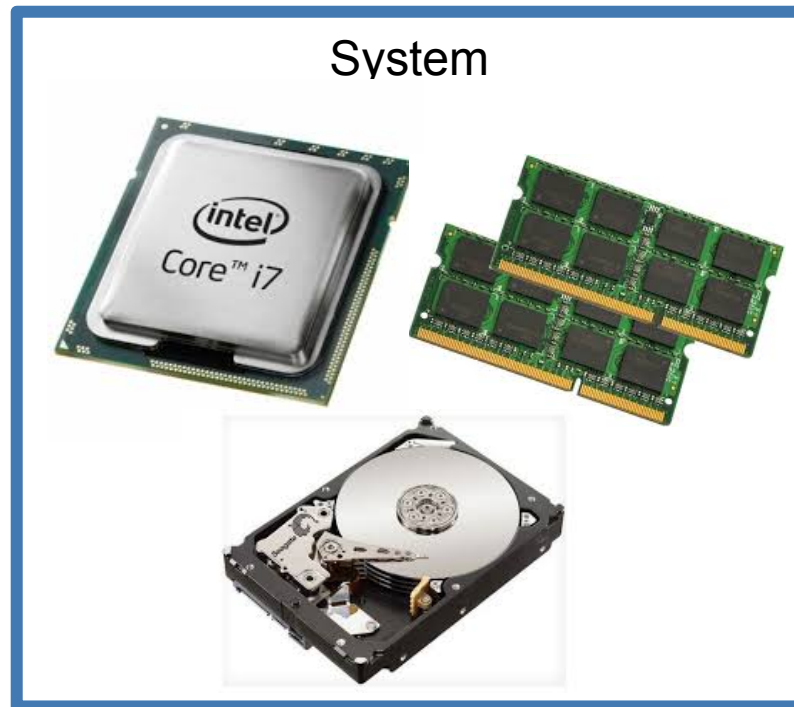


# System Deployment & Benchmarking

# Monitoring

- A monitor observes the activity of a system

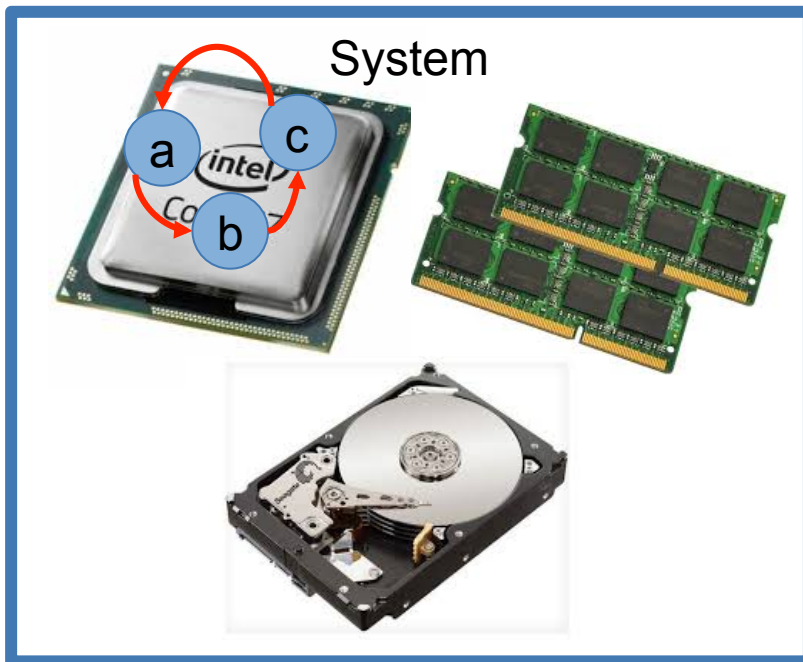


Monitor



# Monitoring concepts

- A system contains physical and logical resources with state
- State changes as events
- Trace is log of events:
  - Time stamp, variable detail...



Monitor



Trace

10:00 – a>b  
10:01 – b>c  
...

# Monitoring concepts

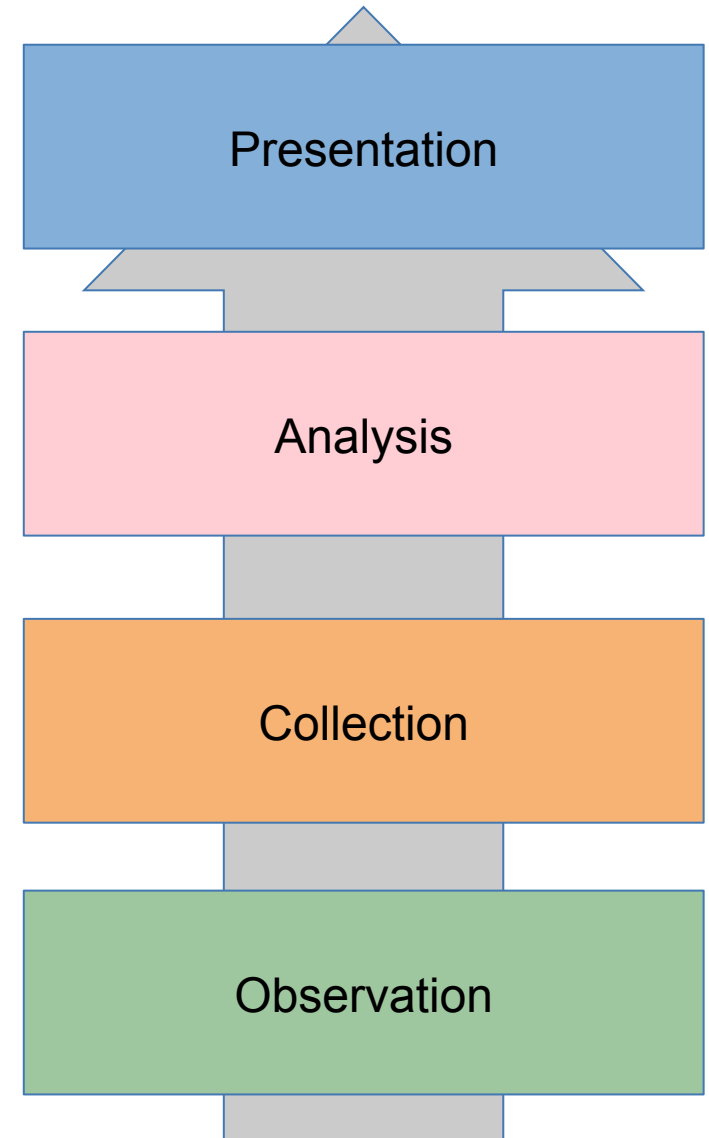
- Domain is the set of activities observed
- The detail varies:
  - In time according to the input rate
  - In scape, according to the resolution
- A monitor imposes overhead, changing the observed activity

# Monitor classification

- Event-driven vs sampling: what triggers observation
- On-line vs batch: when observation is available
- Hardware vs software
- Centralized vs distributed

# Monitor architecture

- Presentation produces reports, alarms, ...
- Analysis layer filters, relates and summarizes data
- Collection and normalization of data
- Observation of raw events in systems

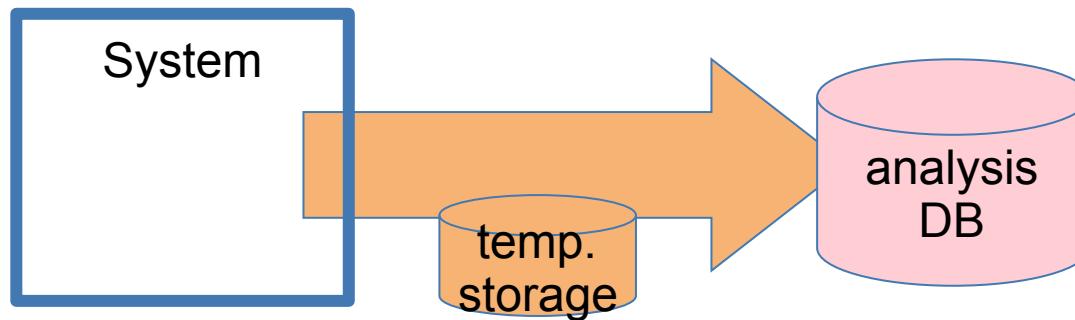


# Observation

- Passive observation or spying:
  - Network sniffer
- Instrumentation:
  - Counters built in the system (hardware and OS)
  - Log generation
- Probing with additional requests:
  - Ping

# Collection

- Push data vs pull data
  - Depends on configuration, legacy systems, ...
- Reliability and persistence



- Time synchronization in distributed systems
- Examples:
  - collectd, Beats, logstash



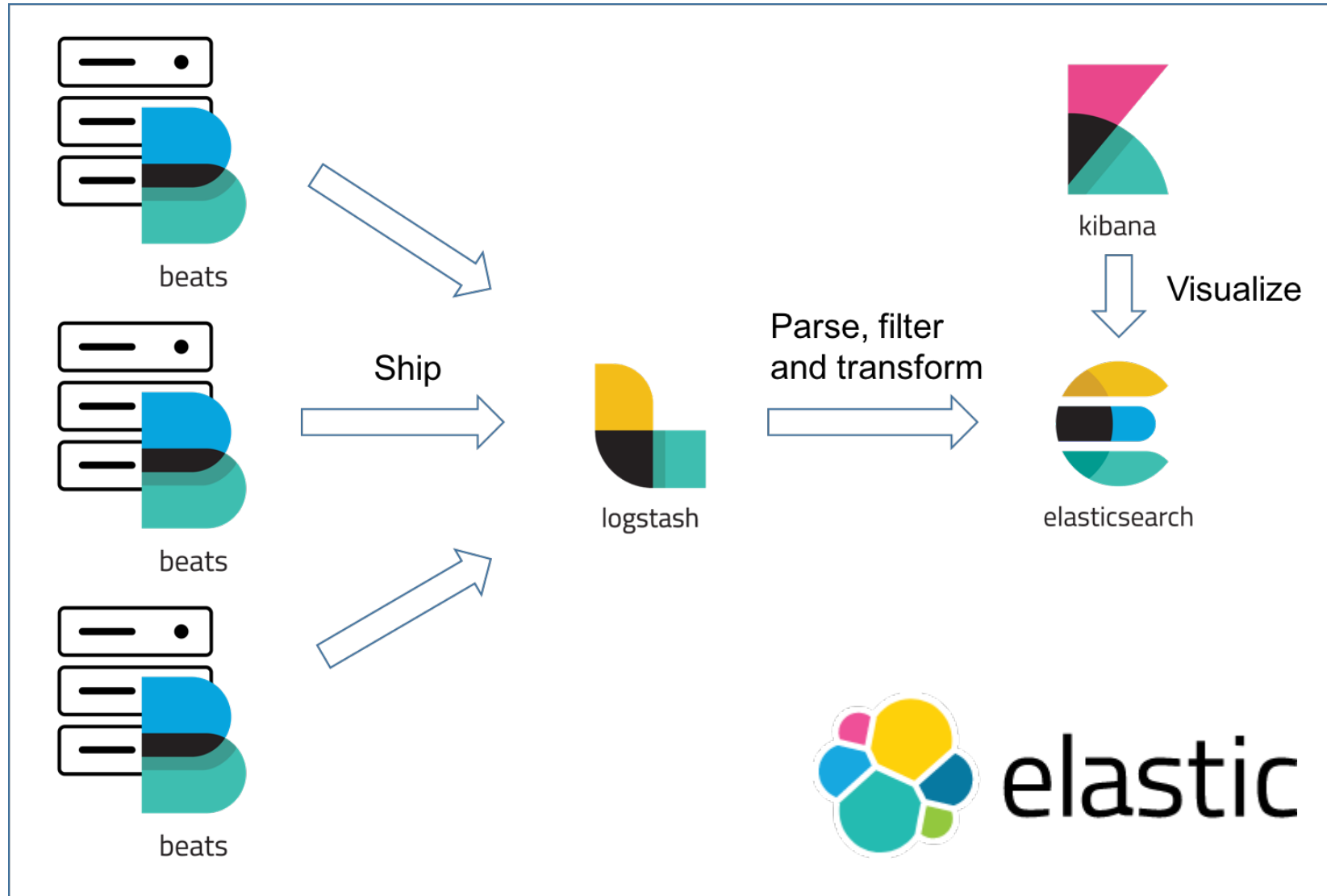
# Analysis

- Data processing task:
  - Time series
  - Searching
- “Big data” in large infrastructures
- Examples:
  - Elasticsearch, Graphite

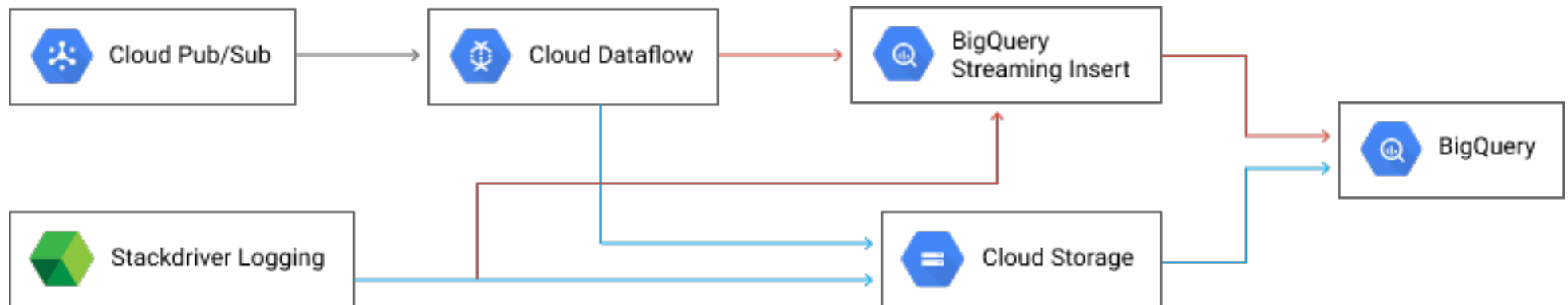
# Presentation

- Goals:
  - Performance metrics
  - Error detection
  - Configuration tracking
- Results:
  - Alert generation
  - Graphical presentation
- Examples:
  - Kibana, Grafana

# Case study: ELK

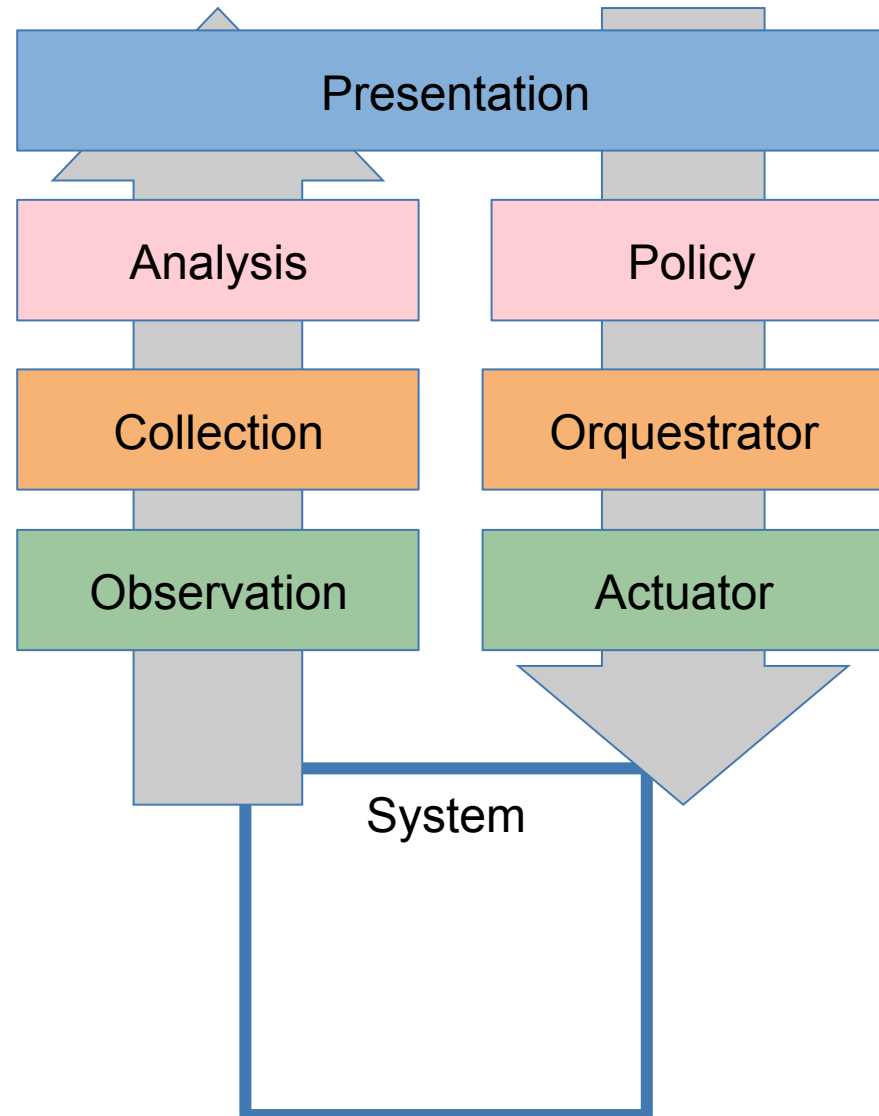


# Case study: Stackdriver



Stackdriver

# Monitoring and Management



# More...

- R. Jain, *“The Art of Computer Systems Performance Analysis.”* Wiley, 1991.
  - Chapters 7 and 8

