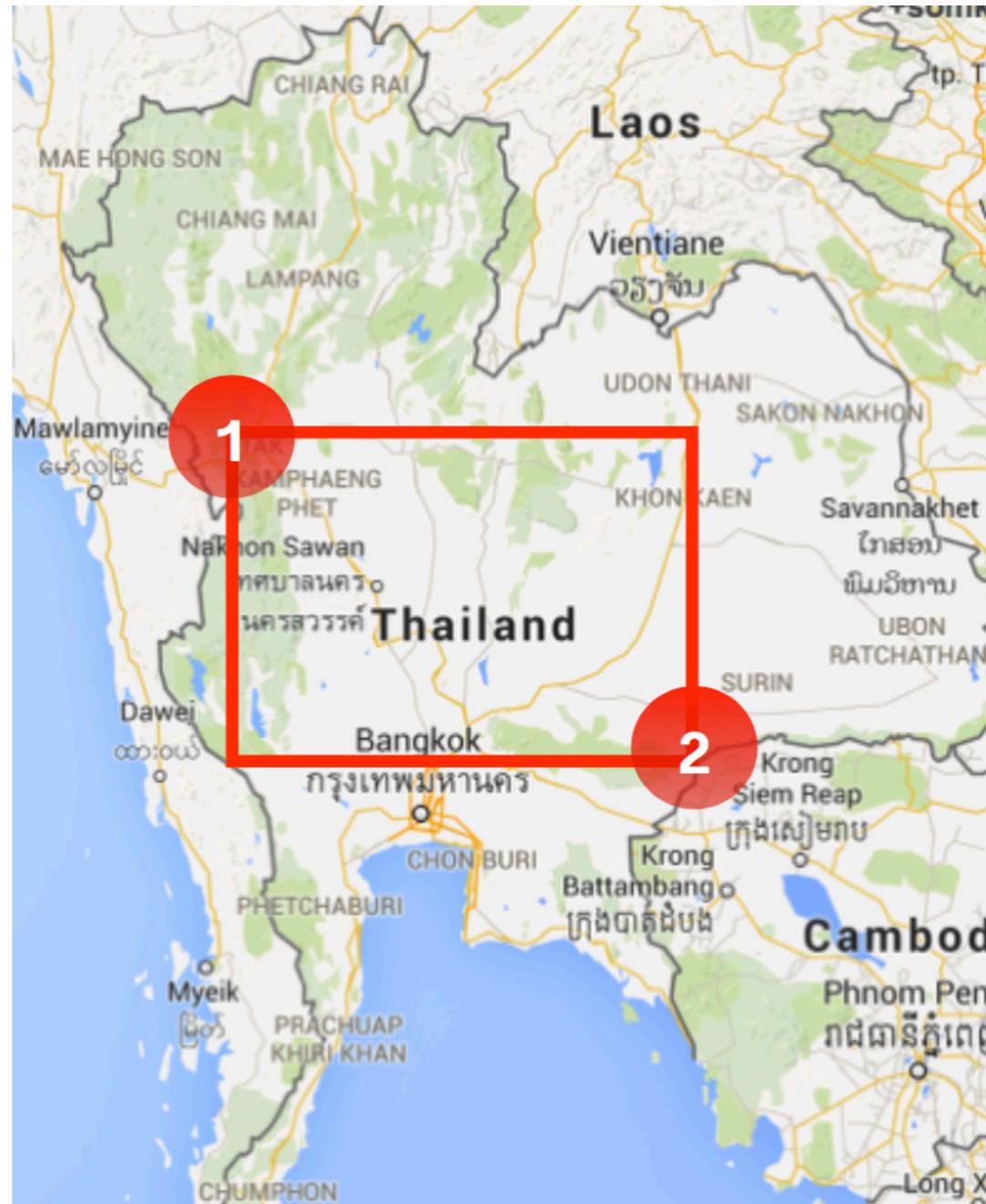
<https://www.elastic.co/guide/en/elasticsearch/reference/current/geo-queries.html>



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# Bounding Box



<https://www.elastic.co/guide/en/elasticsearch/reference/current/query-dsl-geo-bounding-box-query.html>



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# Geo Distance



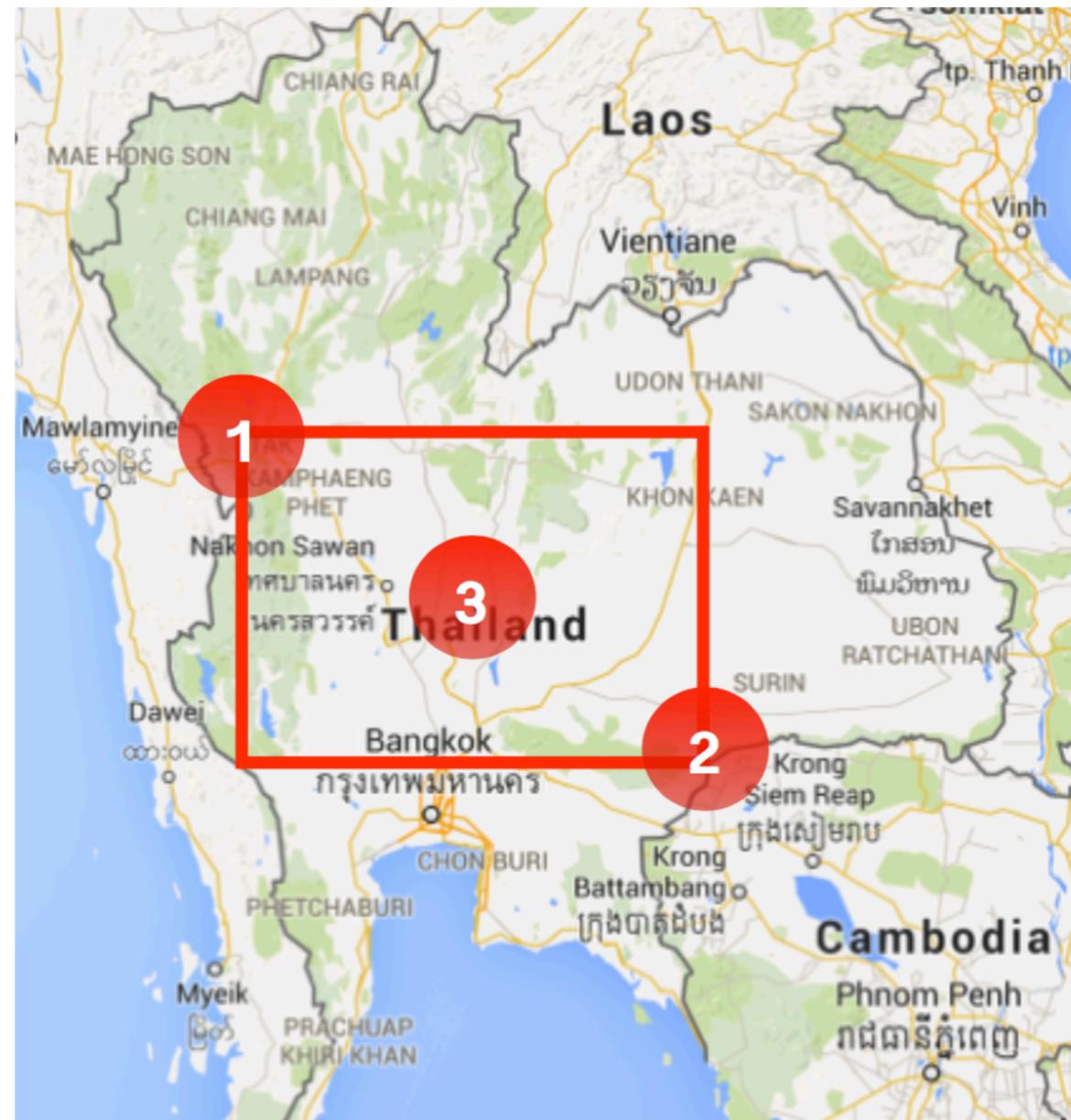
<https://www.elastic.co/guide/en/elasticsearch/reference/current/query-dsl-geo-distance-query.html>



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# Try to ordering result



# Explain and Profiling your query



# 2 ways

Explain API  
Profile API



# Explain API

GET /my\_map/\_search

```
{  
  "explain": true,  
  "query": {  
    "bool": {
```

<https://www.elastic.co/guide/en/elasticsearch/reference/6.3/search-explain.html>



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# Profile API

Debugging tool

Add overhead to search execution

Output is verbose and depend on internal operation

<https://www.elastic.co/guide/en/elasticsearch/reference/6.3/search-profile.html>



# Profile API

GET /my\_map/\_search

```
{  
  "profile": true,  
  "query": {  
    "bool": {
```



# Working with Data

<https://www.elastic.co/guide/en/kibana/current/tutorial-load-dataset.html>



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# Working with Data

\$elasticsearch-plugin install **ingest-geoip**

<https://www.elastic.co/guide/en/elasticsearch/plugins/current/ingest-geoip.html>



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# GeolP with Elasticsearch

geoip/instruction.json



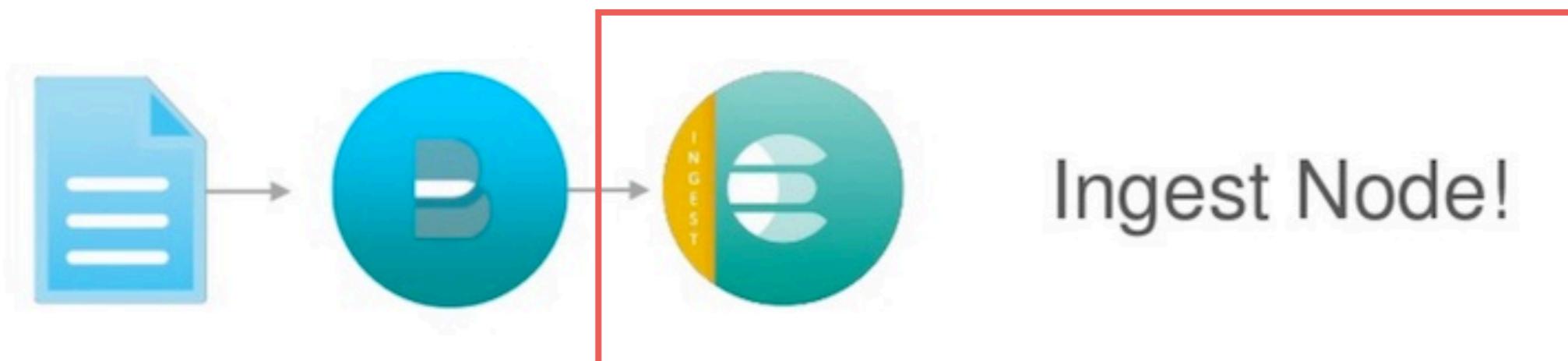
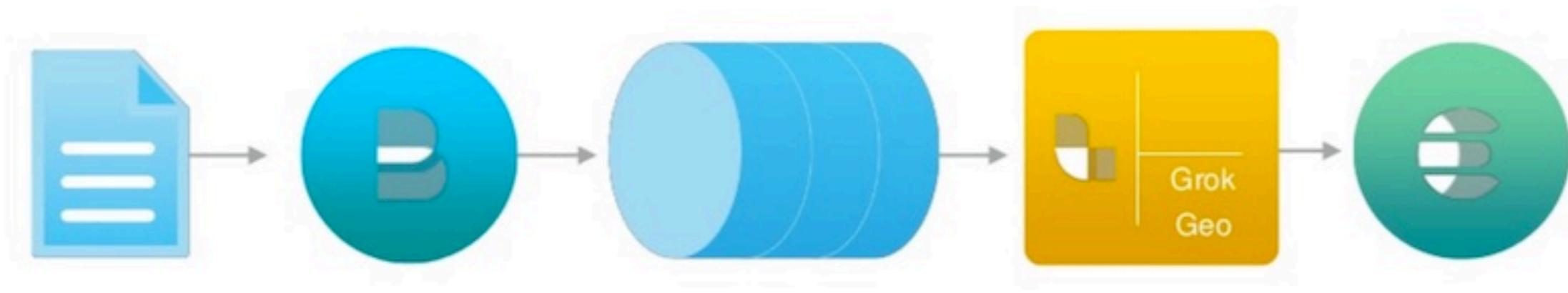
# Sample Data

```
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T09:03:25.877Z","ip":"185.124.182.12"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T12:28:25.013Z","ip":"79.1.14.87","e"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T17:44:34.357Z","ip":"178.209.1.7"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T13:04:18.120Z","ip":"118.140.92.127"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T11:37:40.653Z","ip":"235.154.34.221"},  
{"index":{"_index":"logstash-2015.05.18","_type":"log"}},  
{"@timestamp":"2015-05-18T08:46:07.025Z","ip":"228.216.38.41"}
```



# Working with Ingest

Pre-process document before actual indexing



<https://www.elastic.co/guide/en/elasticsearch/reference/current/ingest.html>



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# Install plugin

```
$elasticsearch-plugin install ingest-geoip
```

<https://www.elastic.co/guide/en/elasticsearch/plugins/current/ingest-geoip.html>



# Alias Index



# Alias Index

TODO

TODO

TODO

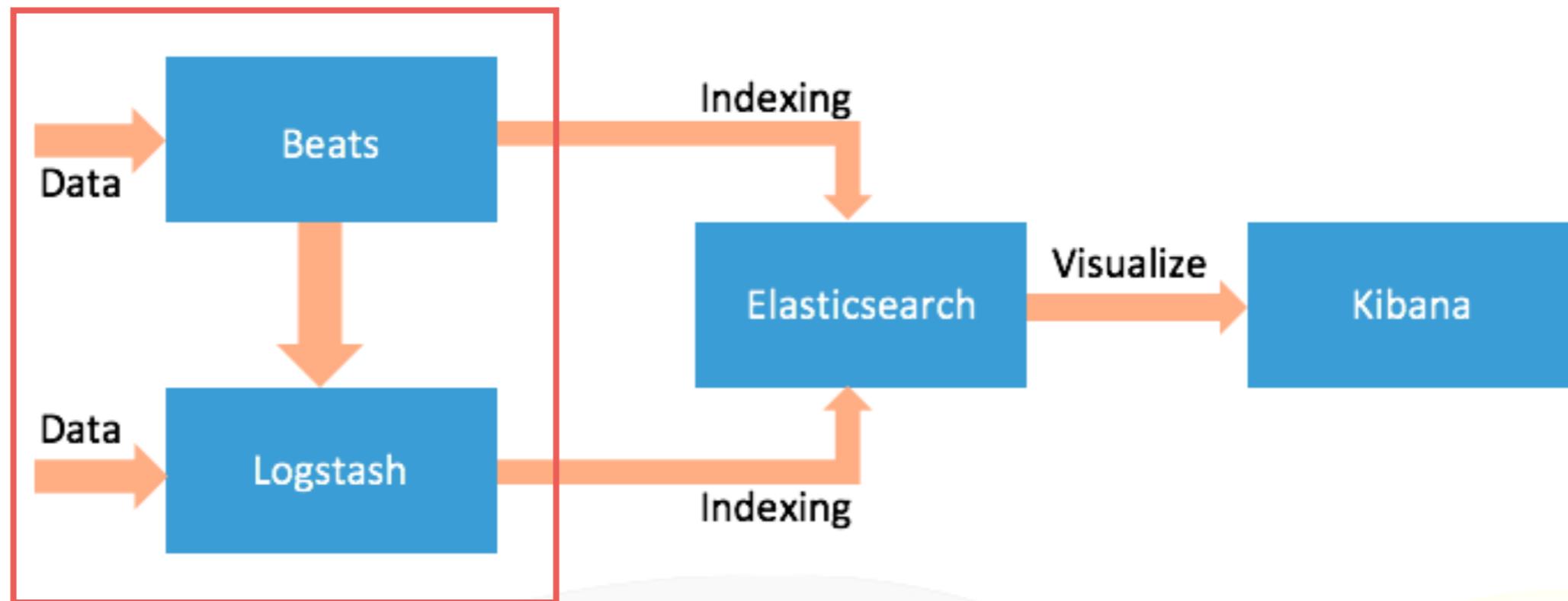
<https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-aliases.html>



ELK Stack

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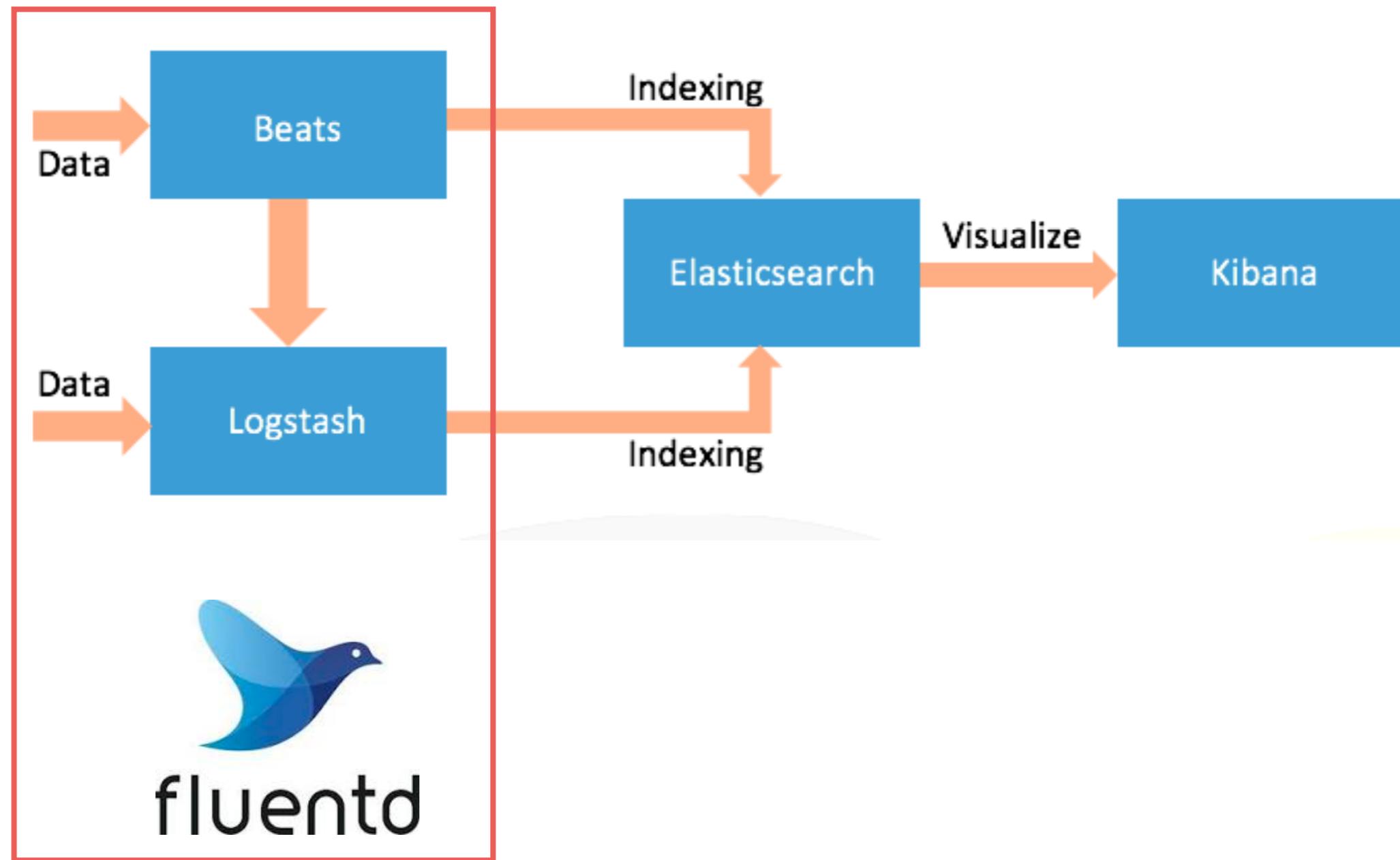
# ELK stack



fluentd



# EFK stack



# Working with Logstash

<https://www.elastic.co/guide/en/logstash/current/index.html>



ELK Stack

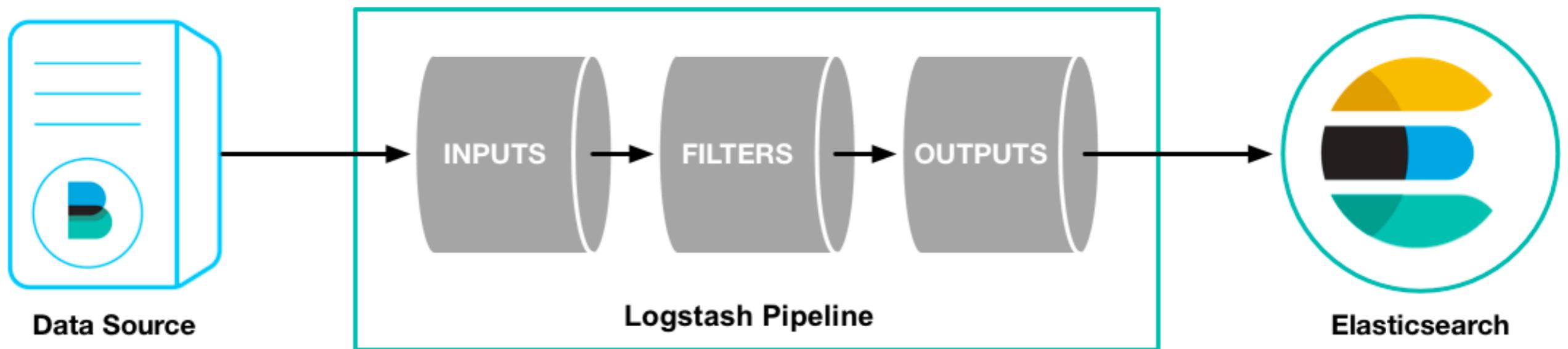
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# Logstash



# Logstash



# Example



# sample.conf

```
input {  
    stdin{  
}  
  
output {  
    stdout {  
        codec => rubydebug  
    }  
}
```



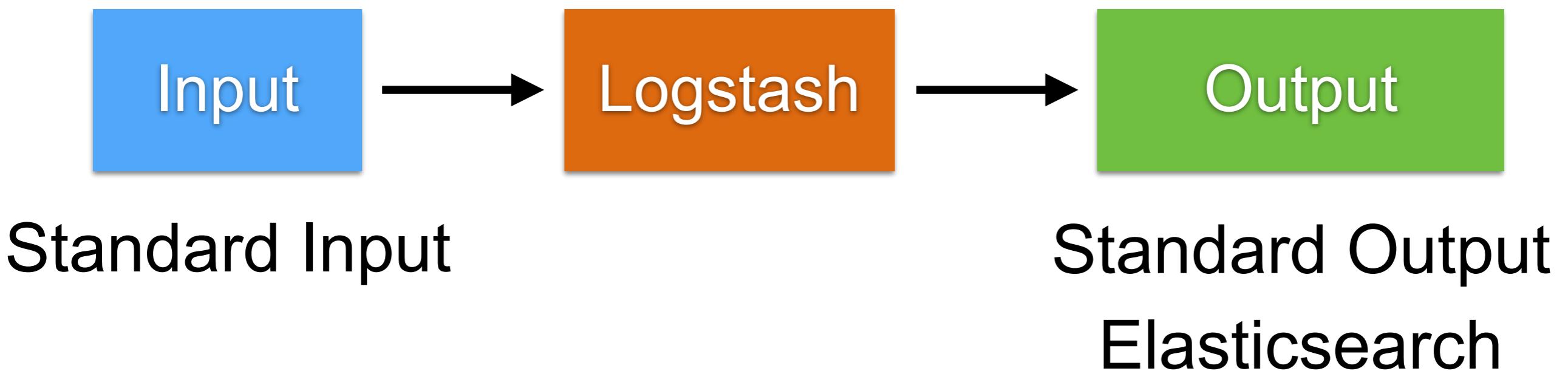
# Example

\$logstash -f sample.conf

```
hello world
{
    "message" => "hello world",
    "@timestamp" => 2019-06-20T06:01:30.048Z,
    "@version" => "1",
    "host" => "Somkiats-MacBook-Pro"
}
```



# Change output to ES



<https://www.elastic.co/guide/en/logstash/current/plugins-outputs-elasticsearch.html>



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# sample.conf

```
input {  
    stdin{  
}  
  
output {  
    stdout {  
        codec => rubydebug  
}  
  
    elasticsearch {  
}  
}
```



# Working with Filter



<https://www.elastic.co/guide/en/logstash/current/filter-plugins.html>



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# sample.conf

```
input {
    stdin{}
}

filter {
    grok {
        match => { "message" => "%{WORD:firstname} %
{WORD:lastname}" }
    }
}

output {
    stdout {
        codec => rubydebug
    }
}
```



# Workshop



File system

Standard Output

Elasticsearch

`workshop/logstash-beat-fluentd/demo.conf`



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# try.conf

```
input {  
    stdin{}  
}  
  
output {  
    stdout {  
        codec => rubydebug  
    }  
  
    elasticsearch {  
    }  
}
```



# Design your input first !!



# Use beats is better

<https://www.elastic.co/products/beats>

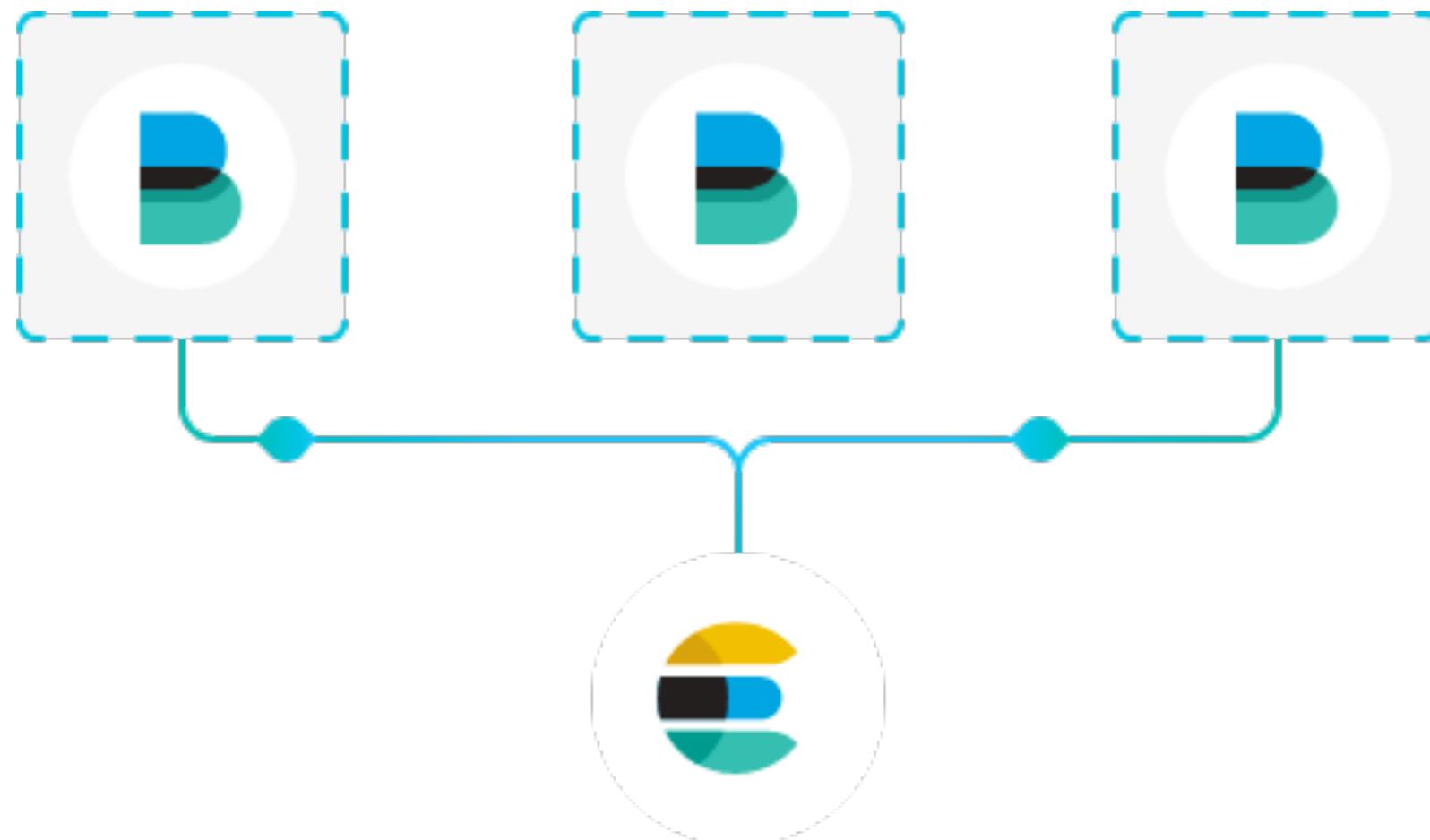


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# Beat



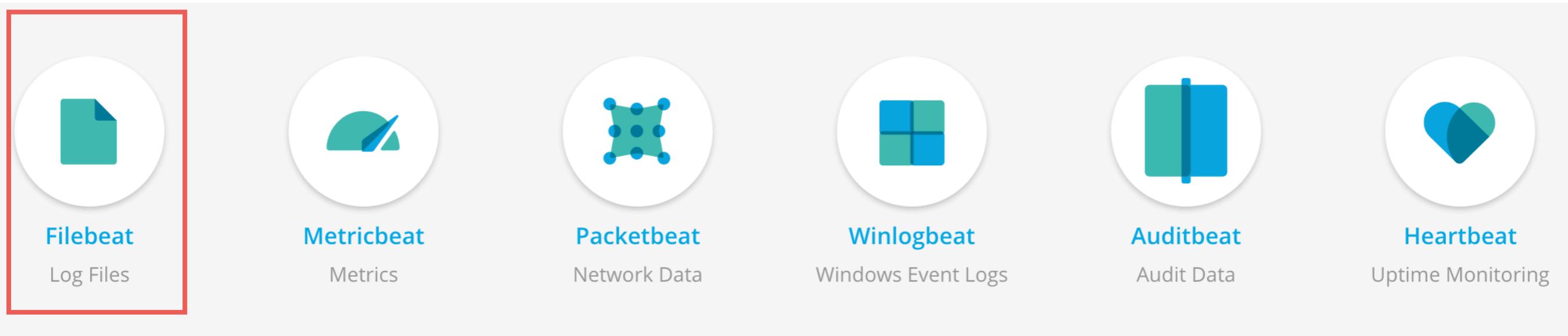
<https://www.elastic.co/guide/en/beats/filebeat/current/index.html>



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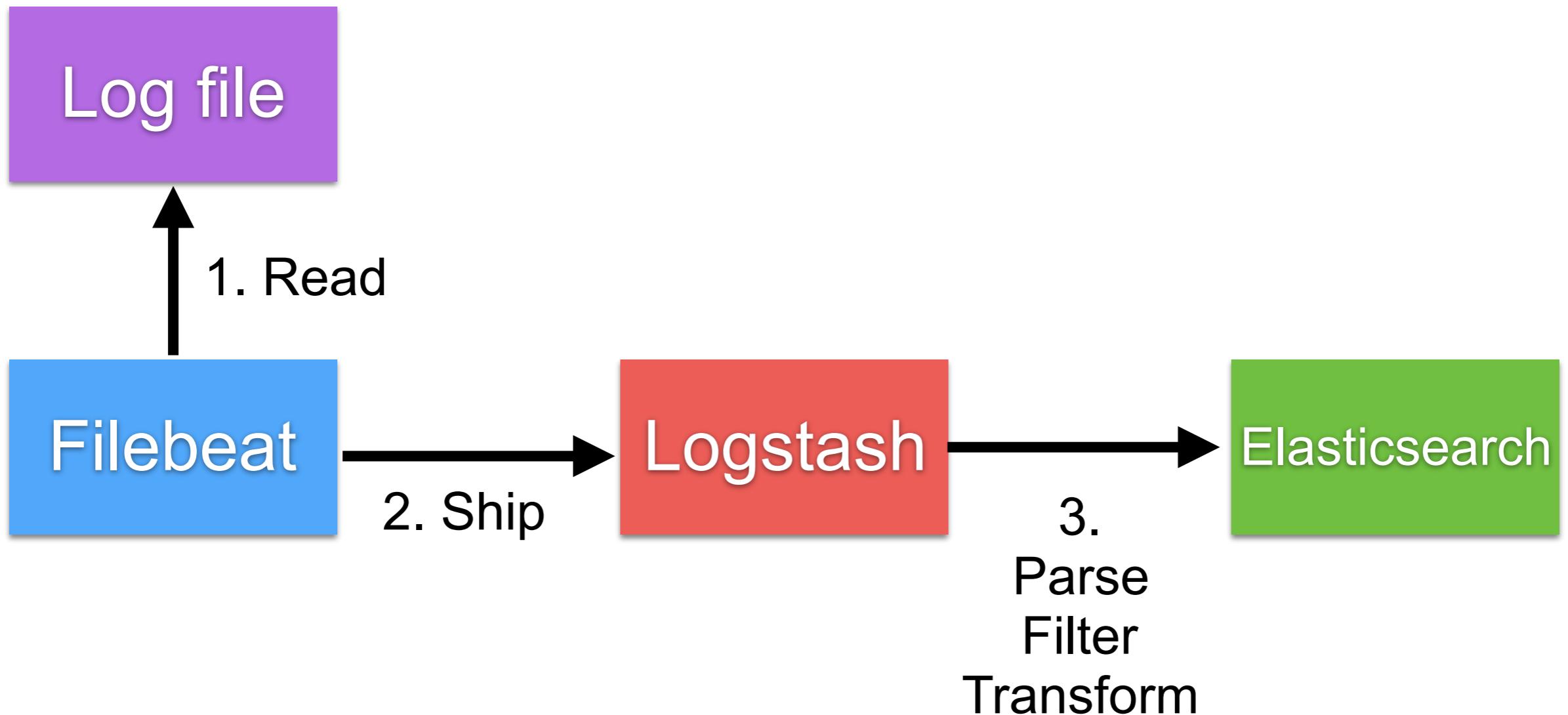
# Beat



ELK Stack

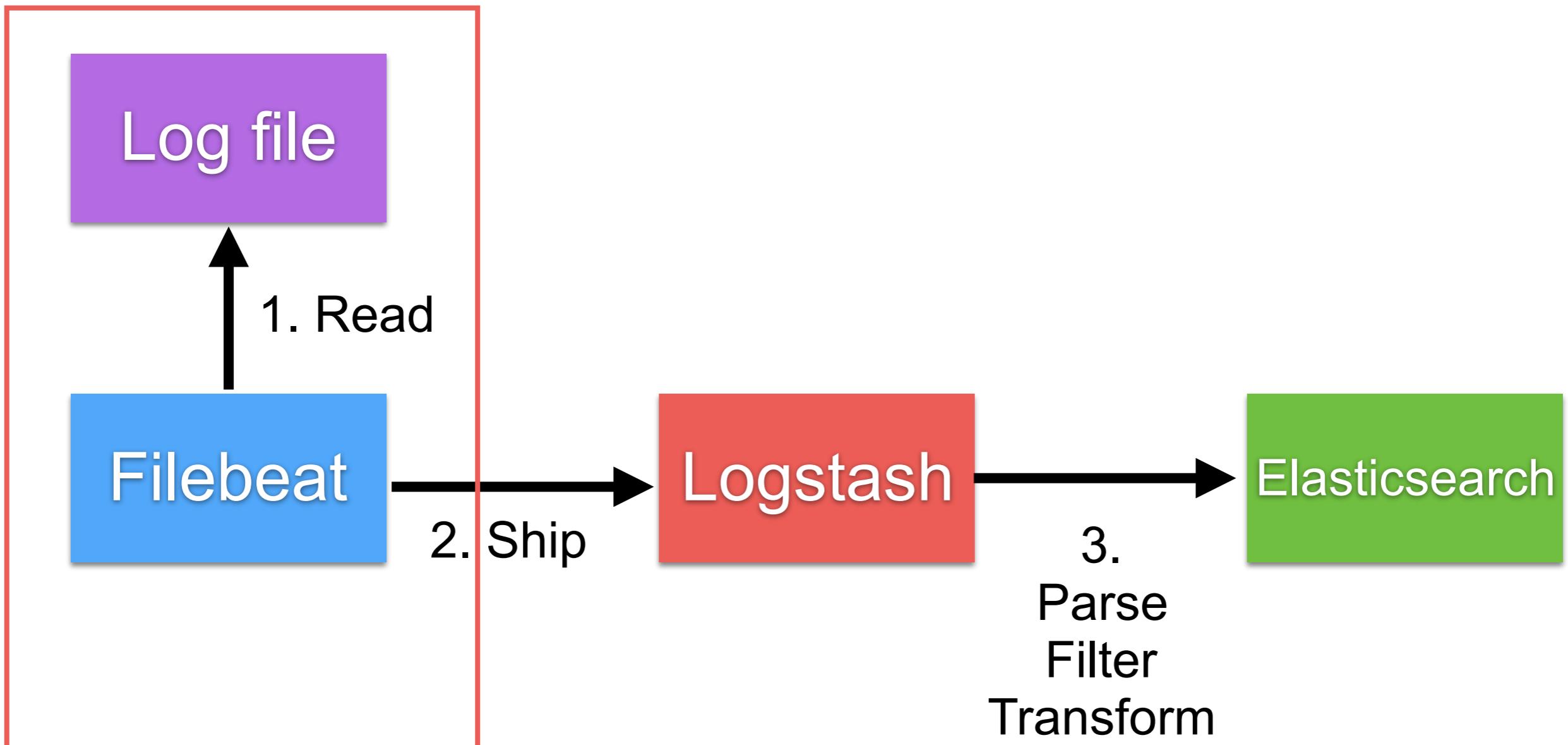
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# Example of filebeat



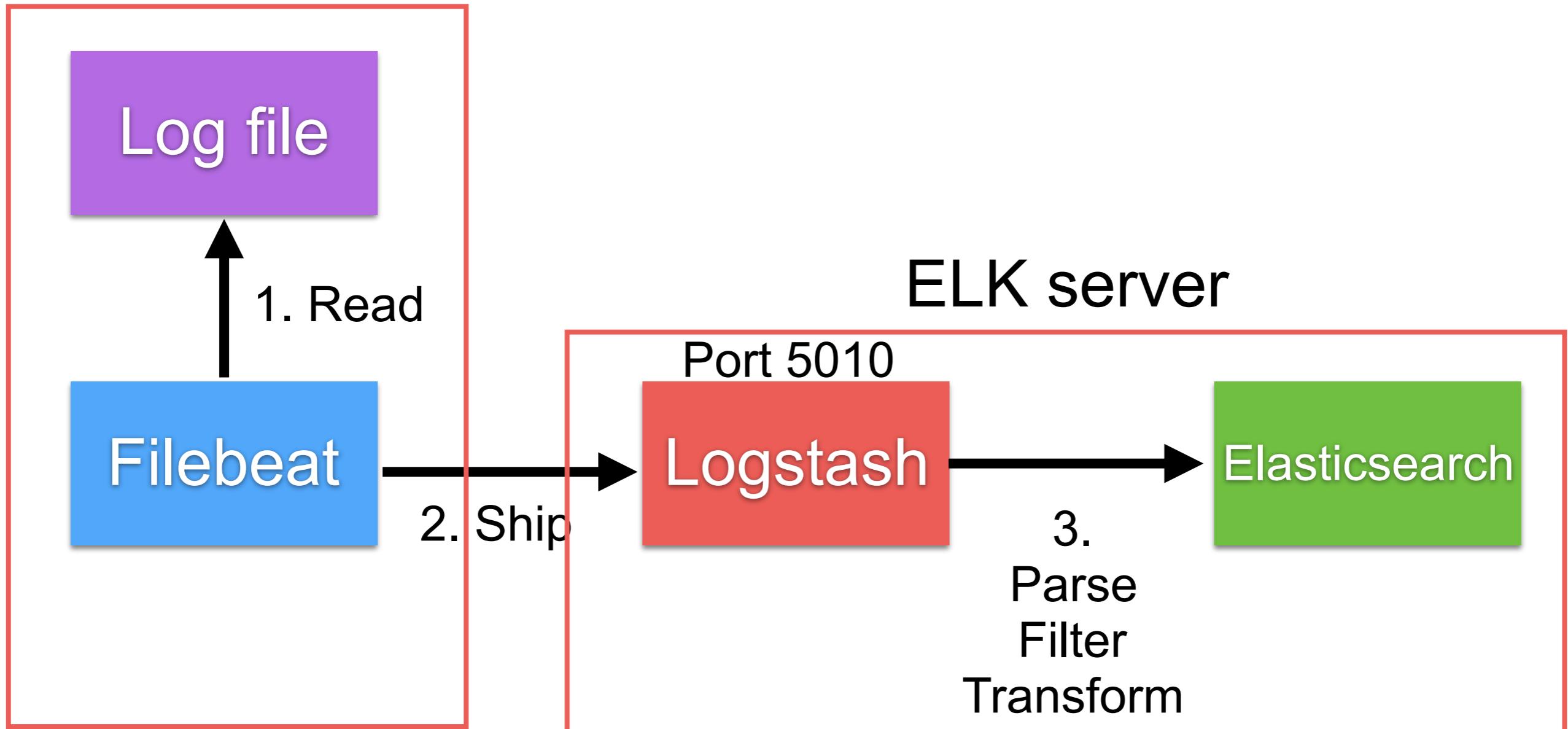
# Example of filebeat

Server A

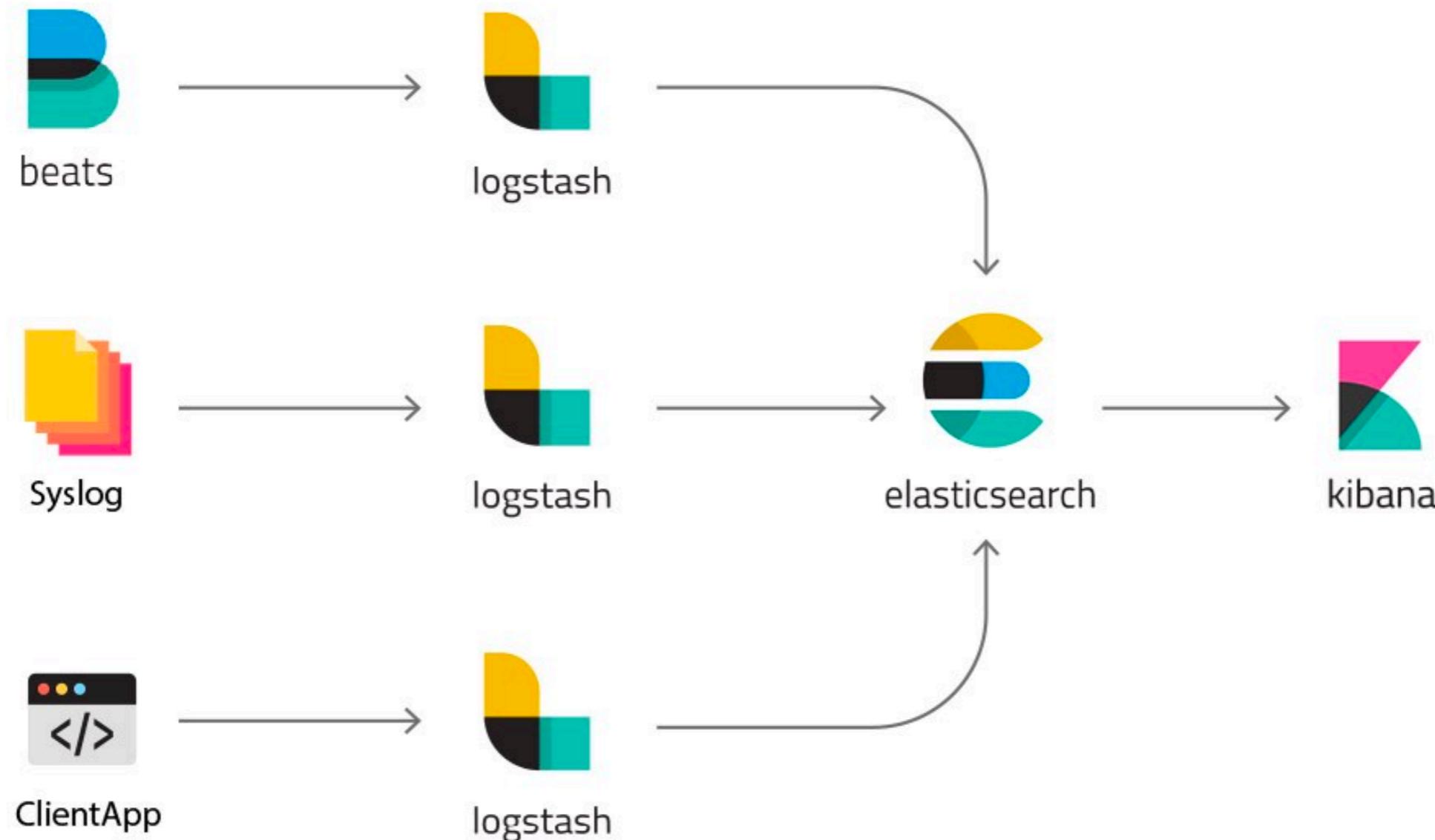


# Example of filebeat

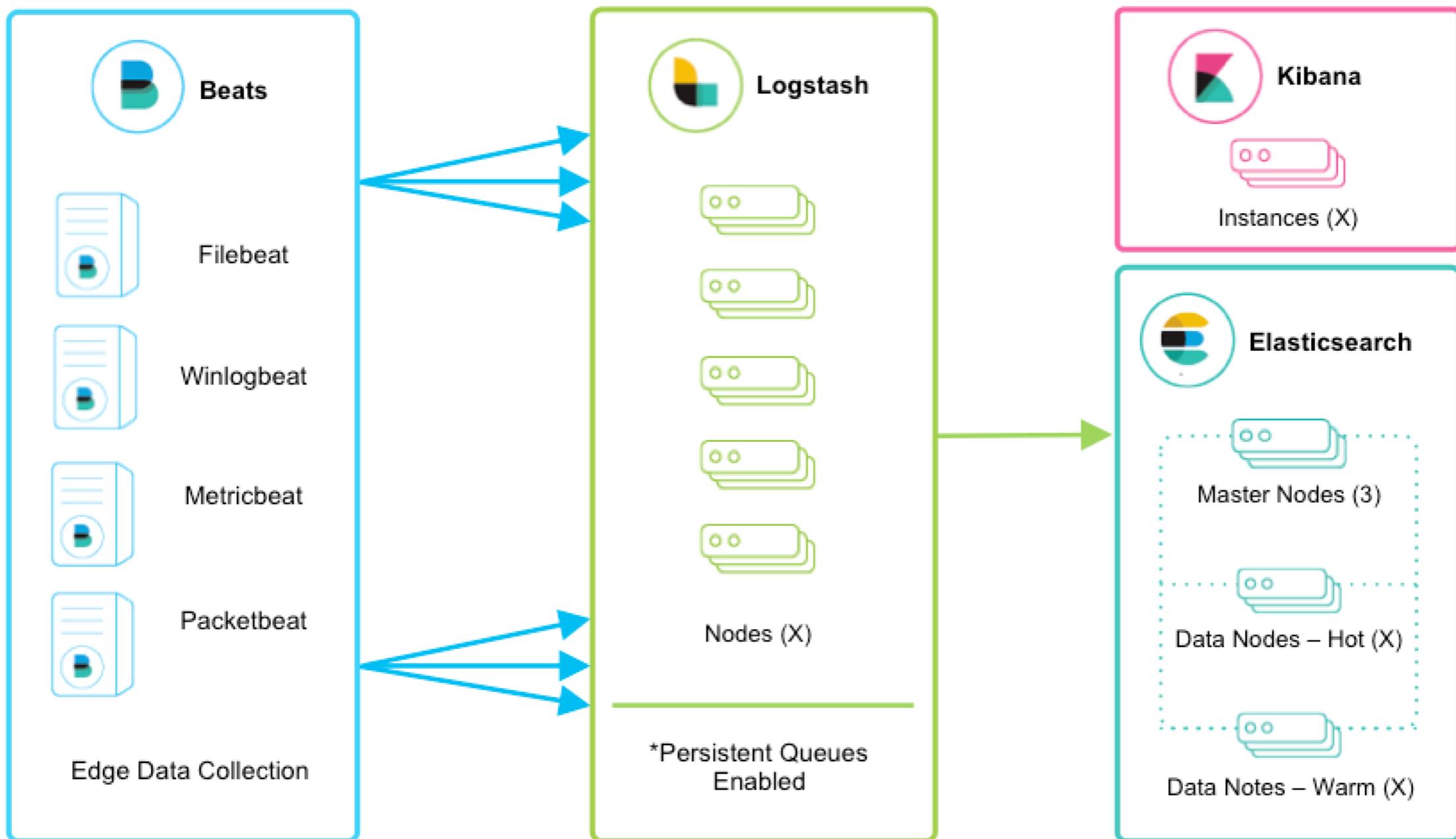
Server A



# Beat and Logstash



# Scaling



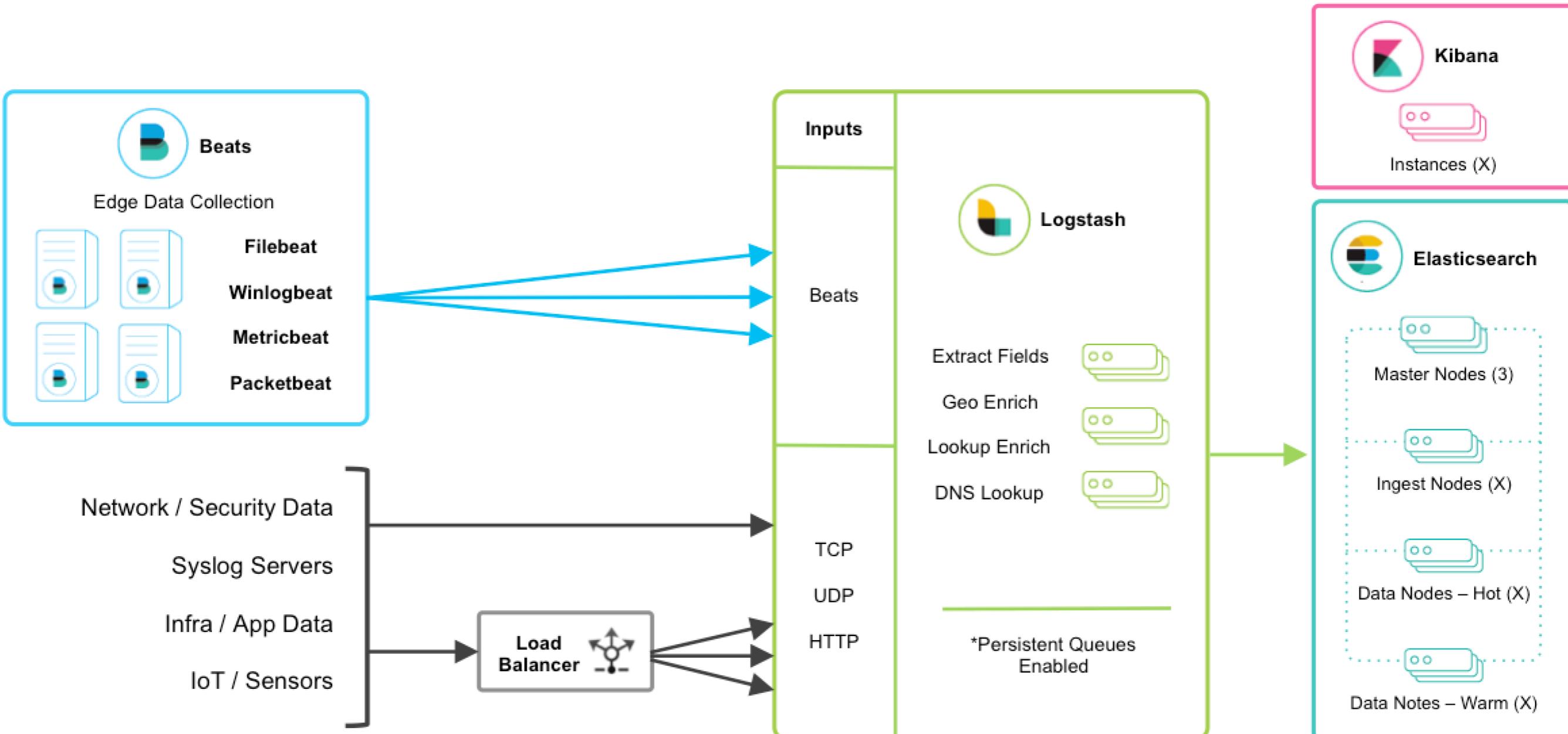
<https://www.elastic.co/guide/en/logstash/current/deploying-and-scaling.html>



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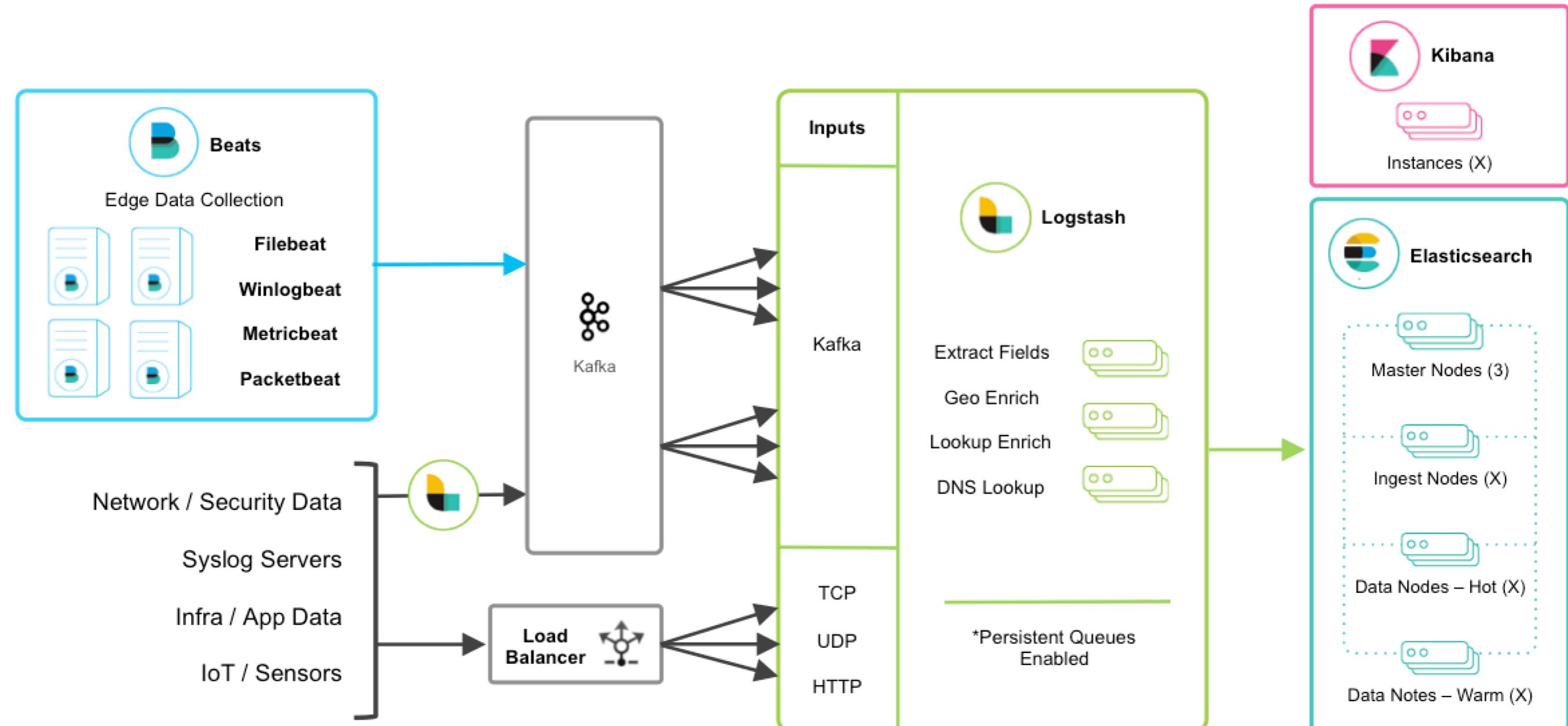
# More data sources



<https://www.elastic.co/guide/en/logstash/current/deploying-and-scaling.html>



# Use messaging Queue



<https://www.elastic.co/blog/logstash-persistent-queue>

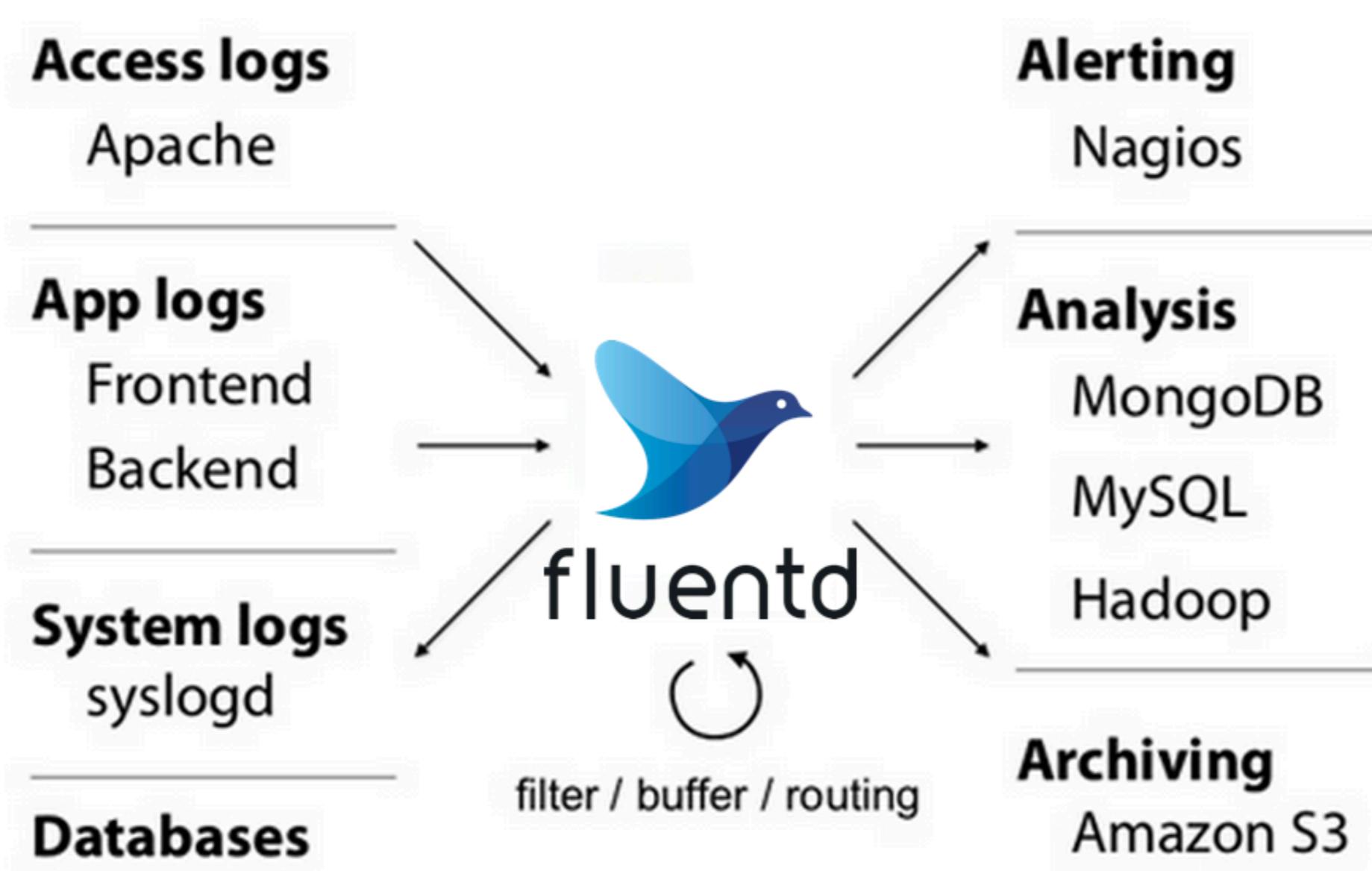


# Working with Fluentd

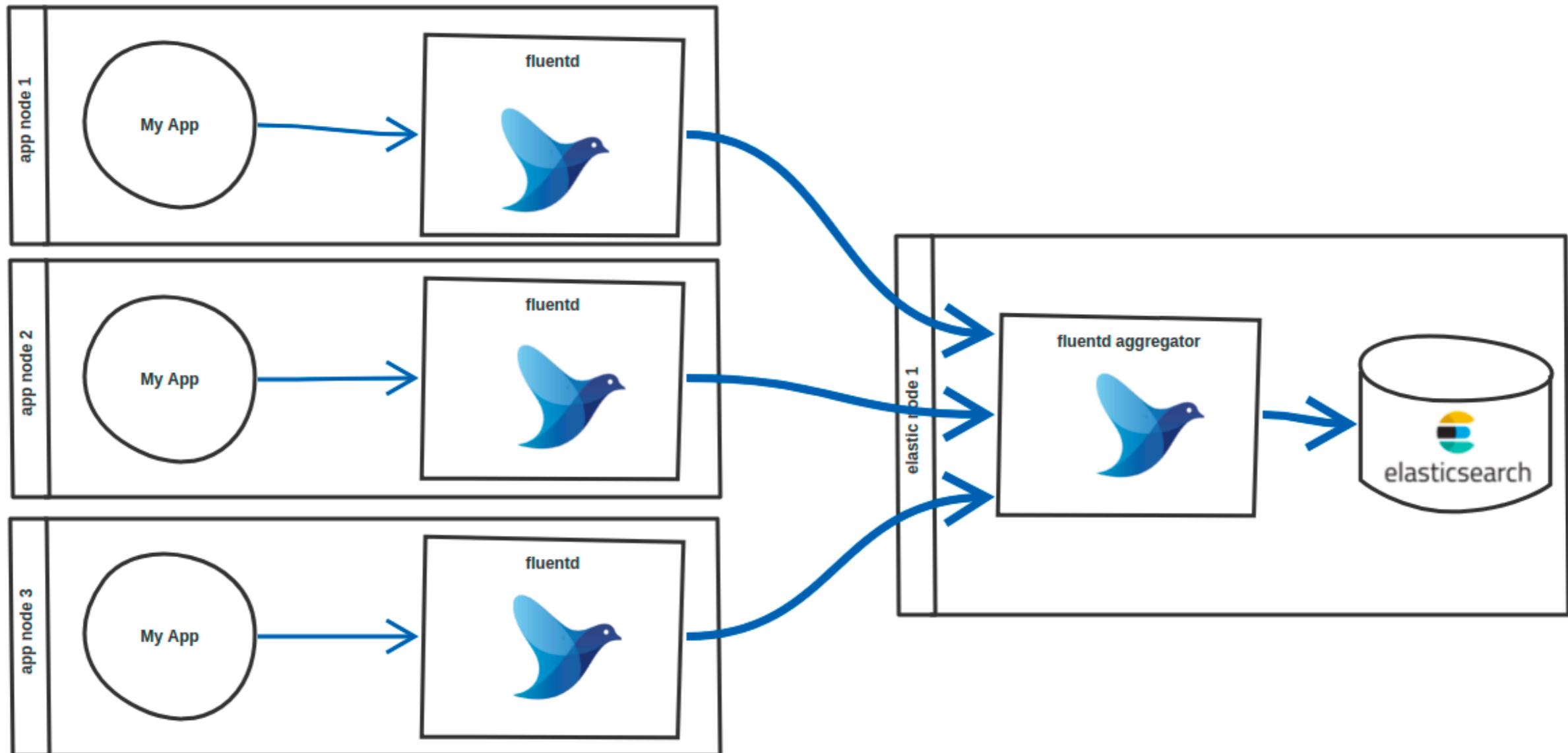
<https://www.fluentd.org/>



# Fluentd

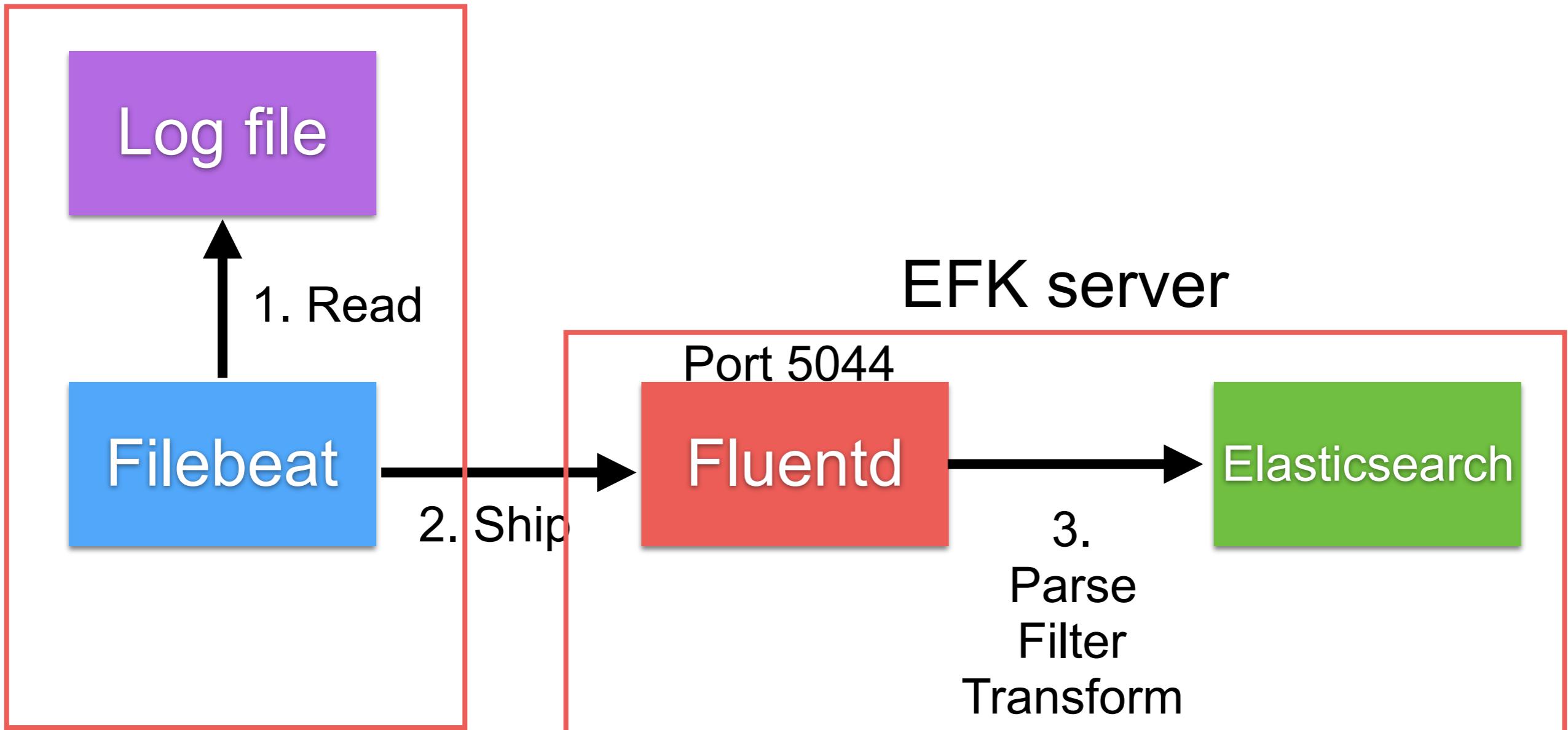


# EFK stack



# Example of fluentd

Server A



# Fluentd regex editor

**Fluentular** fluentd v1.5.2

a Fluentd regular expression editor

</> Regular Expression

```
^(?<host>[^\ ]*) [^\ ]* (?<user>[^\ ]*) \[(?<time>[^\\ ]*)\] "(?<method>\S+)(?: +(?<path>[^\ ]*) +\S*)?" (?<code>[^\ ]*) (?<size>[^\ ]*)(?: "(?<referer>[^\\"]*)" "(?<agent>[^\\"]*)")?$/
```

“ Test String

⌚ Custom Time Format (See also ruby document; [strftime](#))

%d/%b/%Y:%H:%M:%S %z

Parse

## Example (Apache)

Regular expression:

```
^(?<host>[^\ ]*) [^\ ]* (?<user>[^\ ]*) \[(?<time>[^\\ ]*)\] "(?<method>\S+)(?: +(?<path>[^\ ]*) +\S*)?" (?<code>[^\ ]*) (?<size>[^\ ]*)(?: "(?<referer>[^\\"]*)" "(?<agent>[^\\"]*)")?$/
```

Time Format:

```
%d/%b/%Y:%H:%M:%S %z
```

<http://fluentular.herokuapp.com/>

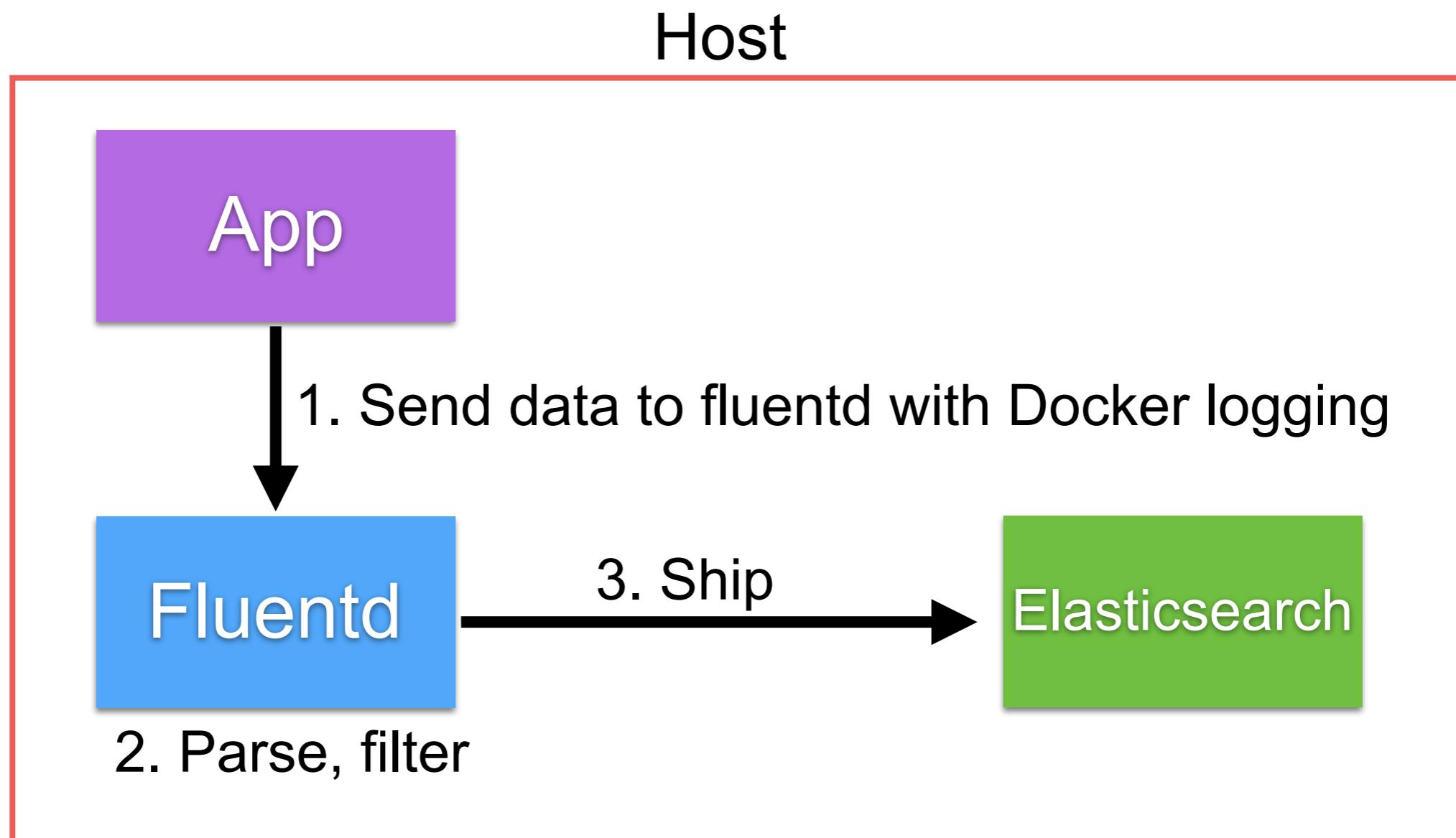


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# Fluentd with Docker

## Using docker-compose



# Design for Failure

09-cluster



# Elasticsearch Nodes

Node Type	Description
Master	Control the cluster
Data	Keep/store data
HTTP/Query	Run your query
Coordinating	Smart Load Balancer
Ingest	Pre-processing documents before indexing
Machine Learning	Required subscription !!

<https://www.elastic.co/guide/en/elasticsearch/reference/current/modules-node.html>



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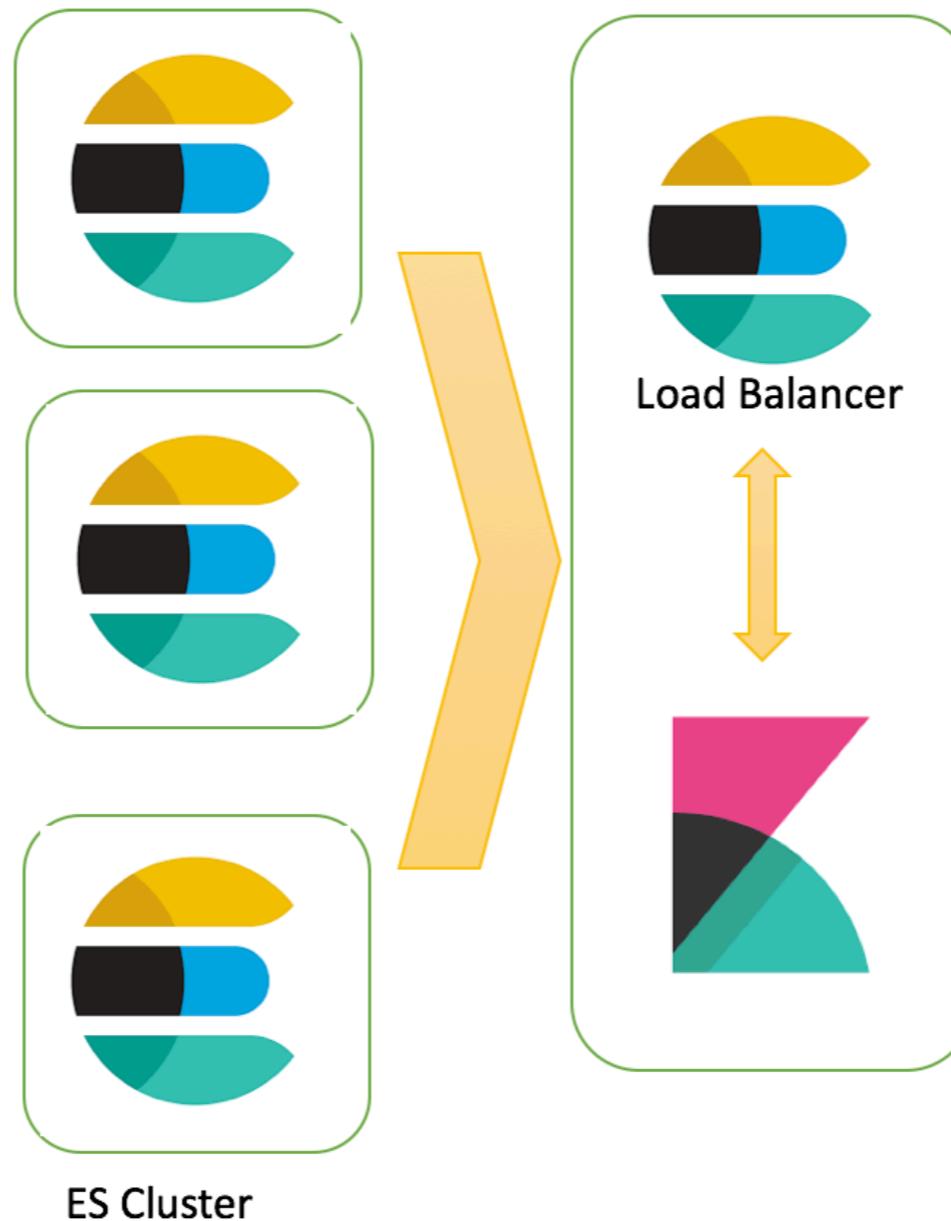
# Elasticsearch Nodes

← → ⌂ ⓘ Not Secure | 35.240.161.188:9200/\_cat/nodes?v&h=ip,name,node.role,master,heap.percent,ram.percent

ip	name	node.role	master	heap.percent	ram.percent
10.148.0.2	master	m	*	17	33
10.148.0.4	query	-	-	10	63
10.148.0.5	coordinator	-	-	9	78
10.148.0.3	data	d	-	13	63



# Elasticsearch Nodes



<https://www.elastic.co/guide/en/kibana/current/production.html#load-balancing>



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# Elasticsearch Nodes



# Apache Lucene

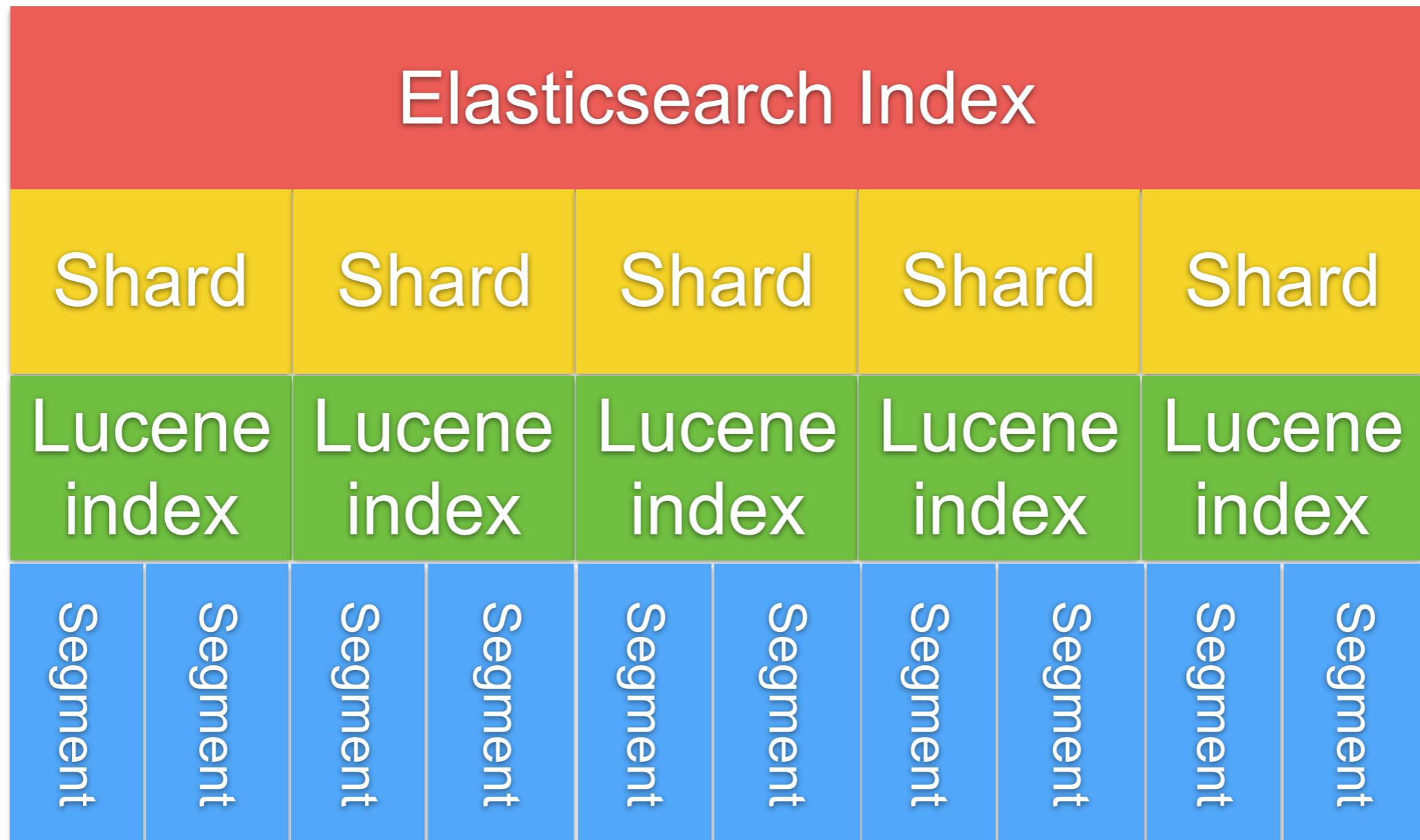
<http://lucene.apache.org/>



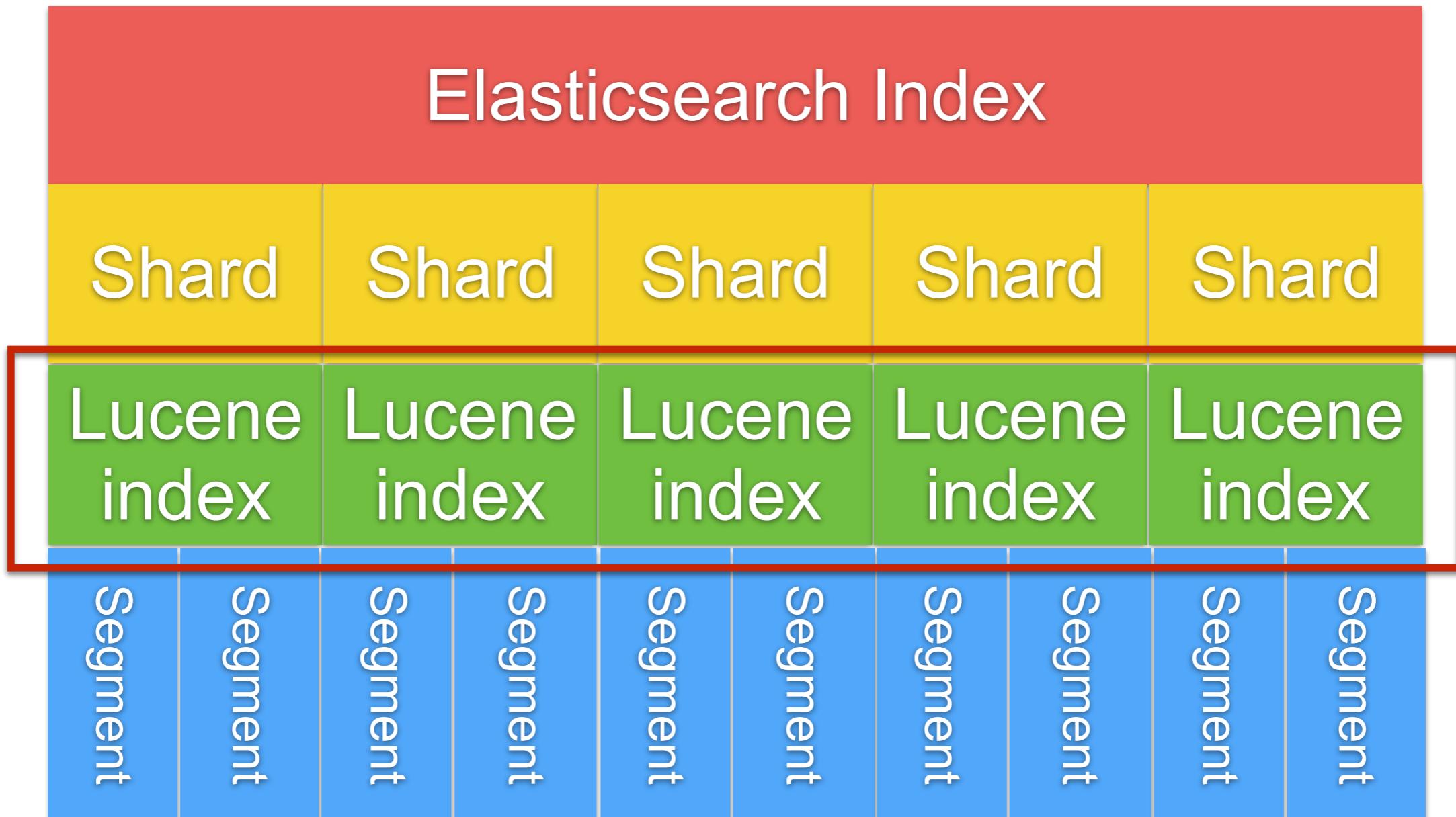
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# Apache Lucene



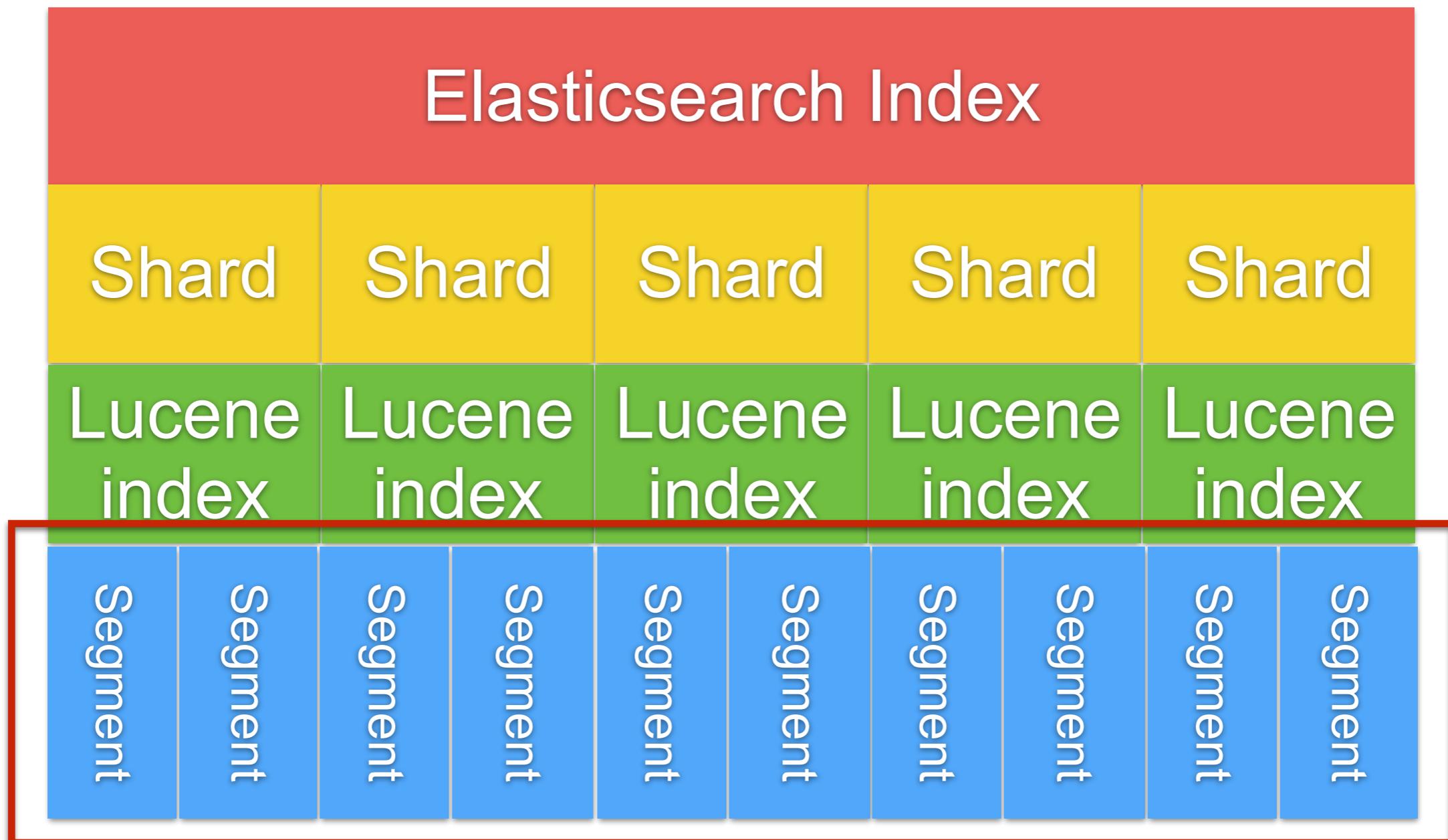
# Apache Lucene



Max # of document of Lucene index = 2,147,483,519



# Apache Lucene



Segments are immutable

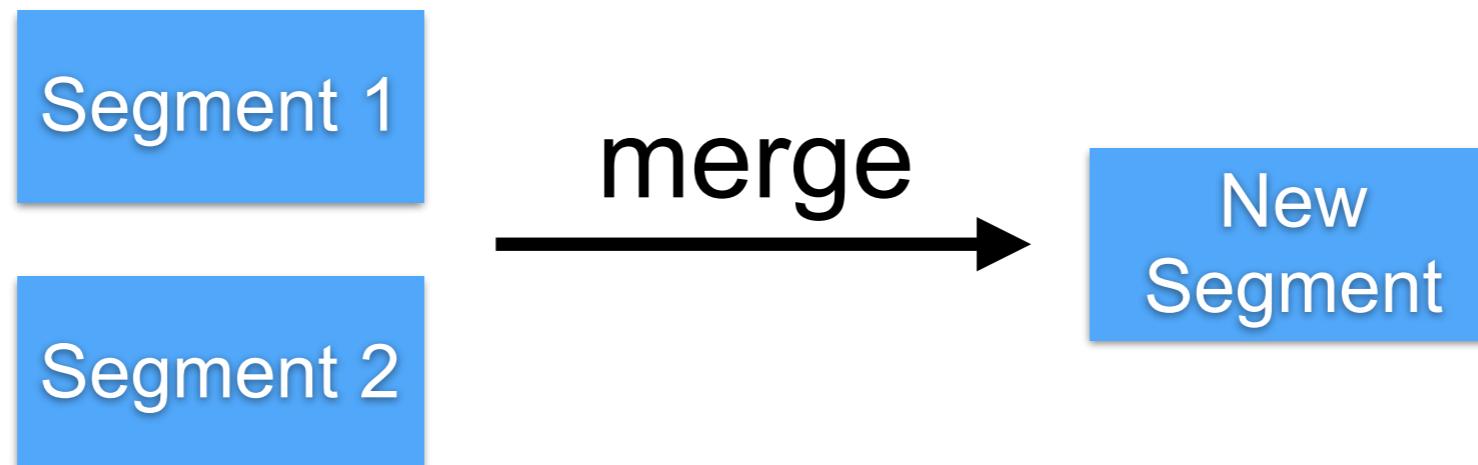


# Segment

More shards, more segments

Documents are never delete !!

Lucene segment **merge** use more CPU/IO  
Segments are immutable



# Hardware



# **Hardware**

CPU  
**Memory**  
Network  
Storage



# Memory

Enable bootstrap.memorylock

Disable all swap files

Change `ES_HEAP_SIZE` (default 1G)

<https://www.elastic.co/guide/en/elasticsearch/reference/current/setup-configuration-memory.html>



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# Design your index



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# Design your index

Sharding  
Replication



# Sharding

Elasticsearch divides the data in **logical** parts  
# of sharding is define when index created



# How many shard ?



# Need to know your size of data

Data Size	# of shard
< 3M	1
>3M <5M	2
>5M	(# of document / 5M) + 1



# Sharding

**Small shards** on multiple nodes make the cluster recovery faster

**Small shards** on a lot of nodes solve memory mgt problem when query on large data



# More shard, more Segment !!

Elasticsearch Index				
Shard	Shard	Shard	Shard	Shard
Lucene index	Lucene index	Lucene index	Lucene index	Lucene index
Segment	Segment	Segment	Segment	Segment

Need to config file descriptor

<https://www.elastic.co/guide/en/elasticsearch/reference/current/system-config.html>



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# **Don't create more shard than you need !!**



# Replication

Prevent data loss

Default = 1

```
# nodes = [(primary + # replication) /2 ] + 1
```



# Problems with scaling

CPU consumption  
Load average  
Request rate  
Search latency



# Slow log

```
PUT /myindex/_settings
```

```
{  
  "index.search.slowlog.threshold.query.warn: 1s",  
  "index.search.slowlog.threshold.query.info: 500ms",  
  "index.search.slowlog.threshold.query.debug: 1500ms",  
  "index.search.slowlog.threshold.query.trace: 300ms",  
  "index.search.slowlog.threshold.fetch.warn: 500ms",  
  "index.search.slowlog.threshold.fetch.info: 400ms",  
  "index.search.slowlog.threshold.fetch.debug: 300ms",  
  "index.search.slowlog.threshold.fetch.trace: 200ms"  
}
```

*If can't optimize then add more resources or rewrite*

<https://www.elastic.co/guide/en/elasticsearch/reference/current/index-modules-slowlog.html>



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# Indexing Data



# Indexing data

Must be define data schema for your need  
Default mapping == more cost (Memory/Disk)  
Default for data is “text” + “keyword”  
Understand analyzer and tokenizer  
Use auto generated IDs if possible



# Indexing data

Prefer bulk indexing

**Change refresh interval**

Time based index for log data

<https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-update-settings.html>



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# For Large data

Increase refresh interval  
Decrease replica number

```
PUT /logstash-2015.05.20/_settings
{
  "index" : {
    "refresh_interval" : "-1",
    "number_of_replicas" : 0
  }
}
```

<https://www.elastic.co/guide/en/elasticsearch/reference/current/indices-update-settings.html>



# Query Data



# Query data

Use filters as much as possible

Use scan and scroll for dumping large data

Node query cache

Shard query cache

Retrieve only necessary fields

<https://www.elastic.co/guide/en/elasticsearch/reference/current/query-cache.html>



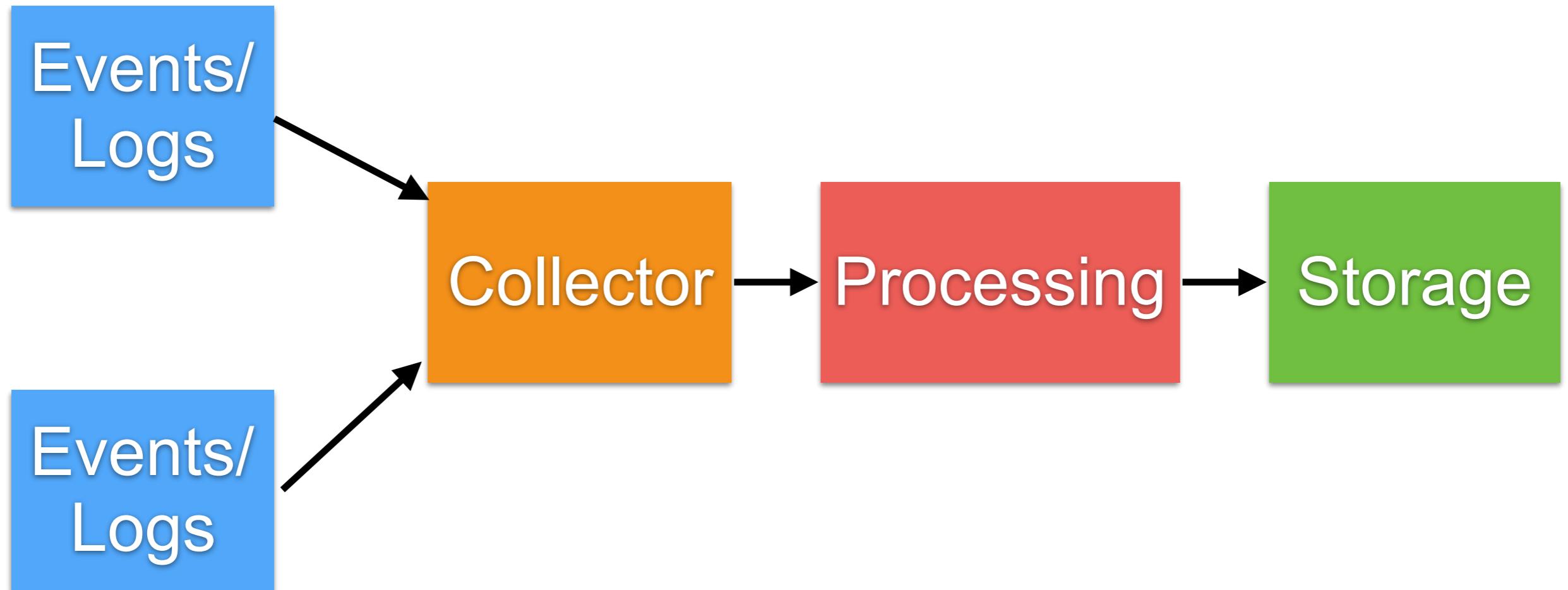
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# Use cases



# Event or Logging from Servers



# Event or Logging from Servers



Data  
Collection

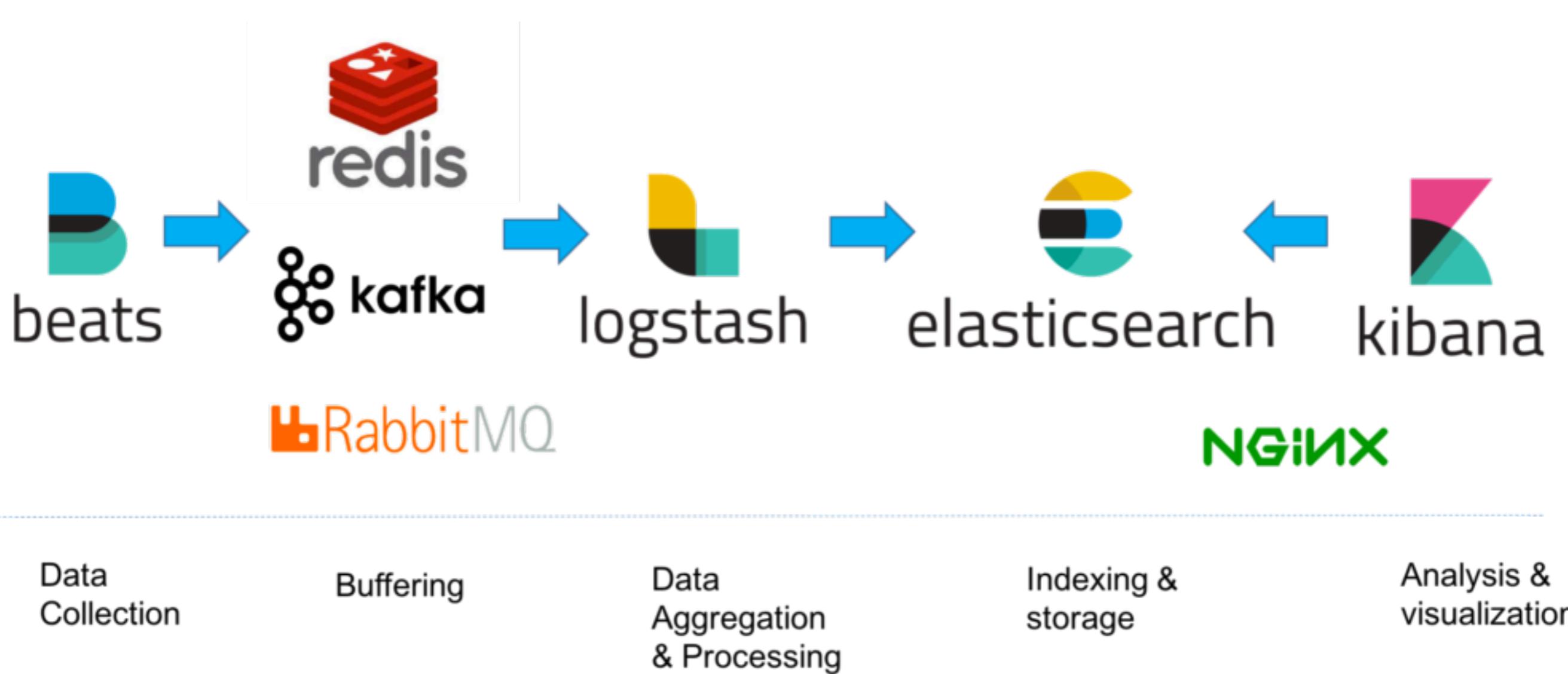
Data  
Aggregation  
& Processing

Indexing &  
storage

Analysis &  
visualization



# Event or Logging from Servers



# Monitoring



# Collect data from ?

Elasticsearch nodes  
Logstash nodes  
Kibana instances

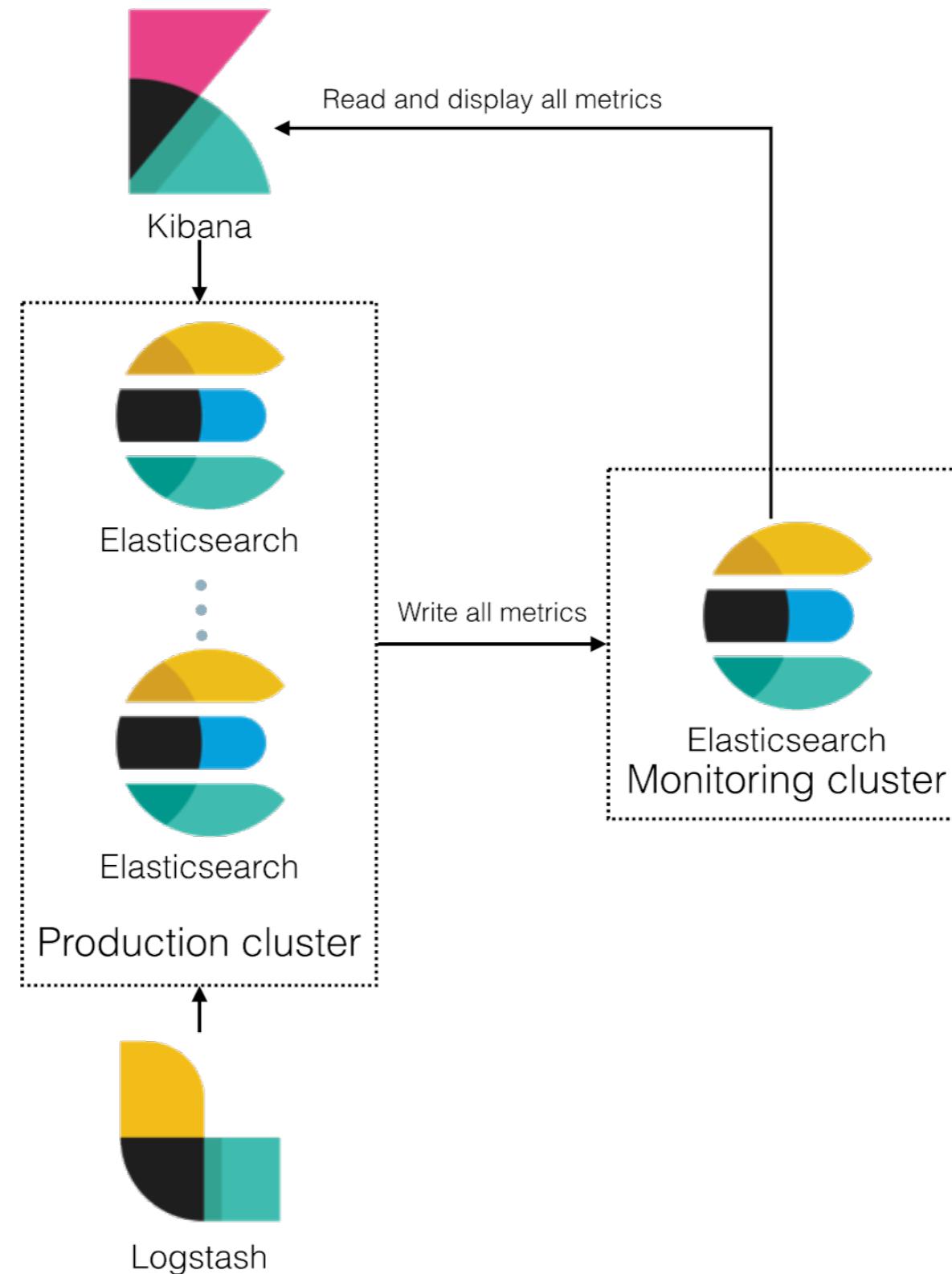
<https://www.elastic.co/guide/en/elasticsearch/guide/6.5/xpack-monitoring.html>



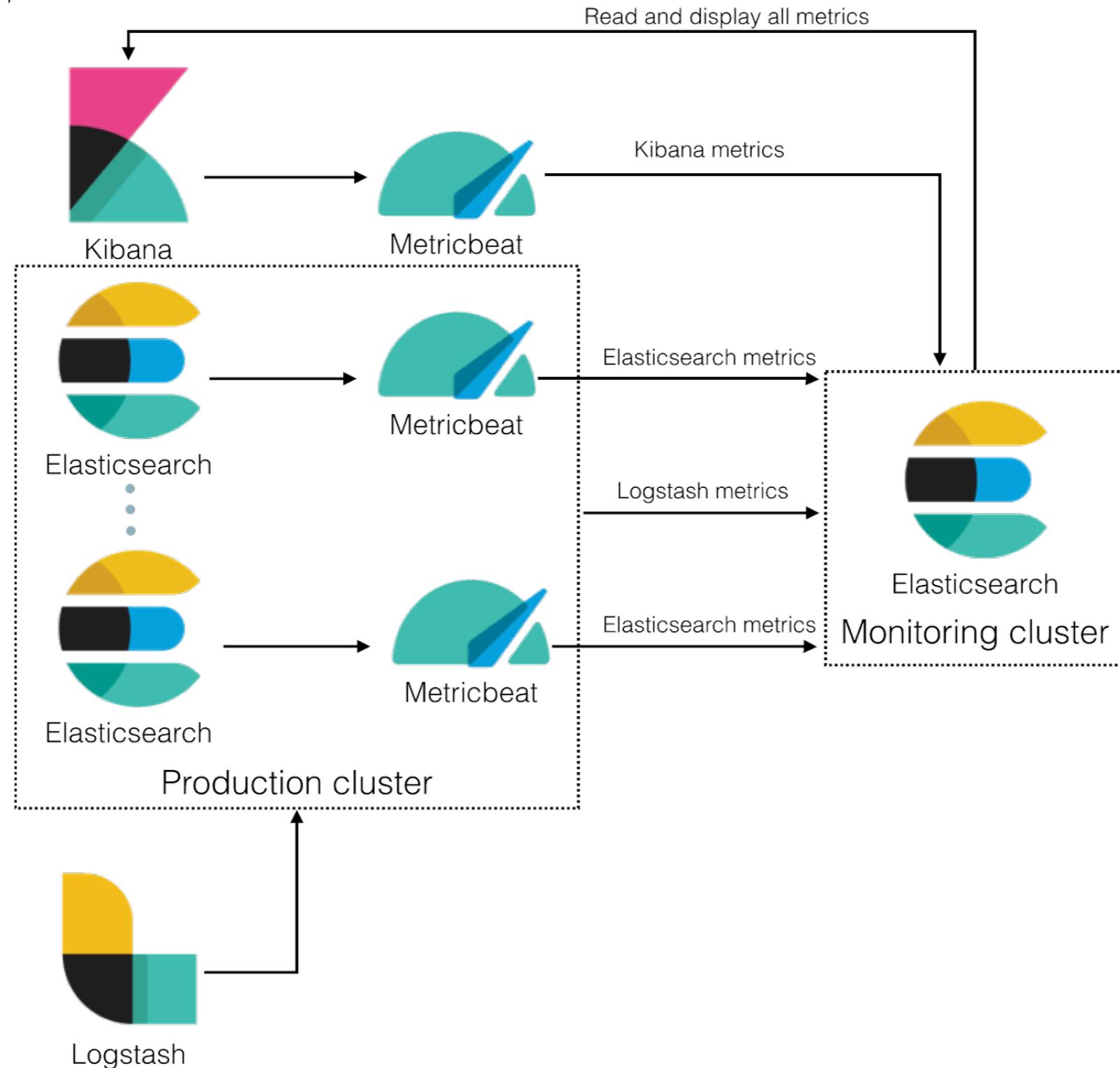
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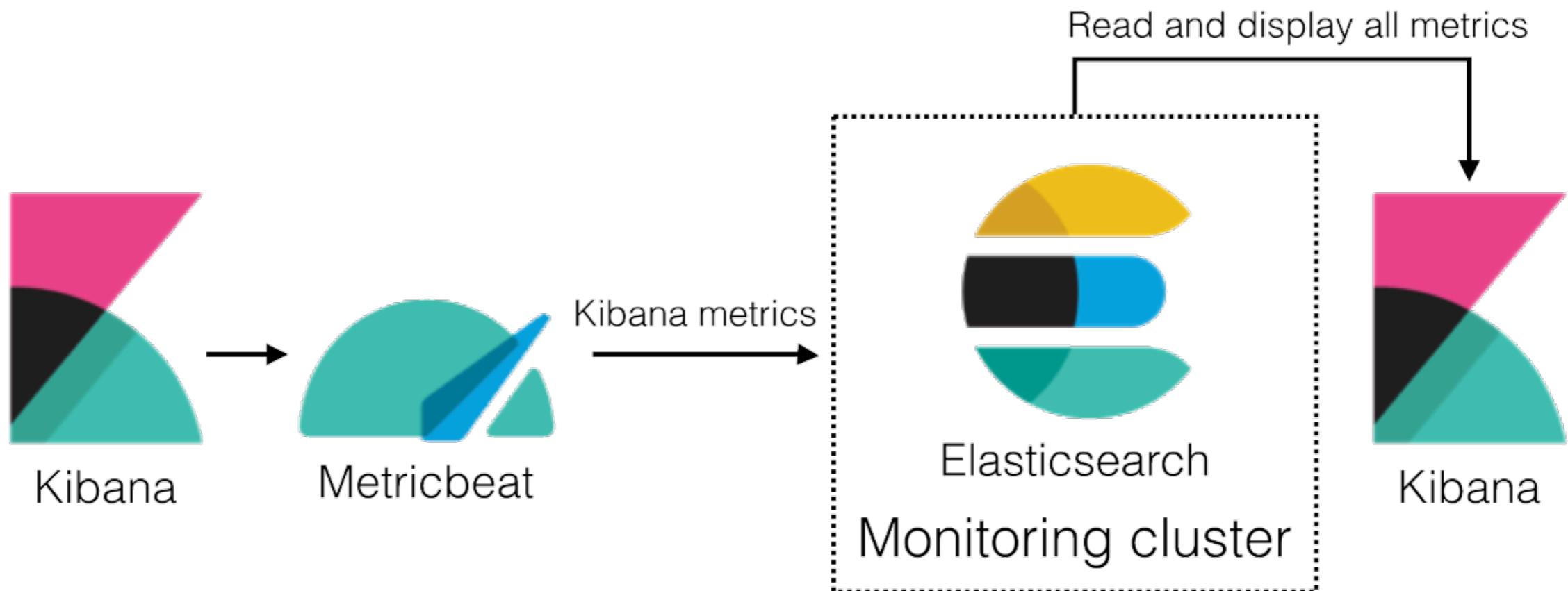
# Recommend architecture



# Elasticsearch 6.4 + (beta)



# Try to separate kibana



# Metrics

workshop/prometheus-grafana



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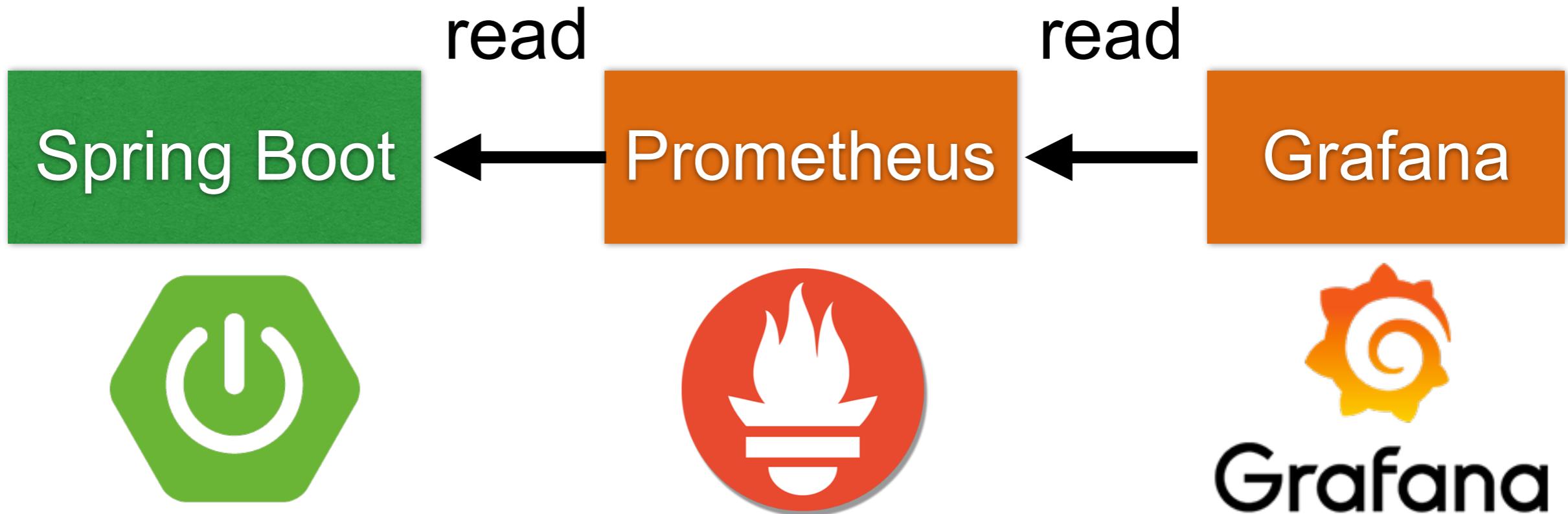
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# Sample Architecture



# Sample Architecture



# Metric in Spring Boot

**Spring Boot Actuator for Spring Boot 1.x**  
**MicroMeter for Spring Boot 2.0**



# Spring Boot Actuator (1)

Add library to pom.xml

```
<dependency>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-actuator</artifactId>
</dependency>
```



# Spring Boot Actuator (2)

Enabled endpoint in application.properties

```
info.app.name=Toy Store
```

```
info.app.description=This is my first spring boot application
```

```
info.app.version=1.0.0
```

```
management.endpoints.web.exposure.include=health,info,metrics,httptrace
```



# Spring Boot Actuator (3)

List of endpoints = /actuator/

```
← → ⌂ ⓘ localhost:8080/actuator/
```

```
{  
  - _links: {  
    - self: {  
        href: "http://localhost:8080/actuator",  
        templated: false  
      },  
    - health: {  
        href: "http://localhost:8080/actuator/health",  
        templated: false  
      },  
    - info: {  
        href: "http://localhost:8080/actuator/info",  
        templated: false  
      },  
    - metrics-requiredMetricName: {  
        href: "http://localhost:8080/actuator/metrics/{requiredMetricName}",  
        templated: true  
      },  
    - metrics: {  
        href: "http://localhost:8080/actuator/metrics",  
        templated: false  
      },  
    - httptrace: {  
        href: "http://localhost:8080/actuator/httptrace",  
        templated: false  
      }  
  }  
}
```



# Spring Boot Actuator (4)

Info endpoint = /actuator/info

```
← → ⌂ ⓘ localhost:8080/actuator/info

{
  - app: {
      name: "Toy Store",
      description: "This is my first spring boot application",
      version: "1.0.0"
    }
}
```



# Spring Boot Actuator (5)

Info endpoint = /actuator/info

```
← → ⌂ ⓘ localhost:8080/actuator/info

{
  - app: {
      name: "Toy Store",
      description: "This is my first spring boot application",
      version: "1.0.0"
    }
}
```



# Spring Boot Actuator (6)

## Info endpoint = /actuator/httptrace

```
← → ⌂ ⓘ localhost:8080/actuator/httptrace

{
  - traces: [
    - {
      timestamp: "2018-03-06T13:33:02.800Z",
      principal: null,
      session: null,
      - request: {
        method: "GET",
        uri: "http://localhost:8080/prometheus",
        - headers: {
          - host: [
            "localhost:8080"
          ],
          - user-agent: [
            "Prometheus/2.0.0"
          ],
          - accept: [
            "text/plain;version=0.0.4;q=1,*/*;q=0.1"
          ],
          - accept-encoding: [
            "gzip"
          ],
          - x-prometheus-scrape-timeout-seconds: [
            "5.000000"
          ]
        },
        remoteAddress: null
      },
    }
  ]
}
```



# Spring Boot Actuator (7)

List of metrics endpoint = /actuator/metrics

```
← → ⌂ ⓘ localhost:8080/actuator/metrics

{
  - names: [
    "jvm.buffer.memory.used",
    "jvm.memory.used",
    "jvm.gc.memory.allocated",
    "jvm.memory.committed",
    "http.server.requests",
    "jdbc.connections.min",
    "tomcat.sessions.created",
    "tomcat.sessions.expired",
    "hikaricp.connections.usage",
    "tomcat.global.request.max",
    "tomcat.global.error",
    "jvm.gc.max.data.size",
    "logback.events",
    "system.cpu.count",
    "jvm.memory.max",
    "jdbc.connections.active",
    "jvm.buffer.total.capacity",
    "jvm.buffer.count",
    "process.files.max",
    "jvm.threads.daemon",
```



# Spring Boot Actuator (8)

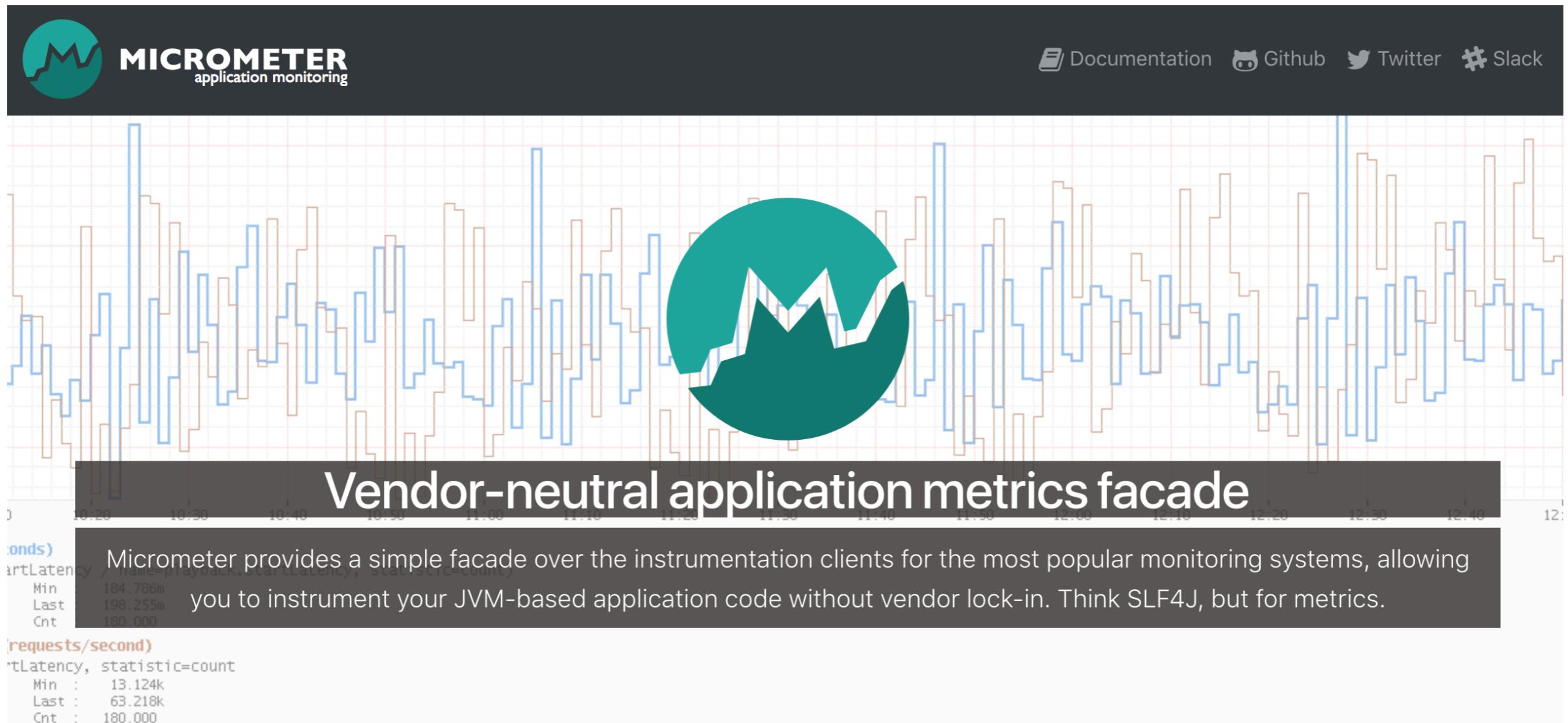
## /actuator/metrics/http.server.requests

```
← → ⌂ ⓘ localhost:8080/actuator/metrics/http.server.requests

{
  name: "http.server.requests",
  - measurements: [
    - {
      statistic: "COUNT",
      value: 269
    },
    - {
      statistic: "TOTAL_TIME",
      value: 1.1072010200000002
    },
    - {
      statistic: "MAX",
      value: 0.04373569
    }
  ],
  - availableTags: [
    - {
      tag: "exception",
      - values: [
        "None"
      ]
    },
    - {
      tag: "method",
      - values: [
        "GET"
      ]
    },
  ],
}
```



# Spring Boot 2.0 with MicroMeter



<https://micrometer.io/>



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# Service metric for Prometheus



# Enable Prometheus (1)

Add library to pom.xml

```
<dependency>
    <groupId>io.micrometer</groupId>
    <artifactId>micrometer-registry-prometheus</artifactId>
    <version>1.0.1</version>
</dependency>
```



# Enable Prometheus (2)

Enabled endpoint in application.properties

```
management.endpoints.web.exposure.include  
=....,prometheus
```



# Enable Prometheus (3)

New endpoint = actuator/prometheus

```
← → ⌂ ⓘ localhost:8080/actuator/prometheus

# HELP jvm_memory_used_bytes The amount of used memory
# TYPE jvm_memory_used_bytes gauge
jvm_memory_used_bytes{area="nonheap",id="Code Cache",} 1.49056E7
jvm_memory_used_bytes{area="nonheap",id="Metaspace",} 5.6766712E7
jvm_memory_used_bytes{area="nonheap",id="Compressed Class Space",} 7617096.0
jvm_memory_used_bytes{area="heap",id="PS Eden Space",} 1.7135864E7
jvm_memory_used_bytes{area="heap",id="PS Survivor Space",} 1.6235192E7
jvm_memory_used_bytes{area="heap",id="PS Old Gen",} 2.1936456E7
# HELP hikaricp_connections_idle Idle connections
# TYPE hikaricp_connections_idle gauge
hikaricp_connections_idle{pool="HikariPool-1",} NaN
# HELP tomcat_threads_config_max
# TYPE tomcat_threads_config_max gauge
tomcat_threads_config_max{name="http-nio-8080",} 200.0
# HELP tomcat_servlet_error_total
# TYPE tomcat_servlet_error_total counter
tomcat_servlet_error_total{name="default",} 0.0
# HELP jvm_threads_peak The peak live thread count since the Java virtual machine start
# TYPE jvm_threads_peak gauge
jvm_threads_peak 28.0
# HELP hikaricp_connections_pending Pending threads
# TYPE hikaricp_connections_pending gauge
hikaricp_connections_pending{pool="HikariPool-1",} NaN
# HELP system_cpu_count The number of processors available to the Java virtual machine
```



# Keep data in Prometheus

<https://prometheus.io/>



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# Prometheus



Prometheus

DOCS

DOWNLOAD

COMMUNITY

BLOG



## From metrics to insight

Power your metrics and alerting with a leading  
open-source monitoring solution.

GET STARTED

DOWNLOAD

Prometheus v2.0 is available now — [Read the announcement blog post!](#)

<https://prometheus.io/>



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# Prometheus

PUBLIC | AUTOMATED BUILD

[prom/prometheus](#) 

Last pushed: 17 hours ago

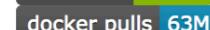
[Repo Info](#) [Tags](#) [Dockerfile](#) [Build Details](#)

## Short Description

Short description is empty for this repo.

## Full Description

Prometheus 

Visit [prometheus.io](https://prometheus.io) for the full documentation, examples and guides.

Prometheus is a systems and service monitoring system. It collects metrics

## Docker Pull Command

`docker pull prom/prometheus`

## Owner



prom

## Source Repository

 [prometheus/prometheus](#)

<https://hub.docker.com/r/prom/prometheus/>



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# Create container of Prometheus

```
$ docker container run --rm  
  -p 9090:9090  
  -v $(pwd)/prometheus.yml:/etc/prometheus/  
prometheus.yml  
  --name monitor prom/prometheus
```



# Check Data in Prometheus

http://localhost:9090/

The screenshot shows the Prometheus web interface at the URL `localhost:9090/graph`. The top navigation bar includes links for Prometheus, Alerts, Graph, Status, and Help. A checkbox labeled "Enable query history" is checked. Below it is a text input field for the expression query, containing the placeholder text "- insert metric at cursor -". There are two tabs: "Graph" (which is selected) and "Console". A table below shows one row with the element "no data" and the value "Value". At the bottom left is a blue button labeled "Add Graph".



# Check Target in Prometheus

Status -> Targets

The screenshot shows the Prometheus web interface at the URL `localhost:9090/targets`. The top navigation bar includes links for Prometheus, Alerts, Graph, Status, and Help. The main section is titled "Targets" and features a checkbox labeled "Only unhealthy jobs" which is unchecked. Below this, a summary box displays "spring-boot (1/1 up)" with a "show less" button. A table lists one target endpoint:

Endpoint	State	Labels	Last Scrape	Error
<a href="http://10.10.99.59:8080/actuator/prometheus">http://10.10.99.59:8080/actuator/prometheus</a>	UP	instance="10.10.99.59:8080"	2.355s ago	



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# Show data in Grafana

<https://grafana.com/>



# Grafana

The screenshot shows the official Grafana website. At the top, there's a navigation bar with links for Plugins (currently installed), Grafana Labs, Panels, Data sources, Apps, Docs, Community, Events, GrafanaCon, Blog, and Log In. Below the navigation, a large central text area features the tagline "The open platform for beautiful analytics and monitoring" with a "Get Grafana" button. To the left, there are cards for "Grafana TestData" and "kubernetes". To the right, there are cards for "Kentik Connect Pro" and "NS1 for Grafana". At the bottom, there's a large "Get Grafana" button and the Grafana logo.

<https://grafana.com/>



# Grafana

PUBLIC REPOSITORY

[grafana/grafana](#) 

Last pushed: 25 minutes ago

[Repo Info](#)

[Tags](#)

## Short Description

The official Grafana docker container

## Full Description

### Grafana Docker image

This project builds a Docker image with the latest master build of Grafana.

## Running your Grafana container

Start your container binding the external port 3000 .

```
docker run -d --name=grafana -p 3000:3000 grafana/grafana
```

## Docker Pull Command

```
docker pull grafana/grafana
```

## Owner



grafana

<https://hub.docker.com/r/grafana/grafana/>



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# Create container of Grafana

```
$ docker container run  
--name=grafana  
-p 3000:3000 grafana/grafana
```



# Grafana Dashboard

<https://grafana.com/dashboards/4701>

All dashboards » [JVM \(Micrometer\)](#)



**JVM (Micrometer)** by [mweirauch](#)

[DASHBOARD](#)

Dashboard for Micrometer instrumented applications (Java, Spring Boot)  
Last updated: 21 days ago

[Overview](#) [Revisions](#)



**Get this dashboard:**

[4701](#) [Copy ID to Clipboard](#)

A dashboard for [Micrometer](#) instrumented applications (Java, Spring Boot).

**Features**

- JVM memory
- Process memory (provided by [micrometer-jvm-extras](#))
- CPU-Usage, Load, Threads, File Descriptors, Log Events
- JVM Memory Pools (Heap, Non-Heap)
- Garbage Collection

**Dependencies:**

 [GRAFANA 4.6.3](#)

 [GRAPH](#)

[Download JSON](#) [How do I import this dashboard?](#)



# Take to your home

Always improve, always practice



# Machine Learning



# Machine Learning

Dataset increase in size and complexity

**Human effort is limited !!**

Infrastructure problem

Cyber attacks

Business issues

<https://www.elastic.co/guide/en/kibana/current/xpack-ml.html>



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# Machine Learning in ES

Supervised  
Unsupervised



# Machine Learning in ES

Supervised  
Classification  
Regression



# Machine Learning in ES

Unsupervised  
Outlier detection  
Anatomy detection



# Machine Learning in ES

For basic licence (30 days trial)

## Data Visualizer

The Machine Learning Data Visualizer tool helps you understand your data, by analyzing the metrics and fields in a log file or an existing Elasticsearch index.

EXPERIMENTAL



### Import data

Import data from a log file. You can upload files up to 100 MB.

[Upload file](#)



### Select an index pattern

Visualize the data in an existing Elasticsearch index.

[Select index](#)

### Start trial

To experience the full Machine Learning features that a [Platinum subscription](#) offers,  
start a 30-day trial.

[Start trial](#)



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# Continuous Learning Process

Data collection  
Feature engineering  
Training model  
Evaluate modele  
Deploy on production  
Monitoring  
Continuous Improvement



# **Let's workshop**

## **machine-learning/instruction.md**



# 1. Data collection



# Add data to ES

## Using Add sample data

### Add Data to Kibana

Use these solutions to quickly turn your data into pre-built dashboards and monitoring systems.



APM

APM automatically collects in-depth performance metrics and errors from inside your applications.

[Add APM](#)



Logging

Ingest logs from popular data sources and easily visualize in preconfigured dashboards.

[Add log data](#)



Metrics

Collect metrics from the operating system and services running on your servers.

[Add metric data](#)



SIEM

Centralize security events for interactive investigation in ready-to-go visualizations.

[Add security events](#)

#### Add sample data

Load a data set and a Kibana dashboard

#### Upload data from log file

Import a CSV, NDJSON, or log file

#### Use Elasticsearch data

Connect to your Elasticsearch index



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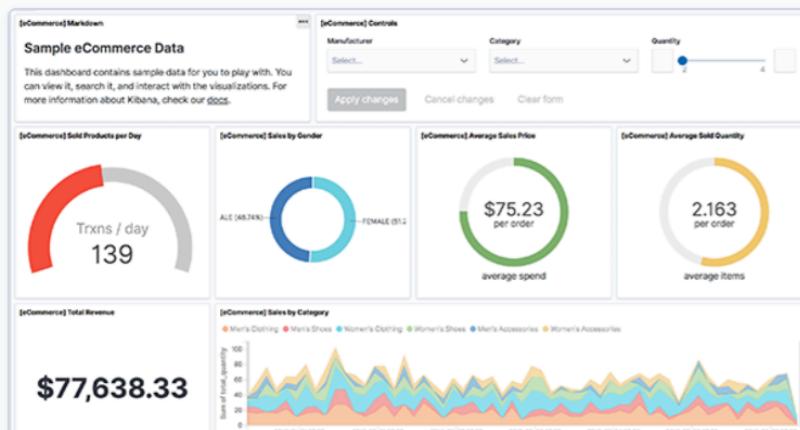
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# Add data to ES

## Add Data to Kibana

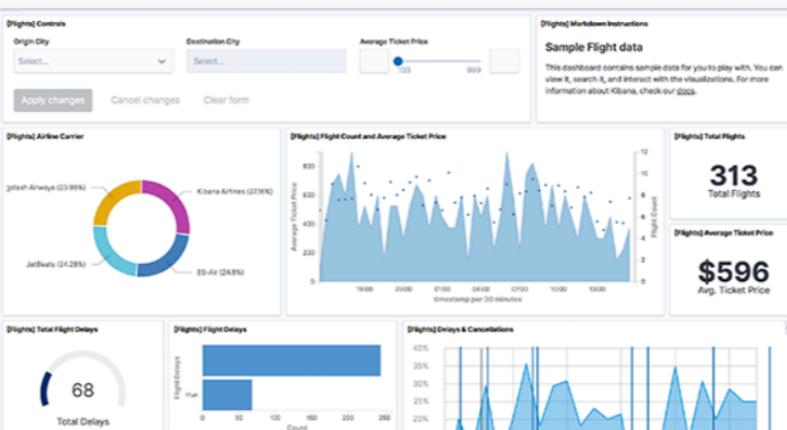
All Logging Metrics SIEM Sample data



### Sample eCommerce orders

Sample data, visualizations, and dashboards for tracking eCommerce orders.

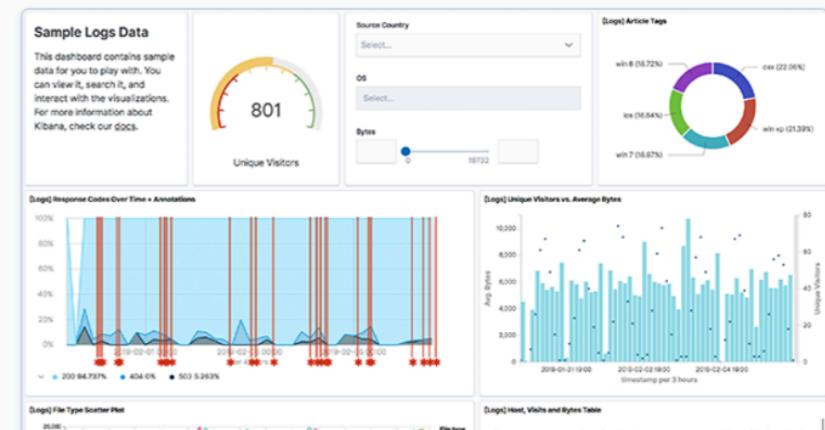
Add data



### Sample flight data

Sample data, visualizations, and dashboards for monitoring flight routes.

Add data



### Sample web logs

Sample data, visualizations, and dashboards for monitoring web logs.

Add data



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# Query sample data

GET \_cat/indices?v

health	status	index	uuid	pri	rep	docs.count
		.size	pri.store.size			
green	open	.kibana_task_manager_1	JeYrzD1dTeeBgp34aFT2Fg	1	0	2
		.4kb	51.4kb			
green	open	.apm-agent-configuration	V9bxRNDIRm-QIT88FKU1Gw	1	0	0
		283b	283b			
green	open	.kibana_1	GMiyZBhbTyaomAA6JfCQ6A	1	0	72
		.6kb	107.6kb			
green	open	kibana_sample_data_flights	I-fLlueyTk22RIHu9TIyRQ	1	0	13059
		6mb	6mb			



# Query sample data

GET kibana\_sample\_data\_flights/\_search

```
{  
  "took" : 0,  
  "timed_out" : false,  
  "_shards" : {  
    "total" : 1,  
    "successful" : 1,  
    "skipped" : 0,  
    "failed" : 0  
  },  
  "hits" : {  
    "total" : {  
      "value" : 10000,  
      "relation" : "gte"  
    },  
    "max_score" : 1.0,  
    "hits" : [  
      {  
        "_index" : "kibana_sample_data_flights",  
        "_type" : "_doc",  
        "_id" : "r8fXHG8B8iN3UstZlXDN",  
        "_score" : 1.0,  
        "geo_point.coordinates" : [40.7128, -74.0060]  
      }  
    ]  
  }  
}
```

# 10,000 != 13,059 ?



# Query sample data

GET kibana\_sample\_data\_flights/\_search?  
scroll=1m

```
{  
  "_scroll_id" : "DXF1ZXJ5QW5kRmV0Y2gBAAAAAAEucL  
  0ZfdlFsYkpBQQ==",  
  "took" : 0,  
  "timed_out" : false,  
  "_shards" : {  
    "total" : 1,  
    "successful" : 1,  
    "skipped" : 0,  
    "failed" : 0  
  },  
  "hits" : {  
    "total" : {  
      "value" : 13059,  
      "relation" : "eq"  
    },  
    "max_score" : 1.0,  
    "hits" : [  
    ]  
}
```

<https://www.elastic.co/guide/en/elasticsearch/reference/current/search-request-body.html#request-body-search-scroll>



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## 2. Training model with ES



# Create data frame

Choose source and destination

Choose features/fields

Choose model to analyse

```
"analysis": {  
    "classification": {  
        "outlier_detection": "FlightDelay",  
        "regression": "FlightDelay",  
        "training_percent": 10  
    }  
},
```

<https://www.elastic.co/guide/en/elastic-stack-overview/7.5/dfa-classification.html>



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# Data frame analytic

<b>Data frame analytics type</b>	<b>Learning type</b>	<b>Evaluation type</b>
outlier detection	unsupervised	binary soft classification
regression	supervised	regression
classification	supervised	classification

[https://www.elastic.co/guide/en/elasticsearch/\\_search/7.5/ml-dfa-overview.html](https://www.elastic.co/guide/en/elasticsearch/_search/7.5/ml-dfa-overview.html)



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# Start job to create model

POST \_ml/data\_frame/analytics/model-flight-delay-classification/\_start

```
"data_frame_analytics" : [  
    {  
        "id" : "model-flight-delay-classification",  
        "state" : "analyzing",  
        "progress" : [  
            {  
                "phase" : "reindexing",  
                "progress_percent" : 100  
            },  
            {  
                "phase" : "loading_data",  
                "progress_percent" : 100  
            },  
            {  
                "phase" : "analyzing",  
                "progress_percent" : 46  
            },  
            {  
                "phase" : "writing_results",  
                "progress_percent" : 0  
            }  
        ]  
    },  
    {  
        "id" : "model-flight-delay-classification",  
        "state" : "analyzing",  
        "progress" : [  
            {  
                "phase" : "reindexing",  
                "progress_percent" : 100  
            },  
            {  
                "phase" : "loading_data",  
                "progress_percent" : 100  
            },  
            {  
                "phase" : "analyzing",  
                "progress_percent" : 46  
            },  
            {  
                "phase" : "writing_results",  
                "progress_percent" : 0  
            }  
        ]  
    }]
```



# See result

## GET df-flight-delayed/\_search

```
"ml" : {  
    "top_classes" : [  
        {  
            "class_probability" : 0  
                .6113160839068559,  
            "class_name" : "true"  
        },  
        {  
            "class_probability" : 0  
                .3886839160931441,  
            "class_name" : "false"  
        }  
    ],  
    "FlightDelay_prediction" : "true",  
    "is_training" : true  
}
```



# 3. Evaluate your model



# See result

## POST \_ml/data\_frame/\_evaluate

```
"classification" : {
    "multiclass_confusion_matrix" : {
        "confusion_matrix" : [
            {
                "actual_class" : "false",
                "actual_class_doc_count" : 8822,
                "predicted_classes" : [
                    {
                        "predicted_class" : "false",
                        "count" : 7660
                    },
                    {
                        "predicted_class" : "true",
                        "count" : 1162
                    }
                ],
                "other_predicted_class_doc_count" : 0
            },
            ...
        ]
    }
}
```



# Continuous Improvement



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# Experiment features in ES !!



# Limitation of data frame

Cross cluster search is not supported

Delete data frame job does not delete index !!

Data frame can't be updated  
Memory limitation

Missing fields are skipped

[https://www.elastic.co/guide/en/elasticsearch/\\_search/7.5/ml-dfa-limitations.html](https://www.elastic.co/guide/en/elasticsearch/_search/7.5/ml-dfa-limitations.html)



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