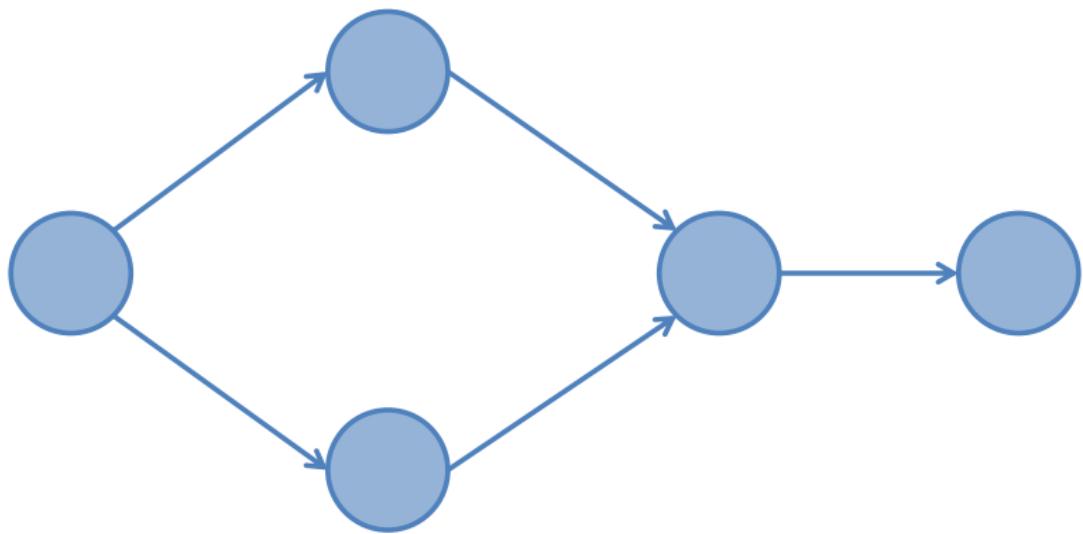
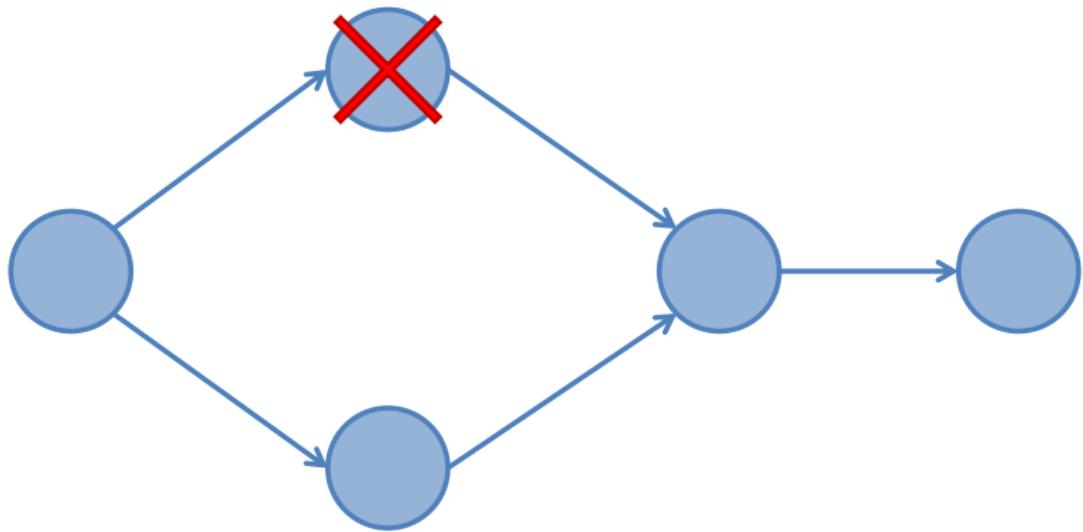


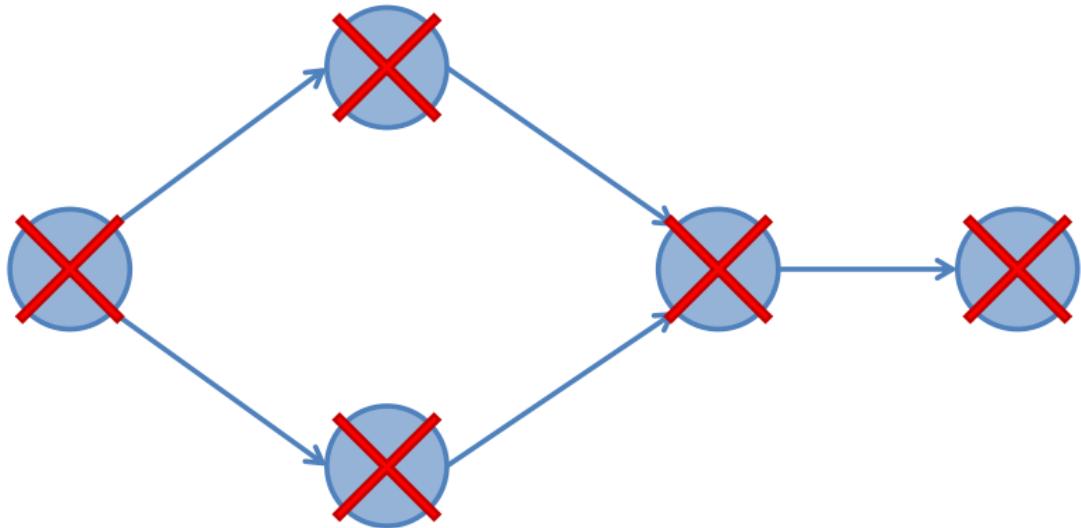


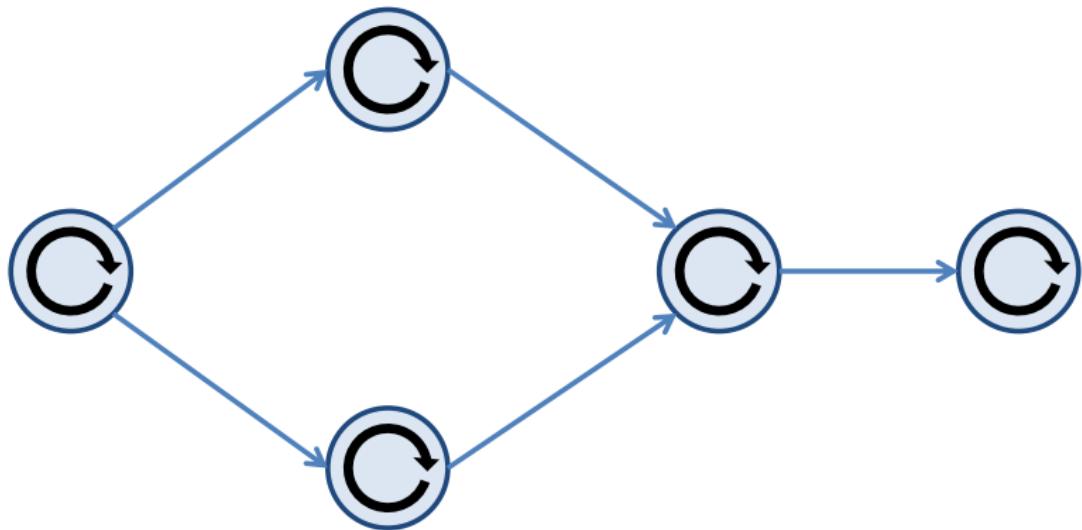
Fault Tolerance in Heterogeneous Environments

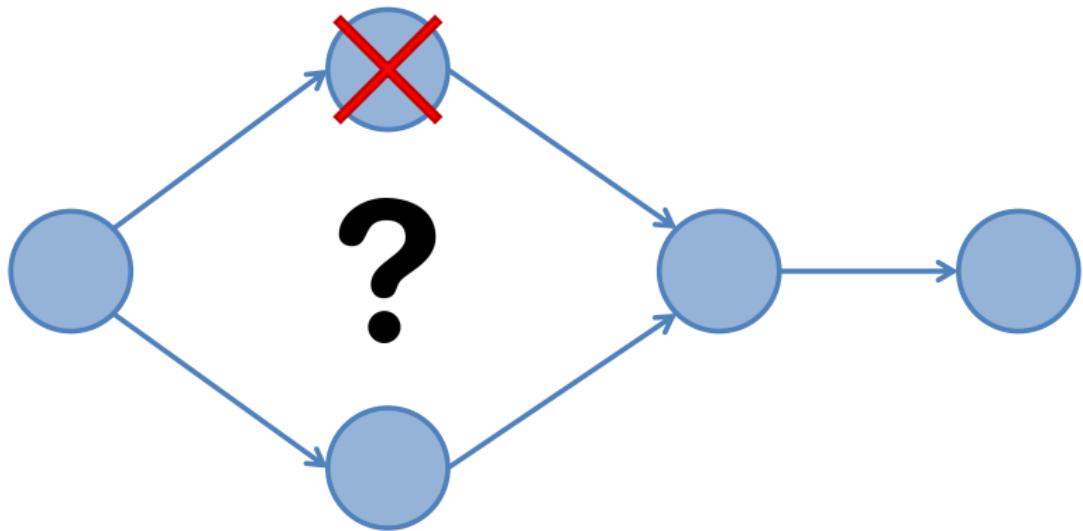
Jessica Woods, Nikhil Singh, Fabian Hofmann | Complex and Distributed IT Systems | July 31, 2019













Background

- Failure Models
- Detection of Failures
- Recovery from Failures
- Heterogeneous Environments

Contribution

- Approach
- Tools
- Demo
- Challenges

Conclusion

References



Failure Models

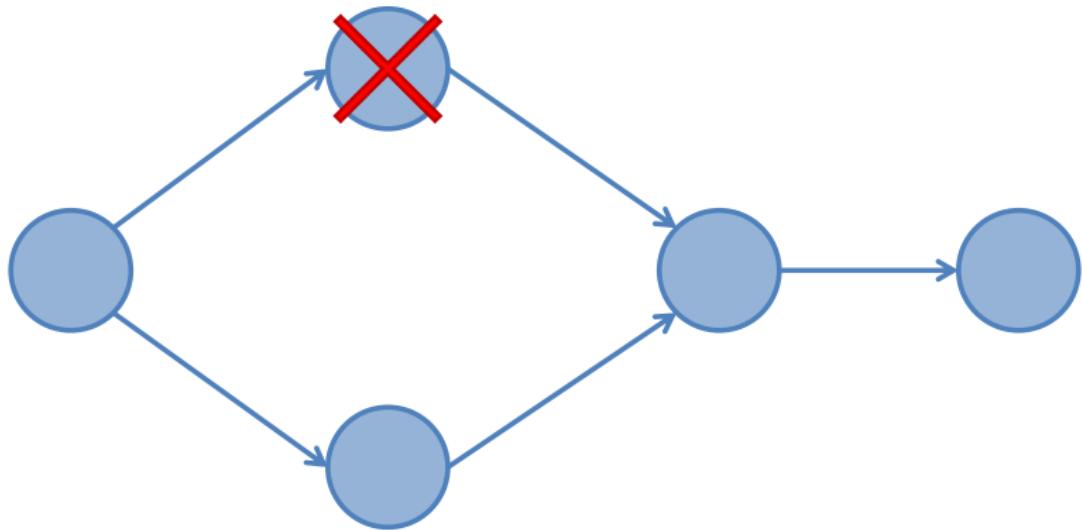


Figure: Fail-stop, fail-recover, and Byzantine failure model



Failure Models

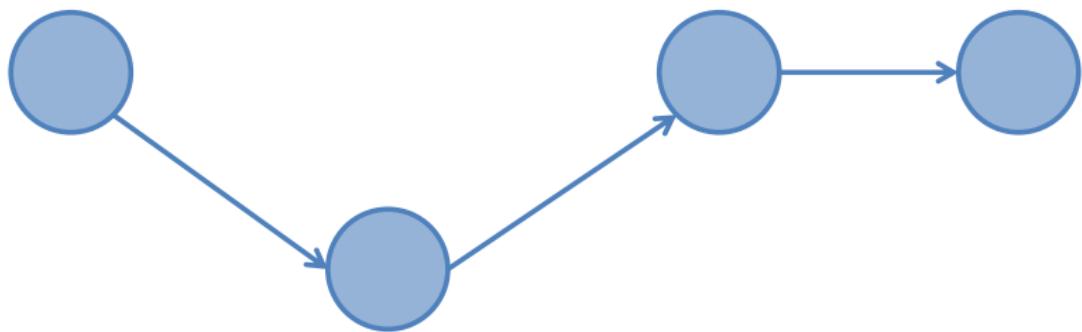


Figure: Fail-stop, fail-recover, and Byzantine failure model



Failure Models

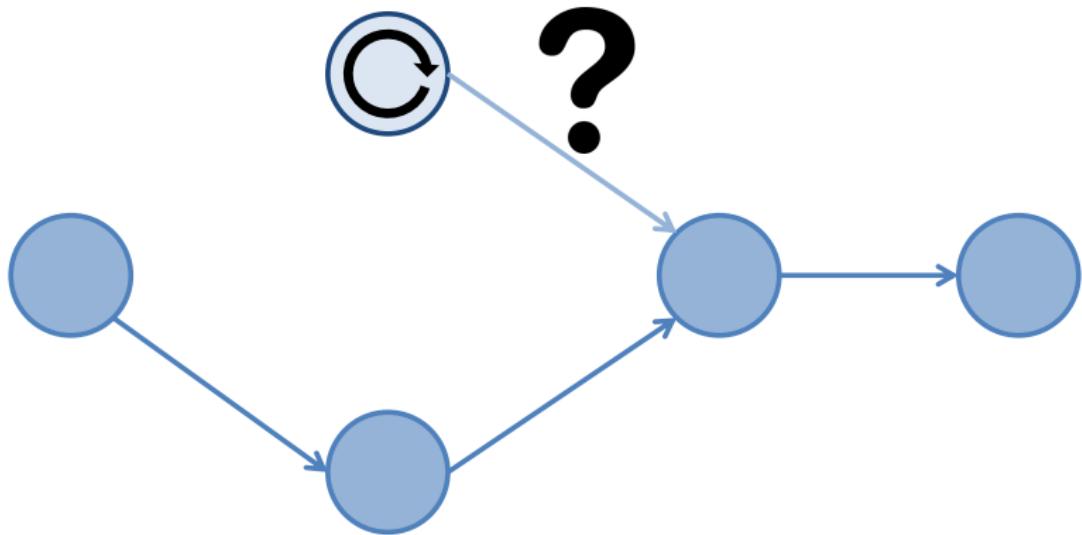


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Failure Models

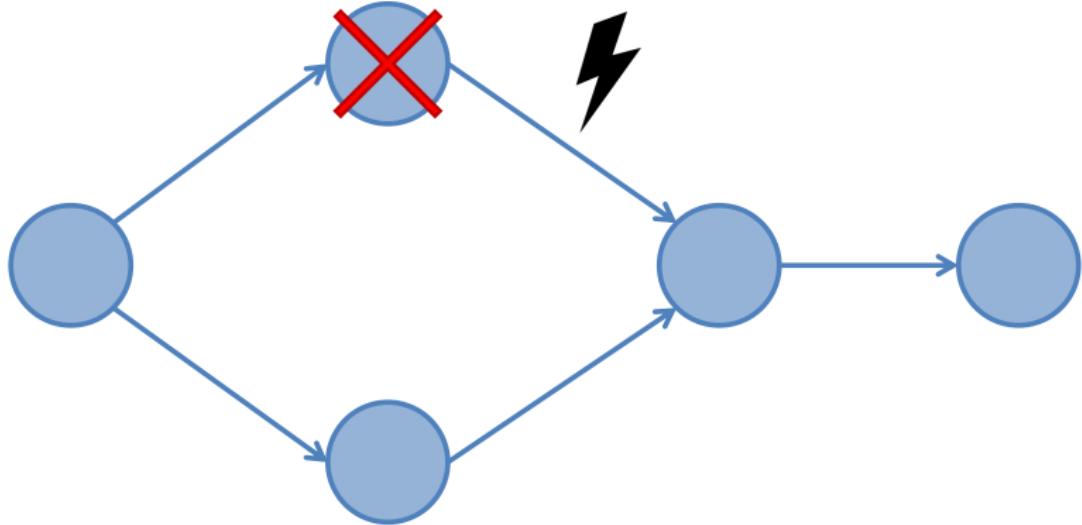


Figure: Fail-stop, fail-recover, and Byzantine failure model



Detection of Failures

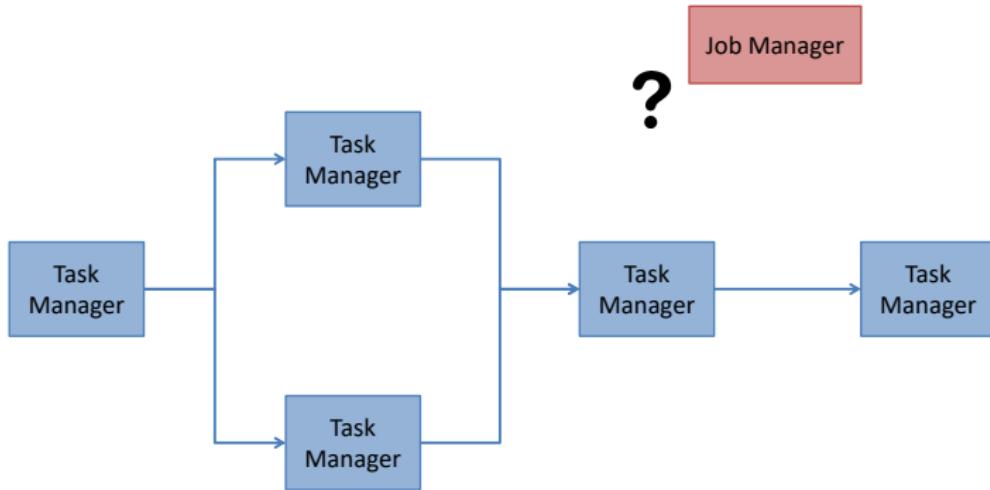


Figure: Detection of failures in case of a fail-stop model



Detection of Failures

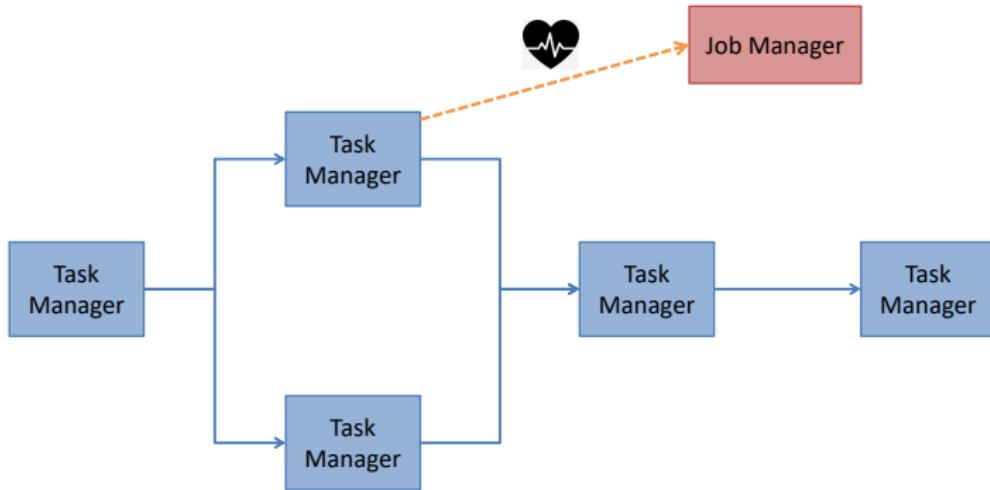


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Detection of Failures

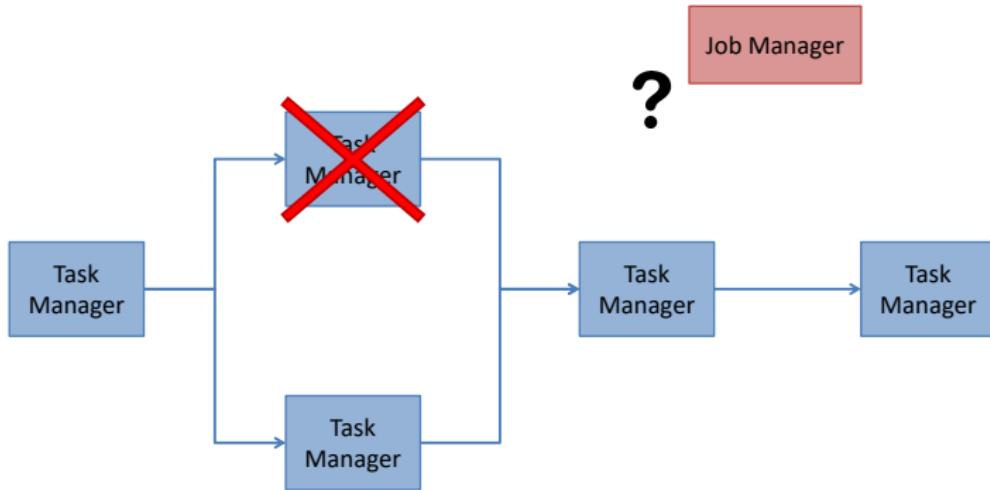


Figure: Detection of failures in case of a fail-stop model



Detection of Failures

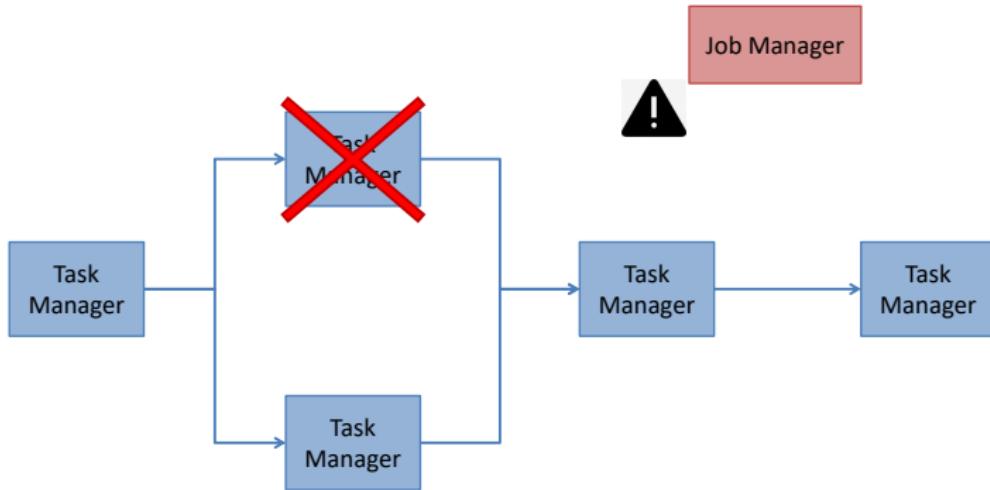


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Recovery from Failures

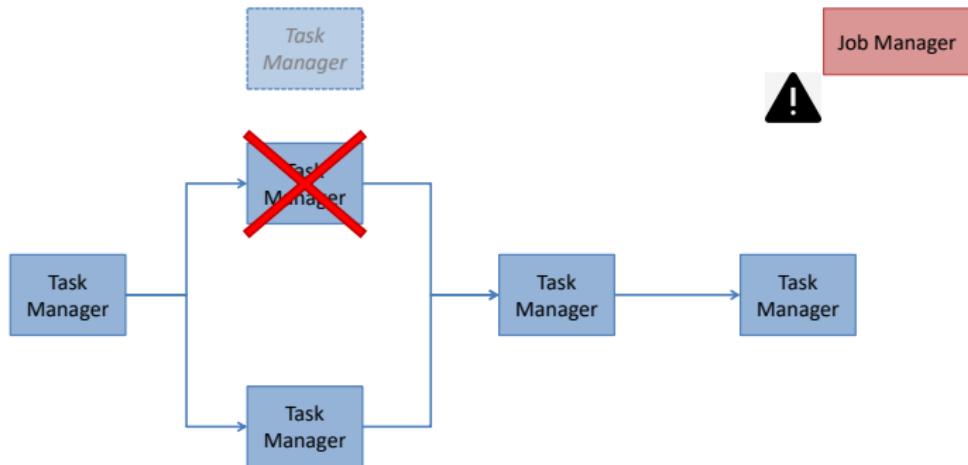


Figure: Recovery from failures in Flink [Katsifodimos et al., 2015]



Recovery from Failures

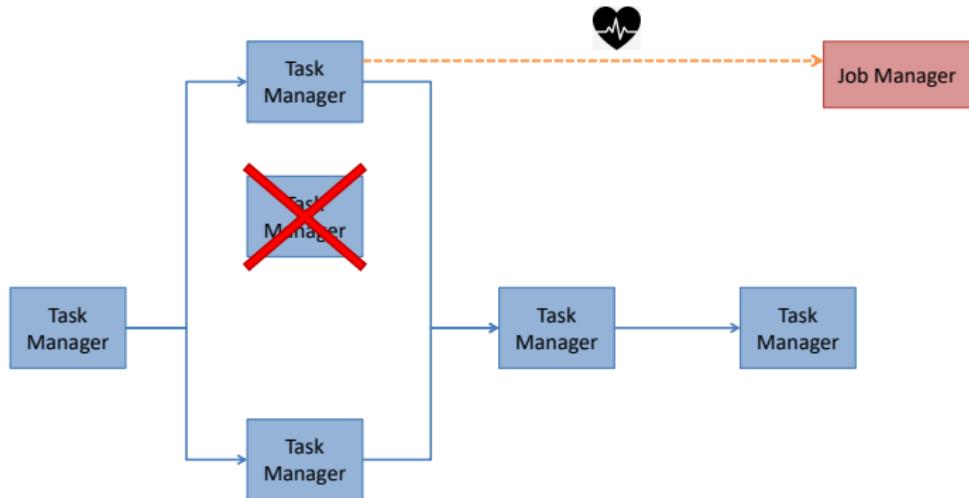


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Recovery from Failures

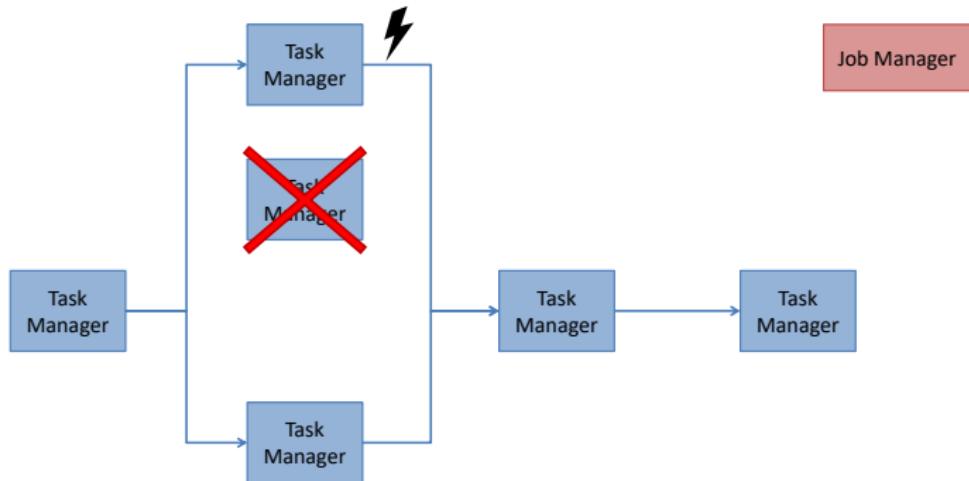


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Recovery from Failures

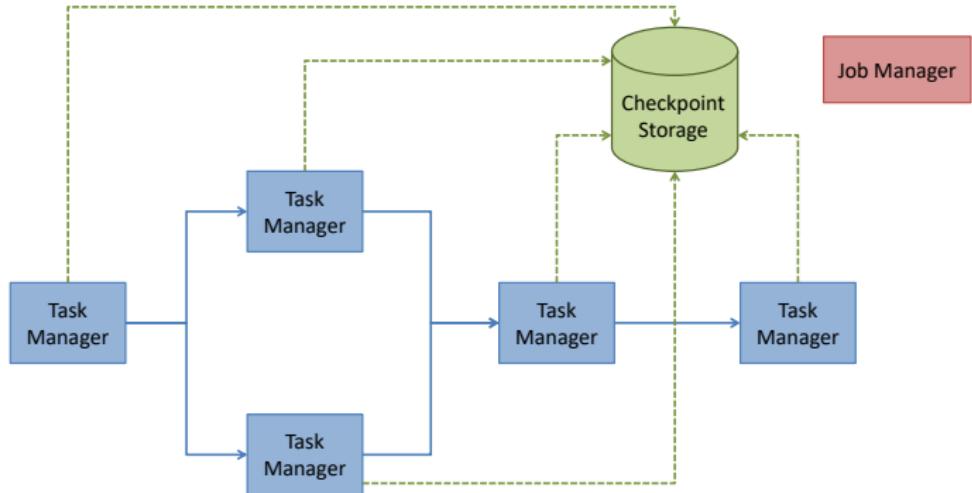


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Recovery from Failures

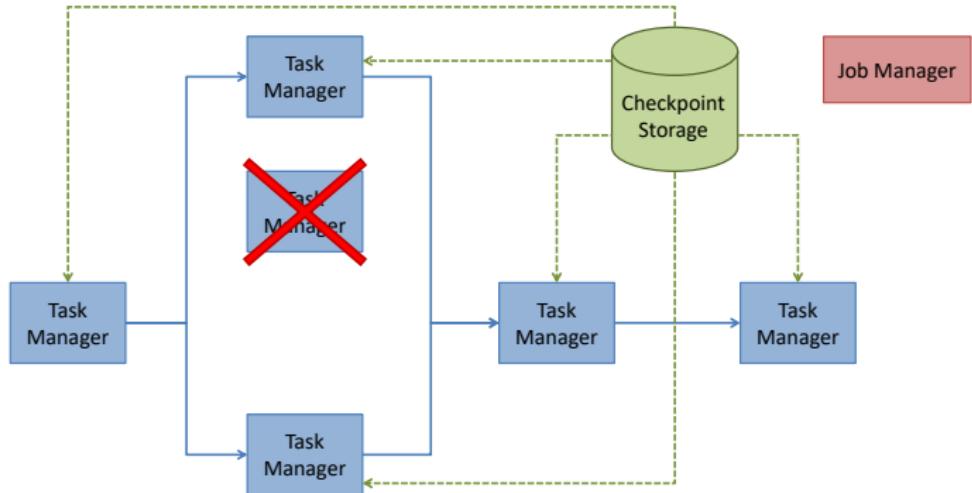


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Recovery from Failures

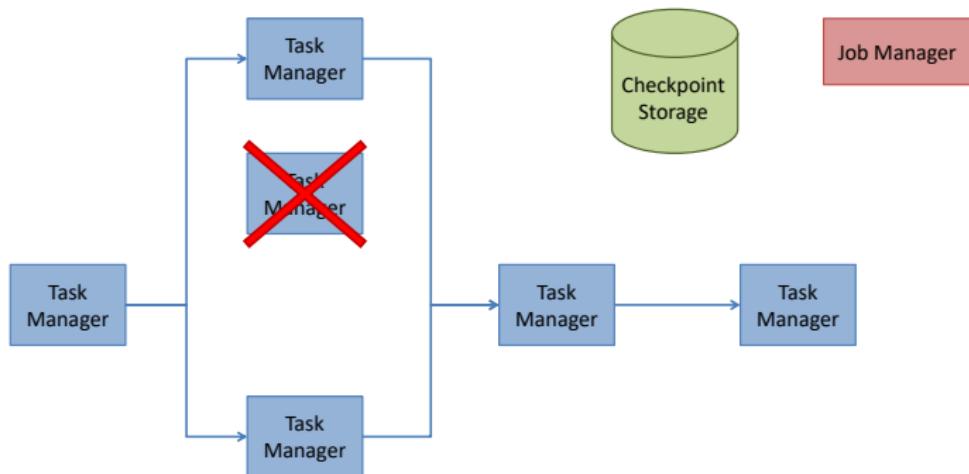


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Heterogeneous Environments



Figure: Flink in a heterogeneous environment [Janßen et al., 2018]



Heterogeneous Environments

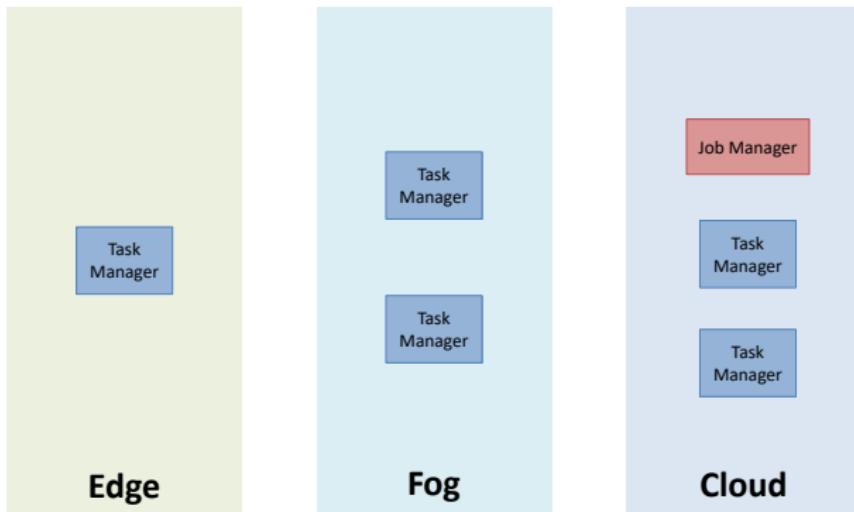


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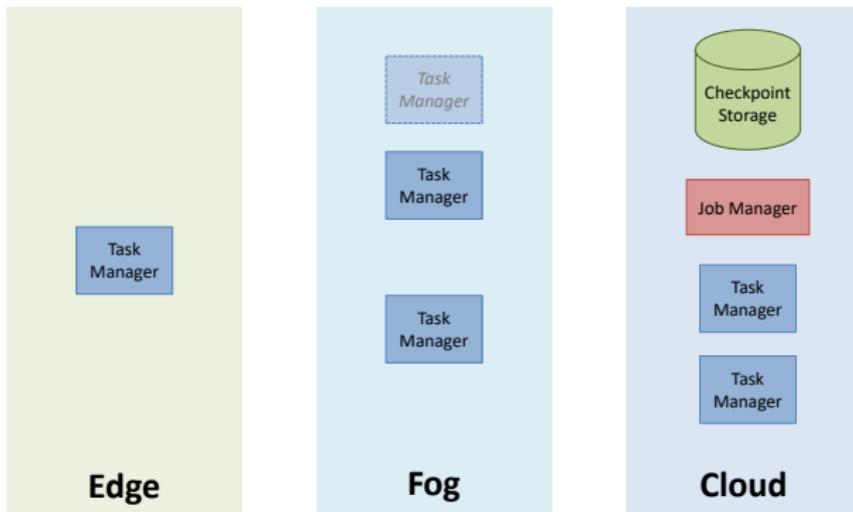


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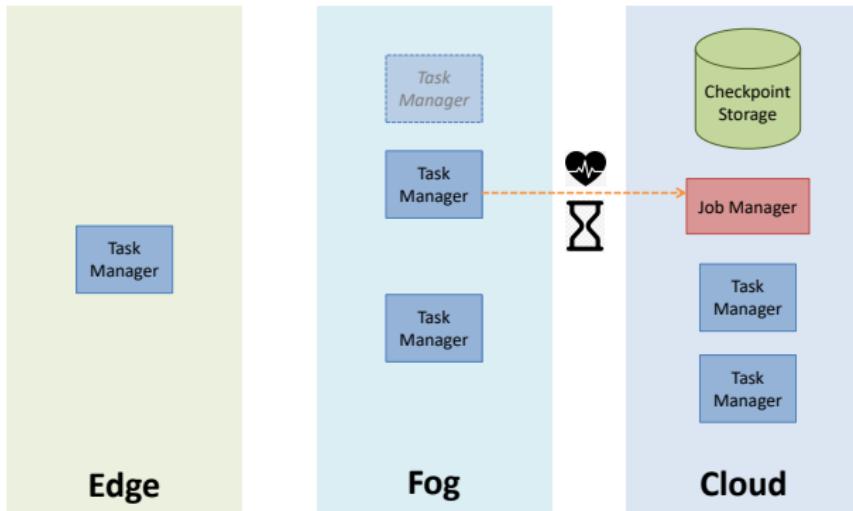


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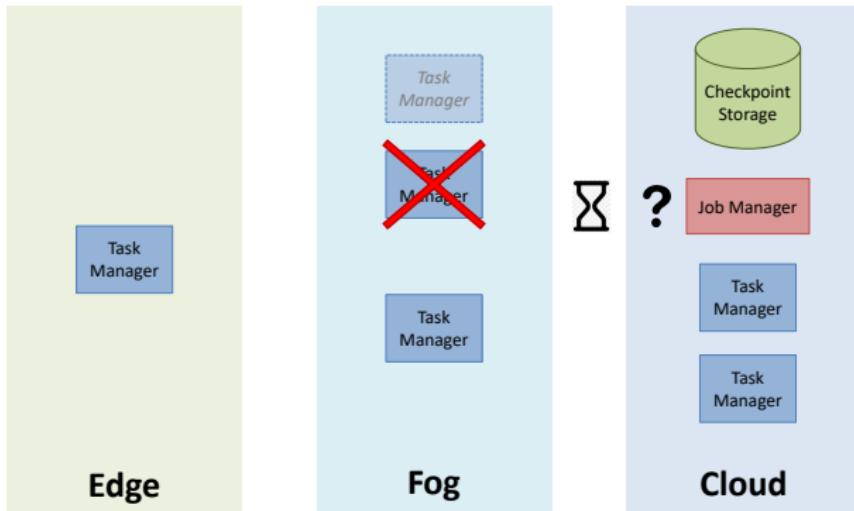


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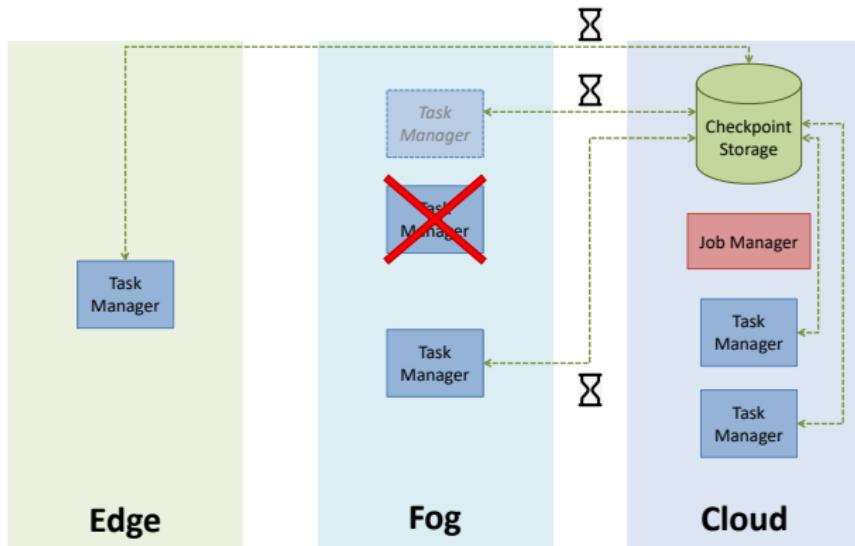
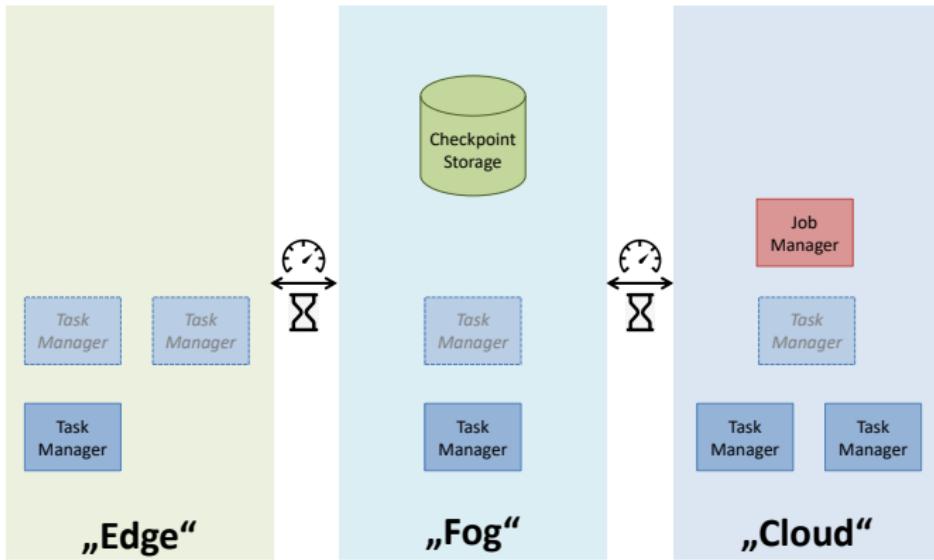


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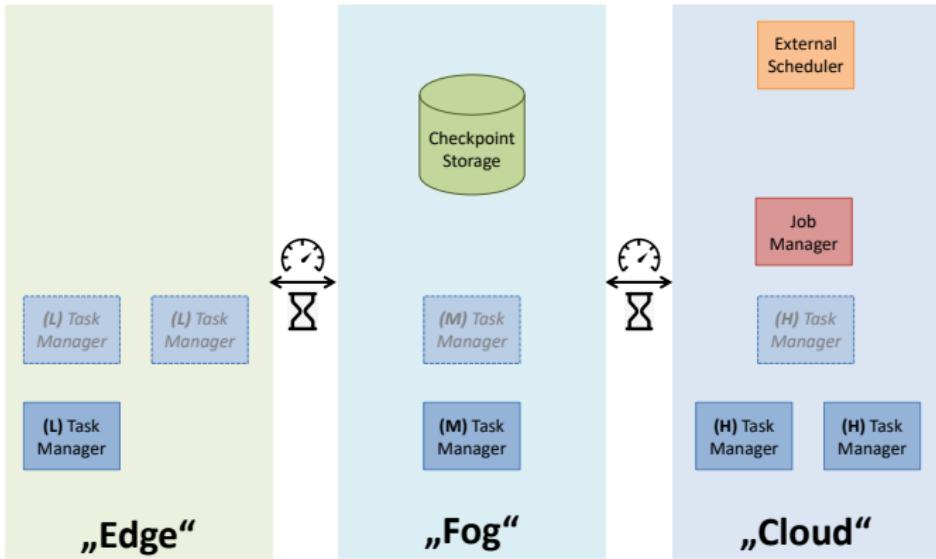


Approach



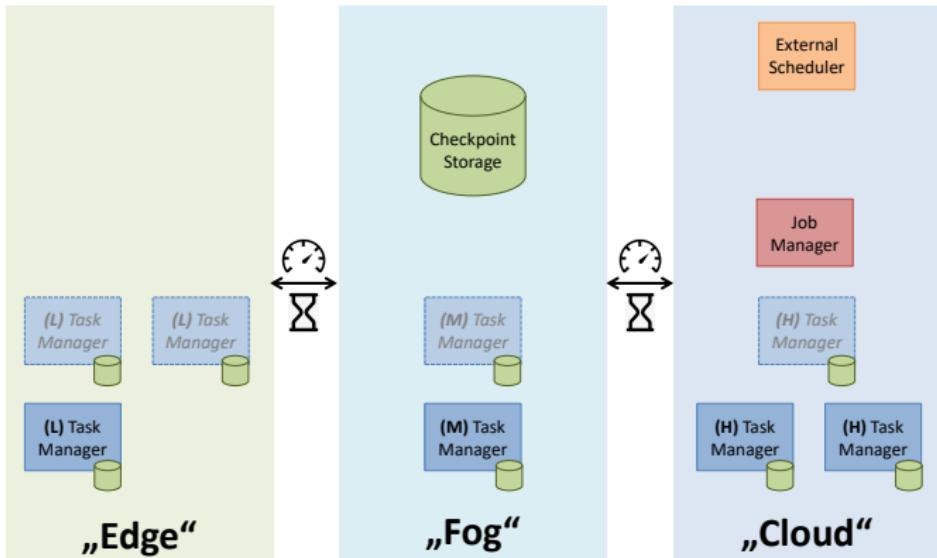


Approach



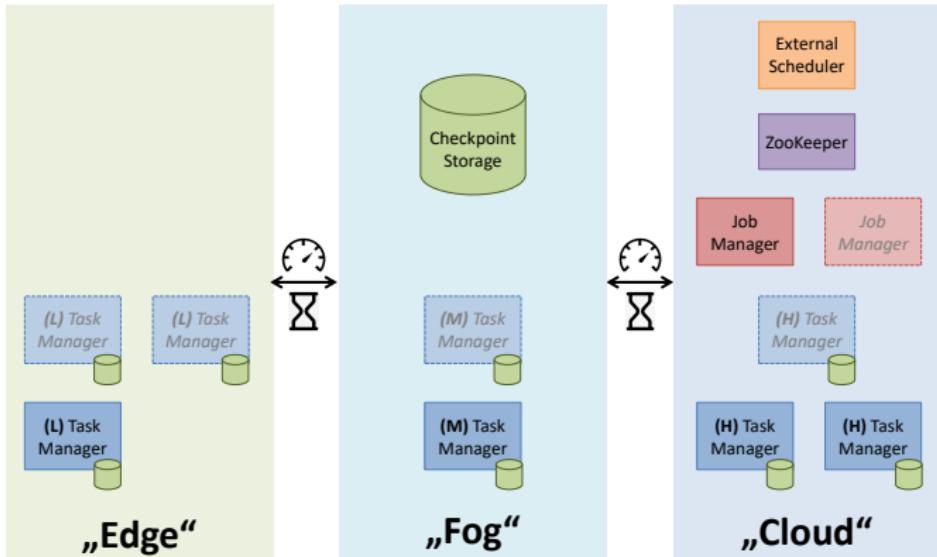


Approach





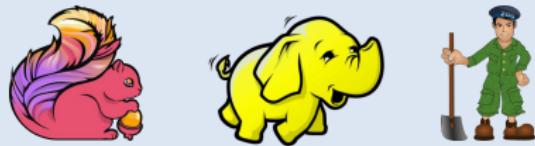
Approach





Tools

Apache
Toolset



Environment
& Testing





Demo



Challenges

Heterogeneous Environment:

- First via docker_compose.yaml, but docker swarm requirement caused problems
- Moved away from all of that, created manual script of deploying the environment

Checkpointing:

- Not trivial to implement due to bad documentation
- Problems with different storage options (local storage, JobManager heap, HDFS)

High Availability Mode:

- Hadoop / Zookeeper / Flink interactions with the external scheduler
- Coordination with multiple JobManagers



Conclusion

Outlook:

- Requirement of expert knowledge:
 - resource requirements of tasks
 - capabilities of task managers
 - location of task managers, job managers and checkpoint storage
- Overhead due to replications should be minimized
- HDFS DataNode placement is not very effective due to concurrent reading
- Predictive fault tolerance is interesting but not really testable with tools like Pumba

Outlook for our paper:

- Concrete evaluation metrics, i.e. avg. recovery time
- Further evaluation of Hadoop- and JobManager-nodes placement



**Thank you for your
attention!**



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- ▶ Katsifodimos, P. C. A., Markl, S. E. V., and Tzoumas, S. H. K. (2015).
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