

# 로봇을 위한 MLOps 1부

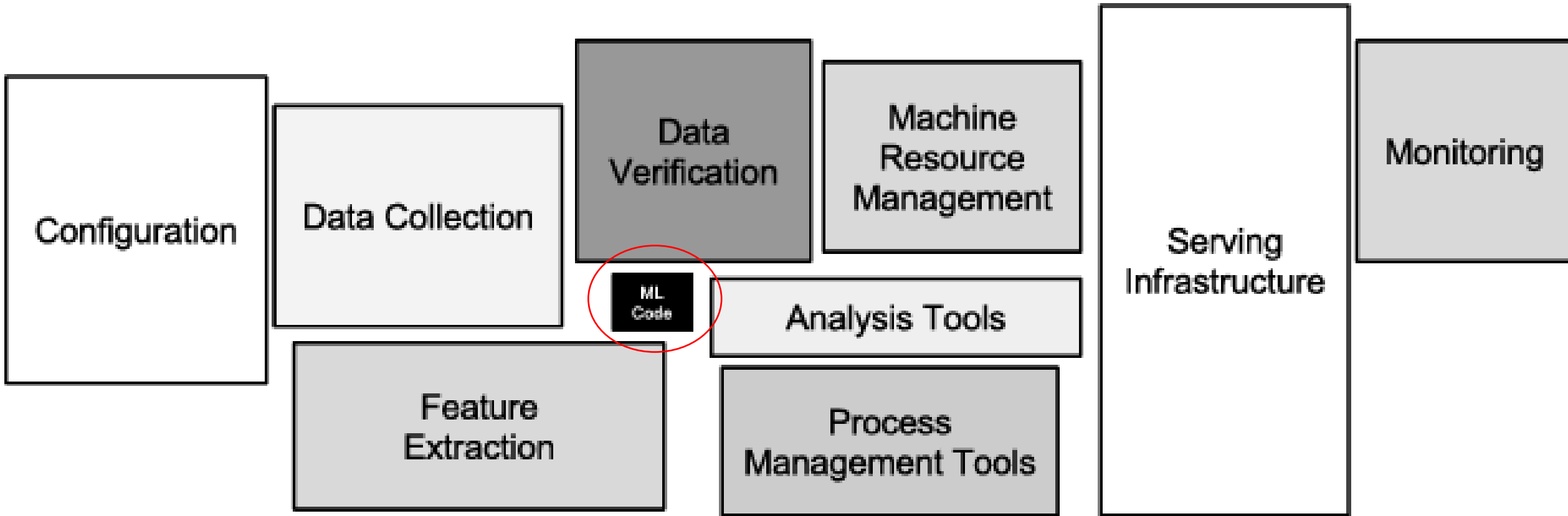
신재익

2025.08.30

# Reference

- 요즘 우아한 AI 개발
- 15장
- 우아한 기술 블로그
- <https://techblog.woowahan.com/17647/>
- 우아콘2023 배달 로봇의 주변 환경 인지
- <https://www.youtube.com/watch?v=7QFMru0HZto>

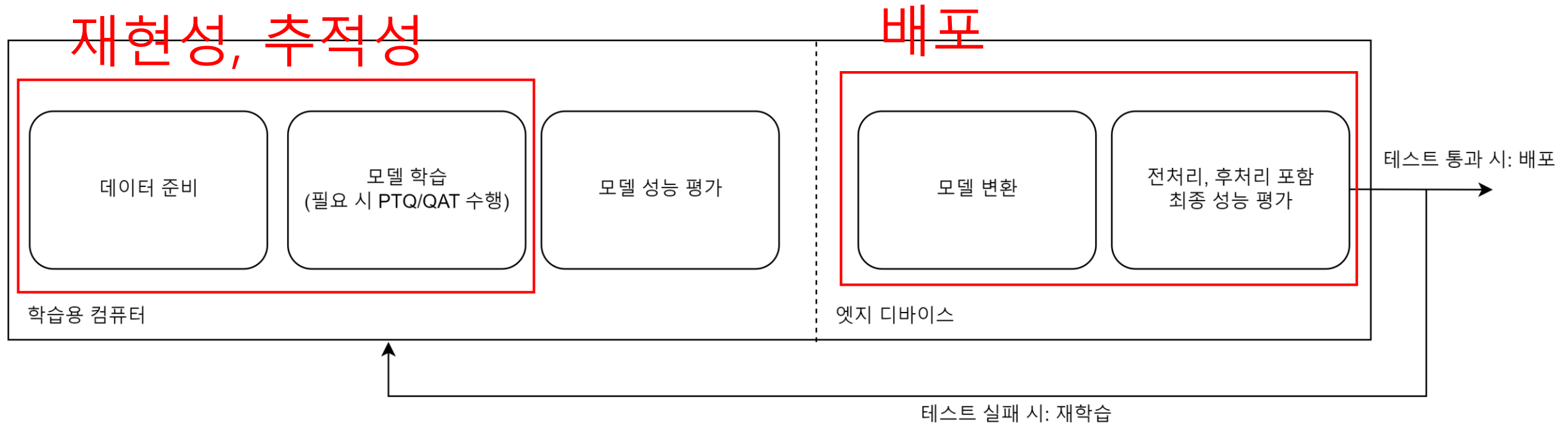
# 기술 부채(technical debt)



Sculley, David, et al. "Hidden technical debt in machine learning systems." Advances in neural information processing systems 28 (2015).

<https://zzsza.github.io/data/2018/01/28/hidden-technical-debt-in-maching-learning-systems/>

# MLOps : 학습 파이프라인, 서빙 파이프라인



모델 변환 : 양자화 (PTQ, QAT)

데이터 보관, 모델 훈련 및 배포



모델 훈련용 계산 자원

엣지 디바이스 : 로봇



모델 배포



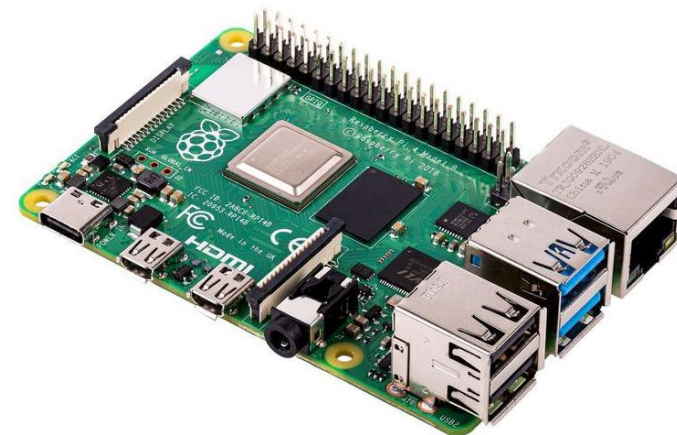
데이터 수집



모델 최적화

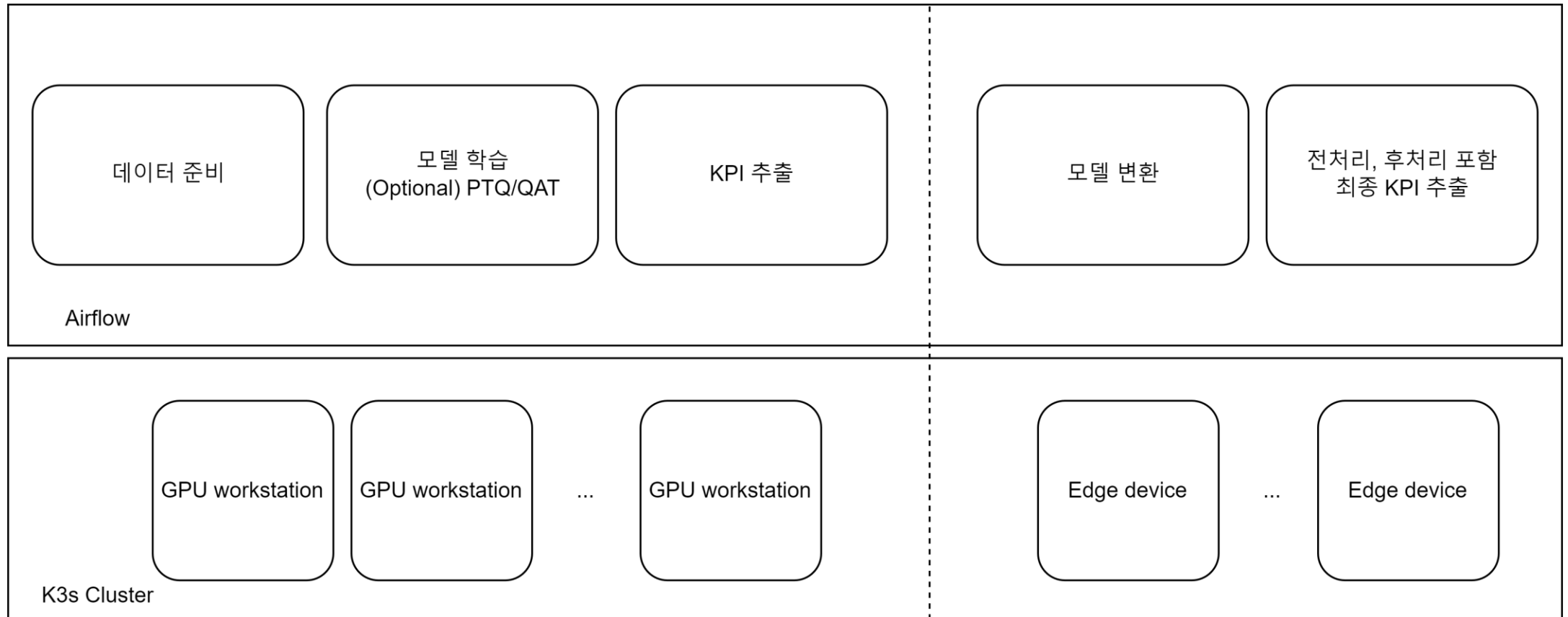


디바이스 정보



모델 추론용 계산 자원

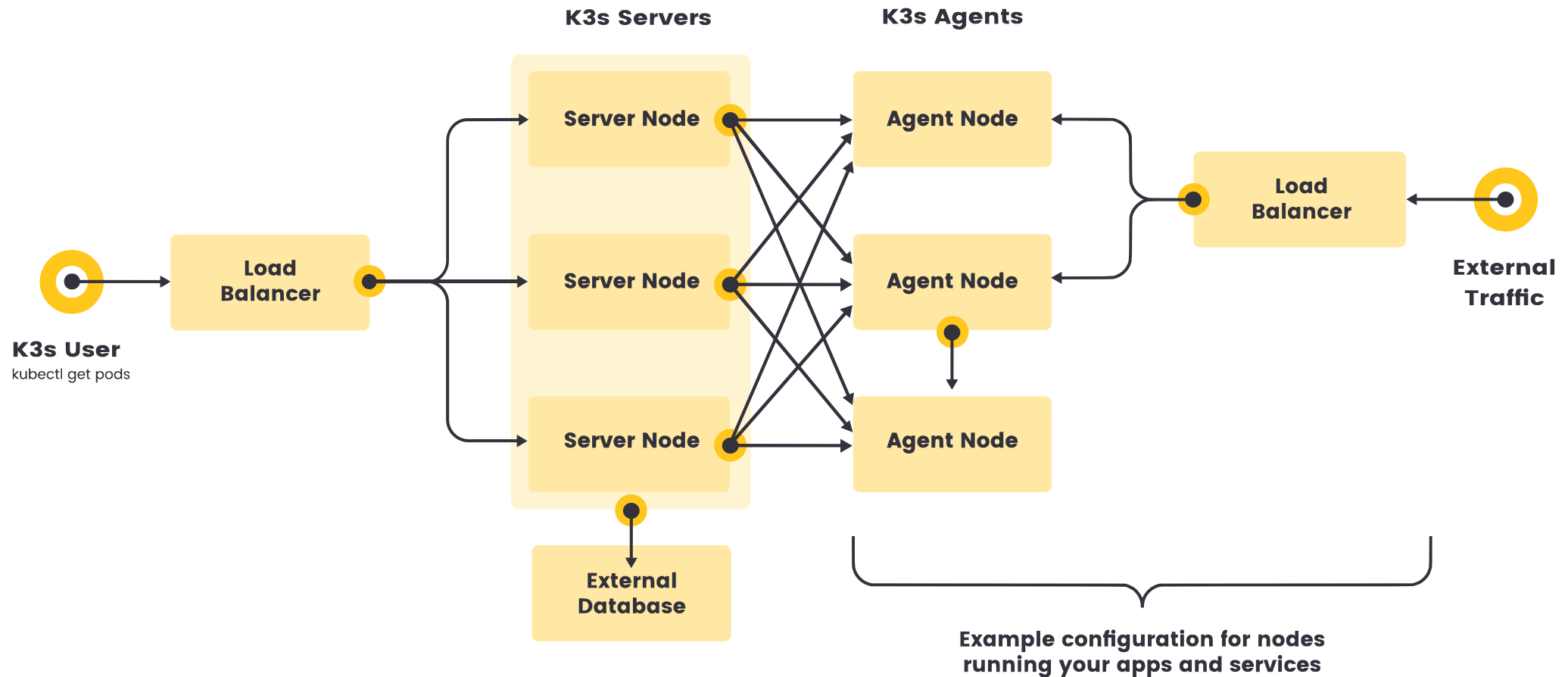
# K3s 과 Airflow 로 구성한 MLOps 시스템



# K3s : lightweight Kubernetes (자원관리)

- K3s
- <https://k3s.io/>
- <https://docs.k3s.io/>
- <https://github.com/k3s-io/k3s/>

# Example of K3s cluster





# Apache Airflow (파이프라인)

- Airflow
- <https://airflow.apache.org/>
- <https://airflow.apache.org/docs/apache-airflow/stable/index.html>
- <https://github.com/apache/airflow/>
- Kubernetes 의 패키지 매니저 helm 을 이용해서 설치

# DAG (directed acyclic graph)

train\_affinity, edge\_affinity를 이용해 실행하는 장소를 명시 (노드 지정)  
Resources를 이용해 GPU 자원을 요청  
train\_task 로 파이토치를 이용한 모델 훈련  
edge\_task 로 nvidia jetson (엣지디바이스) 를 위한 모델 변환

The screenshot shows the Apache Airflow web interface. At the top, there's a navigation bar with the Airflow logo and links to DAGs, Cluster Activity, Datasets, Security, Browse, Admin, and Docs. The current time is 14:14 UTC and the user is AU. Below the navigation bar, the title 'DAGs' is displayed. A filter section shows 'All 9', 'Active 1', and 'Paused 8' buttons, along with 'Running 0' and 'Failed 0' buttons. There's a 'Filter DAGs by tag' input field and a 'Search DAGs' search bar. An 'Auto-refresh' toggle is also present. The main table lists DAGs with columns: DAG, Owner, Runs, Schedule, Last Run, Next Run, Recent Tasks, Actions, and Links. The first row shows a DAG named 'woowa\_sample' owned by 'woowa', with no runs, a 'None' schedule, and no recent tasks. The bottom of the interface shows a pagination bar with '1' selected and the text 'Showing 1-1 of 1 DAGs'.

DAG	Owner	Runs	Schedule	Last Run	Next Run	Recent Tasks	Actions	Links
woowa_sample	woowa	0	None				[Play] [Stop]	...

