Microsoft

31/10/2018

Microsoft Future Decoded

Productionising deep learning:

The confused.com journey

Confused.com
On a mission to save you money

Microsoft

Who are we?

Dr. Tim Scarfe

Machine learning engineer, data scientist and entrepreneur.

Principal Software Engineer

@ecsquendor

Dr. Tempest van Schaik

Biomedical engineer, inventor, designer, researcher. Health + AI.

Software Engineer in Data & AI

@Dr_Tempest

Dr Tim + Dr Tem aka:

Tweat out to #TimTem !

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What you'll hear from us today:

- What we do at Microsoft
- The story of deep learning
- Machine learning is becoming ubiquitous in software
- Many companies are becoming data companies
- Our collaboration with confused.com
- Our deep learning model for car insurance
- The emerging field of DevOps in data science
- Our deep learning DevOps pipeline

Commercial Software Engineering

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Distilled Concepts of Deep Learning

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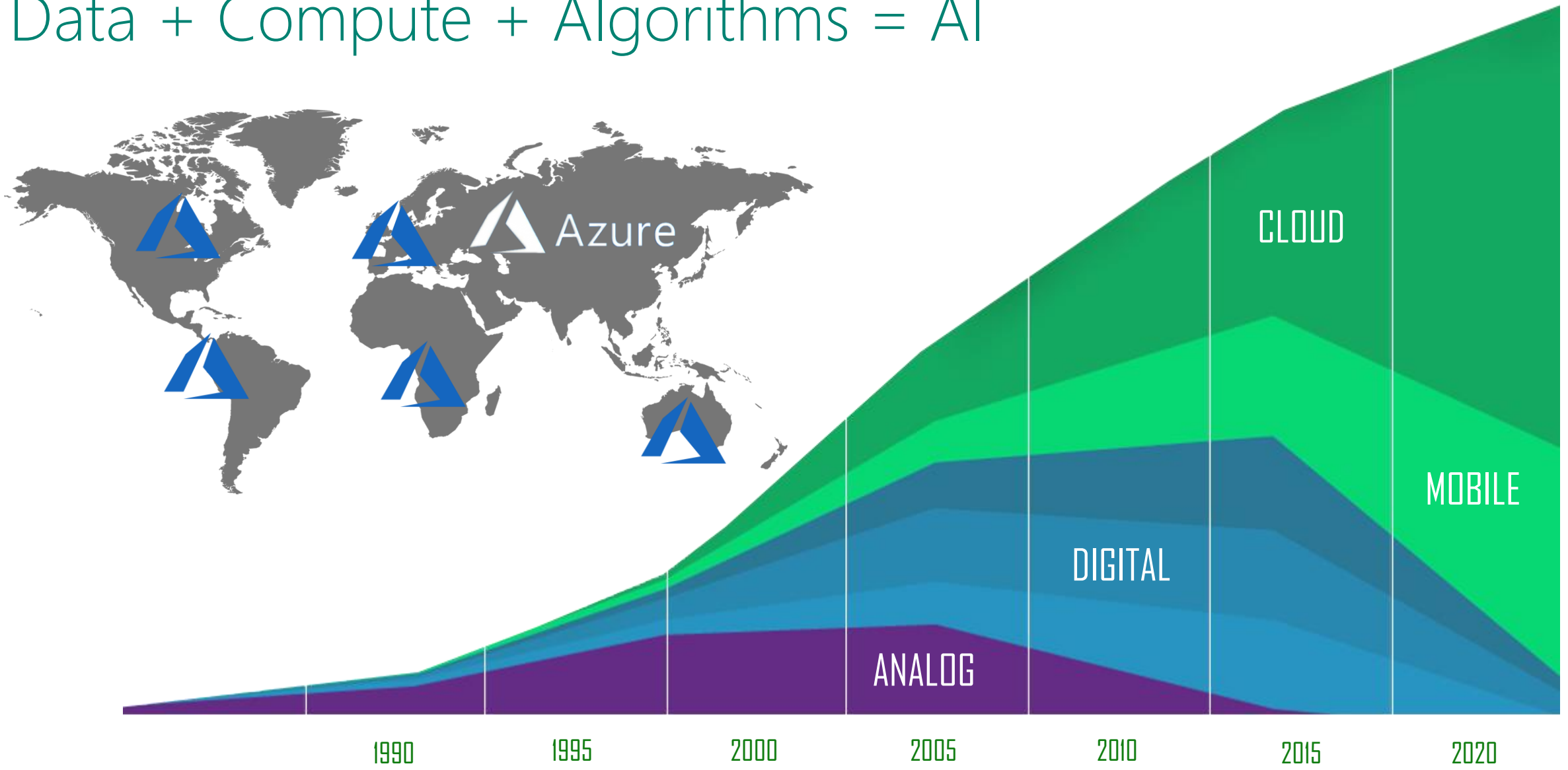
Data + Compute + Algorithms = AI



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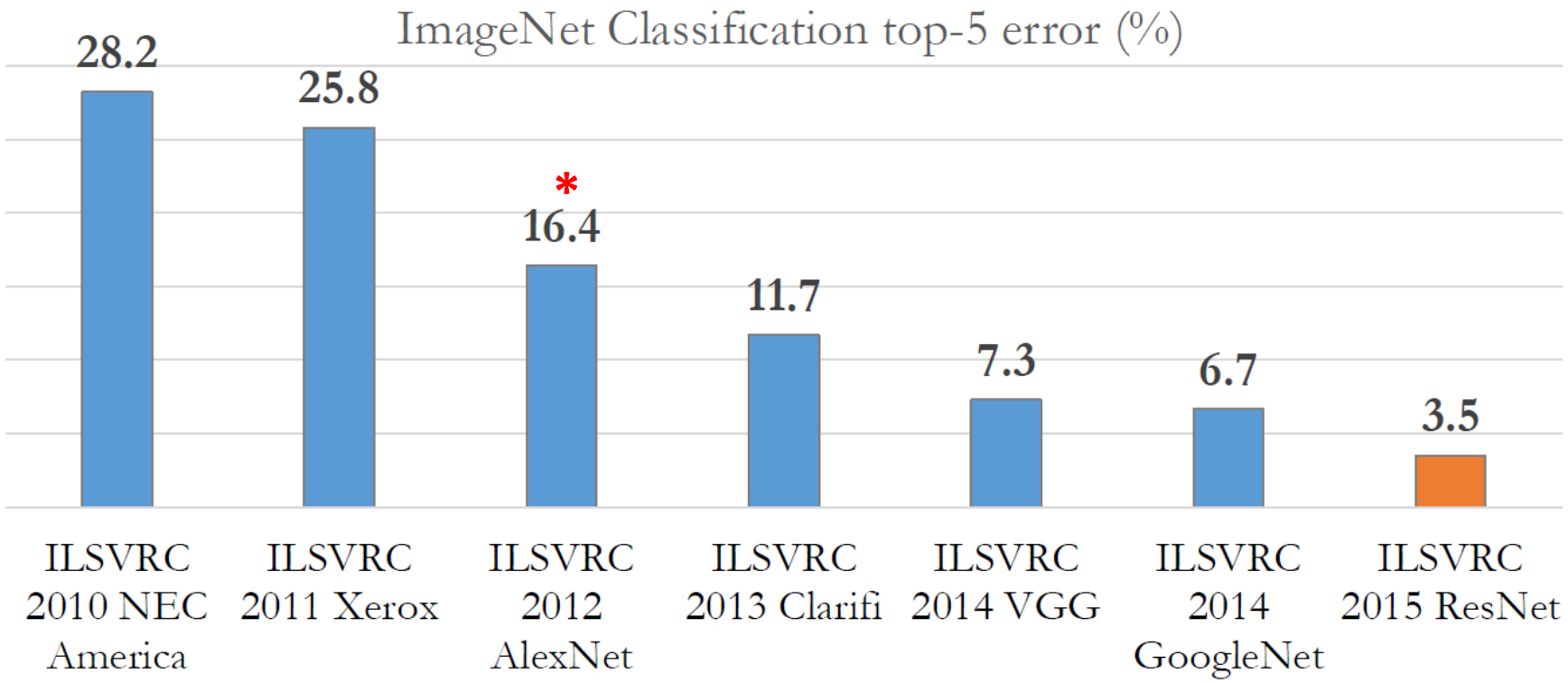
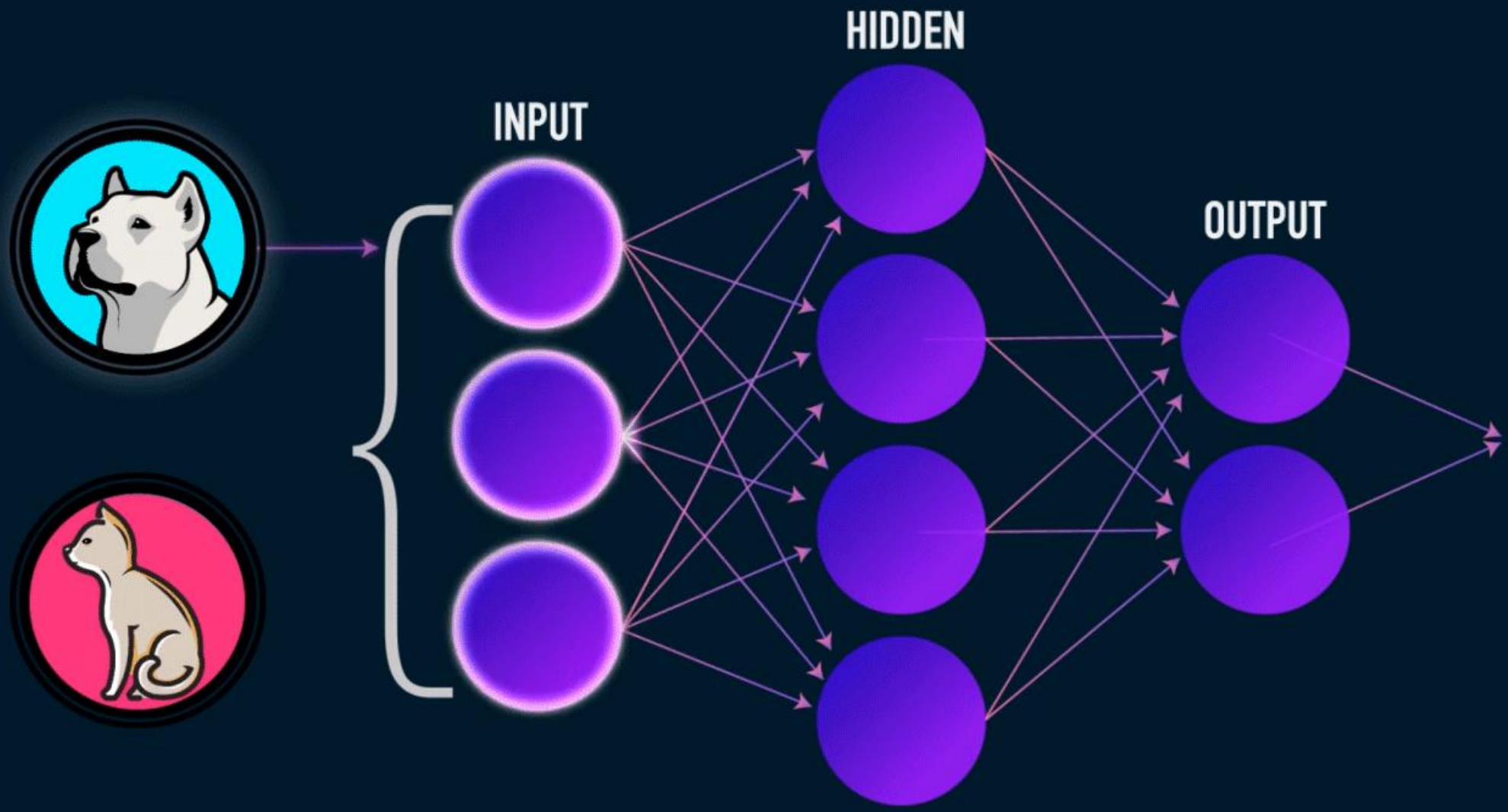
ImageNet

Alex Krizhevsky



- Alex Krizhevsky wins the ImageNet competition in 2012
- AlexNet
- Heralds a new era of AI
- Same story in language processing, speech recognition etc


HIDDEN
INPUT
OUTPUT

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Traditional ML

Manual Features → Trainable Classifier

Deep Learning

Representations are hierarchical and trained automatically

Low Level Features → Mid Level Features → High Level Features → Trainable Classifier

Deep Learning = learning a representation

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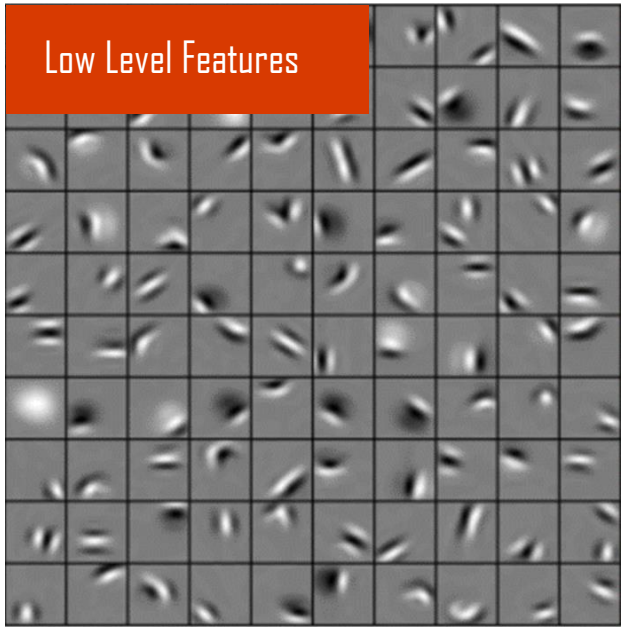

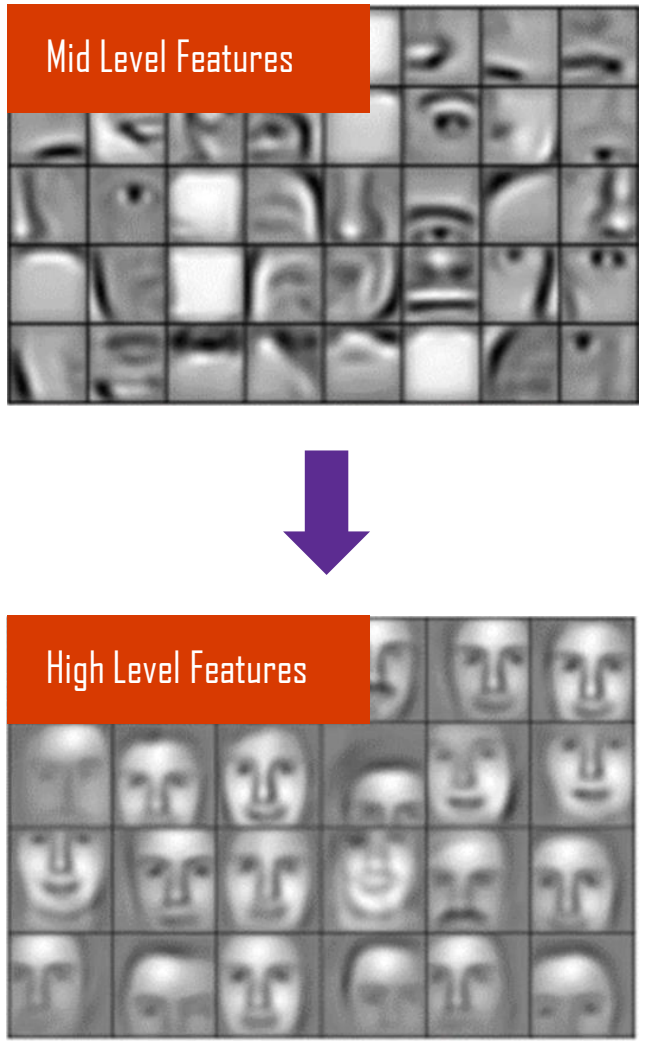

Representations are learned automatically

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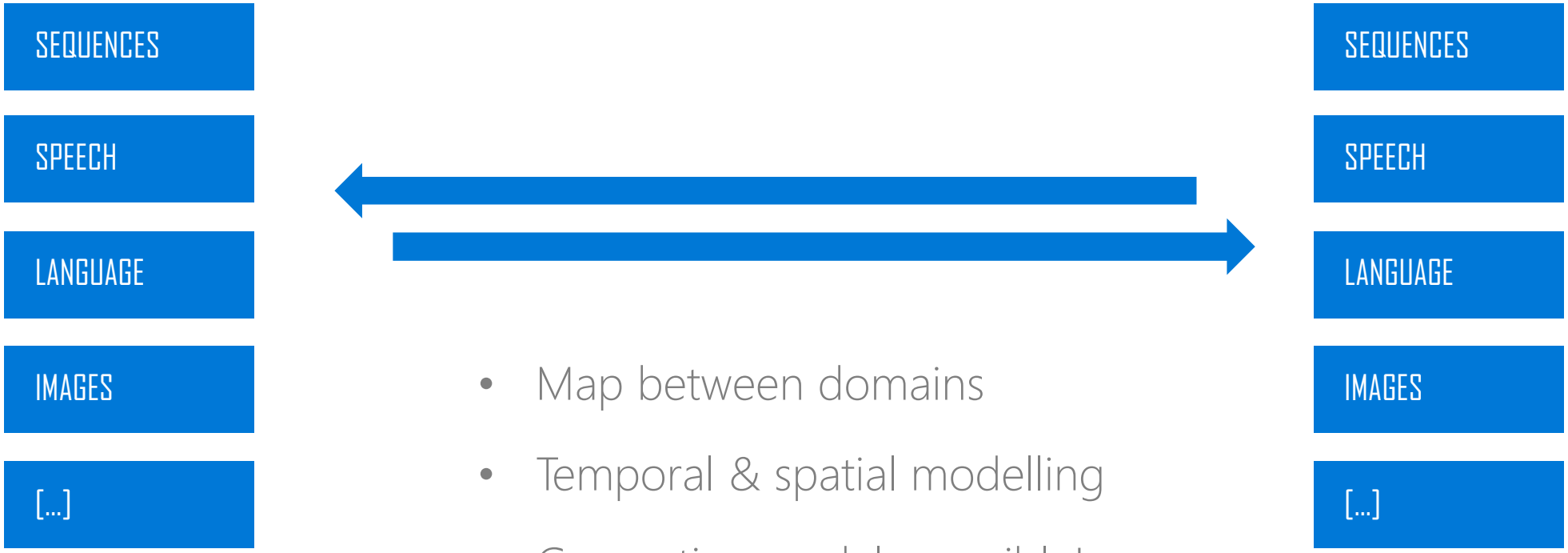
Universal functional approximators



- Map between domains
- Temporal & spatial modelling
- Generative models possible!
- Multiple inputs and outputs!

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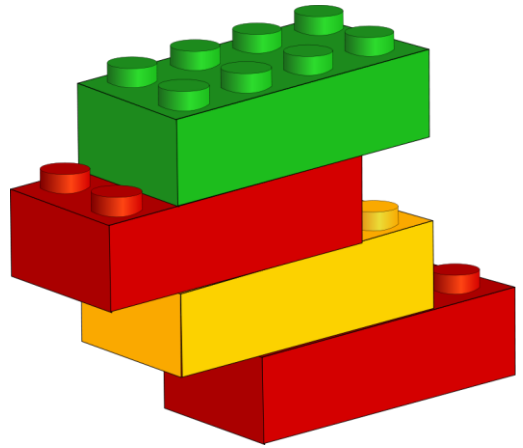
Composability



- Machine learning is becoming a form of software development
- Machine learning models are like software
- There is a dichotomy between the software engineering process and the data science process

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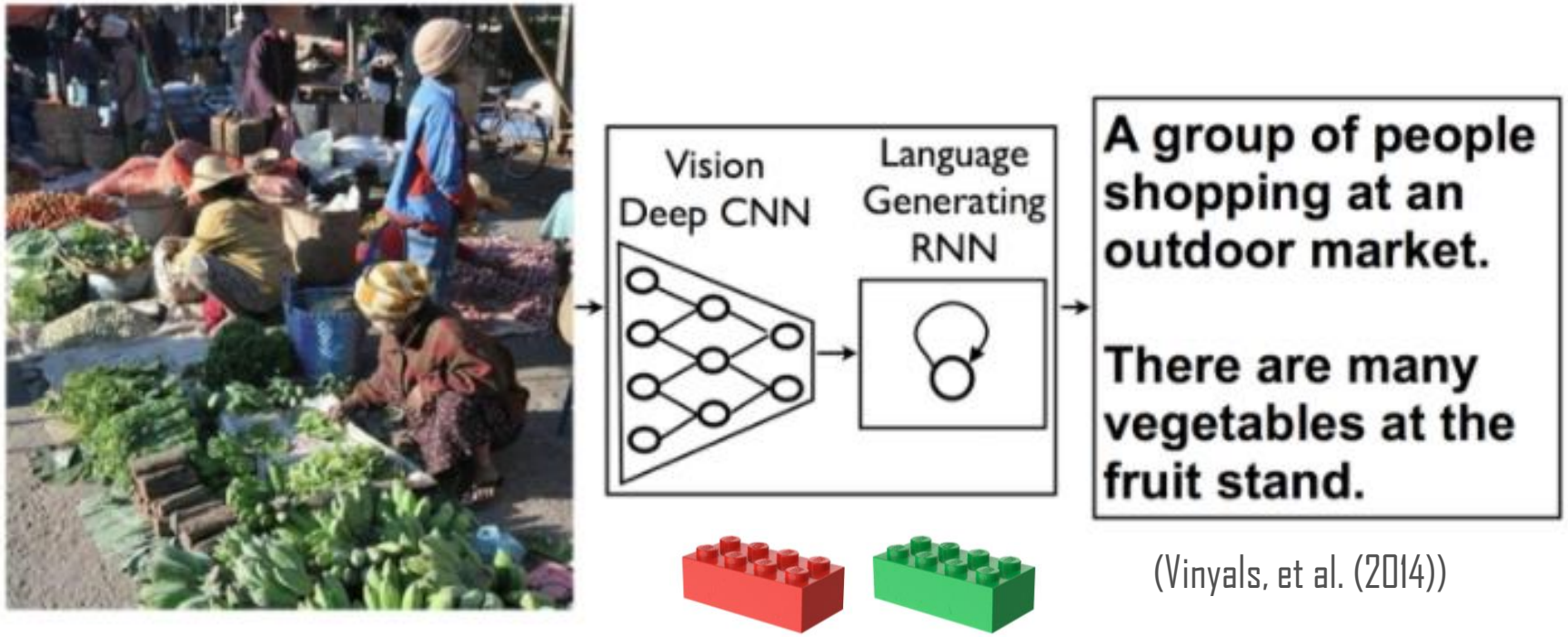
Building predictive architectures like lego blocks



(Vinyals, et al. (2014))

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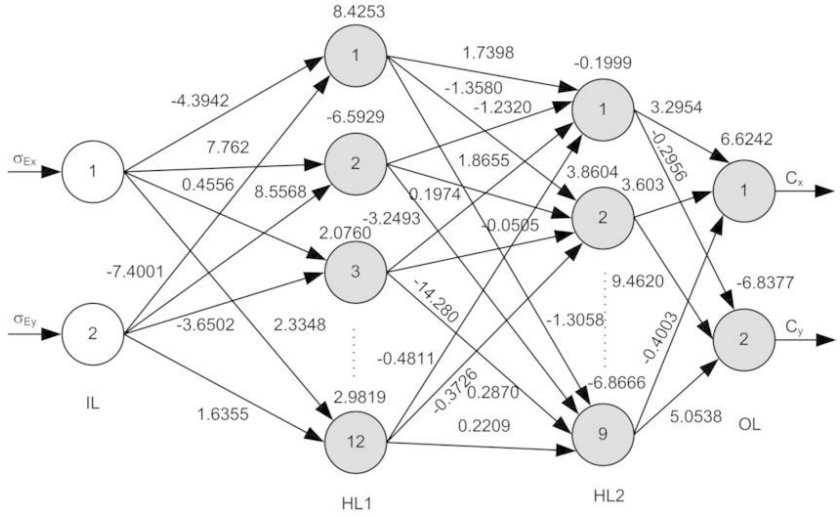
We call this “Software 2.0”

- Software 2.0 is a confection of data generated code and handwritten code
- Some features are **impossible** to write with traditional code i.e. speech synthesis, machine translation, computer vision use cases, game AI
- Computationally homogeneous
- Simple to bake into silicon.
- It is highly portable.
- Composable
- Better than you



https://medium.com/@karpathy/software-2-0-a64152b37c35

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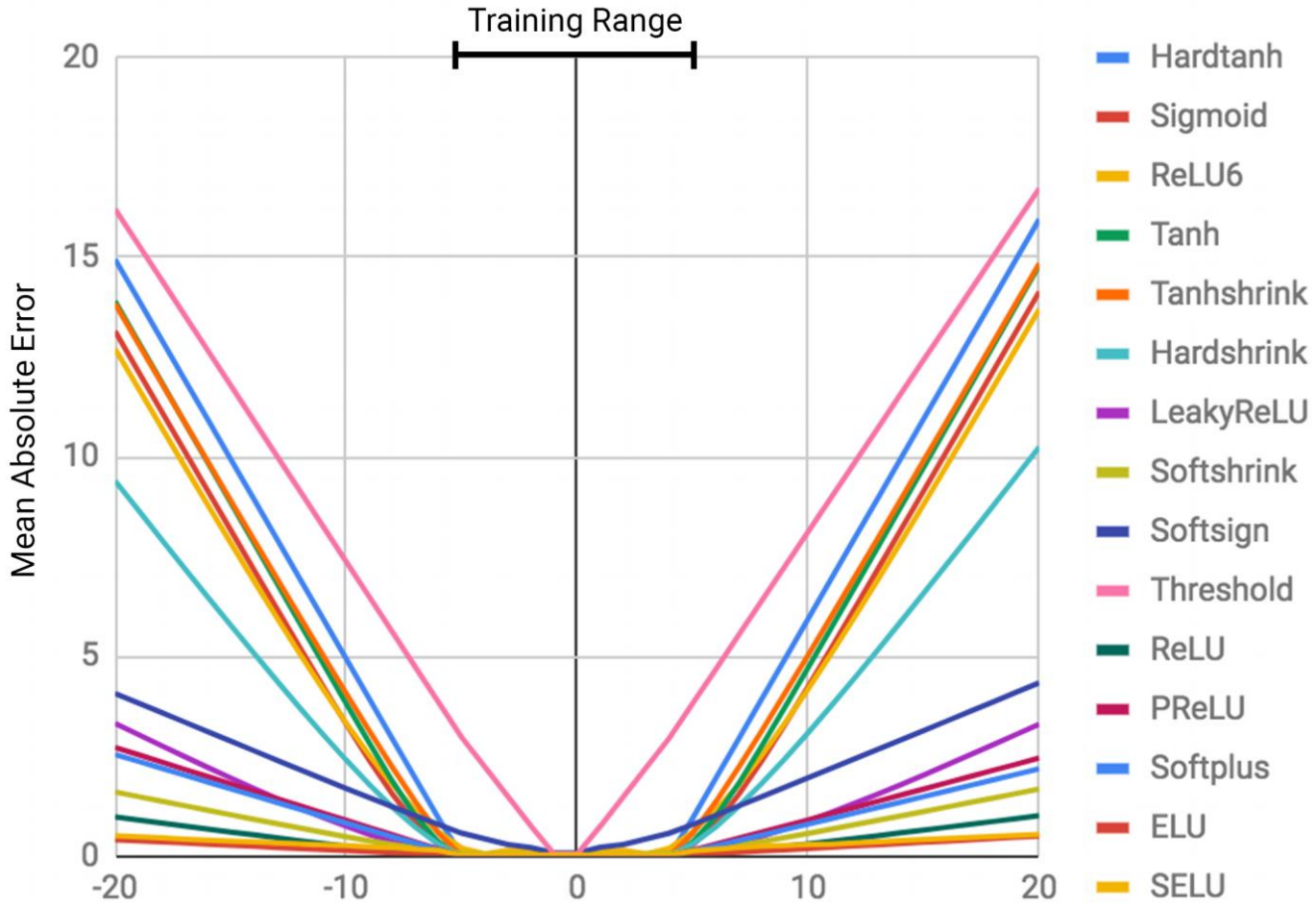
Deep learning is not magic; interpolation vs extrapolation

ML algorithms perform very, very badly on data out of range. They don't generalise as well as you think. Trask et al 2018 (DeepMind)

f(x)=x



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When to use deep learning vs classical machine learning

- Large volumes of data
- Unstructured data i.e. images, video, sound
- Modelling temporal or spatial dependencies
- Novel prediction architectures
- Composability, reusability, transferability of models
- Consistency of approach is more conducive to software engineering

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When not to use deep learning

- When interpretability is important
- When the data is very small deep learning behaves like classical machine learning i.e. no representation learning
- When you need statistical guarantees

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Machine learning models are becoming ubiquitous in software

Software is comprised of some things you can write with code, and some parts which must be generated from data i.e. ML

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More companies are becoming data companies

- Companies are becoming data driven
- Diversifying, creating data products & services

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Deep learning at confused.com

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Our collaboration with confused.com

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Confused.com

- Who are confused.com?
- Evolution from BI experts to data science experts
- Old and new skills coming together beautifully
- Millions of records of structured data
- Building new products and services from this data

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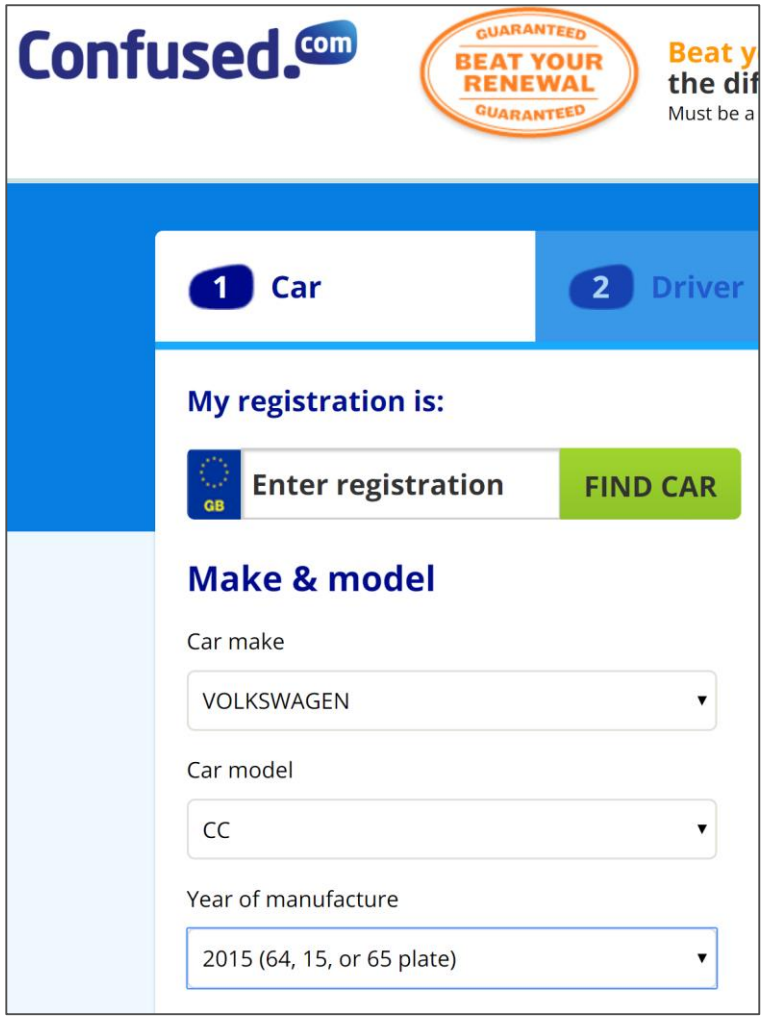

Car & driver details

100+ car insurers

Car insurance quotes

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Potential services from data

- Only sharing customer data when necessary
- Getting a best-price ballpark in the car showroom with less data
- Annual musical chairs

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Helping customers get the best insurance premiums with a deep learning model

Our 2-part model:

- Whether or not a customer will be insured (Quote or not?).
- The best insurance quotes that a customer will get (Quote values in £).

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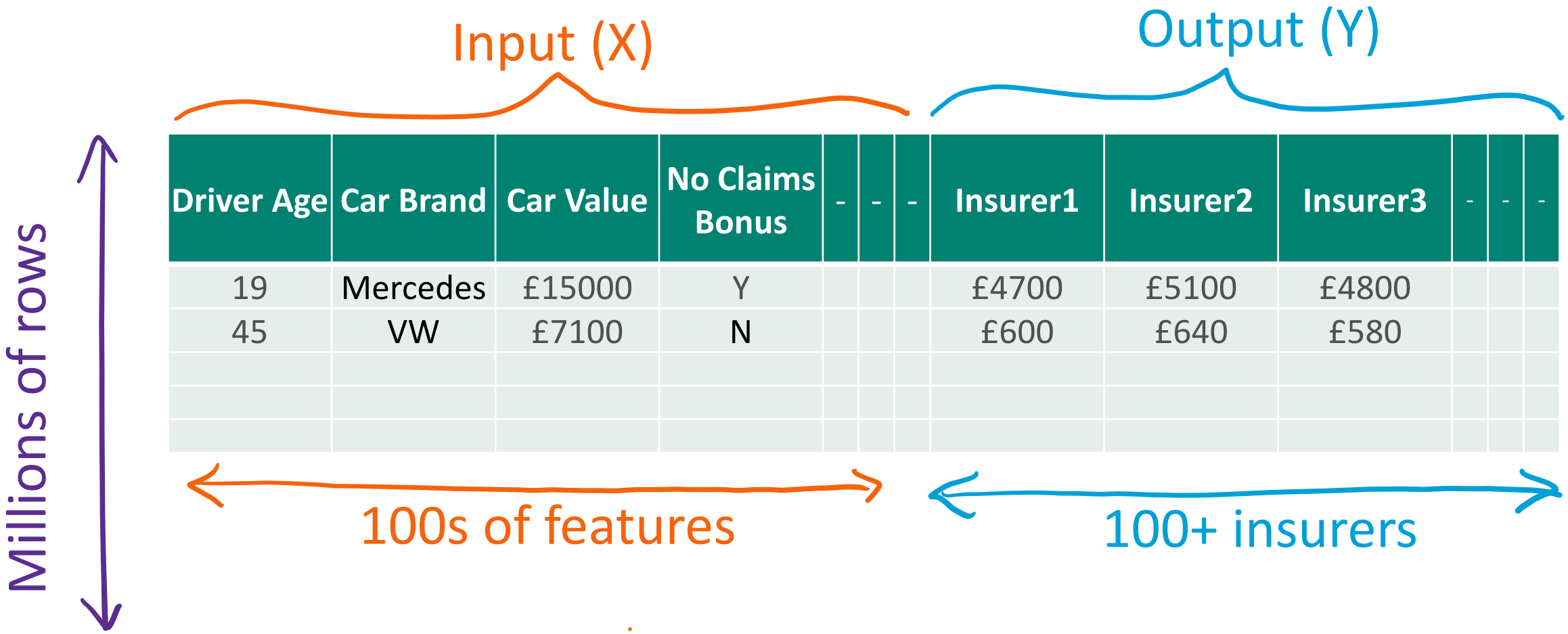
Data structure



Driver Age	Car Brand	Car Value	No Claims Bonus	-	-	-	Insurer1	Insurer2	Insurer3	-	-	-
19	Mercedes	£15000	Y				£4700	£5100	£4800			
45	VW	£7100	N				£600	£640	£580			

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Prediction model

Model built in:

- Keras, Python, Databricks notebooks
- Keras Functional API to build novel prediction architecture: DNN with two branches

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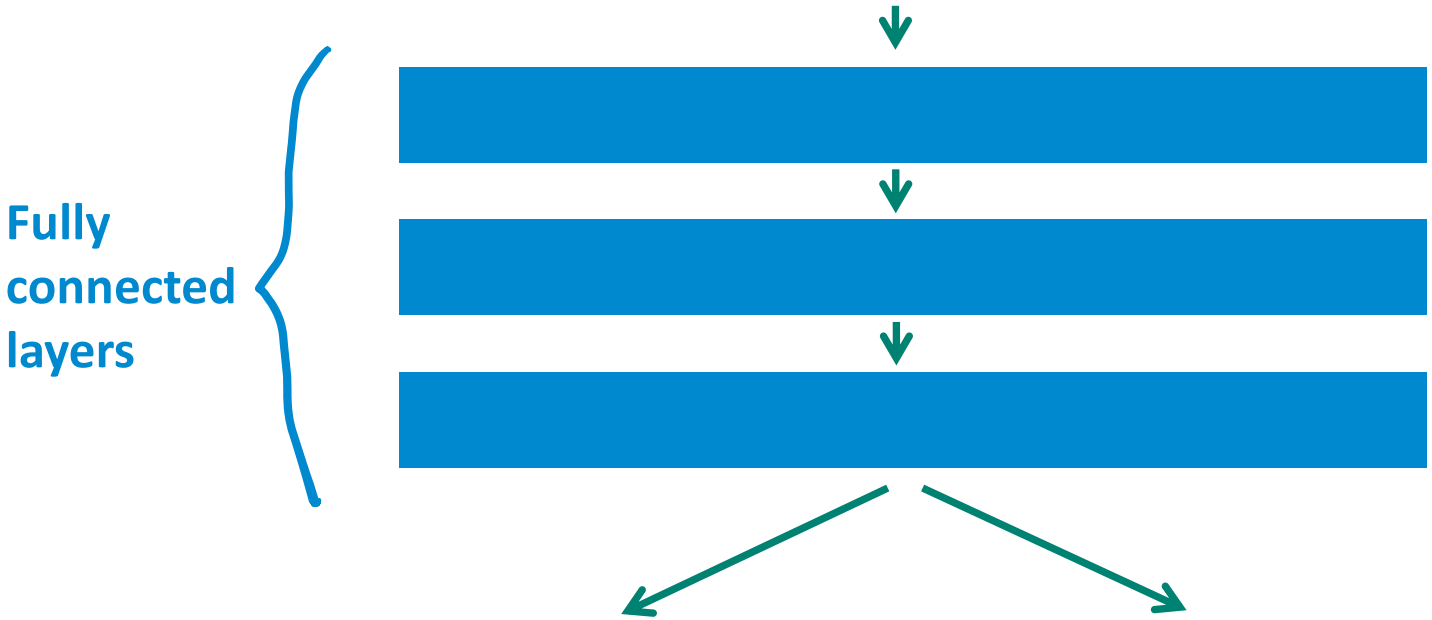
Driver age	Car brand	Car value	-	-	-	-
23	Audi	£12,000				



Insurer 1	Insurer 2	Insurer 3	-	-	-
Quote	No Quote	Quote			

Insurer 1	Insurer 2	Insurer 3	-	-	-
£600	-	£1200			

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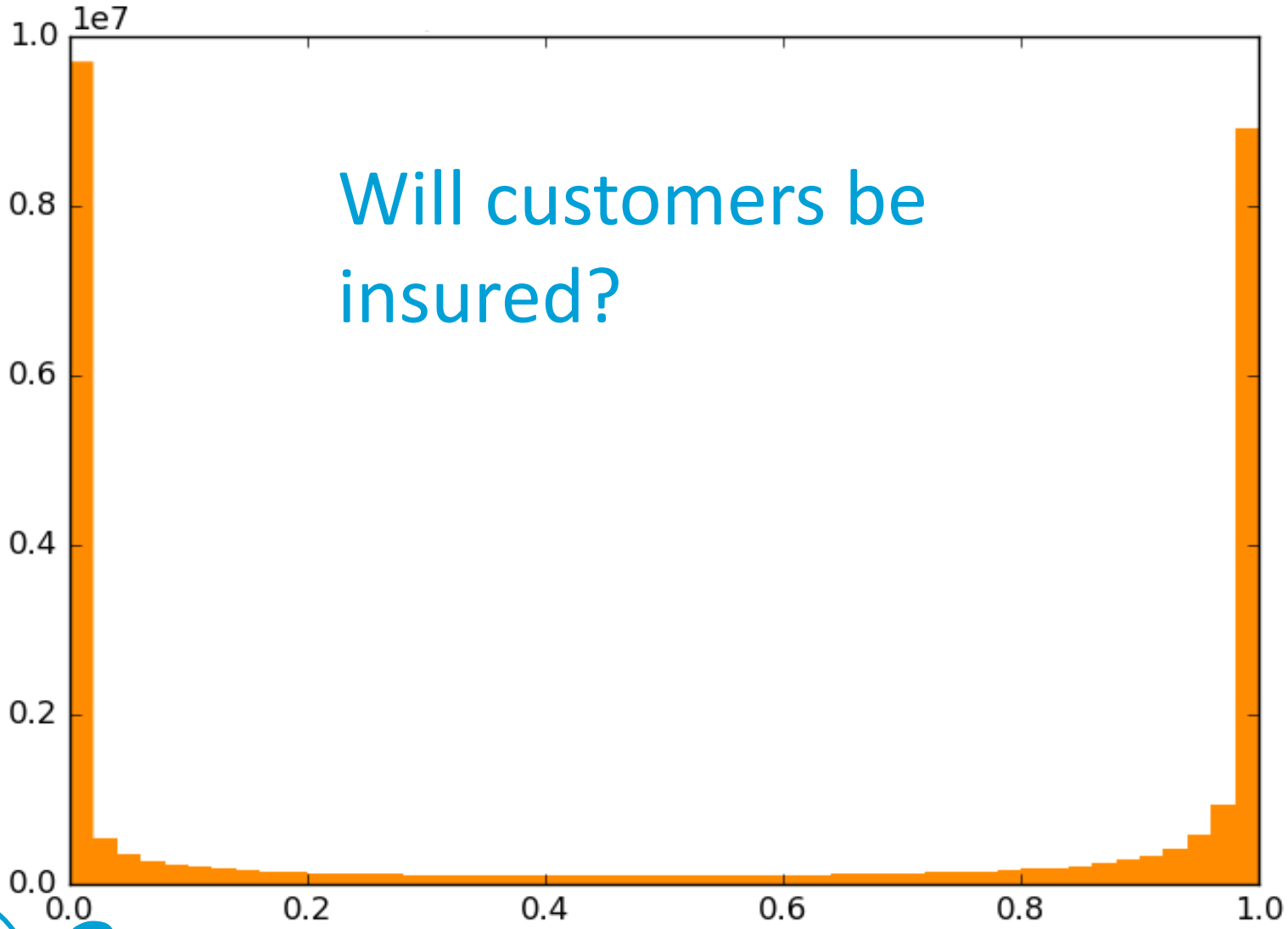

Will customers be insured?

0: No quote

1: Quote

0

1

Probability of getting a quote

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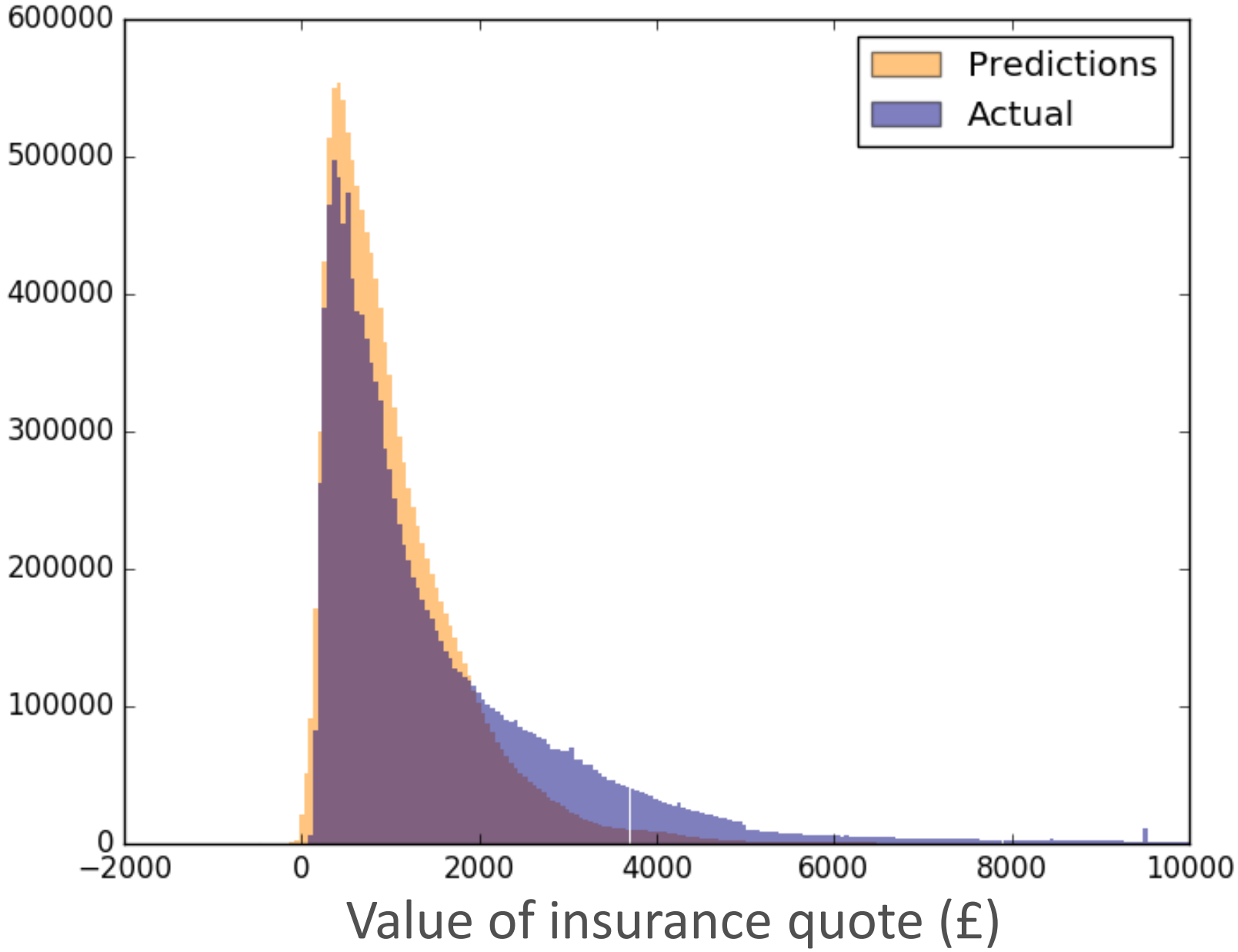
How much will customers be insured for?



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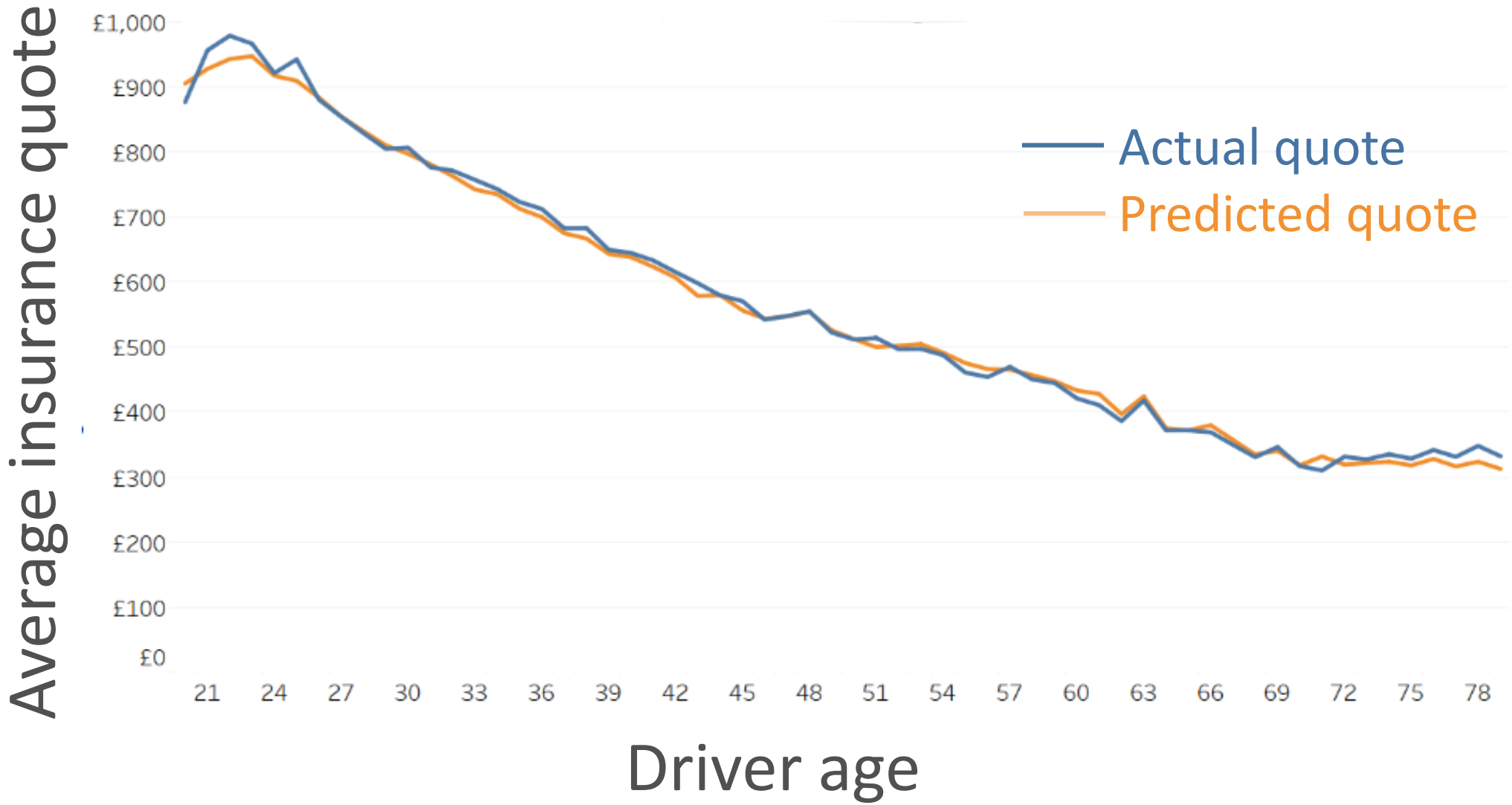
Average insurance quote
£1,000
£900
£800
£700
£600
£500
£400
£300
£200
£100
£0
21
24
27
30
33
36
39
42
45
48
51
54
57
60
63
66
69
72
75
78
Actual quote
Predicted quote
Driver age

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Nice model, now what?

- Now we leave the world of collaborative notebooks and data science, to the world of deployment.
- How do we get this model into a product?
- How do data scientists tweak the model when it is in production, without breaking everything?

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Emergence of DevOps in Data Science

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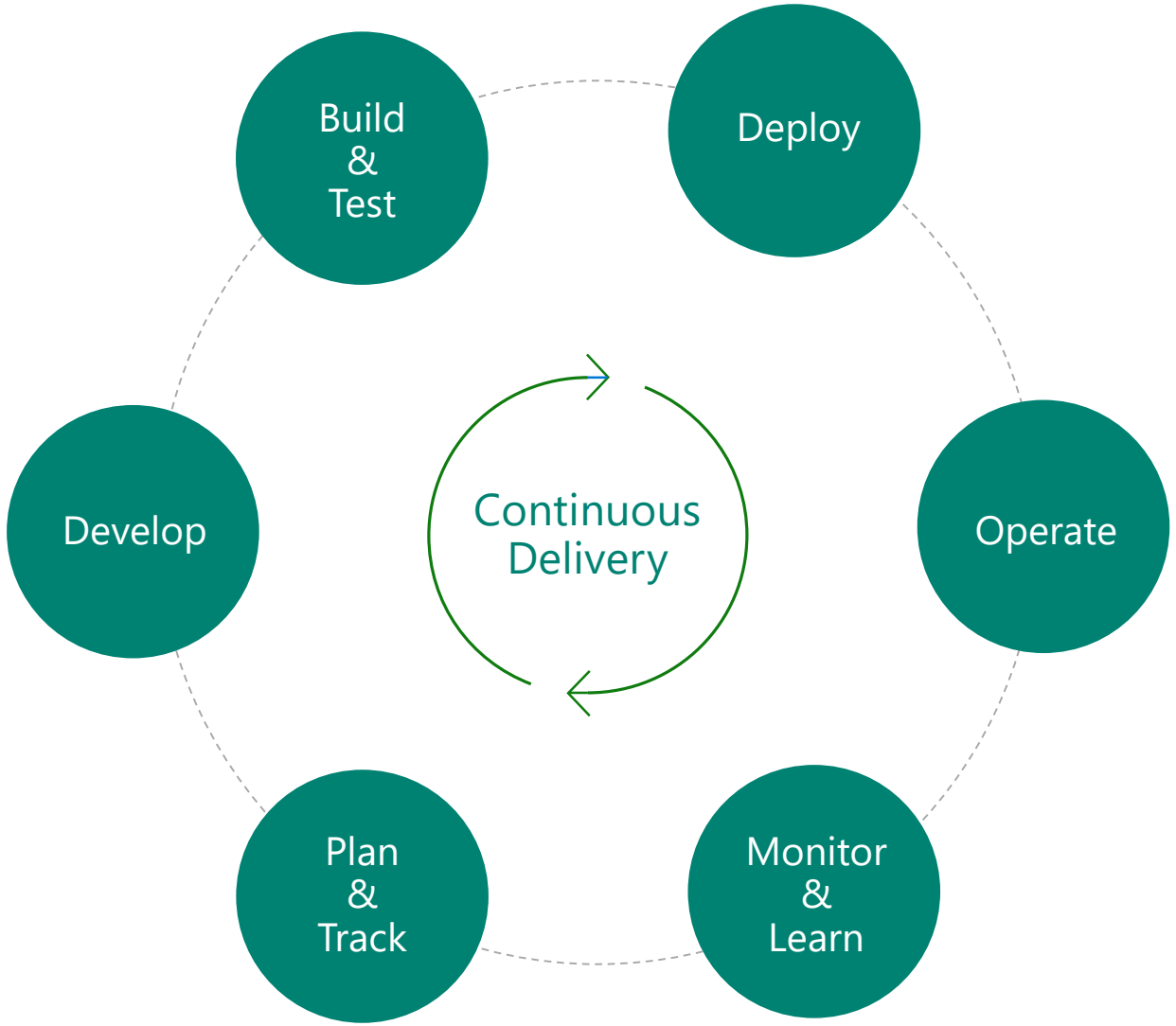
What is DevOps?

People. Process. Products.

DevOps is the union of **people**, **process**, and **products** to enable continuous delivery of value to your end users.

- Donovan Brown



Allianz
Allianz

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Why DevOps is important

- Your competition is doing it already
- Increase velocity
- Reduce downtime
- Reduce human error
- Any language, any platform

Azure DevOps

Azure Boards

Deliver value to your users faster using proven agile tools to plan, track, and discuss work across your teams.

Azure Pipelines

Build, test, and deploy with CI/CD that works with any language, platform, and cloud. Connect to GitHub or any other Git provider and deploy continuously.

Azure Repos

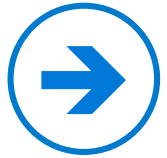
Get unlimited, cloud-hosted private Git repos and collaborate to build better code with pull requests and advanced file management.

Azure Test Plans

Test and ship with confidence using manual and exploratory testing tools.

Azure Artifacts

Create, host, and share packages with your team, and add artifacts to your CI/CD pipelines with a single click.



https://azure.com/devops

@DonovanBrown

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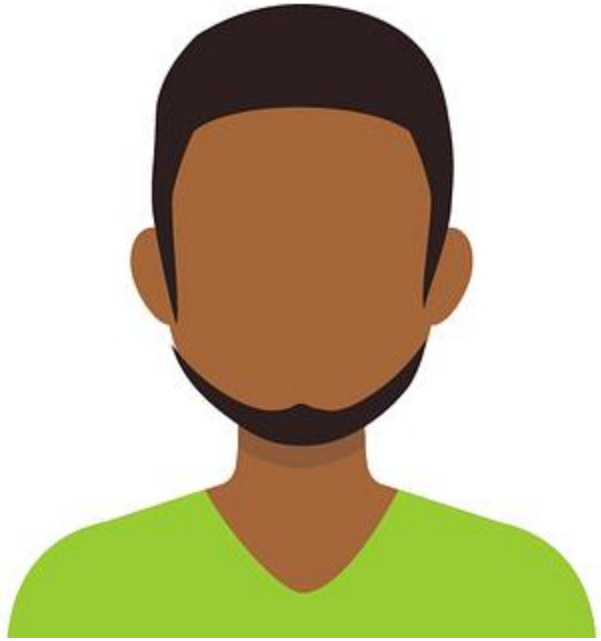
Adding data science to DevOps

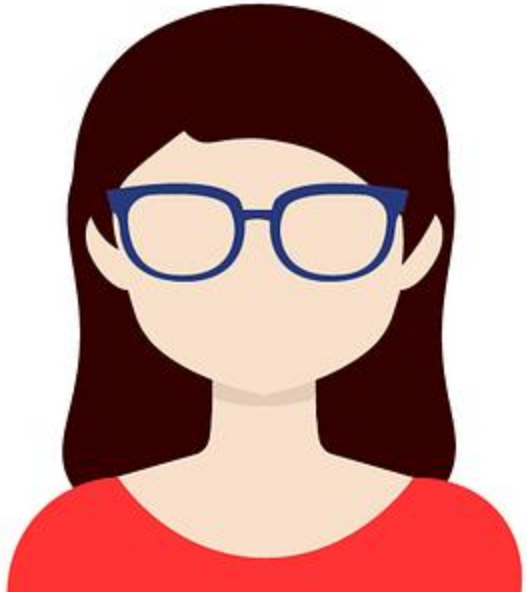
Culture clash

- Data scientists now ship directly
- DevOps in Data Science is *much* harder

Data Scientist



Software Engineer



Operations

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How did confused.com build a pipeline that enabled:

- Software quality/engineering
- Locked down dependencies
- Scalability
- GDPR awareness
- Monitoring
- CICD for models

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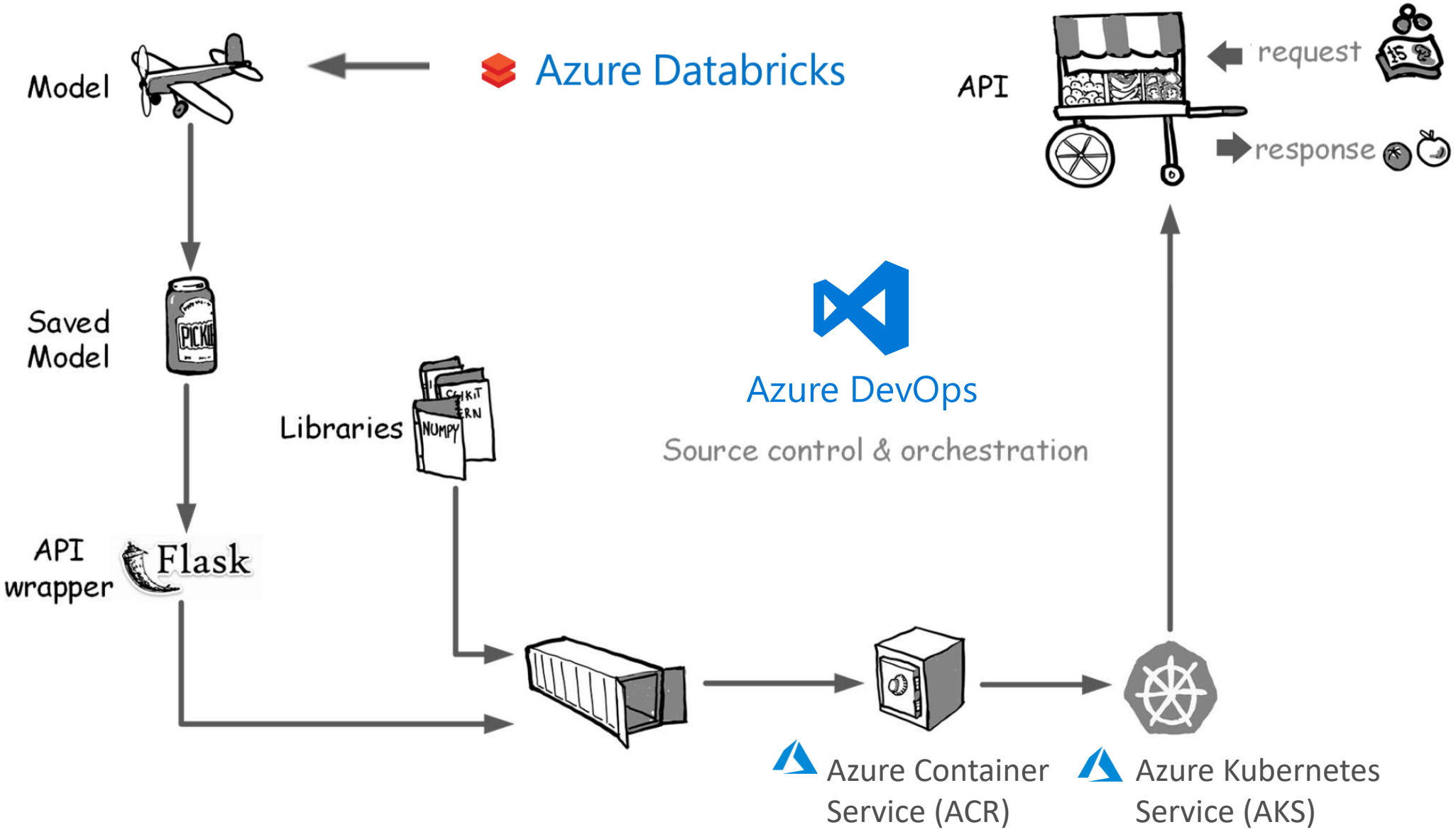
Model
Azure Databricks
API
request
response
Saved Model
Libraries
Azure DevOps
Source control & orchestration
API wrapper
Flask
Azure Container Service (ACR)
Azure Kubernetes Service (AKS)

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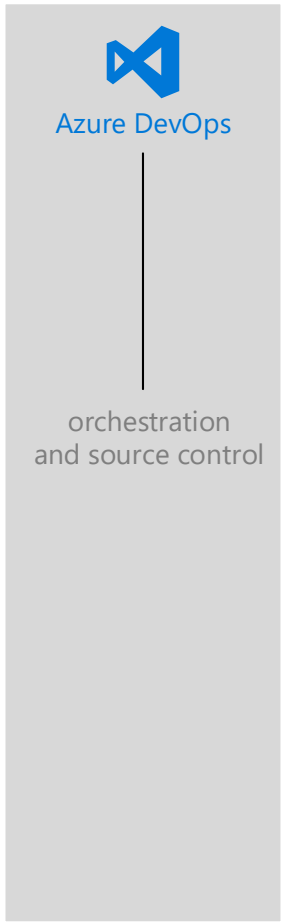
DevOps Architecture



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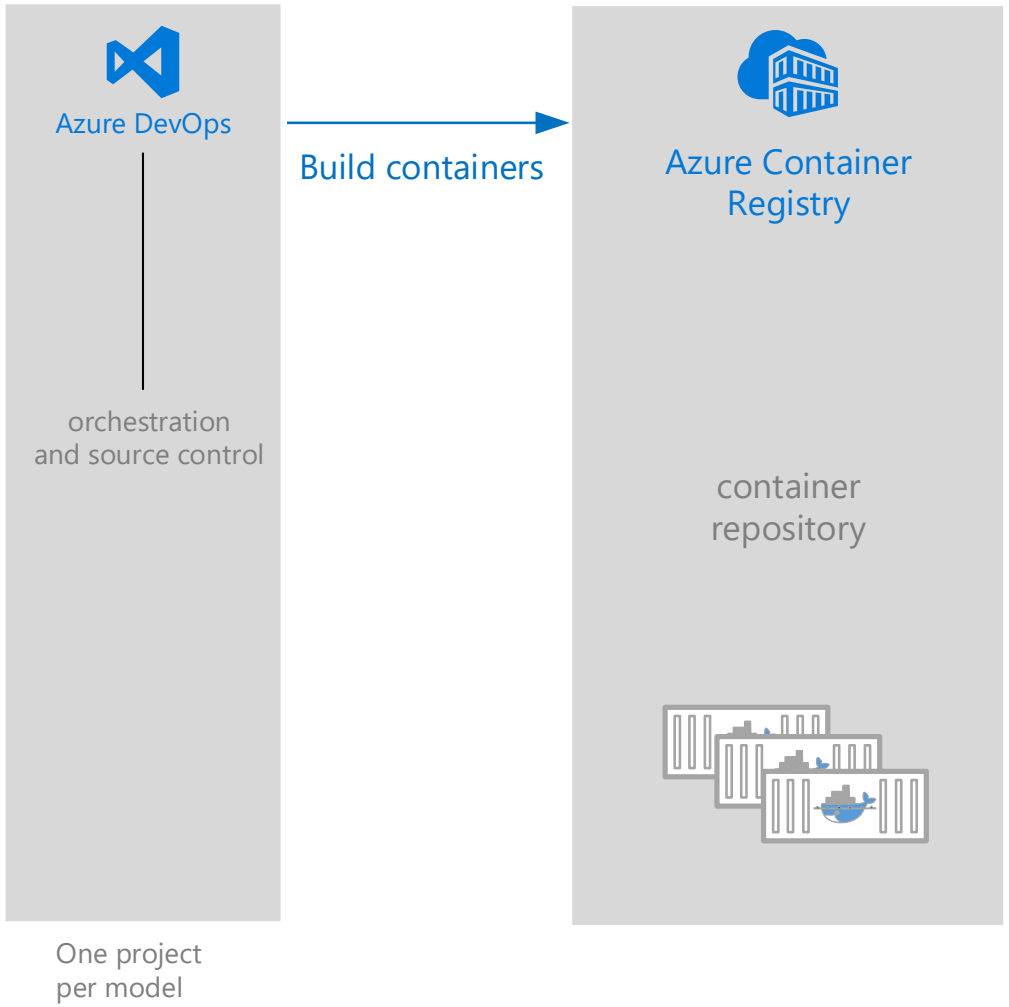
DevOps Architecture



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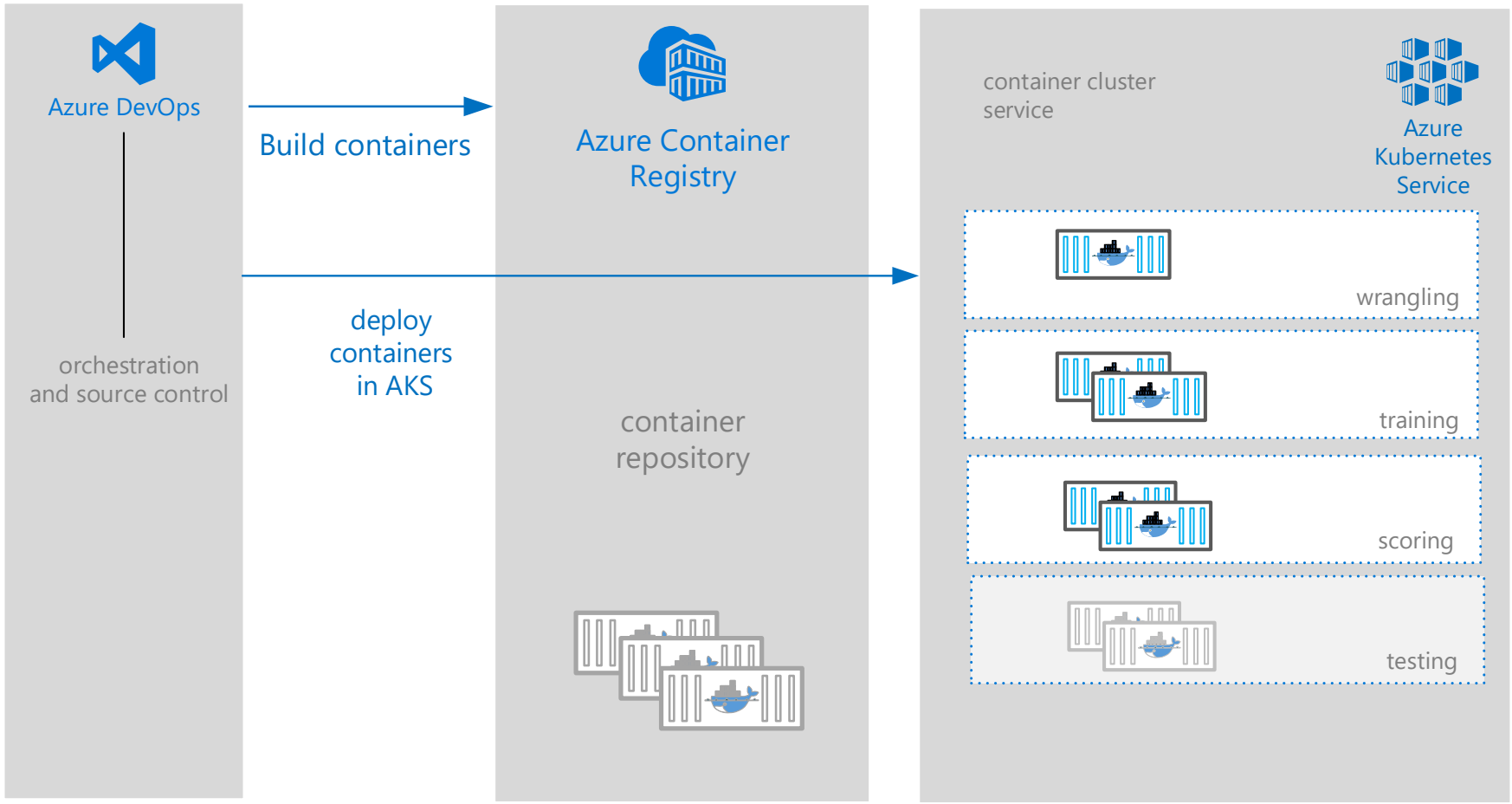
DevOps Architecture



One project
per model

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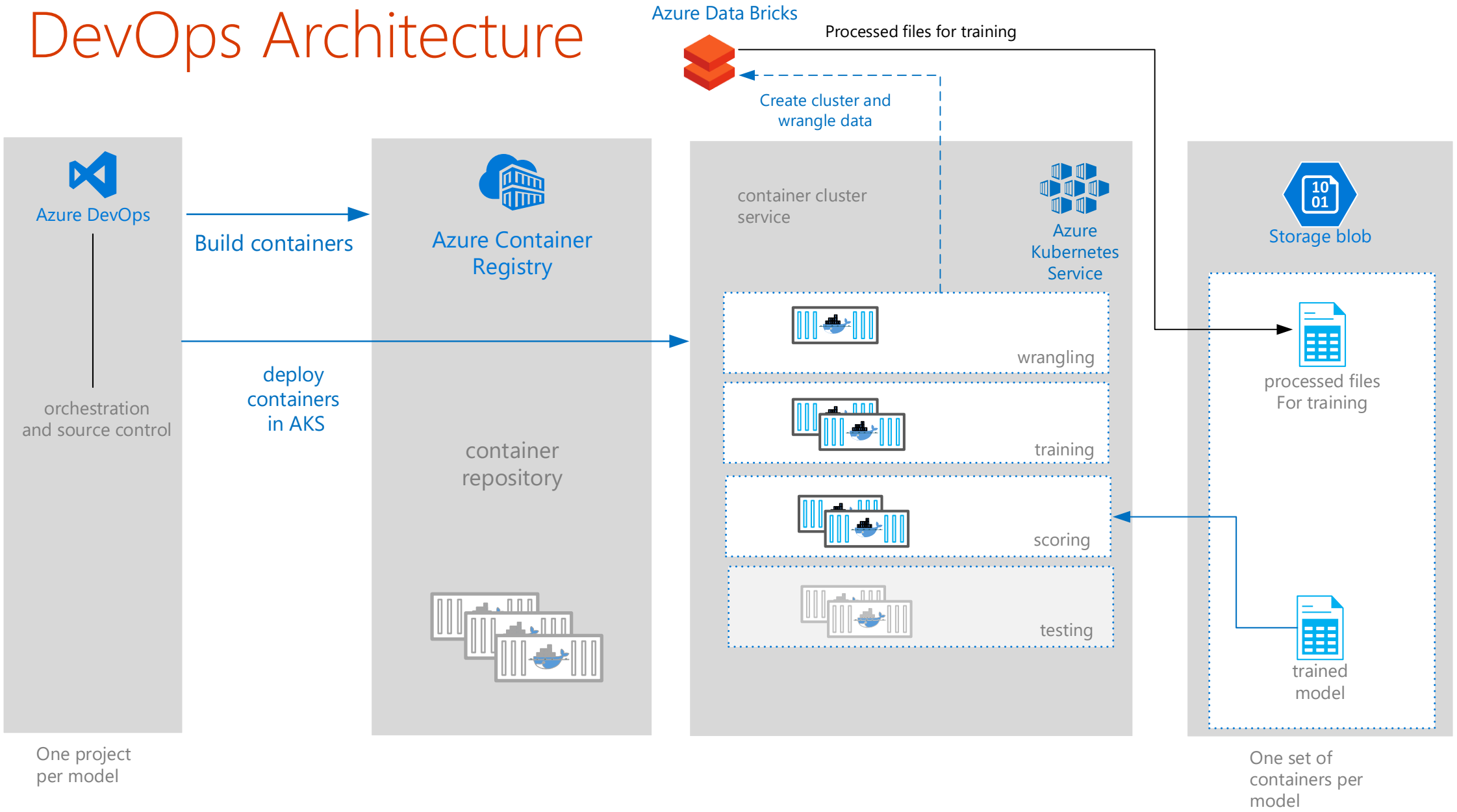
DevOps Architecture



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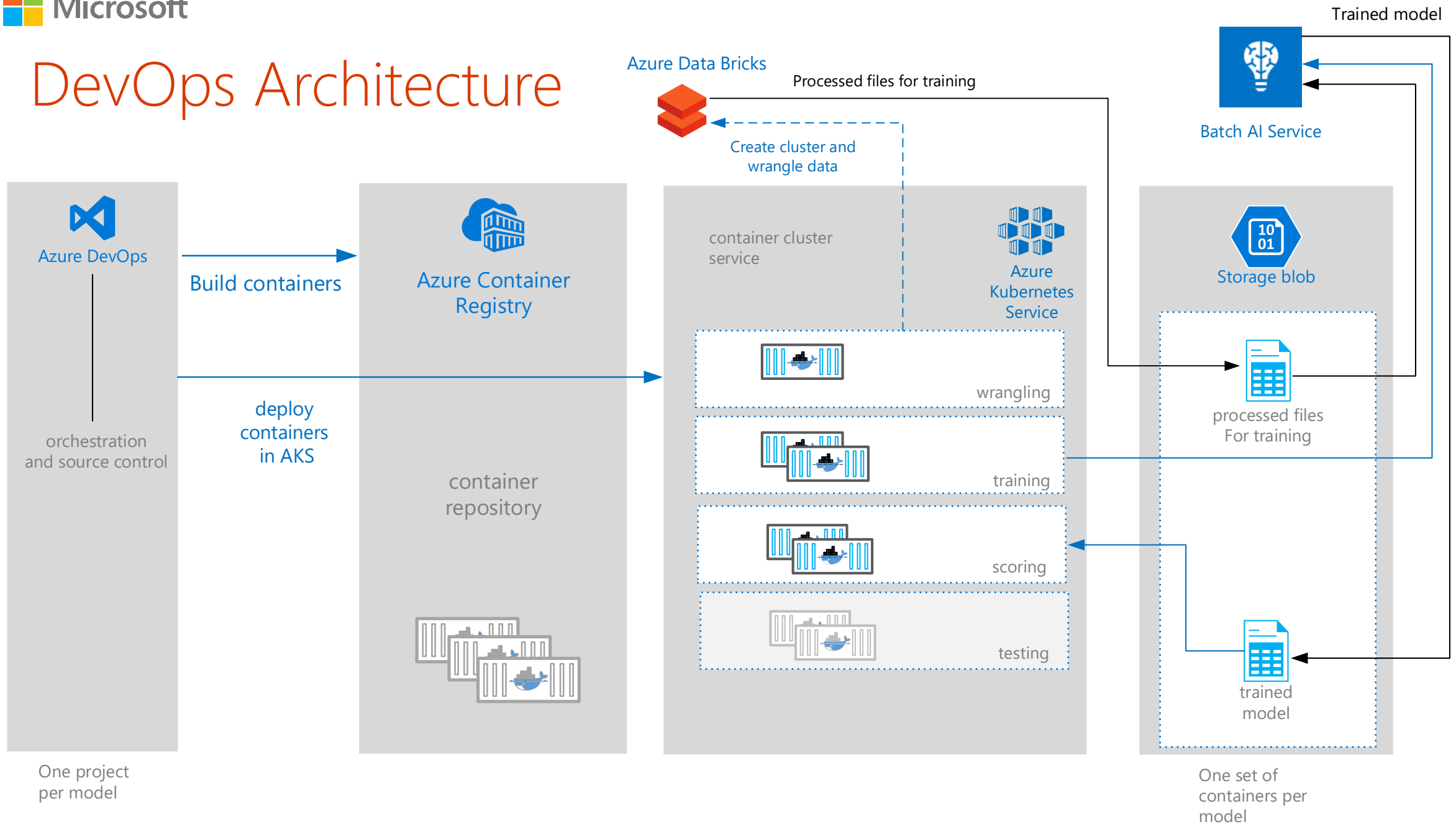
DevOps Architecture



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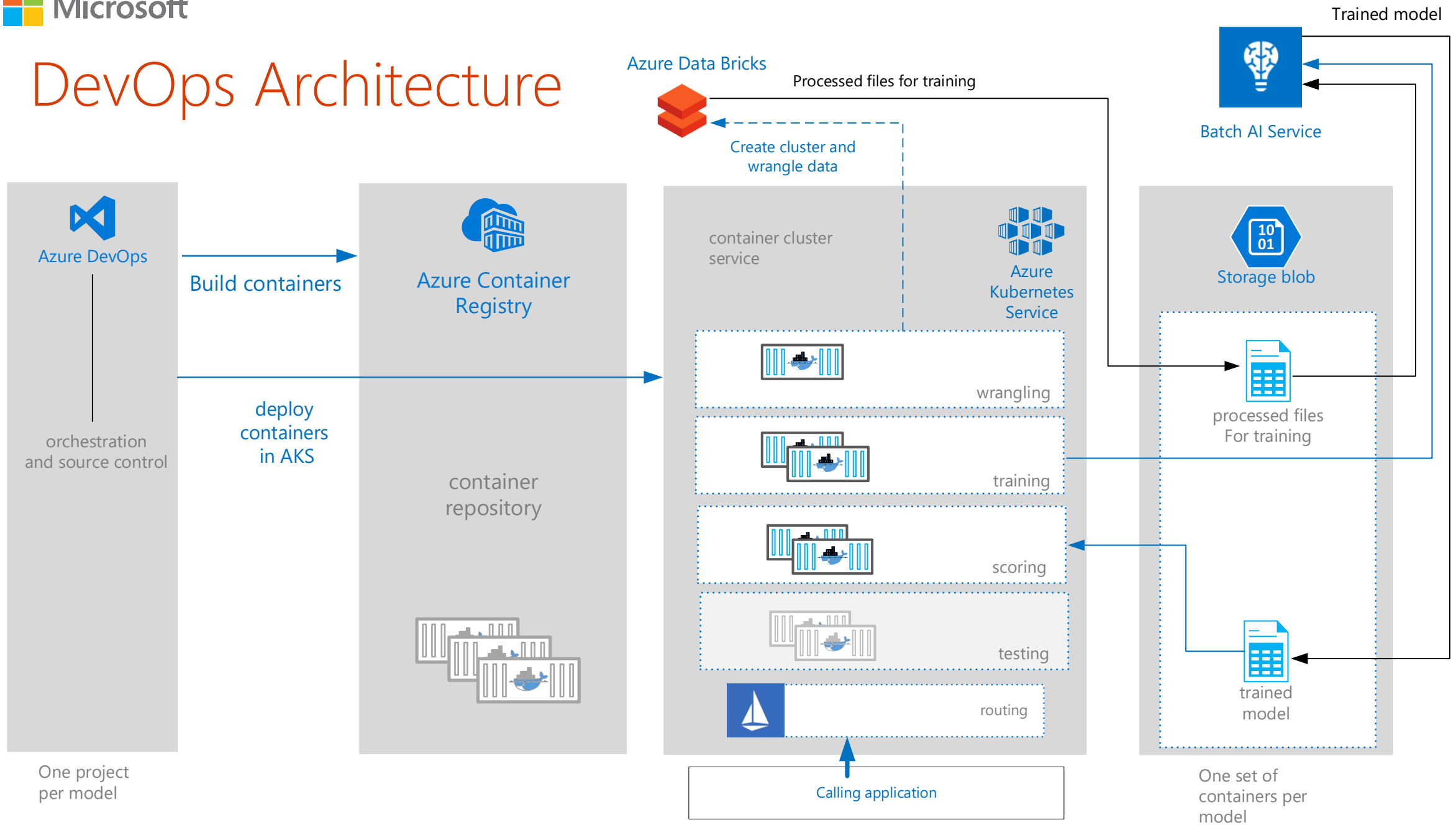
DevOps Architecture



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Confused.com's journey

- Data
- DevOps
- Team

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Wrapping up

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Conclusion & recap

- What we do at Microsoft
- The story of deep learning
- Machine learning is becoming ubiquitous in software
- Many companies are becoming data companies
- The confused.com journey
- Our deep learning model for car insurance
- The emerging field of DevOps in data science
- Our deep learning DevOps pipeline

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What's your data story?

- Data?
- DevOps?
- Team?
- Ready!

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Things to do next

Check out the Azure docs

DevOps: docs.microsoft.com/en-us/azure/devops

Databricks: docs.azuredatabricks.net/

Containers: azure.microsoft.com/en-us/services/container-registry

Kubernetes: azure.microsoft.com/en-us/services/kubernetes-service

Session Feedback

Please rate this session in the Future Decoded app!

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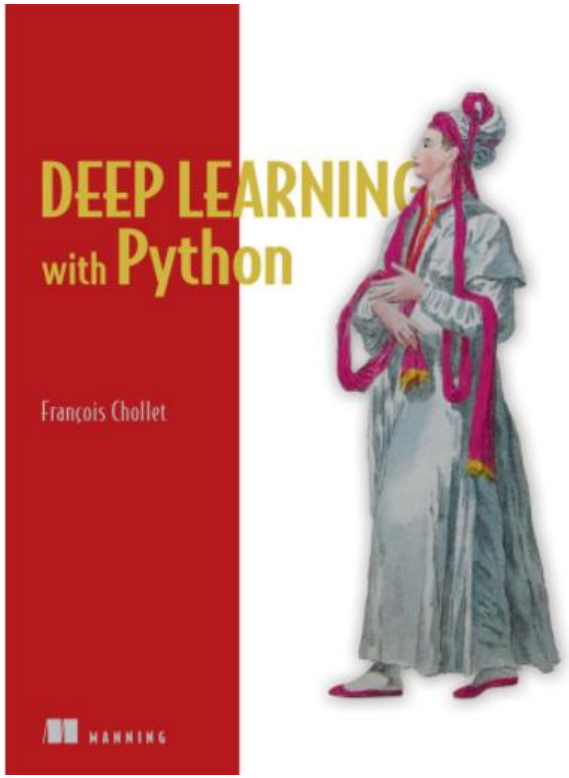
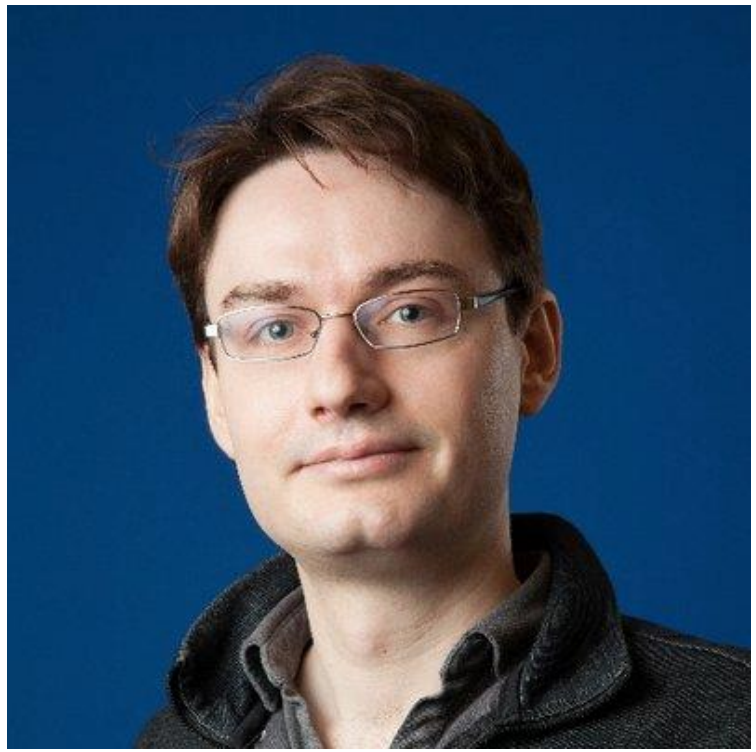
Best intro book on deep learning





Francois Chollet @fchollet

https://www.manning.com/books/deep-learning-with-python
https://github.com/fchollet/deep-learning-with-python-notebooks/

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ank You!

@Ecsquendor @Dr_Tempest #timtem

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, Tempest van Schaik, Andrew Fryer, Luke Devonshire, Anita Ramanan, Alysha

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ding, Tim Lang, Ben Weatherburn, Vaughan Pugsley, Rex Johnson, Simon
h, Danielle Mansfield, Alice Burnett, David Trickey

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Productionising deep learning: The confused.com journey

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Dr Tim + Dr Tem aka #TimTem