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Programming Elasticsearch with PHP

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Summary

- Introduction to Elasticsearch
- Elasticsearch and PHP
- Connect to Elasticsearch
- Index, Bulk, Search
- Fuzzy search, Aggregation
- Schema on read (from 7.12)
- Async communication
- Future work

Elasticsearch

- **Elasticsearch** is a **distributed, free and open search and analytics engine** for all types of data
- Elasticsearch **scale by design** and manage **any size of data**
- Very fast: **near real-time search**
- Wide range of search features: filter, aggregate, analyze, order any type of information
- Elasticsearch is **document oriented (JSON)**, that means it stores entire objects or documents
- A collection of documents is called an **index**, the equivalent of a table in SQL

Elasticsearch

- You can interact with Elasticsearch using **REST APIs**, there is no client or shell tool

```
$ curl -X GET http://localhost:9200
```

```
{
  "name" : "12b27ad95a8b",
  "cluster_name" : "docker-cluster",
  "cluster_uuid" : "yz2VKxzORYCQUjXz0MerxQ",
  "version" : {
    "number" : "7.12.1",
    "build_flavor" : "default",
    "build_type" : "docker",
    "build_hash" : "3186837...b7",
    "build_date" :
"2021-04-20T20:56:39.040728659Z",
    "build_snapshot" : false,
    "lucene_version" : "8.8.0",
    "minimum_wire_compatibility_version" : "6.8.0",
    "minimum_index_compatibility_version" : "6.0.0"
  },
  "tagline" : "You Know, for Search"
}
```

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Install and run Elasticsearch

- The easiest way to install Elasticsearch is to use a **Docker** image. A list of all published Docker images and tags is available at www.docker.elastic.co

```
$ docker pull docker.elastic.co/elasticsearch/elasticsearch:7.13.1
```

- Start a single-node cluster (**localhost:9200**):

```
$ docker run -p 9200:9200 -p 9300:9300 -e "discovery.type=single-node"
docker.elastic.co/elasticsearch/elasticsearch:7.13.1
```

Elasticsearch and PHP

Elasticsearch with PHP

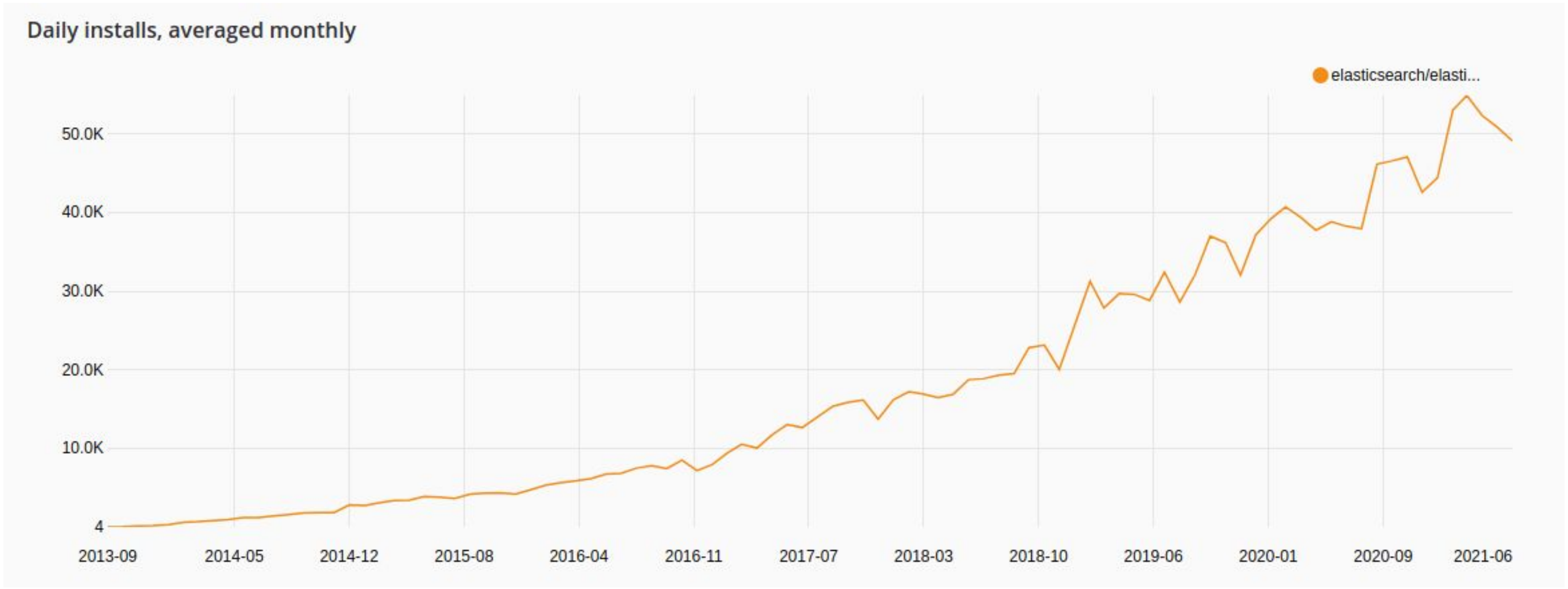
- Official **PHP client** for Elasticsearch: elastic/elasticsearch-php
- Updated and released with the **Elastic** stack version
- Use **connection pool** for cluster configuration
- Exposes the Elasticsearch APIs using functions of a **Client** class
- Each function returns the **body of HTTP response** from Elasticsearch or a **boolean value** for HEAD API (eg. Index exists API)

elastic/elasticsearch-php

- The body is deserialized from JSON using a Serializer interface (using **associative array** as default)
- In case of HTTP errors (4xx, 5xx) the PHP client throws an **ElasticsearchException** (eg. Missing404Exception)
- All the endpoint for Elasticsearch are generated using the **REST API specification** of Elasticsearch (Oss - Xpack)
- The PHP client for elasticsearch is tested using:
  - Unit tests
  - Integration tests
  - Elasticsearch YAML tests (2,369 tests)

Install statistics

- Total install using composer (packagist.org): **50M+**



Source: packagist.org

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Elasticsearch API and PHP

- All the Elasticsearch API are exposed via functions:

Elasticsearch API	**PHP function**
Index: PUT /<target>/_doc/<_id>	$client->**index**($params)
Bulk: POST /_bulk	$client->**bulk**($params)
Update: POST /<index>/_update/<_id>	$client->**update**($params)
Delete: DELETE /<index>/_doc/<_id>	$client->**delete**($params)
Search: POST /<target>/_search	$client->**search**($params)
Cluster Stats: GET /_cluster/stats	$client->**cluster**()->**stats**()

API parameters

- The API parameters are specified using an **associative array $params**

```
/**
 * $params['id']                     = (string) Document ID
 * $params['index']                  = (string) The name of the index (Required)
 * $params['wait_for_active_shards'] = (string) Sets the number of shard copies...
 * $params['op_type']                = (enum) Explicit operation type. Defaults to...
 * $params['refresh']                = (enum) If `true` then refresh the affected shards...
 * $params['routing']                = (string) Specific routing value
 * $params['timeout']                = (time) Explicit operation timeout
 * $params['version']                = (number) Explicit version number for concurrency...
 * $params['version_type']           = (enum) Specific version type (Options = internal...
 * $params['if_seq_no']              = (number) perform the index operation if the last...
 * $params['if_primary_term']        = (number) only perform the index operation if...
 * $params['pipeline']               = (string) The pipeline id to preprocess incoming...
 * $params['require_alias']          = (boolean) When true, requires destination to be an...
 * $params['body']                   = (array) The document (Required)
 *
 * @param array $params Associative array of parameters
 * @return array
 * @see https://www.elastic.co/guide/en/elasticsearch/reference/master/docs-index_.html
 */
public function index(array $params = []) { /* … */}
```

Installing Elasticsearch for PHP

- Install using composer (latest stable version):

```
composer require elasticsearch/elasticsearch
```

- Or add the following require in composer.json:

```
{
   "require": {
        "elasticsearch/elasticsearch" : "^7.13"
   }
}
```

Connect to Elasticsearch

- Connect to **localhost:9200** and call the Info API

```php
use Elasticsearch\ClientBuilder;

$client = ClientBuilder::create()
   ->setHosts(['localhost:9200'])
   ->build();

$result = $client->info();
var_dump($result);
```

```
array(5) {
  'name' => string(12) "cea89f5abf6e"
  'cluster_name' => string(14) "docker-cluster"
  'cluster_uuid' => string(22) "Np1b...qbVi5kQ"
  'version' =>
  array(9) {
    'number' => string(6) "7.10.0"
    'build_flavor' => string(3) "oss"
    'build_type' => string(6) "docker"
    'build_hash' => string(40) "51e9d..96"
    'build_date' => string(27) “2020-11-09T21:30:33.964949Z"
    'build_snapshot' => bool(false)
    'lucene_version' => string(5) "8.7.0"
    'minimum_wire_compatibility_version' => string(5) "6.8.0"
    'minimum_index_compatibility_version' => string(11) "6.0.0"
  }
  'tagline' => string(20) "You Know, for Search"
}
```

Connect to a cluster of nodes

- Connect to **a cluster** and call the Cluster health API:

```php
use Elasticsearch\ClientBuilder;

$client = ClientBuilder::create()
   ->setHosts([
       '192.168.0.1:9200',
       '192.168.0.2:9200',
       '192.168.0.3:9200'
   ])
   ->build();

$result = $client->cluster()->health();
var_dump($result);
```

```
array(15) {
  'cluster_name' => string(34) "elasticsearch-oss-7-10"
  'status' => string(5) "green"
  'timed_out' => bool(false)
  'number_of_nodes' => int(3)
  'number_of_data_nodes' =>  int(3)
  'active_primary_shards' => int(0)
  'active_shards' => int(0)
  'relocating_shards' => int(0)
  'initializing_shards' => int(0)
  'unassigned_shards' => int(0)
  'delayed_unassigned_shards' => int(0)
  'number_of_pending_tasks' => int(0)
  'number_of_in_flight_fetch' => int(0)
  'task_max_waiting_in_queue_millis' => int(0)
  'active_shards_percent_as_number' => double(100)
}
```

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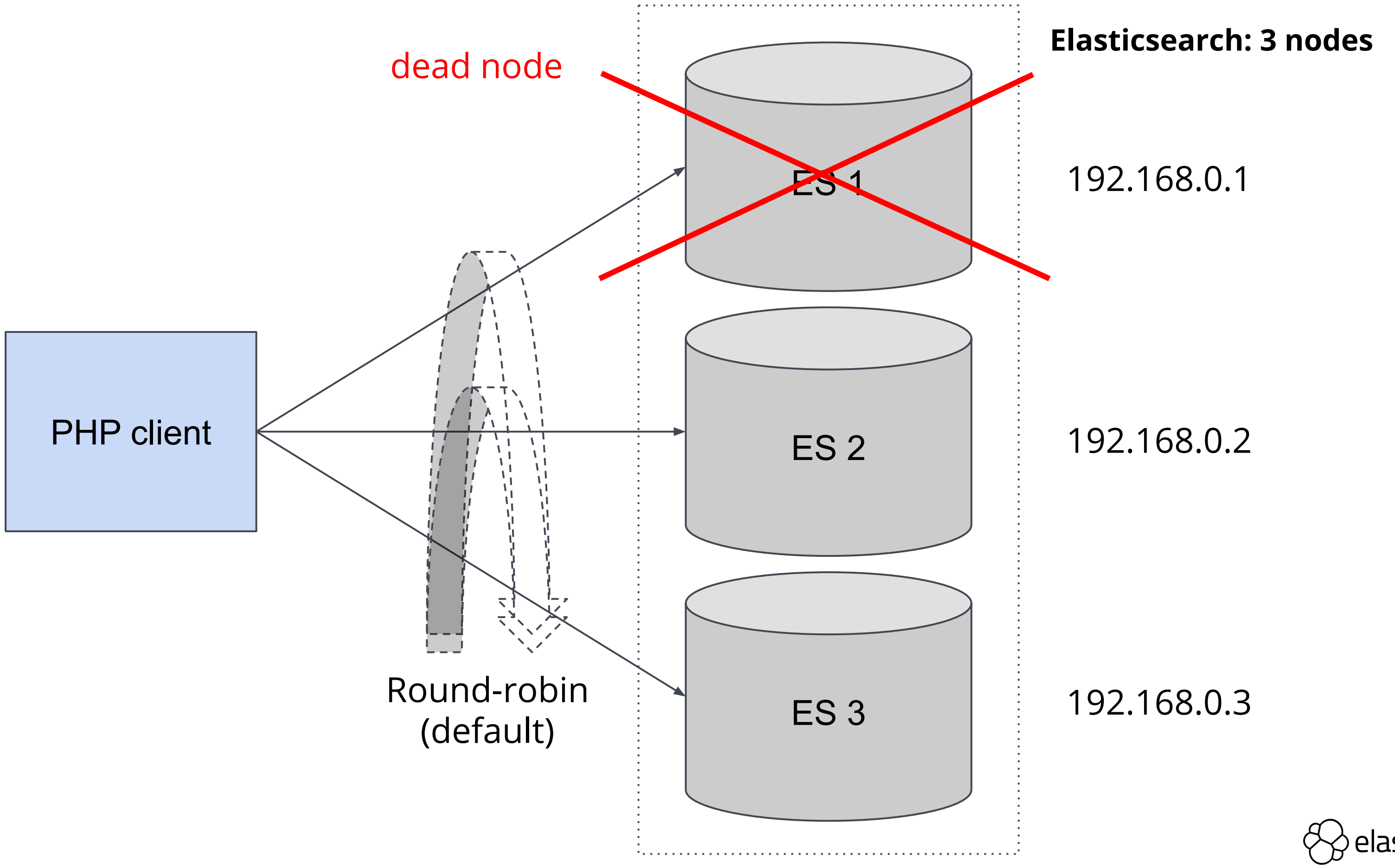
Connection Pool

- You can manage a **connection pool** using the PHP client



Selector

- We provided a SelectorInterface to implement a specific algorithm for selecting the next node
- We offer the following Selector implementations:
  - **Round-robin** (default): iterate over a set of nodes in circular order;
  - **Sticky Round-robin**: use current connection unless it is dead, otherwise round-robin
  - **Random**: select a random node from the set
- You can provide a custom selector implementation using the **ClientBuilder::setSelector()** function

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Elastic Cloud

- You can connect to Elastic Cloud using **Basic Authentication**:

```
$client = ClientBuilder::create()
    ->setElasticCloudId('<cloud-id>')
    ->setBasicAuthentication('<username>', '<password>')
    ->build();
```

- Or using **API key** (Base64(id:key) == API key):

```
$client = ClientBuilder::create()
    ->setElasticCloudId('insert/cloud-id')
    ->setApiKey('<id>', '<key>')
    ->build();
```

JSON vs PHP

- JSON is supported in PHP using the following functions:
  - **json_encode** ($value [, int $flags = 0 [, int $depth = 512]]) : string|false
  - **json_decode** (string $json [, bool|null $associative = NULL [, int $depth = 512 [, int $flags = 0]]]) : mixed
- From **PHP 7.3** we can use **JSON_THROW_ON_ERROR** as $flags to throw a **JsonException** in case of errors

Empty object

- Elasticsearch API uses **empty JSON objects** in several locations which can cause problems for PHP
- An empty JSON object **{}** can be expressed in PHP using an empty object **new stdClass()**

```
{
    "query" : {
        "match" : {
            "content" : "foo"
        }
    },
    "highlight" : {
        "fields" : {
            "content" : {}
        }
    }
}
```

```
$params['body'] = [
    'query' => [
        'match' => [
            'content' => 'foo'
        ]
    ],
    'highlight' => [
        'fields' => [
            'content' => new \stdClass()
        ]
    ]
];
```

Data management API

Single document indexing

- When you add documents to Elasticsearch, you **index** JSON documents

```php
use Elasticsearch\ClientBuilder;

$client = ClientBuilder::create()
   ->setHosts(['localhost:9200'])
   ->build();

$params = [
   'index' => 'my_index',
   'id'    => 'my_id',
   'body'  => [ 'testField' => 'abc']
];

$result = $client->index($params);
var_dump($result);
```

```
array(8) {
  '_index' => string(8) "my_index"
  '_type' => string(4) "_doc"
  '_id' => string(5) "my_id"
  '_version' => int(1)
  'result' => string(7) "created"
  '_shards' => array(3) {
    'total' => int(2)
    'successful' => int(1)
    'failed' => int(0)
  }
  '_seq_no' => int(0)
  '_primary_term' => int(1)
}
```

Bulk indexing

- You can manage multiple documents using the Bulk API
- Perform multiple index, create, delete, and update actions in a single request
- The actions are specified in the request body using NDJSON

```
for($i=0; $i < 100; $i++) {
   $params['body'][] = [
       'index' => [
           '_index' => 'my_index',
       ]
   ];
   $params['body'][] = [
       'my_field'      => 'my_value',
       'second_field' => 'some more values'
   ];
}
$result = $client->bulk($params);
```

Missing document

- If the document does not exist returns a **Missing404Exception**

```
use Elasticsearch\ClientBuilder;
use Elasticsearch\Common\Exceptions\Missing404Exception;

$client = ClientBuilder::create()
   ->setHosts(['localhost:9200'])
   ->build();

$params = [
   'index' => 'my_index',
   'id'    => 'unknown_id'
];
try {
   $result = $client->get($params);
} catch (Missing404Exception $e) {
   printf ("Document not found: %s\n", $e->getMessage());
}
```

You Know, for Search!

Searching a document

- The client gives full access to every query and parameter exposed by the REST API, following the naming scheme as much as possible

```php
$params = [
    'index' => 'my_index',
    'body'  => [
        'query' => [
            'match' => [
                'testField' => 'abc'
            ]
        ]
    ]
];

$result = $client->search($params);
var_dump($result);
```

```
array(4) {
  'took' => int(1)
  'timed_out' => bool(false)
  '_shards' => array(4) {
    'total' => int(1)
    'successful' => int(1)
    'skipped' => int(0)
    'failed' => int(0)
  }
  'hits' => array(3) {
    'total' => array(2) {
      'value' => int(1)
      'relation' => string(2) "eq"
    }
    'max_score' => double(0.2876821)
    'hits' => array(1) {
      [0] =>
      array(5) {
        ...
      }
...
```

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Using raw JSON

- Sometimes it is convenient to use **raw JSON** for testing purposes, or when migrating from a different system
- You can use raw JSON as a string in the body, and the client detects this automatically:

```
$json = '{
   "query" : {
       "match" : {
           "testField" : "abc"
       }
   }
}';
$params = [
   'index' => 'my_index',
   'body'  => $json
];
$result = $client->search($params);
var_dump($result);
```

Scrolling

- The **scrolling** functionality of Elasticsearch is used to paginate over many documents (max. 10,000 hits)*
- It is more efficient than regular search because it doesn’t need to maintain an expensive priority queue ordering the documents
- Scrolling works by maintaining a **"point in time" snapshot** of the index which is then used to page over
- You execute a search request with **scroll enabled**. This returns a **"page"** of documents, and a **scroll_id** which is used to continue paginating through the hits

* = for more than 10’000 we recommend the usage of scroll search result API

Scrolling example

```
$params = [
    'scroll' => '30s',
    'size'   => 50,
    'index'  => 'my_index',
    'body'   => [
        'query' => [ 'match_all' => new \stdClass() ]
    ]
];
$result = $client->search($params);
while (isset($result['hits']['hits']) && count($result['hits']['hits']) > 0) {
    // Work on $result['hits']['hits'] array
    // ...
    $result = $client->scroll([
        'body' => [
            'scroll_id' =>  $result['_scroll_id'],
            'scroll'    => '30s'
        ]
    ]);
}
```

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Fuzzy search

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Fuzzy search

- Returns documents that contain terms similar to the search term, as measured by a Levenshtein edit distance.
- An **edit distance** is the number of one-character changes needed to turn one term into another.
- These changes can include:
  - Changing a character (**b**ox → **f**ox)
  - Removing a character (**b**lack → lack)
  - Inserting a character (sic → sic**k**)
  - Transposing two adjacent characters (**ac**t → **ca**t)

Fuzzy search: example

```
$params = [
    'index' => 'my_index',
    'body'  => [
        'query' => [
            'fuzzy' => [
                'name' => [
                    "value" => "harry"
                ]
            ]
        ]
    ]
];
$result = $client->search($params);
```

doc1: "i will marry you because I love you"
doc2: "i will live with harry"
doc3: "i'm sorry for your loss"

Lev('harry', 'marry') = 1 in doc1
Lev('harry', 'harry') = 0 in doc2
Lev('harry', 'sorry') = 2 in doc3

Where **Lev** is Levenshtein distance.

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Aggregation

Aggregation

- An aggregation summarizes your data as metrics, statistics, or other analytics
- Aggregations help you answer questions like:
    - What's the average load time for my website?
    - Who are my most valuable customers based on transaction volume?
    - What would be considered a large file on my network?
    - How many products are in each product category?

Example

```php
$params = [
    'index' => 'stock-market',
    'body'  => [
        'aggs' => [
            'my-agg-name' => [
                'terms' => [
                    'field' => 'stock'
                ]
            ]
        ]
    ]
];
$result = $client->search($params);
var_dump($result);
```

```
array(5) {
  'took' =>
  int(40)
  'timed_out' =>
  bool(false)
  '_shards' =>
  array(4) {
    'total' =>
    int(1)
    'successful' =>
    int(1)
    'skipped' =>
    int(0)
    'failed' =>
    int(0)
  }
  'hits' =>
  array(3) { ... }
  'aggregations' =>
  array(1) {
    'my-agg-name' =>
    array(3) {
      'doc_count_error_upper_bound' =>
      int(0)
      'sum_other_doc_count' =>
      int(606450)
      'buckets' =>
      array(10) {
        ...
      }
    }
  }
}
```

Results

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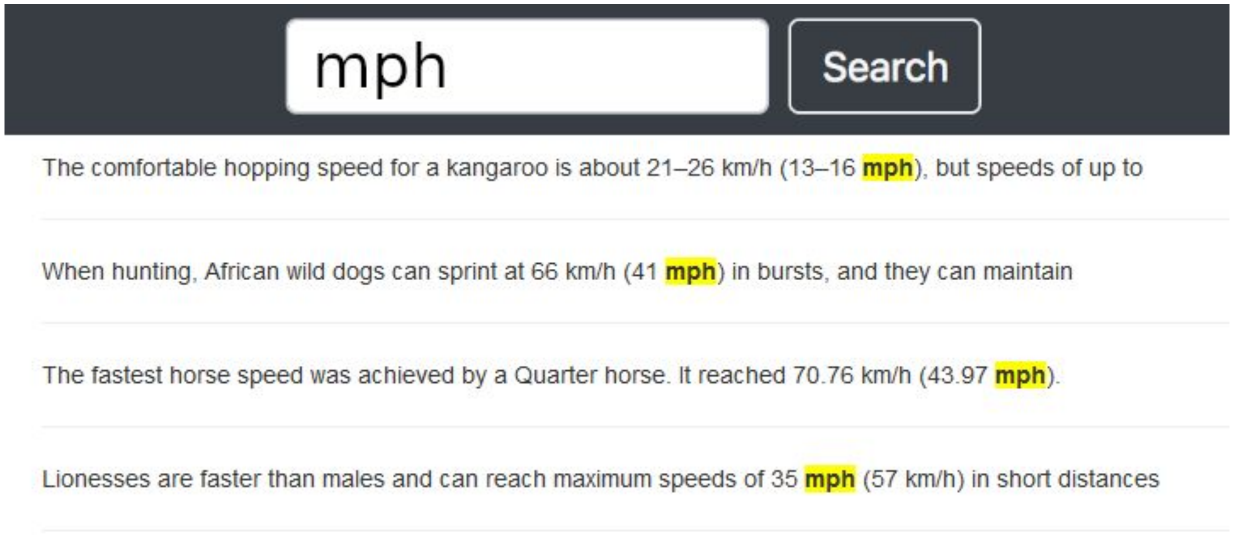
Highlighting

Highlighting

- Highlighters enable you to get **highlighted snippets** from one or more fields in your search results so you can show users where the query matches are



The comfortable hopping speed for a kangaroo is about 21–26 km/h (13–16 **mph**), but speeds of up to

When hunting, African wild dogs can sprint at 66 km/h (41 **mph**) in bursts, and they can maintain

The fastest horse speed was achieved by a Quarter horse. It reached 70.76 km/h (43.97 **mph**).

Lionesses are faster than males and can reach maximum speeds of 35 **mph** (57 km/h) in short distances

Example

```
$params = [
    'index' => 'stock-demo-v1',
    'body'  => [
        'query' => [
            'match' => [
                'name' => 'AAL'
            ]
        ],
        'highlight' => [
            'fields' => [
                'name' => new \stdClass()
            ]
        ]
    ]
];
$result = $client->search($params);
foreach ($result['hits']['hits'] as $res) {
   print_r($res['highlight']['name']);
}
```

```
Array
(
    [0] => The comfortable hooping …
<em>mph</em>) but ...
)
Array
(
    [0] => When hunting …
<em>mph</em>) in burst ...
)
...
```

Schema on read

Schema on read

- **Elasticsearch 7.12** introduced the ability to change **schema on read** using runtime fields
- Runtime fields let you define and evaluate fields at **query time**, which opens a wide range of new use cases
- For instance:
  - adapt to a changing log format or fix an index mapping;
  - don't have intimate knowledge of data, you can use runtime fields and define your schema without impacting others

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Example

- Create a field with the **average** of high and low stock price

```
$result = $client->search([
    'index' => 'stock-options',
    'body' => [
        'runtime_mappings' => [
            'average' => [
                'type' => 'double',
                'script' => [
                    'source' => "emit((double)(doc['high'].value + doc['low'].value)/2)"
                ]
            ]
        ],
        'fields' => [
            'average'
        ]
    ]
]);
```

Asynchronous calls

Future mode (async)

- The client offers a mode called **future** or **async** mode. This allows batch processing of requests (sent in parallel to the cluster), which can have a dramatic impact on performance and throughput
- PHP is fundamentally single-threaded, however, **libcurl** provides a functionality called the "**multi interface**"

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Future mode example

```php
$params = [
    'index'  => 'test',
    'id'     => 1,
    'client' => [
        'future' => 'lazy'
    ]
];

$future = $client->get($params);

$doc = $future['_source']; // This call blocks and forces the future to resolve
```

Future resolution with wait()

```php
$client = ClientBuilder::create()->build();
$futures = [];

for ($i = 0; $i < 1000; $i++) {
    $params = [
        'index'  => 'test',
        'id'     => $i,
        'client' => [
            'future' => 'lazy'
        ]
    ];

    $futures[] = $client->get($params); //queue up the request
}

//wait() forces future resolution and will execute the underlying curl batch
$futures[999]->wait();
```

More information about Future mode

Future work

Future work

- We are working on a new PHP client that will use PSR standards
- In particular:
  - PSR-3 for logging
  - PSR-7 for HTTP messages
  - PSR-17 for HTTP factories
  - PSR-18 for HTTP Client
- We will use Guzzle as default HTTP client library
- We will continue to offer async HTTP call
- For more information: elastic/elastic-transport-php

Thanks!

For more information:

Elasticsearch PHP documentation

Elasticsearch-php github repository

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