

Elasticsearch - Digging deeper into full text search

Alexander Reelsen

Community Advocate

alex@elastic.co | [@spinscale](https://twitter.com/spinscale)

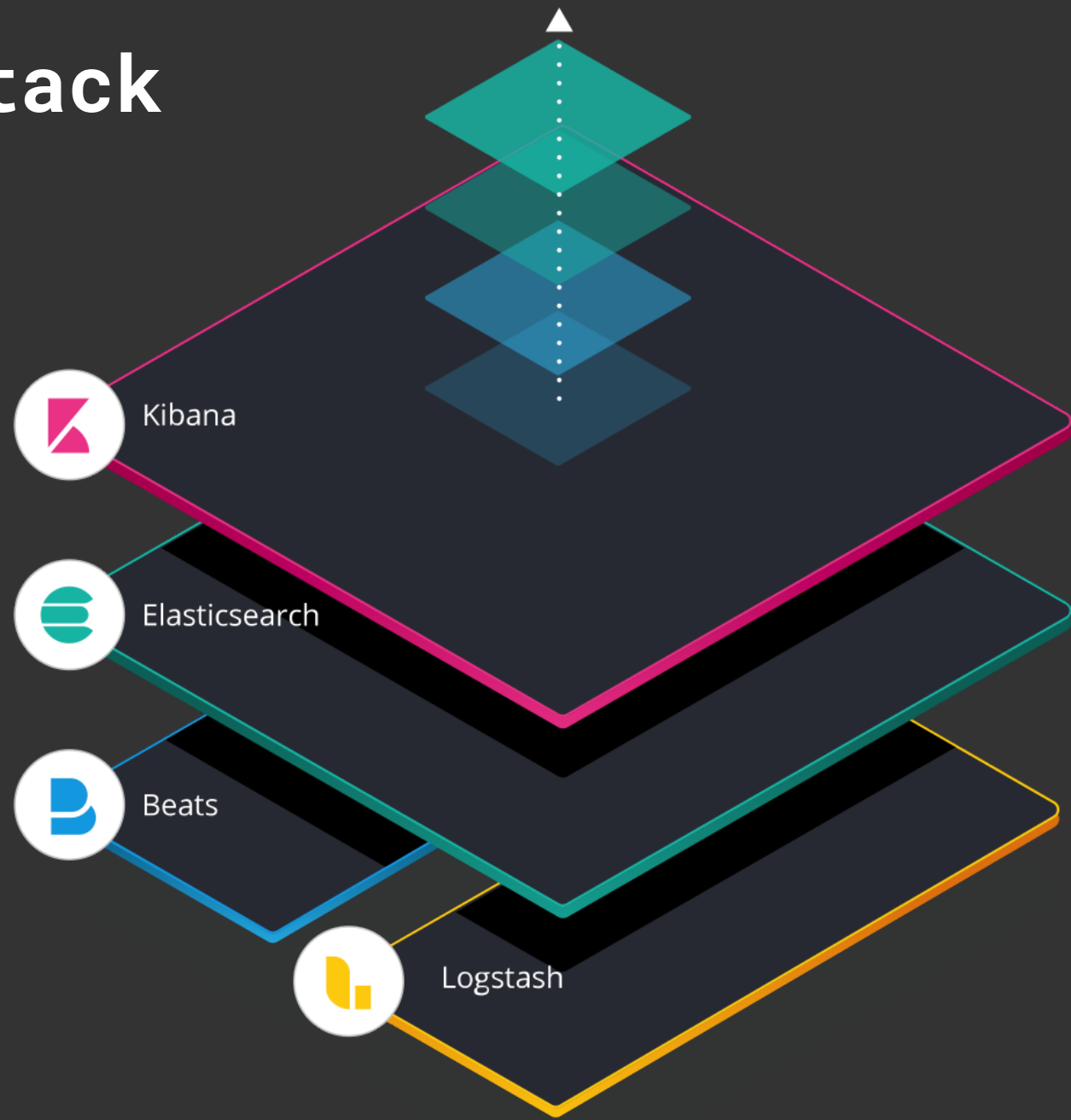


elastic

TOC

- How to run the Elastic Stack
- Datatypes: `range_`, `date_nanos`, `search-as-you-type`, `flattened`
- Search: Field collapsing/ `top_hits`, `distance_feature` query, vector search, phonetic search
- Processors: `dissect`, `enrich`, `inference`
- Index lifecycle management

Elastic Stack



Elasticsearch in 10 seconds

- Search Engine (FTS, Analytics, Geo), near real-time
- Distributed, scalable, highly available, resilient
- Interface: HTTP & JSON
- Heart of the Elastic Stack (Kibana, Logstash, Beats)

Installation & Start

```
# https://www.elastic.co/downloads/elasticsearch
wget https://artifacts.elastic.co/downloads/elasticsearch/elasticsearch-7.6.0-darwin-x86_64.tar.gz
# wget https://artifacts.elastic.co/downloads/elasticsearch/elasticsearch-7.6.0-linux-x86_64.tar.gz
# wget https://artifacts.elastic.co/downloads/elasticsearch/elasticsearch-7.6.0-windows-x86_64.zip

tar xzf elasticsearch-7.6.0-darwin-x86_64.tar.gz
cd elasticsearch-7.6.0

./bin/elasticsearch-plugin install analysis-phonetic
./bin/elasticsearch
```

```
wget https://artifacts.elastic.co/downloads/kibana/kibana-7.6.0-darwin-x86_64.tar.gz
# wget https://artifacts.elastic.co/downloads/kibana/kibana-7.6.0-linux-x86_64.tar.gz
# wget https://artifacts.elastic.co/downloads/kibana/kibana-7.6.0-windows-x86_64.zip

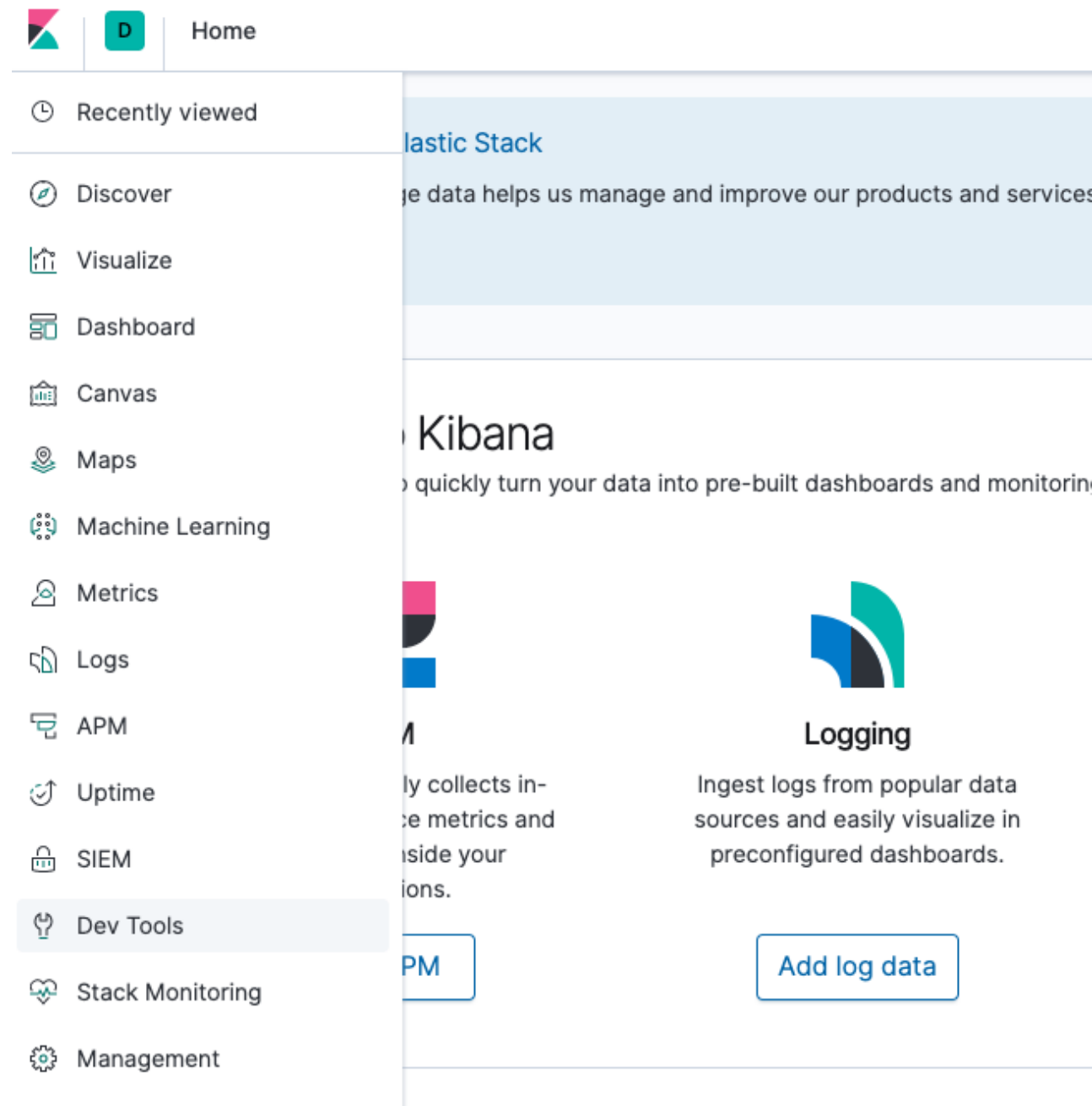
tar xzf kibana-7.6.0-darwin-x86_64.tar.gz
cd kibana-7.6.0
./bin/kibana
```

Point your browser to <http://localhost:5601/>

Click Dev-Tools

Samples in Kibana

Samples in Github



The screenshot shows the Elastic Dev Tools interface. At the top, there are navigation tabs for a logo, a 'D' tab, and a 'Home' tab. A left-hand sidebar contains a list of menu items, each with an icon: 'Recently viewed', 'Discover', 'Visualize', 'Dashboard', 'Canvas', 'Maps', 'Machine Learning', 'Metrics', 'Logs', 'APM', 'Uptime', 'SIEM', 'Dev Tools' (highlighted), 'Stack Monitoring', and 'Management'. The main content area on the right is divided into sections. The top section is titled 'lastic Stack' and contains a paragraph of text. Below this is a section for 'Kibana' with another paragraph. The bottom section features two cards: 'APM' on the left and 'Logging' on the right. The 'Logging' card includes a description: 'Ingest logs from popular data sources and easily visualize in preconfigured dashboards.' and a blue button labeled 'Add log data'.



D

Dev Tools



Console

Search Profiler

Grok Debugger



History

Settings

Help



1 GET /

2



3 GET _cat/indices



1 # GET /

2 {

3 "name" : "rhincodon",

4 "cluster_name" : "elasticsearch",

5 "cluster_uuid" : "fQGQJn_oQgu5ou0Z9WNDHg",

6 {

7 "number" : "7.5.0",

8 "build_flavor" : "default",

9 "build_type" : "tar",

10 "build_hash" : "e9ccaed468e2fac2275a3761849cbee64b39519f",

11 "build_date" : "2019-11-26T01:06:52.518245Z",

12 "build_snapshot" : false,

13 "lucene_version" : "8.3.0",

14 "minimum_wire_compatibility_version" : "6.8.0",

15 "minimum_index_compatibility_version" : "6.0.0-beta1"

16 },

17 "tagline" : "You Know, for Search"

18 }

19

20

21 # GET _cat/indices

22 green open .kibana_task_manager_1 nVdc4g8NRi0mshOWPq63zQ 1 0 2 6 42

.9kb 42.9kb

23 green open .apm-agent-configuration uyFzuj-nS76soUaGN3MYSQ 1 0 0 0

230b 230b

24 green open .kibana_1 JRM24T5aScmZ5fhYxzRCpg 1 0 4 0 16

.3kb 16.3kb

25



Datatypes

range_ datatype

- Search in ranges
- Supported types: `integer` , `float` , `long` , `double` , `date` , `ip`
- Example: Model hotel room availabilities

date_range datatype

```
# date_range datatype
PUT range_index
{
  "mappings": {
    "properties": {
      "time_frame": { "type": "date_range" }
    }
  }
}

PUT range_index/_doc/hotel_1_room_404
{
  "time_frame" : [
    { "gte" : "2015-10-31", "lte" : "2015-11-02" },
    { "gte" : "2015-11-04", "lte" : "2015-11-05" }
  ]
}
```

Search

```
GET range_index/_search
{
  "query": {
    "range": {
      "time_frame": {
        "gte": "2015-11-04",
        "lte": "2015-11-05",
        "relation": "contains"
      }
    }
  }
}
```

date_nanos datatype

```
# date_nanos datatype
PUT nanos_index
{
  "mappings": {
    "properties": {
      "time_in_nanos": {
        "type": "date_nanos",
        "format" : "yyyy-MM-dd'T'HH:mm:ss.nX"
      }
    }
  }
}

PUT nanos_index/_bulk?refresh
{ "index" : {} }
{"time_in_nanos": "2019-12-31T23:59:59.999999999Z" }
{ "index" : {} }
{"time_in_nanos": "2019-12-31T23:59:59.999Z" }
```

date_nanos datatype

```
GET nanos_index/_search
{
  "query": {
    "range": {
      "time_in_nanos": {
        "gt": "2019-12-31T23:59:59.999Z"
      }
    }
  }
}
```

search-as-you-type datatype

- One of the most requested features
- Very fast, but requires maintenance: completion suggester
- Since Elasticsearch 7.0: Lucene Block max WAND

search-as-you-type datatype

```
# search_as_you_type datatype
PUT search_index
{
  "mappings": {
    "properties": {
      "title": {
        "type": "search_as_you_type"
      }
    }
  }
}
```

search-as-you-type datatype

```
PUT search_index/_bulk?refresh
{ "index" : {} }
{ "title" : "This is it!" }
{ "index" : {} }
{ "title" : "This or that?" }
{ "index" : {} }
{ "title" : "Thin or thick?" }
{ "index" : {} }
{ "title" : "This is eval!" }
{ "index" : {} }
{ "title" : "Thick is not sick" }
```


search-as-you-type datatype

```
GET search_index/_search
{
  "query": {
    "match_phrase_prefix": { "title": "thi" }
  }
}
```

```
GET search_index/_search
{
  "query": {
    "match_phrase_prefix": { "title": "this i" }
  }
}
```

```
GET search_index/_search
{
  "query": {
    "match_phrase_prefix": { "title": "this is e" }
  }
}
```

search-as-you-type datatype

```
# no need for terms to be next to each other
GET search_index/_search
{
  "query": {
    "multi_match": {
      "query": "thick s",
      "type": "bool_prefix",
      "operator": "and",
      "fields": [
        "title",
        "title._2gram",
        "title._3gram"
      ]
    }
  }
}
```

flattened datatype

- Maps an entire object as a single field
- Prevents mapping explosion
- Allows only for some basic queries
- Searching: Think of a specialized keyword datatype

flattened datatype

```
# flattened datatype
PUT bug_reports
{
  "mappings": {
    "properties": {
      "labels": {
        "type": "flattened"
      }
    }
  }
}
```

flattened datatype

```
POST bug_reports/_doc/1?refresh
{
  "title": "Results are not sorted correctly.",
  "labels": {
    "priority": "urgent",
    "release": ["v1.2.5", "v1.3.0"],
    "timestamp": {
      "created": 1541458026,
      "closed": 1541457010
    }
  }
}
```

flattened datatype

```
POST bug_reports/_search
{
  "query": {
    "term": {"labels": "urgent"}
  }
}
```

```
POST bug_reports/_search
{
  "query": {
    "term": {"labels.release": "v1.3.0"}
  }
}
```

Searching

Bulk indexing

```
# index some book data to play around with
PUT books/_bulk
{ "index" : { "_id" : "database-internals" } }
{ "isbn13" : "978-1492040347", "author" : "Alexander Petrov", "title" : "Database Internals: A deep-dive into how distributed data systems work", "publisher" : "O'Reilly", "category" : ["databases", "information systems"], "pages" : 350, "price" : 47.28, "format" : "paperback", "rating" : 4.5 }
{ "index" : { "_id" : "designing-data-intensive-applications" } }
{ "isbn13" : "978-1449373320", "author" : "Martin Kleppmann", "title" : "Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems", "publisher" : "O'Reilly", "category" : ["databases" ], "pages" : 590, "price" : 31.06, "format" : "paperback", "rating" : 4.4 }
{ "index" : { "_id" : "kafka-the-definitive-guide" } }
{ "isbn13" : "978-1491936160", "author" : [ "Neha Narkhede", "Gwen Shapira", "Todd Palino" ], "title" : "Kafka: The Definitive Guide: Real-time data and stream processing at scale", "publisher" : "O'Reilly", "category" : ["databases" ], "pages" : 297, "price" : 37.31, "format" : "paperback", "rating" : 3.9 }
{ "index" : { "_id" : "effective-java" } }
{ "isbn13" : "978-1491936160", "author" : "Joshua Block", "title" : "Effective Java", "publisher" : "Addison-Wesley", "category" : ["programming languages", "java" ], "pages" : 412, "price" : 27.91, "format" : "paperback", "rating" : 4.2 }
{ "index" : { "_id" : "daemon" } }
{ "isbn13" : "978-1847249616", "author" : "Daniel Suarez", "title" : "Daemon", "publisher" : "Quercus", "category" : ["dystopia", "novel" ], "pages" : 448, "price" : 12.03, "format" : "paperback", "rating" : 4.0 }
{ "index" : { "_id" : "cryptonomicon" } }
{ "isbn13" : "978-1847249616", "author" : "Neal Stephenson", "title" : "Cryptonomicon", "publisher" : "Avon", "category" : ["thriller", "novel" ], "pages" : 1152, "price" : 6.99, "format" : "paperback", "rating" : 4.0 }
{ "index" : { "_id" : "garbage-collection-handbook" } }
{ "isbn13" : "978-1420082791", "author" : [ "Richard Jones", "Antony Hosking", "Eliot Moss" ], "title" : "The Garbage Collection Handbook: The Art of Automatic Memory Management", "publisher" : "Taylor & Francis", "category" : ["programming algorithms" ], "pages" : 511, "price" : 87.85, "format" : "paperback", "rating" : 5.0 }
{ "index" : { "_id" : "radical-candor" } }
{ "isbn13" : "978-1250258403", "author" : "Kim Scott", "title" : "Radical Candor: Be a Kick-Ass Boss Without Losing Your Humanity", "publisher" : "Macmillan", "category" : ["human resources", "management", "new work" ], "pages" : 404, "price" : 7.29, "format" : "paperback", "rating" : 4.0 }
{ "index" : { "_id" : "never-split-the-difference" } }
{ "isbn13" : "978-1847941497", "author" : "Chris Voss", "title" : "Never Split the Difference: Negotiating as if Your Life Depended on It", "publisher" : "Random House Business", "category" : ["negotiation", "sales" ], "pages" : 288, "price" : 10.49, "format" : "paperback", "rating" : 4.3 }
{ "index" : { "_id" : "not-giving-a-fsck" } }
{ "isbn13" : "978-0062641540", "author" : "Mark Manson", "title" : "The Subtle Art of Not Giving a F*ck: A Counterintuitive Approach to Living a Good Life", "publisher" : "Harper", "category" : ["success", "motivation" ], "pages" : 224, "price" : 12.99, "format" : "paperback", "rating" : 4.4 }
{ "index" : { "_id" : "permanent-record" } }
{ "isbn13" : "978-1250756541", "author" : "Edward Snowden", "title" : "Permanent Record", "publisher" : "Macmillan", "category" : ["politics", "biography" ], "pages" : 339, "price" : 12.99, "format" : "paperback", "rating" : 4.7 }
```


Field Collapsing

```
# field collapsing
GET books/_search
{
  "query": {
    "bool": {
      "must_not": [
        { "term": { "category.keyword": "novel" } }
      ]
    }
  },
  "collapse": {
    "field": "publisher.keyword"
  },
  "sort": [
    { "rating": { "order": "desc" } }
  ]
}
```

top_hits Aggregation

```
# top_hits aggregation
GET books/_search
{
  "size": 0,
  "aggs": {
    "by_format": {
      "terms": {
        "field": "format.keyword"
      },
      "aggs": {
        "by_rating": {
          "top_hits": {
            "size": 1,
            "sort": [ { "rating": "desc" } ]
          }
        }
      }
    }
  }
}
```

distance_feature datatype & query

```
# Add a new release_year field
PUT books/_mapping
{
  "properties" : {
    "release_year" : {
      "type" : "date",
      "format" : "strict_year"
    }
  }
}
```

distance_feature datatype & query

```
# update release_year of all books
PUT books/_bulk
{ "update" : { "_id" : "database-internals" } }
{ "doc" : { "release_year" : "2019" } }
{ "update" : { "_id" : "designing-data-intensive-applications" } }
{ "doc" : { "release_year" : "2017" } }
{ "update" : { "_id" : "kafka-the-definitive-guide" } }
{ "doc" : { "release_year" : "2017" } }
{ "update" : { "_id" : "effective-java" } }
{ "doc" : { "release_year" : "2017" } }
{ "update" : { "_id" : "daemon" } }
{ "doc" : { "release_year" : "2011" } }
{ "update" : { "_id" : "cryptonomicon" } }
{ "doc" : { "release_year" : "2002" } }
{ "update" : { "_id" : "garbage-collection-handbook" } }
{ "doc" : { "release_year" : "2011" } }
{ "update" : { "_id" : "radical-candor" } }
{ "doc" : { "release_year" : "2018" } }
{ "update" : { "_id" : "never-split-the-difference" } }
{ "doc" : { "release_year" : "2017" } }
{ "update" : { "_id" : "not-giving-a-fsck" } }
{ "doc" : { "release_year" : "2016" } }
{ "update" : { "_id" : "permanent-record" } }
{ "doc" : { "release_year" : "2019" } }
```

distance_feature datatype & query

```
# newer books are more relevant
# like function score, but waaaay faster
GET /books/_search
{
  "query": {
    "bool": {
      "filter": {
        "range": { "pages": { "gte": 500 } }
      },
      "should": {
        "distance_feature": {
          "field": "release_year",
          "pivot": "2555d",
          "origin": "now"
        }
      }
    }
  }
}
```

Vector based scoring

- Scoring based on features
- Two datatypes: `sparse` & `dense`
- vectors can be used for scoring using `vector field functions`
- query vector required

Feature modelling

- Prefers long books: Range 0-10
- Prefers good rated one: Range 0-5
- Prefers cheaper books: 0-10 (inverse, 0 more than 100 EUR, 10 less than 10 EUR)

Mapping update

```
# add vector field
PUT books/_mapping
{
  "properties": {
    "vector_recommendation": {
      "type": "dense_vector",
      "dims": 3
    }
  }
}
```


Add vectors to documents

```
# Add a vector for each document
PUT books/_bulk
{ "update" : { "_id" : "database-internals" } }
{ "doc" : { "vector_recommendation" : [3.5, 4.5, 5.2] } }
{ "update" : { "_id" : "designing-data-intensive-applications" } }
{ "doc" : { "vector_recommendation" : [5.9, 4.4, 6.8] } }
{ "update" : { "_id" : "kafka-the-definitive-guide" } }
{ "doc" : { "vector_recommendation" : [2.97, 3.9, 6.2] } }
{ "update" : { "_id" : "effective-java" } }
{ "doc" : { "vector_recommendation" : [4.12, 4.2, 7.2] } }
{ "update" : { "_id" : "daemon" } }
{ "doc" : { "vector_recommendation" : [4.48, 4.0, 8.7] } }
{ "update" : { "_id" : "cryptonomicon" } }
{ "doc" : { "vector_recommendation" : [10.0, 4.0, 9.3] } }
{ "update" : { "_id" : "garbage-collection-handbook" } }
{ "doc" : { "vector_recommendation" : [5.1, 5.0, 1.3] } }
{ "update" : { "_id" : "radical-candor" } }
{ "doc" : { "vector_recommendation" : [4.0, 4.0, 9.2] } }
{ "update" : { "_id" : "never-split-the-difference" } }
{ "doc" : { "vector_recommendation" : [4.0, 4.3, 8.9] } }
{ "update" : { "_id" : "not-giving-a-fsck" } }
{ "doc" : { "vector_recommendation" : [2.8, 4.4, 8.9] } }
{ "update" : { "_id" : "permanent-record" } }
{ "doc" : { "vector_recommendation" : [3.3, 4.7, 8.7] } }
```

Search for short, cheap books with a good rating

```
# short, good rating, cheap
GET books/_search
{
  "query": {
    "script_score": {
      "query": {
        "match_all": {}
      },
      "script": {
        "source": "cosineSimilarity(params.query_vector, doc['vector_recommendation']) + 1.0",
        "params": {
          "query_vector": [1.0, 5.0, 10.0]
        }
      }
    }
  }
}
```

Search for long, any priced books with a good rating

```
# long, good rating, any price
GET books/_search
{
  "query": {
    "script_score": {
      "query": {
        "match_all": {}
      },
      "script": {
        "source": "cosineSimilarity(params.query_vector, doc['vector_recommendation']) + 1.0",
        "params": {
          "query_vector": [10.0, 5.0, 5.0]
        }
      }
    }
  }
}
```

Phonetic search

- Find similar terms by converting terms to their phonetic representation

```

# phonetic mapping
PUT phonetic_sample
{
  "mappings": {
    "properties": {
      "name": {
        "type": "text",
        "fields": {
          "metaphone": { "type": "text", "analyzer": "metaphone_analyzer" },
          "koelner": { "type": "text", "analyzer": "koelner_analyzer" },
          "soundex": { "type": "text", "analyzer": "soundex_analyzer" }
        }
      }
    }
  },
  "settings": {
    "index": {
      "analysis": {
        "analyzer": {
          "metaphone_analyzer": { "tokenizer": "standard", "filter": [ "lowercase", "phonetic_filter" ] },
          "soundex_analyzer": { "tokenizer": "standard", "filter": [ "lowercase", "soundex_filter" ] },
          "koelner_analyzer": { "tokenizer": "standard", "filter": [ "lowercase", "koelner_filter" ] }
        },
        "filter": {
          "phonetic_filter": { "type": "phonetic", "encoder": "metaphone", "replace": false },
          "soundex_filter": { "type": "phonetic", "encoder": "soundex", "replace": false },
          "koelner_filter": { "type": "phonetic", "encoder": "koelnerphonetik", "replace": false }
        }
      }
    }
  }
}

```

Metaphone/Soundex

```
POST phonetic_sample/_analyze
{
  "field": "name.metaphone",
  "text": "Joe Blocks"
}
```

```
POST phonetic_sample/_analyze
{
  "field": "name.soundex",
  "text": "Joe Blocks"
}
```

Koelner phonetik

```
POST phonetic_sample/_analyze
{
  "field": "name.koelner",
  "text": "Aleksander"
}
```

```
POST phonetic_sample/_analyze
{
  "field": "name.koelner",
  "text": "Alexander"
}
```

Meier/Maier/Mayer/Meyer

```
PUT phonetic_sample/_bulk?refresh
```

```
{ "index" : { "_id" : 1 } }
```

```
{ "name" : "Peter Meyer" }
```

```
{ "index" : { "_id" : 2 } }
```

```
{ "name" : "Peter Meier" }
```

```
{ "index" : { "_id" : 3 } }
```

```
{ "name" : "Peter Maier" }
```

```
{ "index" : { "_id" : 4 } }
```

```
{ "name" : "Peter Mayer" }
```

```
GET phonetic_sample/_search
```

```
{ "query" : { "match" : { "name.metaphone" : "Maier" } } }
```

```
GET phonetic_sample/_search
```

```
{ "query" : { "match" : { "name.koelner" : "Maier" } } }
```


Ingest Processors

Dissect processor

- Grok processor is hard to configure for simple cases
- regular expressions are complex and CPU heavy
- `dissect` does not use regexes, syntax is simpler

Dissect processor

```
# dissect processor
POST _ingest/pipeline/_simulate
{
  "pipeline": {
    "processors": [
      {
        "dissect": {
          "field": "input",
          "pattern": "%{url}?%{param_string}"
        }
      },
      {
        "kv": {
          "field": "param_string",
          "target_field": "params",
          "field_split": "&",
          "value_split": "="
        }
      }
    ]
  },
  "docs": [
    { "_source" : { "input" : "https://example.org?foo=bar&spam=eggs" } }
  ]
}
```

Enrich processor

- Enrich documents with data from another index
- Processor uses an `enrich policy`
- Since: 7.5

Enrich processor: zip to city lookup

```
# enrich processor
PUT cities/_bulk?refresh
{ "index" : { "_id" : "munich" } }
{ "zip" : "80331", "city" : "Munich" }
{ "index" : { "_id" : "berlin" } }
{ "zip" : "10965", "city" : "Berlin" }

PUT /_enrich/policy/zip-policy
{
  "match" : {
    "indices" : "cities",
    "match_field" : "zip",
    "enrich_fields" : [ "city" ]
  }
}

POST /_enrich/policy/zip-policy/_execute

GET _cat/indices/.enrich-*
```

Enrich processor: zip to city lookup

```
POST /_ingest/pipeline/_simulate
{
  "pipeline": {
    "processors": [
      {
        "enrich": {
          "policy_name": "zip-policy",
          "field": "zip",
          "target_field": "city",
          "max_matches": "1"
        }
      }
    ]
  },
  "docs": [
    { "_id": "first", "_source": { "zip": "80331" } },
    { "_id": "second", "_source": { "zip": "50667" } }
  ]
}
```

Inference processor

- Uses a pre-trained data frame analytics model to infer
- Built-in language identification

Inference processor

```
# inference processor
POST _ingest/pipeline/_simulate
{
  "pipeline": {
    "processors": [
      {
        "inference": {
          "model_id": "lang_ident_model_1",
          "inference_config": { "classification": {} },
          "field_mappings": {}
        }
      }
    ]
  },
  "docs": [
    { "_source": { "text": "This is an english text" } },
    { "_source": { "text": "Das ist ein deutscher Text" } },
    { "_source": { "text": "我爱北京天安门" } },
    { "_source": { "text": "Ceci est un texte en français" } }
  ]
}
```


Index Lifecycle Management

Index Lifecycle Management

- control aging indices
- configuration via a lifecycle policy
- policy split into phases per action
- `hot` action: set priority, unfollow, rollover
- `warm` action: set priority, unfollow, read-only, allocate, shrink, force merge
- `cold` action: set priority, allocate, freeze
- `delete` action: delete

Sample policy

```
# index lifecycle management
PUT _ilm/policy/full_policy
{
  "policy": {
    "phases": {
      "hot": {
        "actions": { "rollover": { "max_age": "7d", "max_size": "50G" } }
      },
      "warm": {
        "min_age": "30d",
        "actions": {
          "forcemerge": { "max_num_segments": 1 },
          "shrink": { "number_of_shards": 1 },
          "allocate": { "number_of_replicas": 2 }
        }
      },
      "cold": {
        "min_age": "60d",
        "actions": { "allocate": { "require": { "type": "cold" } } }
      },
      "delete": {
        "min_age": "90d",
        "actions": { "delete": {} }
      }
    }
  }
}
```

Summary

Summary

- Understanding search is hard
- Use the reference documentation
- Ask your users about expectations, do not guess!

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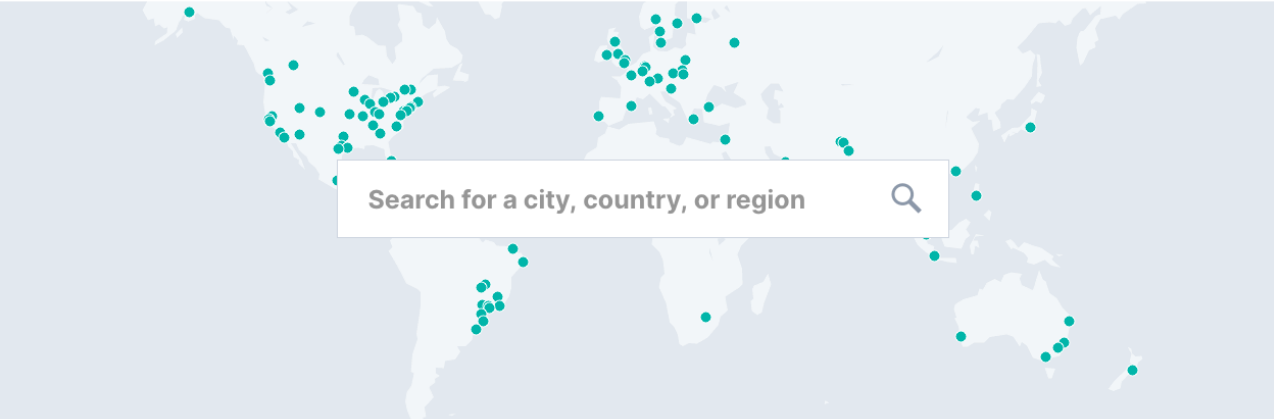
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Logs Everything related to the Logs app - setup with Filebeat, Filebeat modules, and using the Kibana Logs app.	55	Elastic APM Java agent - sanitize_fields_names on application/json* data 1 APM java 21m
Metrics Everything related to metrics - Metricbeat, integrations and modules, Kibana dashboards and the Metrics app.	1 / week	Metricbeat Failed to connect EOF 5 Metricbeat 22m
		Mix free and paid licenses 0 Elasticsearch license 23m
		Filebeat CPU utilization metrics are not normalized by default 2 Beats stack-monitoring 23m
		How do i aggregate these documets 6 Logstash 26m
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Q & A

Alexander Reelsen

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