Anatomy of a Python OpenTelemetry instrumentation

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Elastic Observability

Maintainer OpenTelemetry Python

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Agenda

How OpenTelemetry Python works:

- opentelemetry-bootstrap to install instrumentation libraries

Agenda

How OpenTelemetry Python works:

- opentelemetry-bootstrap
- opentelemetry-instrument for automatic instrumentation

Agenda

How OpenTelemetry Python works:

- opentelemetry-bootstrap
- opentelemetry-instrument
- Entry points to discover components

Agenda

How OpenTelemetry Python works:

- opentelemetry-bootstrap
- opentelemetry-instrument
- Entry points
- Instrumentation libraries for third party code

Observability and OpenTelemetry

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Observability

Observability is the ability to understand the internal state of a system by examining its outputs.

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OpenTelemetry

An open source observability framework providing specifications and implementations in order to create and manage telemetry data:

- Traces: execution paths

OpenTelemetry

An observability framework providing specifications and implementations in order to create and manage telemetry data:

- Traces: execution paths
- Metrics: measurements

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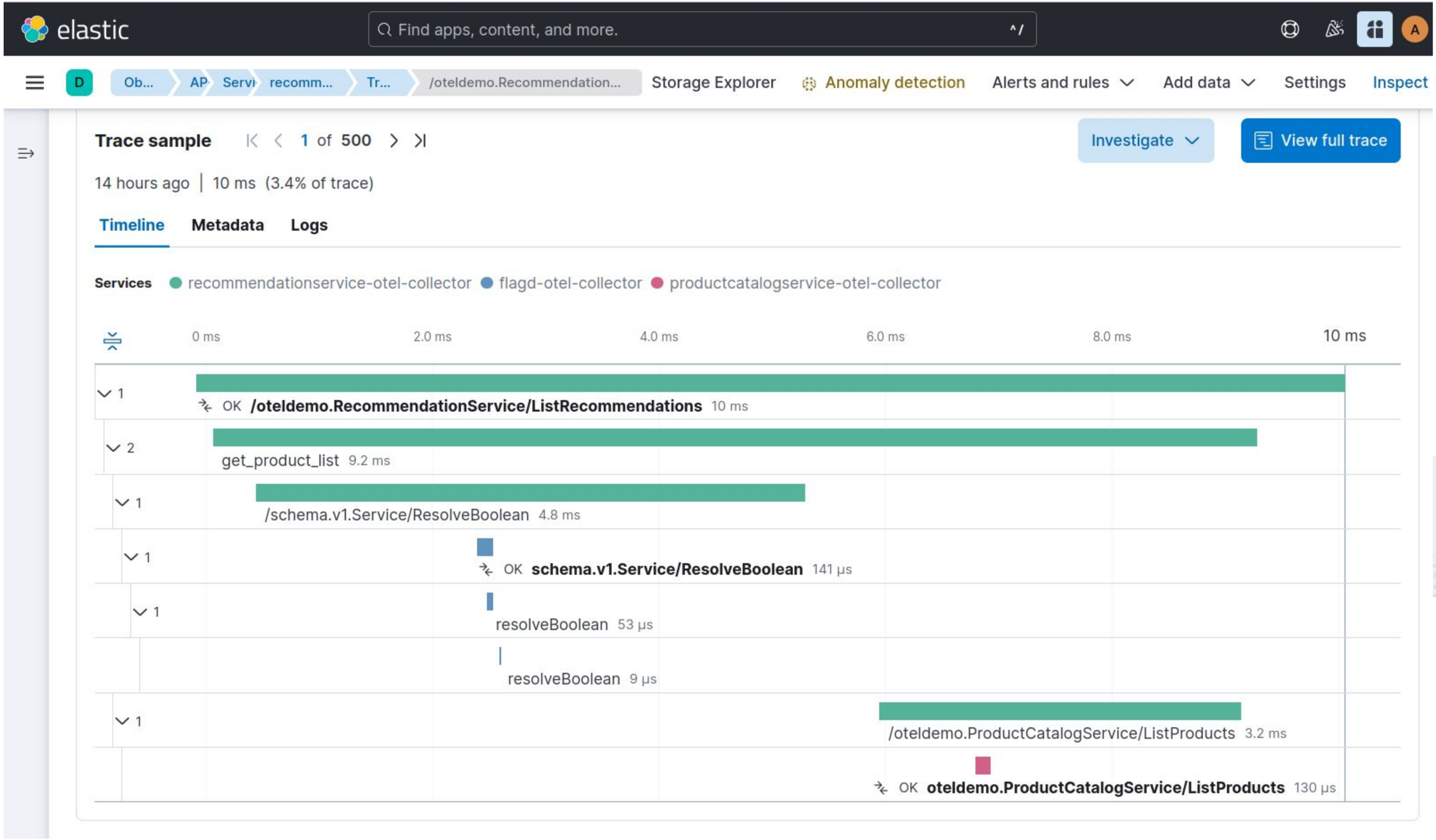
OpenTelemetry

An observability framework providing specifications and implementations in order to create and manage telemetry data:

- Traces: execution paths
- Metrics: measurements
- Logs: time stamped text


elastic
Find apps, content, and more.
^/
A
D
Ob...
AP
Servi
recomm...
Tr...
/oteldemo.Recommendation...
Storage Explorer
Anomaly detection
Alerts and rules
Add data
Settings
Inspect
Trace sample
1 of 500
Investigate
View full trace
14 hours ago | 10 ms (3.4% of trace)
Timeline
Metadata
Logs
Services
recommendationservice-otel-collector
flagd-otel-collector
productcatalogservice-otel-collector
0 ms
2.0 ms
4.0 ms
6.0 ms
8.0 ms
10 ms
1
OK /oteldemo.RecommendationService/ListRecommendations 10 ms
2
get_product_list 9.2 ms
1
/schema.v1.Service/ResolveBoolean 4.8 ms
1
OK schema.v1.Service/ResolveBoolean 141 µs
1
resolveBoolean 53 µs
resolveBoolean 9 µs
1
/oteldemo.ProductCatalogService/ListProducts 3.2 ms
OK oteldemo.ProductCatalogService/ListProducts 130 µs

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OpenTelemetry Python

- opentelemetry-python
  - API: defines the interface

OpenTelemetry Python

- opentelemetry-python
  - API: defines the interface
  - SDK: an implementation of the API

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OpenTelemetry Python

- opentelemetry-python
  - API: defines the interface
  - SDK: an implementation of the API
  - Semantic conventions: attributes definitions for traces, metrics, logs

OpenTelemetry Python

- opentelemetry-python
- opentelemetry-python-contrib
  - instrumentation*/opentelemetry-instrumentation-*: instrumentations libraries

OpenTelemetry Python

- opentelemetry-python
- opentelemetry-python-contrib
  - instrumentation*/opentelemetry-instrumentation-*
  - opentelemetry-instrumentation: auto-instrumentation

OpenTelemetry Python

- opentelemetry-python
- opentelemetry-python-contrib
  - instrumentation/opentelemetry-instrumentation-*
  - opentelemetry-instrumentation
  - opentelemetry-distro: default configurations

Demo application

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Flask application

```
# app.py
from flask import Flask


app = Flask(__name__)


@app.route("/")
def hello_world():
    return "Hello, World!"
```

Flask application setup

```
$ python3 -m venv
$ . ./venv/bin/activate
$ pip install flask
# the distro depends on api, sdk and instrumentation packages
$ pip install opentelemetry-distro
```

opentelemetry-bootstrap

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opentelemetry-bootstrap

CLI tool from opentelemetry-instrumentation package to list or install any instrumentation library available for your project dependencies.

opentelemetry-bootstrap

```
# opentelemetry.instrumentation.boostrap_gen
libraries = [
  {
    "library": "flask >= 1.0",
    "instrumentation": "opentelemetry-instrumentation-flask==0.50b0",
    }, ...
]
default_instrumentations = [
    "opentelemetry-instrumentation-asyncio==0.50b0",
    ...
]
```


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opentelemetry-bootstrap

$ opentelemetry-bootstrap –action=install

this is the output of listing, install too verbose

opentelemetry-instrumentation-asyncio==0.50b0

...

opentelemetry-instrumentation-wsgi==0.50b0

opentelemetry-instrumentation-flask==0.50b0

...

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opentelemetry-instrument

Auto instrumentation

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opentelemetry-instrument

The tool used to implement auto instrumentation: the ability to setup OpenTelemetry tracing, logging and metering for your application without touching its code

sitecustomize?

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sitecustomize

By default the site module of your python installation tries to load from your python path a module named sitecustomize.

Reference
https://docs.python.org/3/library/site.html#module-sitecustomize

sitecustomize.py

```
$ python3 -c 'print("world")'
world
```


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sitecustomize.py

```
$ python3 -c 'print("world")'
world
$ PYTHONPATH=. python3 -c 'print("world")'
hello world
```


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sitecustomize.py

```
$ PYTHONPATH=. python3 -c 'print("world")'
hello world
$ cat sitecustomize.py
print("hello", end=” “)
```


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opentelemetry-instrument

- Loads the distro
- Loads the configuration
- Loads the instrumentations

opentelemetry-instrument

```
$ opentelemetry-instrument --traces_exporter=console --metrics_exporter=none --logs_exporter=none flask run
{
    "name": "GET /",
    "context": {
        "trace_id": "0x37b87d1a4361879180cd87eb082cf57b",
        "span_id": "0xf461041d79e0b85a",
        "trace_state": "[]"
    },
    "kind": "SpanKind.SERVER",
    "parent_id": null,
    "start_time": "2024-08-24T18:06:58.270986Z",
    "end_time": "2024-08-24T18:06:58.272434Z",
    ...
```


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opentelemetry-instrument

```
$ opentelemetry-instrument --traces_exporter=console --metrics_exporter=none flask run
    ...
    "attributes": {
        "http.method": "GET",
        "http.server_name": "127.0.0.1",
        "http.scheme": "http",
        "net.host.name": "127.0.0.1:5000",
        ...
    }
}
```


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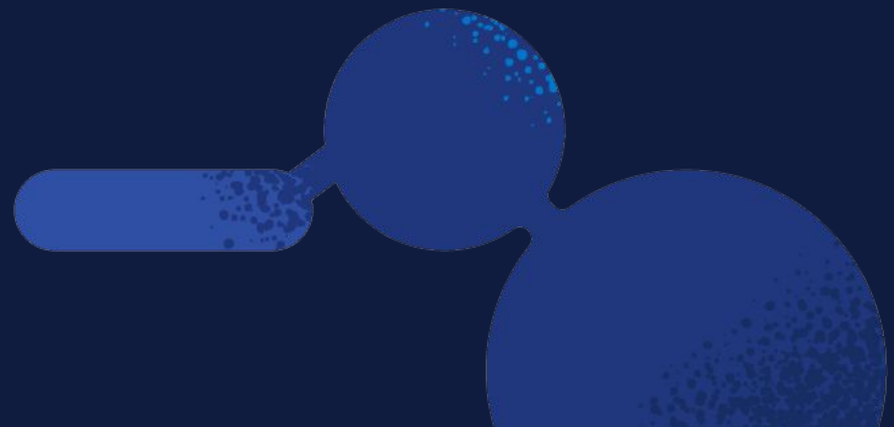
Entry points



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Entry points

Entry points are a mechanism that packages use to provide discoverability over some of their code.

Entry points

opentelemetry-distro/pyproject.toml

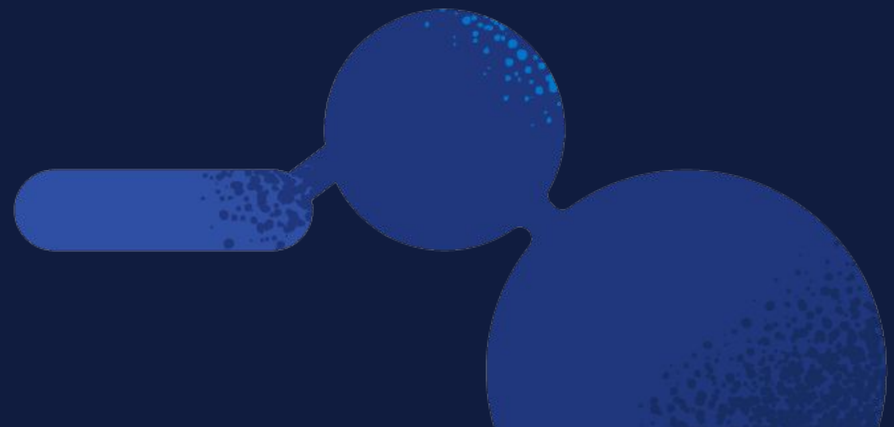
```
[project.entry-points.opentelemetry_configurator] # group
# name = code reference
configurator = "opentelemetry.distro:OpenTelemetryConfigurator"
```

Entry points

```
from opentelemetry.util._importlib_metadata import entry_points

for entry_point in entry_points(group="opentelemetry_configurator"):
    # call configure method of OpenTelemetryConfigurator instance
    entry_point.load()().configure()
    print(f"Configured: {entry_point.name}")
```

Patching third party code



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Monkey patching

Monkey patching is a technique used to dynamically change the behavior of some code at runtime.

wrapt

Just use wrapt!

Documentation https://wrapt.readthedocs.io/en/master/

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Patching example

From https://github.com/xrmx/opentelemetry-instrumentation-asgiref/

```
from wrapt import wrap_function_wrapper


class AsgirefInstrumentor(BaseInstrumentor):
    def _instrument(self, **kwargs):
        wrap_function_wrapper(asgiref.sync, "async_to_sync", self.__wrapper)
    def _uninstrument(self, **kwargs):
        unwrap(asgiref.sync, "async_to_sync")
```

Patching example

From https://github.com/xrmx/opentelemetry-instrumentation-asgiref/

```
class AsgirefInstrumentor(BaseInstrumentor):
    ...
    def __wrapper(self, wrapped, instance, args, kwargs):
        with self.tracer.start_as_current_span( “async_to_sync", kind=SpanKind.INTERNAL) as span:
            attributes = {
                "exception.type": “async_to_sync”,
                "exception.stacktrace": "\n".join(traceback.format_stack(limit=10))
            }
            span.add_event(name="exception", attributes=attributes)
        return wrapped(*args, **kwargs)
```

Patching example #2

From [opentelemetry-instrumentation-botocore]:

```
from wrapt import ObjectProxy

class ConverseStreamWrapper(ObjectProxy):
    # USAGE: result["stream"] = ConverseStreamWrapper(result["stream"])
    def __init__(self, stream: botocore.eventstream.EventStream):
        super().__init__(stream)


    def __iter__(self):
        for event in self.__wrapped__: # see first param of __init__
            self._process_event(event) # this is calling our own code
            yield event
```


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Conclusions

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Conclusions

- opentelemetry-bootstrap for installing instrumentations
- site and sitecustomize to run our code first
- Entry points for components discovery
- wrapt for third party code patching

Contacts

- https://opentelemetry.io
- opentelemetry-python and opentelemetry-python-contrib
- #otel-python on CNCF slack
- @rmistaken@hachyderm.io

Thank you!