TEACHING SOFTWARE ENGINEERING FOR AI-ENABLED SYSTEMS

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https://ckaestne.github.io/seai/

ICSE-SEET 2020

SOFTWARE ENGINEERING FOR ML-ENABLED SYSTEMS

Building, operating, and maintaining software systems with machine-learned components

SE 4 ML-SYSTEMS != TRAINING MODELS

G4 playground.ipynb

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1096	4	12	26	3	2	0
235	4	4	23	1	2	0

525 rows × 6 columns

```
# learning a classifier whether the result will be nonZero

from sklearn import tree

classifier=tree.DecisionTreeClassifier(max_depth=8)
classifier=classifier.fit(Xtrain,ynztrain)

print(classifier.score(Xtrain, ynztrain))
print(classifier.score(Xtest, ynztest))
```

```
0.8266666666666667
0.7295238095238096
```

```
# learning a regression model only on the nonZero data (test is on all data and somewhat

from sklearn import tree
```

```python
predictor=tree.DecisionTreeRegressor(max_depth=8)
predictor=predictor.fit(XnzTrain,YnzTrain)


print(predictor.score(XnzTrain, YnzTrain))
print(predictor.score(Xtest, ytest))
```

```
0.9376379365613154
-2.437397740412892
```

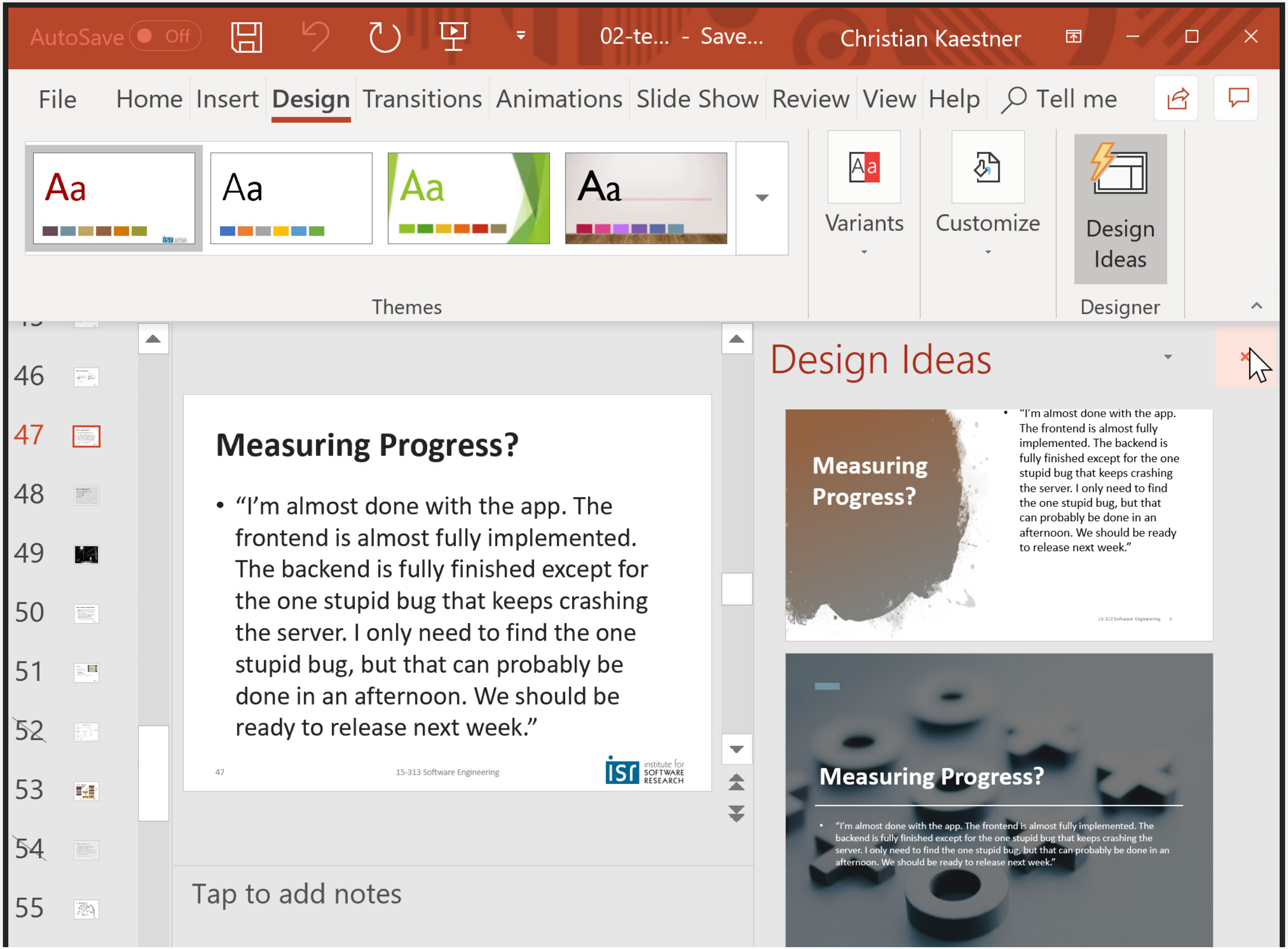
SE 4 ML-SYSTEMS != ML 4 SE

```python
import numpy as np

start = -1
stop = 1

x = np.lins
```

f	linspace	function
f	linspace(start, stop)	function
f	linspace(stop, start)	function
f	linspace(start, stop, sto…	function



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Measuring Progress?
• "I'm almost done with the app. The frontend is almost fully implemented. The backend is fully finished except for the one stupid bug that keeps crashing the server. I only need to find the one stupid bug, but that can probably be done in an afternoon. We should be ready to release next week."
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Design Ideas
Measuring Progress?
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Measuring Progress?
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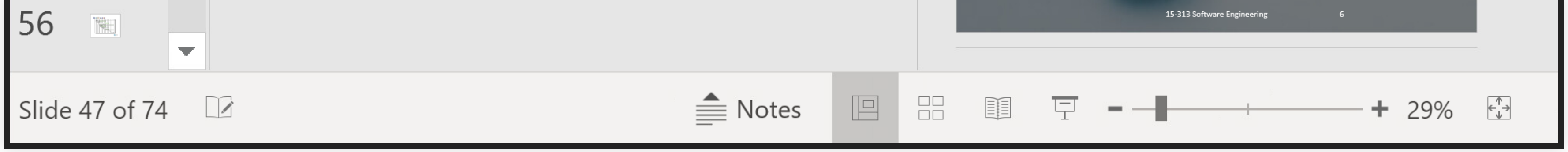
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Notes
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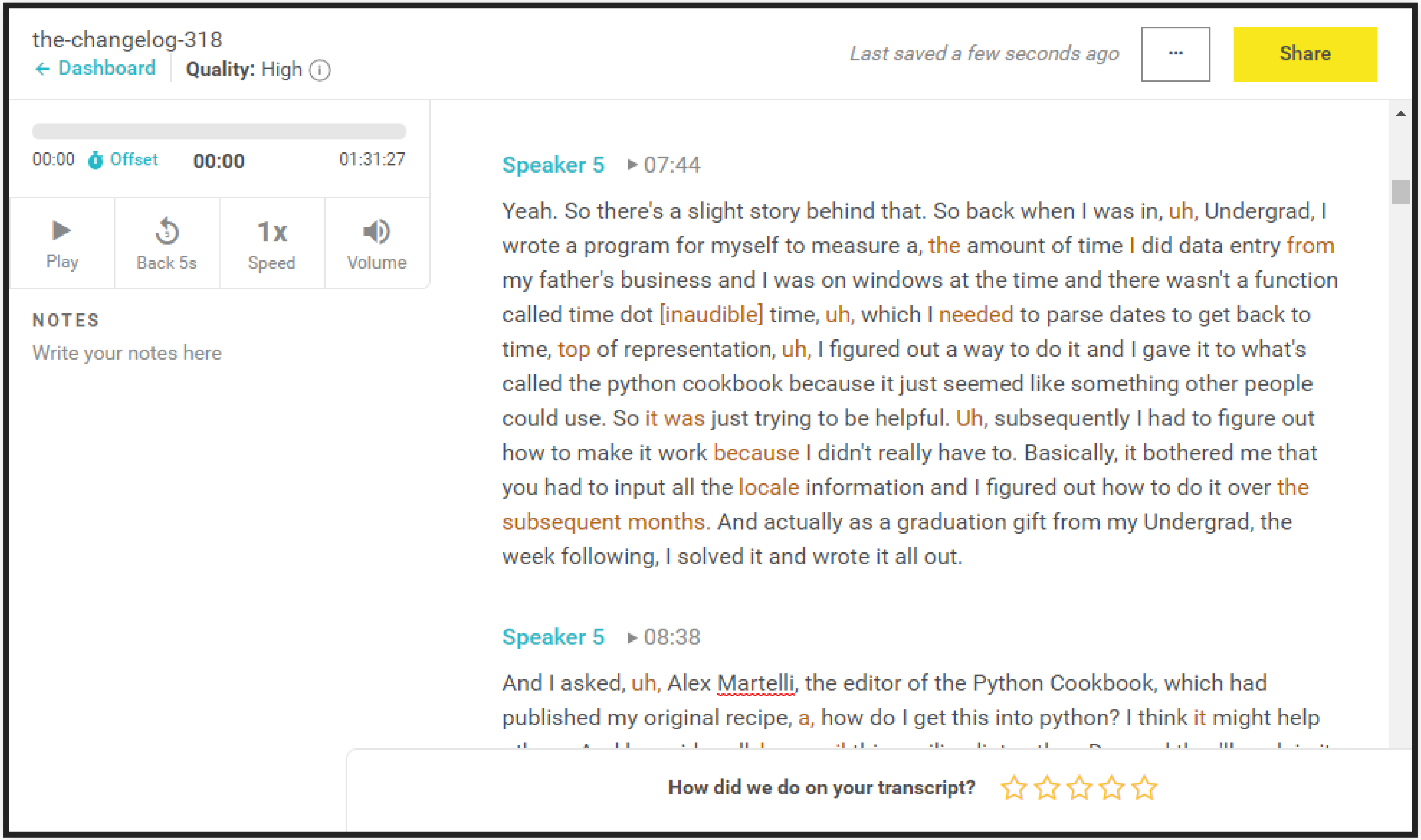
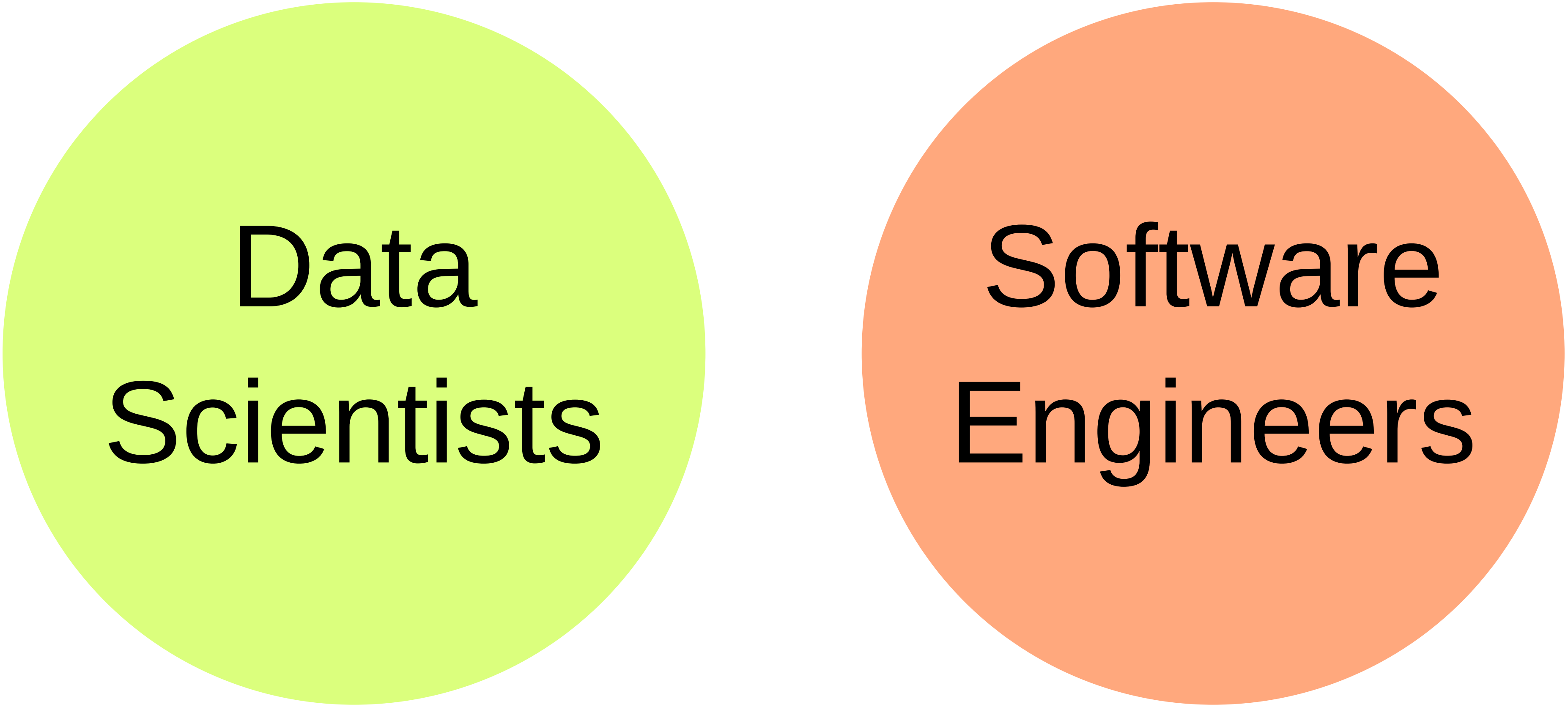
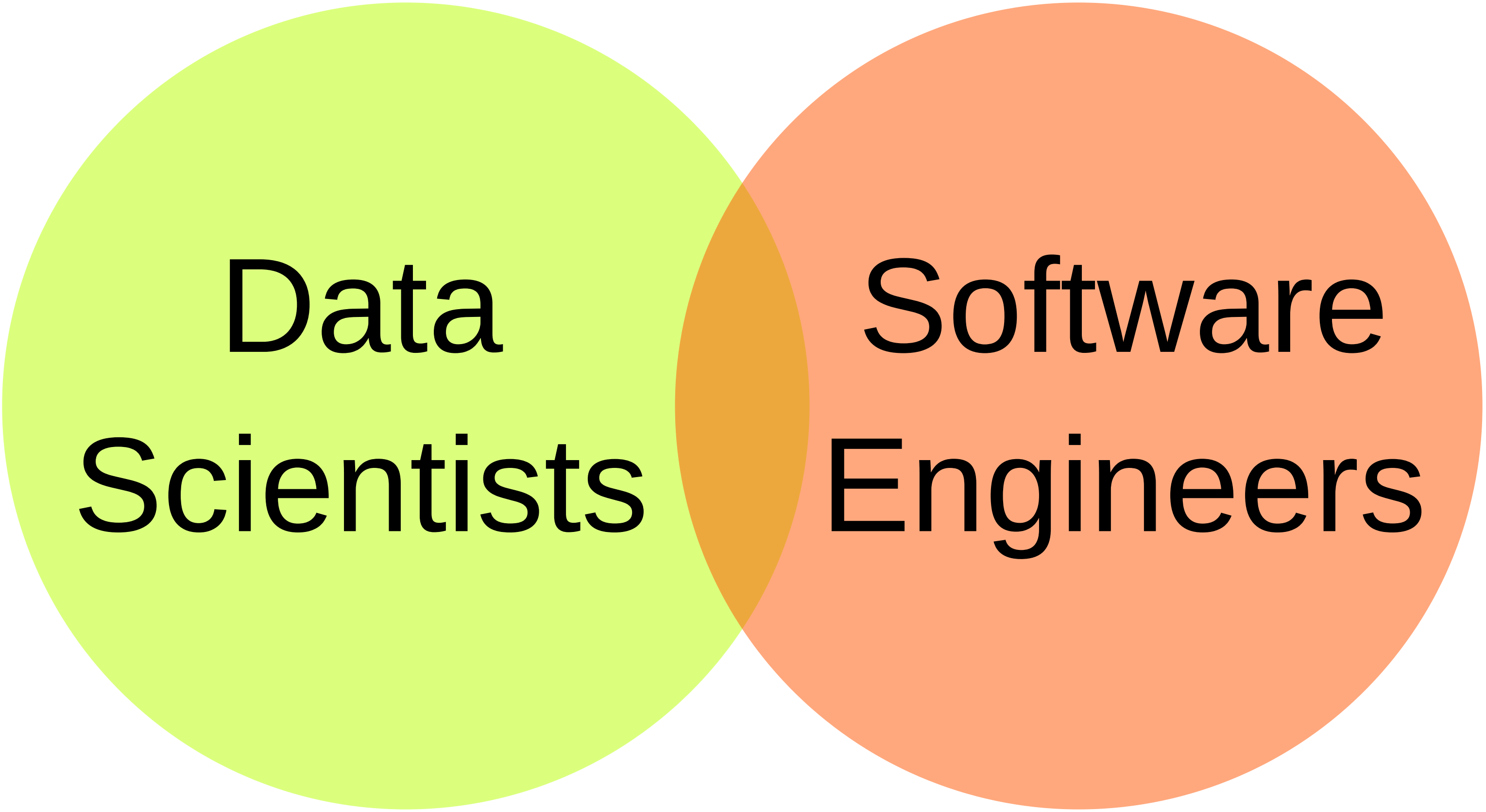


the-changelog-318
Dashboard
Quality: High
Last saved a few seconds ago
...
Share
00:00
Offset
00:00
01:31:27
Play
Back 5s
1x
Speed
Volume
NOTES
Write your notes here
Speaker 5 07:44
Yeah. So there's a slight story behind that. So back when I was in, uh, Undergrad, I wrote a program for myself to measure 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?


Data Scientists
Software Engineers

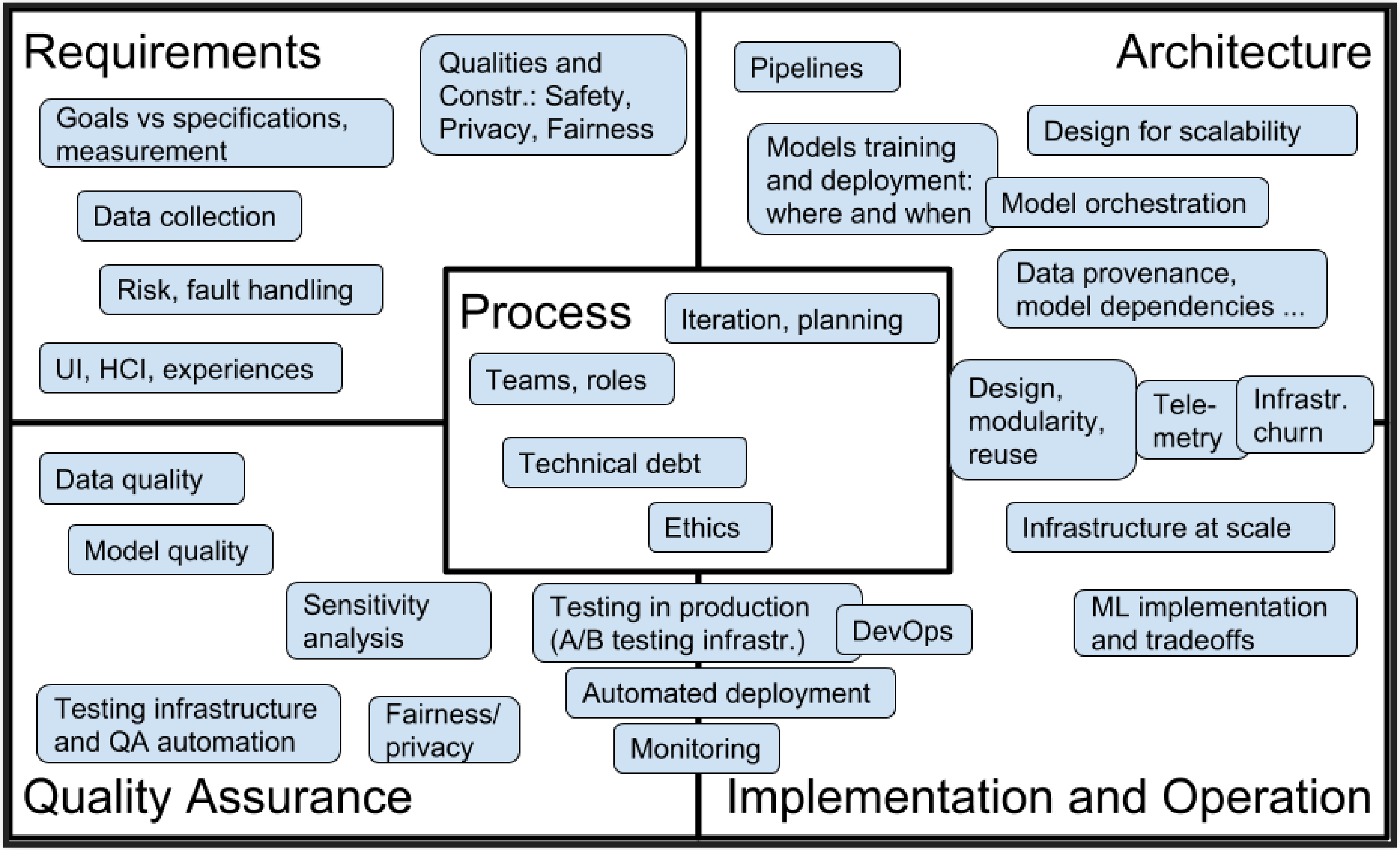

Data Scientists
Software Engineers

MANY CHALLENGES

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

SOFTWARE ENGINEERS CAN CONTRIBUTE

- Missing specifications -- *implicit, vague specs very common; safe systems from unreliable components, risk analysis* ("ML is requirements engineering")
- Environment is important -- *the world vs the machine* (paper)
- 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*
- Fairness, robustness, interpretability -- *traditional requirements engineering questions*



https://github.com/ckaestne/seai

OUR VIEW

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

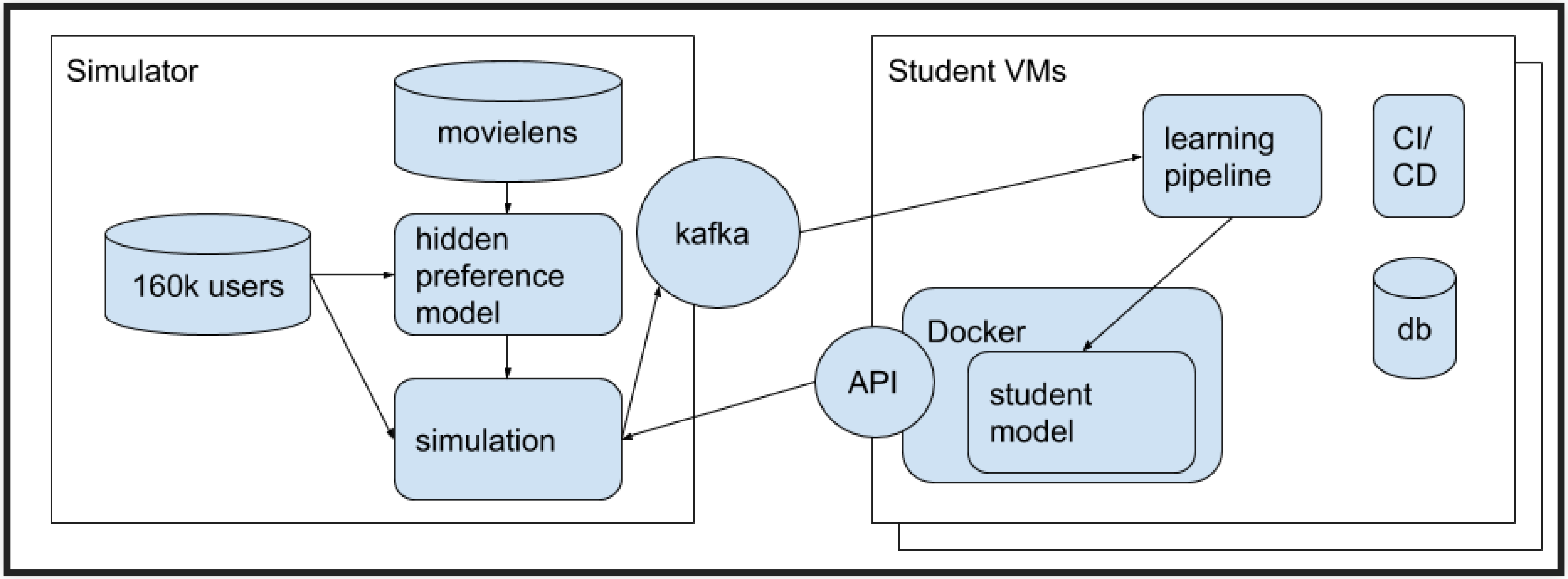
This is an education problem, more than a research problem.

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 recommendations for 1 million simulated users in real time



SUMMARY: SOFTWARE ENGINEERING FOR ML-ENABLED SYSTEMS

- Building, operating, and maintaining systems with ML component
- Data scientists and software engineers have different expertise, both needed
- Software engineering view on intelligent *systems*:
    - User interaction design
    - Model qualities and deployment tradeoffs
    - Risk analysis and safety
    - Architecture, deployment, telemetry design
    - Quality assurance, fairness, robustness, interpretability
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