Wrocław University of Science and Technology

Large Scale Data Processing

Lecture 4 – Flink

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HR EXCELLENCE IN RESEARCH

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Overview

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Actor programming

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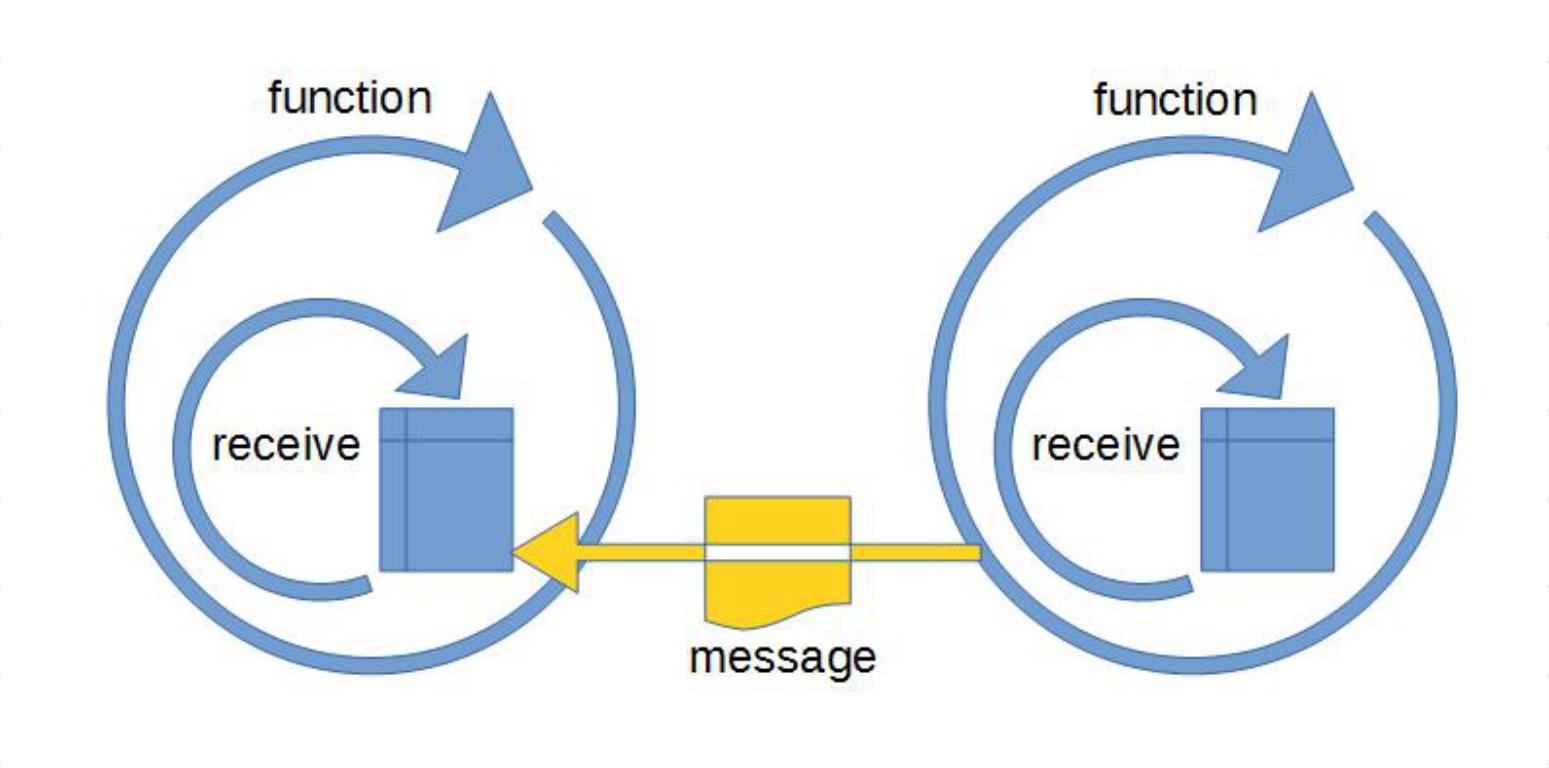

Actor programming

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- Actors - can send message, modify hist state, spawn new actors
- Message queues
- Actor behaviour

Actor programming

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- Message - envelope with sender and receiver
- Offload response processing to third-actor
- Queues - communication decoupled from processing
- Only local state is mutable

Reactive manifesto

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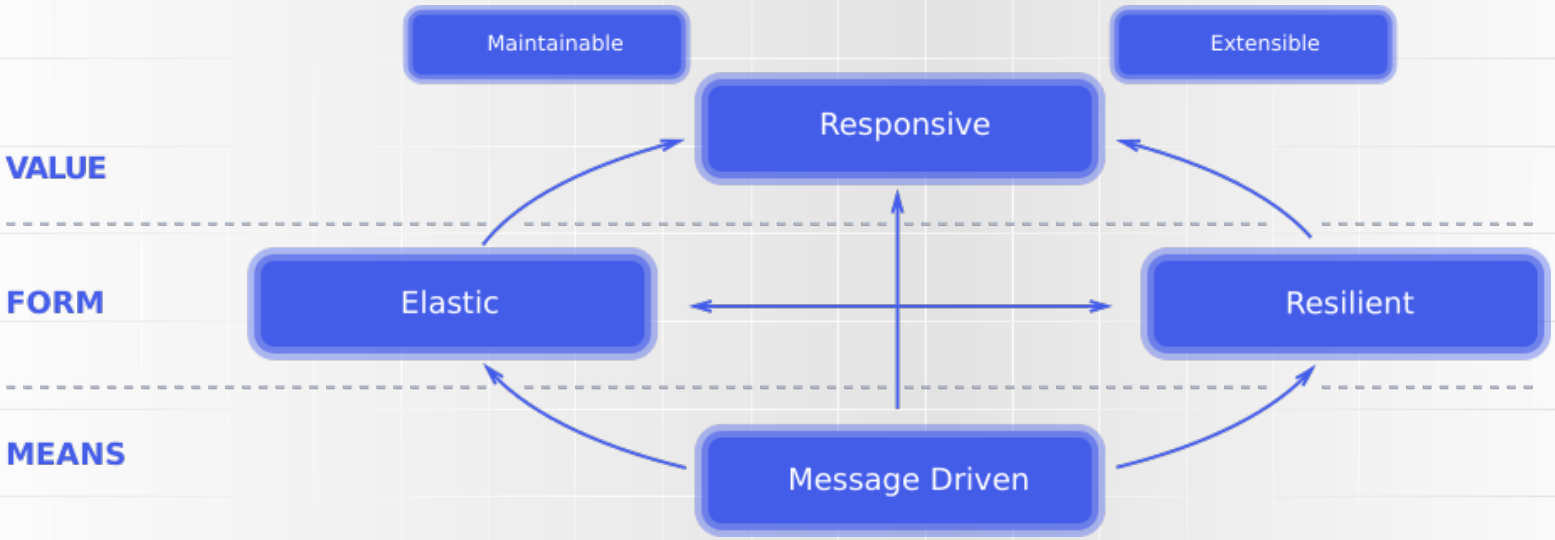

Akka platform

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Akka platform

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- Akka Actors
- Akka typed
- Akka streams
- Akka persistance
- Alpakka

Akka platform- Akka Actors

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- core
- overhead - 300 bytes per actor
- actor system
- actor primitive
- communication patterns
  - tell
  - ask
  - forward
- coordination
- supervision

Akka platform- Akka typed

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- new actor api
- typed communication
- typed behaviour
- typed state

Akka platform- Akka streams

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- powerfull stream processing API
- processing graph DSL
- backpreasure
- reactive streams
- materializes to actors

Akka platform- Akka cluster

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- cluster formation
- cluster shutdown
- sharding
- singletons
- remote actors
- load balancing

Akka platform- Akka persistence

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- event sourcing - next lecture
- persist actor state - by persisting events
- snapshot actor state - so the recover is not from all events
- recover actors
- latest state behaviour - persist only state not all events

Akka platform- Alpakka

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- akka stream connectors
- Cassandra
- Kafka
- AWS

Akka cluster problems

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- Split-brains
- Cluster formation
- Failure detection

Akka cluster - SB

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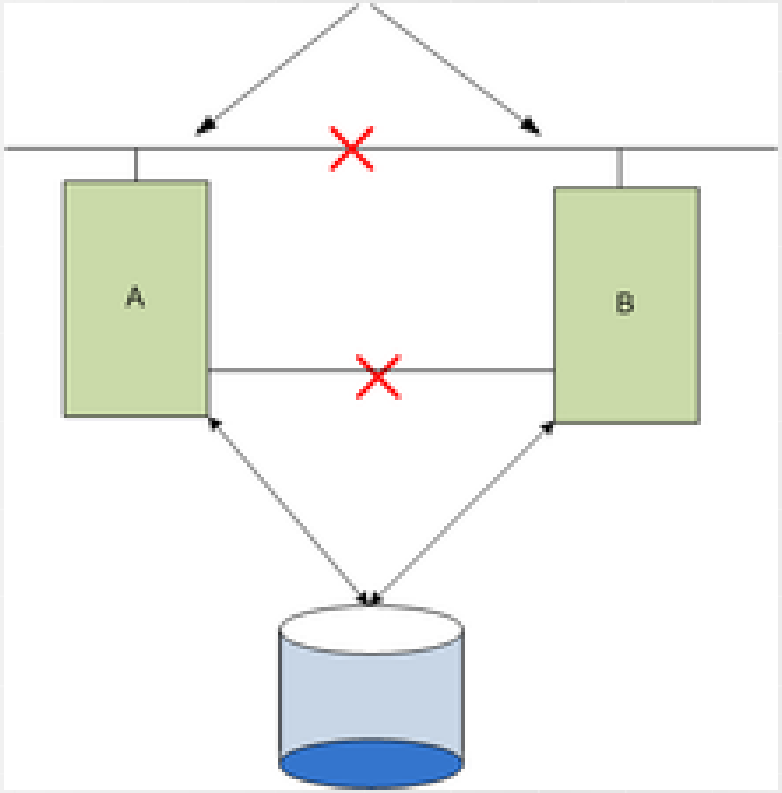

Akka cluster - SBR

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- Detect that some nodes are not responding
- Apply configured policy to handle split

Akka cluster - SBR - Keep majority

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- cluster know it size
- on split, each part also knows size, and the size of new "cluster"
- down smaller part

Akka cluster - SBR - Static quorum

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- configure quorum-size
- compare new "cluster" size to quorum
- down if size is smaller

Akka cluster - SBR - Keep oldest

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- singletons are kept on oldest node
- on failure, if oldest node is not part of the new "cluster" - down

Akka cluster - SBR - Down all

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- kill the cluster

Akka cluster - SBR - Lease

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- utilize external "lock"
- K8S
- time based
- lose lock if not updated in time

Partitioning

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- Horizontal
- Vertical
- Functional

Partitioning - Horizontal

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- Range
- Hash

Partitioning

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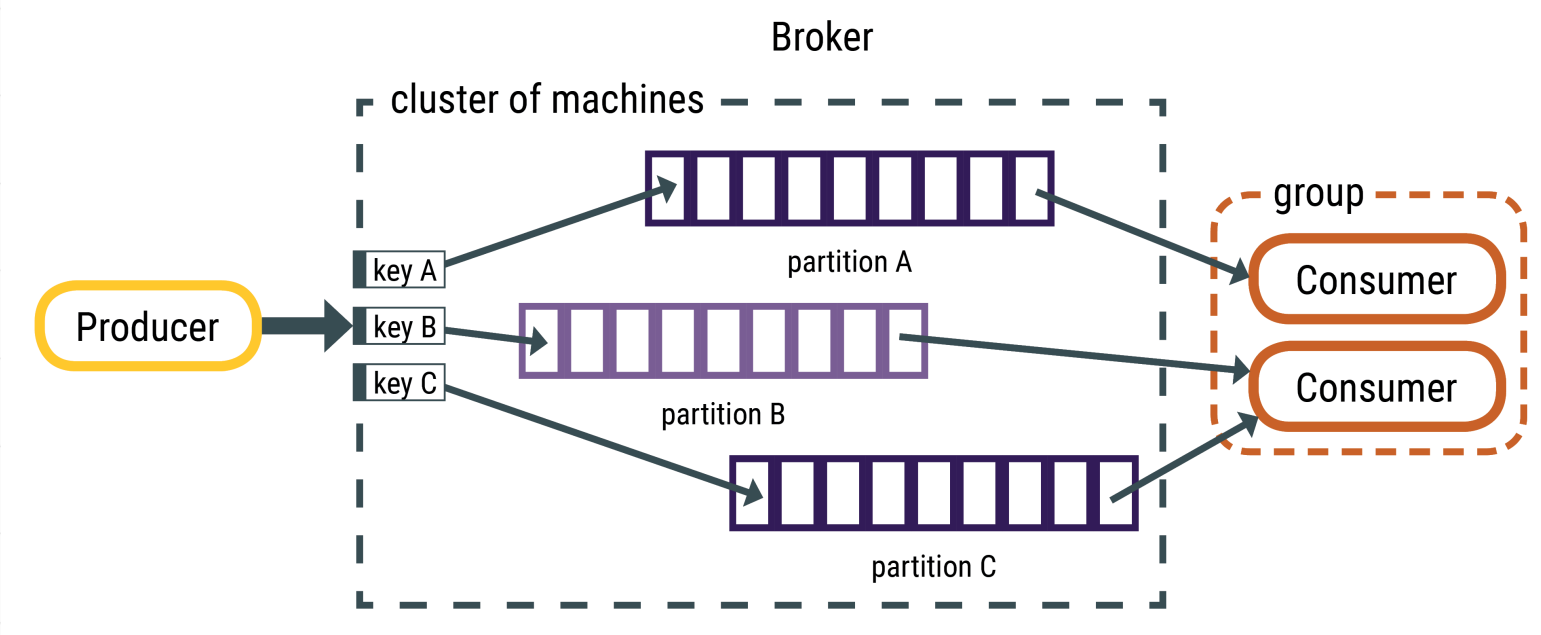

Architecture

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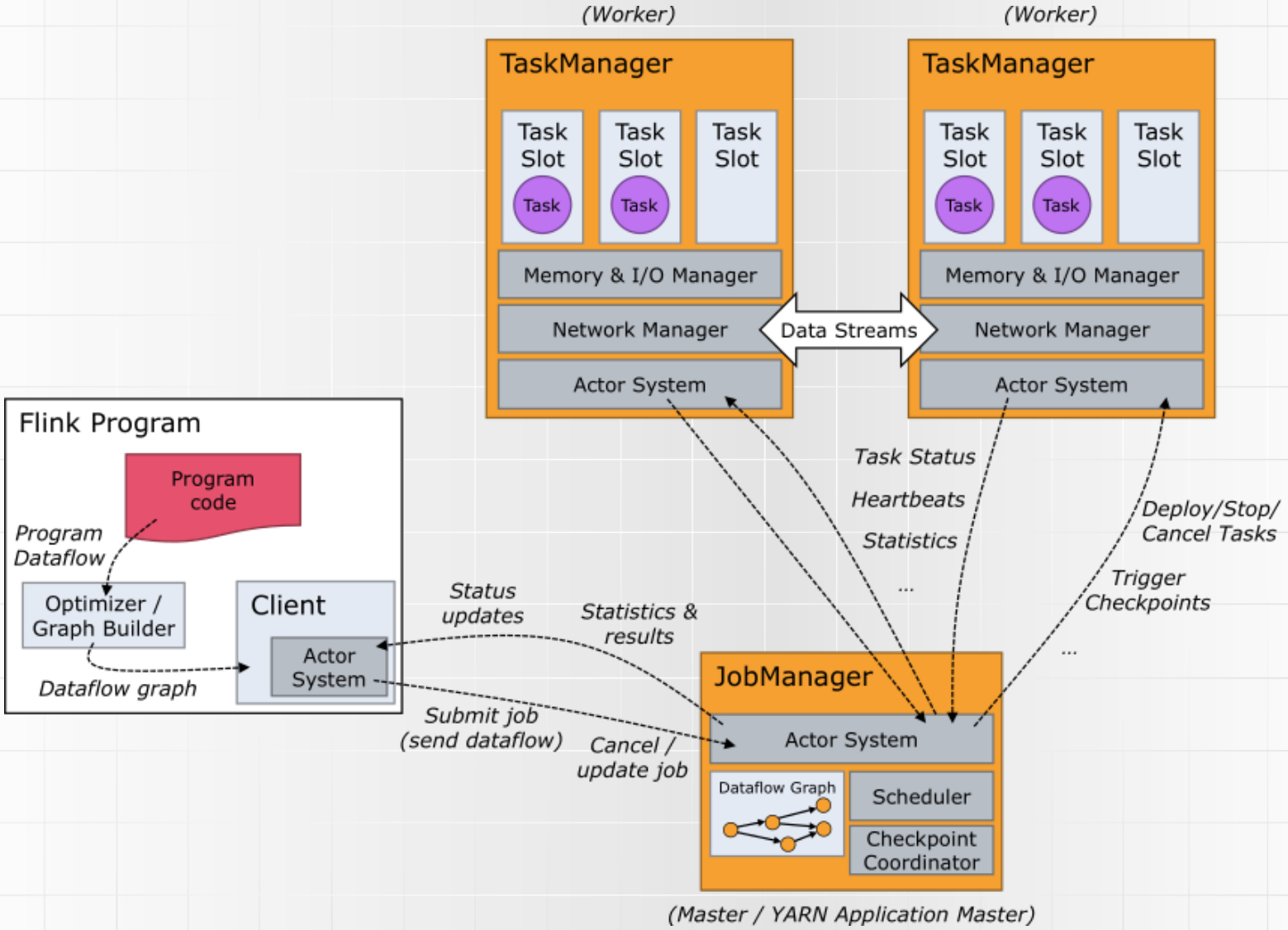

Architecture - components

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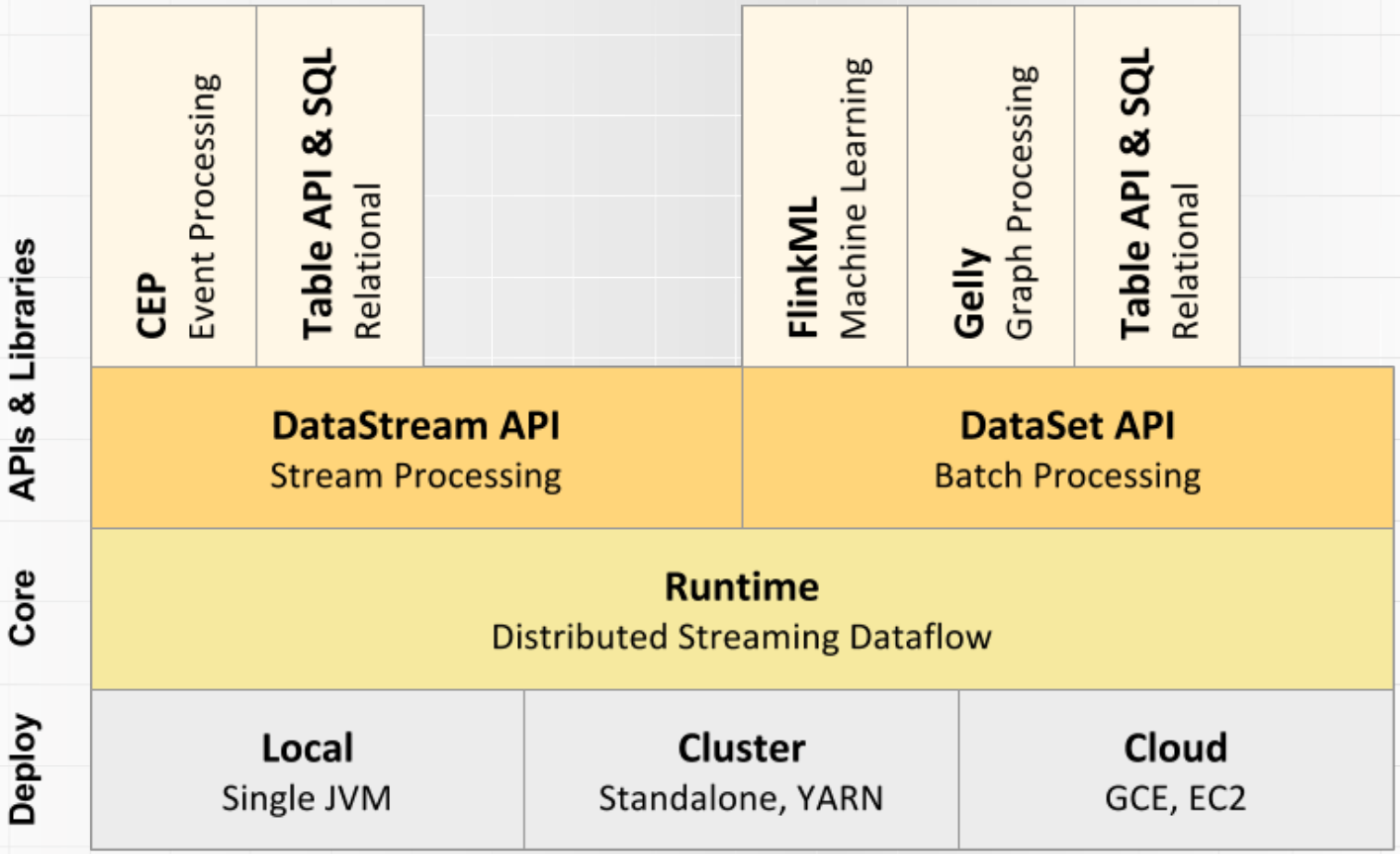

Concepts - Programs and DataFlows

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- never ending flow of data
- transformations - operators
- "DAG"
- streaming dataflow - 1-n sources -> 1-n sinks

Concepts - Parallel DataFlows

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- parallel by partitioning
- each operator - one or more subtask
- parallelism of stream = parallelism of upstream
- one-to-one - preserve partitioning
- redistributing - repartition

Concepts - Windows

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- impossible to count all elements in a stream
- scope aggregation operations
- time drive
- data driven
- tumbling
- sliding
- session

Concepts - Time

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- event time
- ingestion time
- processing time

Concepts - Statefull operations

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- Simple processing - look only at current event
- remember information in between events - statefull operations
- partition by key
- only on "keyed" streams

Concepts - Checkpointing

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- fault tolerance - reply + checkpointing
- checkpoint - might be expensive, do only in some intervals
- on failure - load checkpoint and reply events after the checkpoint

Concepts - Batch processing

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- under the hood - streams
- no checkpoints
- in-memory state
- iterations

Concepts - Tasks and operators

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- operator - for example map()
- task - chained operators, executed on single thread
- chaining - optimization
- configurable - programmable API

Concepts - Job managers, task managers, clients

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- Job manager - master
- Task manager - worker
- Client - starts processing

Concepts - Task slots

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- Task manager -Single JVM
- Task slot - part (or whole) part of task manager
- control on task isolation granularity
- task slot sharing
- needs at least as many task slots as max-parallelism

Concepts - State backend

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- key/value store
- in-memory map
- RocksDB
- snapshotting as part of checkpoint

CEP

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- Complex Event Processing
- on-top
- detect event patterns
- "regexp" for event streams

Serialization

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- by default internal efficient serialization for some primitive types, POJOs, case classes
- fallback - Kryo - schema in every event
- fallback - custom

Object reuse

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- Flink - Java
- mutability
- user program can mutate objects, that is why Flink needs to copy them to be safe
- instruct Flink programatically to reuse
- be immutable (copy where needed manually)

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Next week

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- Cassandra, CQRS, ES

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