KubeCon | CloudNativeCon

China 2018

A Day in the Life of a Data Scientist

Conquer Machine Learning Lifecycle on Kubernetes

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- Avid marathon runner and outdoors enthusiast
- World traveler

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- Kubernetes upstream features, Azure Kubernetes Service

@ritazzhang

OpenAI
Scaling Kubernetes to 2,500 Nodes

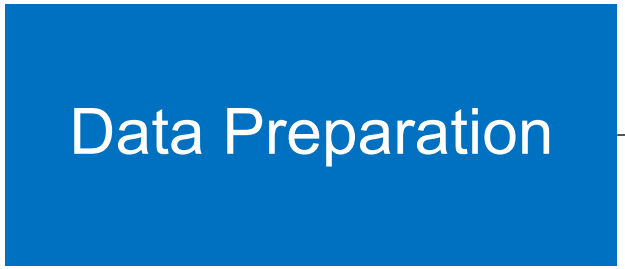
https://blog.openai.com/scaling-kubernetes-to-2500-nodes/

Agenda

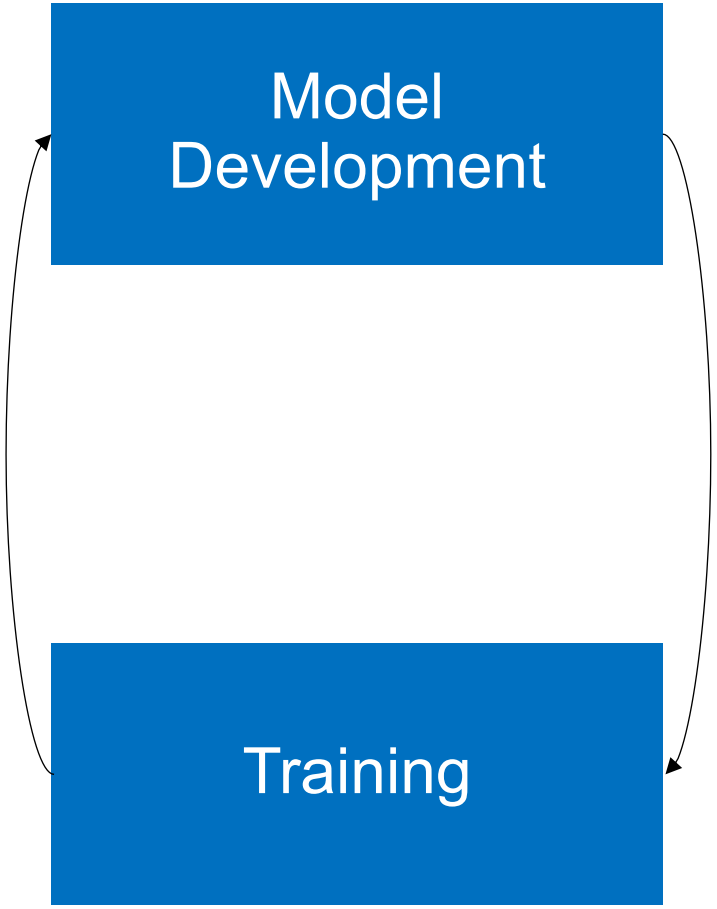
- What is the typical ML workflow and some of their shortcomings
- Why DevOps?
- Why Containers, Kubernetes, and Helm?
- Intro to Kubeflow, Helm, Argo
- Demos
  - Image classification with Inception v3 and transfer learning
  - Automate repeatable ML experiments with containers
  - Deploy ML components to Kubernetes with Kubeflow
  - Scale and test ML experiments with Helm
  - Manage training jobs and pipelines with Argo
  - Serve trained models for inference with TF Serving
  - Rapid prototyping with self-service Jupyter notebook from JupyterHub

Simplified ML Workflow/Pipeline

- Keeping track of datasets is hard
- How to do automatic retraining when data changes?
- Storage and network bottlenecks



- Slow sequential training
- Hard to explore hyperparameter space
- Distributed training is difficult to setup



Classic App Dev Issues:

- “Works on my machine”
- Scalability
- Feedback from production
- Automation

What is DevOps?

- “A cross-disciplinary community of practice dedicated to the study of building, evolving and operating rapidly-changing resilient systems at scale” (Jez Humble)

- Applying Agile practices to operations
  - Infrastructure as code
  - Ops teams embracing source control (git)
  - Automated testing
  - Repeatable/consistent
  - CI/CD

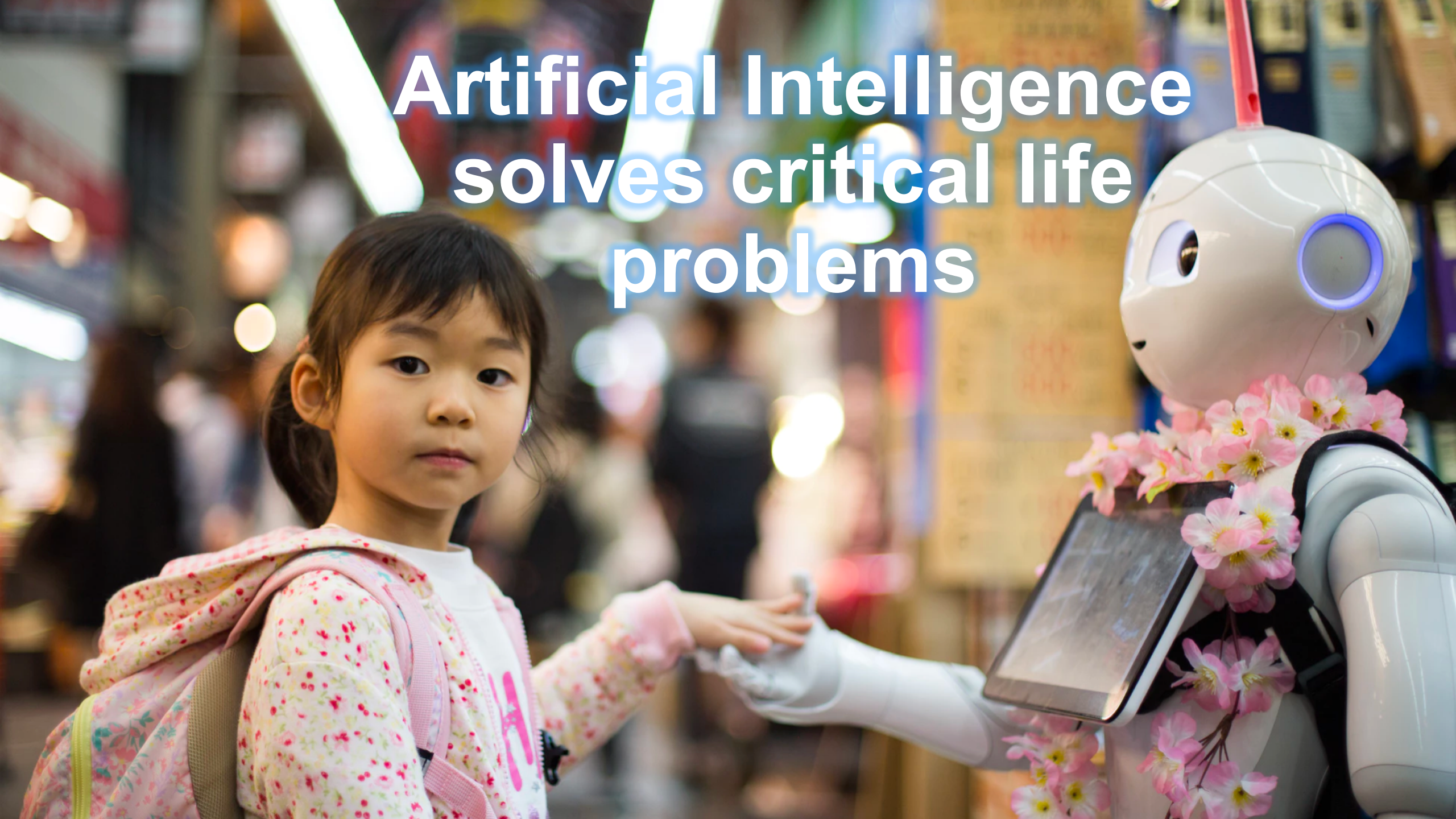
- This has worked well for App Dev. Now time for AI/ML
  - But, must ensure data scientist are not hindered by structure

Why Containers, Kubernetes & Helm?

- Container
  - Contains everything needed to run your application
  - Build once run anywhere
  - Starts in seconds: Great for scalability
  - Images are stored in a centralized place (Docker Hub, Azure Container Registry, gcr, ECR etc.)
- Container orchestration
  - Automating deployment, scaling, and management of containerized applications
  - Declarative
  - Can be a mix of GPU or CPU nodes
- Massive Scale
  - OpenAI dedicates up to 10k cores for a single experiment
- Autoscaling capabilities: Pay for what you use, scale down when idle
- Parallel training instead of sequential: huge time saver for large trainings

Kubeflow

- Machine Learning Toolkit for Kubernetes
  - To make ML workflows on Kubernetes simple, portable, and scalable
- Training controllers – simplify and manage the deployment of training jobs
  - TFJob – custom resource to handle drivers and config
  - Tensorflow, PyTorch, MXNet, Chainer, and more
- JupyterHub to create and manage interactive Jupyter notebooks
- Model serving – serve exported models with TF Serving or Seldon
- Additional components for storage, workflow, etc.


Artificial Intelligence solves critical life problems

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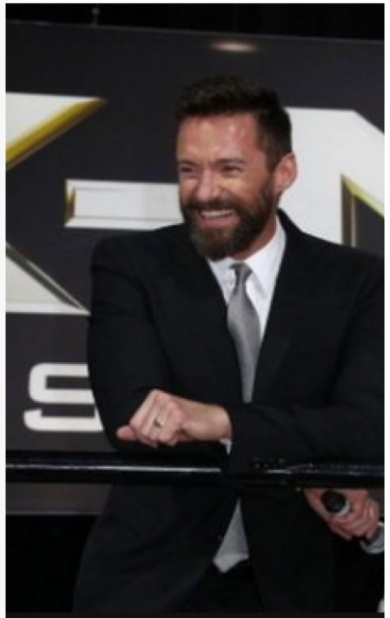
'Disappearance
Fan Bingbing c

By Kerry Allen
BBC Monitoring

1 August 2018



Fan Bingbing recently received globa

CNN World + Live TV U.S. Edition +

Chinese star Fan Bingbing seen i
disappearance

By Ben Westcott, CNN

Updated 6:28 AM ET, Wed October 17, 2018

Fan Bingbing seen after lengthy disappearance 00:35

ENTERTAINMENT

Fan Bingbing outside the airport in Beijing.

Home / Entertainment / Movies

Fan Bingbing spotted for first time in months, outside Beijing airport

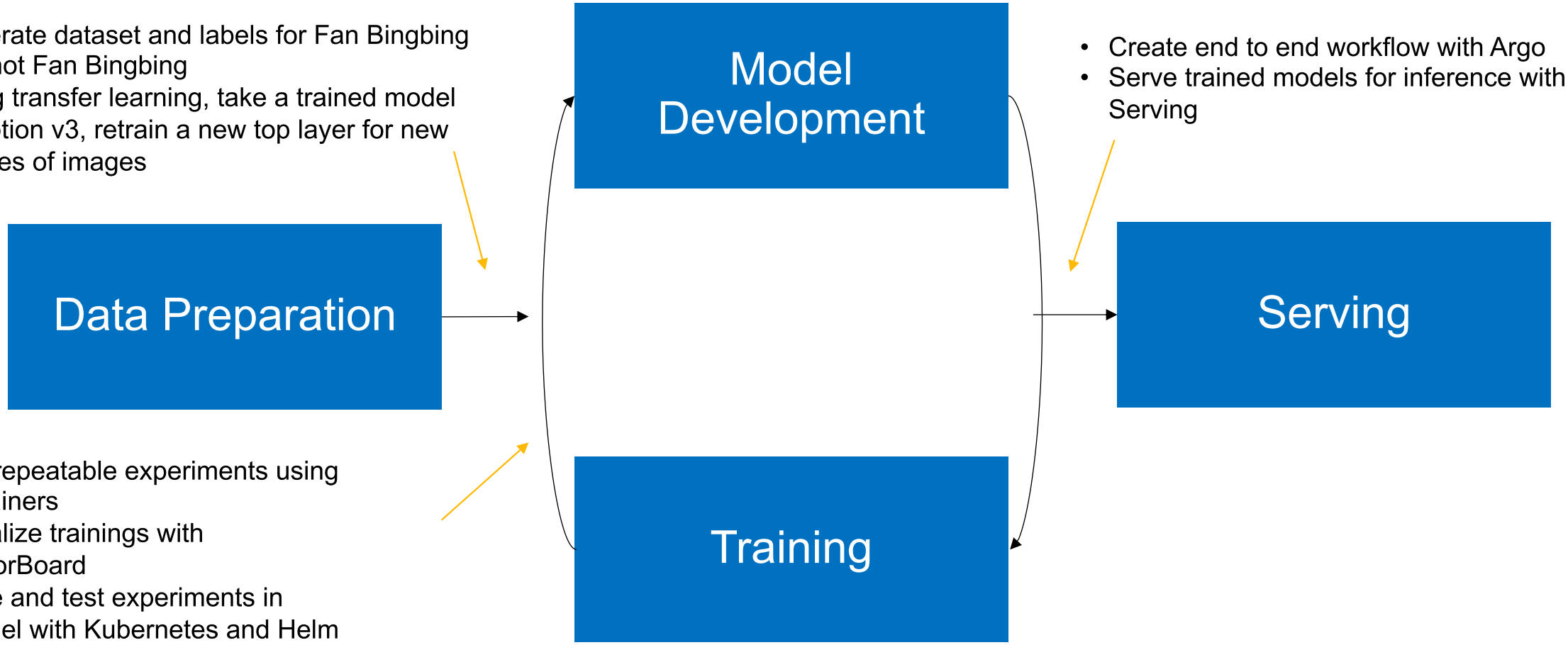
OCTOBER 17, 2018 ENTERTAINMENT, MOVIES, PEOPLE

BY AGENCY

Demo: Find 范冰冰

Image classification with Inception v3 and transfer learning

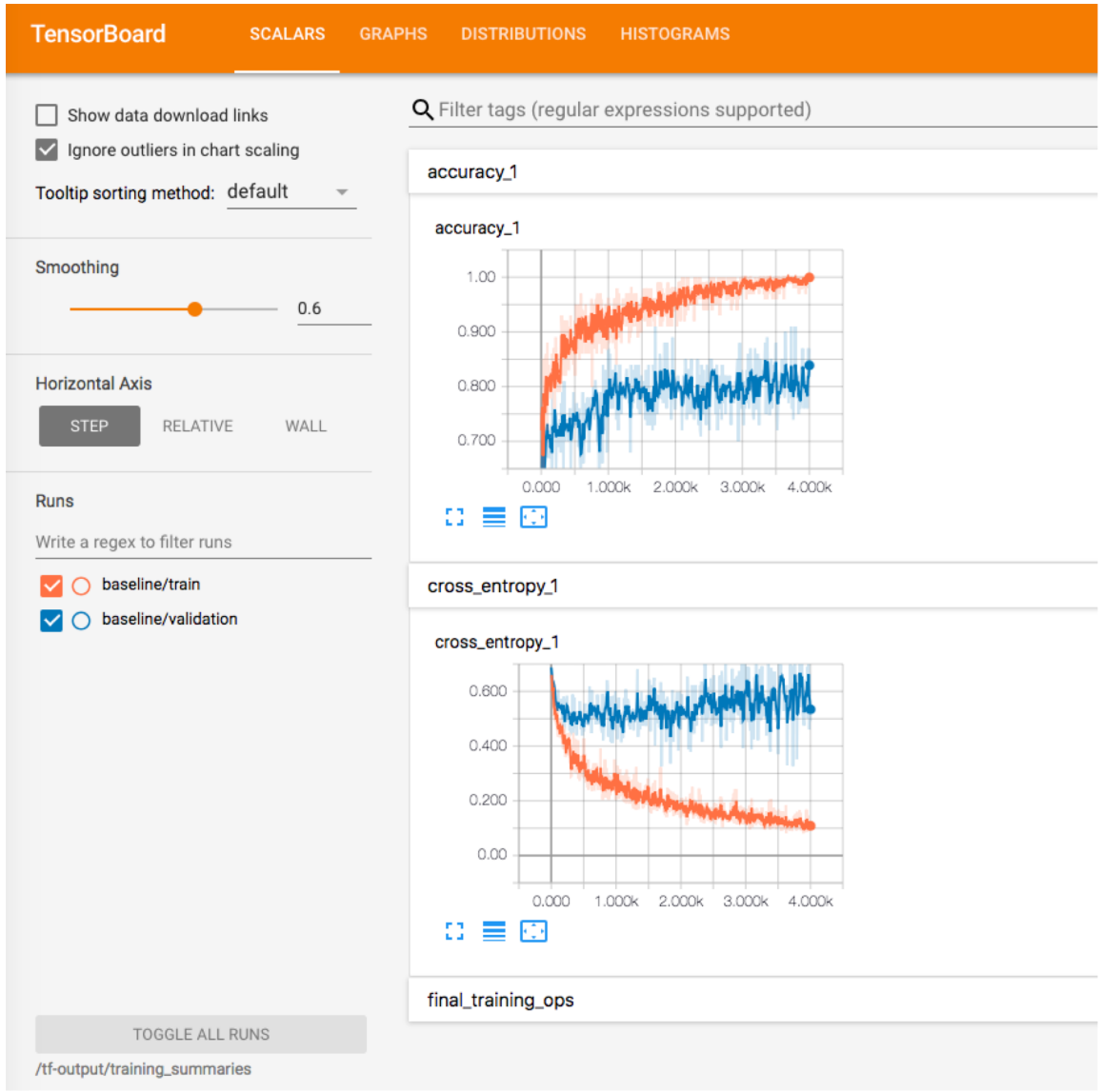
- Generate dataset and labels for Fan Bingbing and not Fan Bingbing
- Using transfer learning, take a trained model Inception v3, retrain a new top layer for new classes of images



- Create end to end workflow with Argo
- Serve trained models for inference with TF Serving

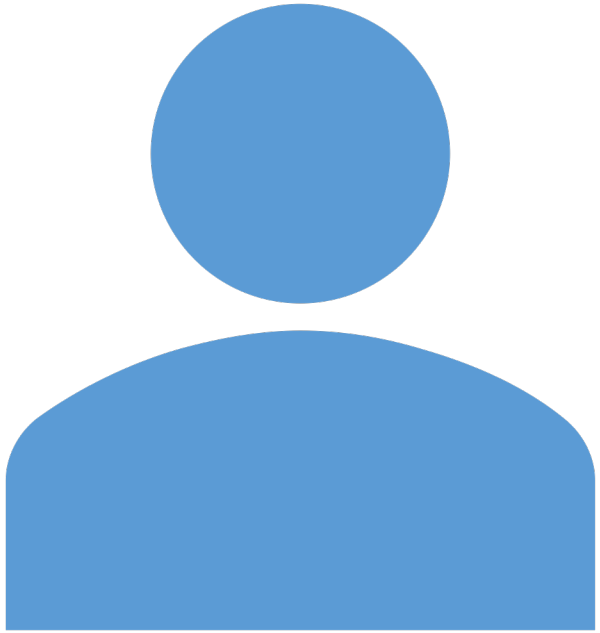
- Run repeatable experiments using containers
- Visualize trainings with TensorBoard
- Scale and test experiments in parallel with Kubernetes and Helm

Demo: Run TensorFlow Training with Containers



Demo: Serving the Model with TF Serving

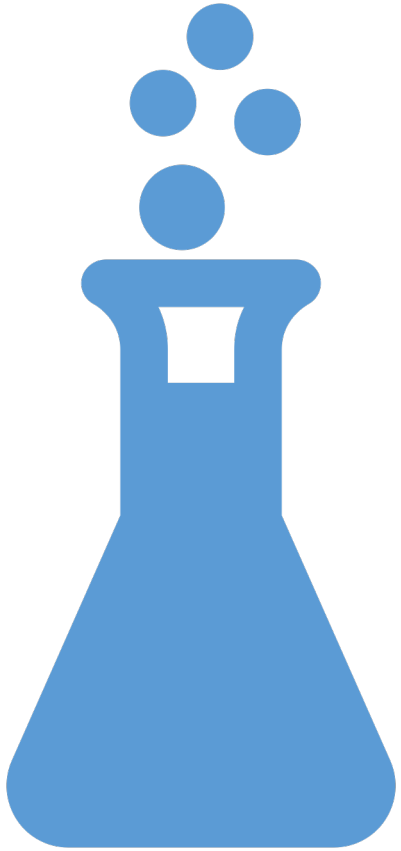
- Options for serving
  - Wrap model in a web framework (eg – Flask)
  - Tensorflow Serving
  - Seldon



Demo:
Run TensorFlow Training with Kubeflow

Demo: Scale and Test Experiments in Parallel using Kubernetes, TFJob, and Helm

- Spin up pods for each variation of hyperparameters
- One centralized TensorBoard instance
- Autoscaling will create / remove VMs as needed to save cost



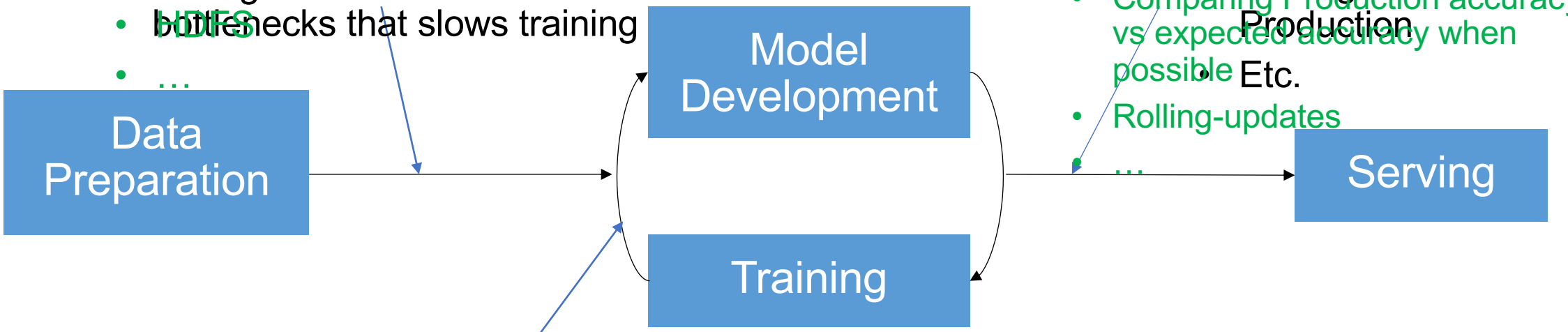
Demo:
Create End to End ML Pipelines with Argo

Demo: Rapid prototyping with self-service Jupyter notebook from JupyterHub

What's Next?

- Pachyderm can version datasets and trigger new trainings when changes occur
- Distributed File Systems
  - NFS
  - HDFS
  - …

- Keeping track of datasets
  - How to do automatic retraining when data changes ?
- Storage and Network bottlenecks that slows training



- Slow Sequential Training
- Hard to explore hyper-parameters space
- Distributed training is hard to set up

(one) Solution is Kubernetes:

- Highly Scalable
- Easy to explore hyper-parameters space
- Easy to do distributed training

But really, Data Scientists shouldn't have to care about containers, kubernetes and all that stuff

Classic DevOps solutions:

- Containers
- CI/CD
- Autoscaling
- A/B testing and canary release of Models
- Comparing Production accuracy vs expected accuracy when possible
- Rolling-updates
- …

Classic App dev. issues:

- Reproducibility ("it works on my machine")
- Scalability
- Getting feedback from Production
- Etc.

Resources

- Source code for this talk: https://github.com/ritazh/kubecon-ml
- Kubeflow labs for AKS: https://github.com/Azure/kubeflow-labs
- Provision a Kubernetes cluster on Azure: https://github.com/Azure/kubeflow-labs/tree/master/2-kubernetes#provisioning-a-kubernetes-cluster-on-azure

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