

The modern MLOps framework

MLOPS DEPLOYMENT AND LIFE CYCLING



Nemanja Radojkovic

Senior Machine Learning Engineer

About me

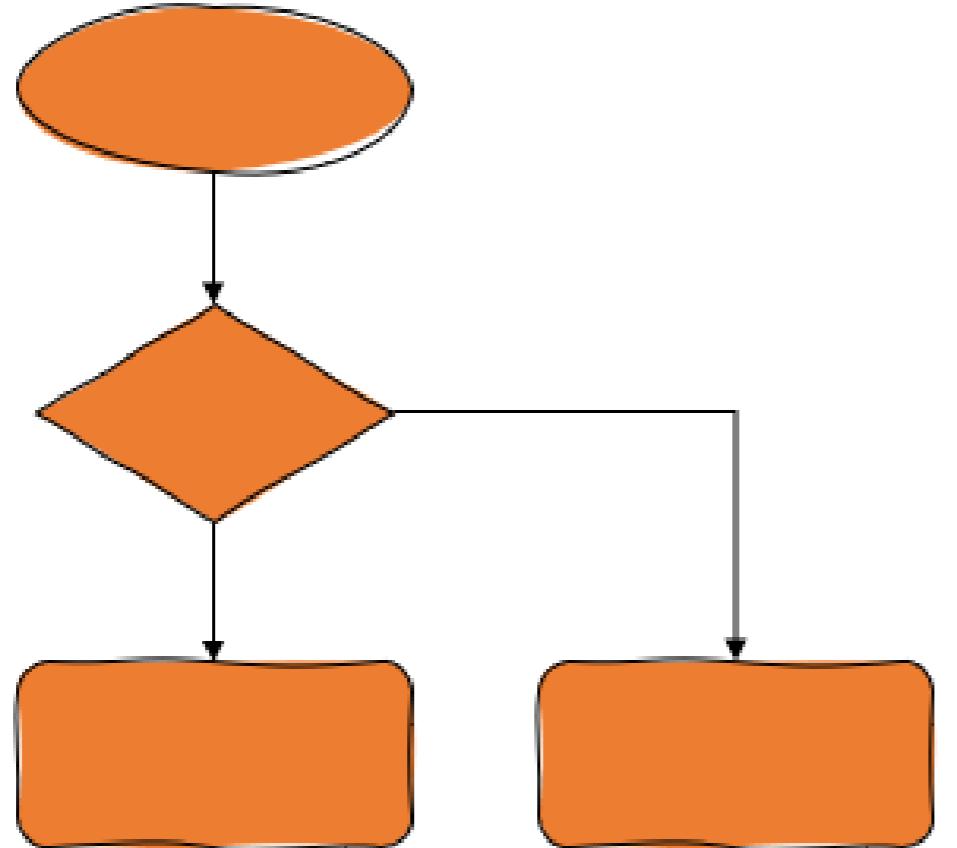


- Senior Machine Learning Engineer
- Experience developing, deploying, and maintaining Machine Learning models in production
- Current focus: ML deployment and life-cycling

¹ www.linkedin.com/in/radojkovic

Conceptual course

YES: High-level understanding



NO: Hands-on skills



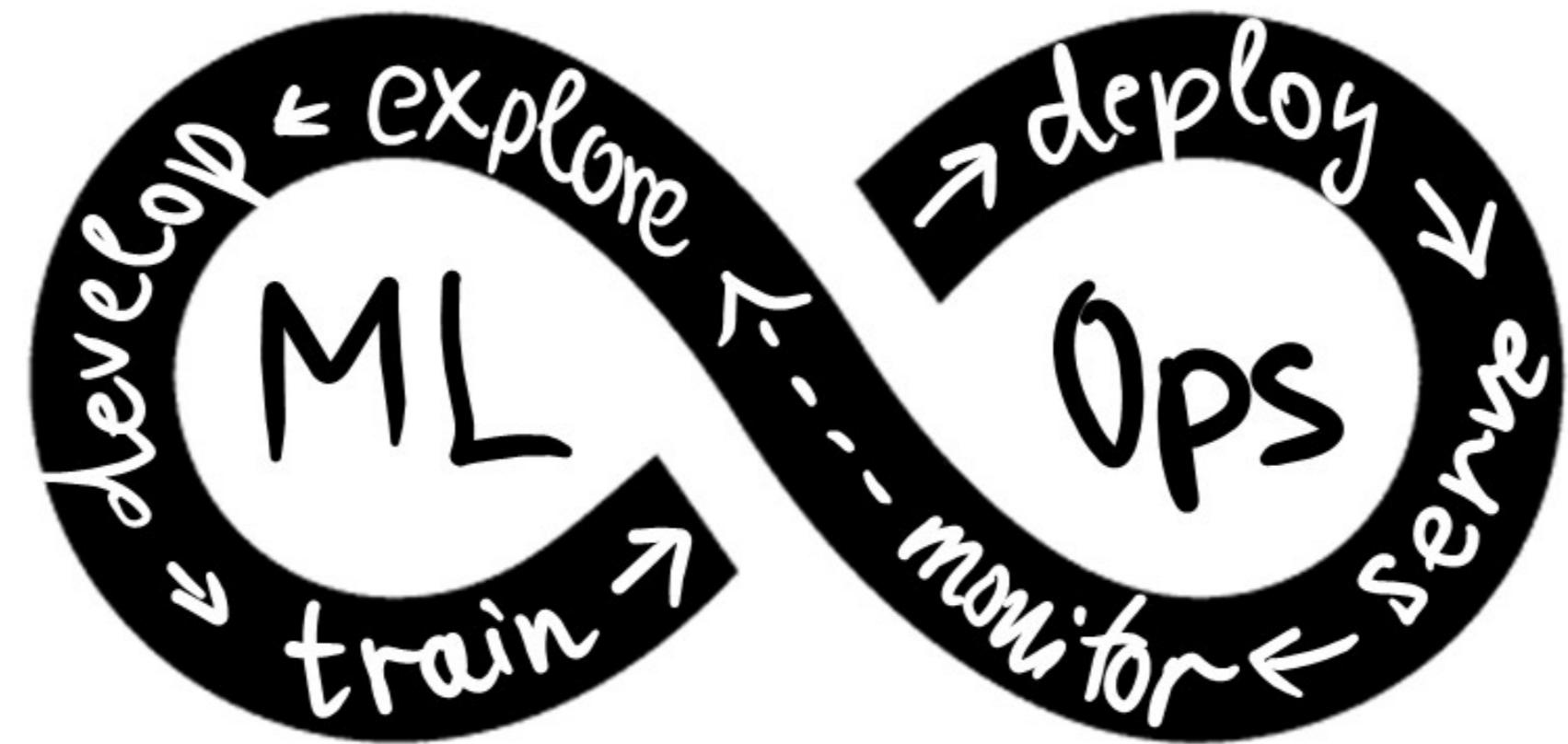
MLOps

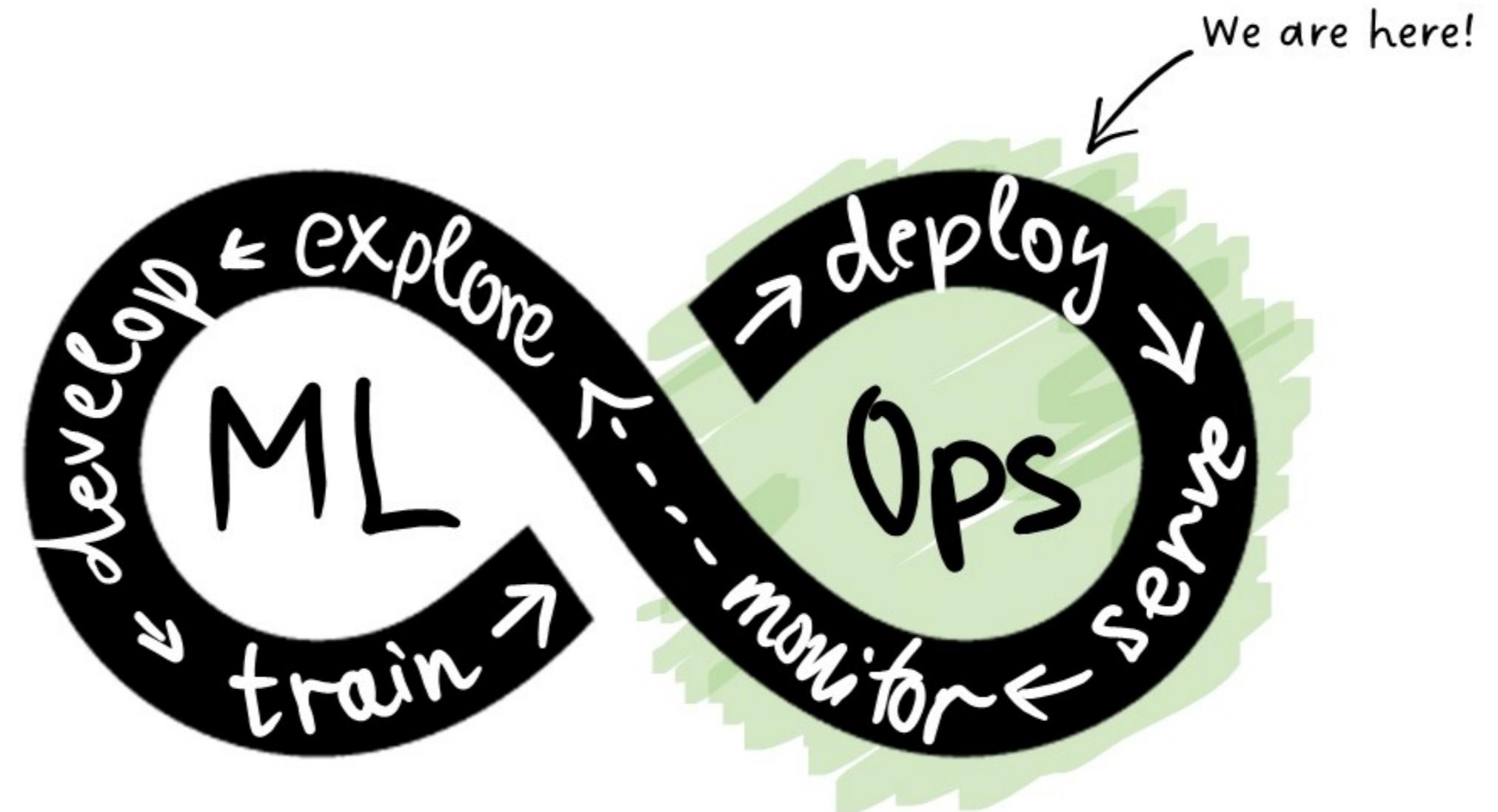
Machine Learning Operations

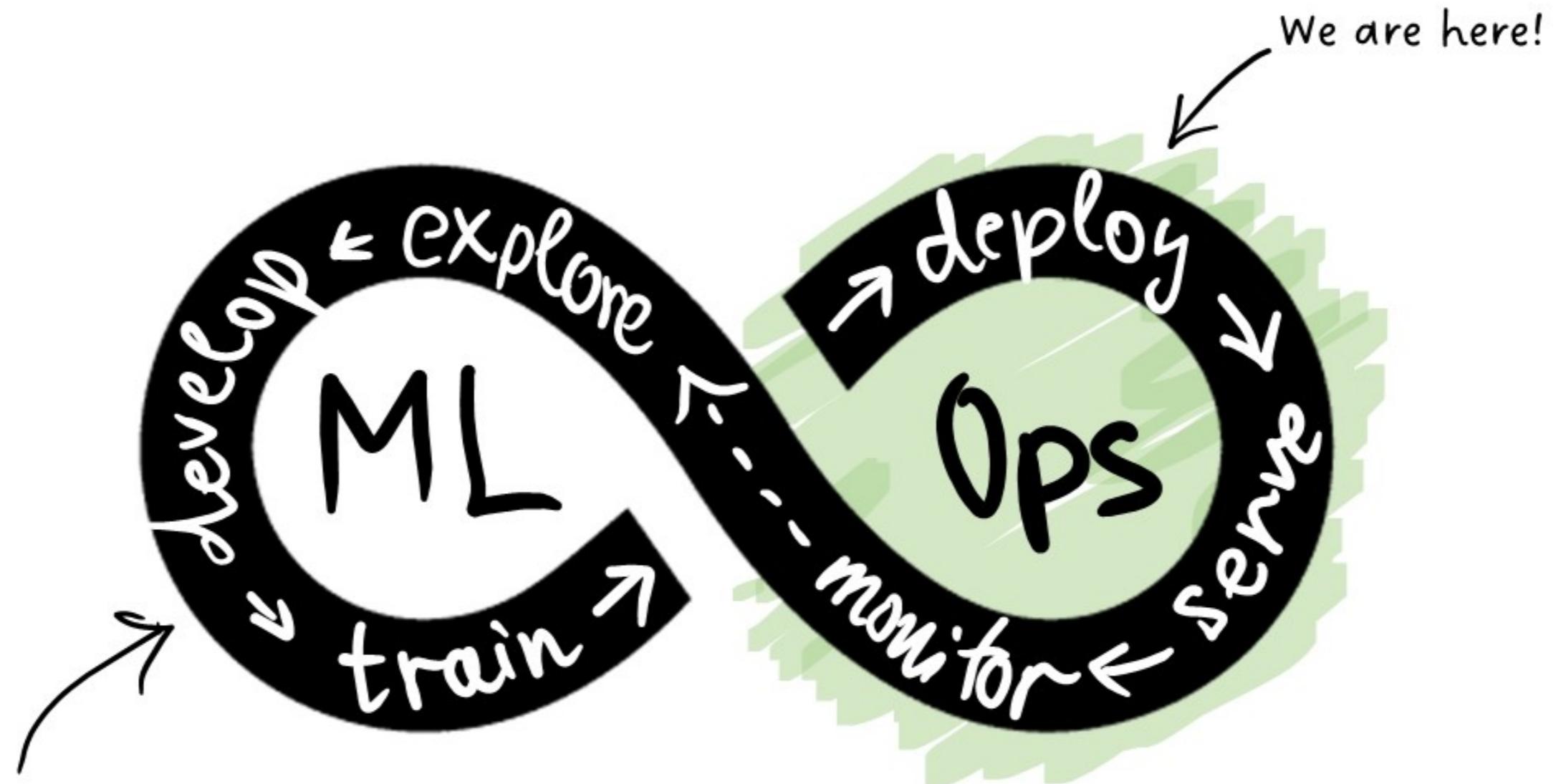
- Principles
- Practices
- Tools

Goal: ML workflows and services

- Automated
- Reproducible
- Integrated







Chapter I

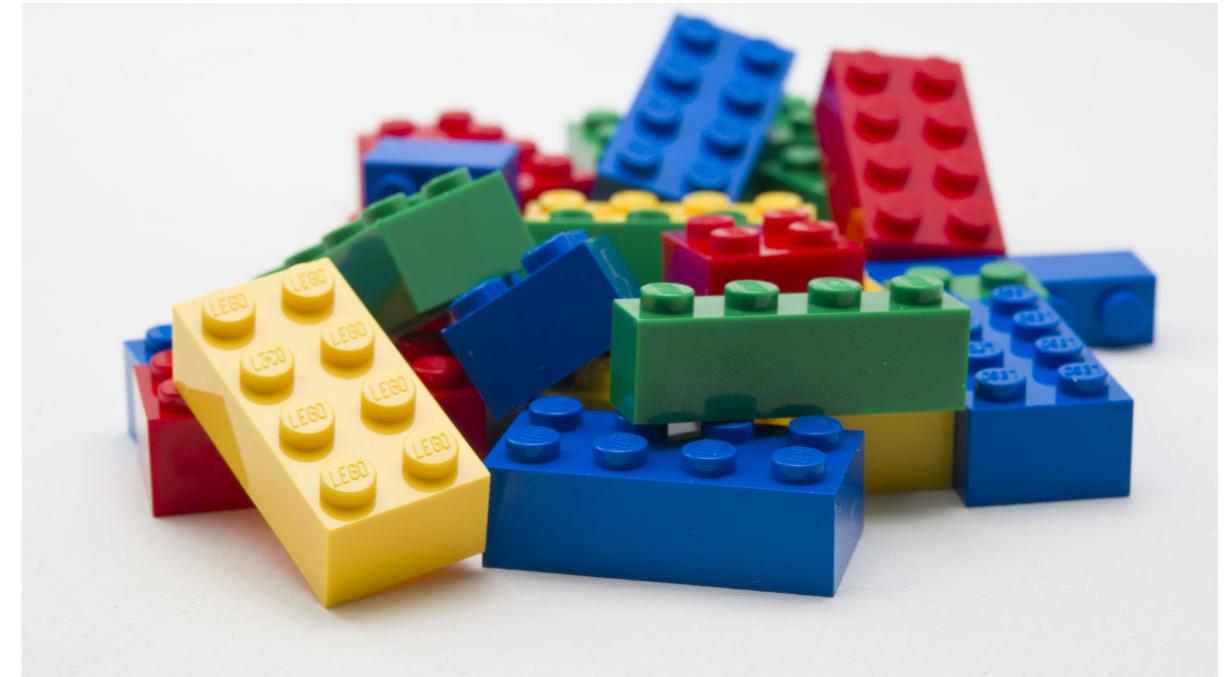
Value and necessity of MLOps

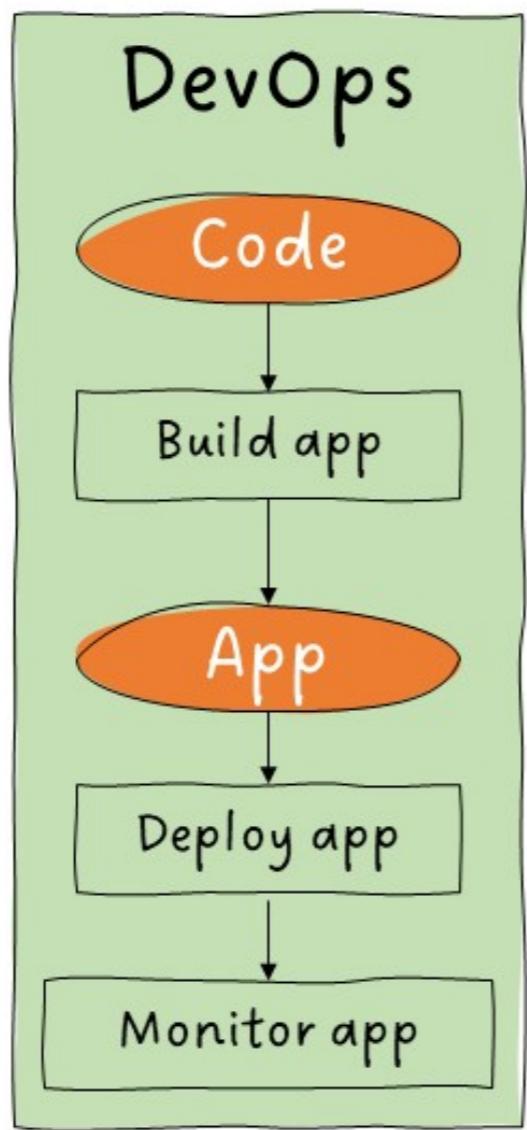


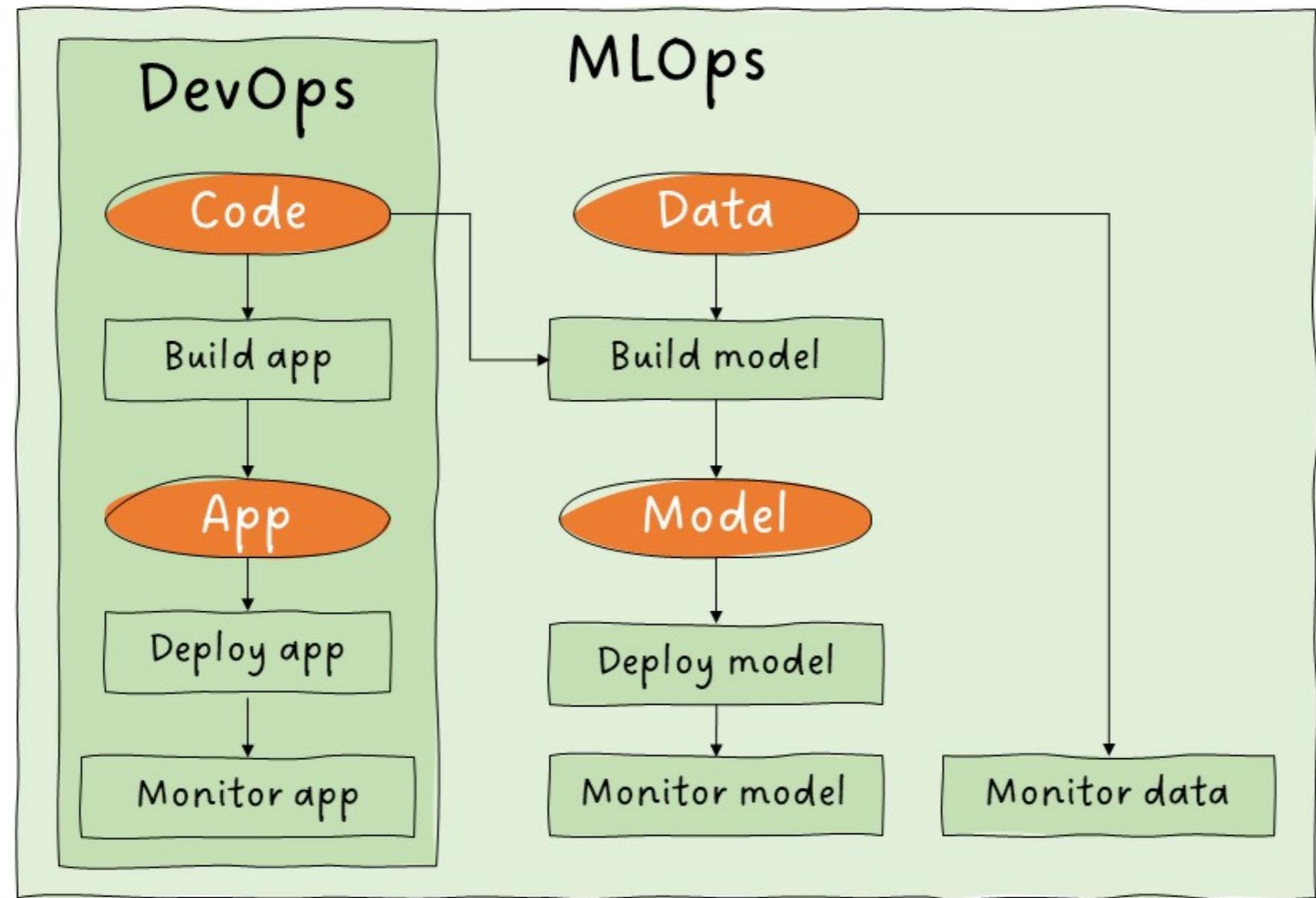
Model life cycle stages



Components of the MLOps framework







High cost of ML without the Ops

USUAL STARTING POINT

- Manual ML workflows
- Manual deployment
- Ad hoc monitoring

=> Accumulation of technical debt

Technical Debt

the implied cost of additional rework caused by choosing an easy (limited) solution now instead of using a better approach that would take longer

~ Wikipedia[1]

MORE TIME AND MODELS DEPLOYED

- More technical debt and model risk
- Process slower, more frustrating and error prone
- Ability to deliver value impaired

Famous Google paper on the topic:

"Machine Learning: The high-interest credit card of technical debt"[2]

¹ https://en.wikipedia.org/wiki/Technical_debt ² <https://research.google/pubs/pub43146/>

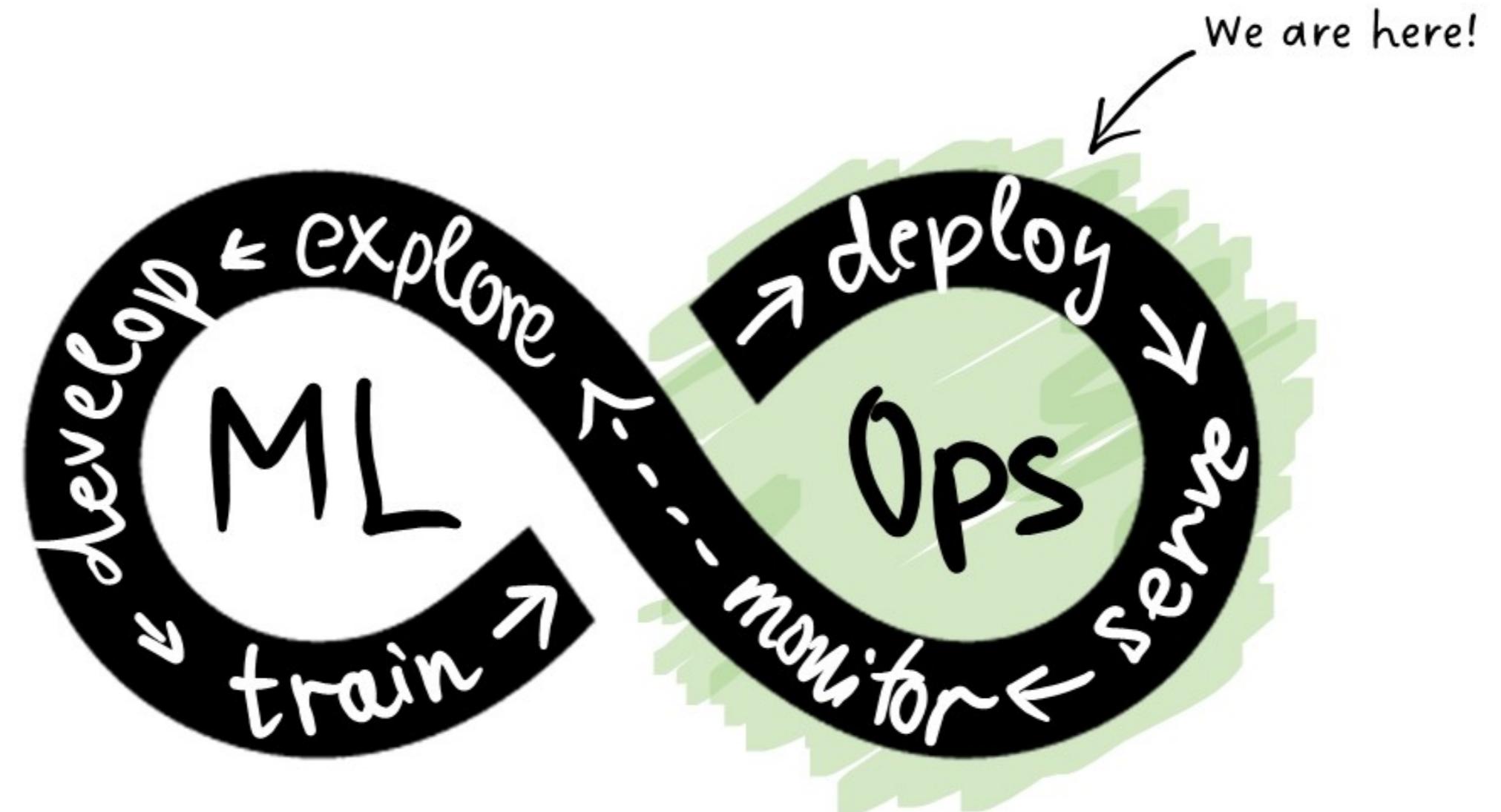
ML workflows

- Data collection and preparation
- Data-labeling
- Model selection
- Model training
- Model packaging
- Model deployment
- Model monitoring and maintenance

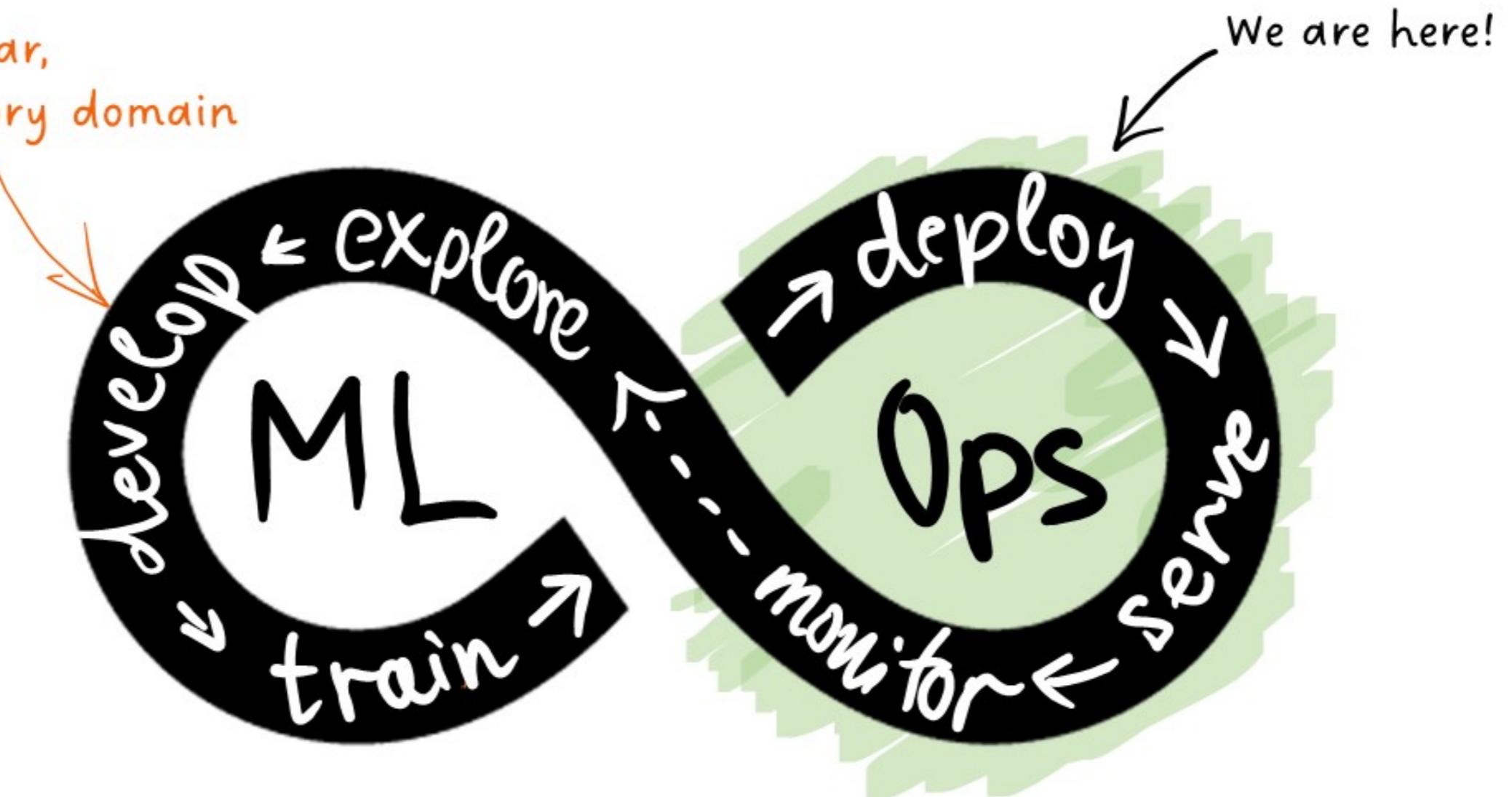
ML workflow automation == MLOps maturity

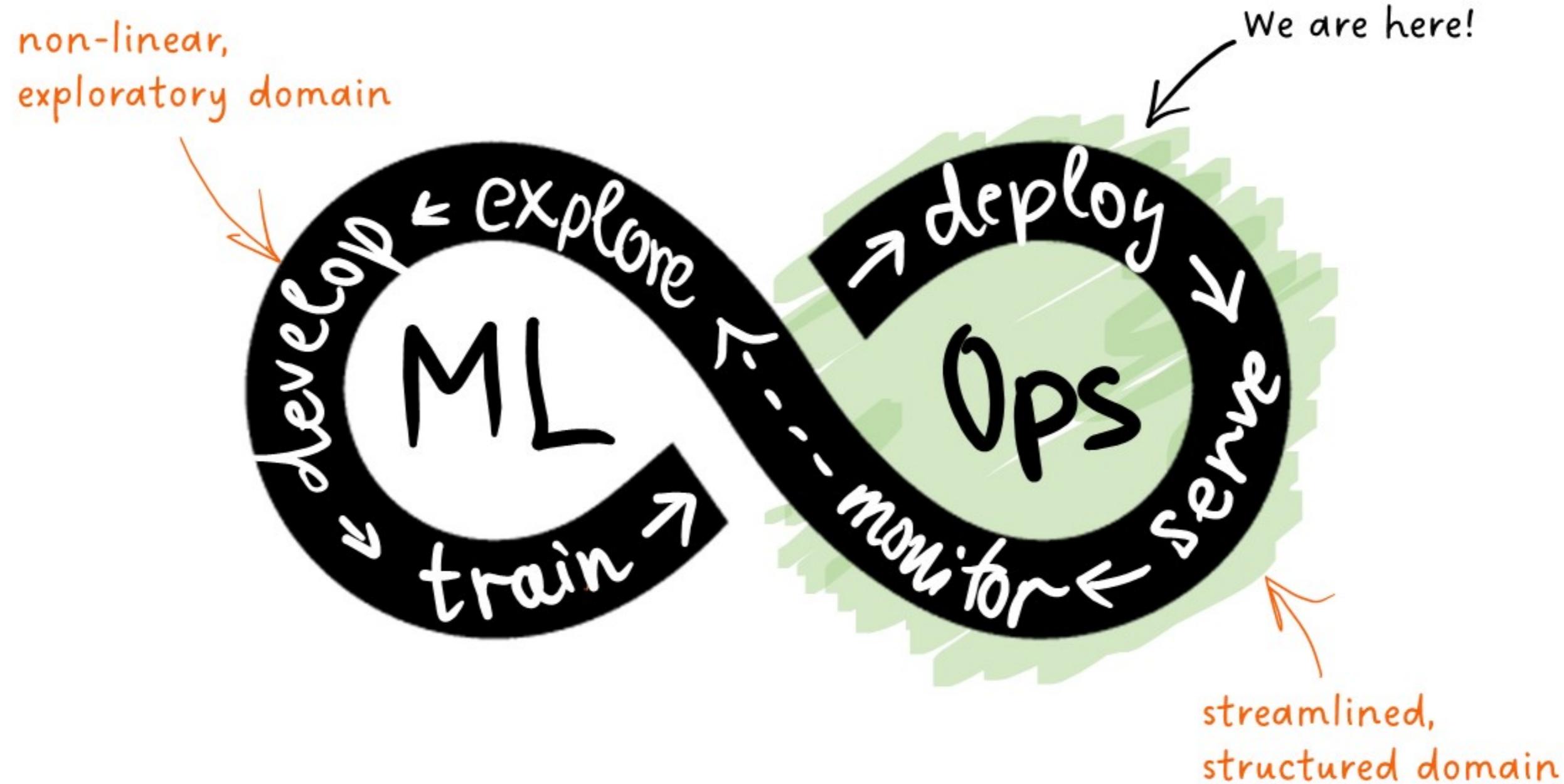
MLOps implemented

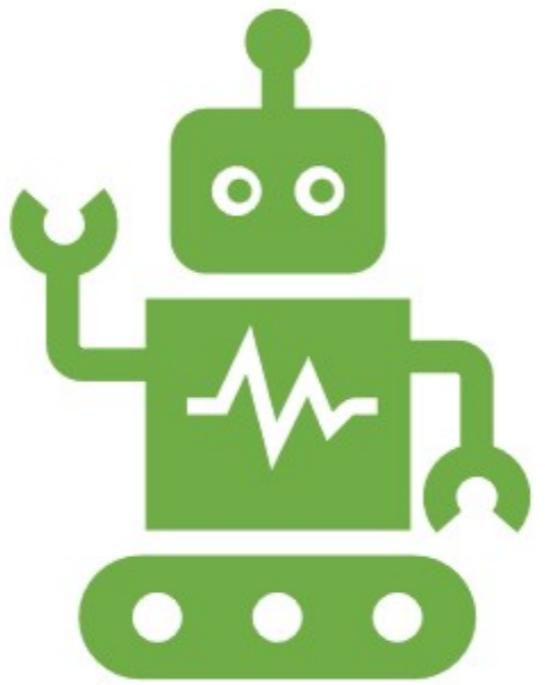
- Automated
- Fast
- Reproducible
- Explainable



non-linear,
exploratory domain



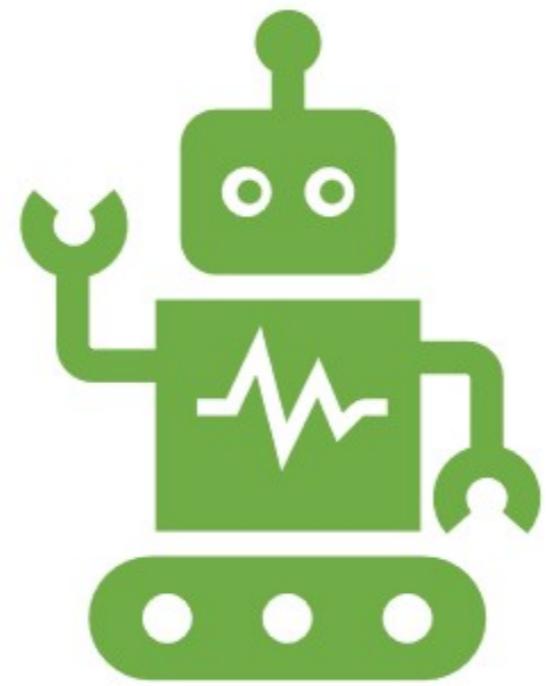






short
response
time

high visibility



narrow error
margins



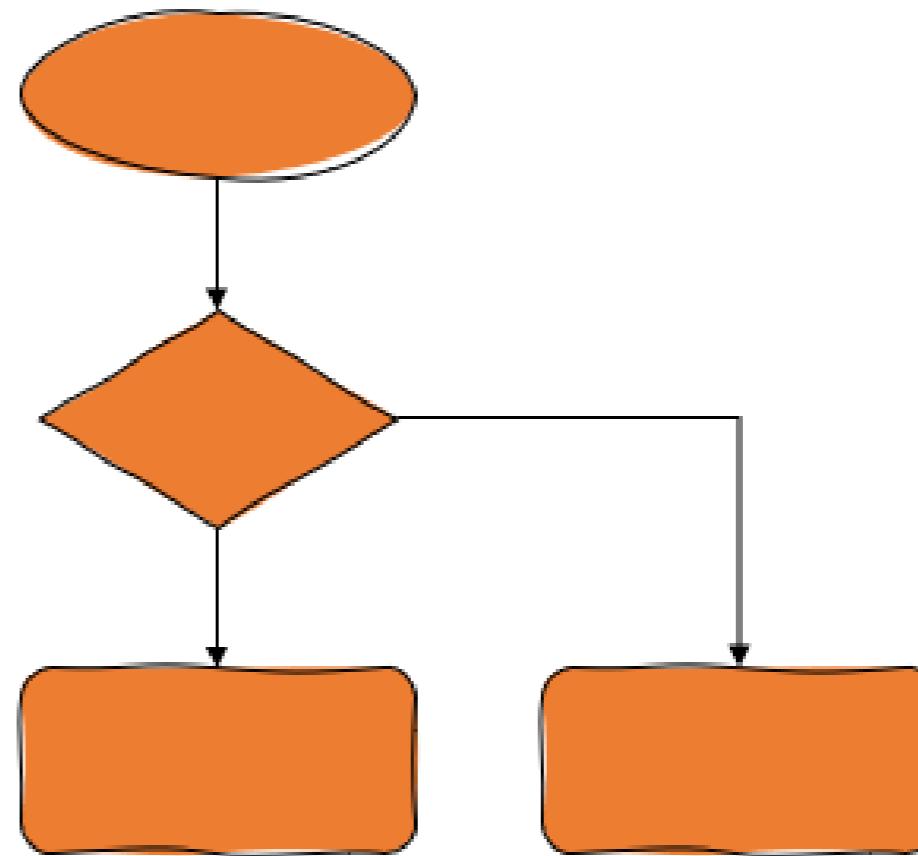


Coming up!

Model life-cycling



MLOps architecture



Let's practice!

MLOPS DEPLOYMENT AND LIFE CYCLING

Life-cycling stages

MLOPS DEPLOYMENT AND LIFE CYCLING



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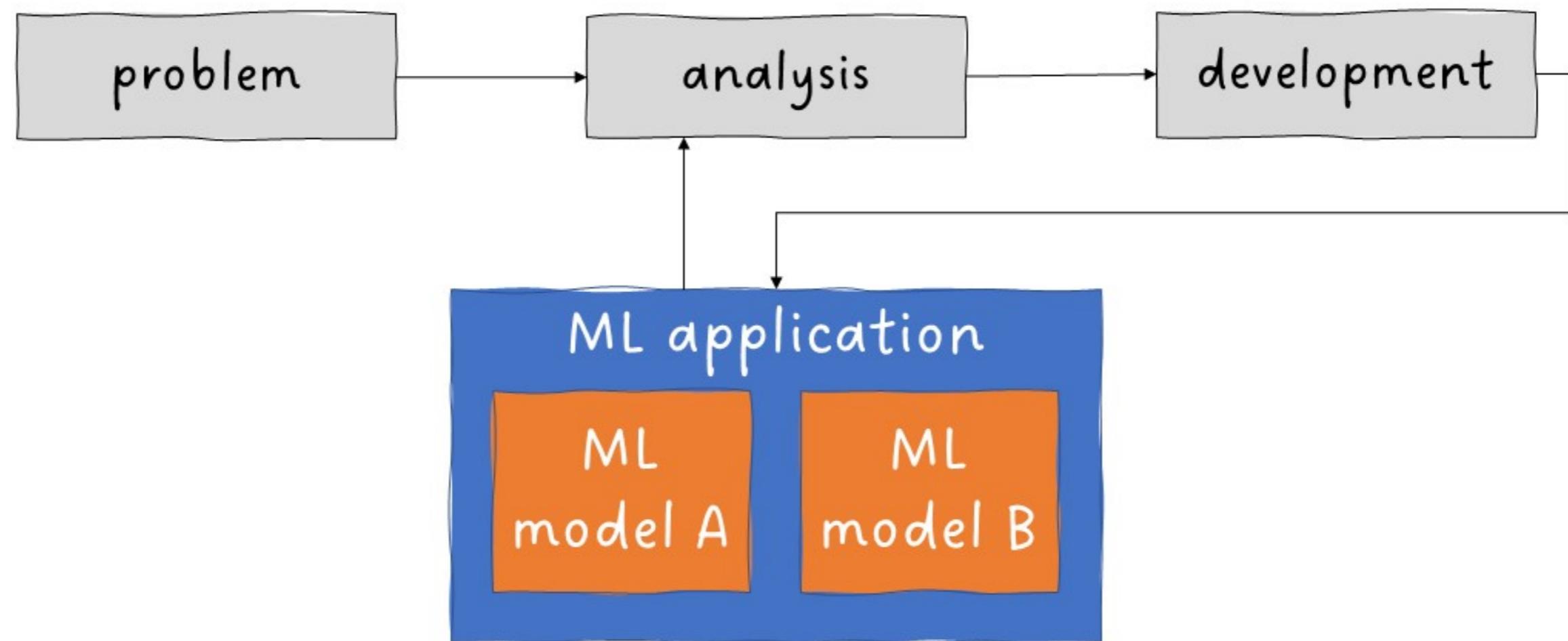
Machine Learning life cycles

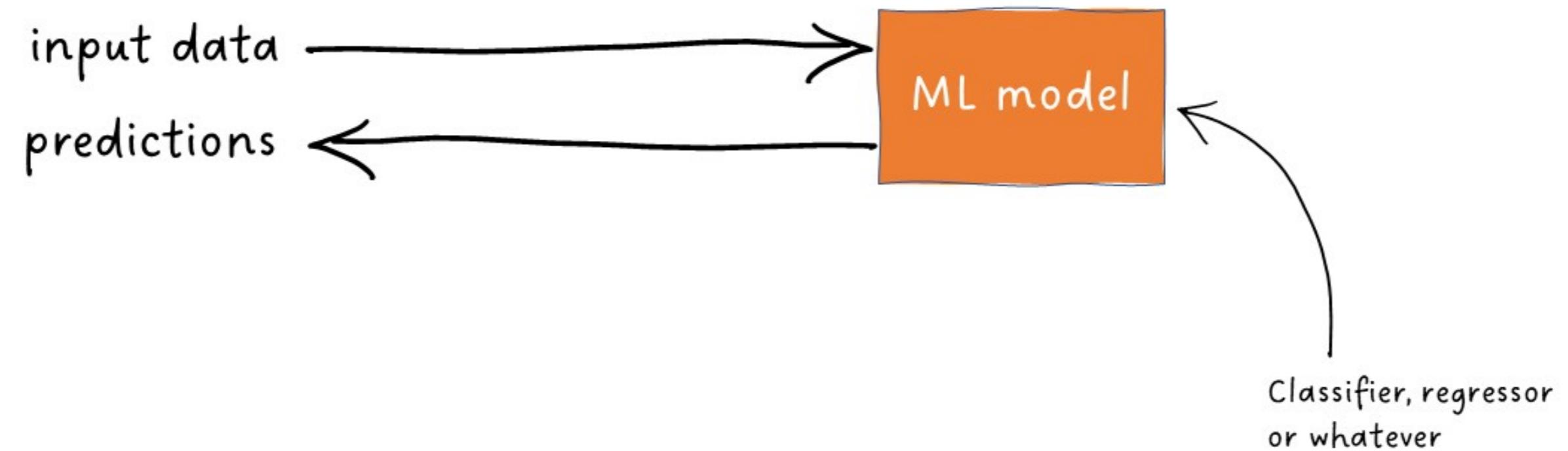
1. ML project life cycle
2. ML application life cycle
3. ML model life cycle

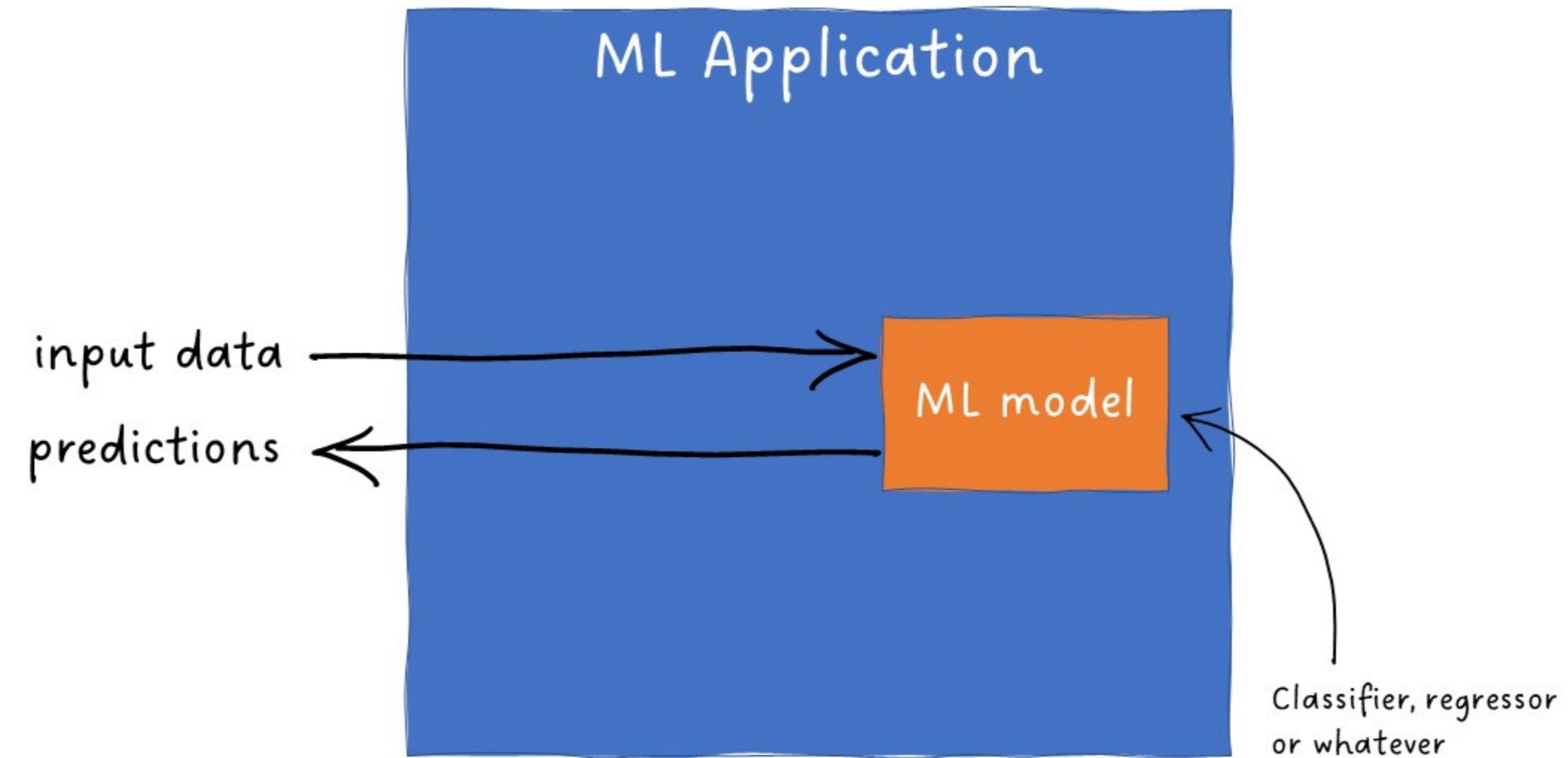
ML PROJECT

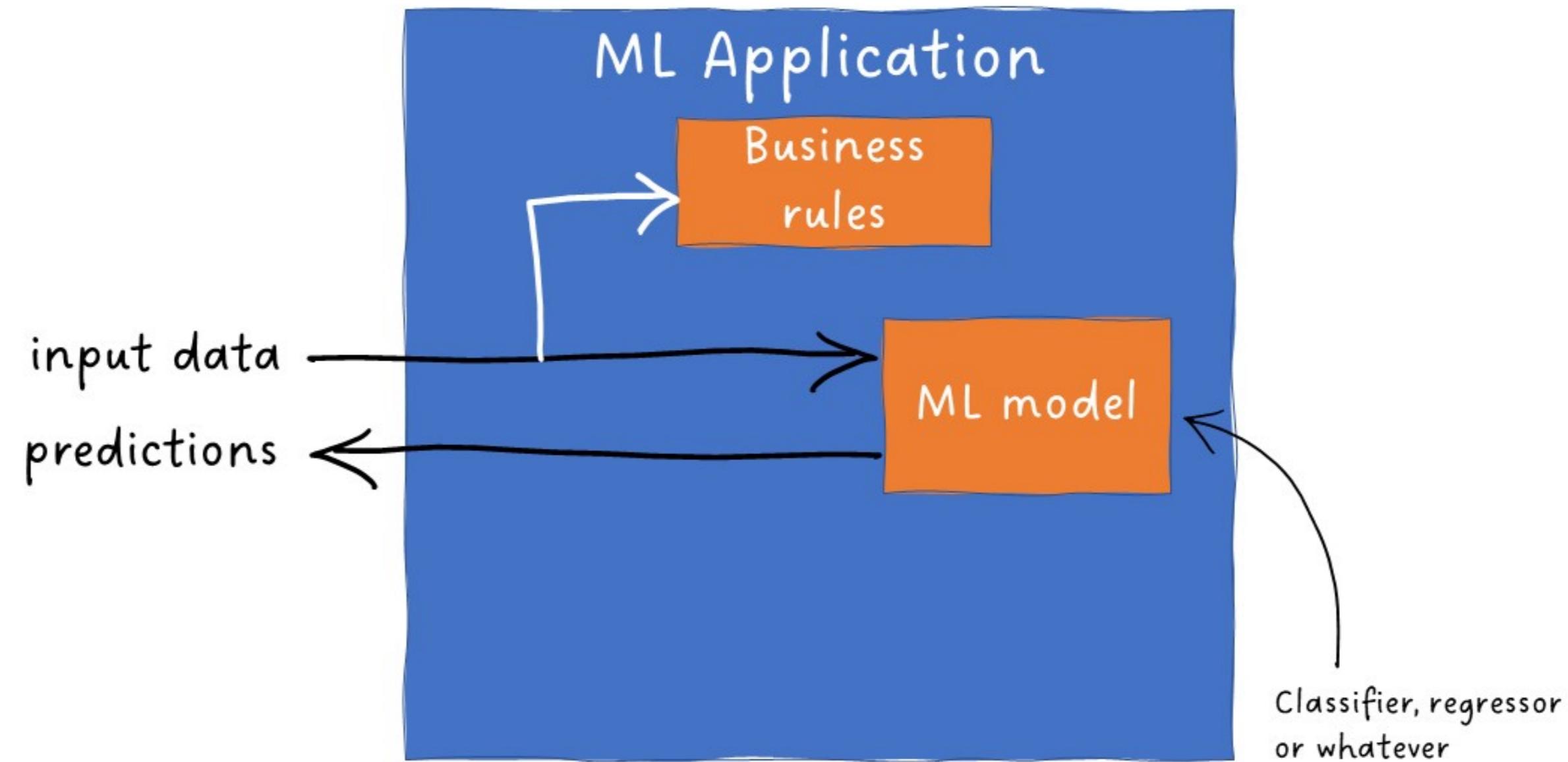


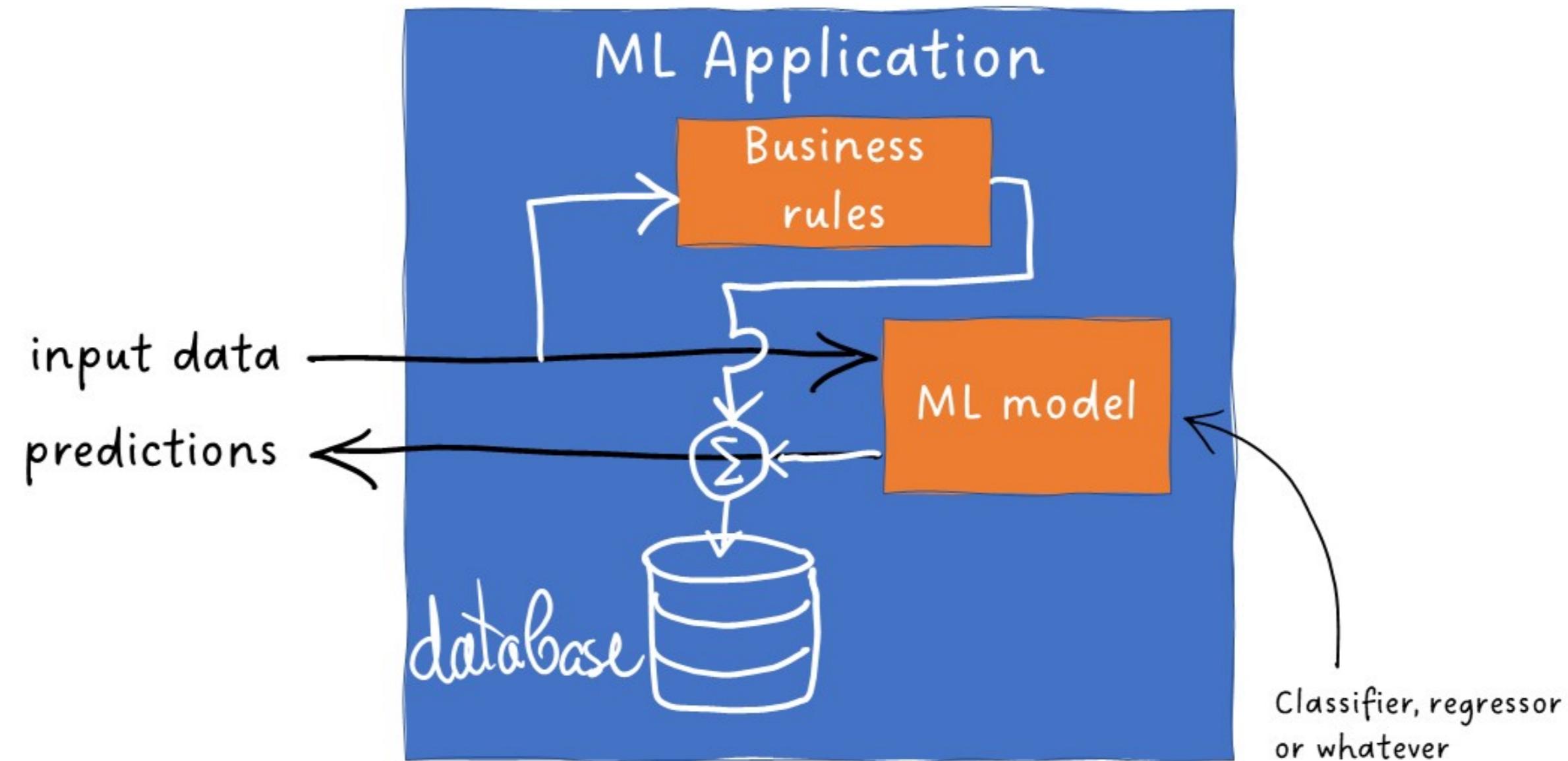
ML PROJECT

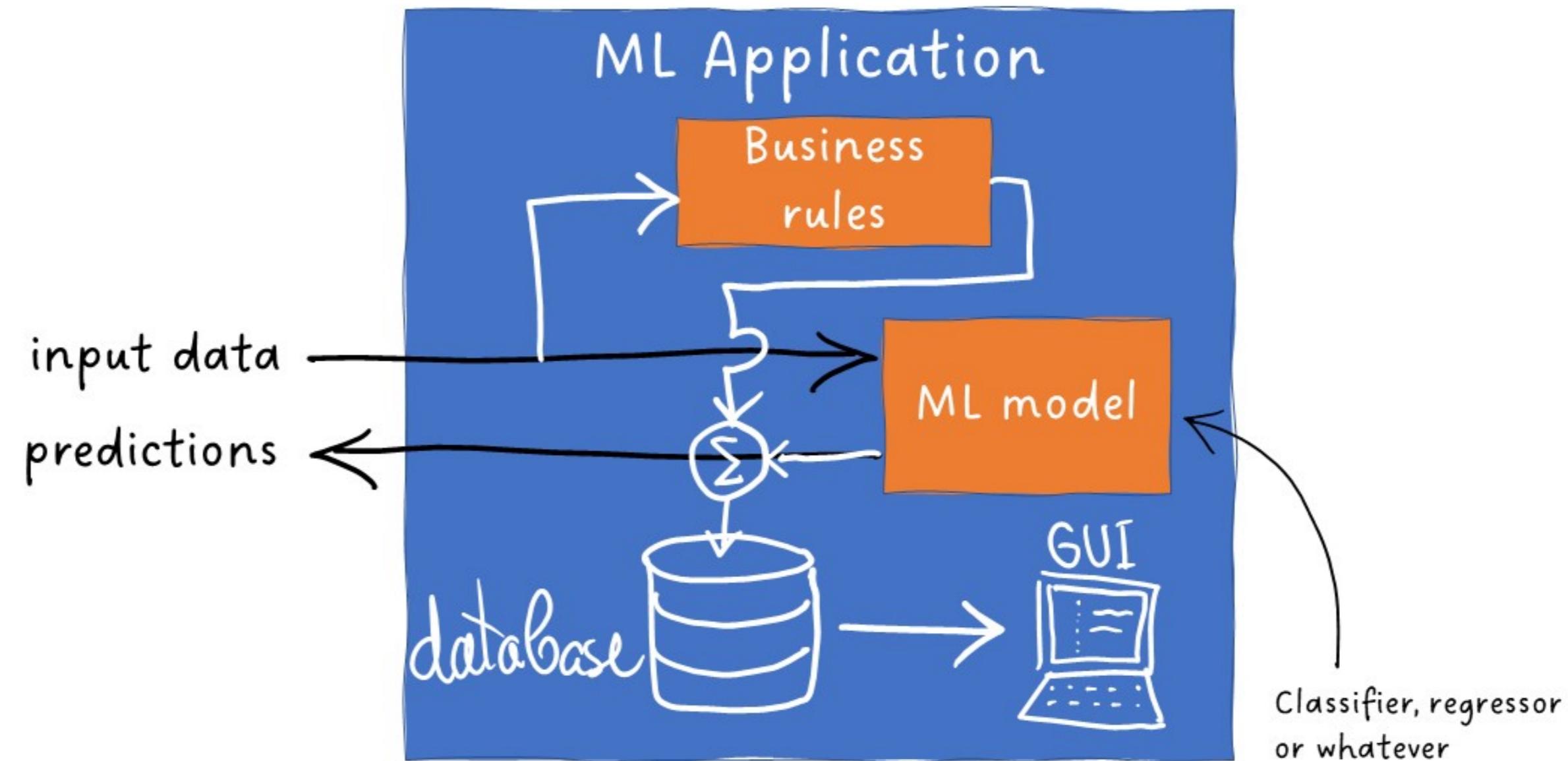


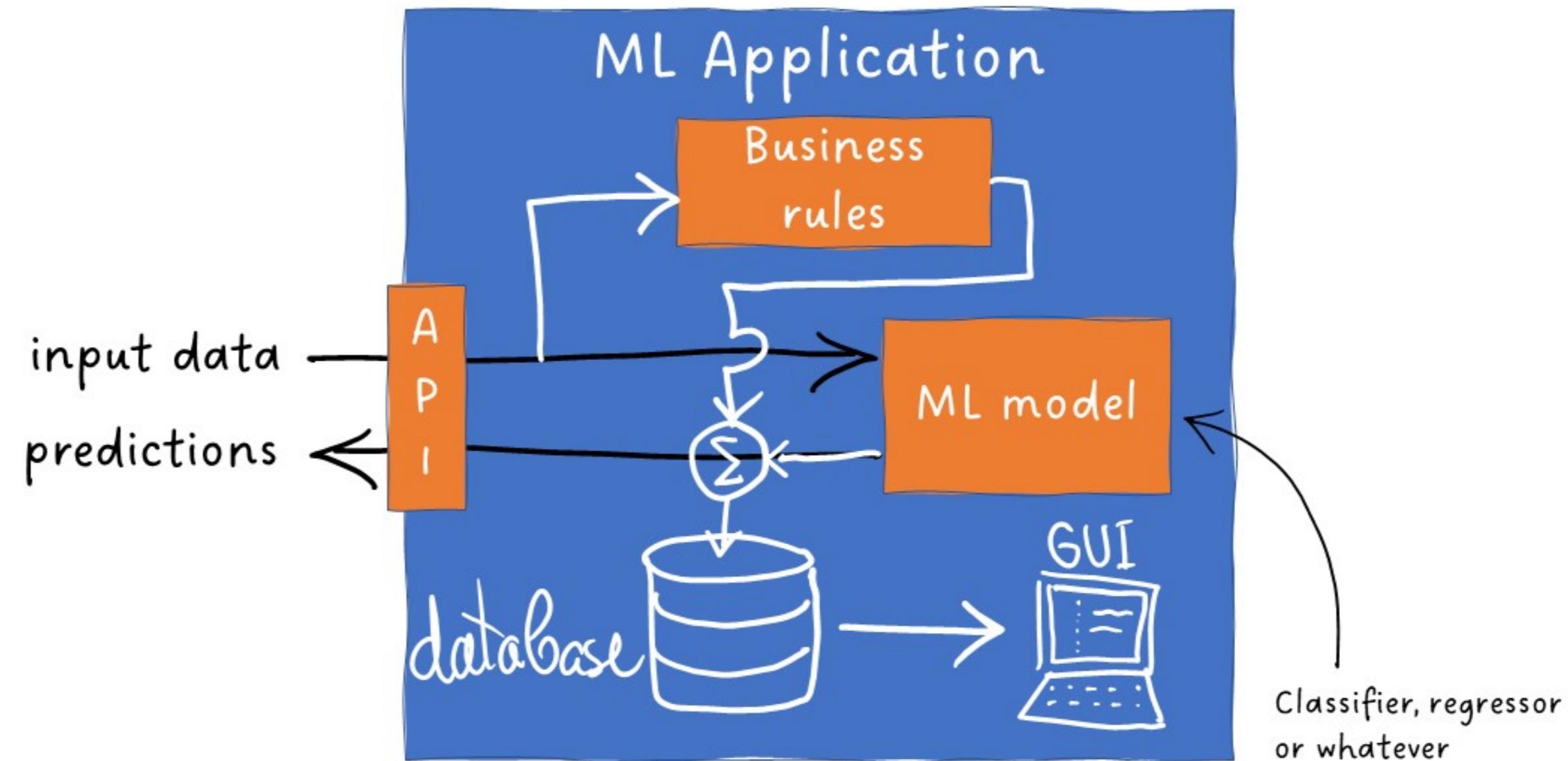




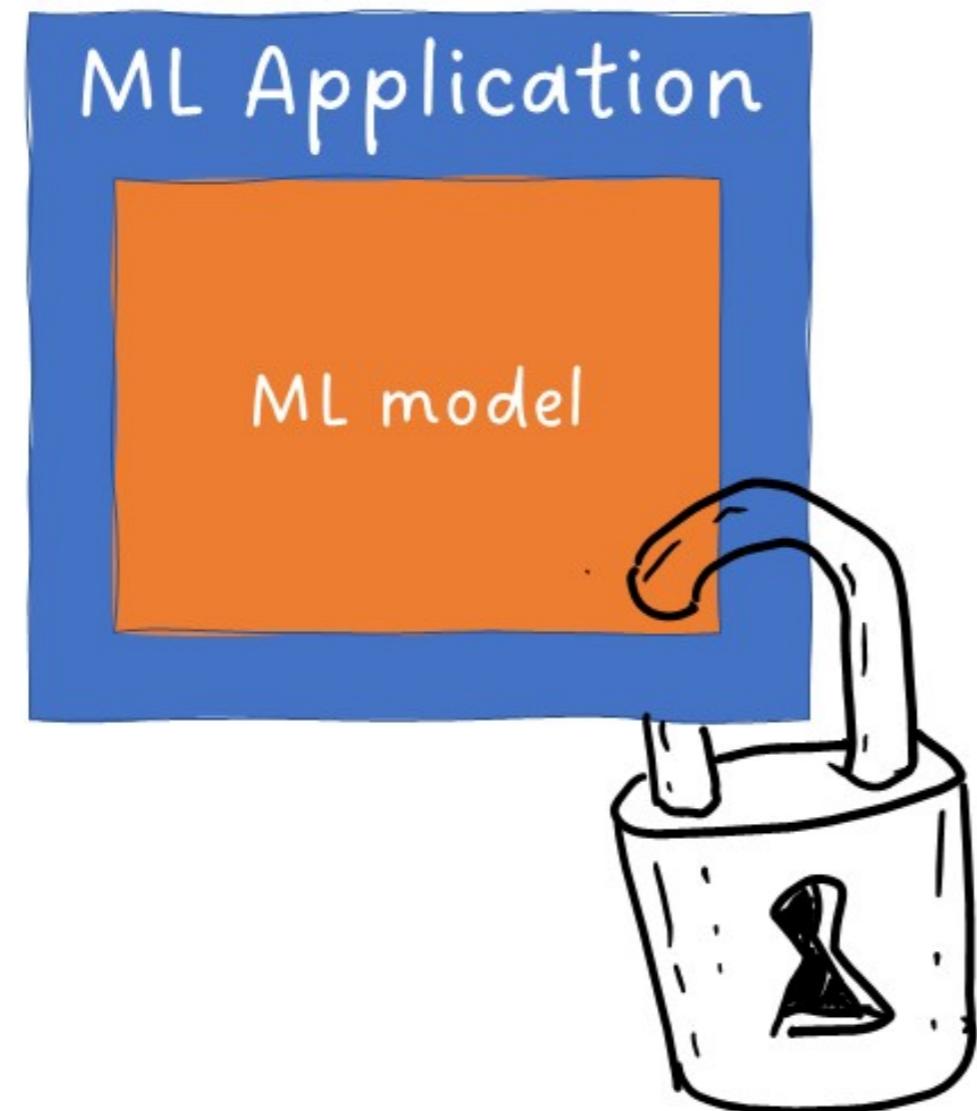


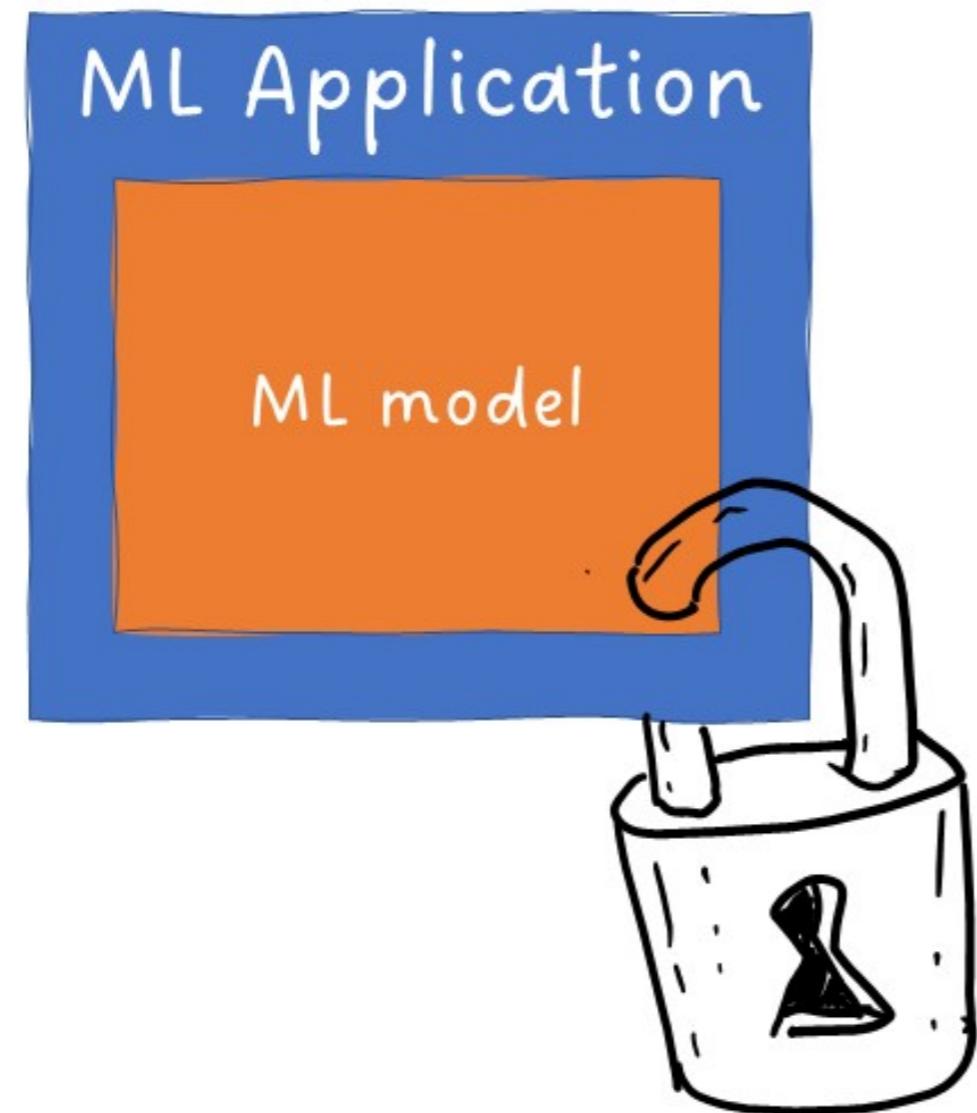


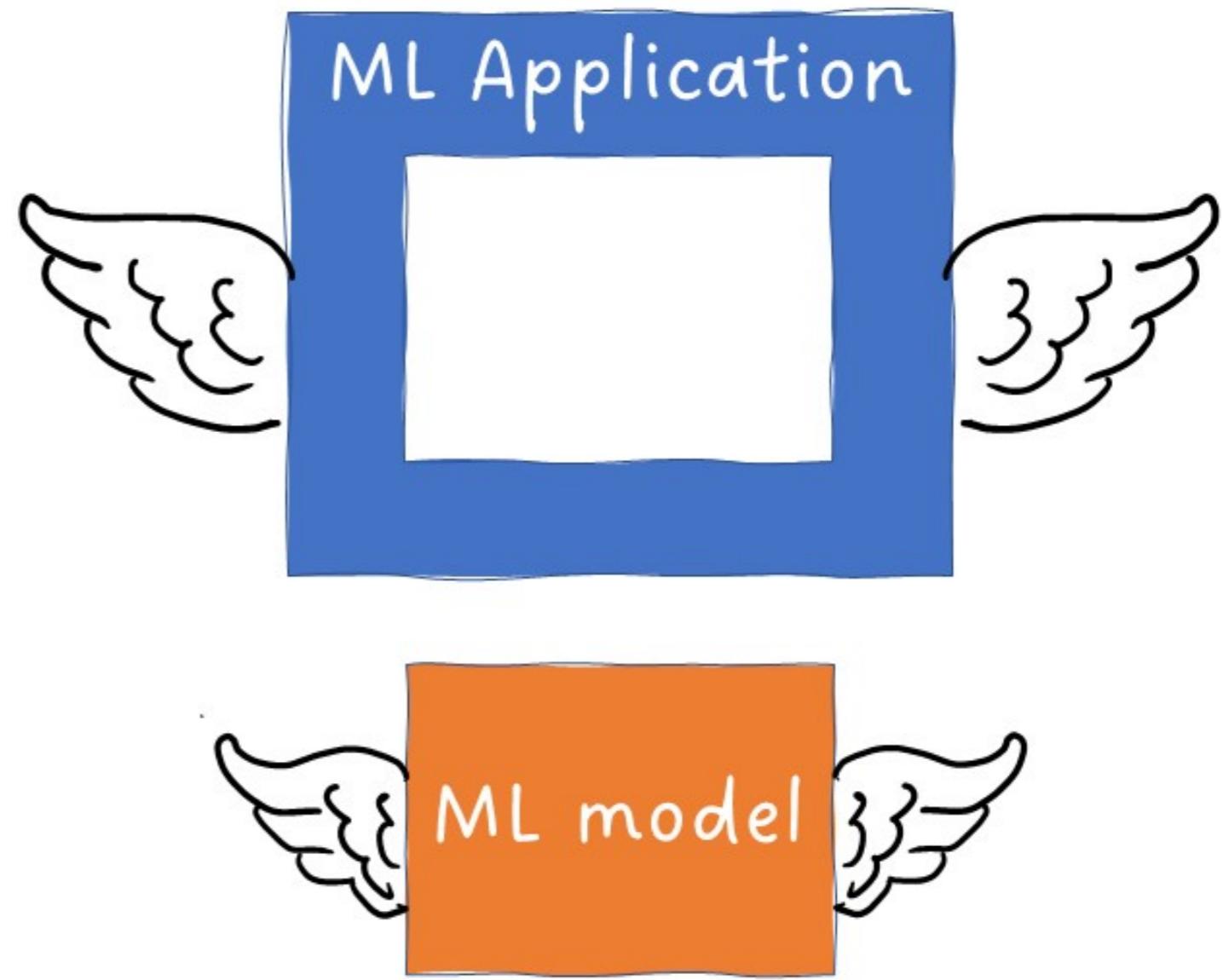
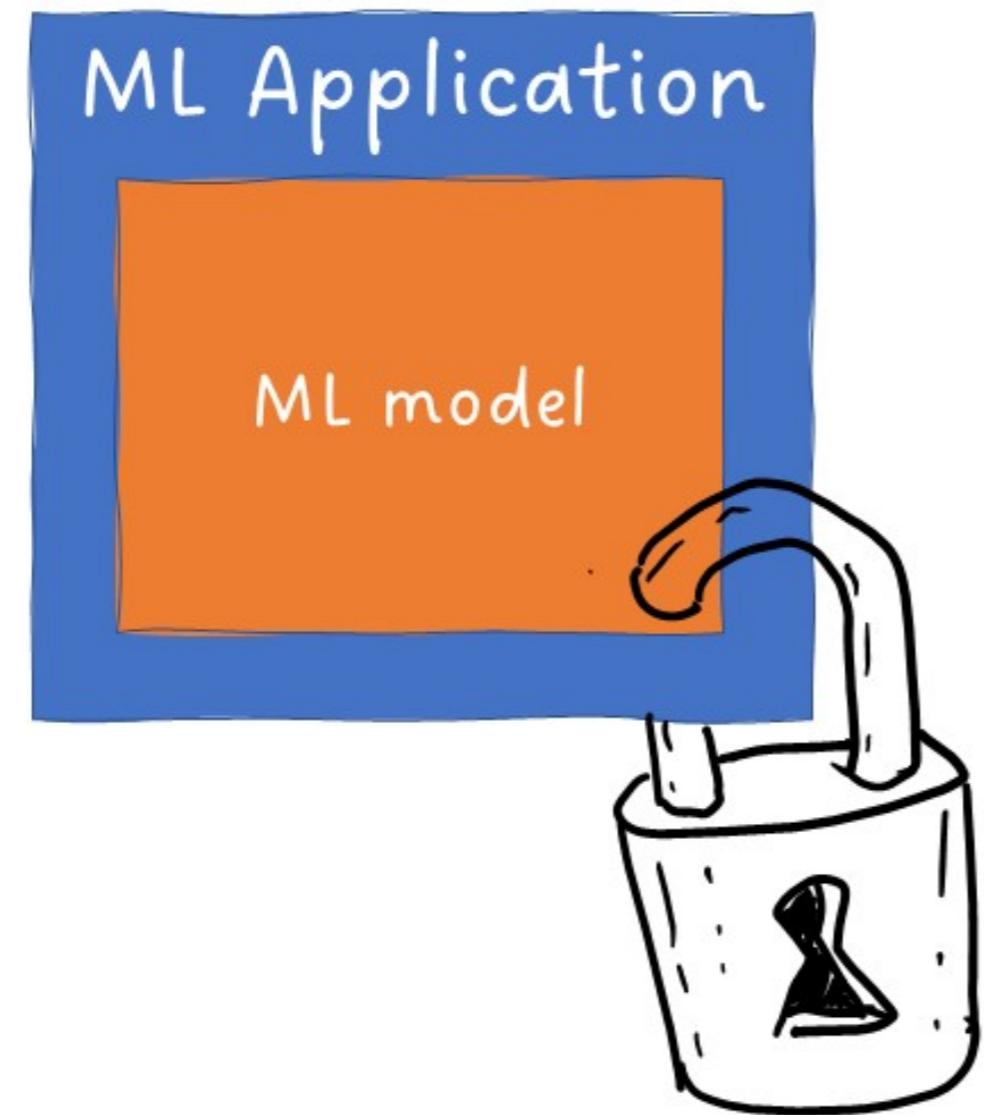




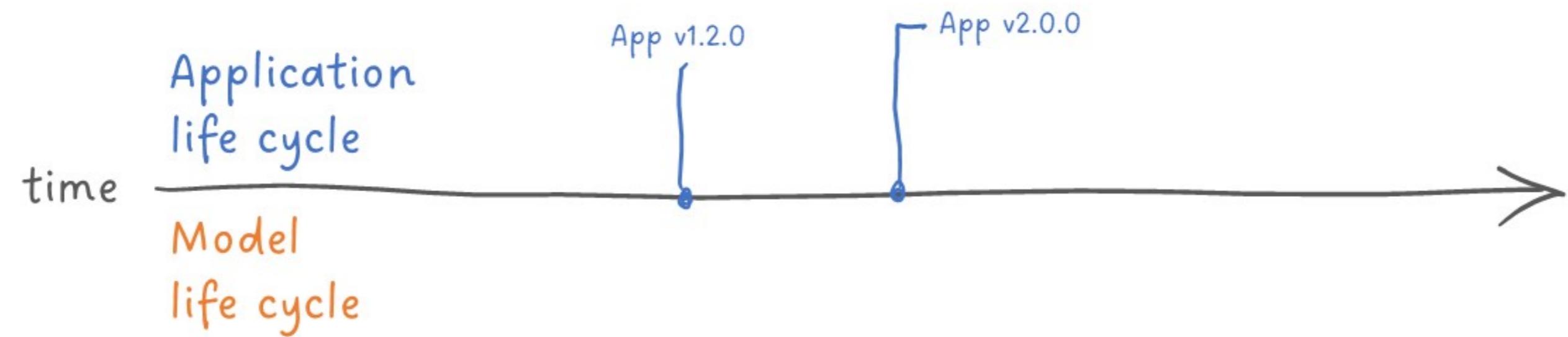


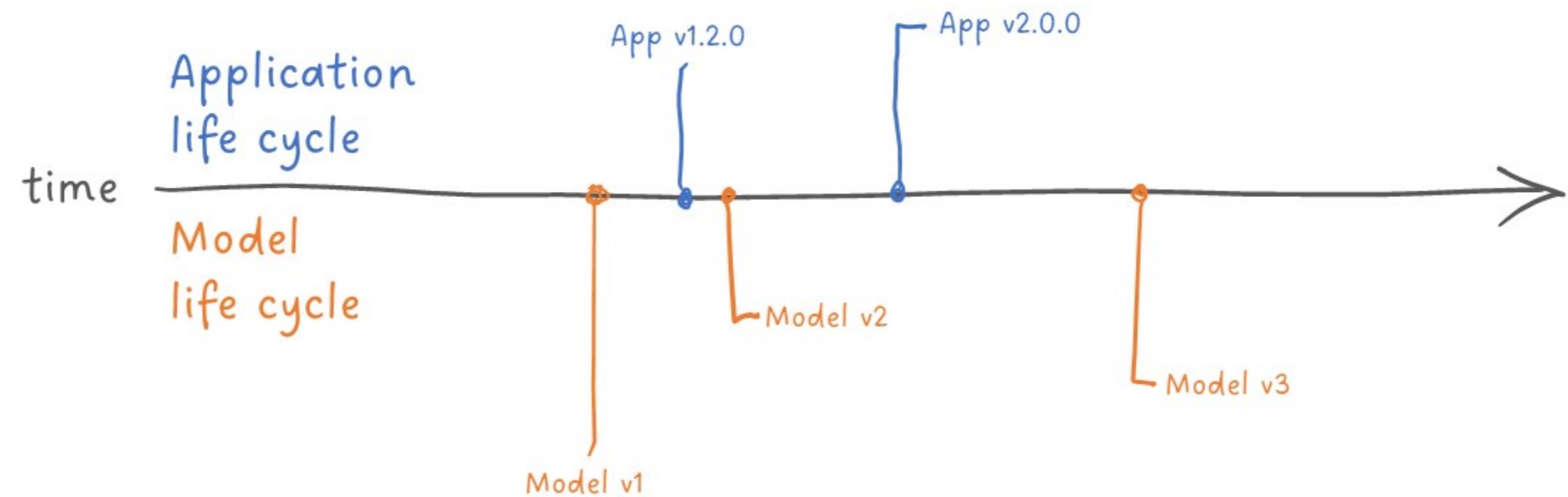


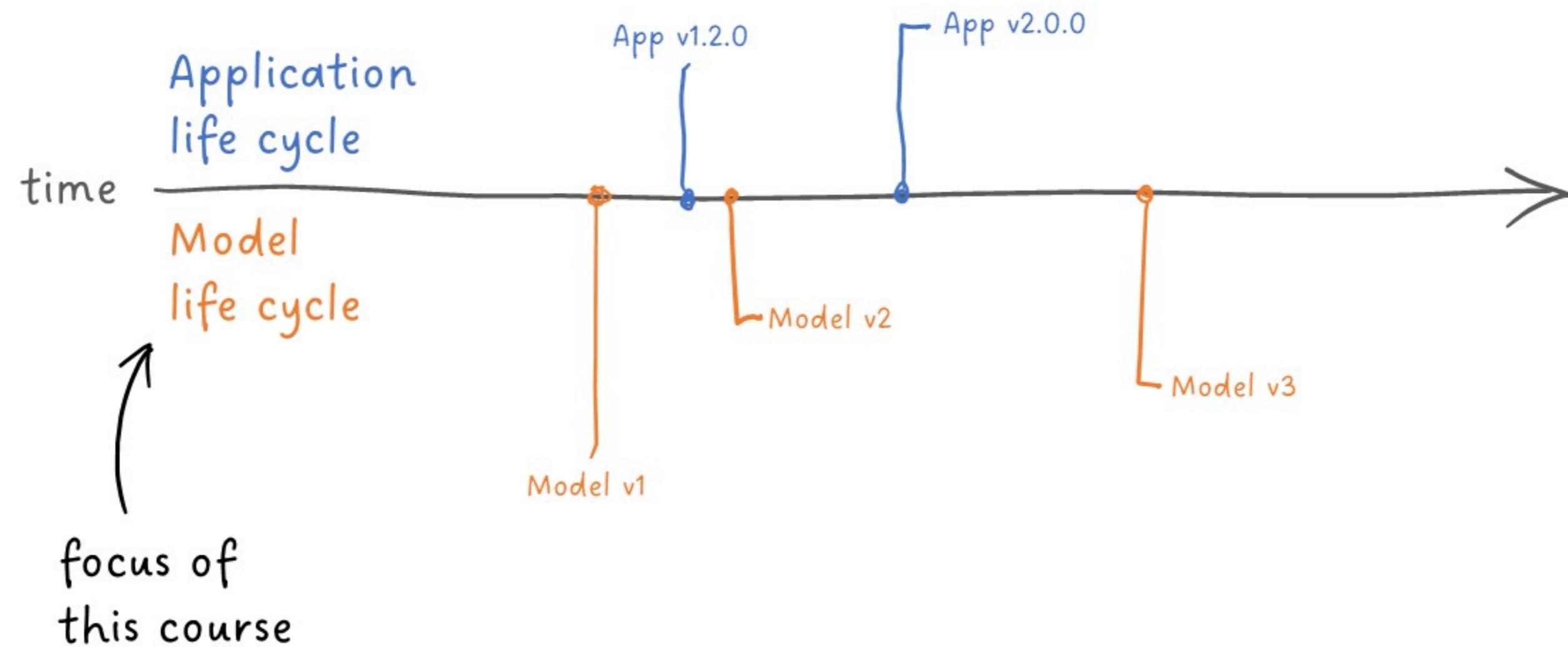












A model is...

NOT something abstract and/or theoretical

A model IS

- a concrete, trained model
- ready to be put in use

Deployment

- Model object + deployment resources = model deployment package
- Putting our model in use = deployment



Model monitoring

- Is the model server running?
- Are the model inputs and outputs as expected?
- Also known as *post-deployment monitoring*



Decommissioning



Possible reasons

- Better model discovered
- More informative features created
- Modeled process changed, invalidating the existing model

=> Out with the old, in with the new

Model archiving

- Important in regulated industries.
 - Why did your credit-risk model green-light this loan back in 2020?
- Reproducibility: ability to recreate, re-load, and use an old version of a model
 - Not a trivial requirement



Let's practice!

MLOPS DEPLOYMENT AND LIFE CYCLING

MLOps components

MLOPS DEPLOYMENT AND LIFE CYCLING



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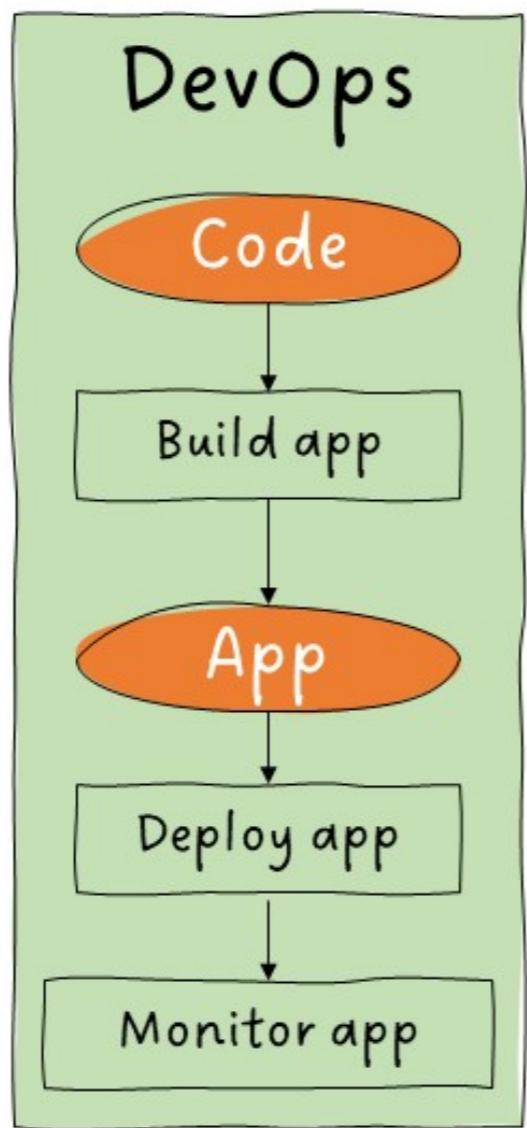
Concepts

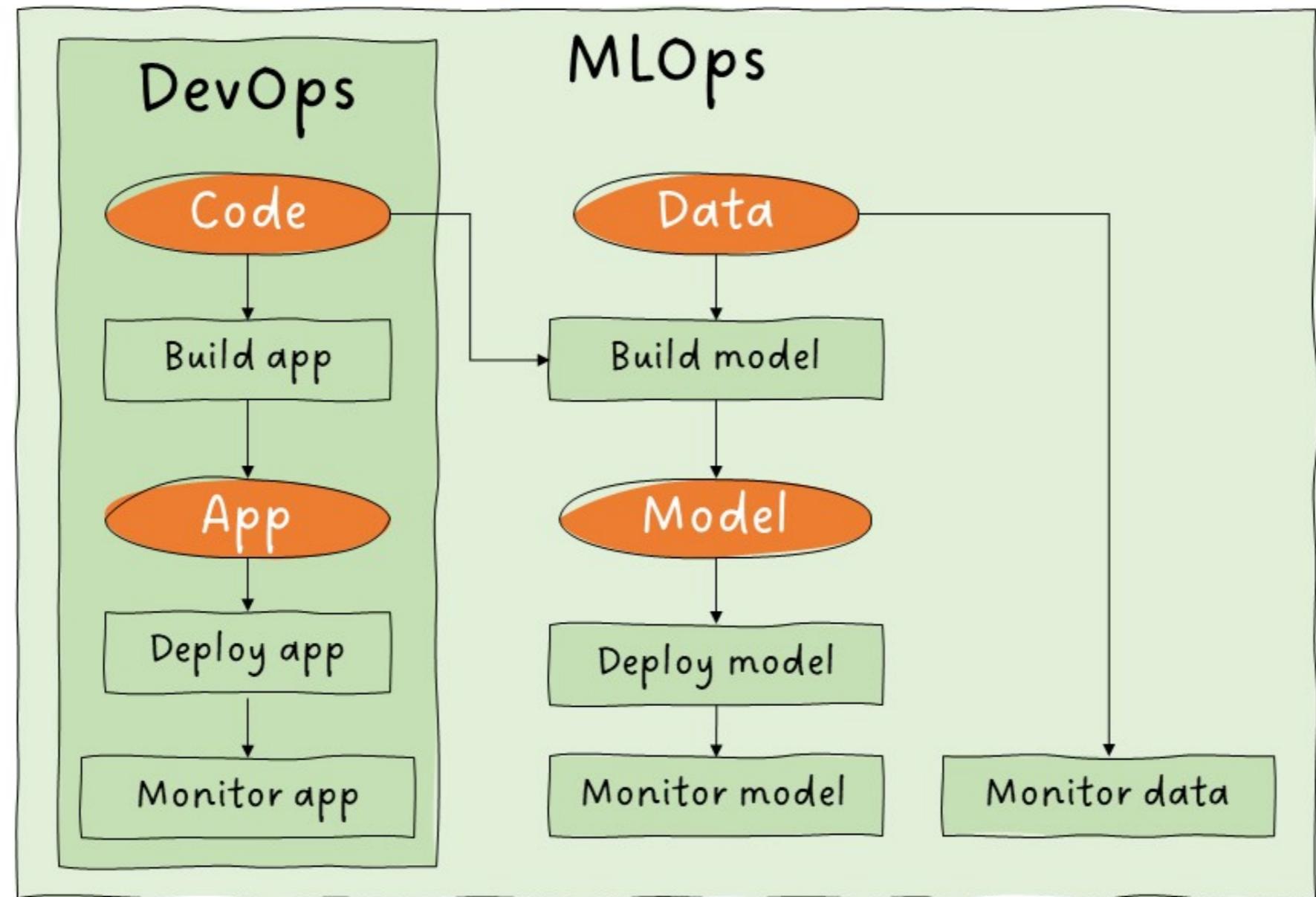
GENERIC (Software Development)

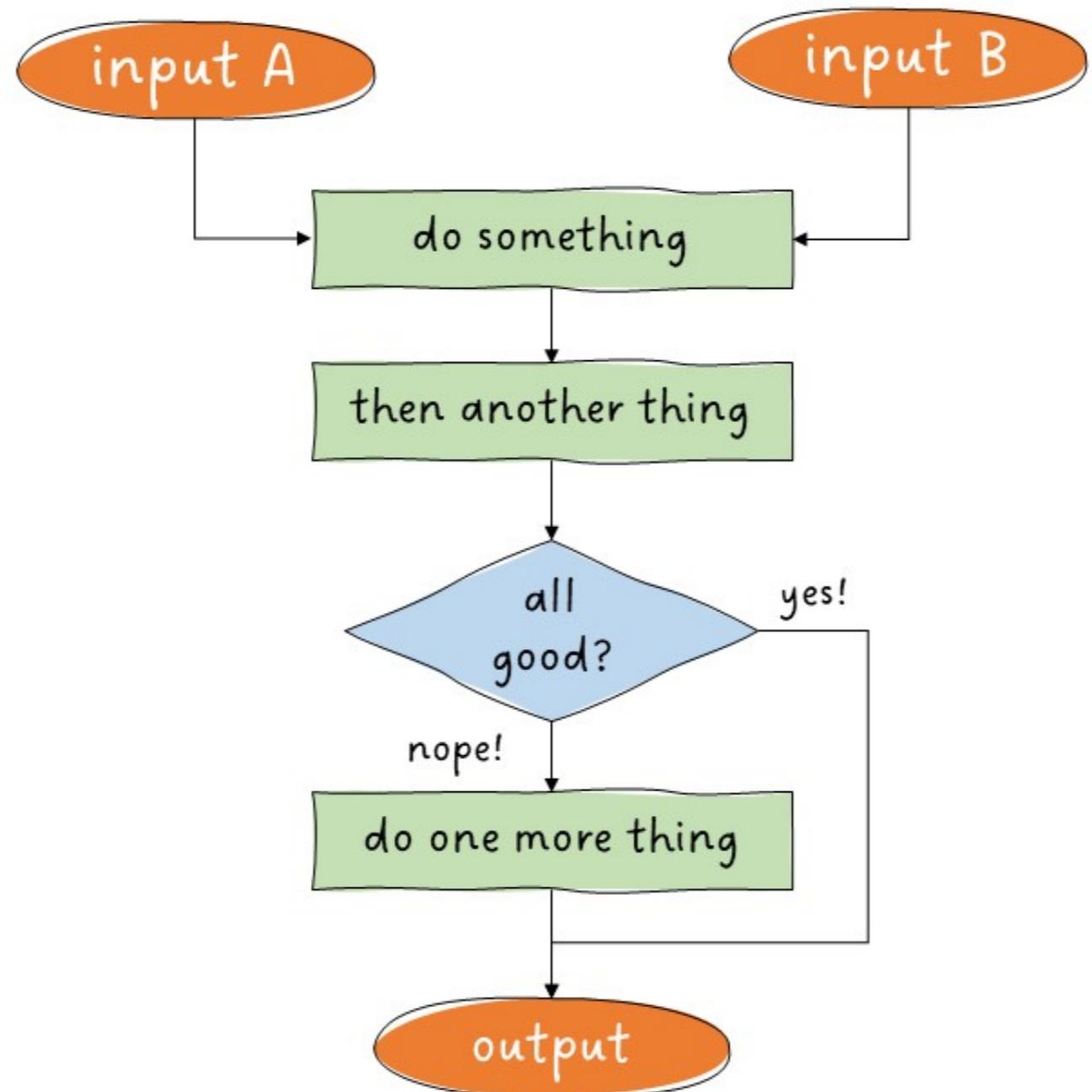
- Workflows
- Pipelines
- Artifacts

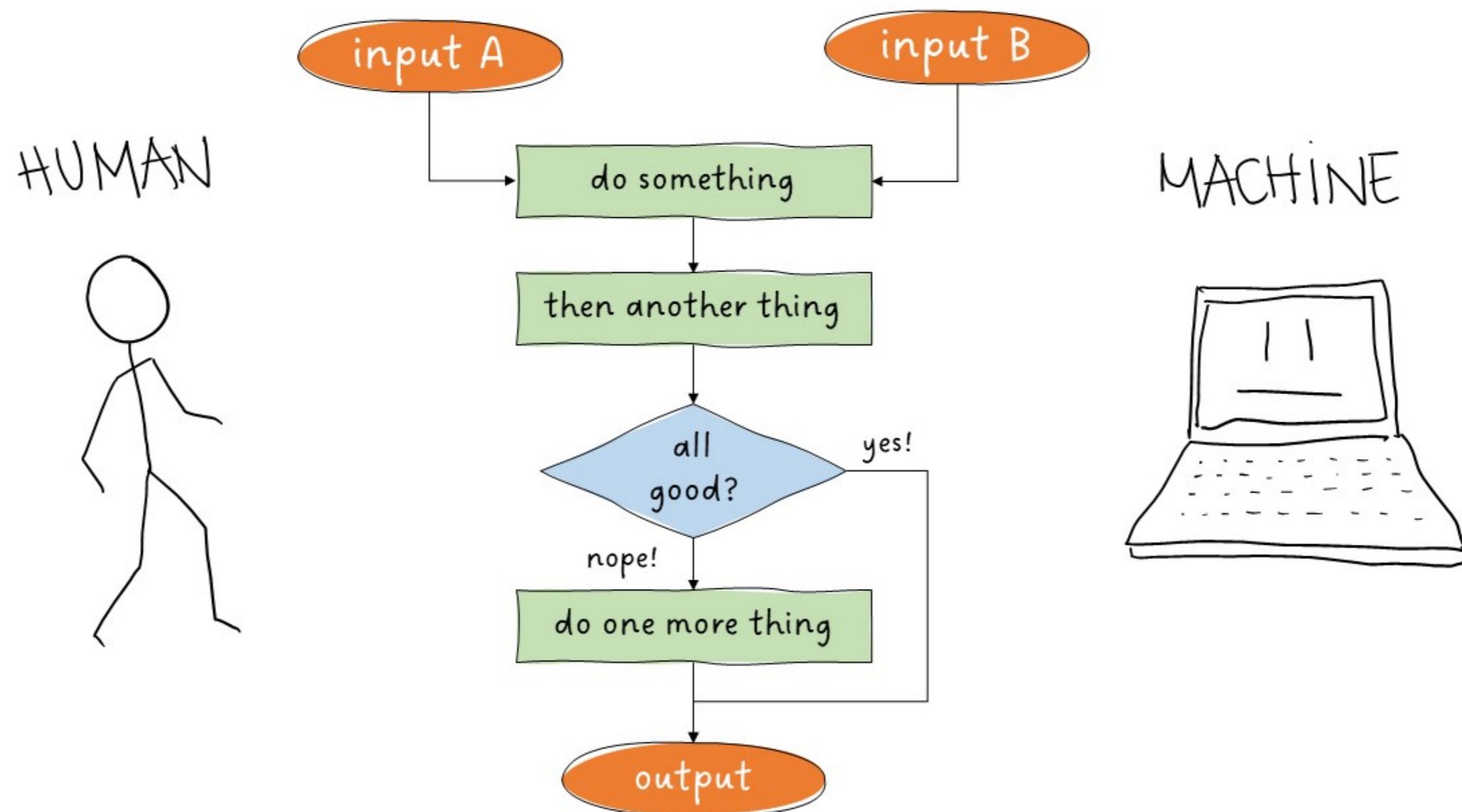
ML-SPECIFIC

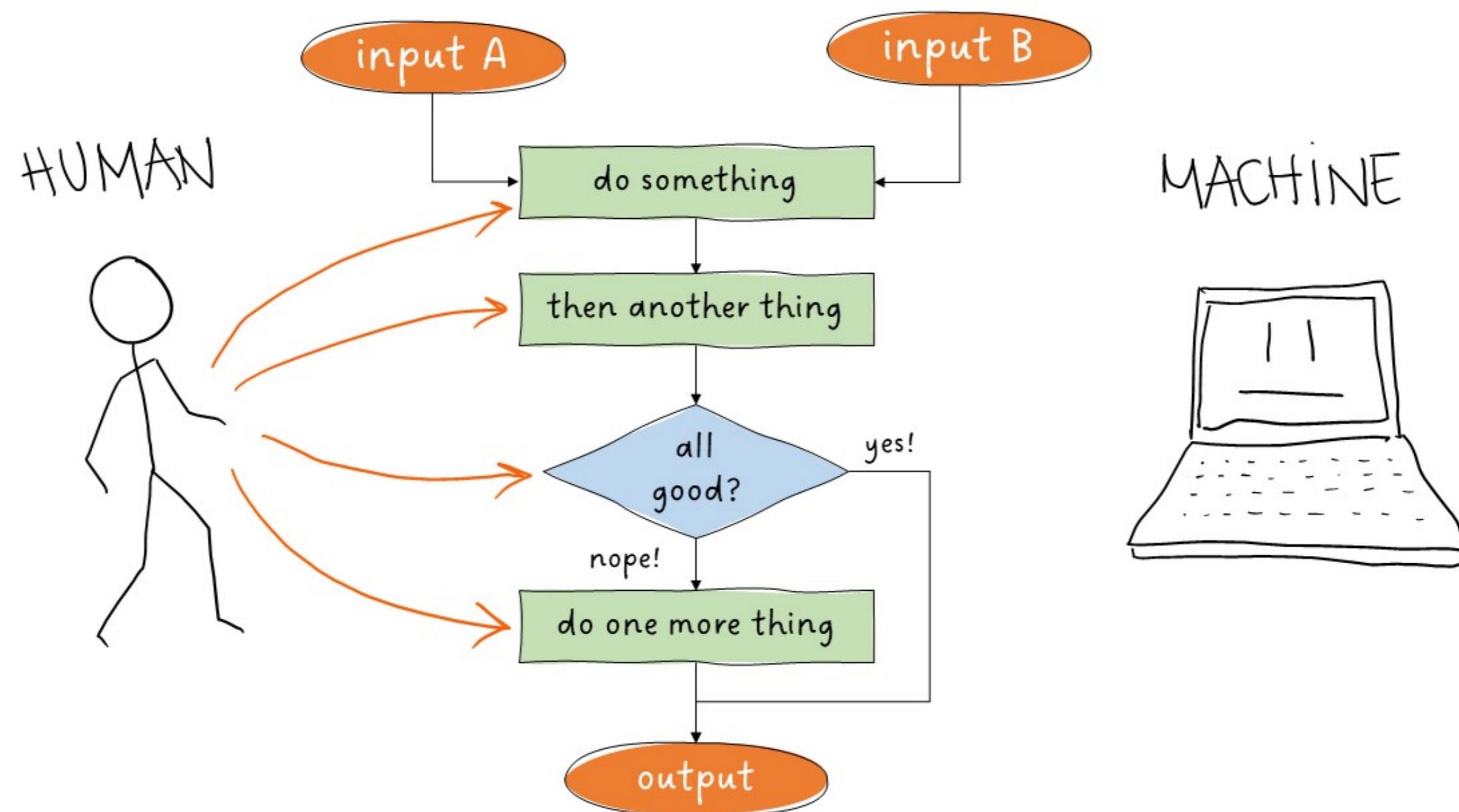
- Model registry
- Feature store
- Metadata store

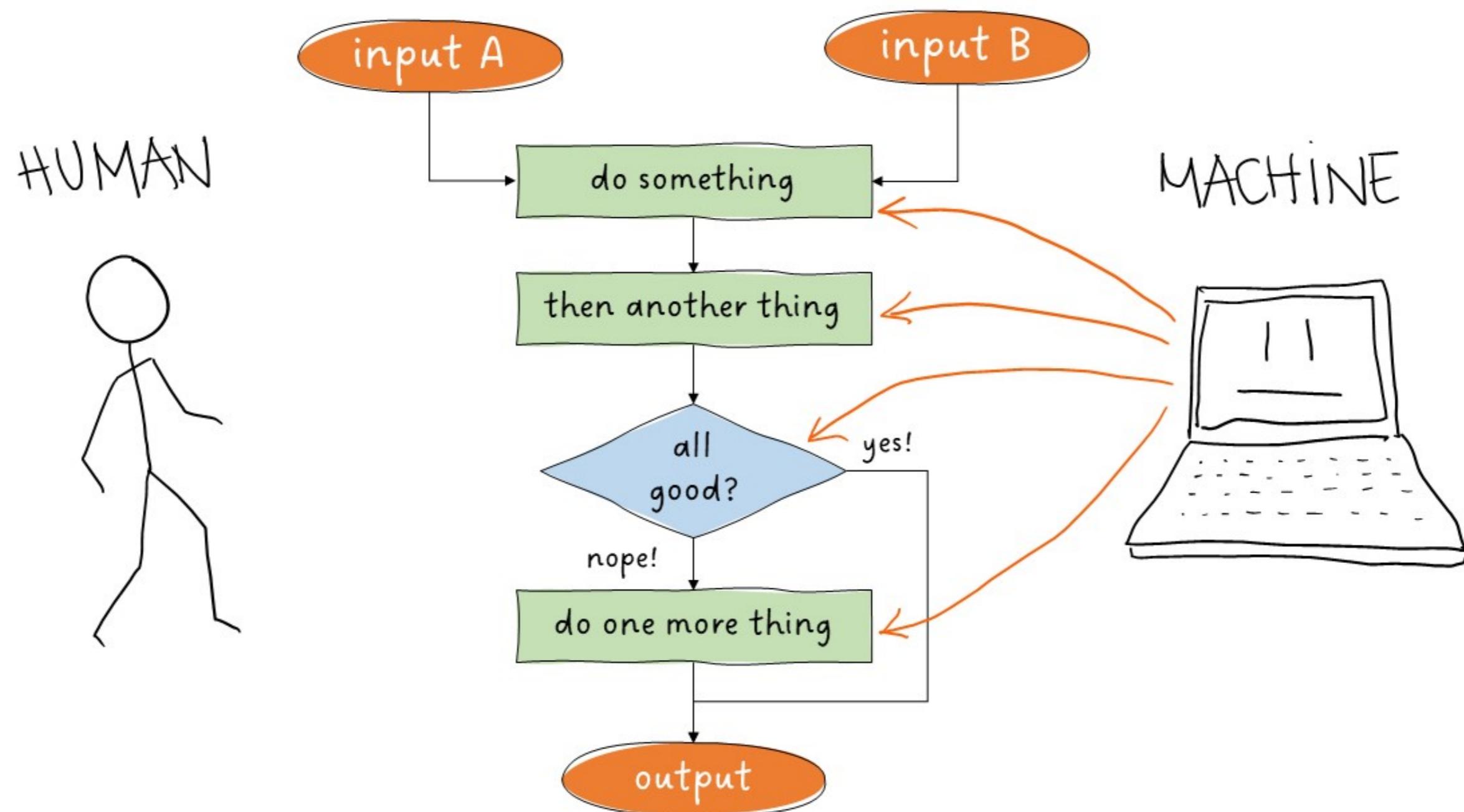


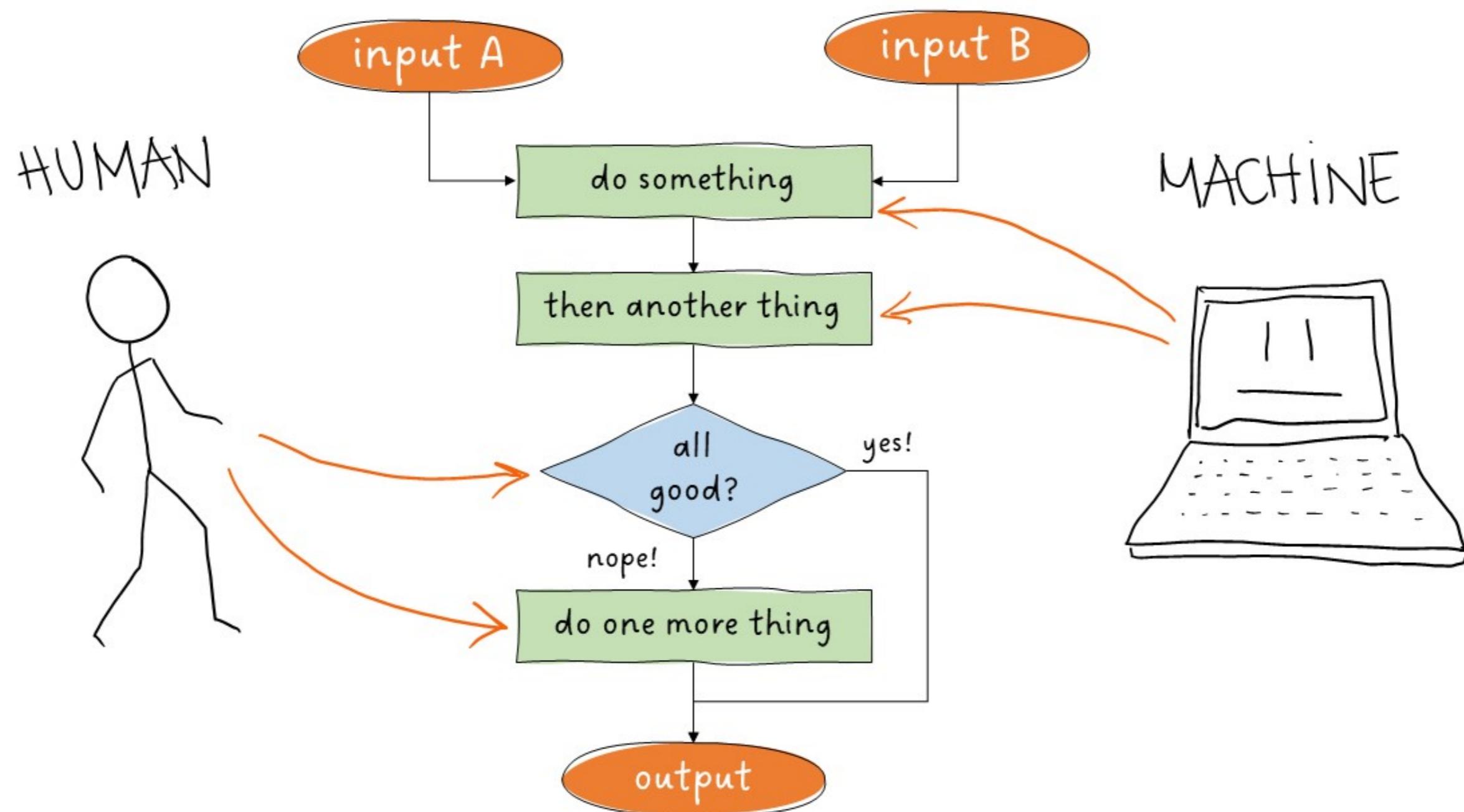


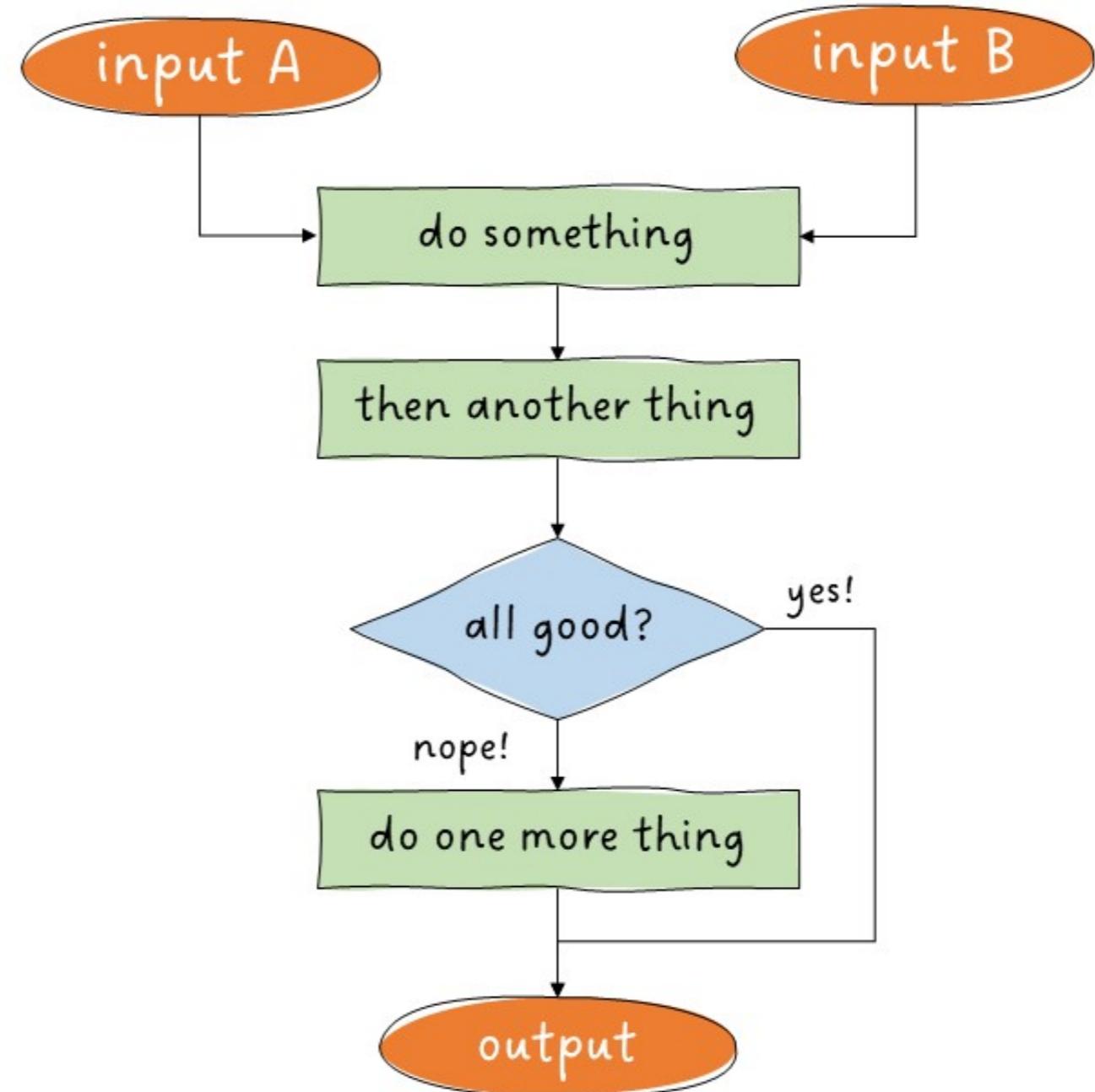


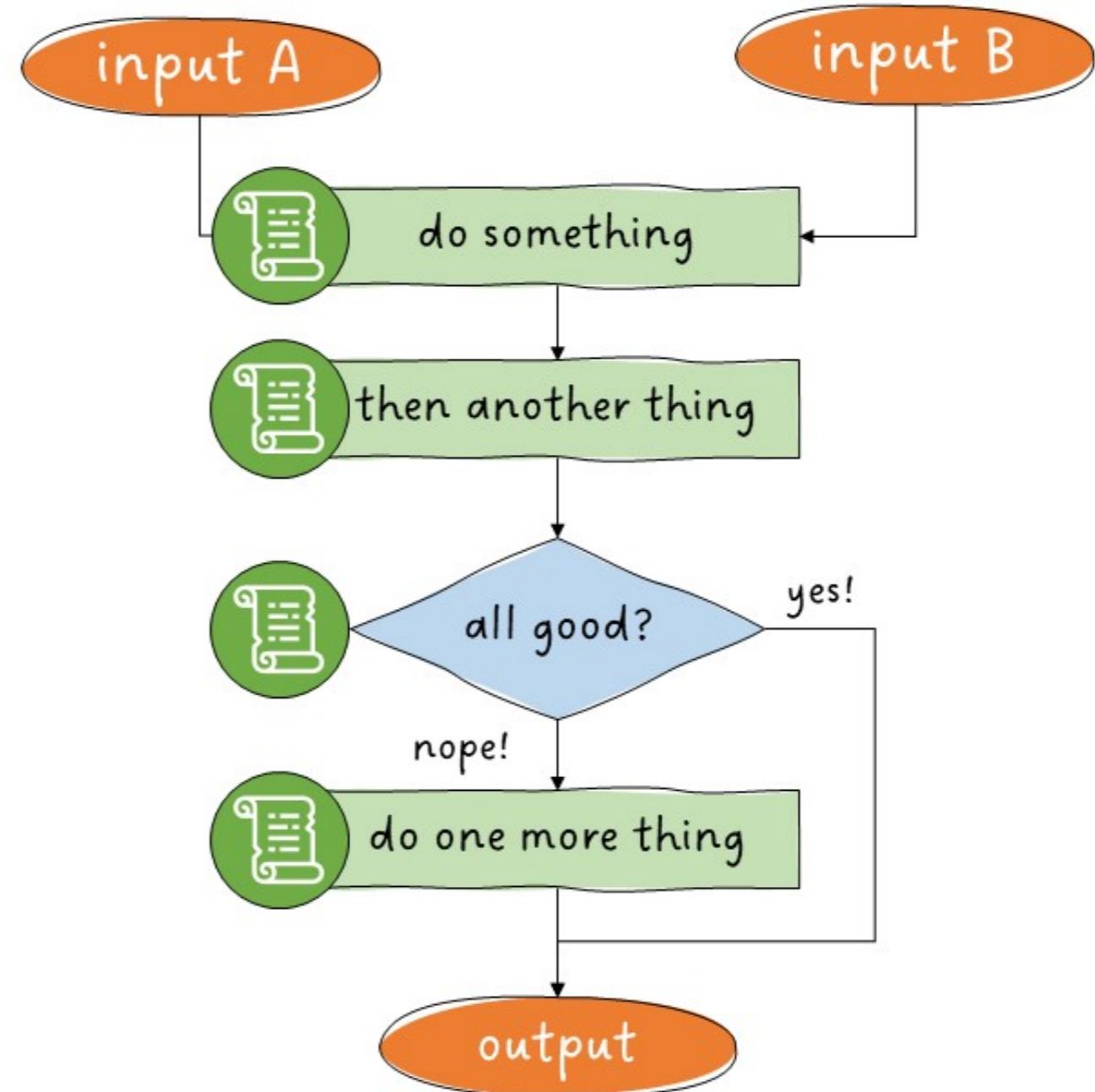


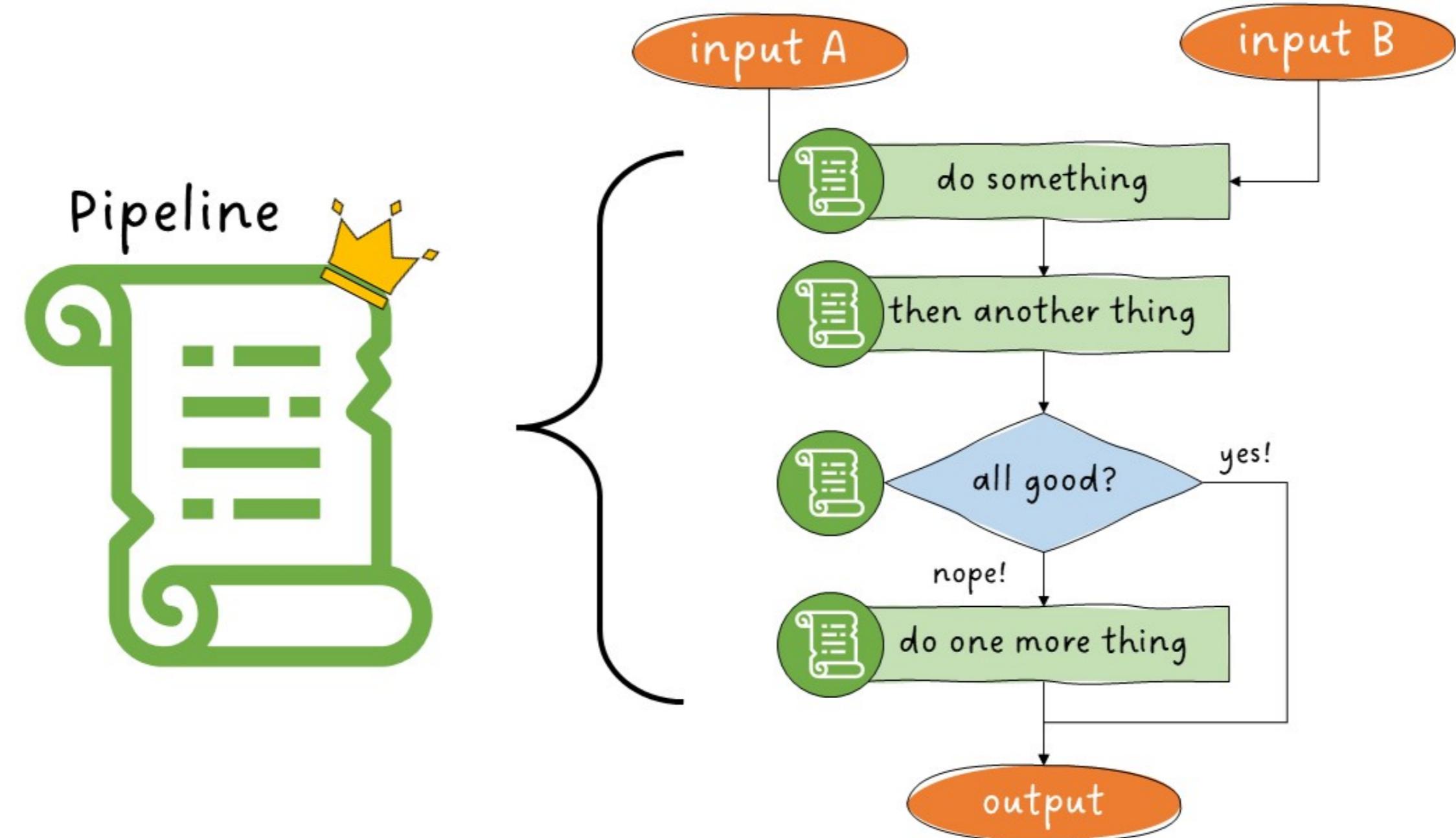


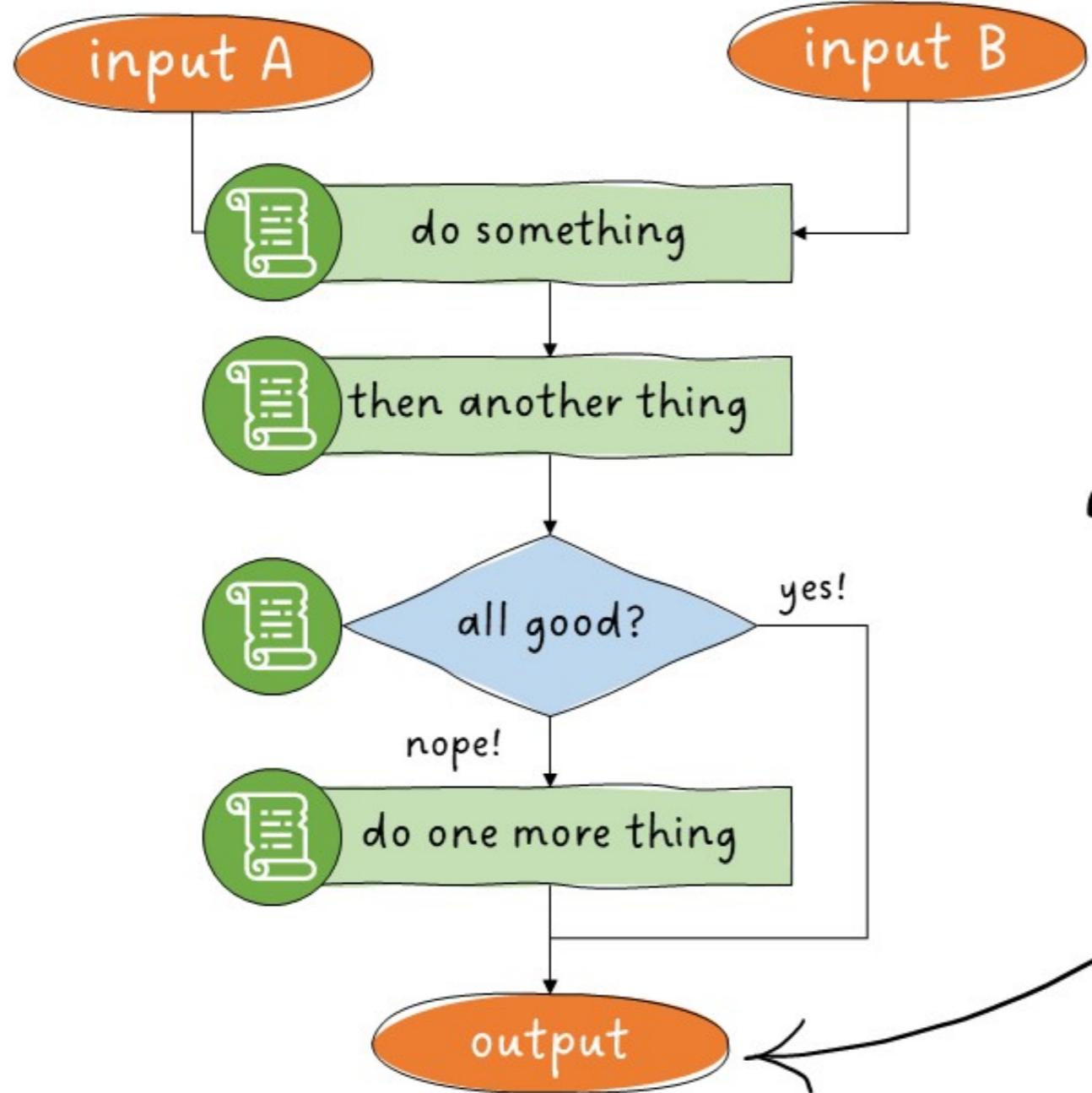






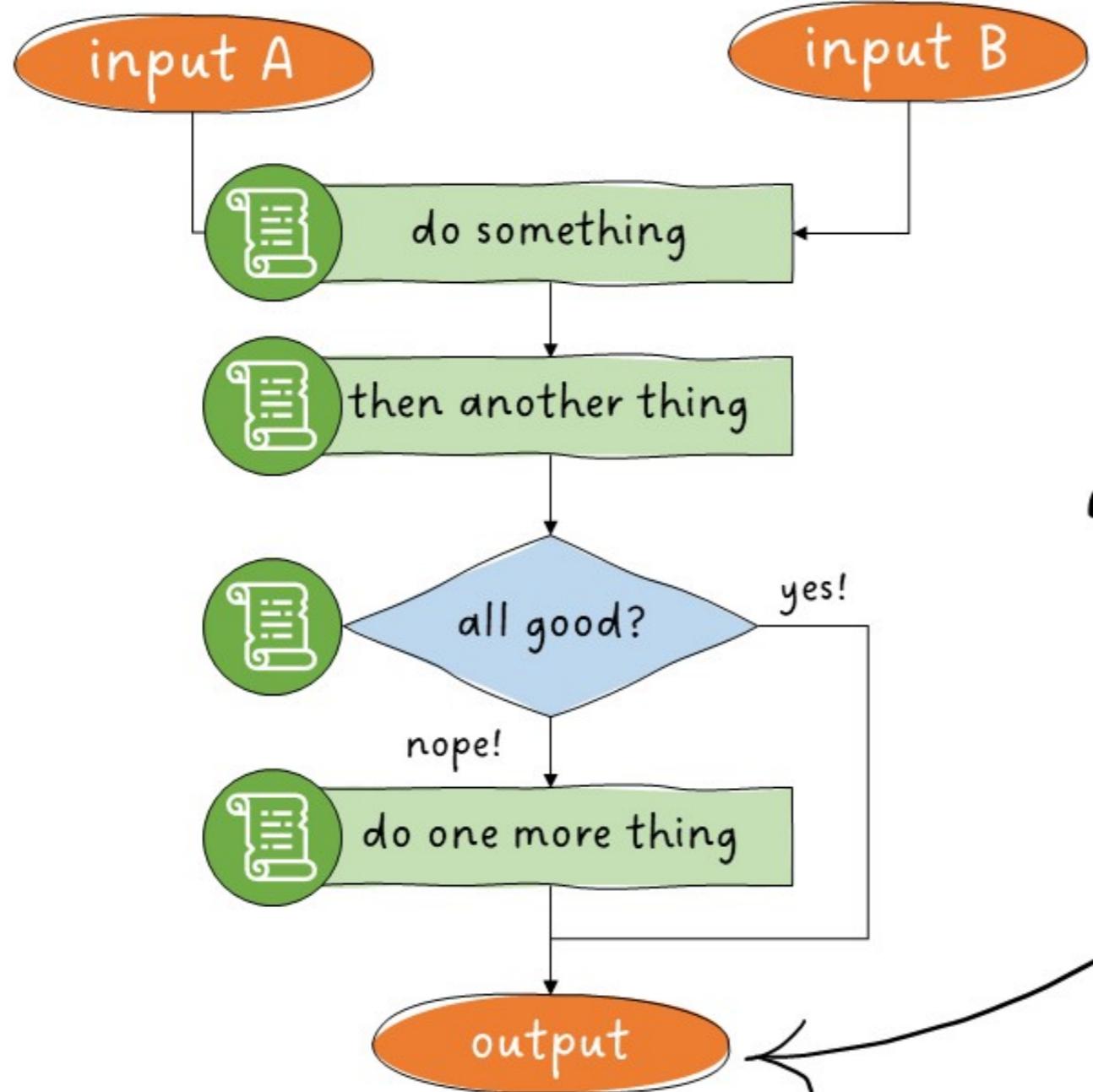






“artifacts”

¹ https://en.wikipedia.org/wiki/Artifact_%28software_development%29



"artifacts"

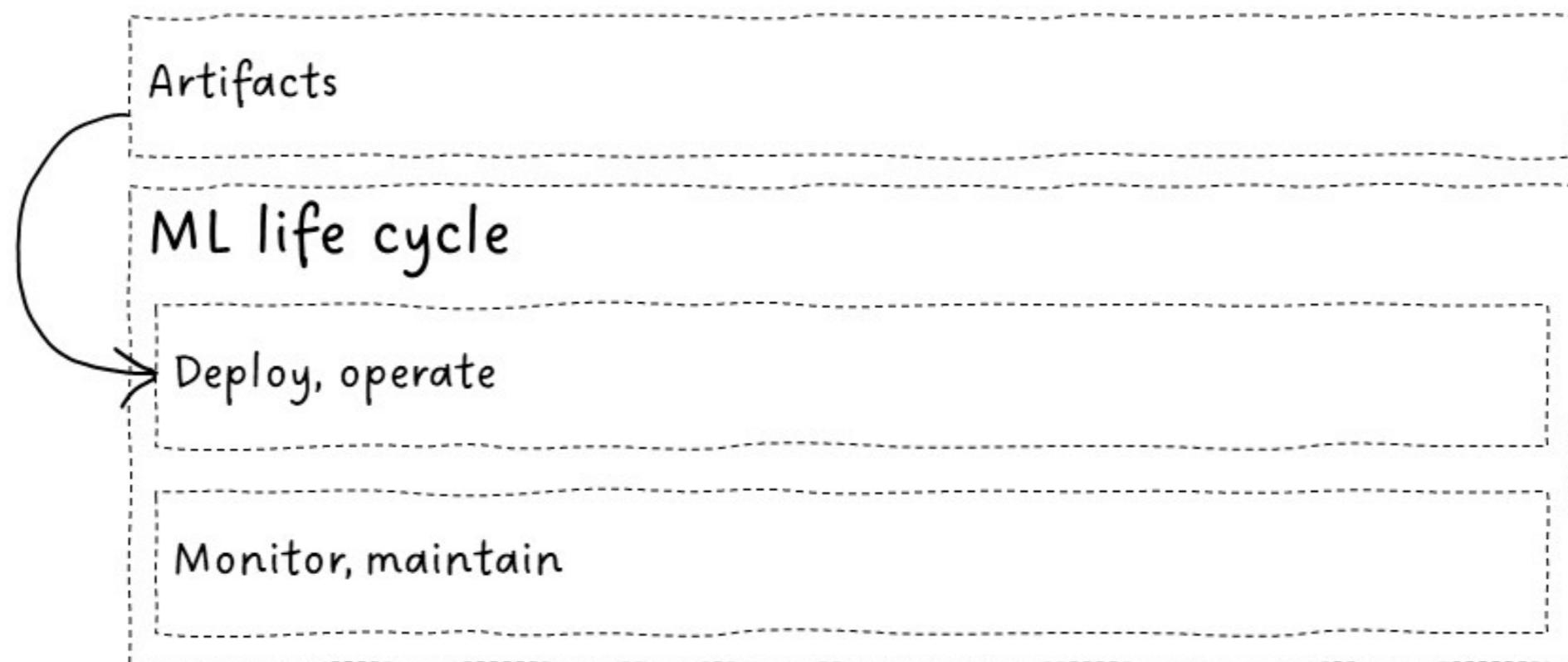
* any by-product
of software
development

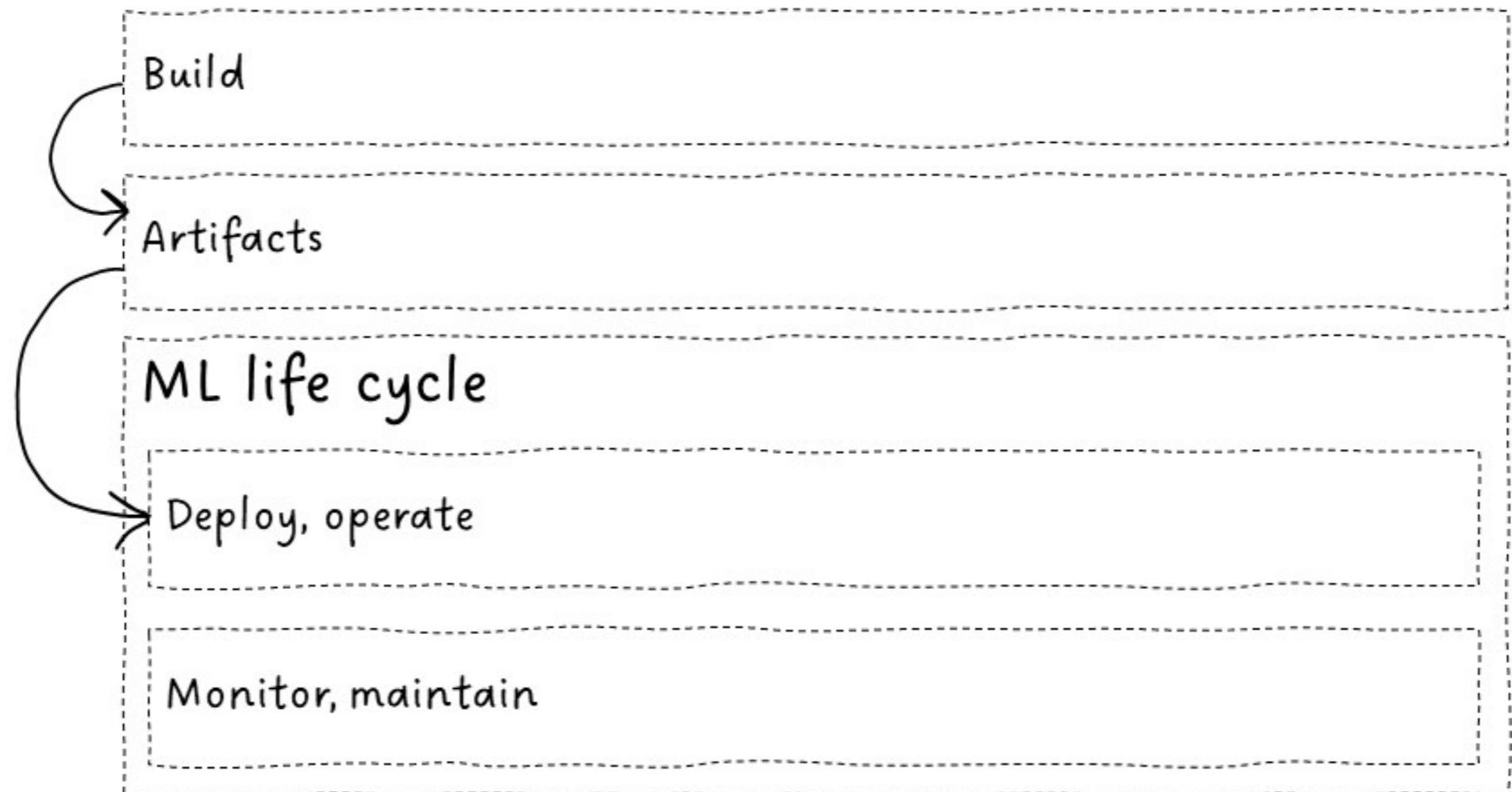
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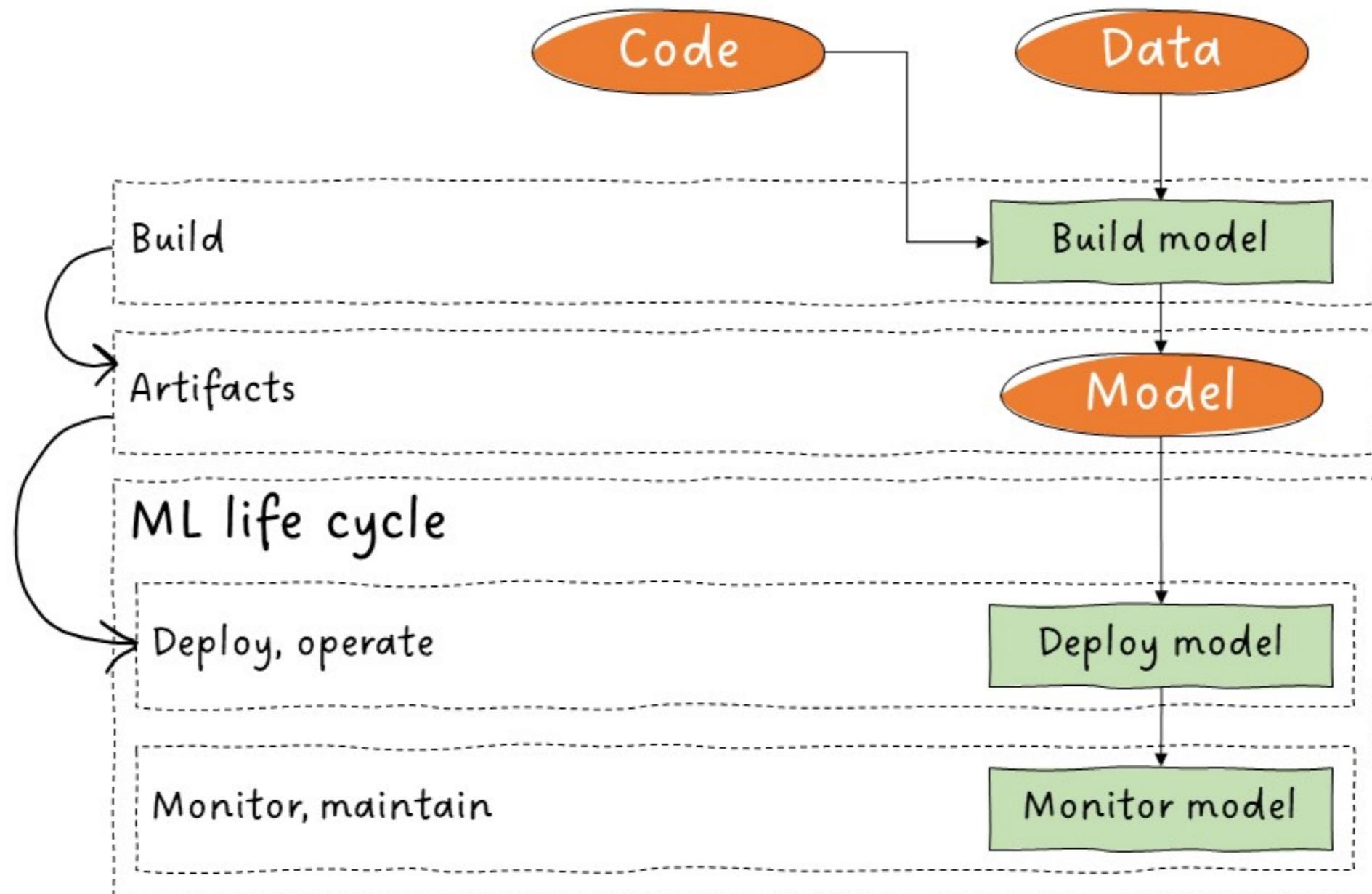
ML life cycle

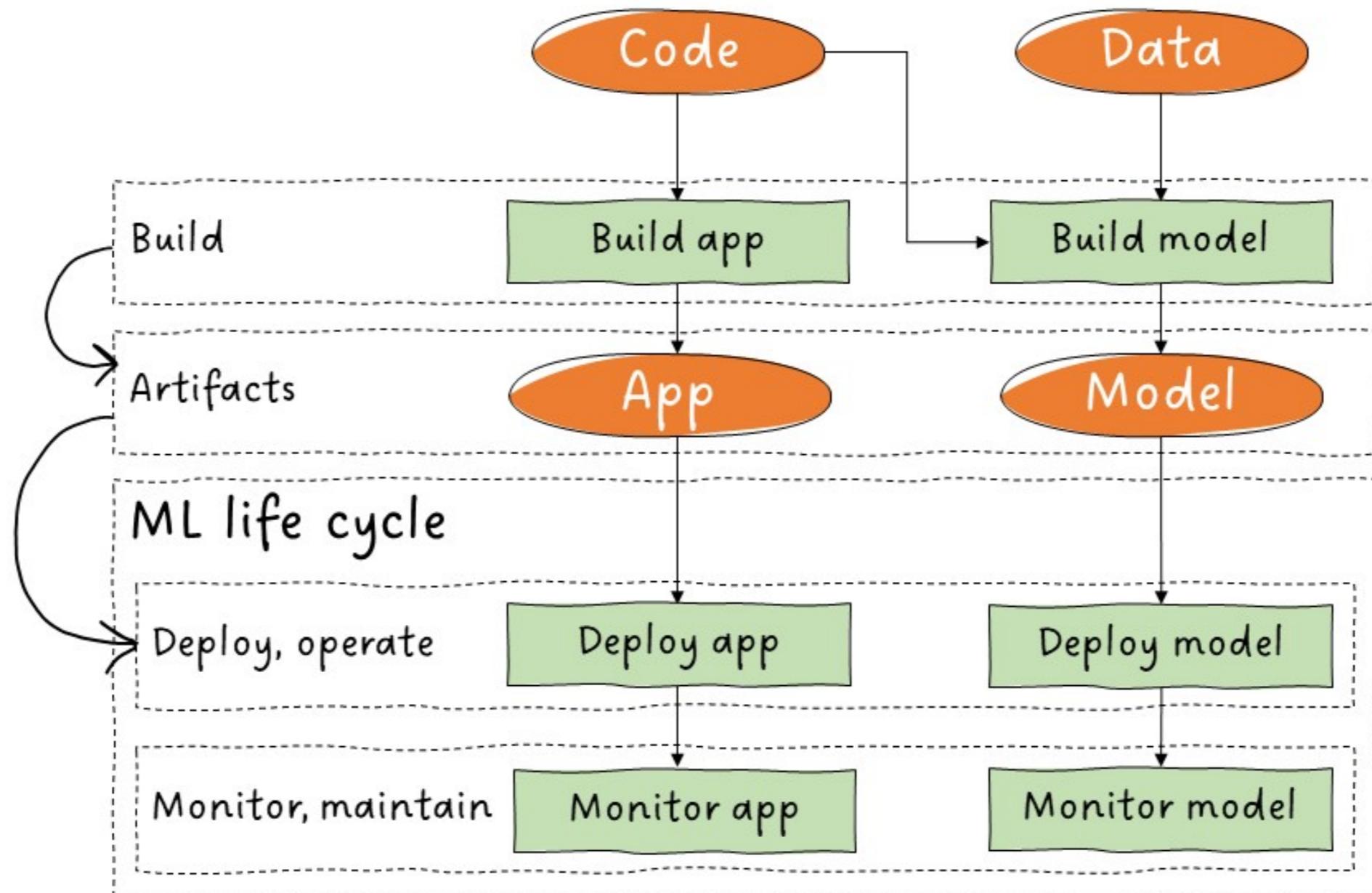
Deploy, operate

Monitor, maintain

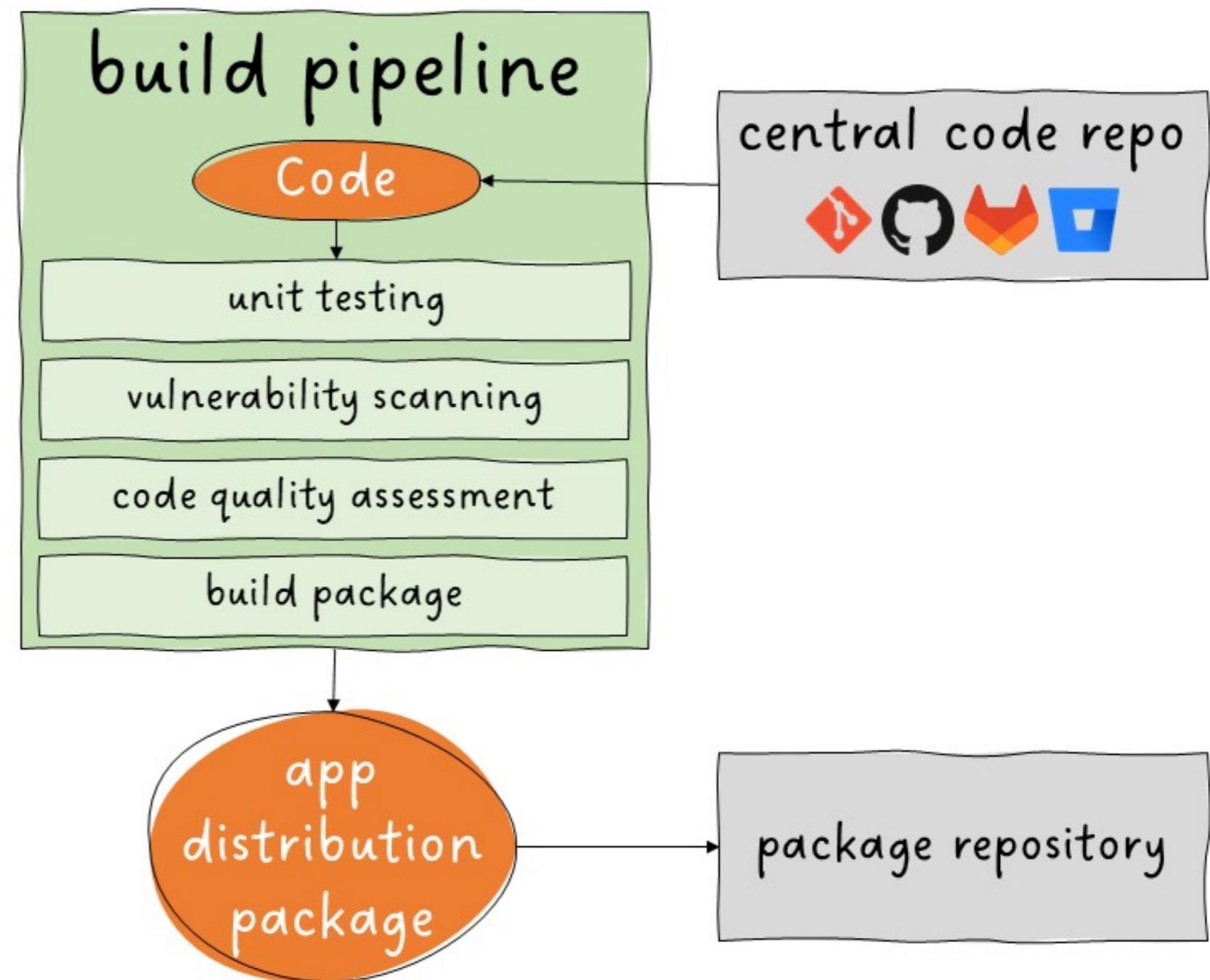


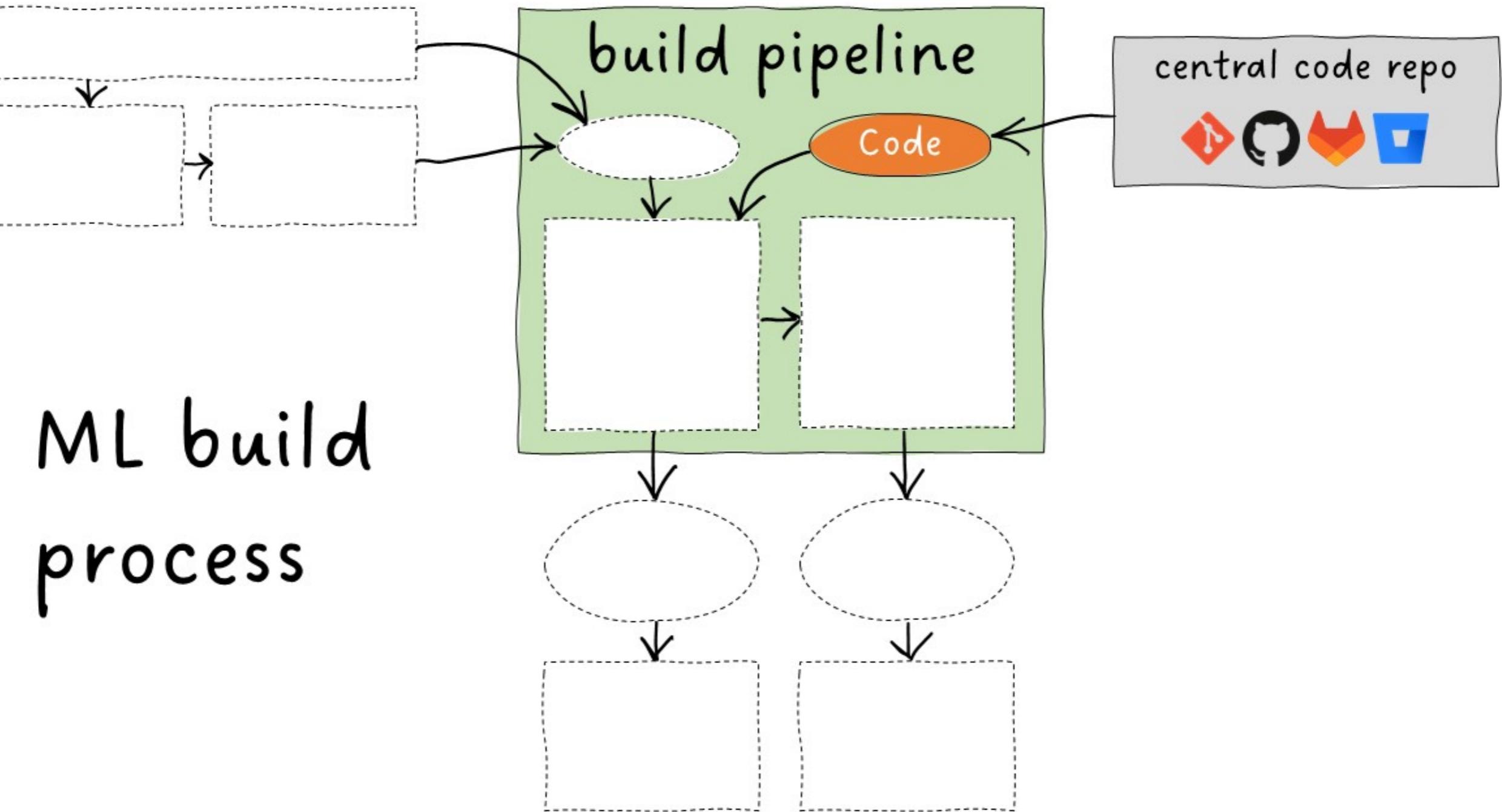


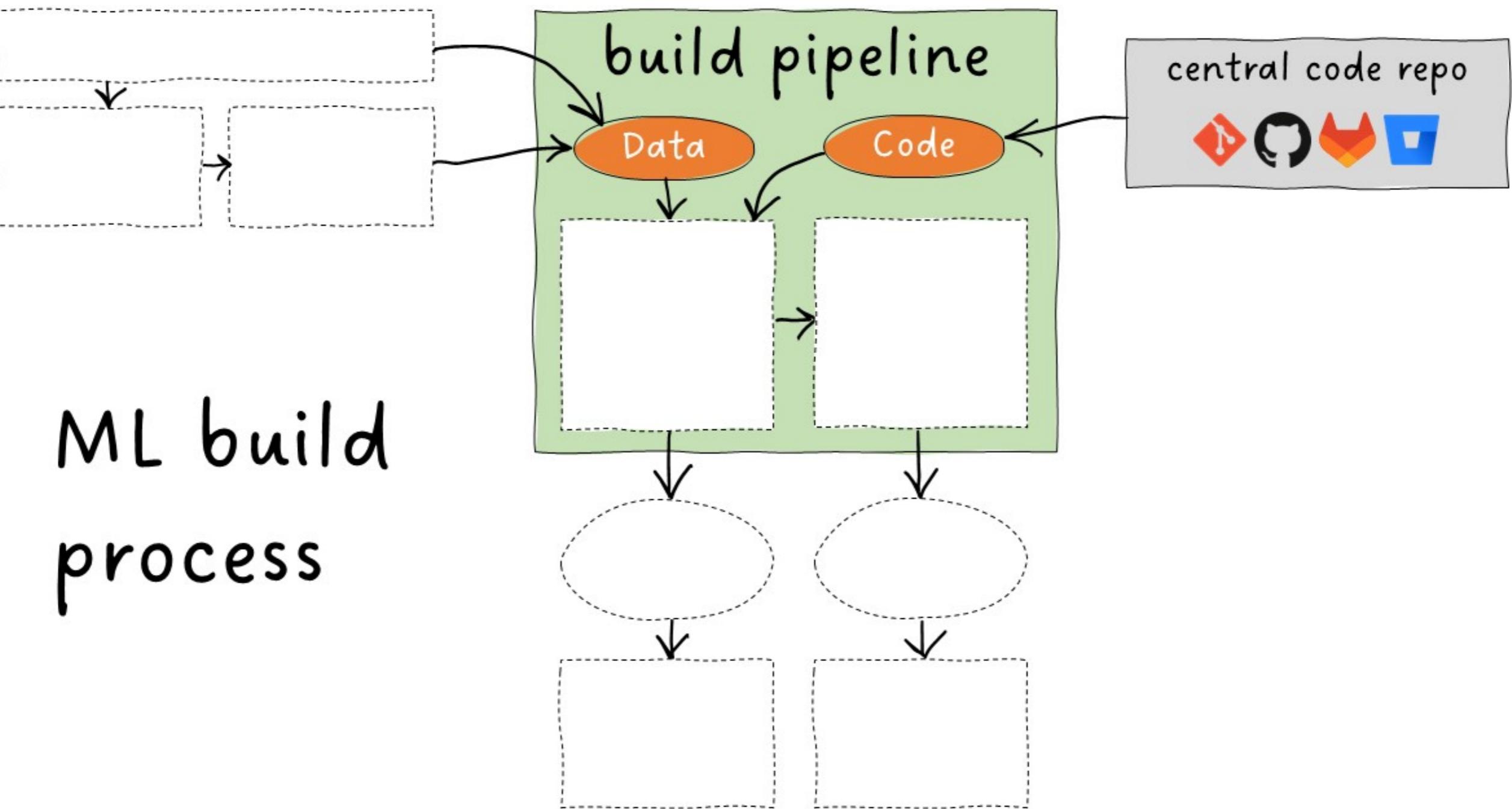


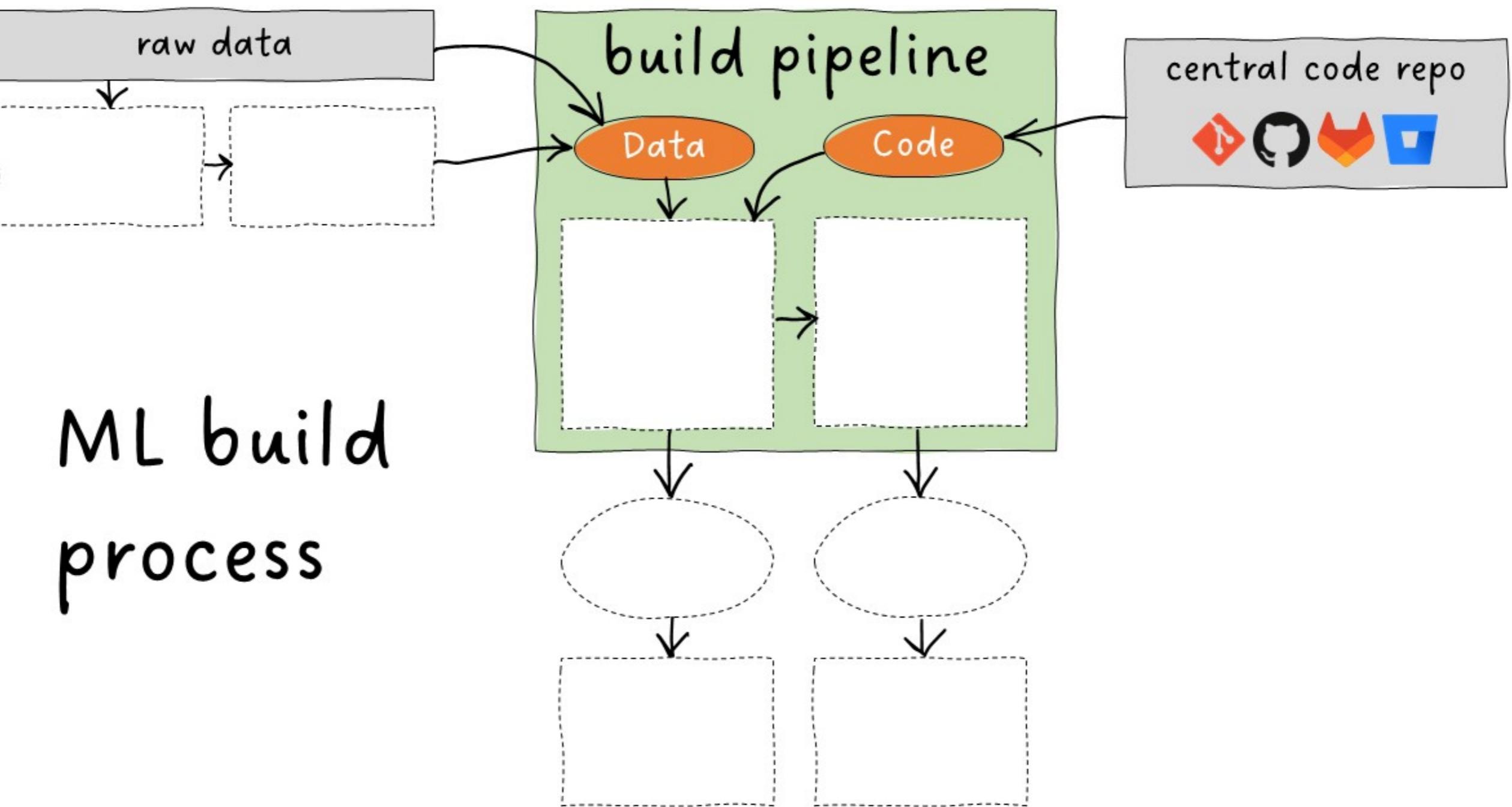


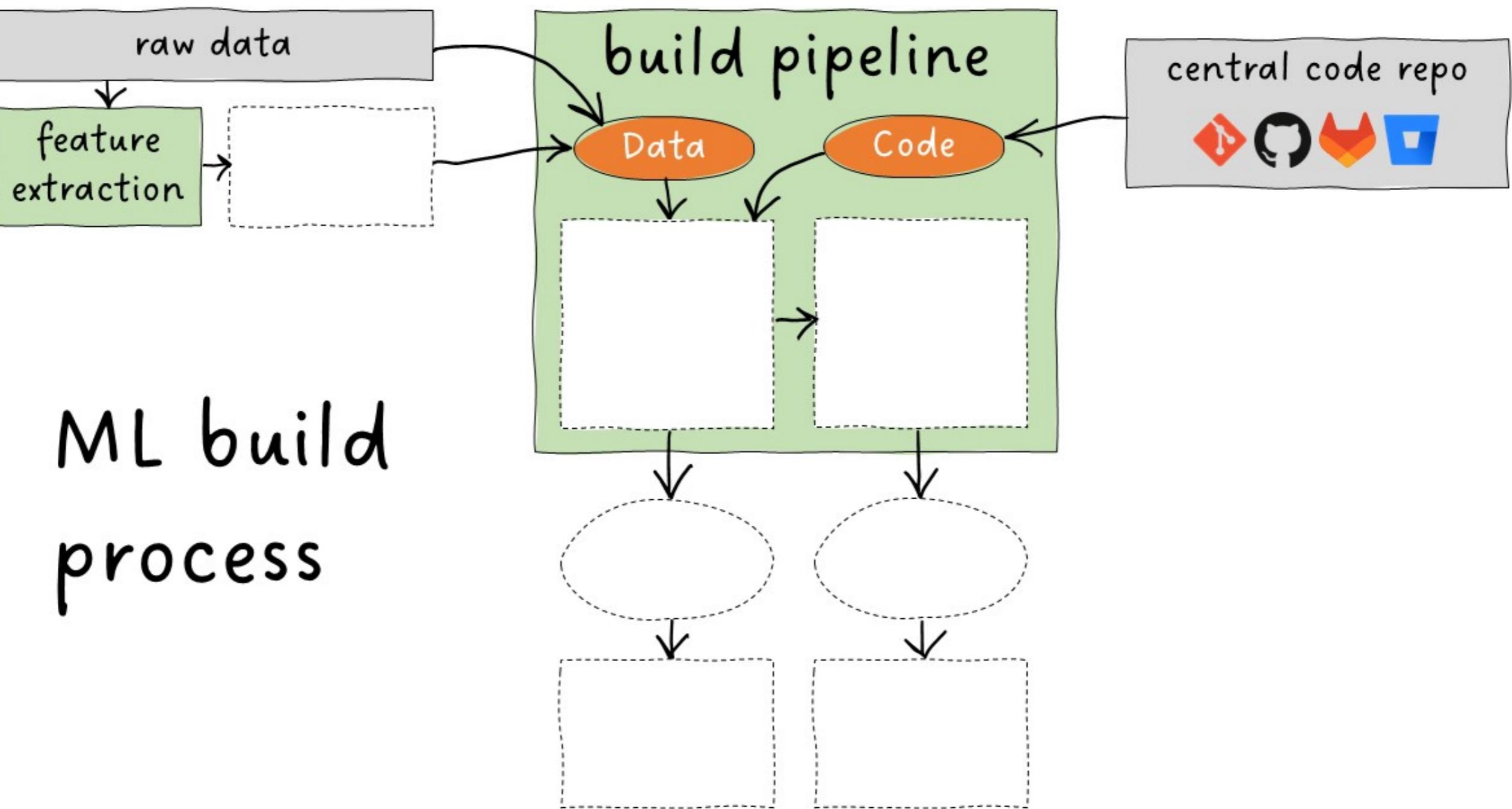
App build process

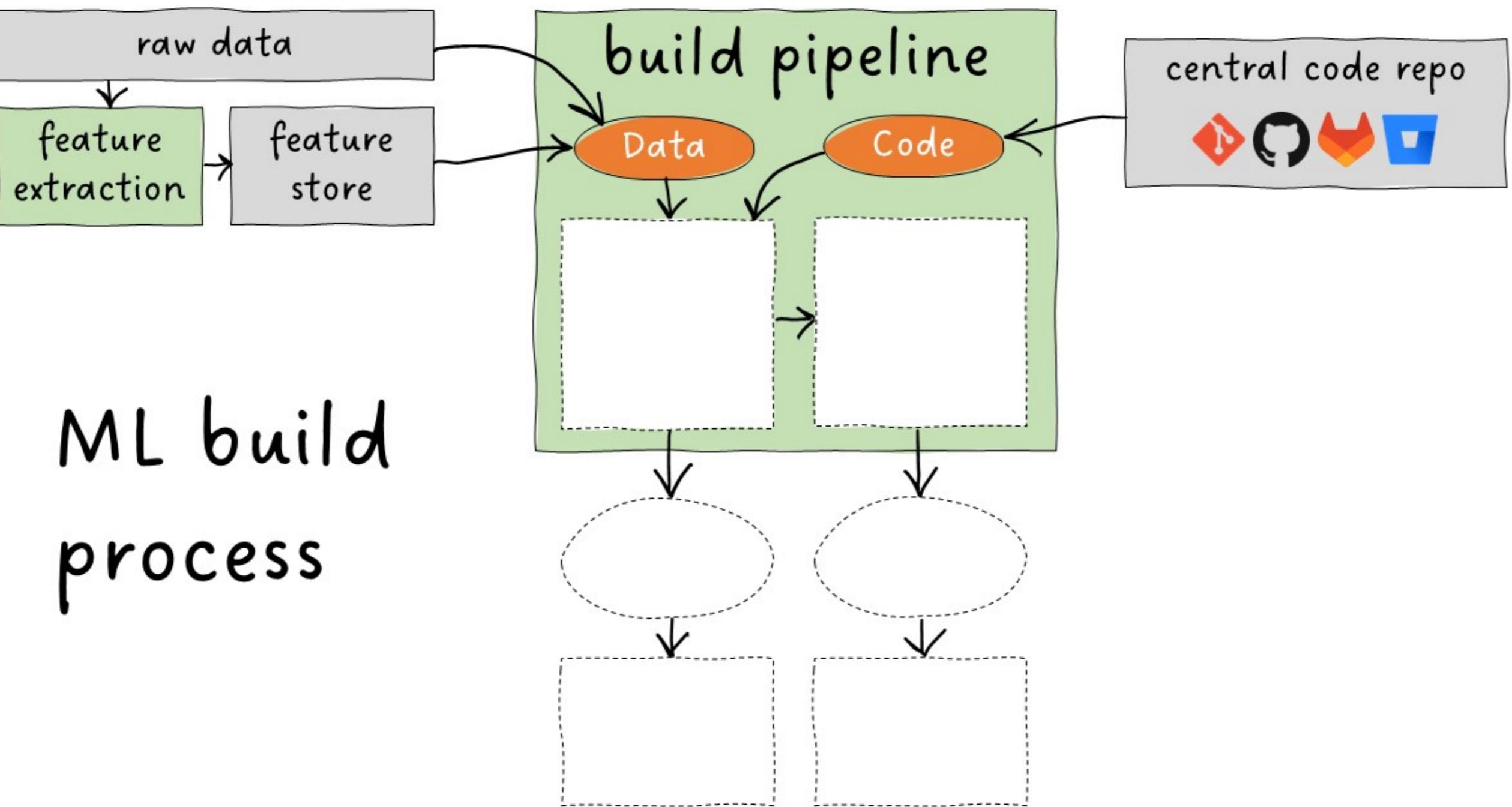


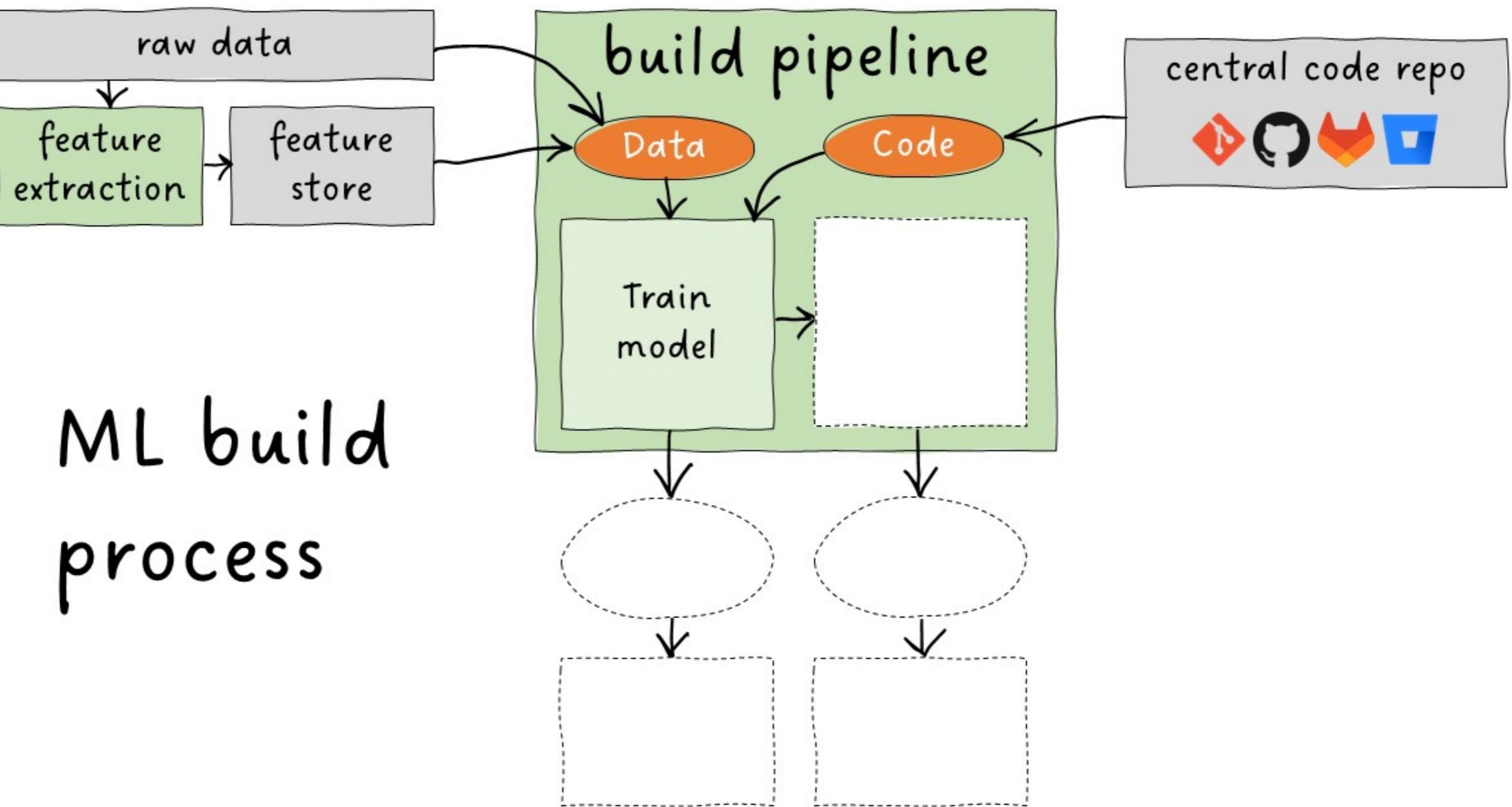


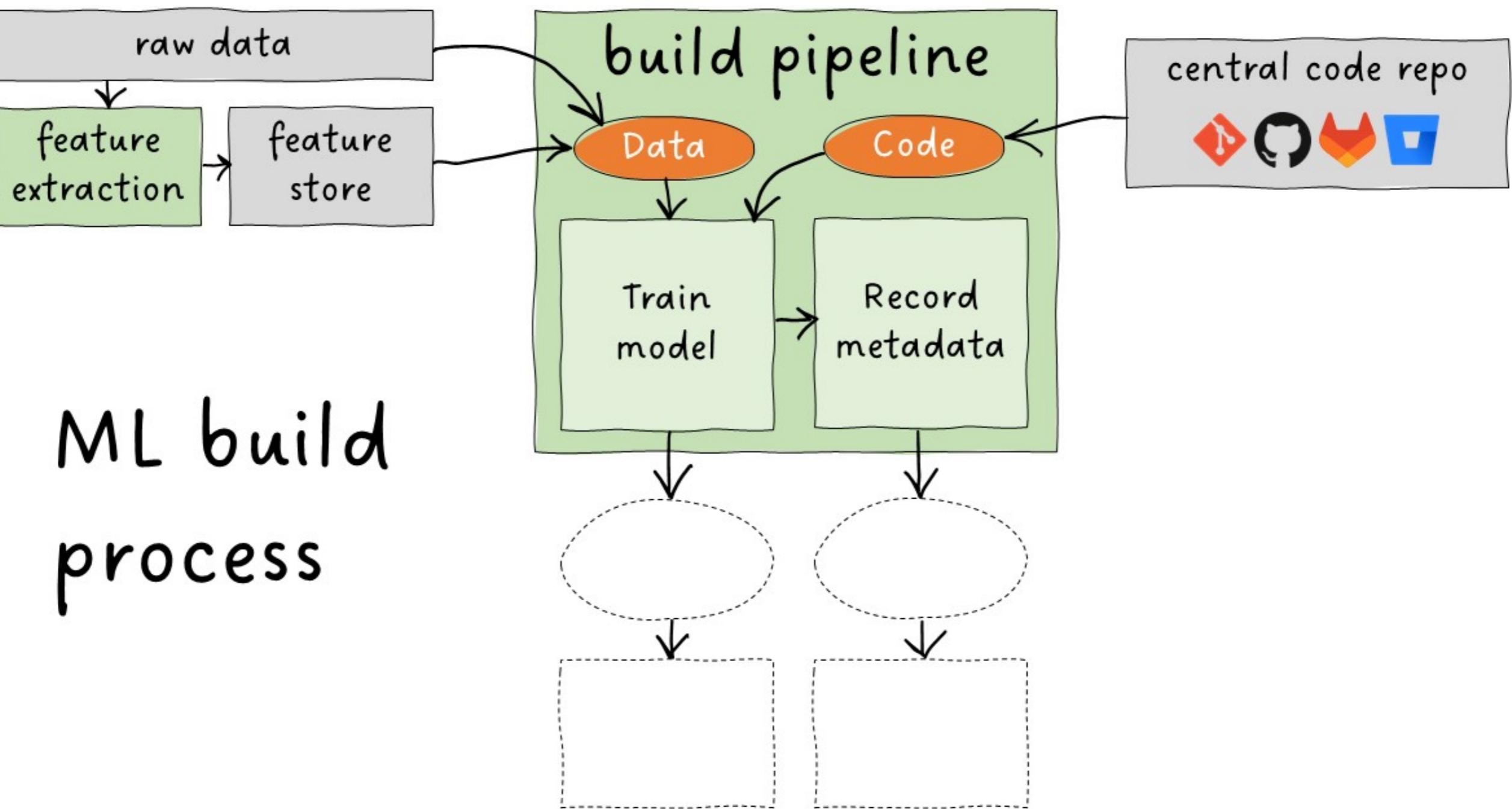


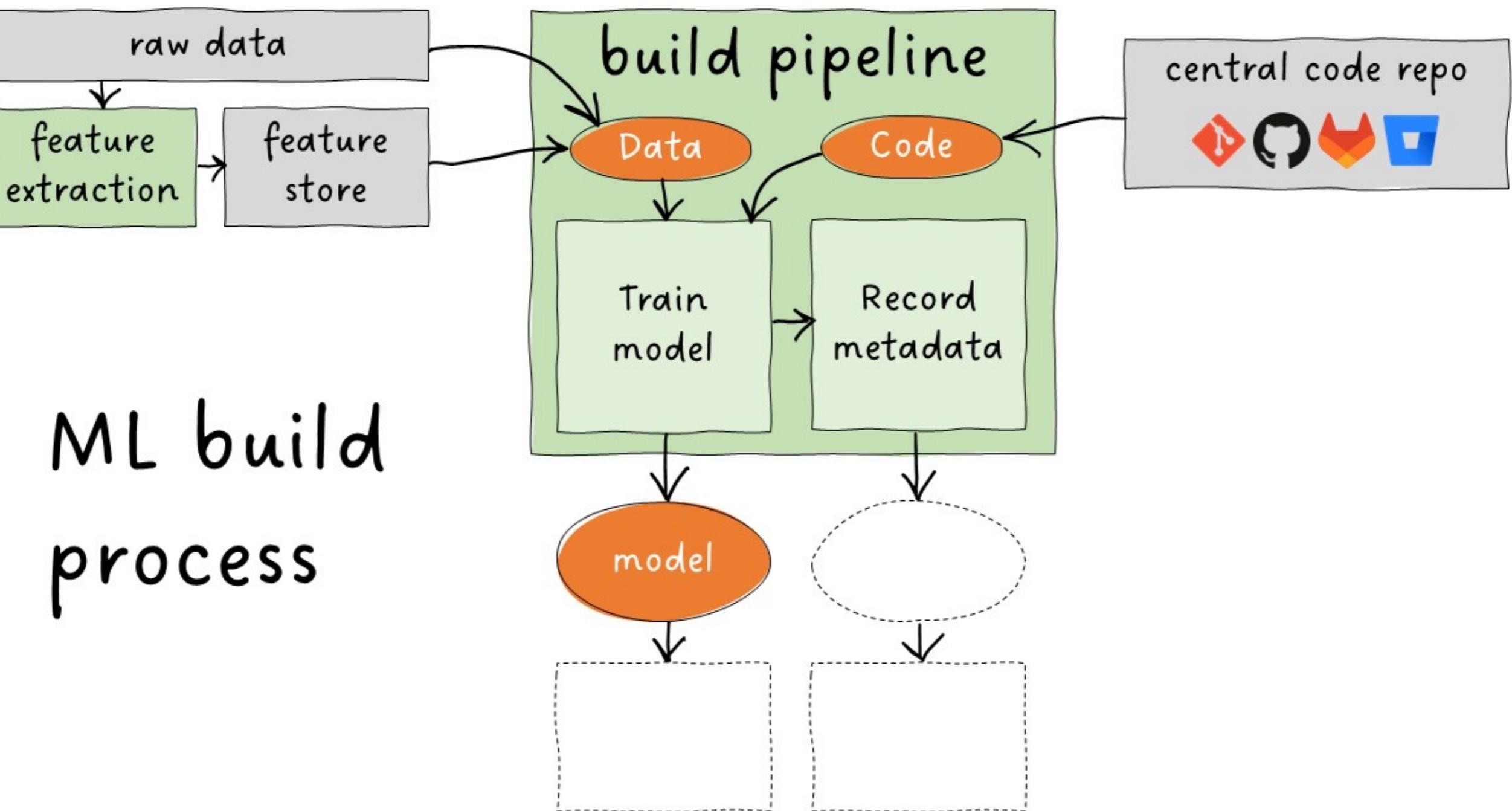


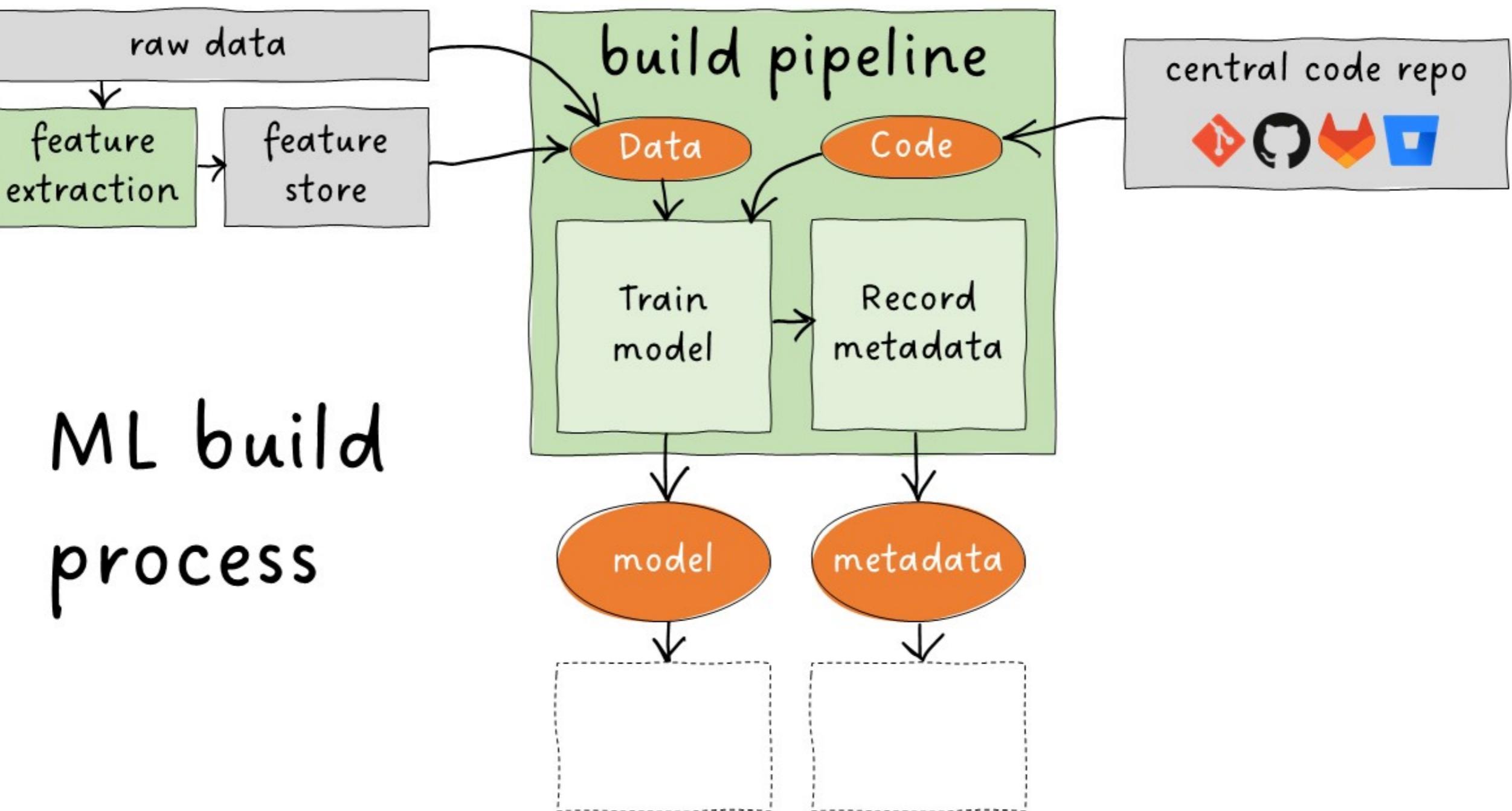


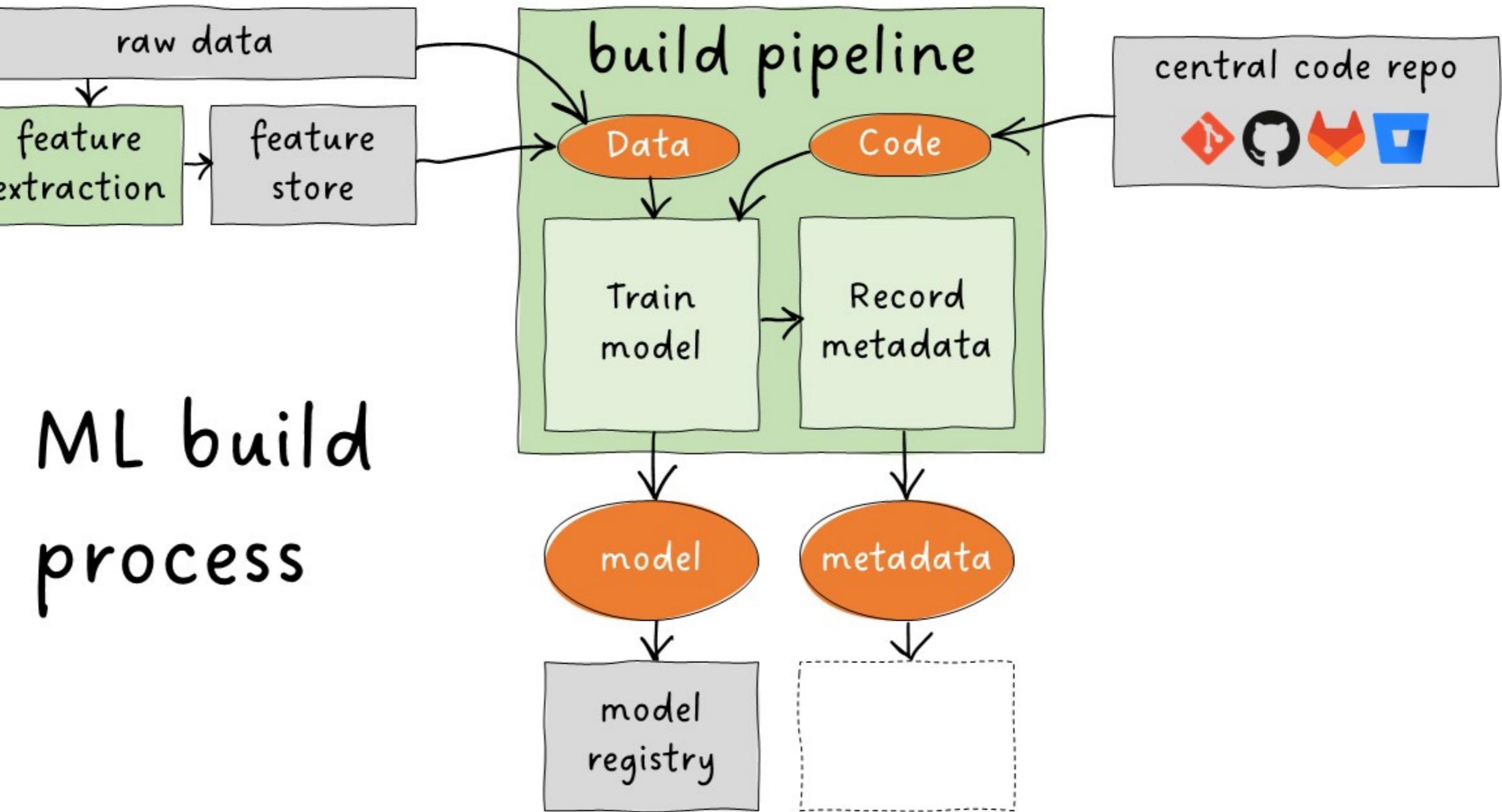


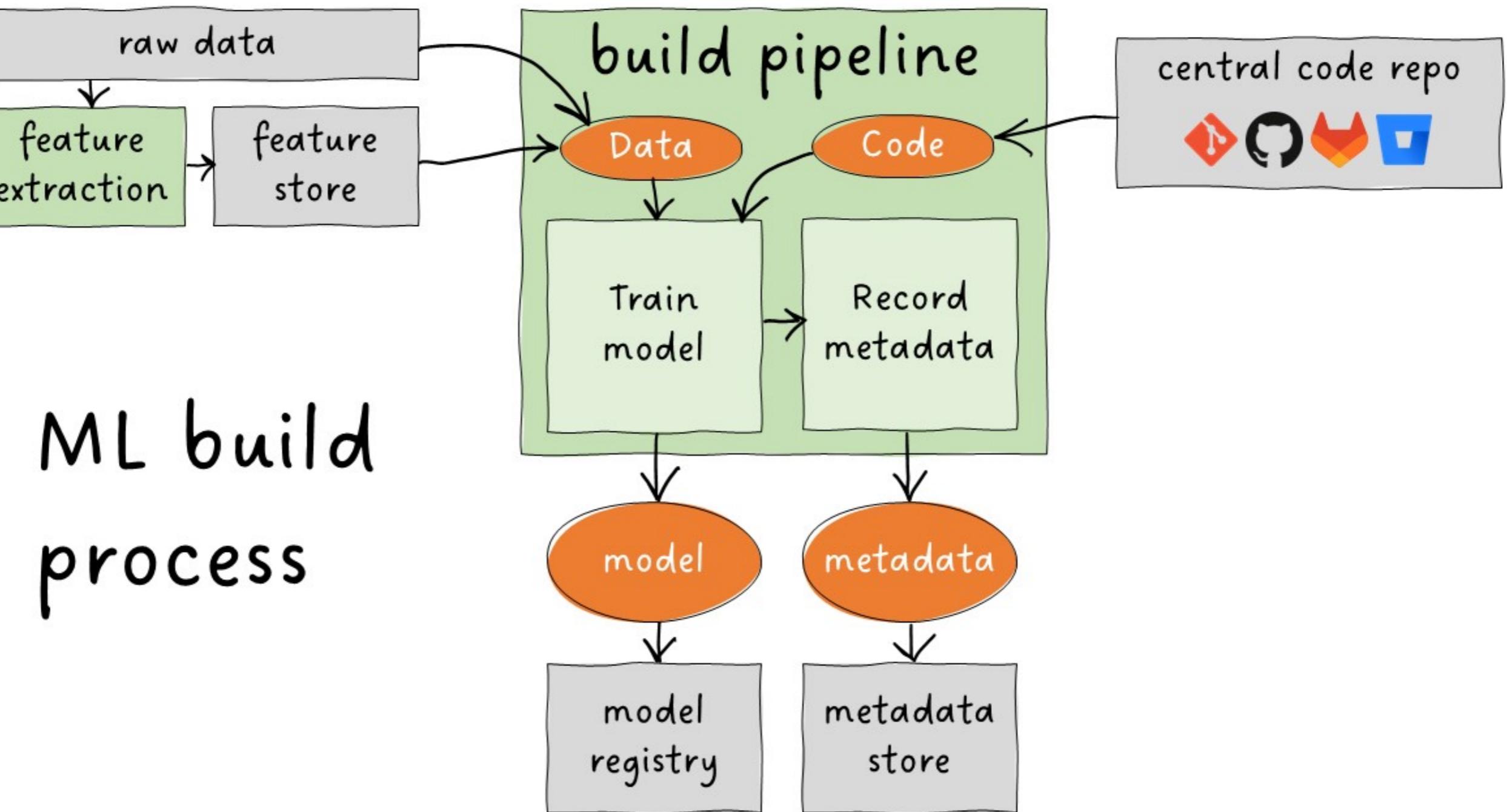






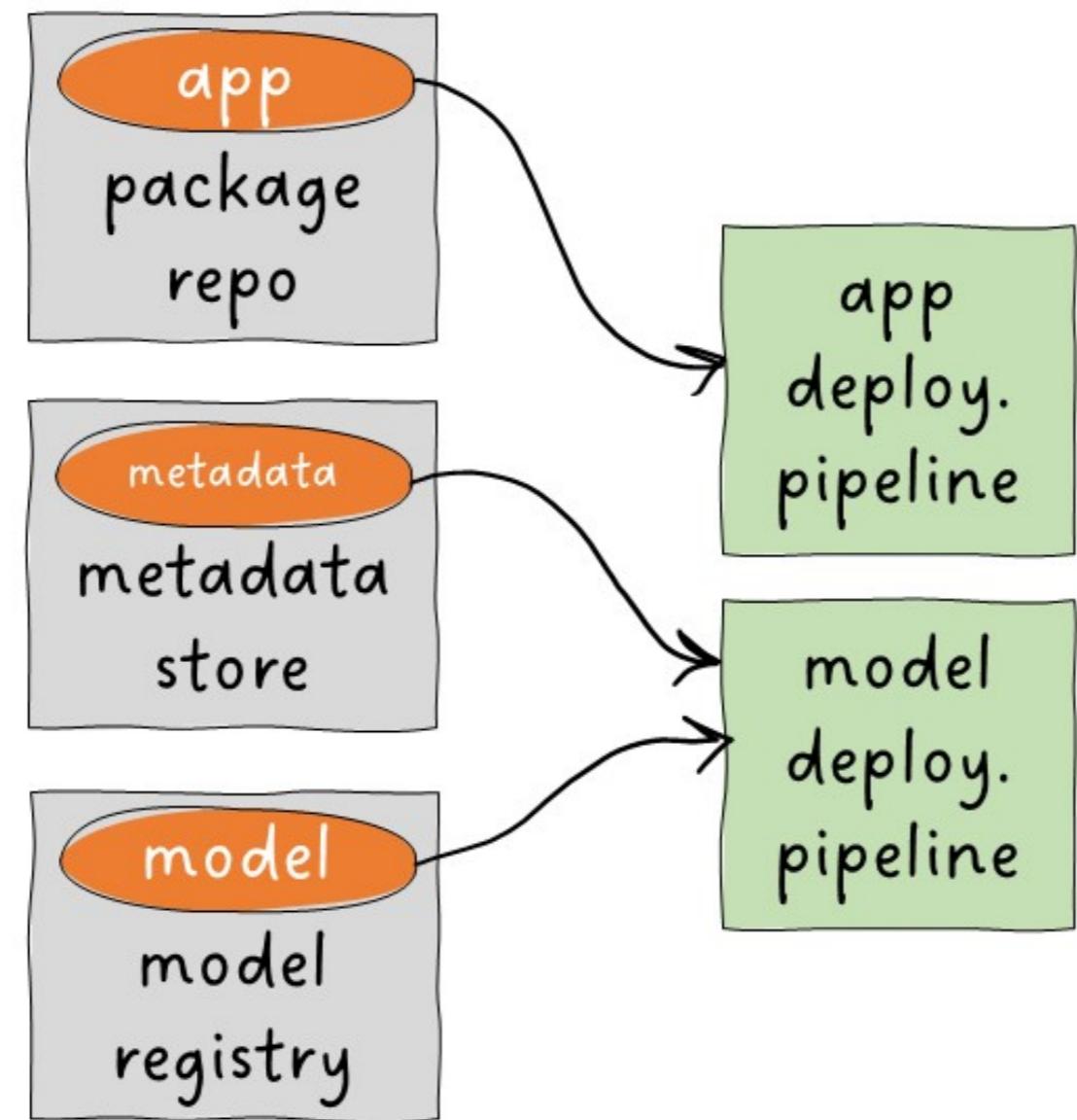


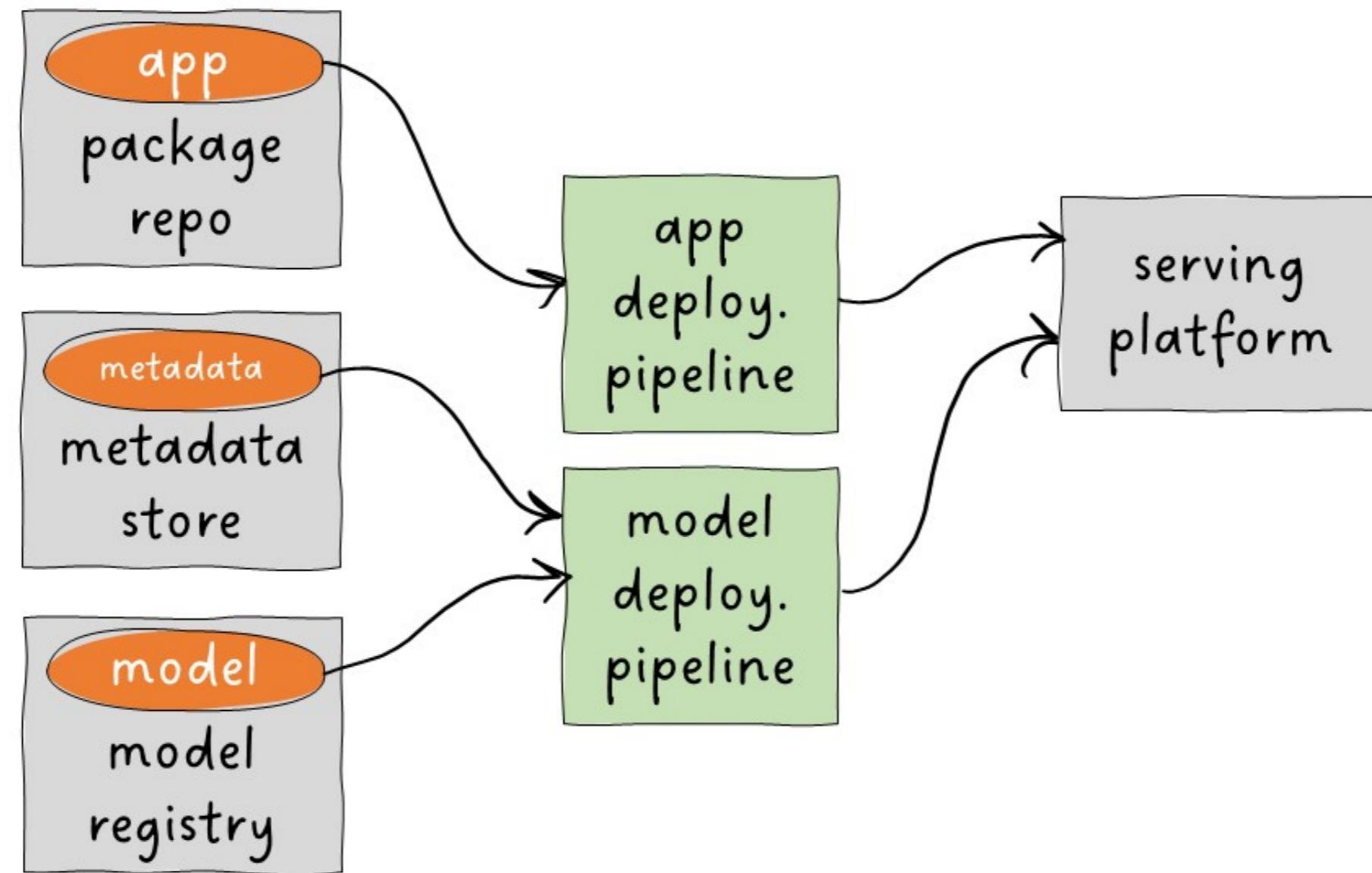


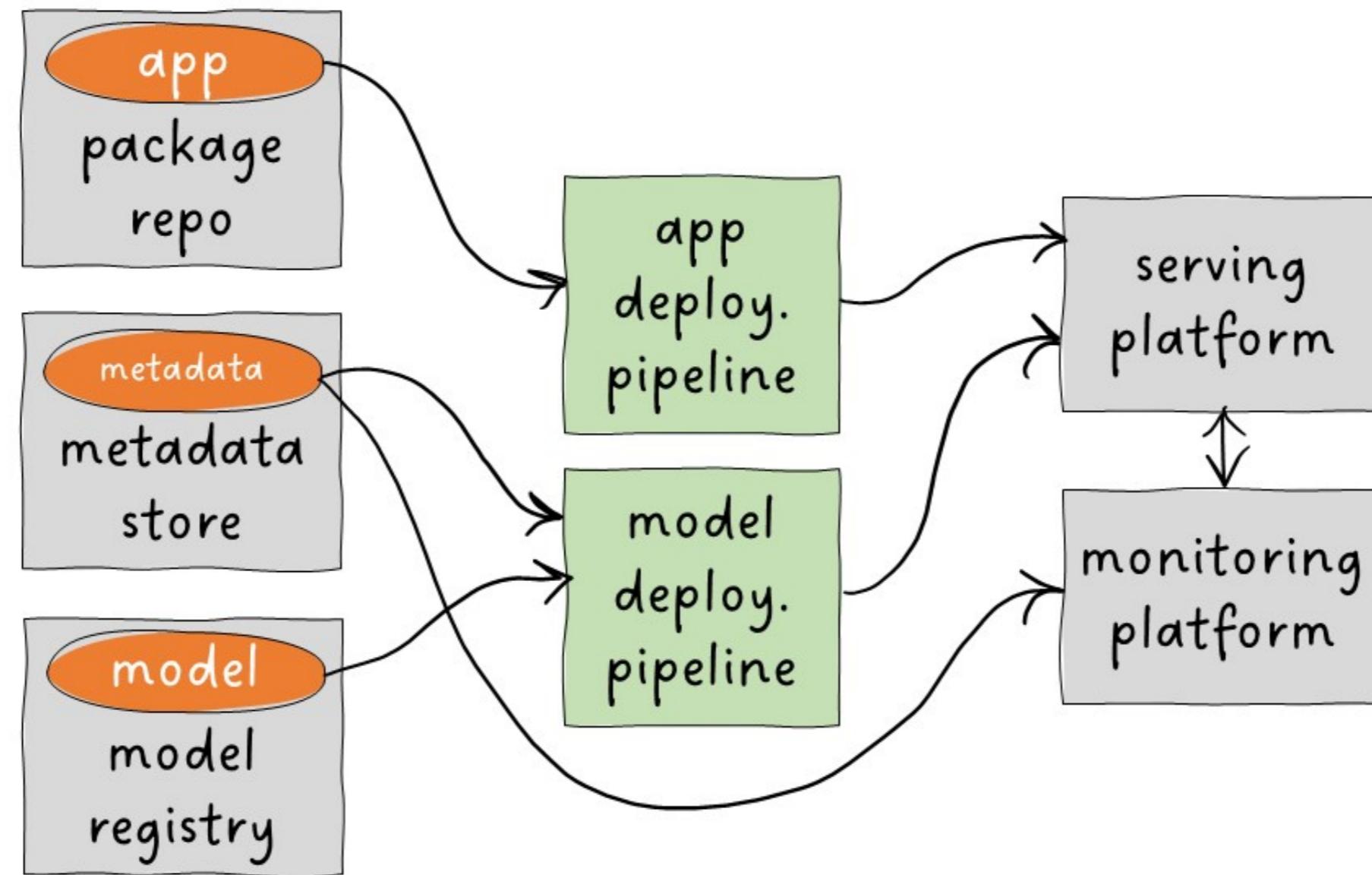


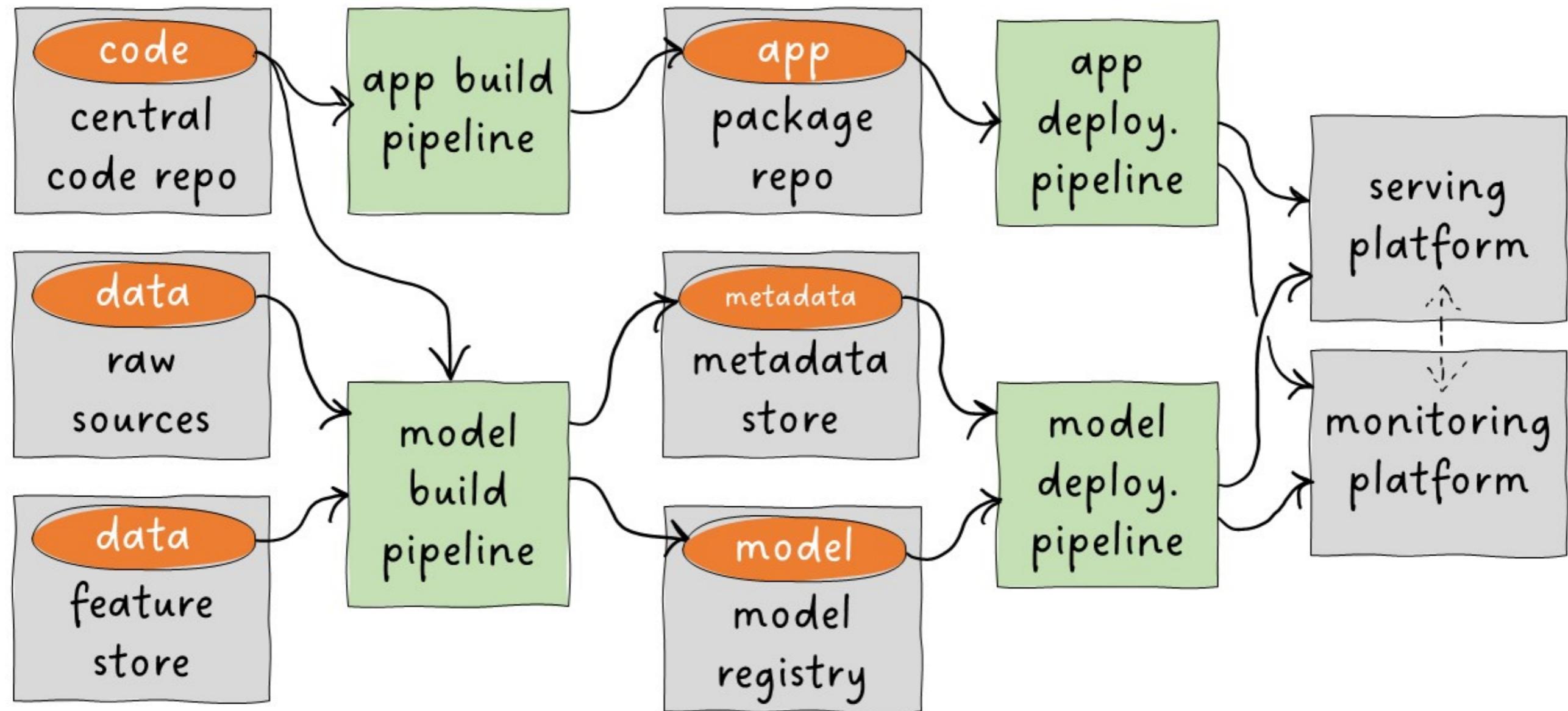
app
deploy.
pipeline

model
deploy.
pipeline









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