TEACHING SOFTWARE ENGINEERING FOR AI-ENABLED SYSTEMS

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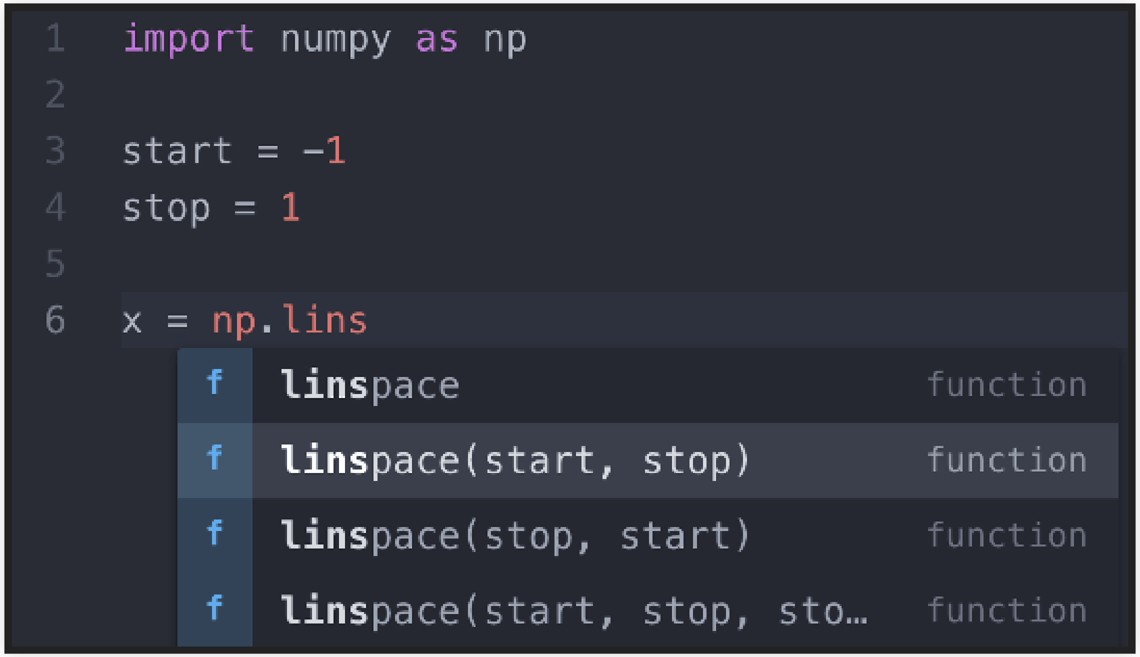
https://github.com/ckaestne/seai

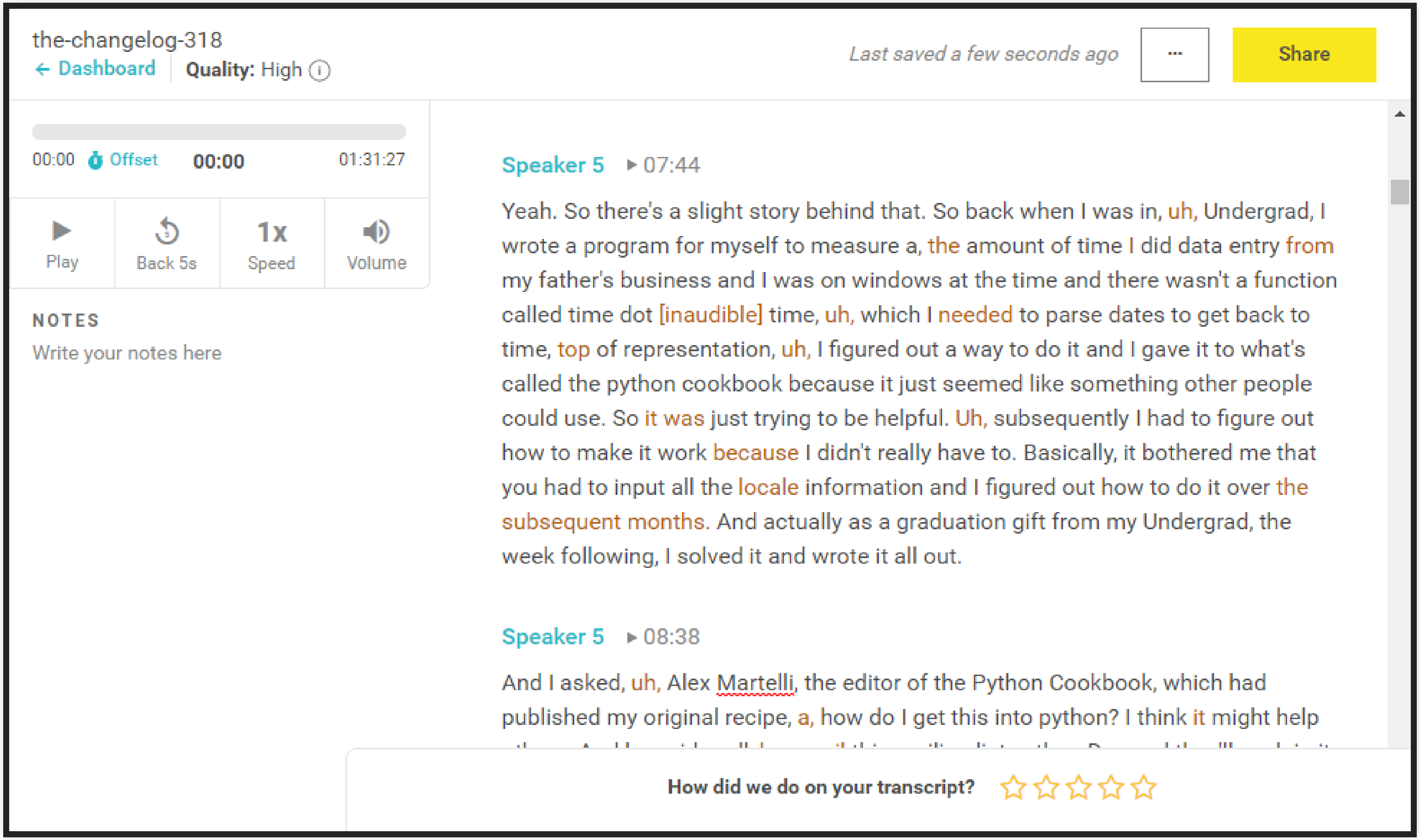
SOFTWARE ENGINEERING FOR AI-ENABLED SYSTEMS

SOFTWARE ENGINEERING FOR AI-ENABLED SYSTEMS != CODING ML FRAMEWORKS

SOFTWARE ENGINEERING FOR AI-ENABLED SYSTEMS != ML4SE



SOFTWARE ENGINEERING FOR AI-ENABLED (AI-ML-BASED, ML-INFUSED) SYSTEMS



(SE 4 ML-enabled systems)

SOFTWARE ENGINEERING

> *Software engineering is the branch of computer science that creates practical, cost-effective solutions to computing and information processing problems, preferentially by applying scientific knowledge, developing software systems in the service of mankind.*

Engineering judgements under limited information and resources

A focus on design, tradeoffs, and the messiness of the real world

Many qualities of concern: cost, correctness, performance, scalability, security, maintainability, ...

"it depends..."

Mary Shaw. ed. Software Engineering for the 21st Century: A basis for rethinking the curriculum. 2005.

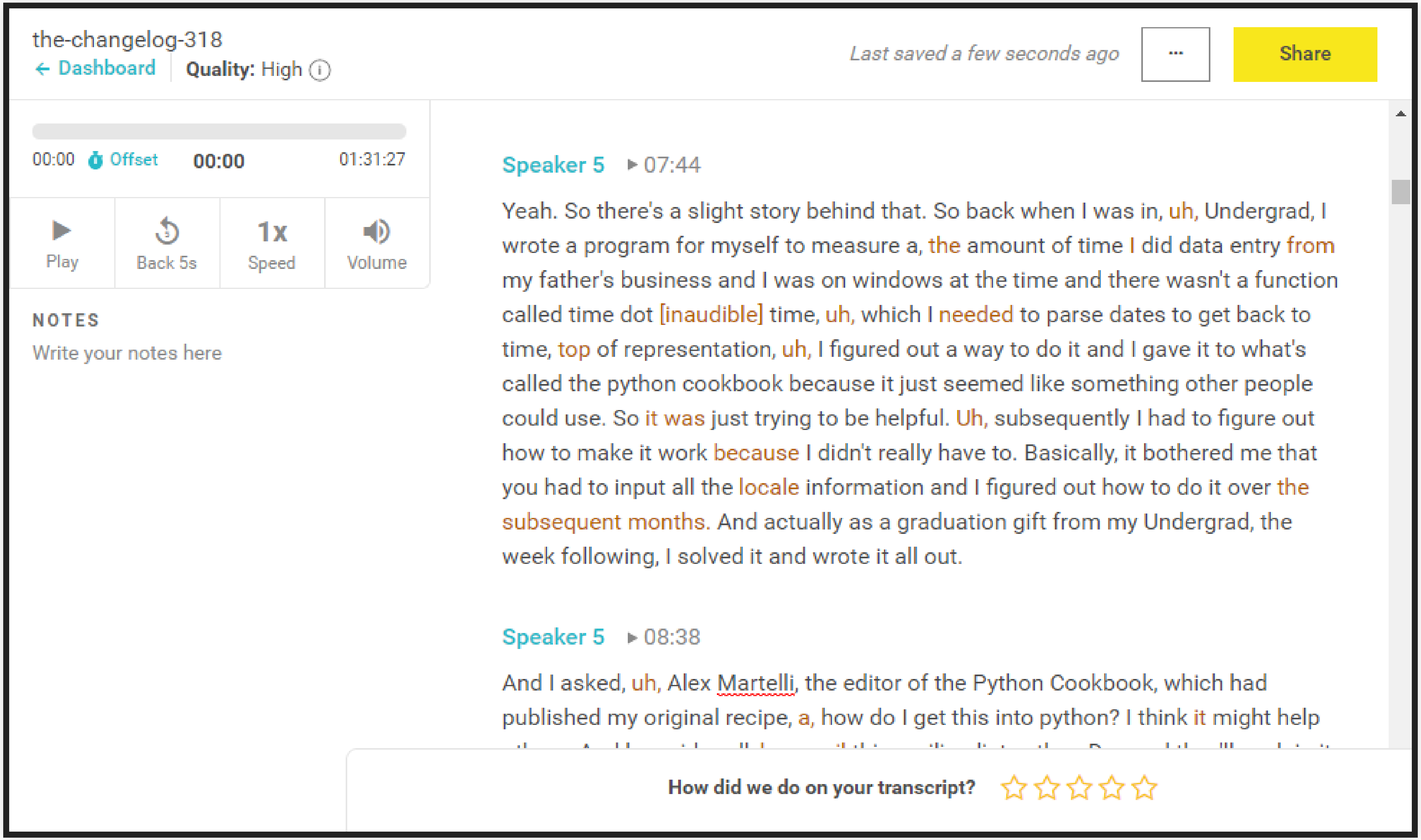
MOST AI/ML COURSES

Focus narrowly on modeling techniques or building models

Using notebooks, static datasets, evaluating accuracy

Little attention to software engineering aspects of building complete systems

(see Antonio's talk)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← Dashboard
Quality: High
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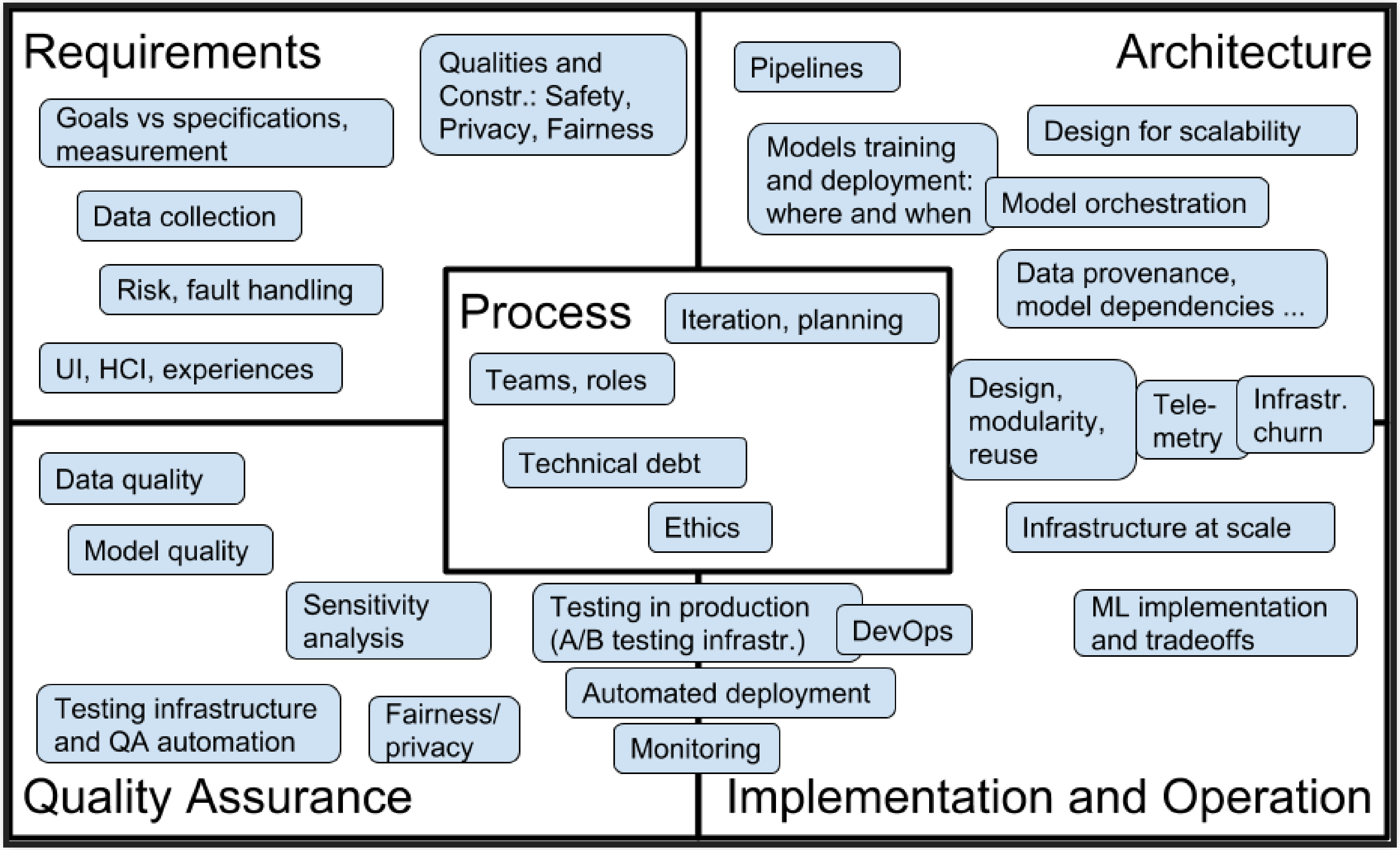
Speaker 5
07:44
Yeah. So there's a slight story behind that. So back when I was in, uh, Undergrad, I wrote a program for myself to measure a, the amount of time I did data entry from my father's business and I was on windows at the time and there wasn't a function called time dot [inaudible] time, uh, which I needed to parse dates to get back to time, top of representation, uh, I figured out a way to do it and I gave it to what's called the python cookbook because it just seemed like something other people could use. So it was just trying to be helpful. Uh, subsequently I had to figure out how to make it work because I didn't really have to. Basically, it bothered me that you had to input all the locale information and I figured out how to do it over the subsequent months. And actually as a graduation gift from my Undergrad, the week following, I solved it and wrote it all out.
Speaker 5
08:38
And I asked, uh, Alex Martelli, the editor of the Python Cookbook, which had published my original recipe, a, how do I get this into python? I think it might help
How did we do on your transcript?

EXAMPLE SOFTWARE ENGINEERING CONCERNS

- How to build robust AI pipelines and facilitate regular model updates?
- How to deploy and update models in production?
- How to evaluate data and model quality in production?
- How to deal with mistakes that the model makes and manage associated risk?
- How to trade off between various qualities, including learning cost, inference time, updatability, and interpretability?
- How to design a system that scales to large amounts of data?
- How to version models and data?
- How to manage interdisciplinary teams with data scientists, software engineers, and operators?



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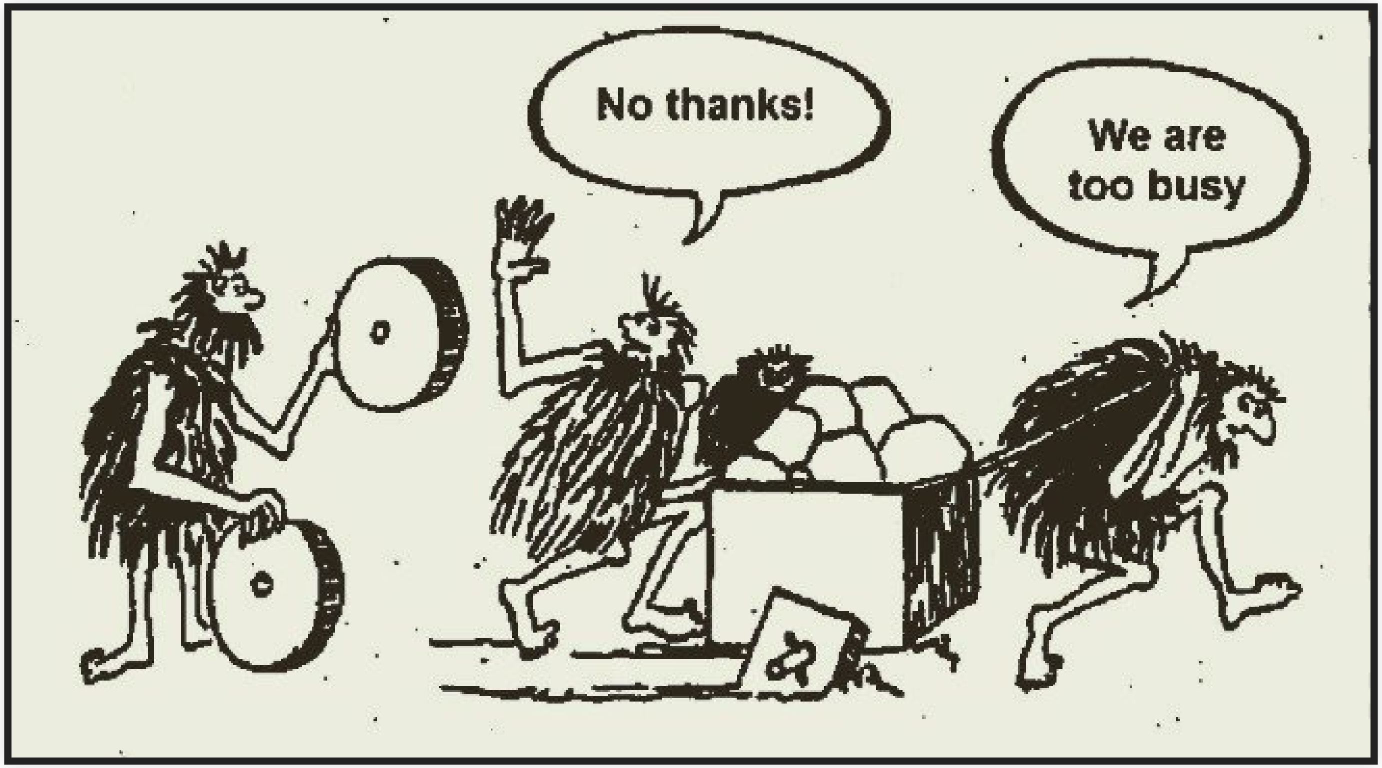
WHAT'S DIFFERENT?

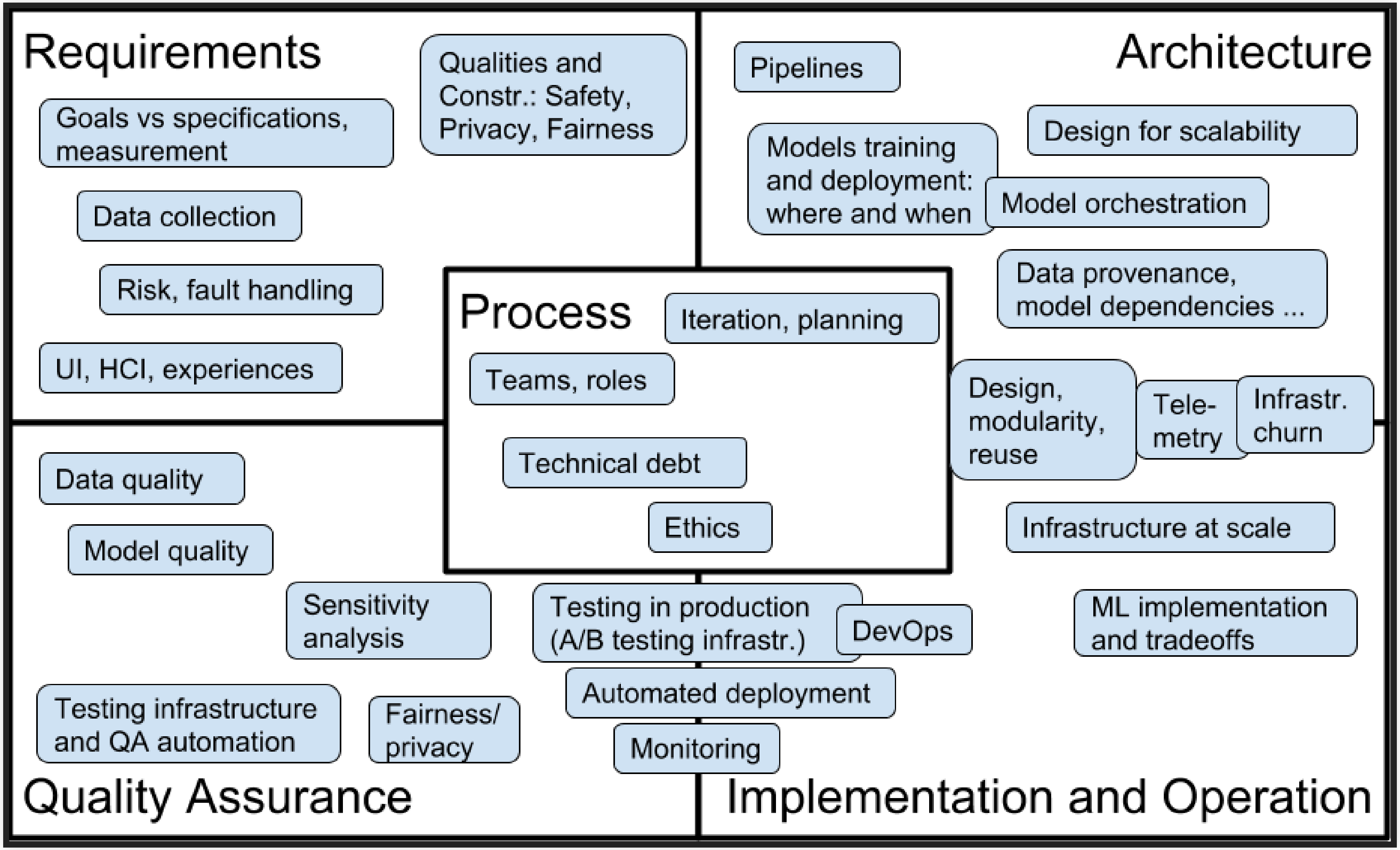
- Missing specifications
- Environment is important (feedback loops, data drift)
- Nonlocal and nonmonotonic effects
- Testing in production
- Data management, versioning, and provenance

REALLY DIFFERENT?

- Missing specifications -- *implicit, vague specs very common; safe systems from unreliable components*
- Environment is important -- *the world vs the machine*
- Nonlocal and nonmonotonic effects -- *feature interactions, system testing*
- Testing in production -- *continuous deployment, A/B testing*
- Data management, versioning, and provenance -- *stream processing, event sourcing, data modeling*


No thanks!
We are
too busy

While developers of simple traditional systems may get away with poor practices, most developers of AI-enabled systems will not.



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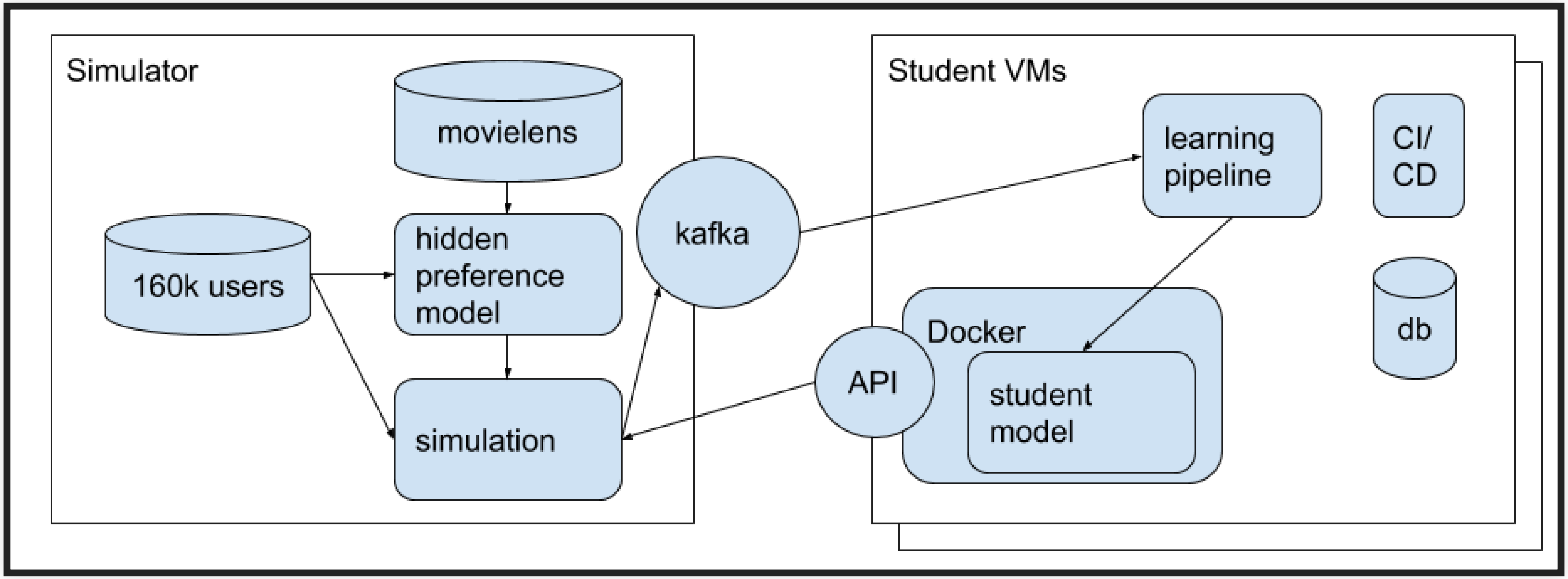
ASSIGNMENTS

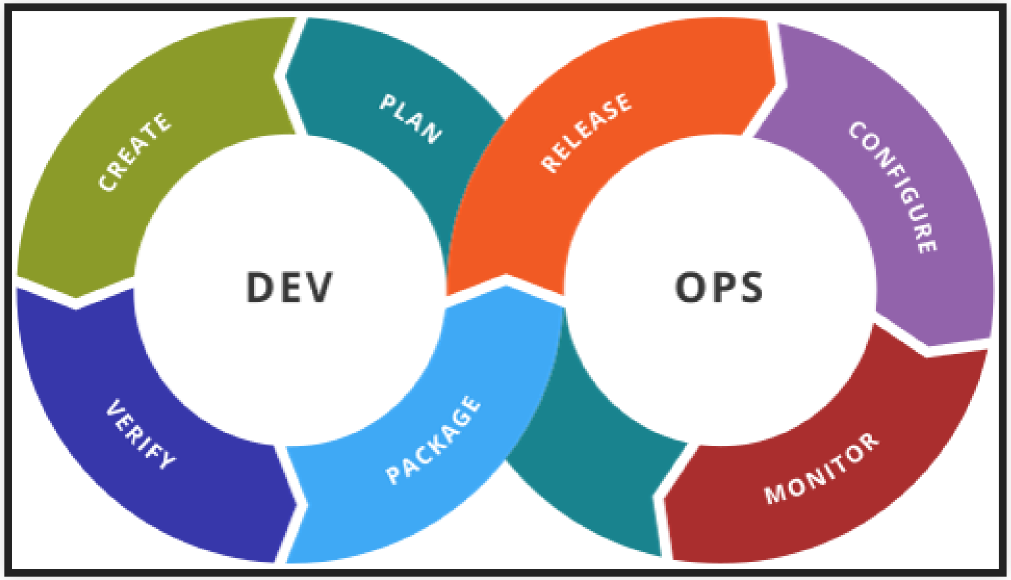
Break the habit of modeling in notebooks on static datasets

Design for realistic "production" setting: deployment, experimentation in production, data drift and feedback loops

Movie recommendation scenario, simulating 160k users watching movies in real time



ASIDE: DEVOPS

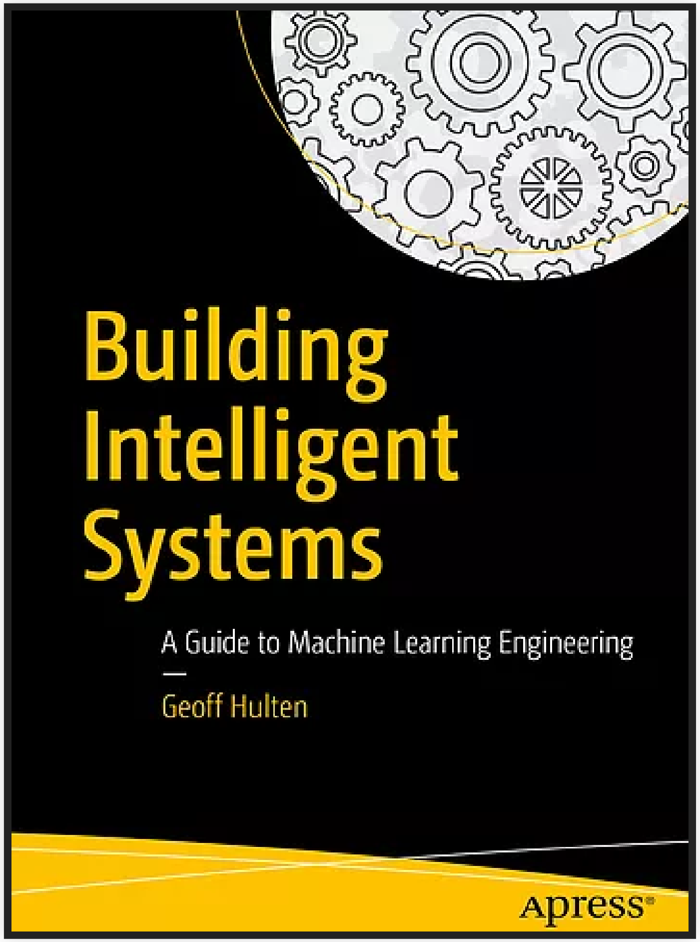


READINGS

All lecture material (except simulator):
https://github.com/ckaestne/seai

Annotated bibliography:
https://github.com/ckaestne/seaibib

ICSE SEET'20 paper



SUGGESTED TOPICS

- Identifying the right requirements for fairness, robustness, privacy, security, usefulness, ...
- Supporting exploratory programming
- Modularity, nonmodularity, and feature interactions
- Versioning of data and models; provenance
- Designing telemetry
- Testing and experimenting in production
- Architectural reasoning and deployment
- Ensuring safety: Designing fallback strategies, railguards, ...
- Designing interactions with users (forcefulness of experience)
- Monitoring, data drift, feedback loops, data quality
- Quality assurance of ML pipeline