Desenvolvimento de Aplicações com Arquitetura Baseada em Microservices

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[IF1007] - Tópicos Avançados em SI 4
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AssertLab
Advanced Software and Systems Engineering Research Technologies
Centro de Informática UFPE
40 anos

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Resources

- There is no textbook required. However, the following are some books that may be recommended:
  - Building Microservices: Designing Fine-Grained Systems
  - Spring Microservices
  - Spring Boot: Acelere o desenvolvimento de microsserviços
  - Microservices for Java Developers A Hands-on Introduction to Frameworks and Containers
  - Migrating to Cloud-Native Application Architectures
  - Continuous Integration
  - Getting started guides from spring.io

Warm up

- Last lecture we discuss the importante of autoscaling when deploying large-scale microservices
- We also explored the concept of autoscaling and the different models of and approaches to autoscaling
  - the time-based, resource-based, queue length-based, and predictive ones
- We then reviewed the role of a life cycle manager in the context of microservices and reviewed its capabilities

Logging and Monitoring Microservices

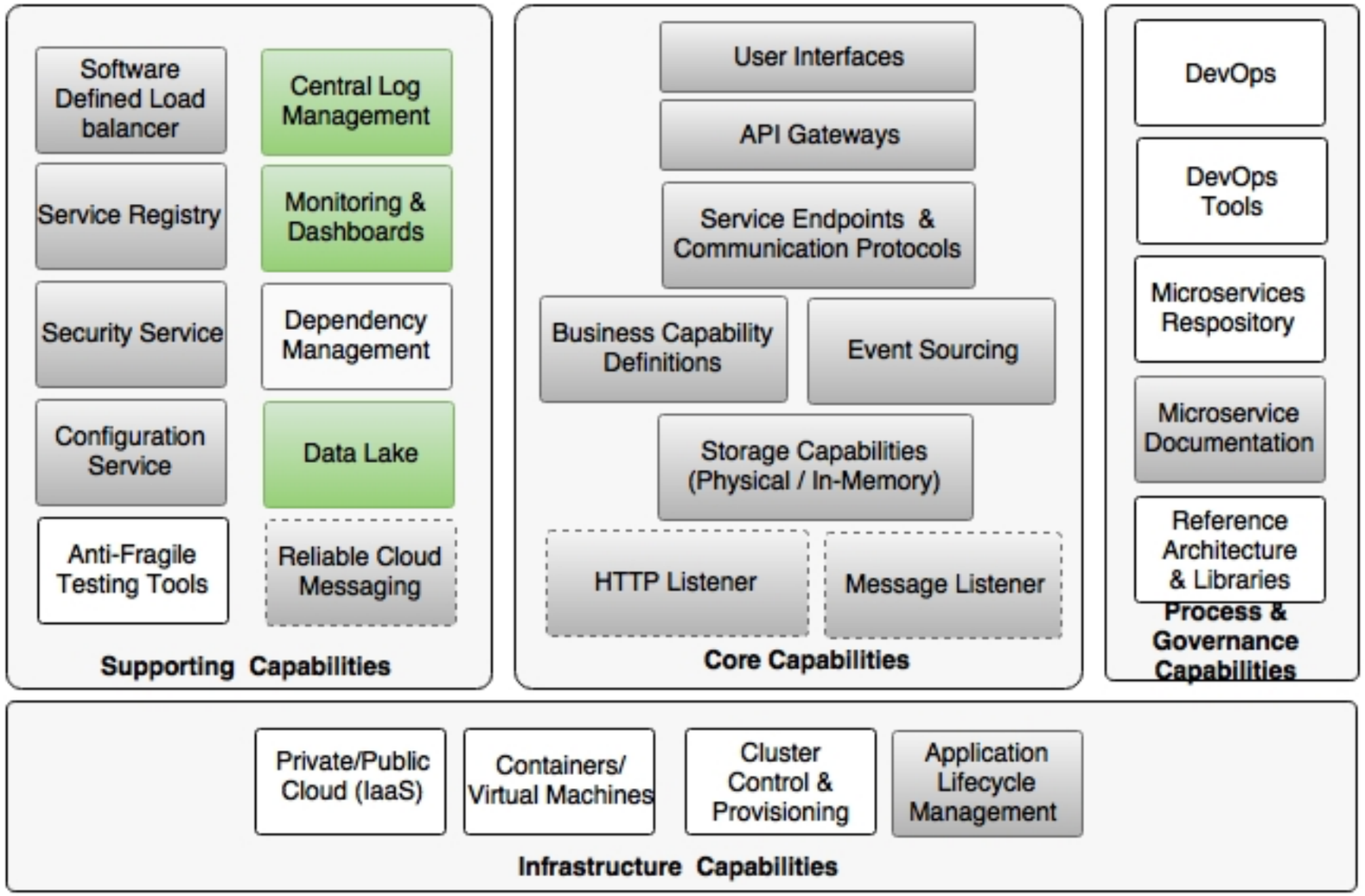
Context

- One of the biggest challenges due to the very distributed nature of Internet-scale microservices deployment is the logging and monitoring of individual microservices
- It is difficult to trace end-to-end transactions by correlating logs emitted by different microservices

Topics

- The different options, tools, and technologies for log management
- The use of Spring Cloud Sleuth in tracing microservices
- The different tools for end-to-end monitoring of microservices
- The use of Spring Cloud Hystrix and Turbine for circuit monitoring
- The use of data lakes in enabling business data analysis

Reviewing the microservice capability model



Understanding log management challenges

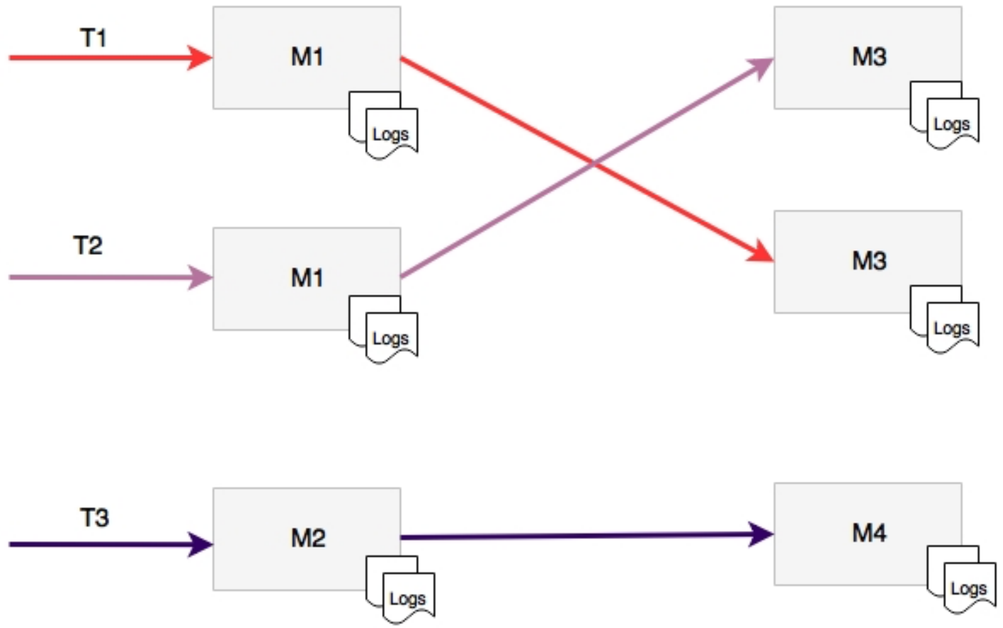
- Logs are nothing but streams of events coming from a running process
- Applications send log entries to the console or to the filesystem
  - File recycling techniques are generally employed to avoid logs filling up all the disk space
  - Writing logs into the disk also requires high disk capacity
- Logging frameworks provide options to control logging at runtime to restrict what is to be printed and what not

Understanding log management challenges

- When moved from traditional to cloud deployment, applications are no longer locked to a particular, predefined machine
- The machines used for deployment can change from time to time
- Logs written to the disk are lost once the container is stopped and restarted

Understanding log management challenges

- One of the principles of the Twelve-Factor app is to avoid routing or storing log files by the application itself
- In the context of microservices, they will run on isolated physical or virtual machines, resulting in fragmented log files
- In this case, it is almost impossible to trace end-to-end transactions that span multiple microservices

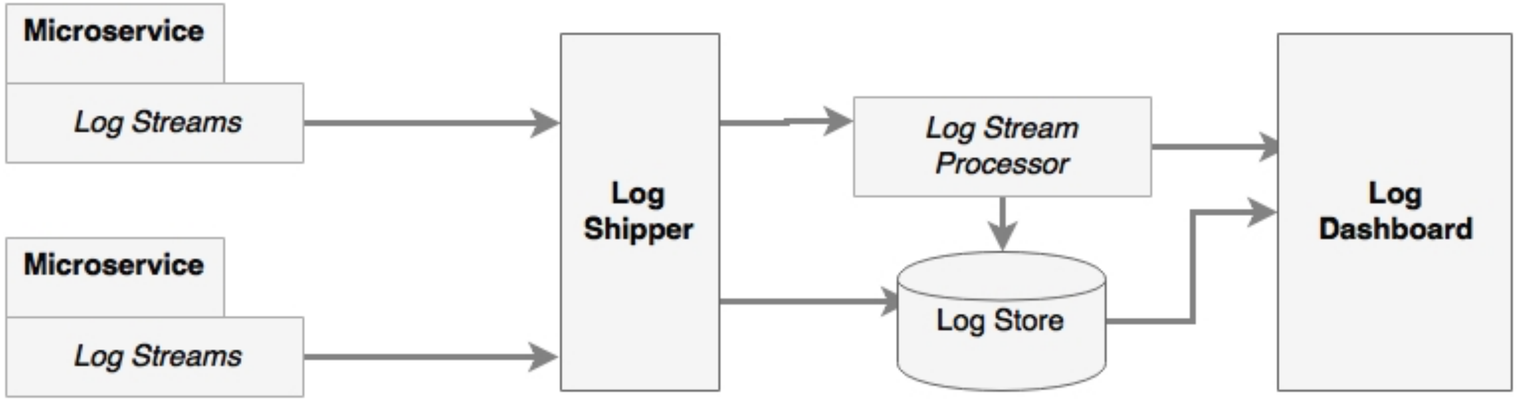


A centralized logging solution

- The new logging solution, in addition to addressing the preceding challenges, is also expected to support the following capabilities:
  - The ability to collect all log messages and run analytics on top of the log messages
  - The ability to correlate and track transactions end to end
  - The ability to keep log information for longer time periods for trending and forecasting
  - The ability to eliminate dependency on the local disk system
  - The ability to aggregate log information coming from multiple sources such as network devices, operating system, microservices, and so on

A centralized logging solution

- The solution to these problems is to centrally store and analyze all log messages, irrespective of the source of log
- The fundamental principle employed in the new logging solution is to detach log storage and processing from service execution environments
- In the centralized logging solution, log messages will be shipped from the execution environment to a central big data store
  - Log analysis and processing will be handled using big data solutions



The selection of logging solutions

- Cloud services
  - Loggly (AWS CloudTrail can be integrated with Loggly for log analysis)
  - Papertrial, Logsene, Sumo Logic, Google Cloud Logging, and Logentries are examples of other cloud-based logging solutions
  - Latency is one of the key factors to be considered when selecting cloud logging as a service

The selection of logging solutions

- Off-the-shelf solutions
  - Graylog uses Elasticsearch for log storage and MongoDB as a metadata store
  - Splunk uses the log file shipping approach, compared to log streaming used by other solutions to collect logs

Best-of-breed integration

- Log shippers
  - Logstash acts as a broker that provides a mechanism to accept streaming data from different sources and sync them to different destinations
  - Fluentd is another tool that is very similar to Logstash, as is Logspout, but the latter is more appropriate in a Docker container-based environment

Best-of-breed integration

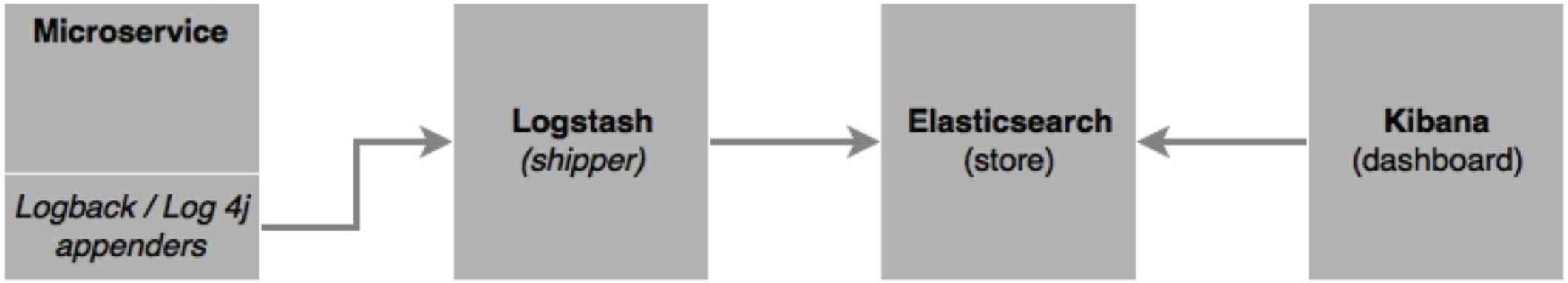
- Log stream processors
  - A typical architecture used for stream processing is a combination of Flume and Kafka together with either Storm or Spark Streaming
- Log storage
  - Real-time log messages are typically stored in Elasticsearch, which allows clients to query based on text-based indexes
  - Apart from Elasticsearch, HDFS is also commonly used to store archived log messages
  - MongoDB or Cassandra is used to store summary data, such as monthly aggregated transaction counts
  - Offline log processing can be done using Hadoop's MapReduce programs

Best-of-breed integration

- Dashboards
  - The most commonly used dashboard for log analysis is Kibana on top of an Elasticsearch data store
  - Graphite and Grafana are also used to display log analysis reports

A custom logging implementation

- The most commonly used architecture for custom log management is a combination of Logstash, Elasticsearch, and Kibana, also known as the ELK stack



Monitoring microservices

- Microservices are truly distributed systems with a fluid deployment topology
- To add more complication, these services dynamically change their topologies
- It is important for operations teams to understand the runtime deployment topology and also the behavior of the systems
  - This demands more than a centralized logging can offer

Monitoring challenges

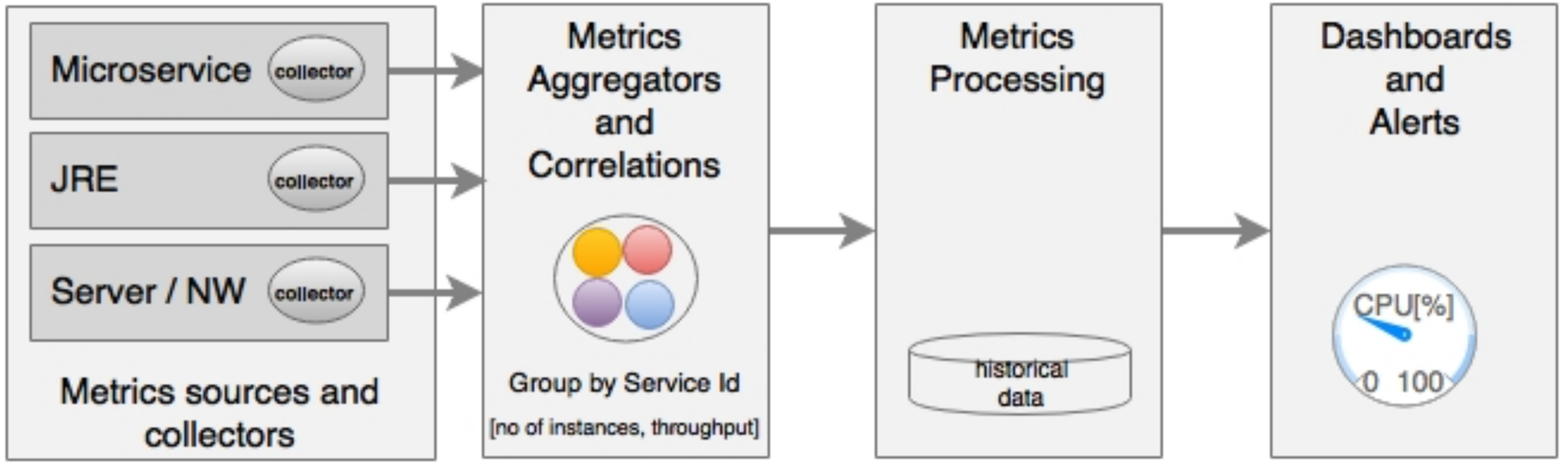
- The statistics and metrics are fragmented across many services, instances, and machines
- Heterogeneous technologies may be used to implement microservices, which makes things even more complex.
  - A single monitoring tool may not give all the required monitoring options
- Microservices deployment topologies are dynamic, making it impossible to preconfigure servers, instances, and monitoring parameters

Monitoring challenges

- Many of the traditional monitoring tools are good to monitor monolithic applications
- Many of the traditional monitoring systems are agent-based preinstall agents on the target machines or application instances
- Challenges:
  - If the agents require deep integration with the services or operating systems, then this will be hard to manage in a dynamic environment
  - If these tools impose overheads when monitoring or instrumenting the application, it may lead to performance issues

Monitoring challenges

- Many traditional tools need baseline metrics
- New-generation monitoring applications learn the application's behavior by themselves and set automatic threshold values
  - Automated baselines are sometimes more accurate than human forecasts



Monitoring tools

- AppDynamics, Dynatrace, and New Relic are top commercial vendors in the Application Performance Management (APM) space
- Cloud vendors come with their own monitoring tools, but in many cases, these monitoring tools alone may not be sufficient for large-scale microservice monitoring
- Some of the data collecting libraries, such as Zabbix, statd, collectd, jmxtrans, and so on operate at a lower level in collecting runtime statistics, metrics, gauges, and counters
  - Typically, this information is fed into data collectors and processors such as Riemann, Datadog, and Librato, or dashboards such as Graphite

Monitoring tools

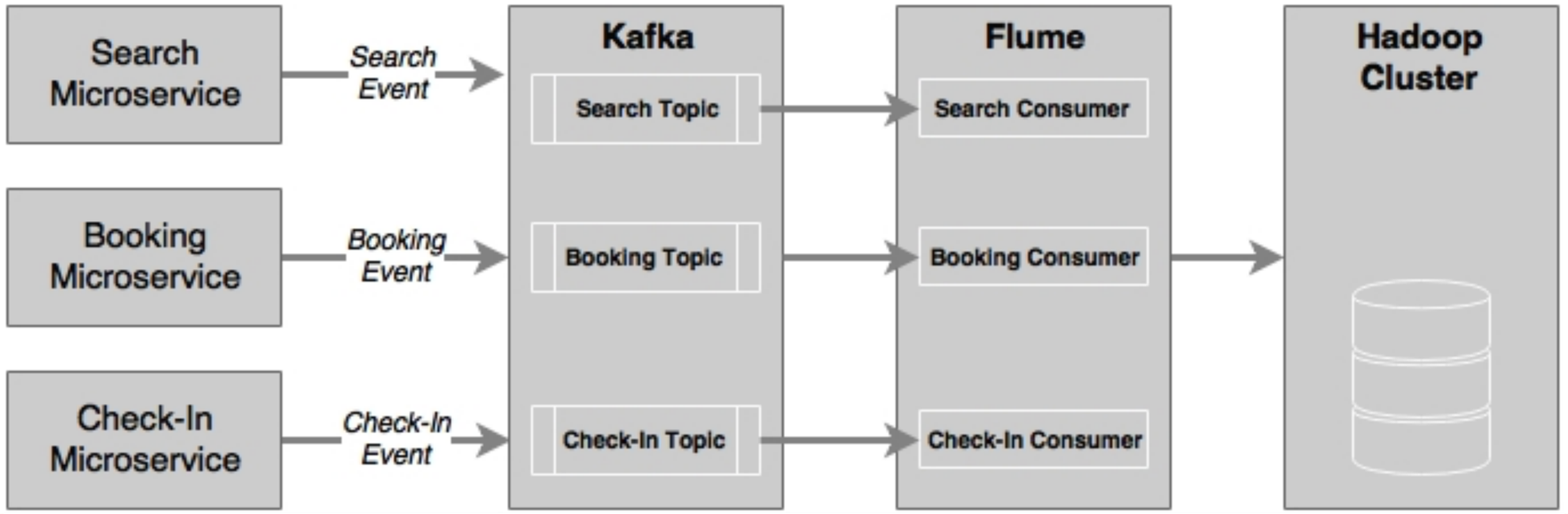
- Spring Boot Actuator is one of the good vehicles to collect microservices metrics, gauges, and counters
  - Netflix Servo, a metric collector similar to Actuator, and the QBit and Dropwizard metrics also fall in the same category of metric collectors
  - All these metrics collectors need an aggregator and dashboard to facilitate full-sized monitoring
- Monitoring through logging is popular but a less effective approach in microservices monitoring
- Sensu is a popular choice for microservice monitoring from the open source community
- Circonus is classified more as a DevOps monitoring tool but can also do microservices monitoring
- Prometheus provides a time series database and visualization GUI useful in building custom monitoring tools

Monitoring microservice dependencies

- Mentoring tools such as AppDynamics, Dynatrace, and New Relic can draw dependencies among microservices
- End-to-end transaction monitoring can also trace transaction dependencies

Data analysis using data lakes

- Fragmented data poses challenges in data analytics
- A data lake or data hub is an ideal solution to handling such scenarios
  - An event-sourced architecture pattern is generally used to share the state and state changes as events with an external data store



Microservice management

- Microservice management is another important challenge we need to tackle when dealing with large-scale microservice deployments
- In the next lecture we will explore how containers can help in simplifying microservice management

Homework 8.1

- How to implement a custom centralized logging using Elasticsearch, Logstash, and Kibana (ELK)?
- In order to understand distributed tracing, try to upgraded BrownField microservices using Spring Cloud Sleuth.

Homework 8.2

- How to enhance The BrownField microservices with Spring Cloud Hystrix and Turbine to monitor latencies and failures in inter-service communications?
  - Use the circuit breaker pattern to fall back to another service in case of failures