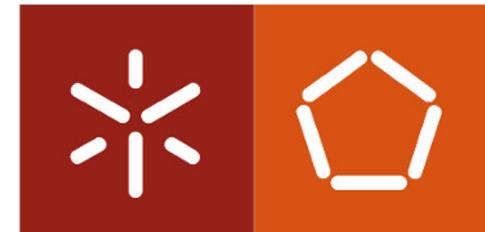


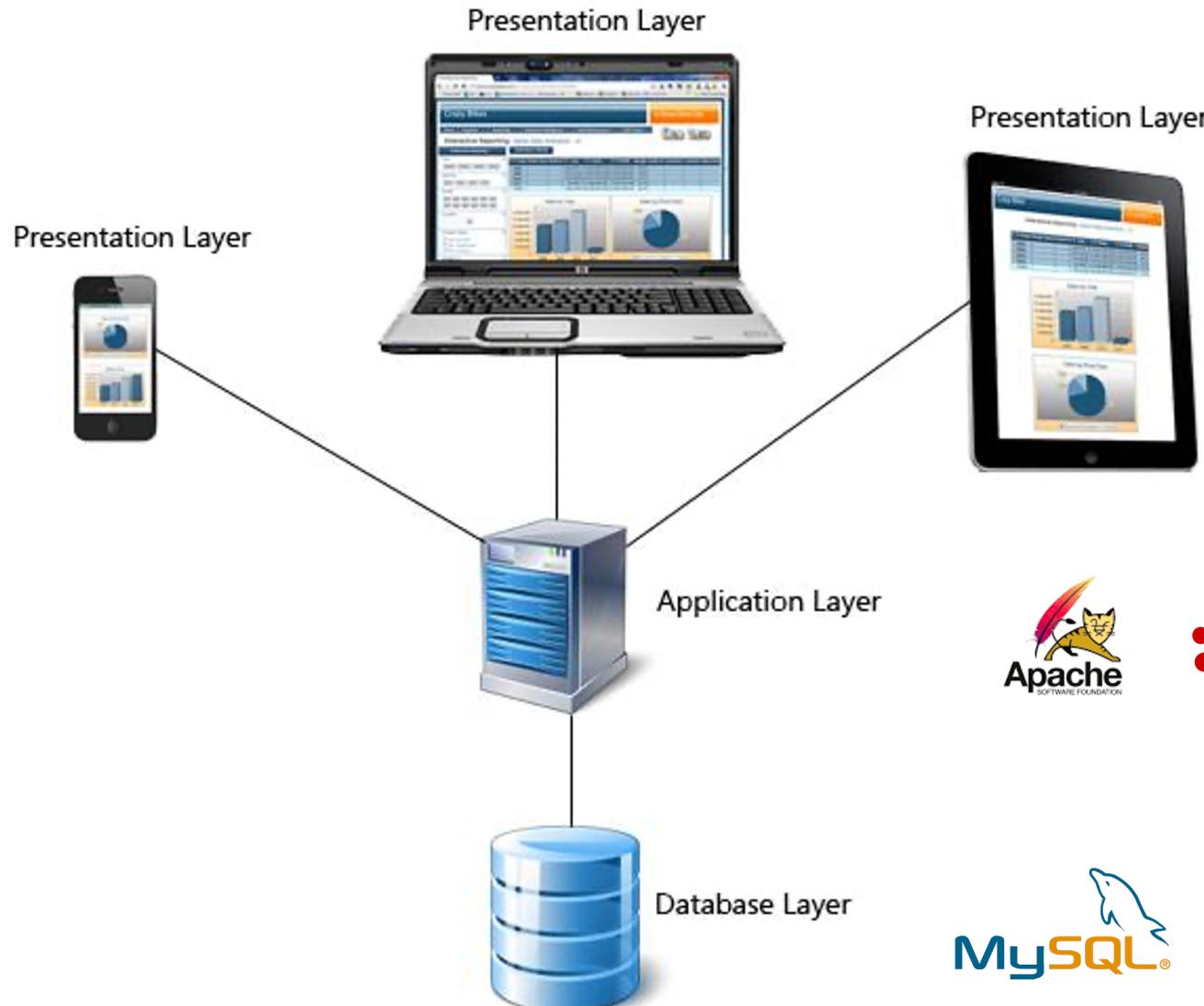
Cloud Computing Applications and Services (Aplicações e Serviços de Computação em Nuvem)

Introduction

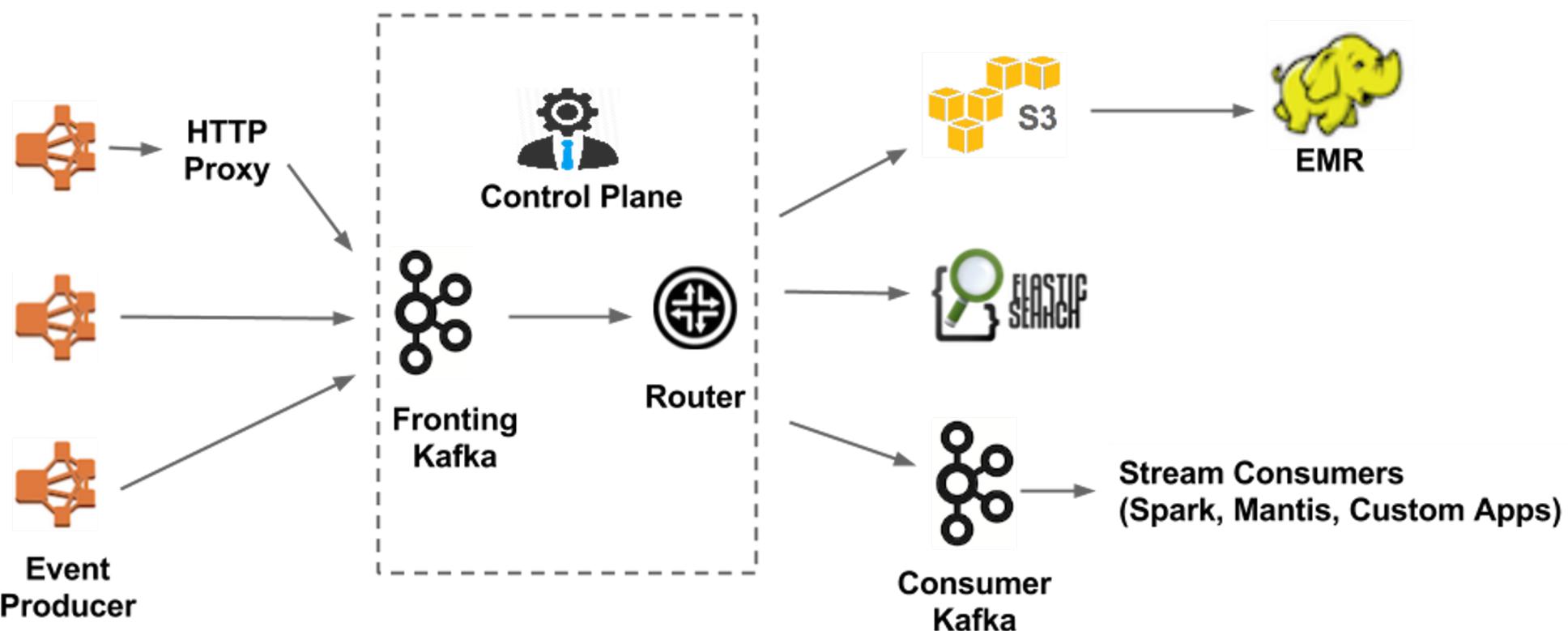
University of Minho
2022/2023



A “Simple” Application

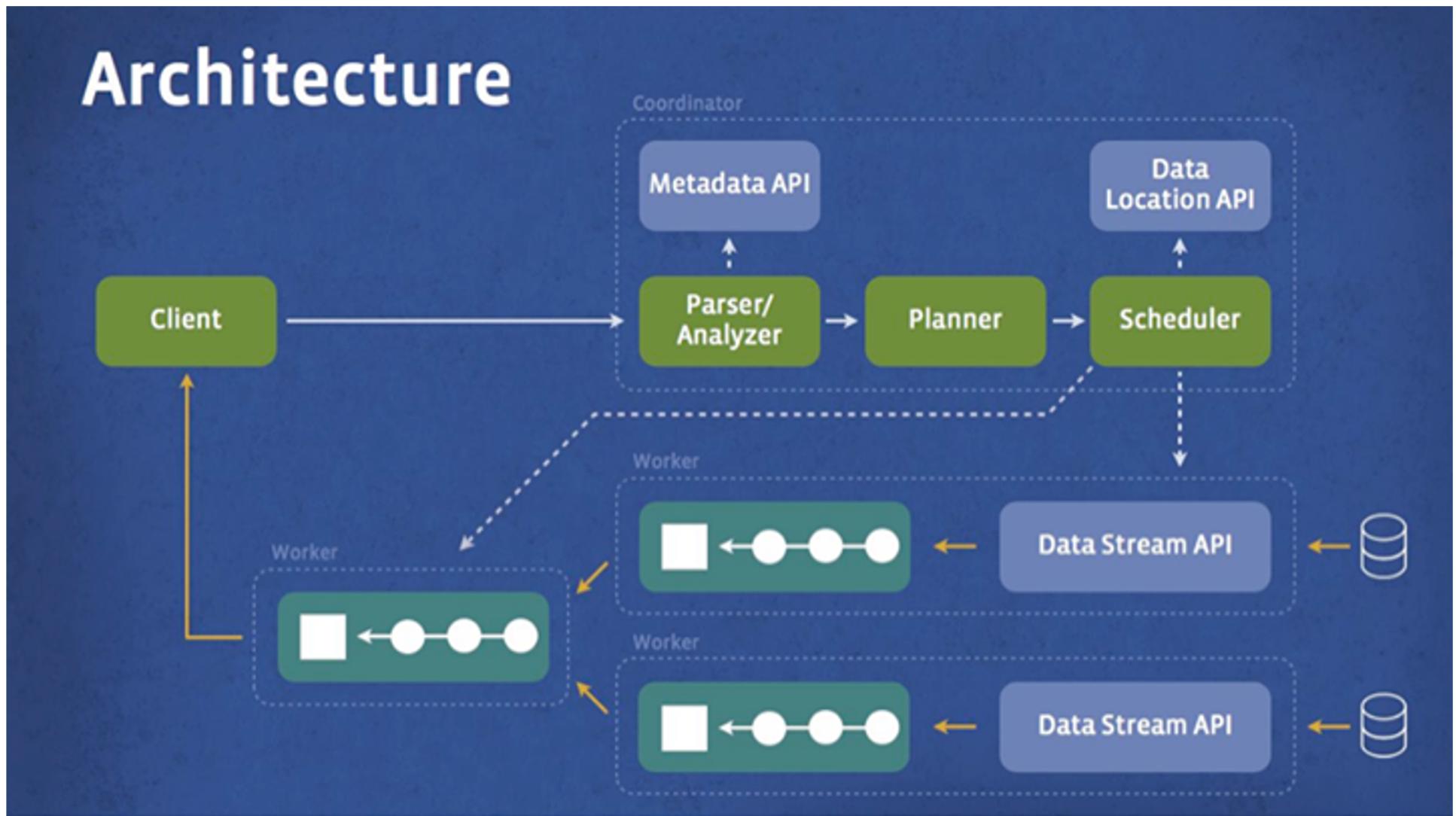


Complex Applications (Netflix – Keystone Data Pipeline)



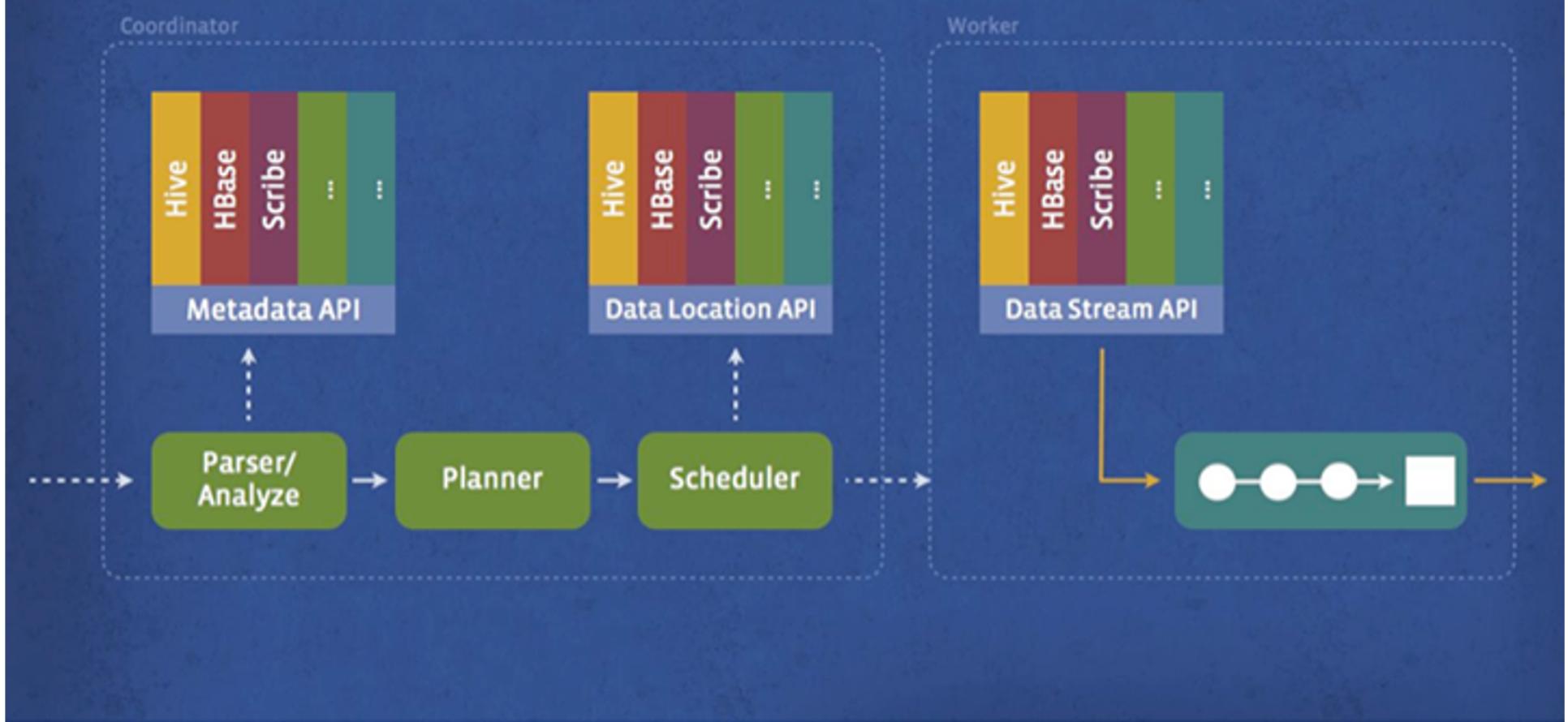
Complex Applications (Facebook – Presto SQL Engine)

Architecture



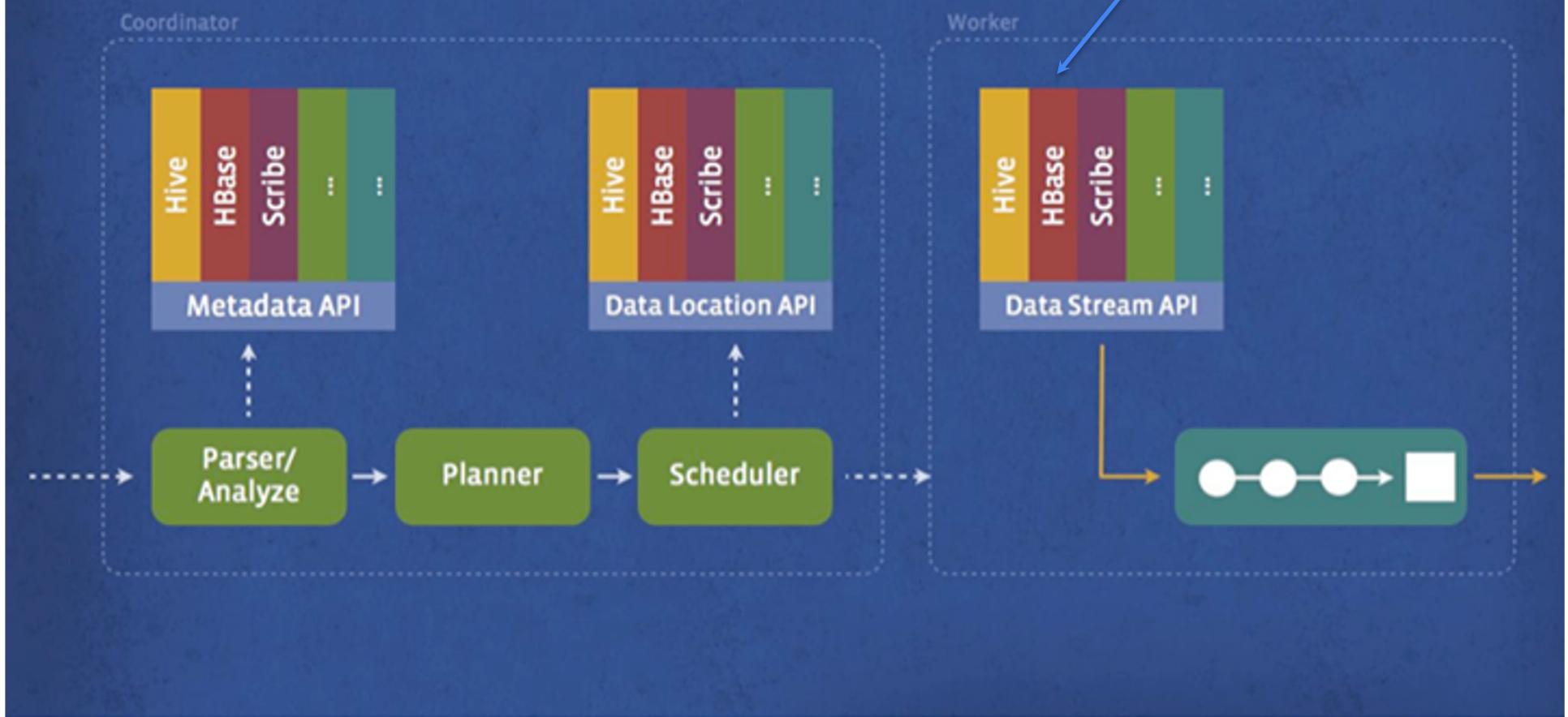
Complex Applications (Facebook – Presto Backends)

Pluggable backends

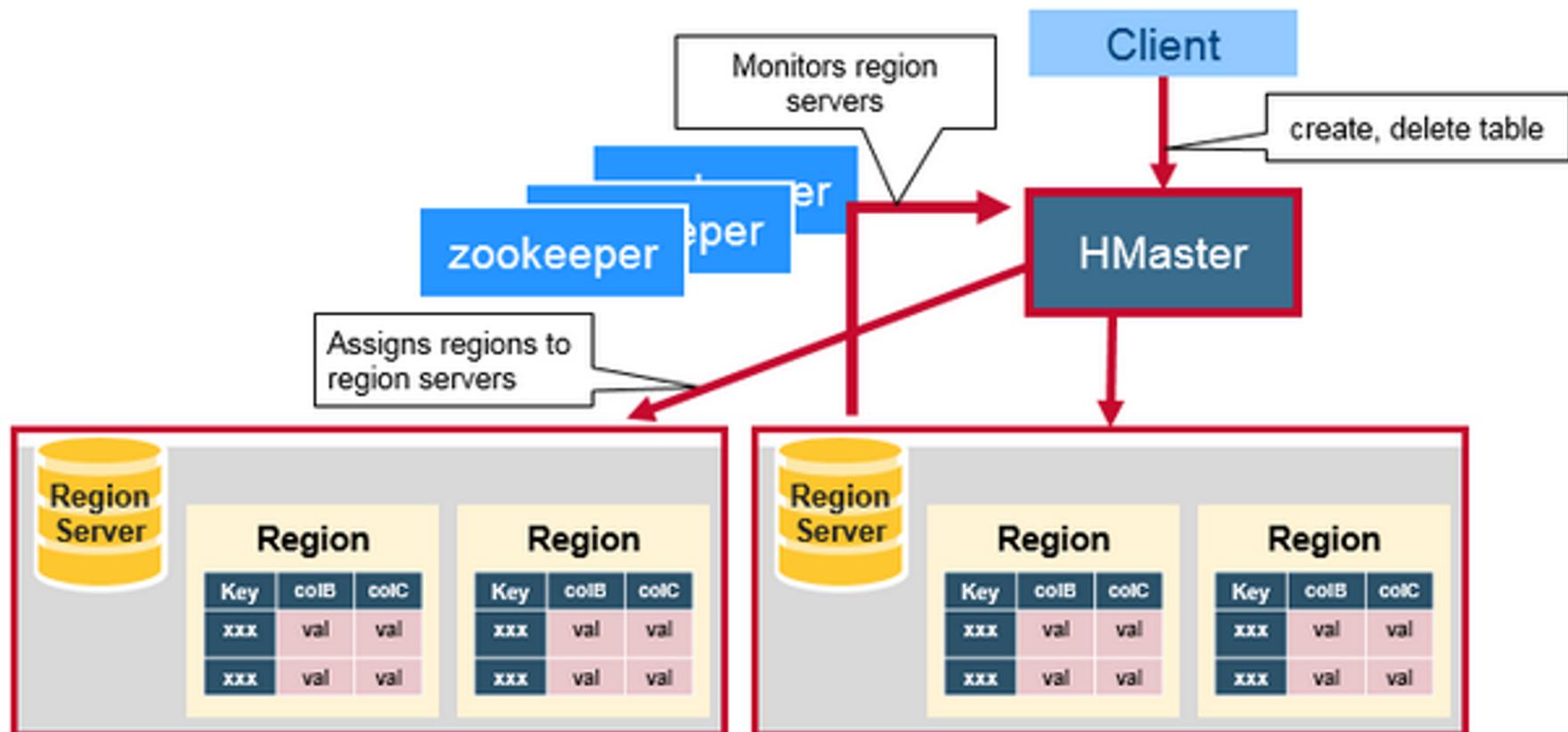


Complex Applications (Facebook – Presto Backends)

Pluggable backends



Complex Applications (HBase)



Complex Infrastructures



Challenges

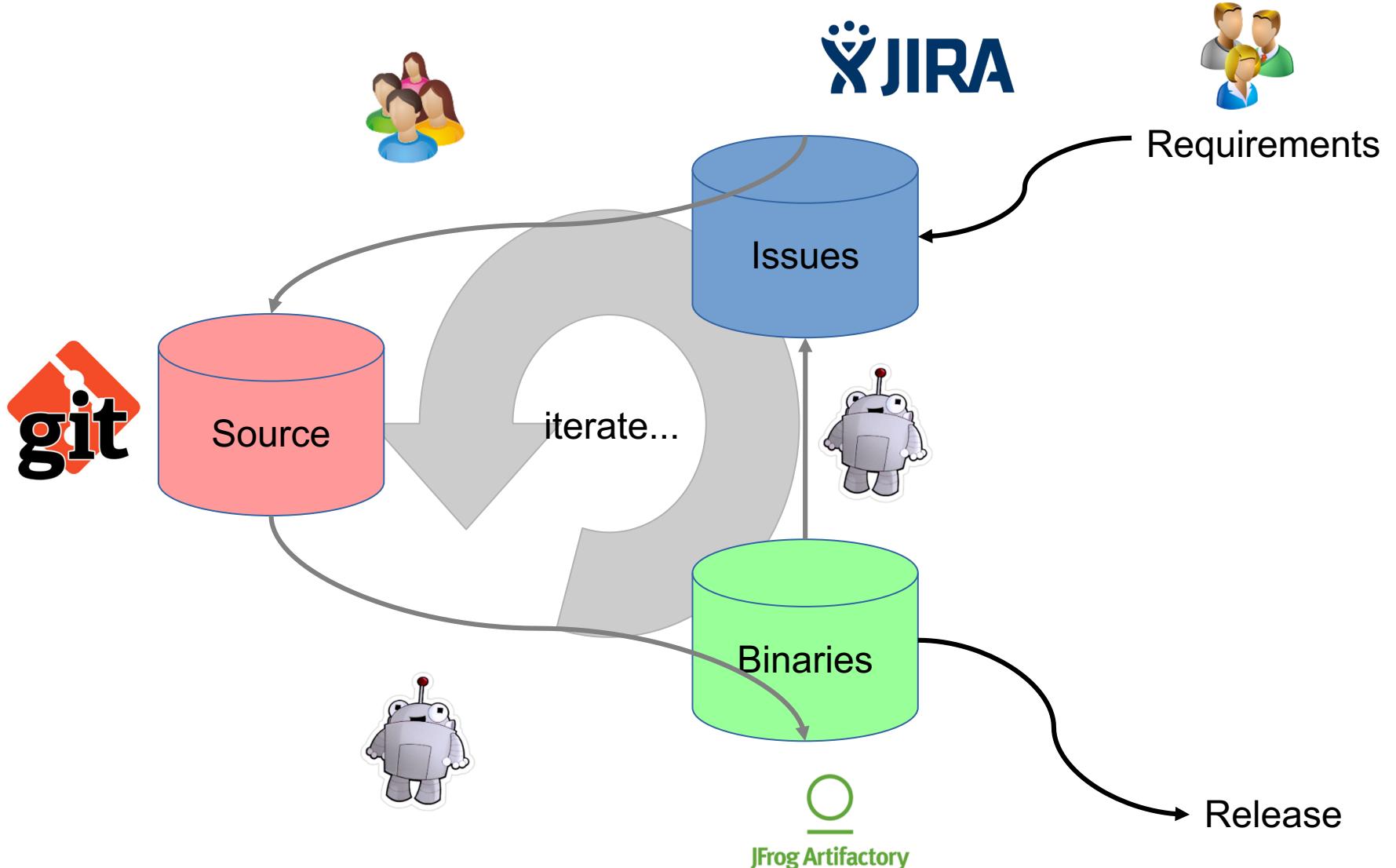
- Deployment
 - Multiple components with specific requirements
 - Heterogeneous hardware, software and services (e.g., cloud computing services)
- Management & Configuration
 - Specific to each software/hardware component
 - Optimal configurations will change with time...
- Monitoring and Benchmarking
 - Finding anomalies (performance, failures, ...) in complex applications and infrastructures



Google Cloud Platform

Yet another example...

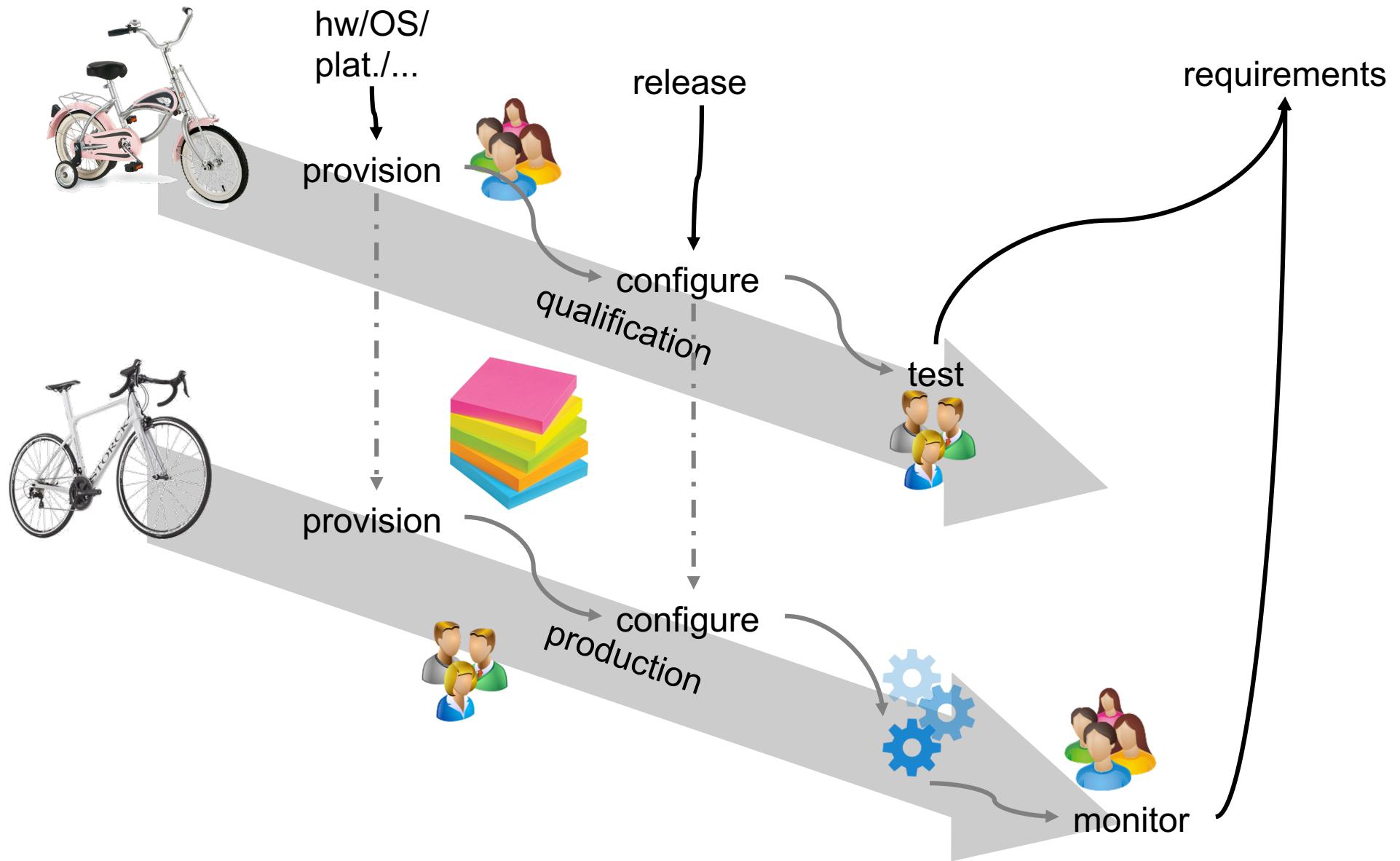
Agile development



Agile development

- Rests on formal (versioned) source, binary and documentation repositories
 - Unambiguous current state
 - Ability to back track
- Automated build and test
 - Fast feedback
- Fast iterations
- Quick reaction to frequent small changes

Operations



Operations

- Manual provisioning and configuration
- Informal communication between qualification and production stages
- Consequences:
 - Not repeatable or reproducible
 - Configuration drift
 - “Snowflake” servers (don't even look at it...)
 - Subjective monitoring

Infrastructure as Code

- Hardware provisioning with scripts
 - In contrast to: physically unboxing and plugging
- Software provisioning with scripts
 - In contrast to: clicking through setup wizards
- Configuration with scripts
 - In contrast to: clicking through control panels
- Include infrastructure scripts in agile process!

Agile development

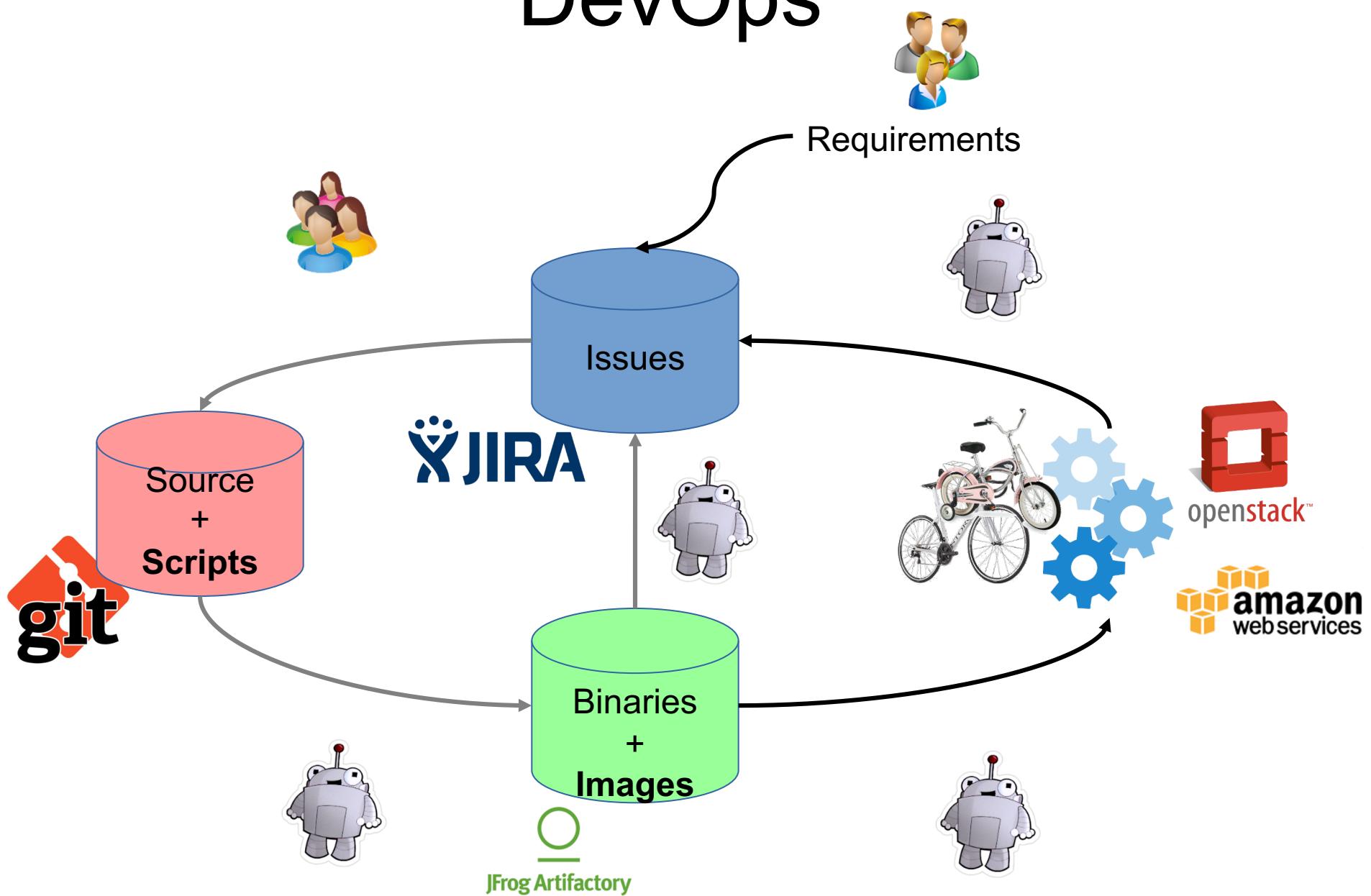
+

Infrastructure as Code



DevOps

DevOps



DevOps

- Development and deployment are self-documenting and versioned
- Deployment is reproducible and repeatable
- Servers are disposable and consistent
- Supports fast, frequent, small changes!

Roadmap

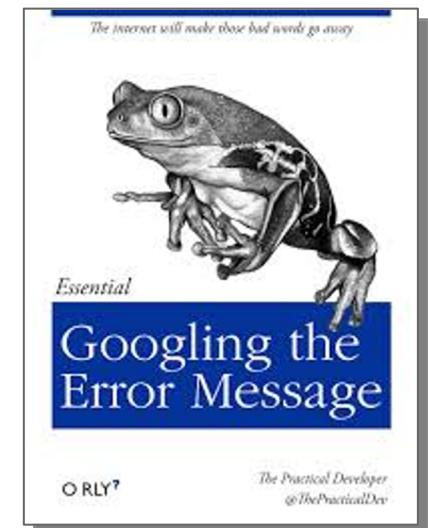
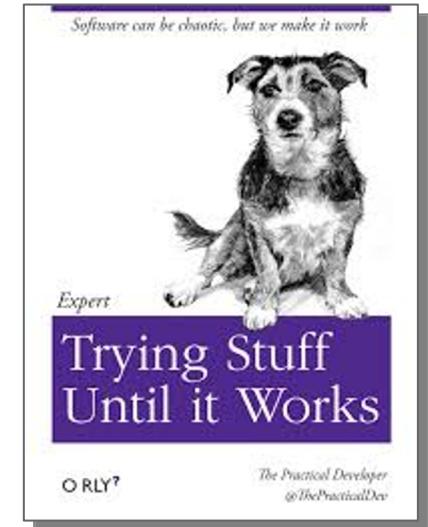
- Distributed systems architectures & deployment
 - Common distribution patterns
 - Reliability and scalability
 - Automatic provision and configuration
- Cloud computing
 - Services and abstractions
 - Infrastructure management
 - virtualization, storage, ...
- Monitoring and evaluation
 - Monitoring frameworks and metrics
 - Benchmarking

Assessment

- Project (50%) – minimum grade: 10 values
 - Report: 14/01/2023
 - Presentation: 16-20/01/2023 (week)
- Written exam (50%) – minimum grade: 8 values
 - 07/01/2023

Main references

- K. Morris. *Infrastructure as Code: Managing Servers in the Cloud*. O'Reilly, 2016
- M. Kleppmann. *Designing Data-Intensive Applications: The Big Ideas Behind Reliable, Scalable, and Maintainable Systems*. O'Reilly, 2017
- T. Erl, R. Puttini e Z. Mahmood. *Cloud Computing: Concepts, Technology and Architecture*. Prentice Hall, 2013
- S. Alapati. *Modern Linux Administration: How to Become a Cutting-edge Linux Administrator*. O'Reilly, 2016
- R. Jain. *The art of computer systems performance analysis - techniques for experimental design, measurement, simulation, and modeling*. Wiley, 1991



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Complementary Classes

- Distributed Systems (SD)
- Applications Engineering (EA)
- Cryptography and Information Security (CSI)

Questions?