Next Generation AI: Transitioning to the Continuous, Self-Learning Enterprise

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Centralize Infrastructure

Manage the availability of powerful data science resources in a secure and governed system-of-record.

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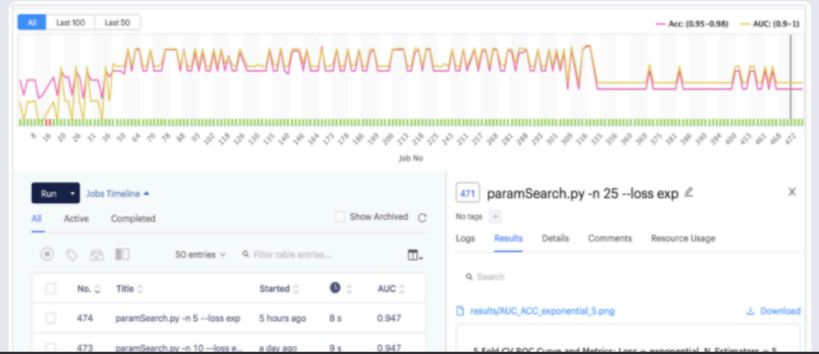
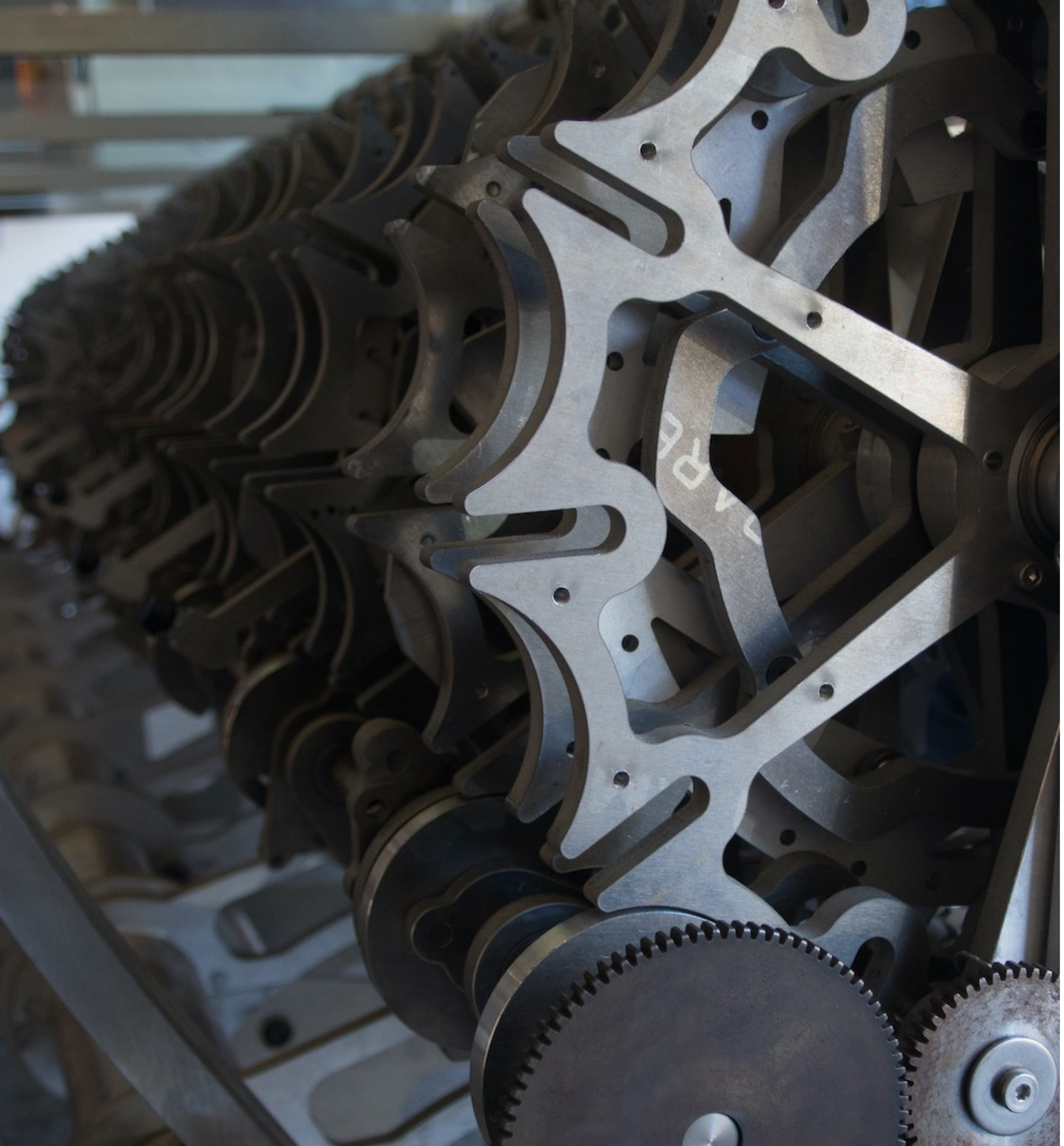
Deploy and Monitor Models

Expedite model consumption with apps, APIs, and more – and ensure their



DOMINO



Outline

- The Promise of AI
- AI in the Enterprise
  - The Past
  - The Present
  - The Future
- Conclusions

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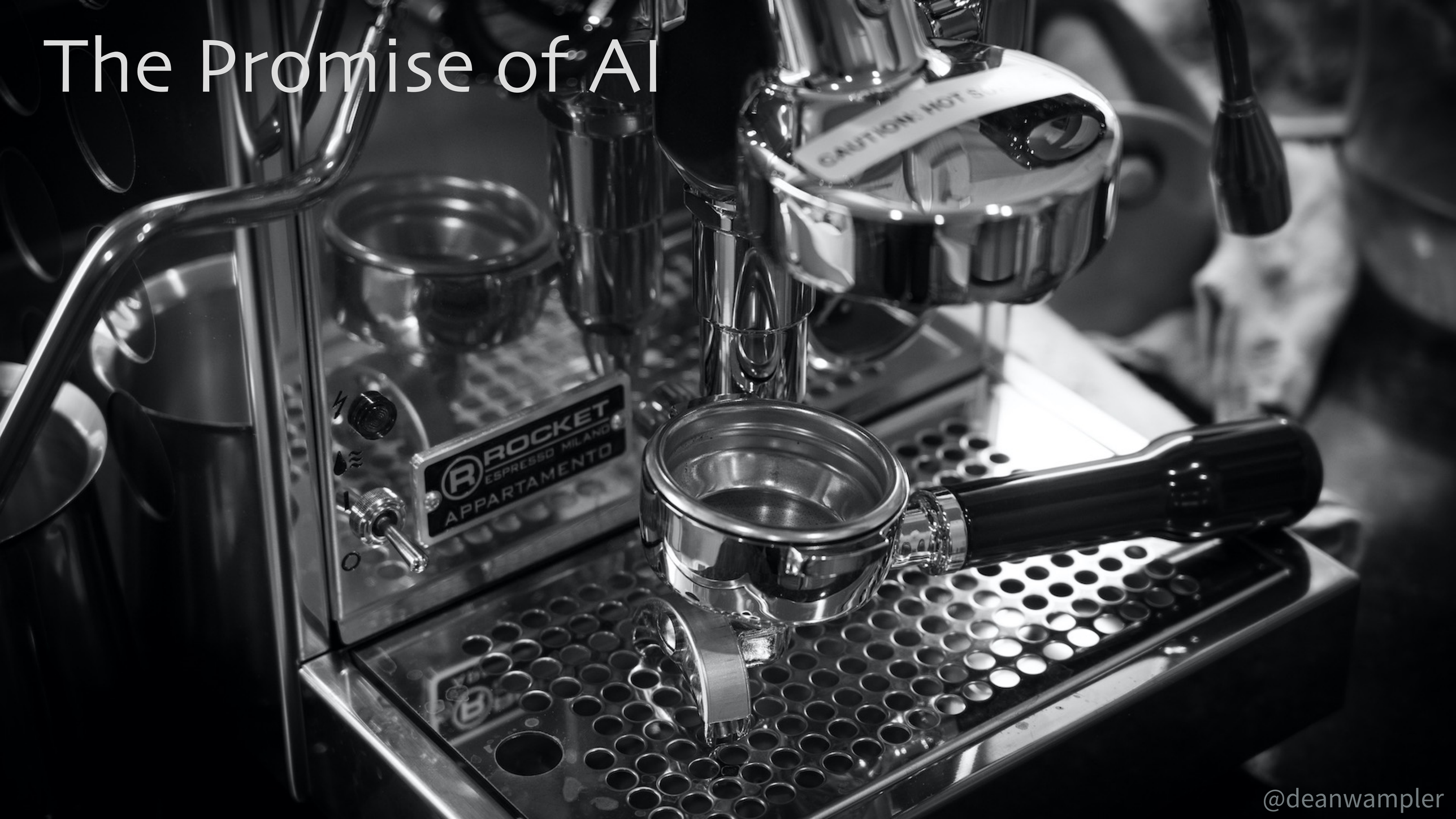
The Promise of AI



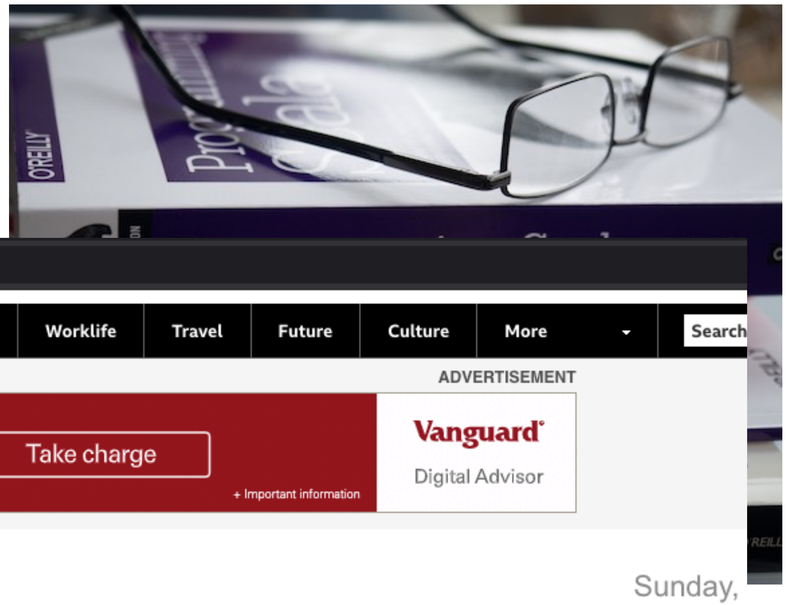
Natural Language Processing

Applications

- Summarization
- Dialogues
- Naturalistic text to speech
- Translation
- Sentiment Analysis
- Fraud & Veracity Analysis
- Question Answering & Search

Summarization

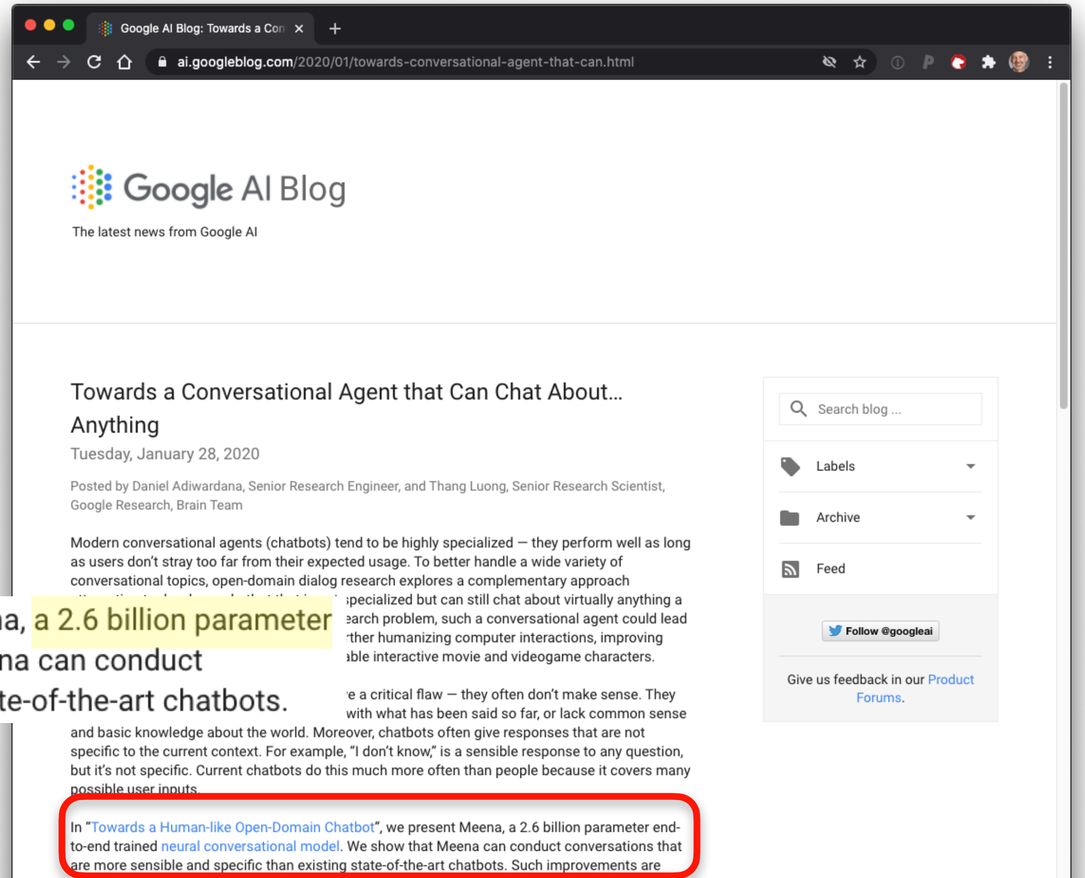
- Legal documents
- Research papers
- News
- …



Dialogs

- Chatbots
- Human-computer dialogs

In "Towards a Human-like Open-Domain Chatbot", we present Meena, a 2.6 billion parameter end-to-end trained neural conversational model. We show that Meena can conduct conversations that are more sensible and specific than existing state-of-the-art chatbots.



Naturalistic text to speech

- Needed for dialog generation

Translation

- Domain-specific languages
  - Medicine
  - Air traffic control
  - …
- “Rare” languages

Sentiment Analysis

- Customer support
- Social media
- Public relations

Fraud & Veracity Analysis

- "Fake news"
- Better SPAM, Phishing, etc. detection and mitigation.

Question Answering & Search

- Customer support
- More advanced, targeted search results
  - Support natural language queries
  - Search legal docs, research papers, patents, ...

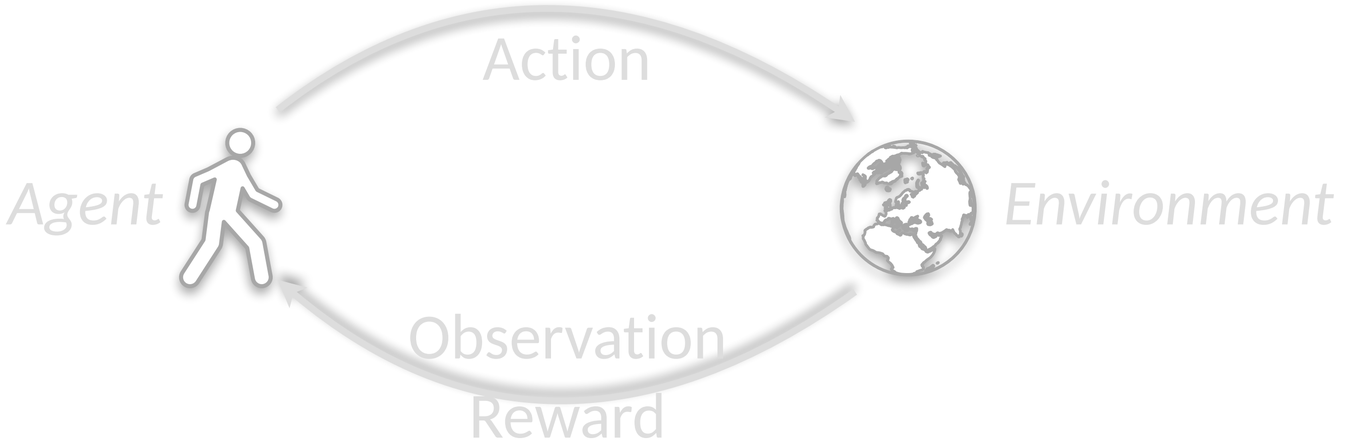
Images and Videos…

- Many of these same techniques and applications apply to image and video applications, too.

Reinforcement Learning

What Is RL?

- An agent observes an environment, takes a sequence of actions
- Goal: maximize the cumulative reward

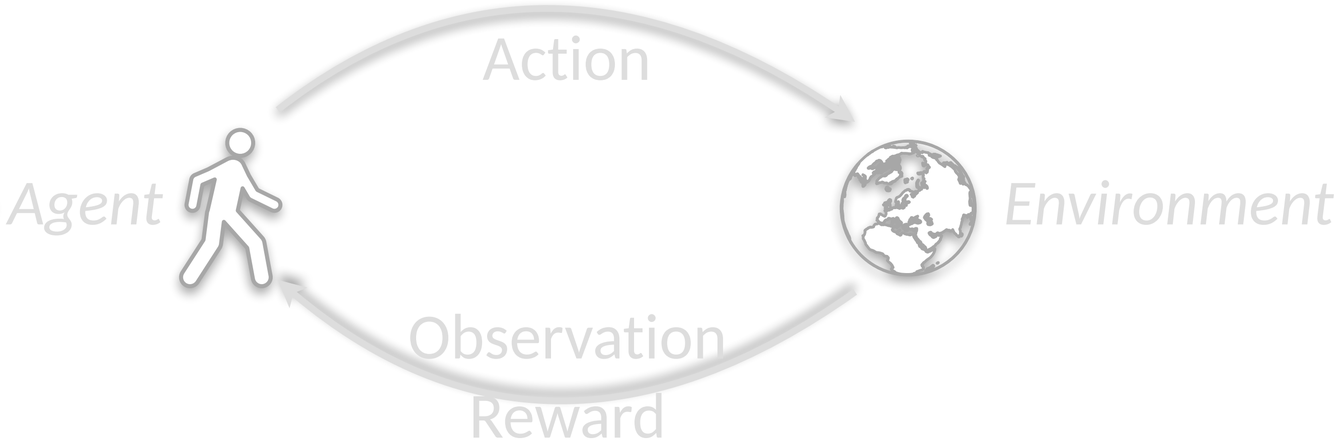


Episodes. RL is ideal for problems with sequential events.

Learn an optimal policy. Cumulative reward reinforces learning.

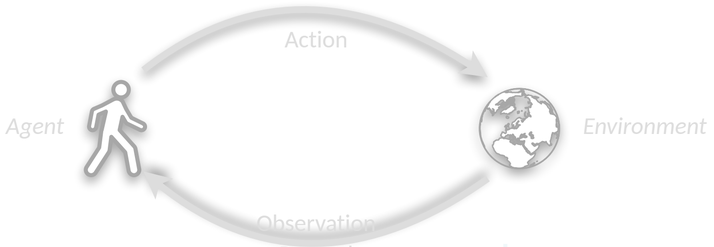
What Is RL?

- An agent observes an environment, takes a sequence of actions
- Goal: maximize the cumulative reward



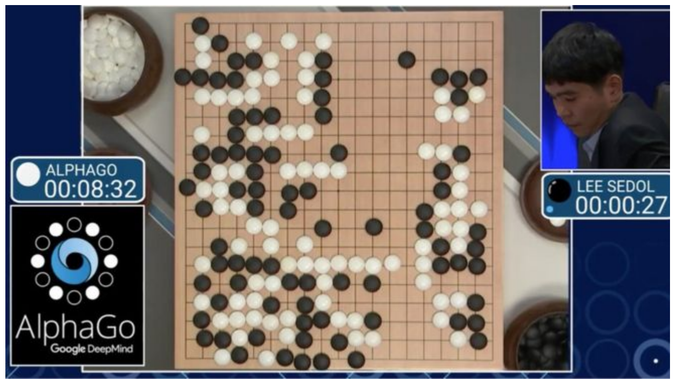
Applications

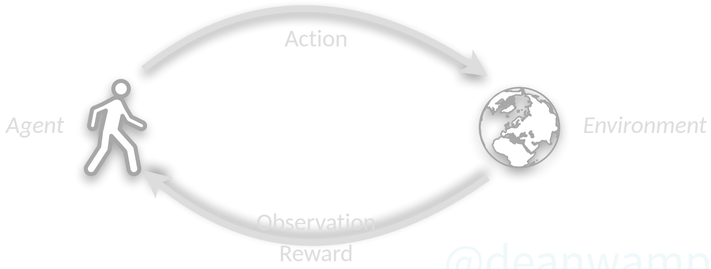
- Games
- Robots & Autonomous Vehicles
- Process Modeling & Automation
- System Optimization
- Advertising & Recommendation
- Markets



Games

- World's best expert game play in:

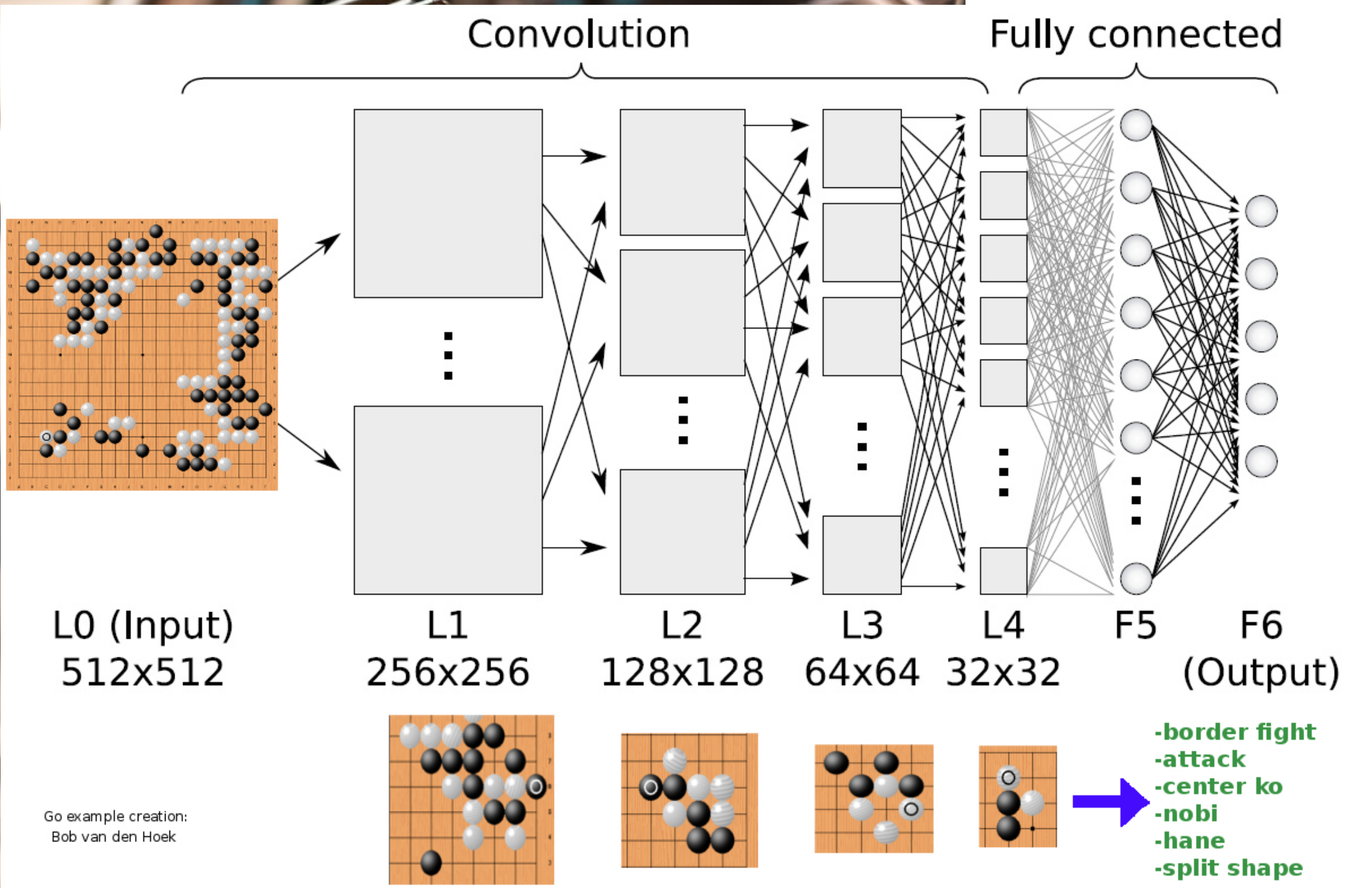


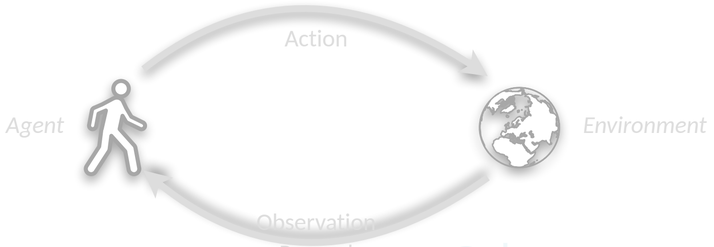


https://www.geekwire.com/2016/alphago-ai-program-wins-1-million-prize-go-showdown-champion-lee-sedol/
https://towardsdatascience.com/tutorial-double-deep-q-learning-with-dueling-network-architectures-4c1b3fb7f756

Games

- AlphaGo
  - Observations: board state
  - Actions: place stones
  - Rewards:
    - 1 if you win
    - 0 otherwise

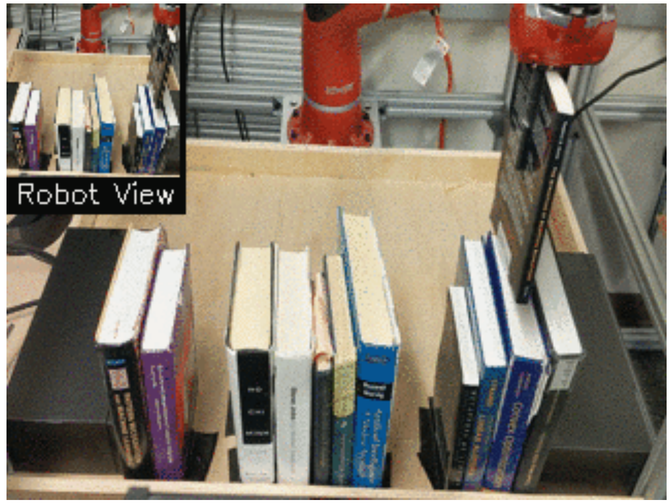


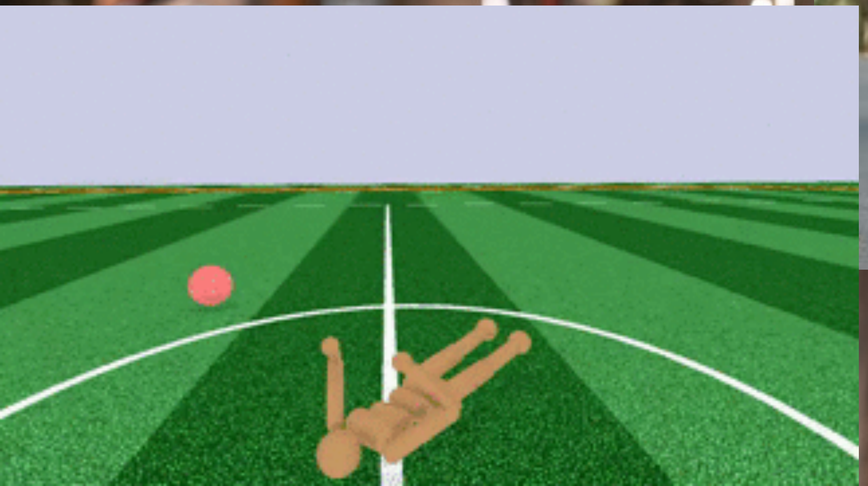


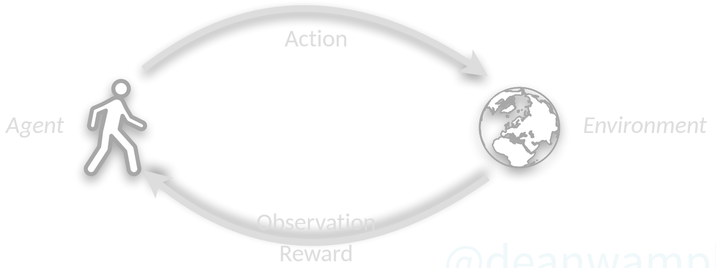
nature.com/articles/nature16961

Robotics & Autonomous Vehicles

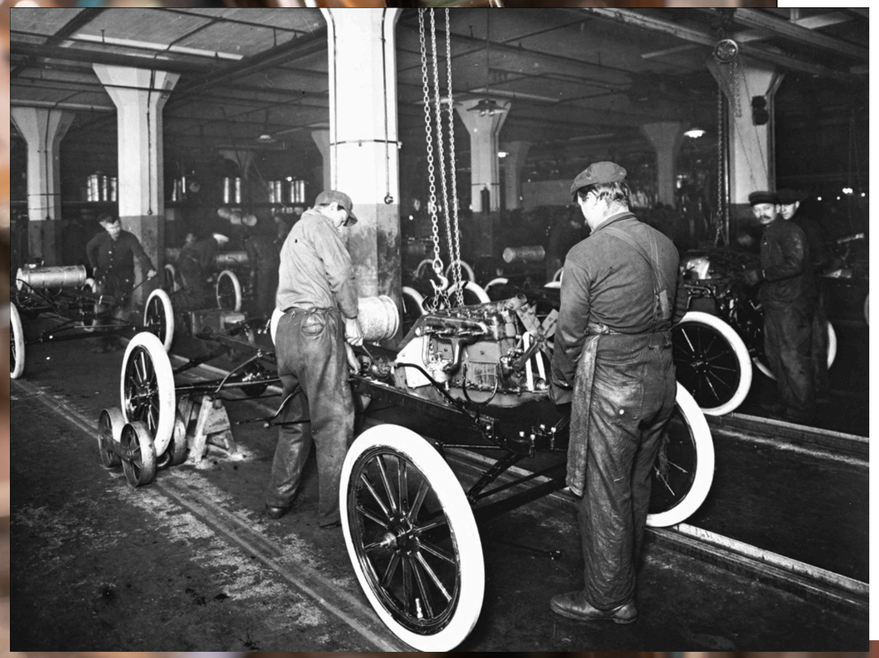
- Start with simulators, work up to real machines.







Process Modeling & Automation



Simulation Optimization | Add

pathmind.com

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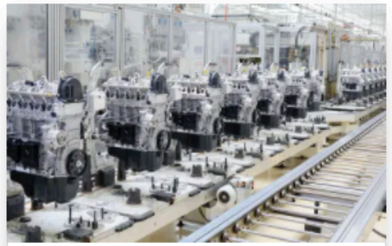
Products Services Industries Resources Company

SIGN IN REQUEST DEMO

Recent Updates



Engineering Group: Manufacturing Optimization with AI Minimizes Factory Flow Bottlenecks

Oct 30, 2020 | Customer Success

Summary Engineering Group, a global engineering firm and technology consultancy with a strong practice in simulation, worked with Pathmind to apply reinforcement learning to intelligently route heavy industrial parts over a complex assembly line in...

Engineering Group: Using AI to Maximize Factory Output with Better Order Sequencing

Oct 29, 2020 | Customer Success

Summary Engineering Group, a global engineering firm and technology consultancy with a strong practice in simulation, worked with Pathmind to apply reinforcement learning to maximize factory output by making smarter decisions about order...

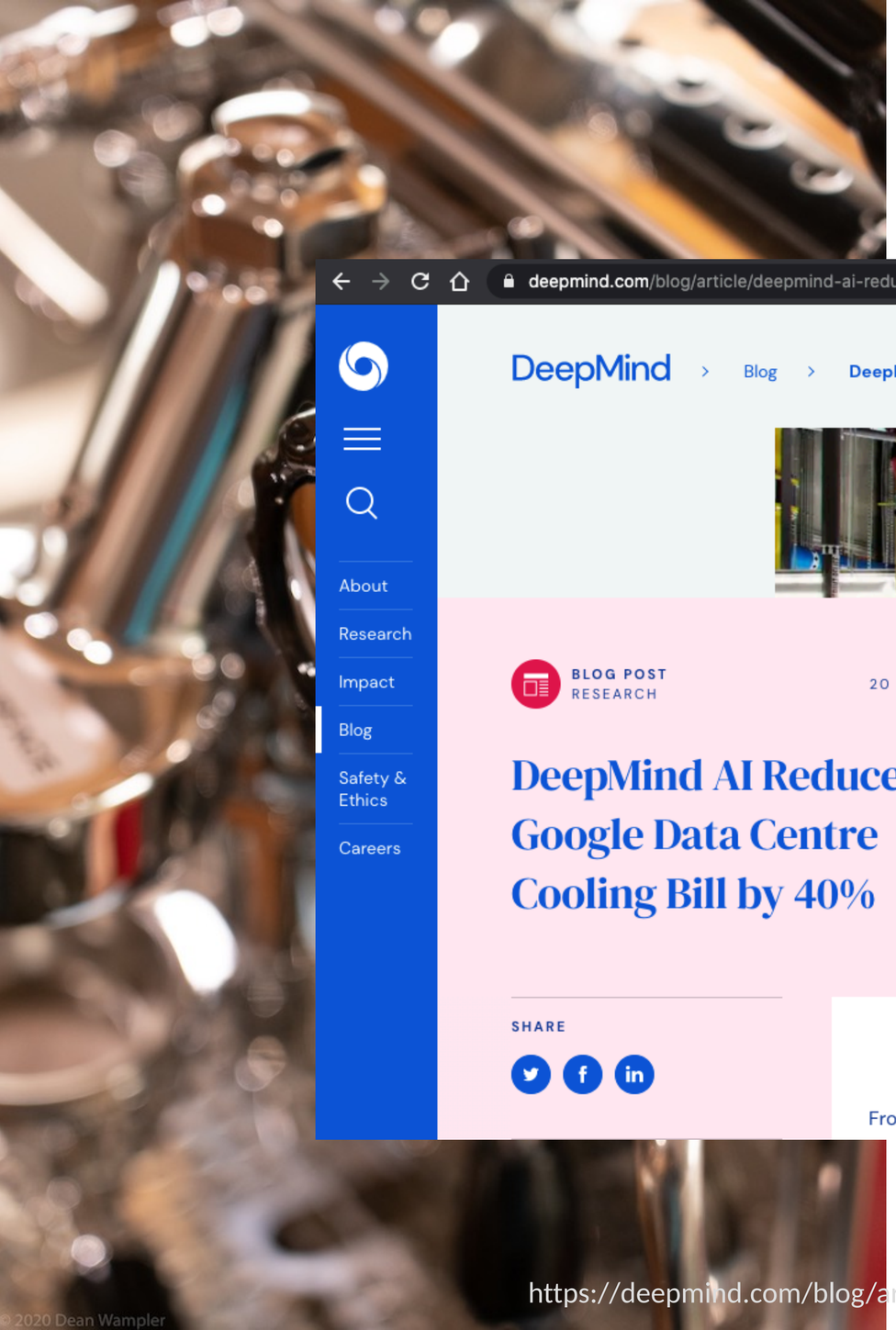
Princeton Consultants: Using AI to Maximize Efficiency of Machine Scheduling

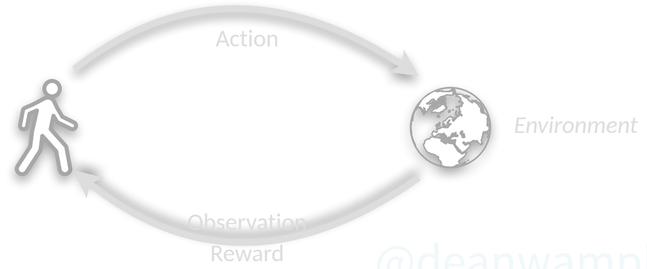
Oct 13, 2020 | Customer Success

Summary Princeton Consultants, a simulation consulting firm, serves a manufacturing client with a hard machine scheduling problem. Its optimizer had difficulty scheduling machines for new types of items that needed to be processed; it was not able...

https://media.ford.com/content/fordmedia/fna/us/en/features/game-changer--100th-anniversary-of-the-moving-assembly-line.html

System Optimization

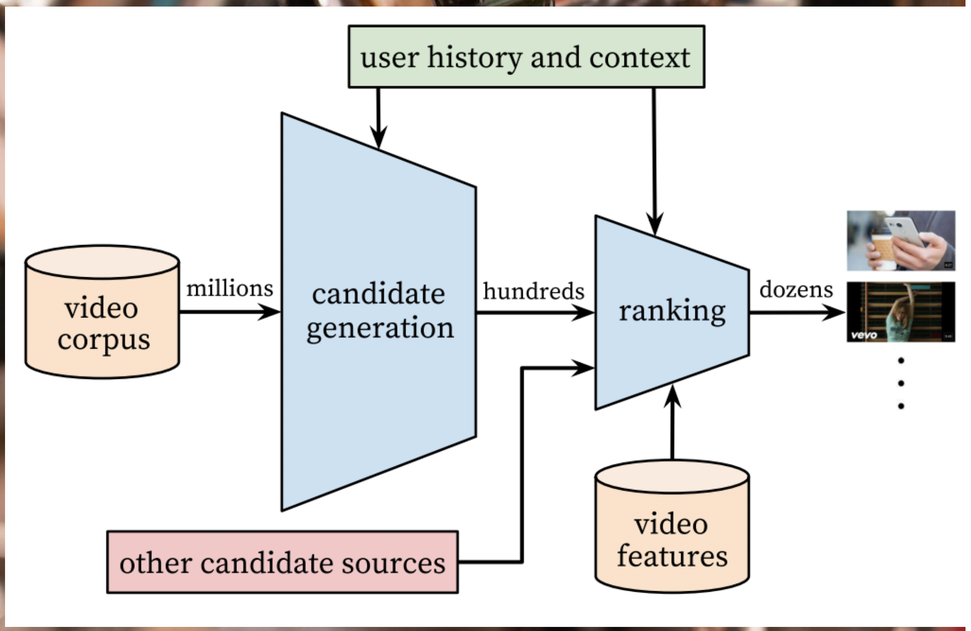


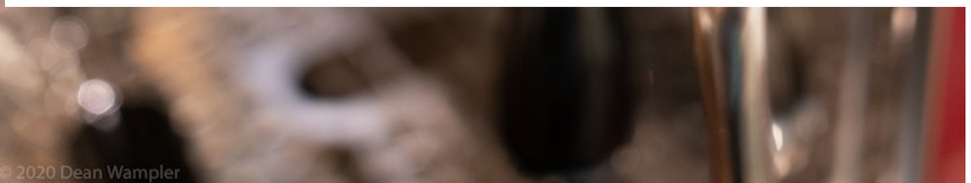


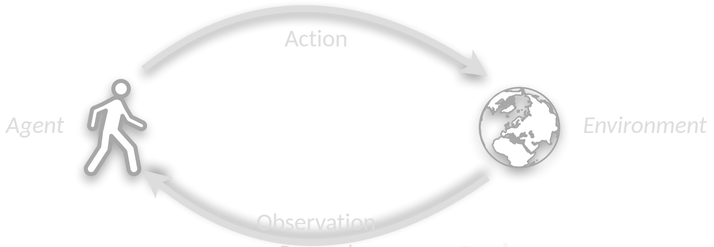
https://deepmind.com/blog/article/deepmind-ai-reduces-google-data-centre-cooling-bill-40

Advertising & Recommendation

- A "mature" problem, yet RL is providing a new approach.
  - Better modeling of evolving preferences.
  - Better scalability than collaborative filtering, etc.



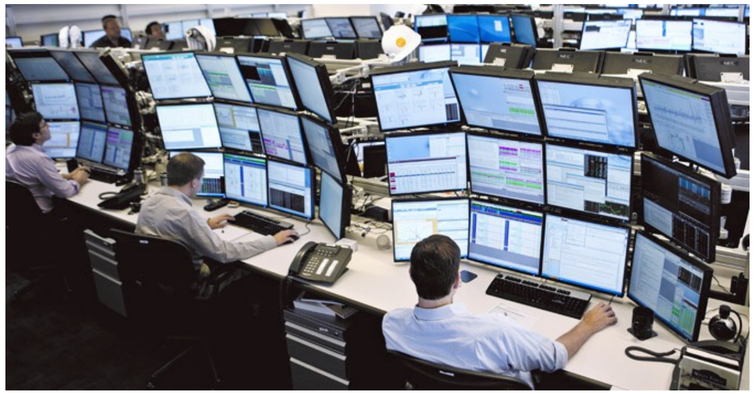


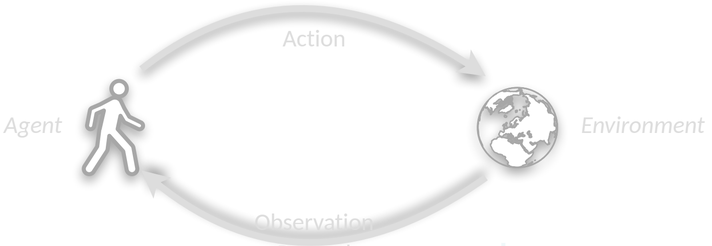


https://research.google/pubs/pub45530/

Markets

- Inherently time-ordered
- Lots of different "signals"
- Contextual, multi-armed bandits

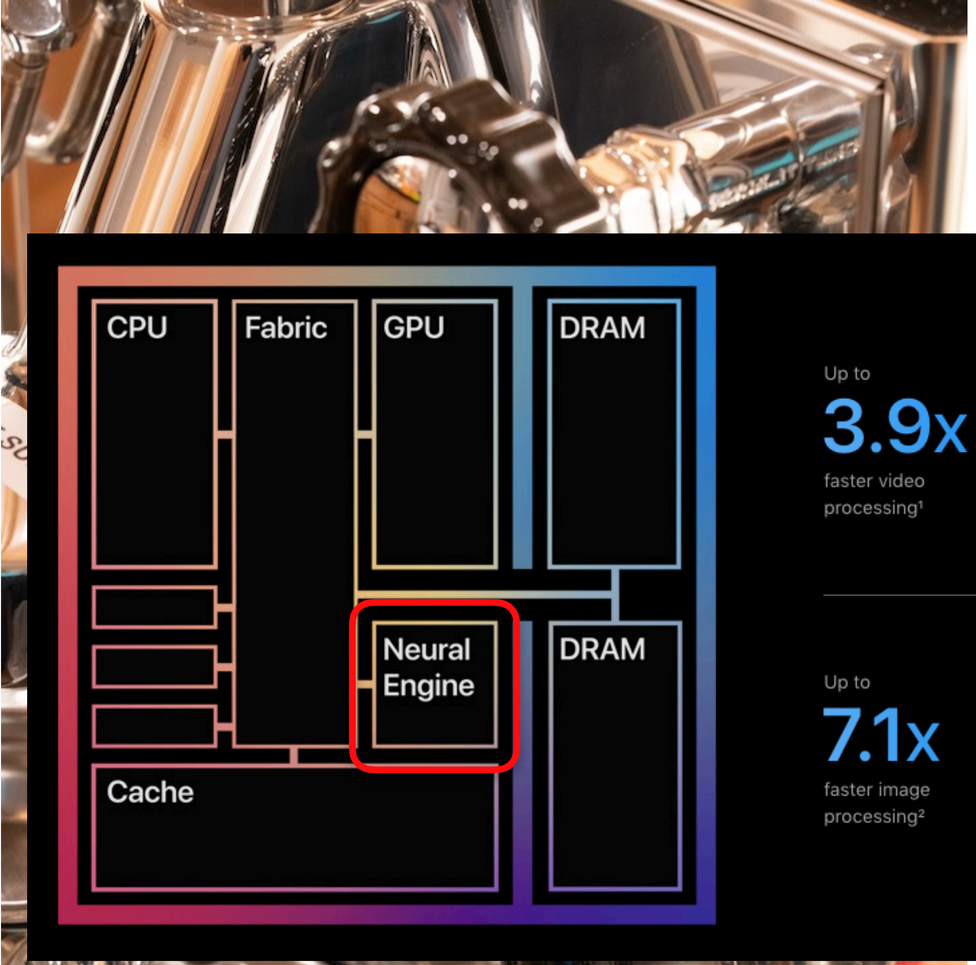


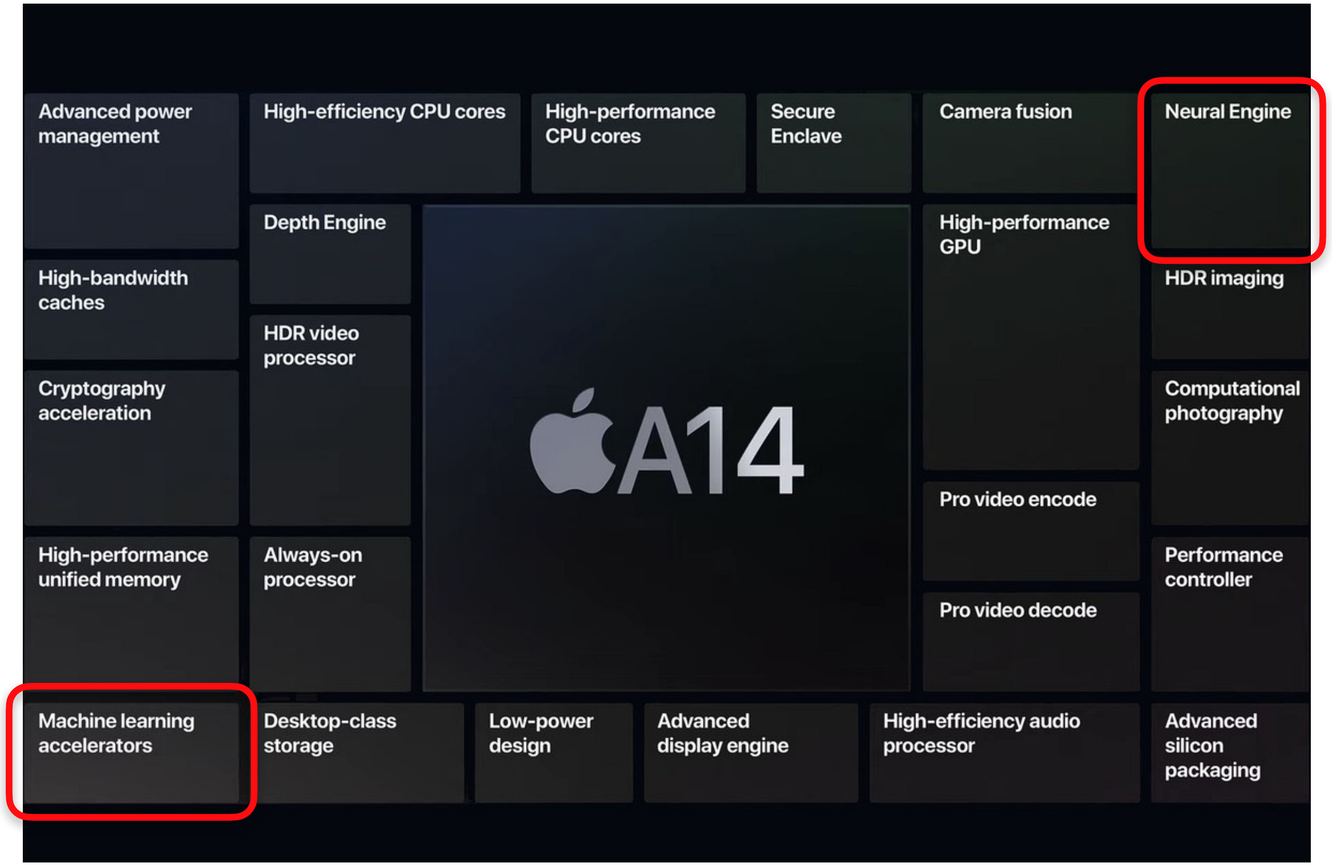


http://tradinghub.co/watch-list-for-mar-26th-2015/

What Our Phones Are Telling Us...

Apple Silicon





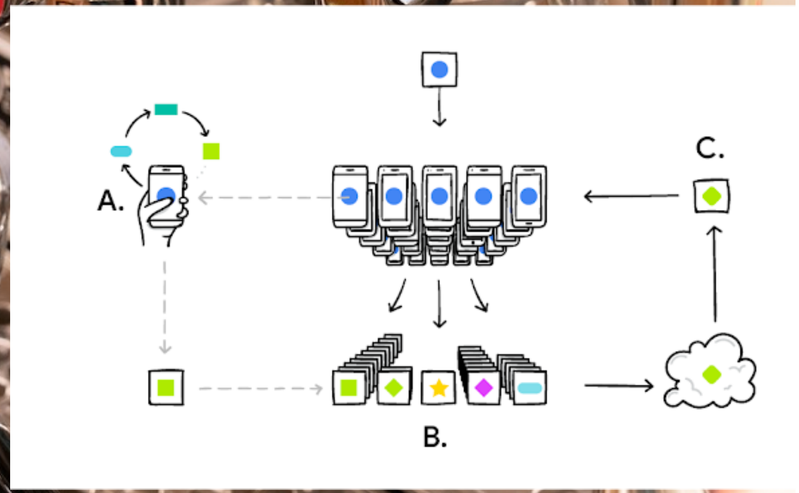
apple.com

Applications that Exploit ML/AI

- Unlocking: finger and face ID
- Predictive typing
- Siri
- Recommendations
- …
- Probably most will use it in one or another, sooner or later!

Technologies that Make this Possible

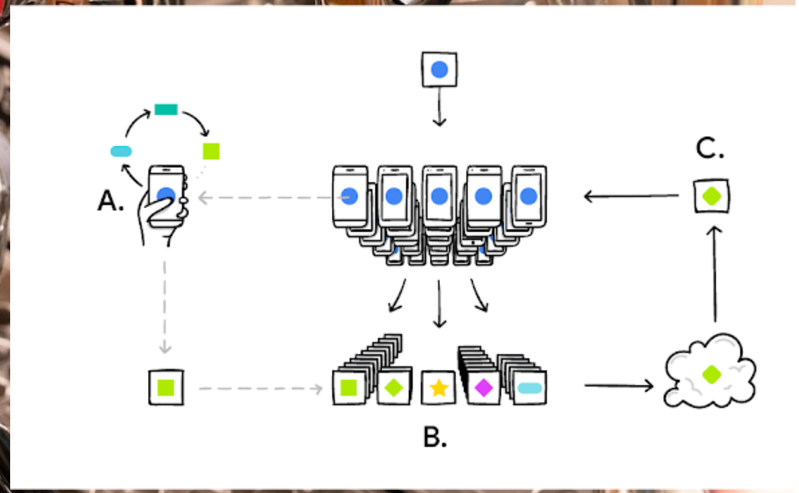
- Federated Learning
  A. Your local usage trains a model
  B. Many users updates are aggregated to form a consensus update
  C. Updated model propagated to all users.
  D. Repeat…



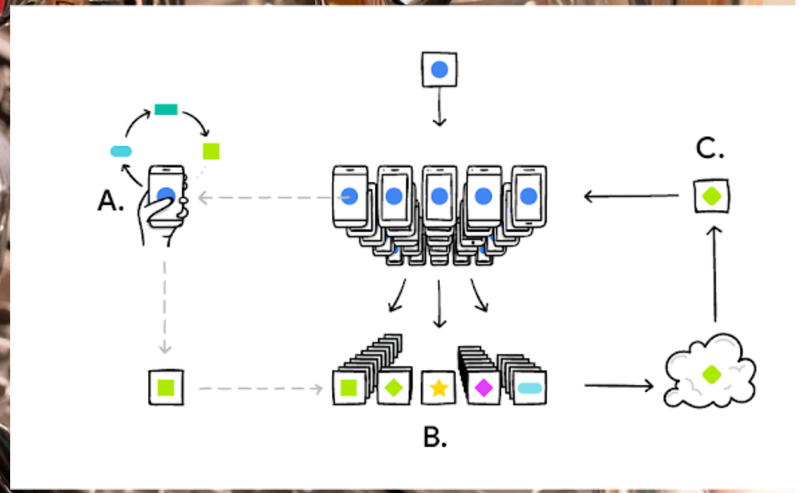
https://ai.googleblog.com/2017/04/federated-learning-collaborative.html

Technologies that Make this Possible

- Federated Learning Advantages
  - Your private data stays local
  - Local model is fine tuned for you
  - No central data storage required
  - Central processing is minimized
    - Instead, all our phones do most of the training



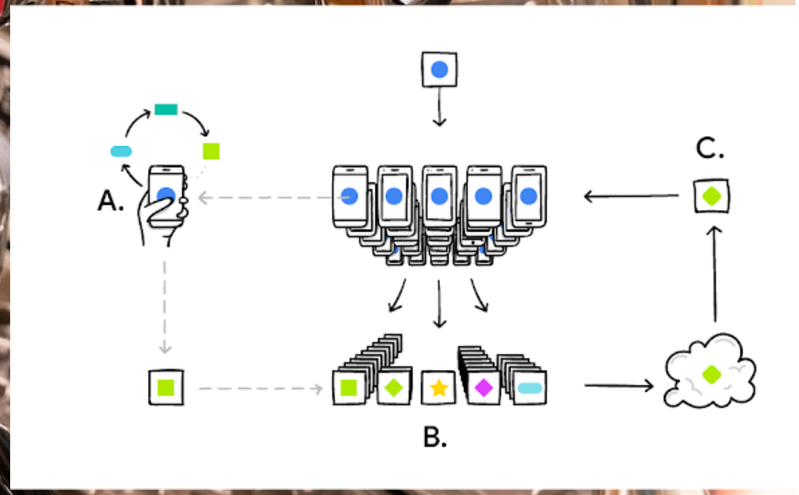
https://ai.googleblog.com/2017/04/federated-learning-collaborative.html



Technologies that Make this Possible

- Differential Privacy
  - "Differential" - If I run a query without your record, then with your record, what can I learn about you from the difference??
  - Introduce "noise" into the data so that:
    - Private data is obscured
    - Introduced error is bounded

https://ai.googleblog.com/2017/04/federated-learning-collaborative.html



Enterprise Applications?

- What services would your customers reject now, but accept if you offered the services using Federated Learning & Differential Privacy??

https://ai.googleblog.com/2017/04/federated-learning-collaborative.html

Classic techniques that still deliver lots of value

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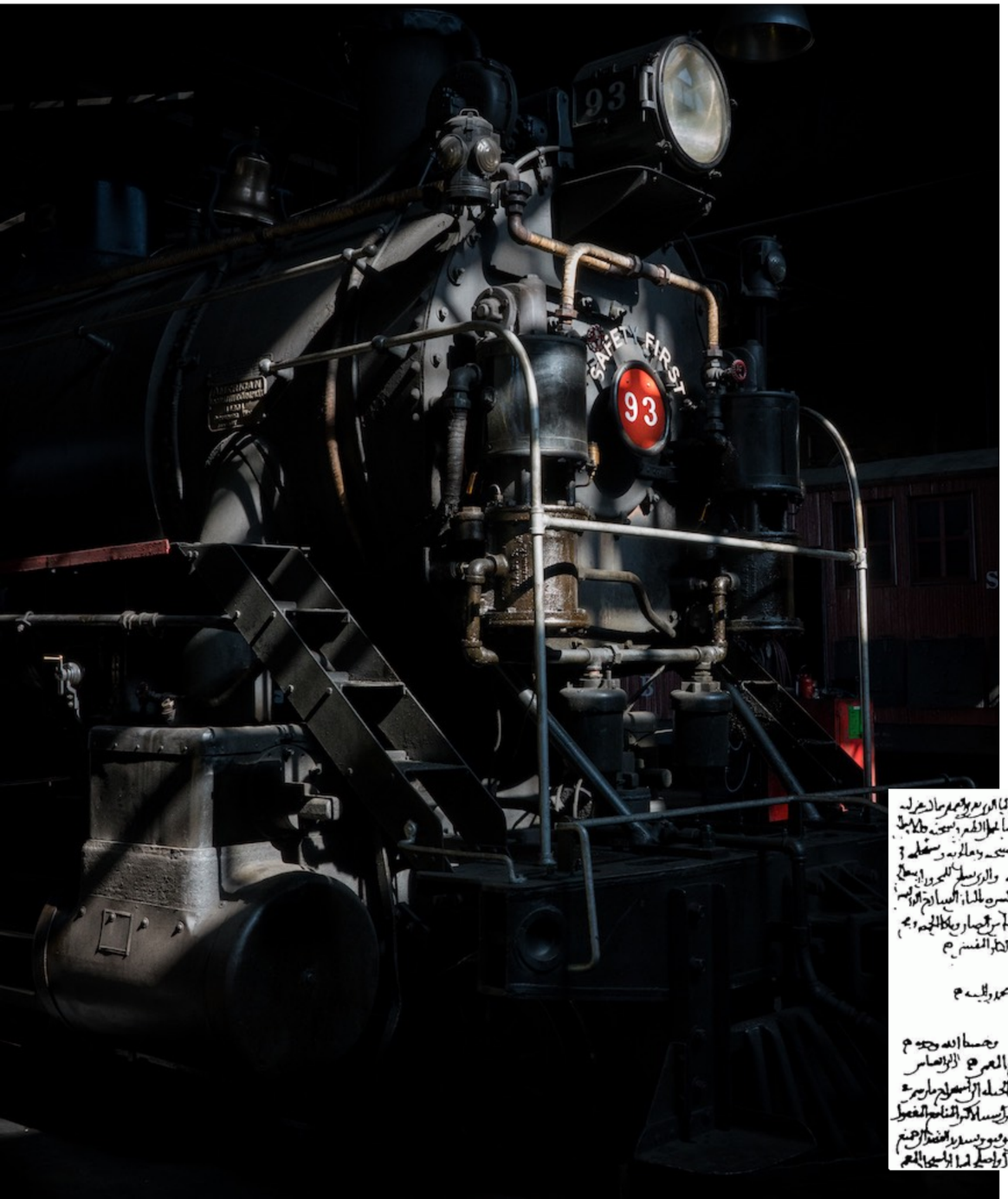


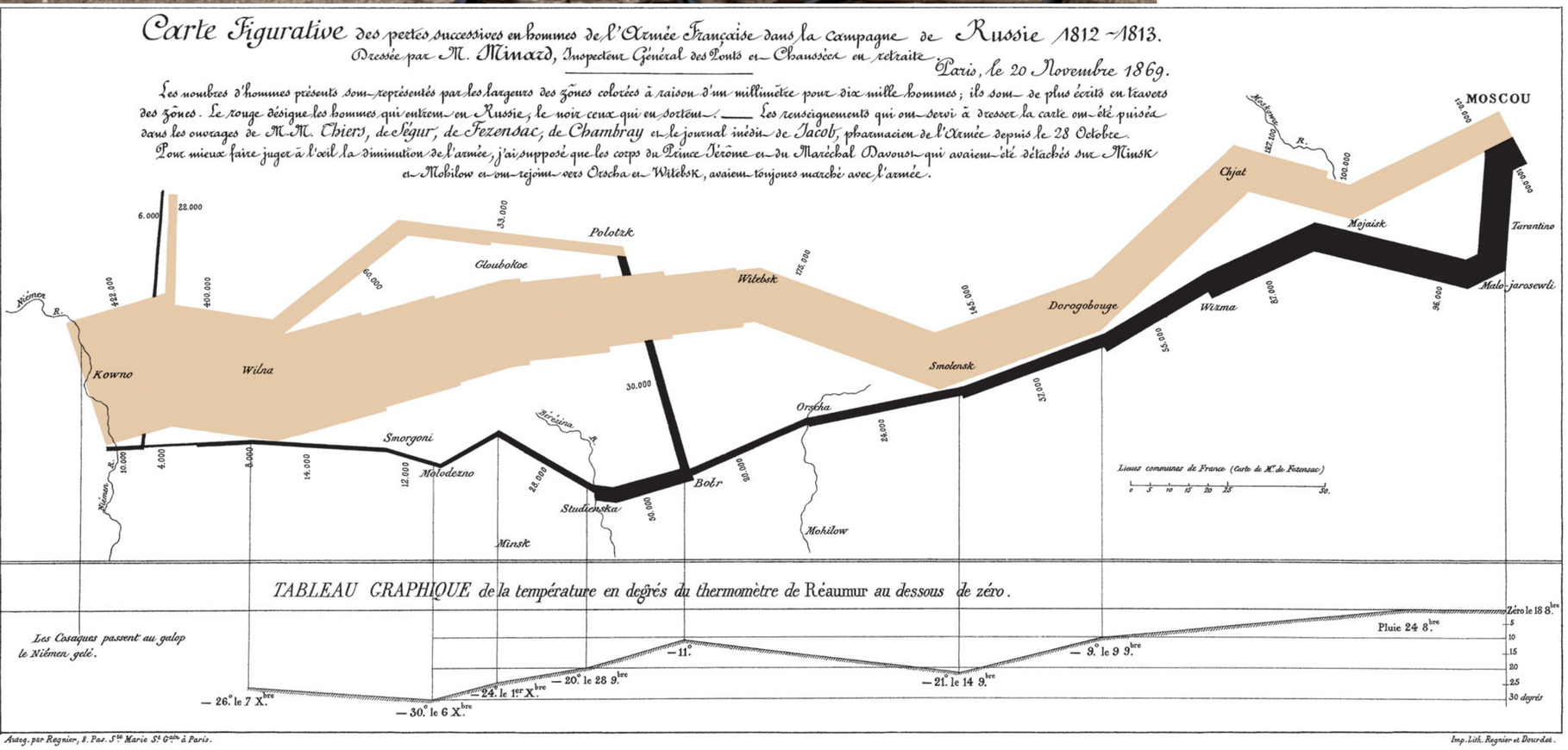
Statistical Inference

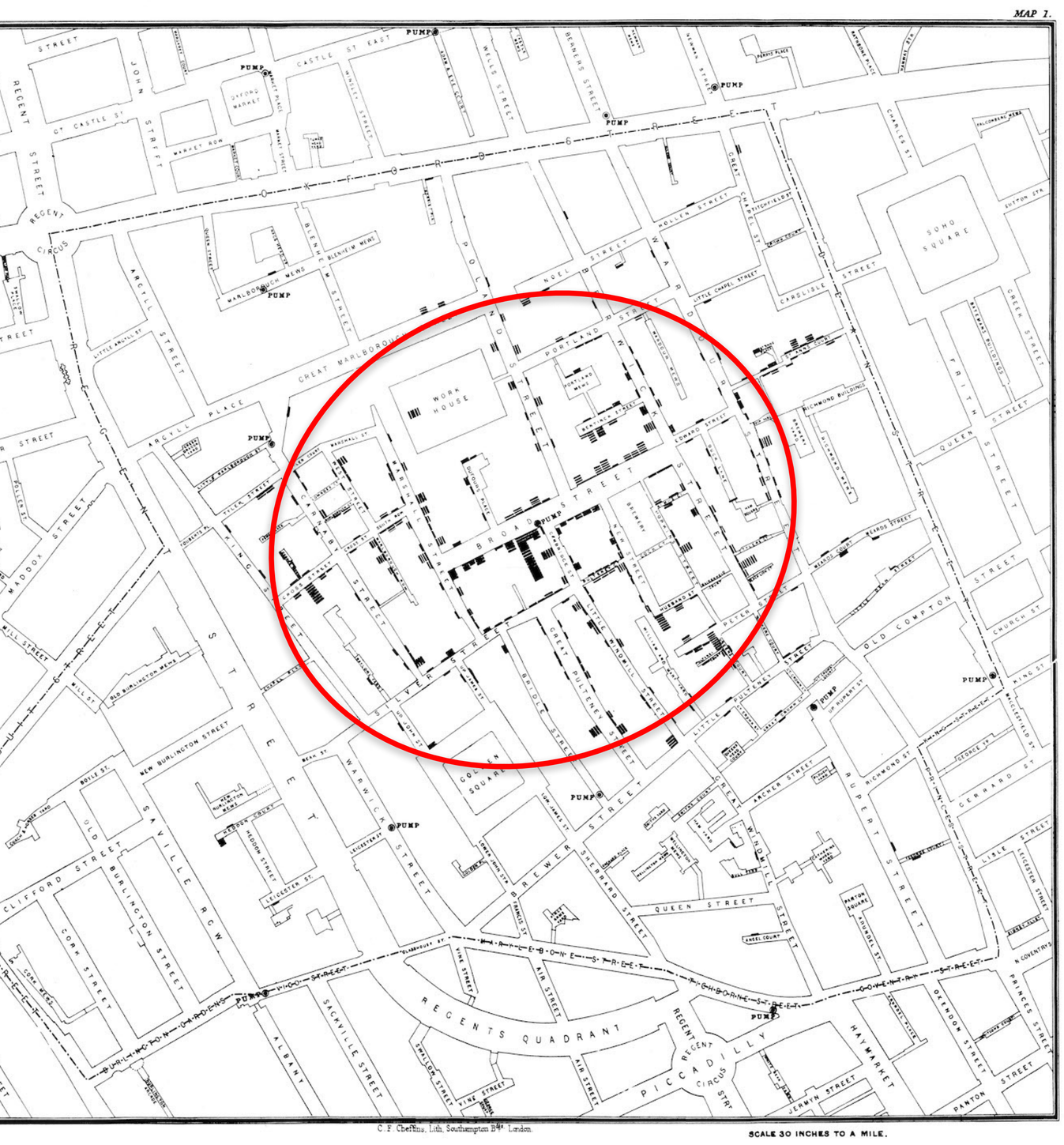
- Al Kindi (801-873):
  - On Deciphering Cryptographic Messages
  - Creator of cryptanalysis
  - Earliest known use of statistical inference

https://datavizblog.com/2013/05/26/dataviz-history-charles-minards-flow-map-of-napoleons-rus

Visualization

- Charles Minard's visualization of Napoleon's Russia Campaign (drawn 1861)





Visualization

- "On the Mode of Communication of Cholera", by John Snow (1854)

Neural Nets

- 1943 - McCulloch and Pitts - single layer
- ...
- Le Cun, et al. (1989-1990)

Handwritten Zip Code Recognition with Multilayer Networks

Y. Le Cun, O. Matan, B. Boser, J. S. Denker, D. Henderson,
R. E. Howard, W. Hubbard, L. D. Jackel and H. S. Baird
AT&T Bell Laboratories, Holmdel, N. J. 07733

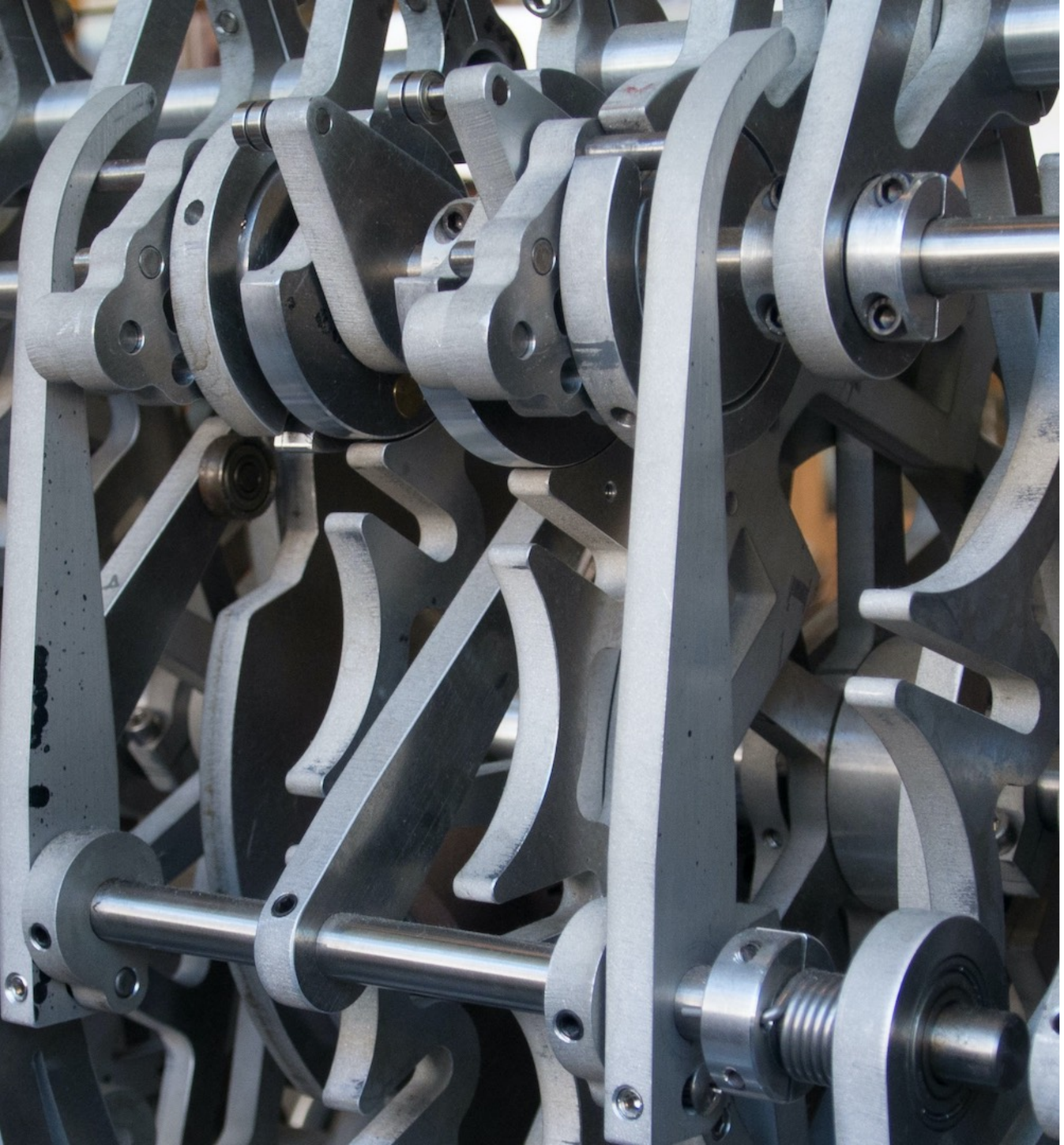
A zip code

Abstract

We present an application of back-

only be obtained by designing a network architecture that contains a certain amount of *a priori* knowledge about the problem. The basic design

http://yann.lecun.com/exdb/publis/pdf/lecun-90e.pdf



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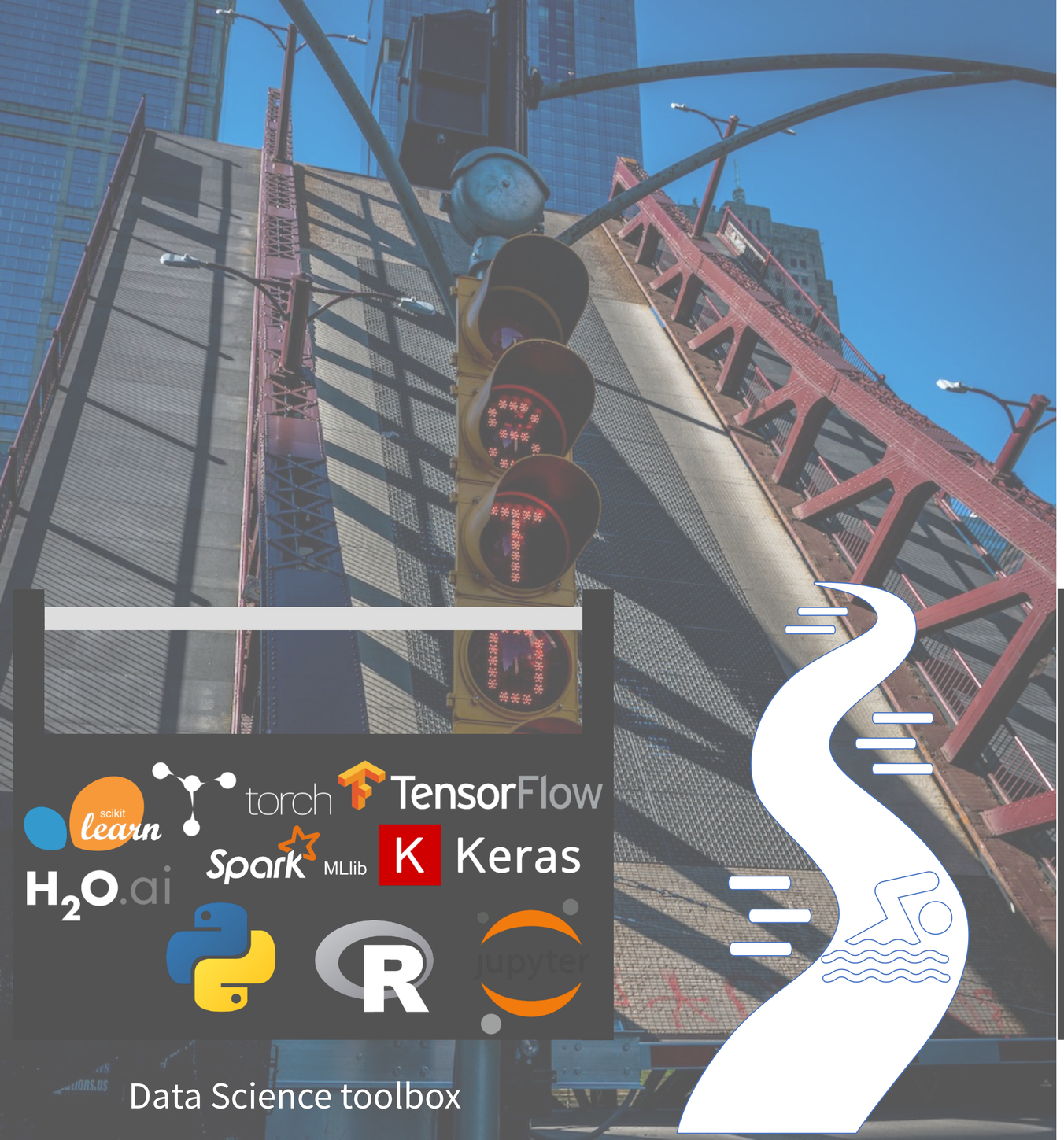
All the current capabilities of the
Promise of AI section are
available now, but they are hard
to build and use.
@deanwampler

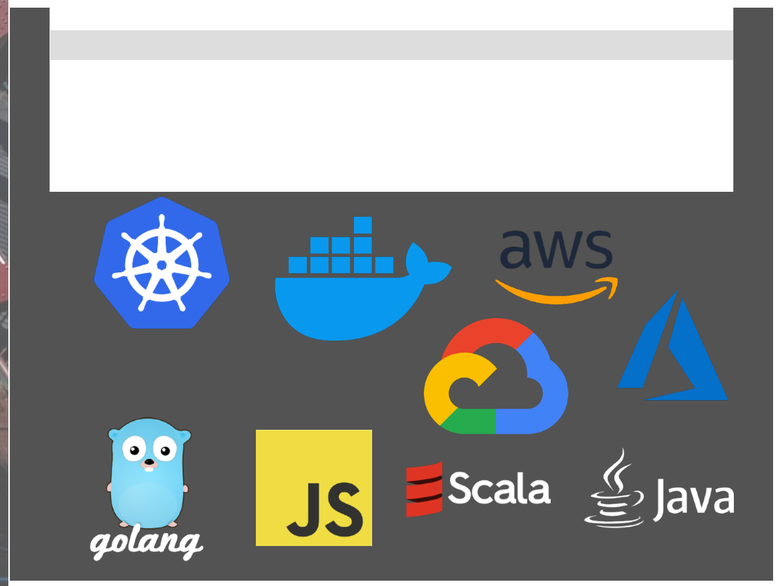
Data Science vs. Data Engineering

Data Science vs. Data Engineering

- A cultural and technical divide



Data Science toolbox



Data Scientists

- Comfortable with uncertainty
- Less process oriented
  - Iterative, experimental

Data Engineers

- Uncomfortable with uncertainty
- Process oriented
  - Agile Manifesto
  - … which does not mention data!

https://derwen.ai/s/6fqt

Bridging the Divide

Data Scientists

- Embrace control and repeatability

Data Engineers

- DevOps ⇒ ModelOps

Bridging the Divide

Data Scientists

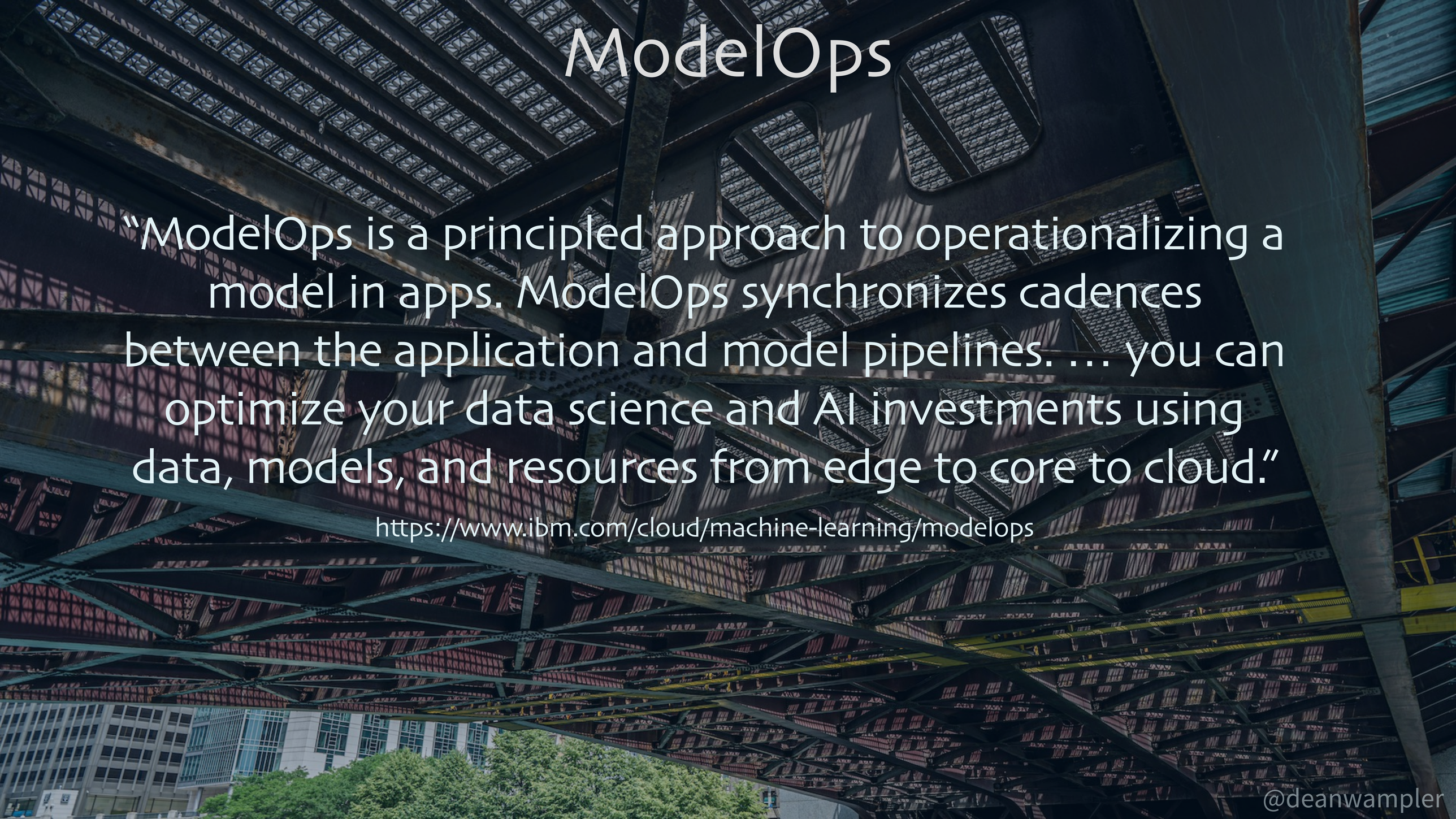
- Embrace control and repeatability

Data Engineers

- DevOps ⇒ ModelOps

Model: An algorithm that makes a prediction or recommendation or prescribes some action based on a probabilistic assessment. Data scientists make models.

https://www.dominodatalab.com/blog/model-management-and-the-era-of-the-model-driven-business/



ModelOps

"ModelOps is a principled approach to operationalizing a model in apps. ModelOps synchronizes cadences between the application and model pipelines. … you can optimize your data science and AI investments using data, models, and resources from edge to core to cloud."

https://www.ibm.com/cloud/machine-learning/modelops

ModelOps

And if you look at the most successful companies in the world, you'll find models at the heart of their business driving that success.

- Example: Netflix recommendation model
  - Drives subscriber engagement, retention, and operational efficiency.
  - Their recommendation model is worth more than $1B per year (2016).

https://www.dominodatalab.com/blog/model-management-and-the-era-of-the-model-driven-business/

ModelOps

And if you look at the most successful companies in the world, you'll find models at the heart of their business driving that success.

- Example: Coca-Cola
  - Optimizes orange juice production, …
- Example: Stitch Fix
  - Clothing recommendations for customers

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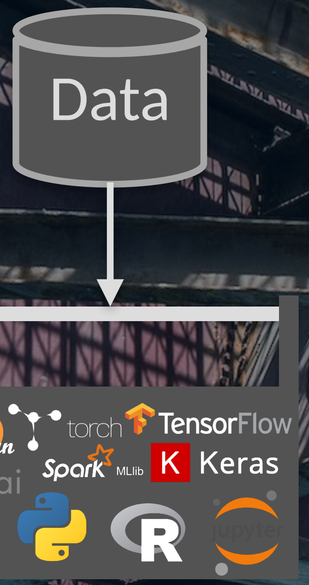
ModelOps

And if you look at the most successful companies in the world, you'll find models at the heart of their business driving that success.

- Example: Insurance companies
  - Actuarial models (very old technique…)
  - Now using models to make automated damage estimates from accident photos, reducing dependence on claims adjusters.

https://www.dominodatalab.com/blog/model-management-and-the-era-of-the-model-driven-business/

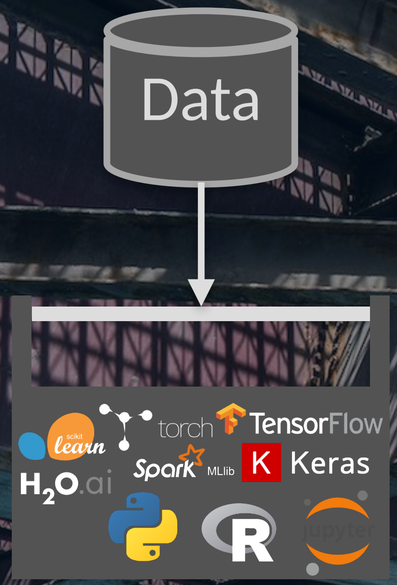
ModelOps



Model Development

Research new models

ModelOps



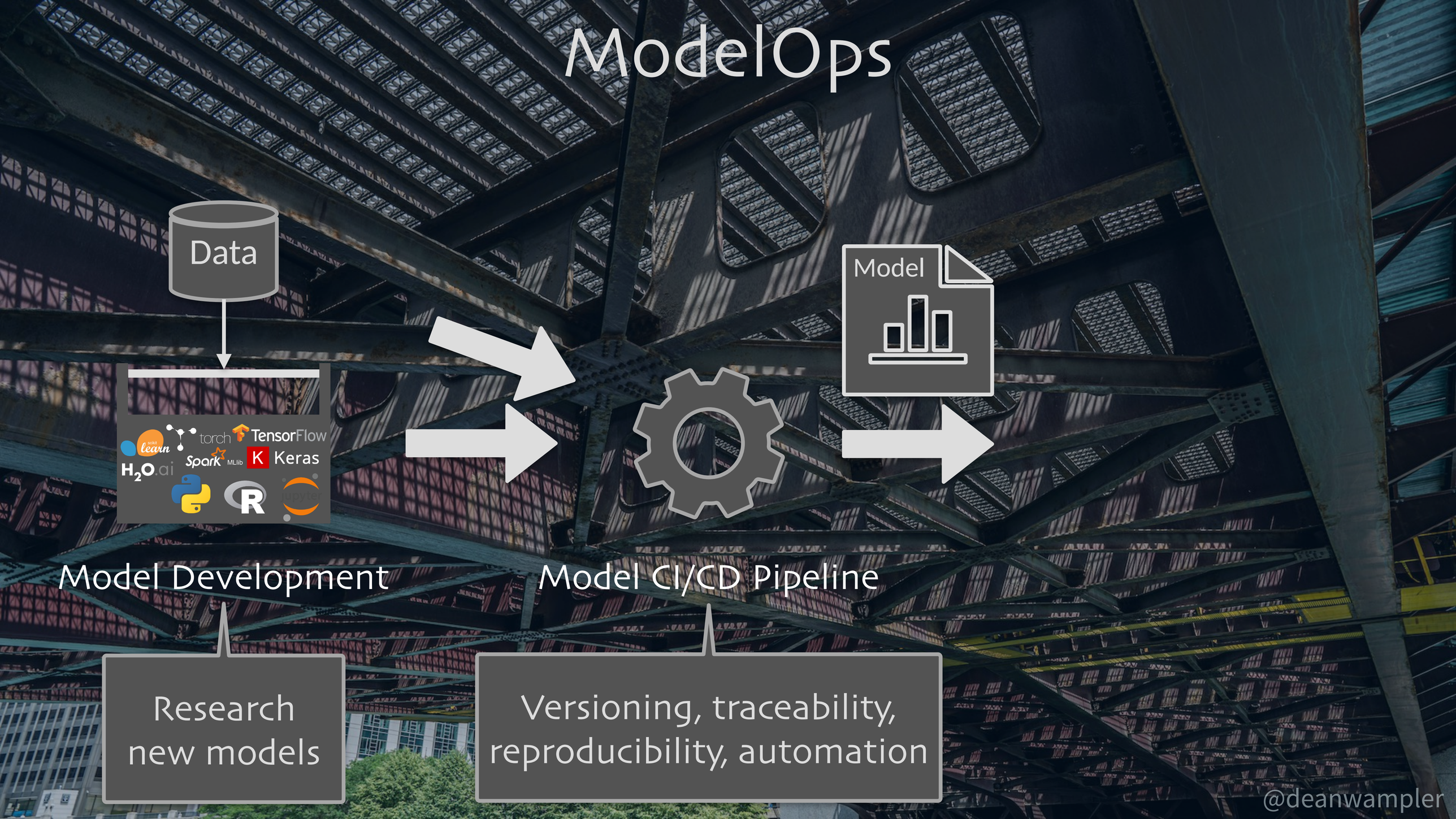
Model Development

Research new models

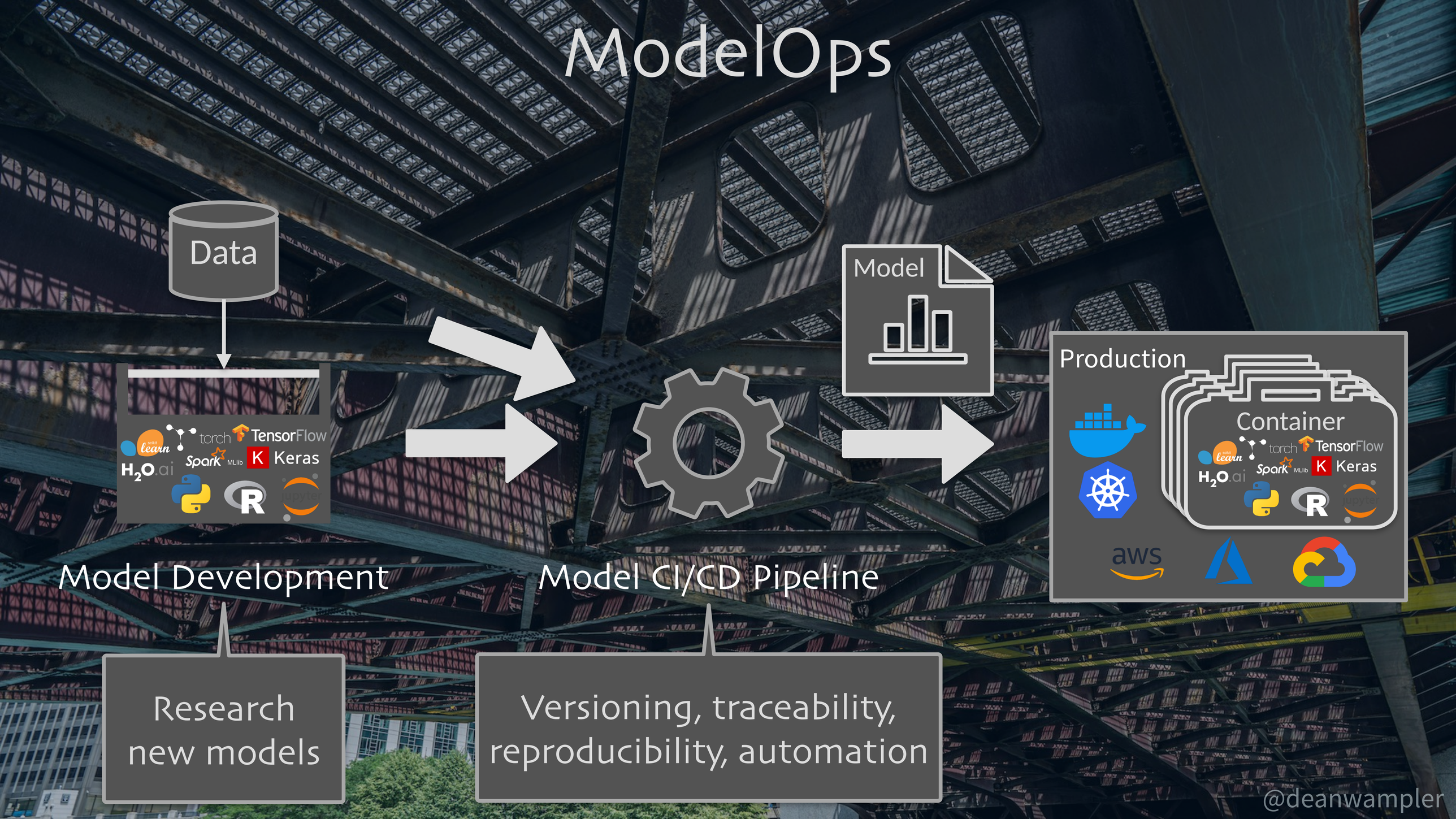
Model CI/CD Pipeline

Versioning, traceability, reproducibility, automation

ModelOps


Data
Model
torch
TensorFlow
Spark MLlib
K Keras
R
jupyter
Model Development
Model CI/CD Pipeline
Research new models
Versioning, traceability, reproducibility, automation

ModelOps


Data
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Production
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Research new models
Versioning, traceability, reproducibility, automation

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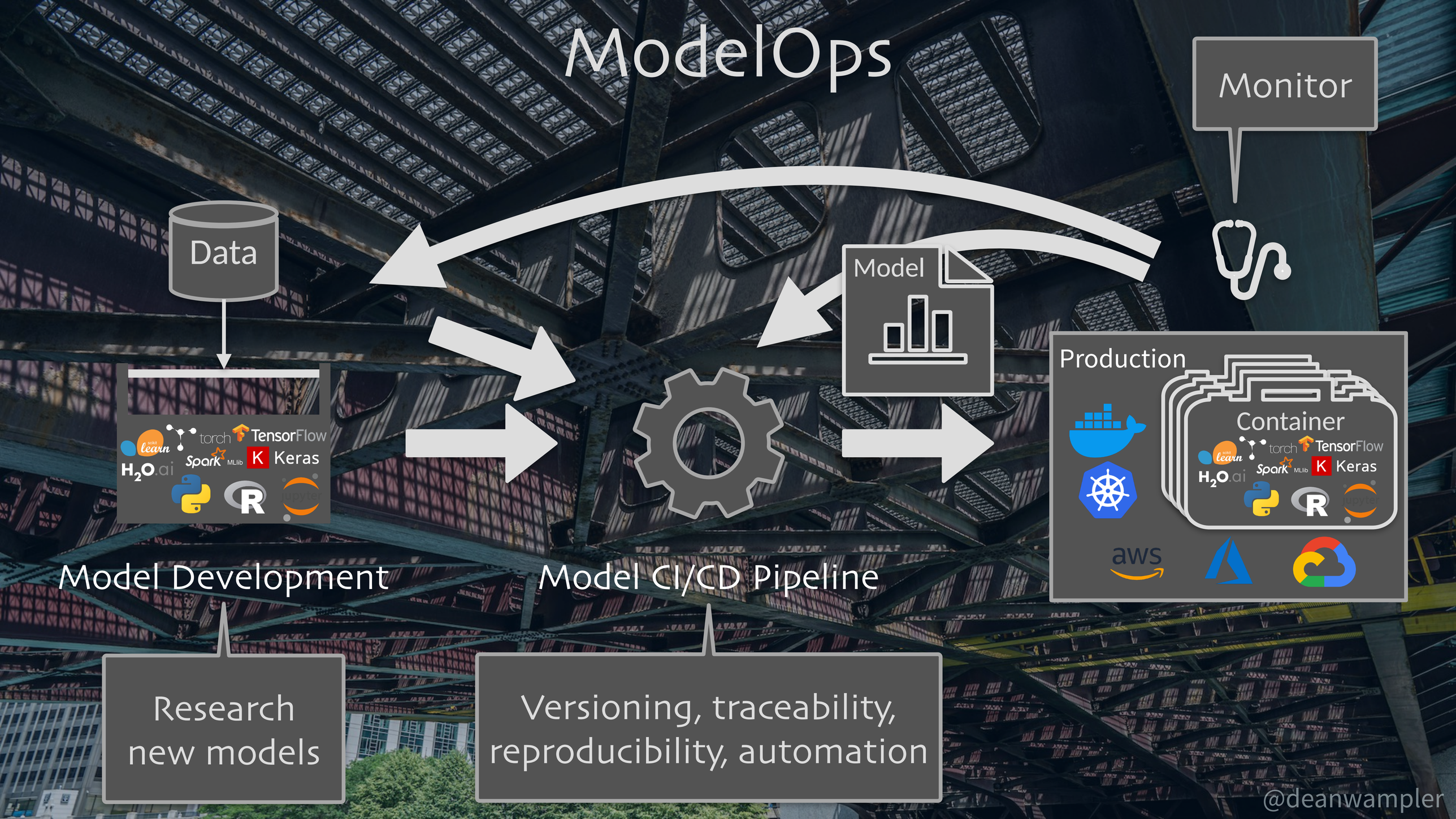
Monitor
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Research new models
Versioning, traceability, reproducibility, automation

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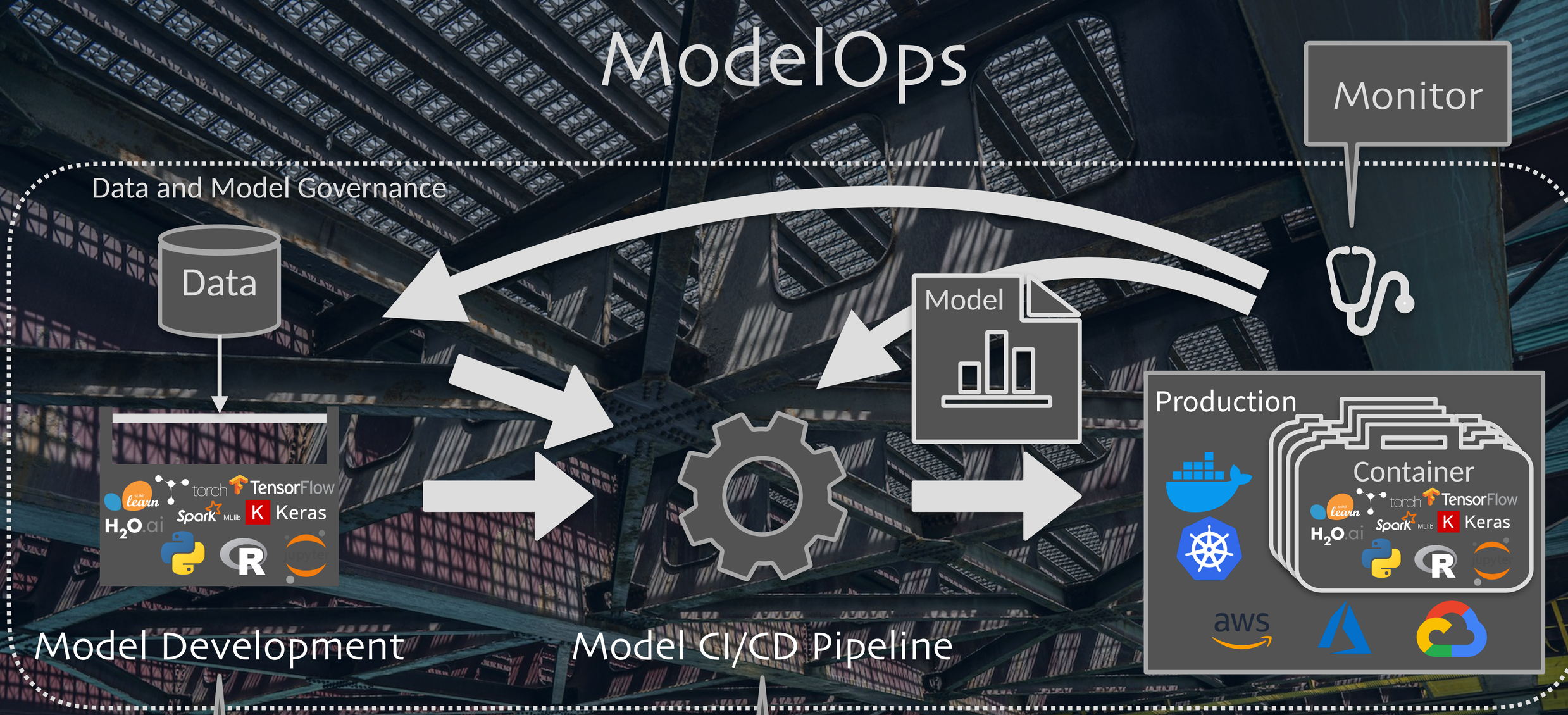


ModelOps

Monitor

This is shown as a batch process, but expect these processes to evolve into streaming pipelines, with continuous training.

Mode

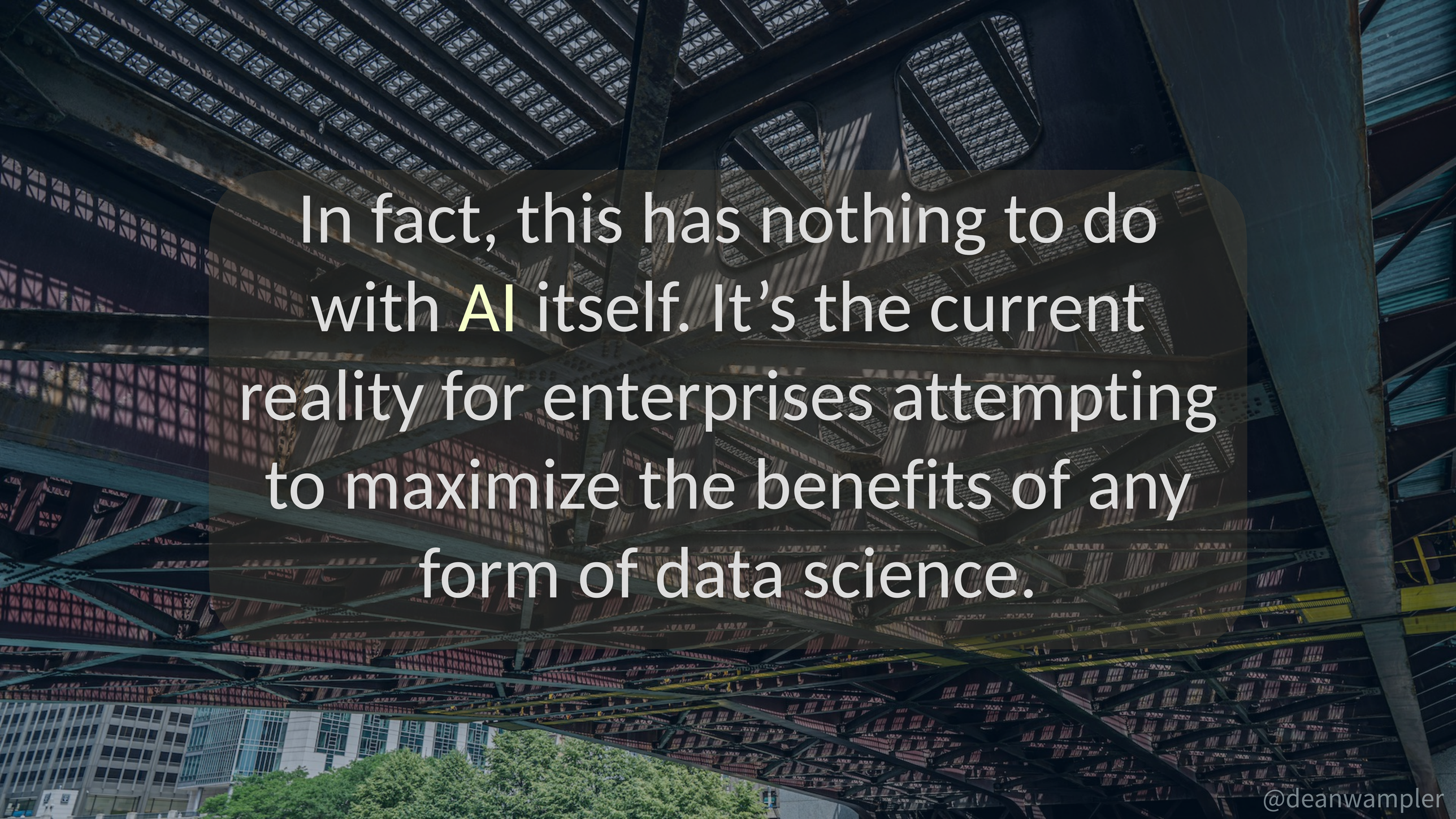
ntainer

torch TensorFlow

K Keras

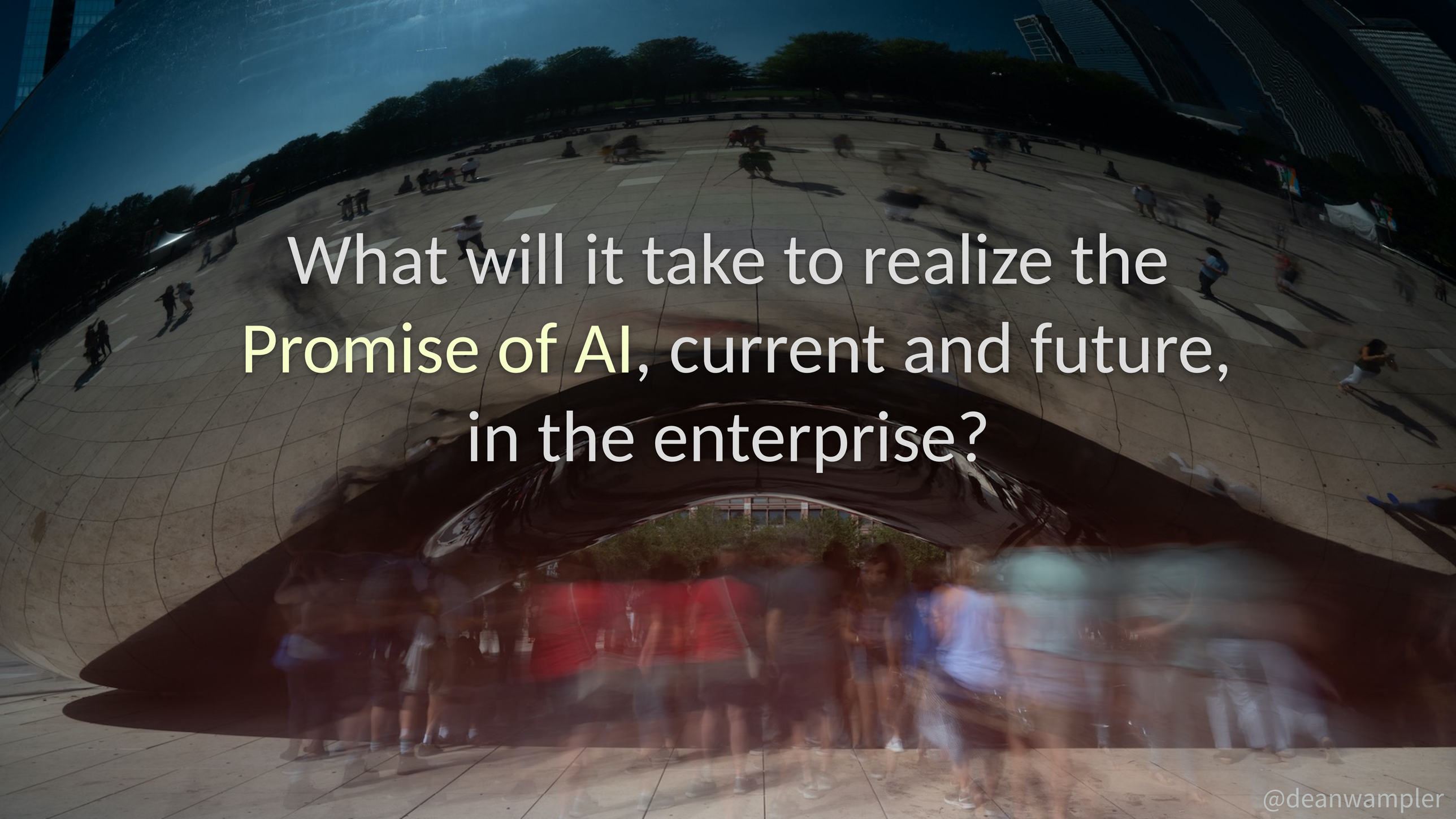
new models

reproducibility, automation


In fact, this has nothing to do with AI itself. It’s the current reality for enterprises attempting to maximize the benefits of any form of data science.
@deanwampler

Outline

- The Promise of AI
-
  - The Past
  - The Present
  - The Future
- Conclusions


What will it take to realize the
Promise of AI, current and future,
in the enterprise?
@deanwampler

AI in the Enterprise

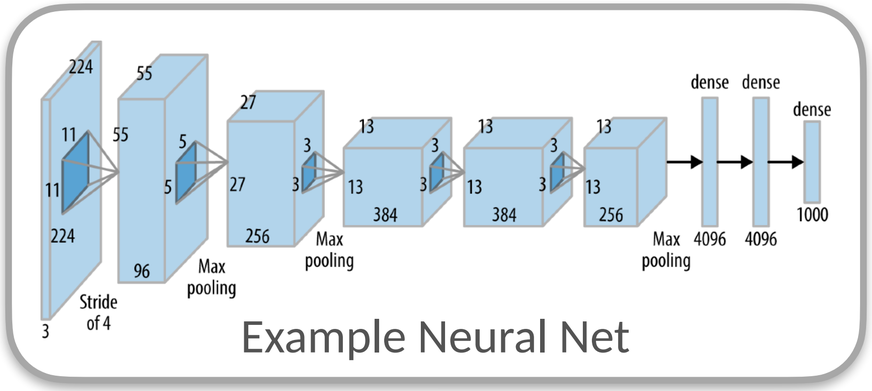
-
  -
  -
-

Along the way...

-
  -
  -
  -
-

NLP

-



https://in.springboard.com/blog/openai-gpt-3/

Transfer Learning

-

https://analyticssteps.com/blogs/how-transfer-learning-done-neural-networks-and-convolutional-neural-networks

Reinforcement Learning

-
-

https://arxiv.org/abs/2005.01643

Infrastructure

-
  expensive
  - Burst
  -

Infrastructure

- hybrid-cloud
  -
  -

Infrastructure

- cost of moving data

Infrastructure

- federated learning
- differential privacy
-
-

https://openmined.org/

Software Development Impacts

- Ubiquitous AI requires:
  - Heterogeneous tools
  - Batch and stream data processing
  - Statistical & probabilistic thinking

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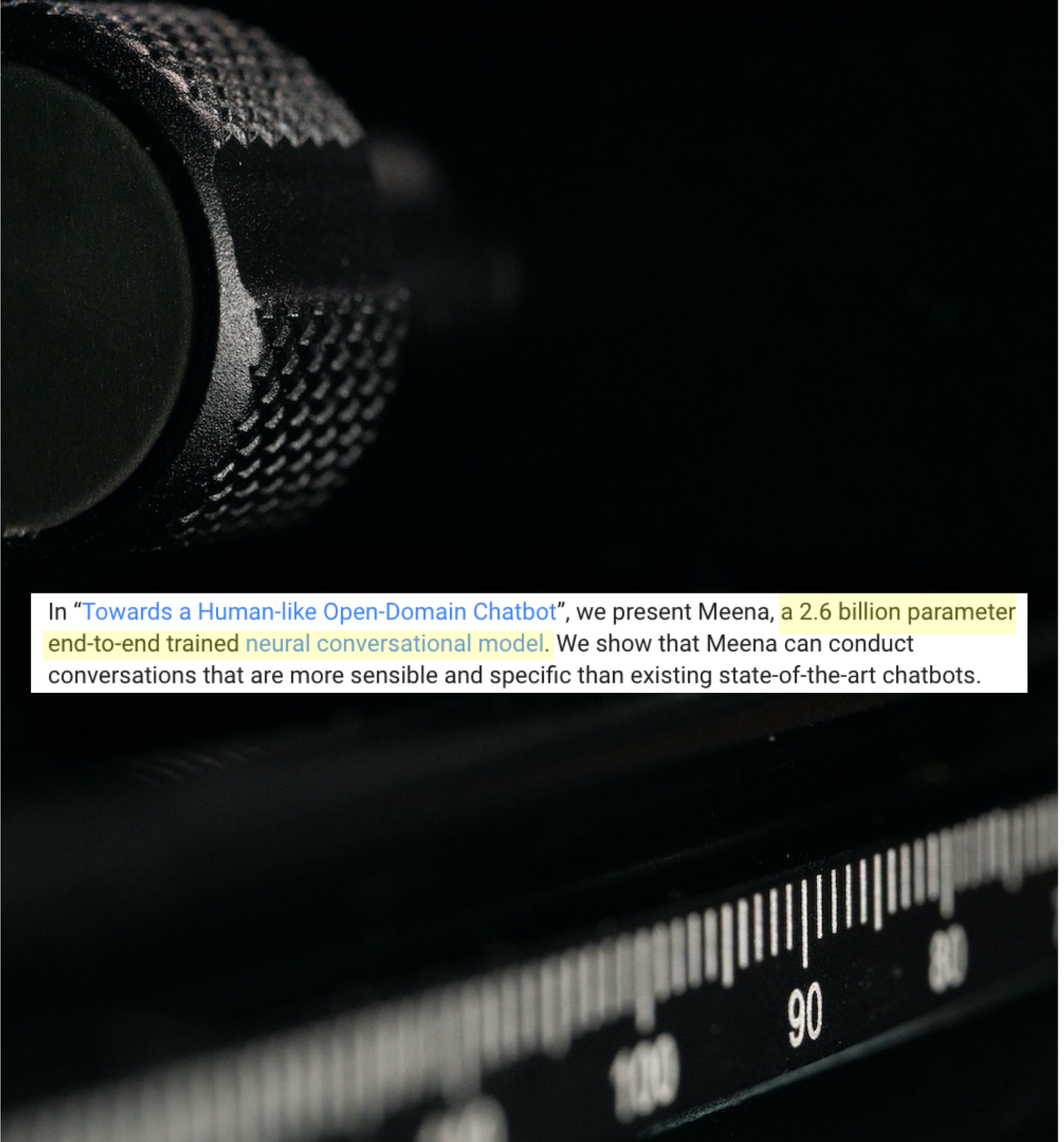
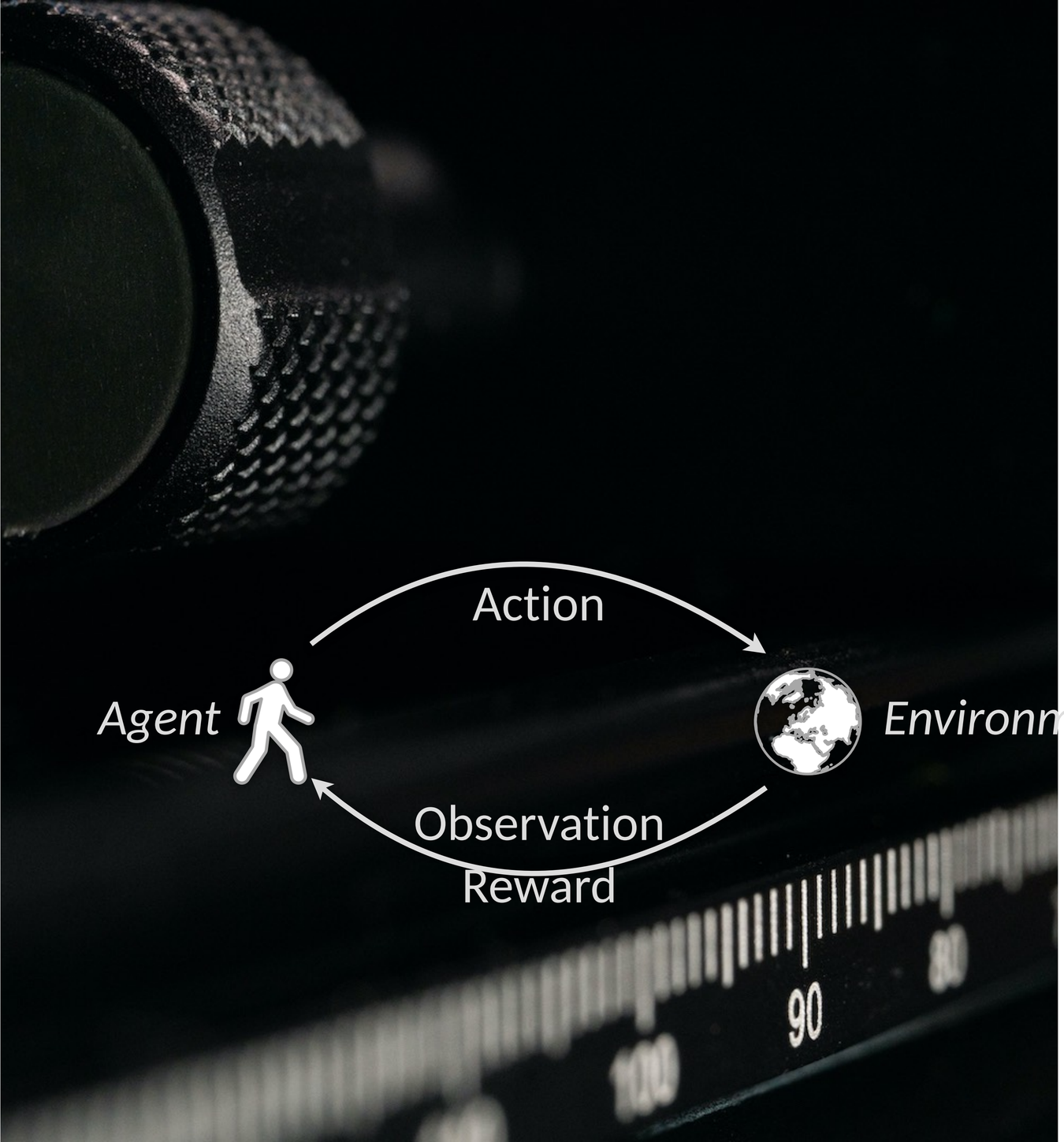


AI’s Promise

- Natural Language Processing has become very capable, with wide applications

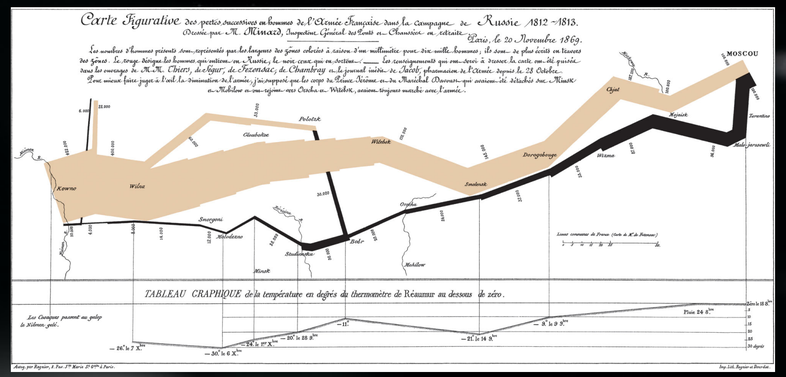


AI's Promise

- Reinforcement Learning is being applied to many enterprise problems where sequential activity is central.

AI's Promise

- Mobile phones are showing us how AI is enabling new system features and enhancing capabilities in applications

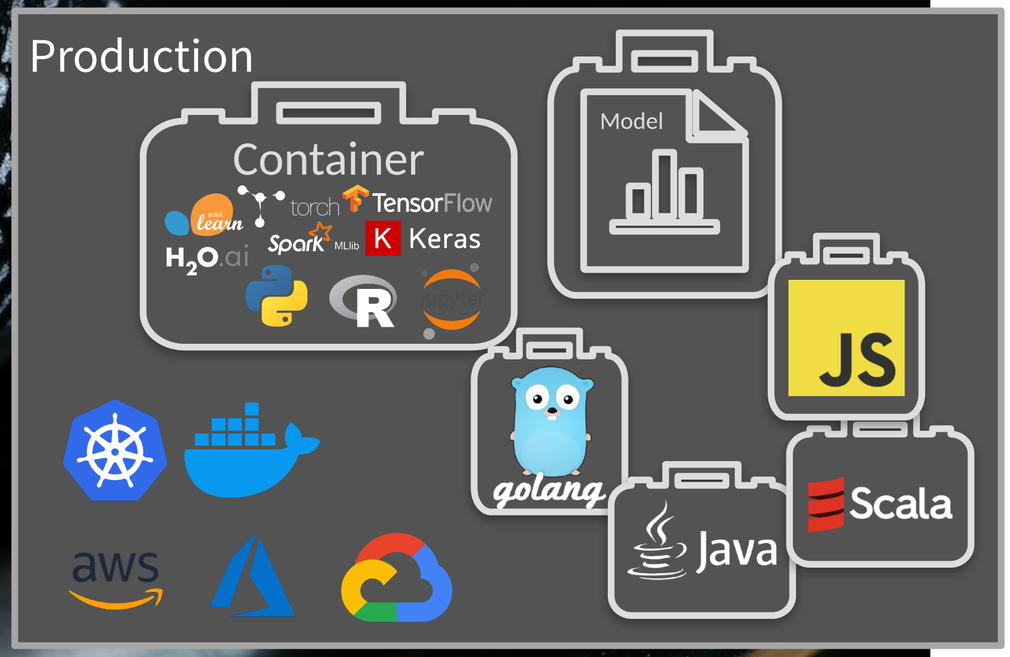


The Past

- Traditional data science tools still provide important benefits:
  - Proven Maturity
  - Explainability
  - Cheap to use!

The Present

- We have to bridge the divide between data science and data engineering now.
- Or AI won't be an option.



The Future

- To fully benefit, we need to embrace:
  - Scalable compute
  - Hybrid cloud
  - Kubernetes & containers
  - New SW design and implementation tools and techniques

Thank You!

DOMINO

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@deanwampler
polyglotprogramming.com/talks