IBM **Developer**

Open Source Workshop

Democratizing AI with Open Source and Open Standards

ML TEAM - CODAIT
codait.org

Please go to

ibm.biz/max-workshop

Center for Open Source Data and AI Technologies (CODAIT)

CODAIT aims to make AI solutions **easier** to create, deploy, and manage in the enterprise

Relaunch of the Spark Technology Center (STC) to reflect expanded mission

30+ open source developers!

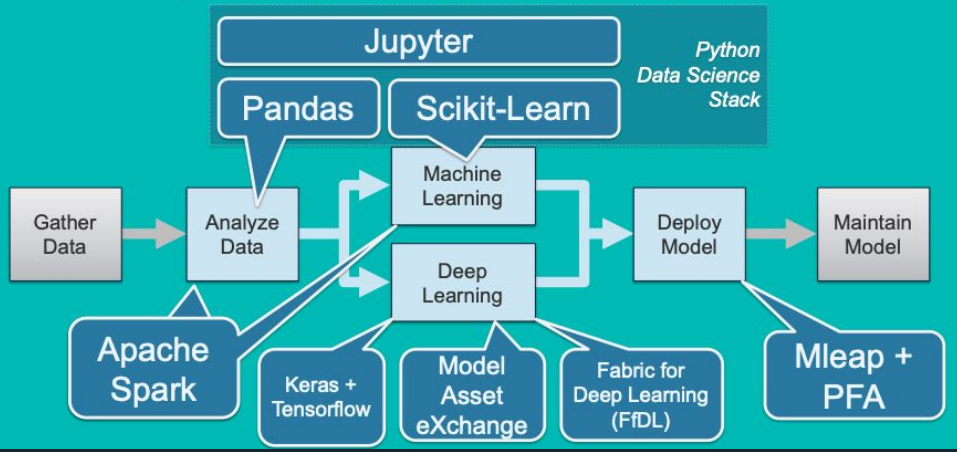
IBM **Developer**

CODAIT

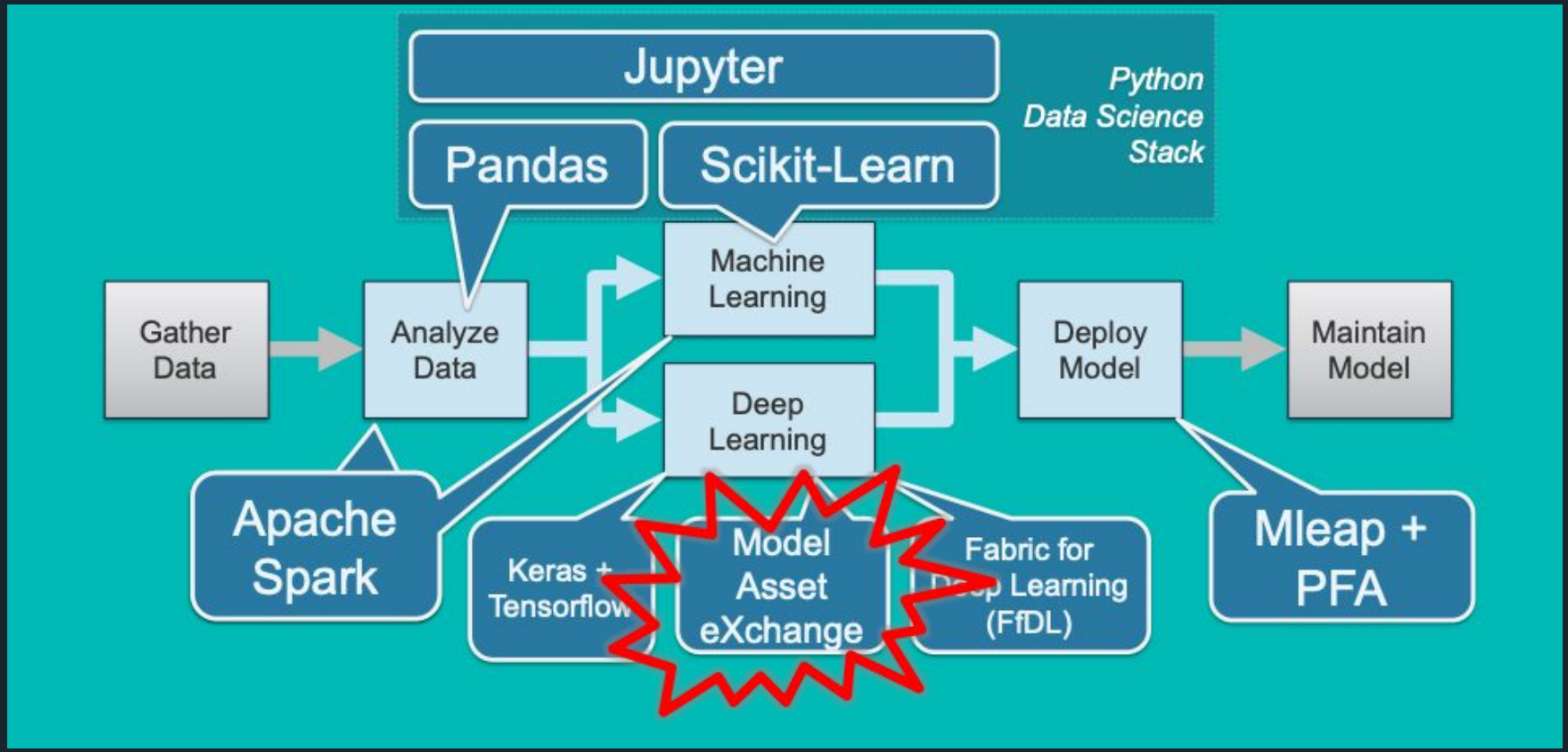
codait.org

Watson West Building
505 Howard St.
San Francisco, California

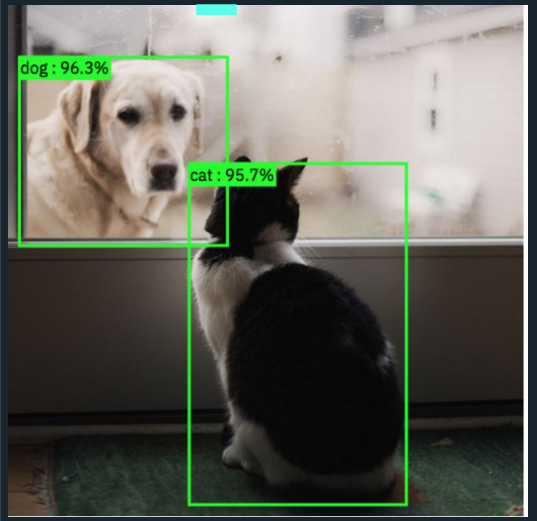
Improving Enterprise AI lifecycle in Open Source

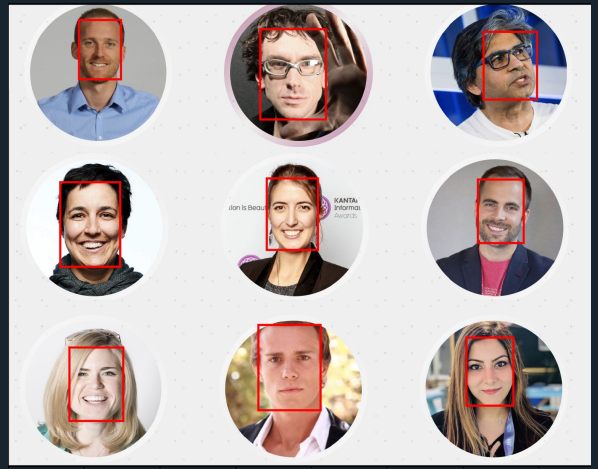


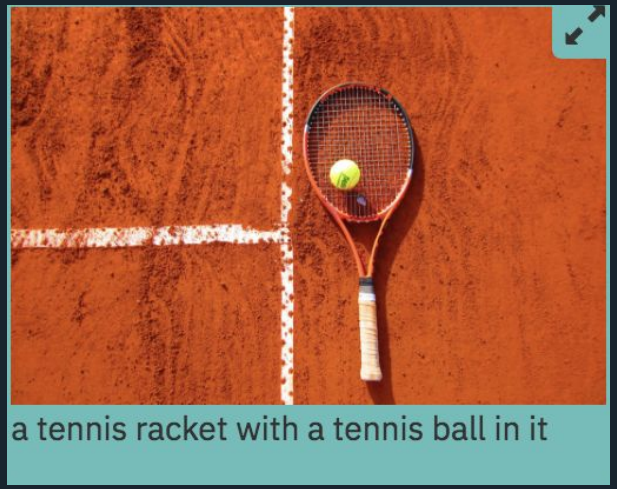
CODAIT: Enabling End-to-End AI in the Enterprise



Have you ever wanted to classify images, recognize faces or places or generate captions of images?








With the
Model Asset
eXchange,
you can!

The Model Asset eXchange enables **domain experts** to use **deep learning** in the enterprise.

Q: What is deep learning?

A: Machine learning using deep neural networks.

Q: What is a deep neural network?

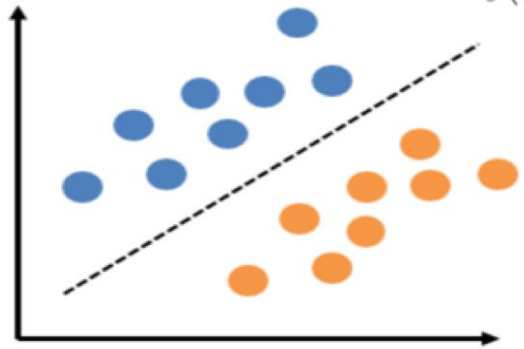
A: A neural network with multiple hidden layers.

What is a neural network?

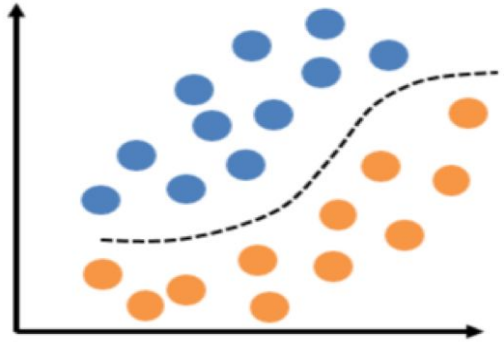
Separability: Linear and Non-linear

Linear

$$h_\theta(x) = \theta_0 + \theta_1 x$$



Nonlinear



One variable for linearly separable

Hypothesis: $h_\theta(x) = \theta_0 + \theta_1 x$

Parameters: θ_0, θ_1

Multiple variables for separability

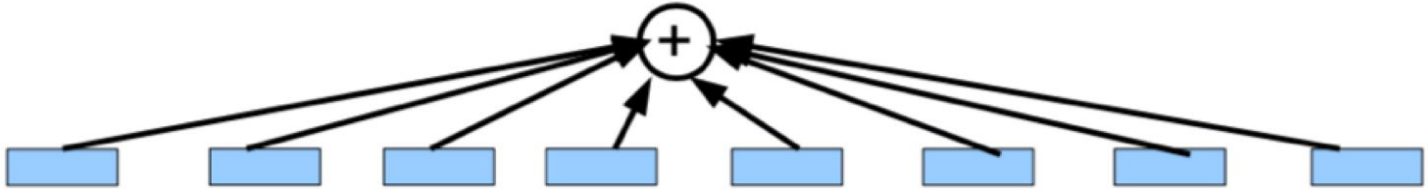
Hypothesis $h_\theta(x) = \theta_0 + \theta_1 x_1 + \theta_2 x_2 + \cdots + \theta_n x_n$

Parameters: $\theta_0, \theta_1, \ldots, \theta_n$

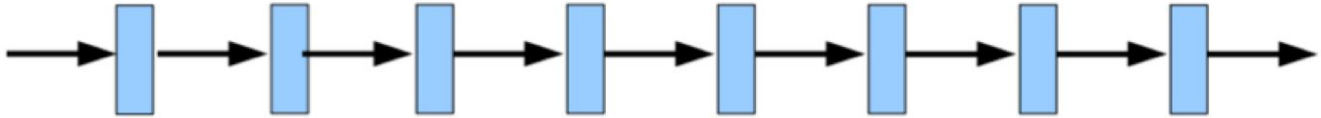
Source: https://isuliiy.github.io/perceptron/; http://cs229.stanford.edu/syllabus.html

Learning Features

Linear combination : $f(x) \approx \sum_j g_j$

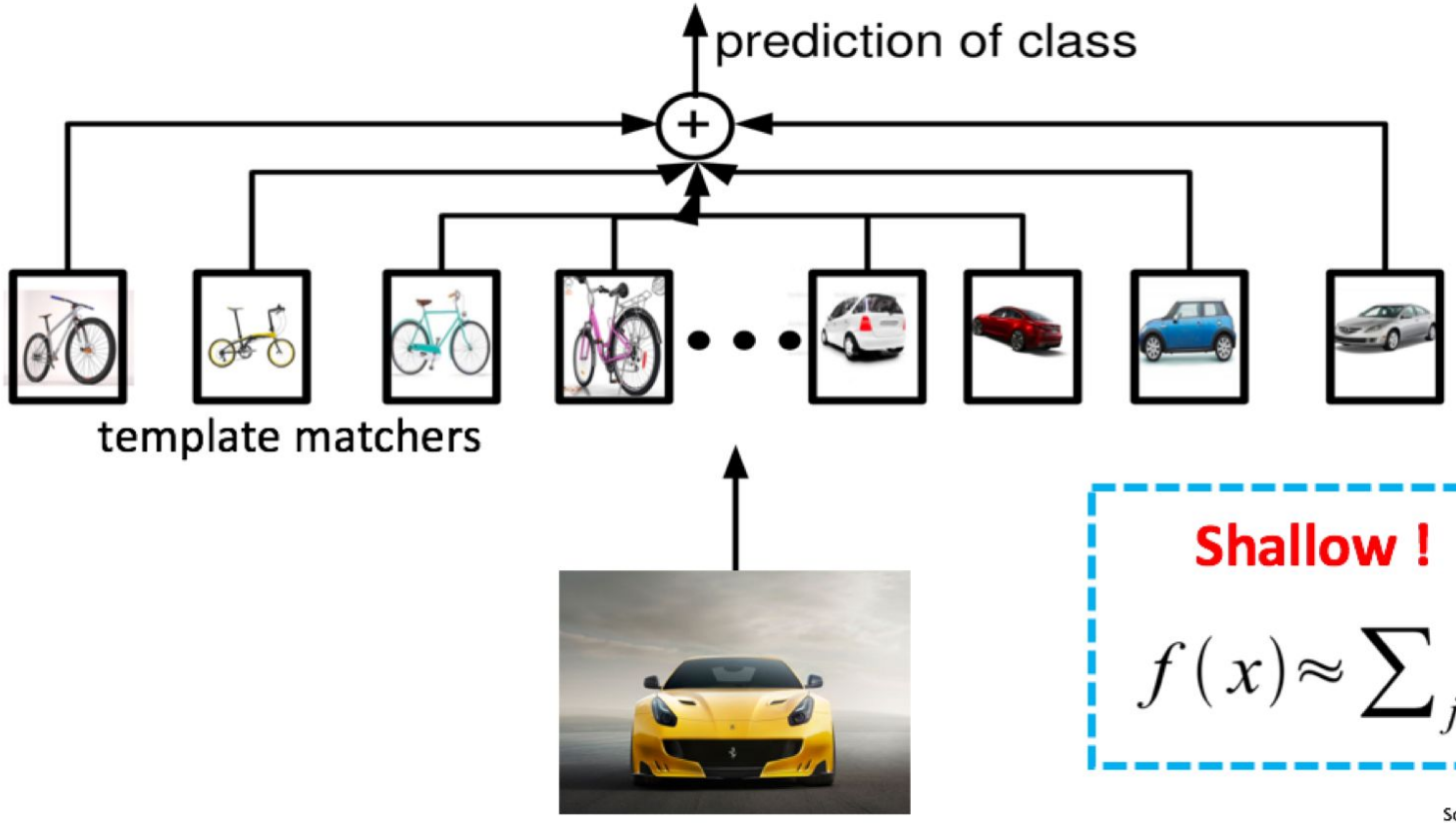


Composition : $f(x) \approx g_1(g_2(\ldots g_n(x)\ldots))$



Source: Fergus, Ranzato

Linear Combination

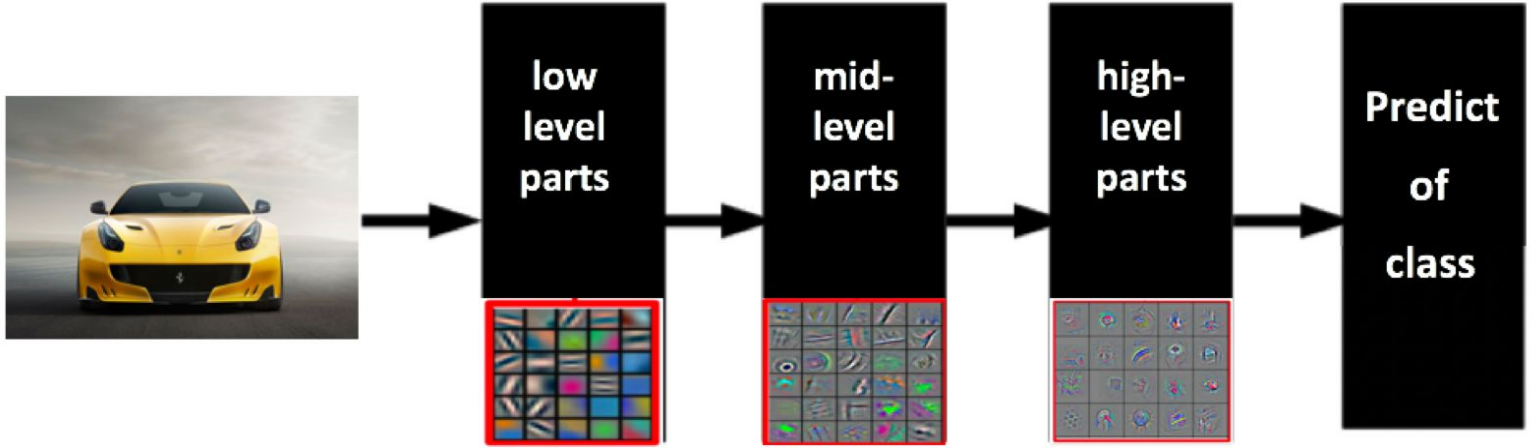


Shallow !

$$f(x) \approx \sum_j g_j$$

Source: Fergus, Ranzato

Composition



- **Advantage: intermediate concepts can be re-used**
- Given lots of data => **engineer less** and learn more!

Deep !

$$f(x) \approx g_1(g_2(\ldots g_n(x)\ldots))$$

Source: Fergus, Ranzato

Linear Regression

Hypothesis => Logistic function:

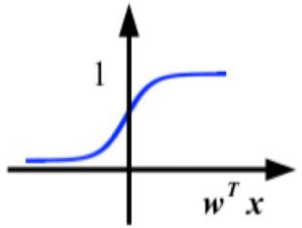
Generalized Linear Model

Input: $\boldsymbol{x} \in R^D$

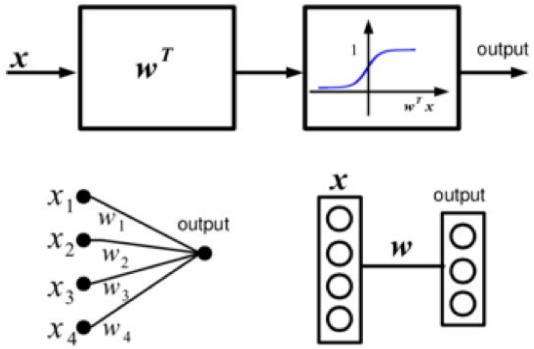
Binary label: $y \in \{-1, +1\}$

Parameters: $\boldsymbol{w} \in R^D$

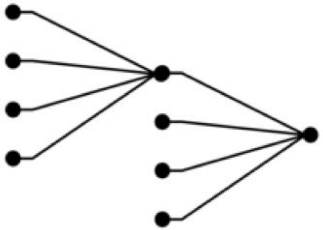
Output prediction: $p(y=1|\boldsymbol{x}) = \dfrac{1}{1+e^{-w^T x}}$



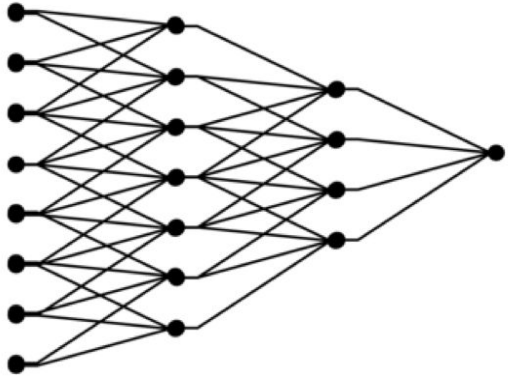
1 Graphical Representation



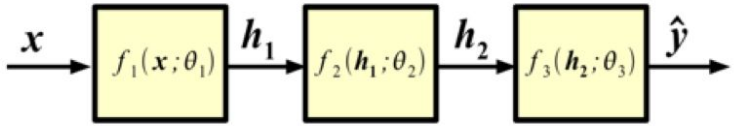
2 Logistic Regression → Neural Nets



3 Logistic Regression → Neural Nets



4 Neural Nets



NOTE: In practice, each module does **NOT** need to be a logistic regression classifier

Figure credit: Fergus, Ranzato

What is a neural network?

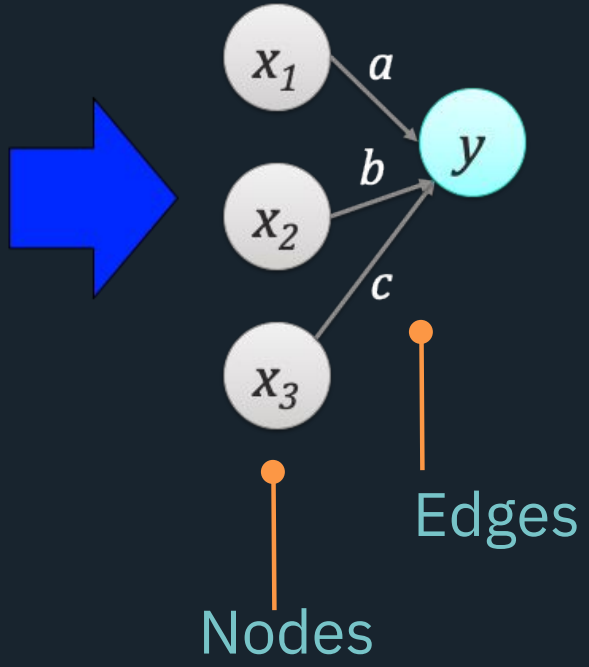
$$y = ax_1 + bx_2 + cx_3$$

Linear regression

What is a neural network?

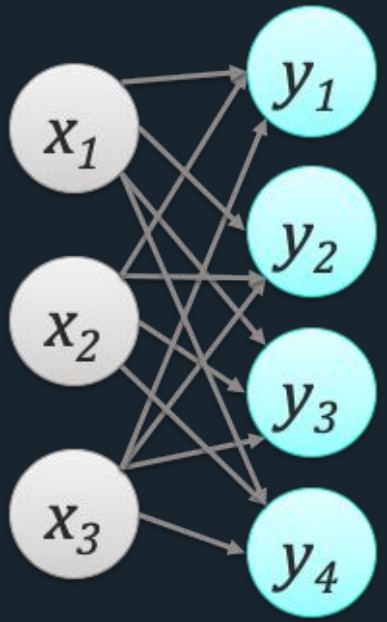
$$y = ax_1 + bx_2 + cx_3$$

Linear regression

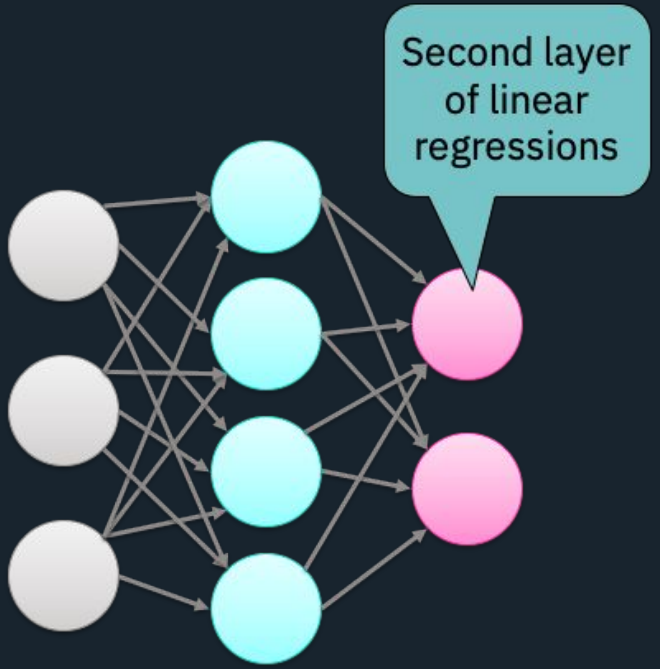


What is a neural network?

Multiple linear regressions at the same time



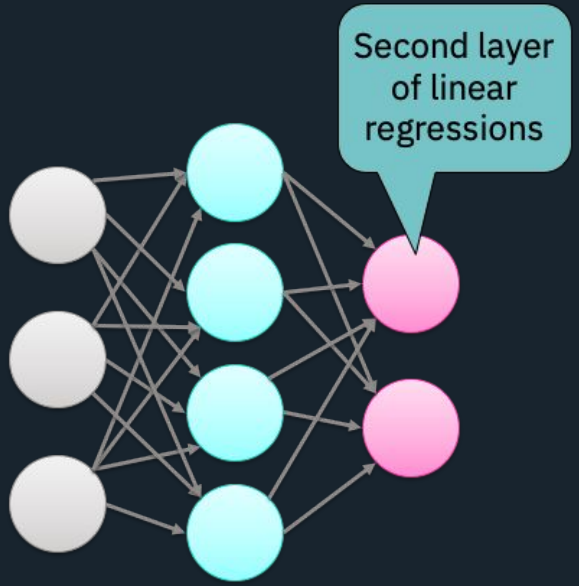
What is a neural network?



Multilayer Perceptron Neural Network

What is a neural network?

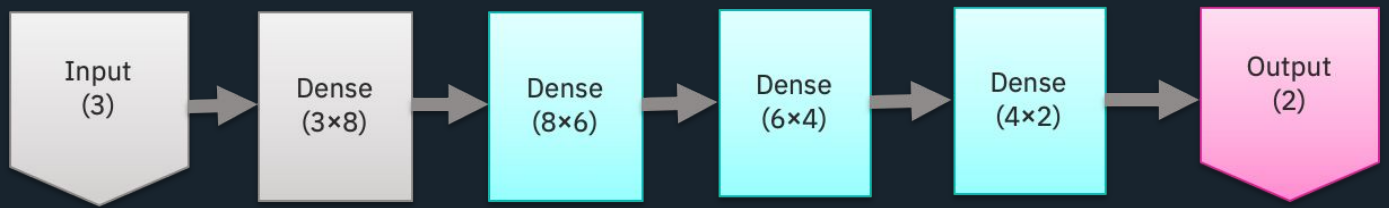
Same network in a more compact notation



Multilayer Perceptron Neural Network

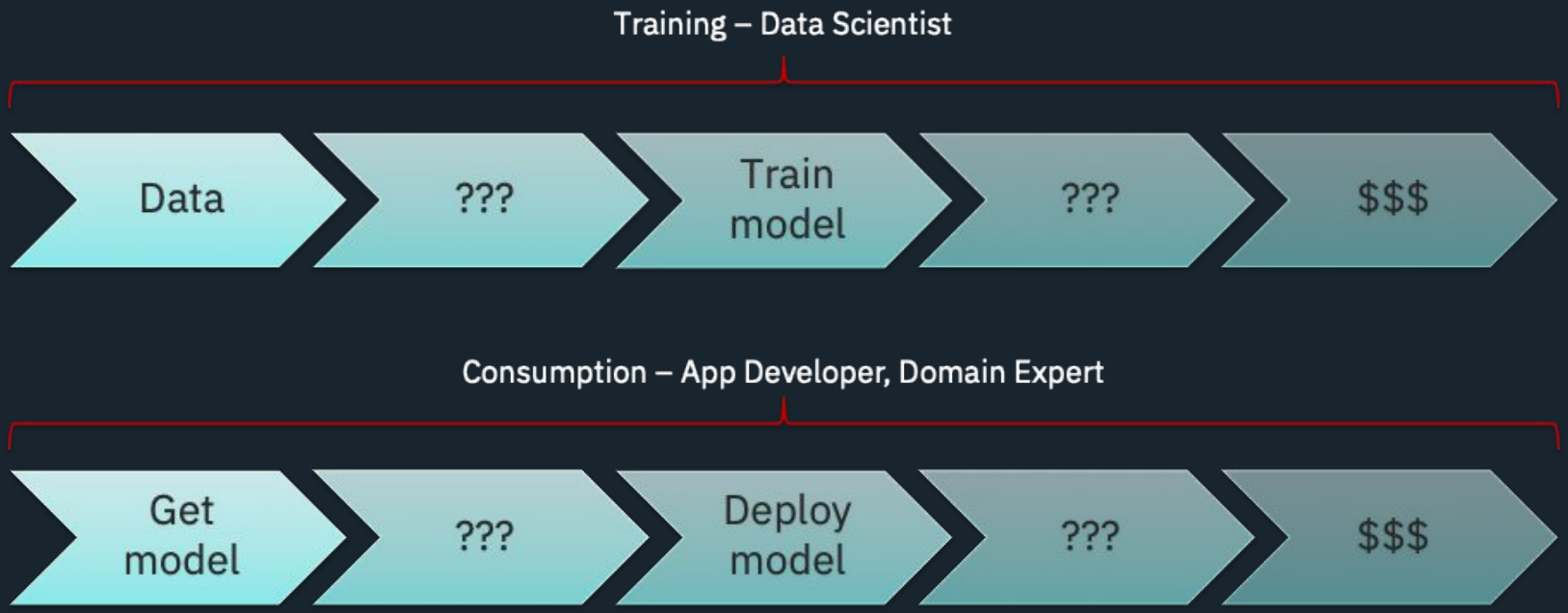
What is a deep neural network?

A neural network with multiple hidden layers

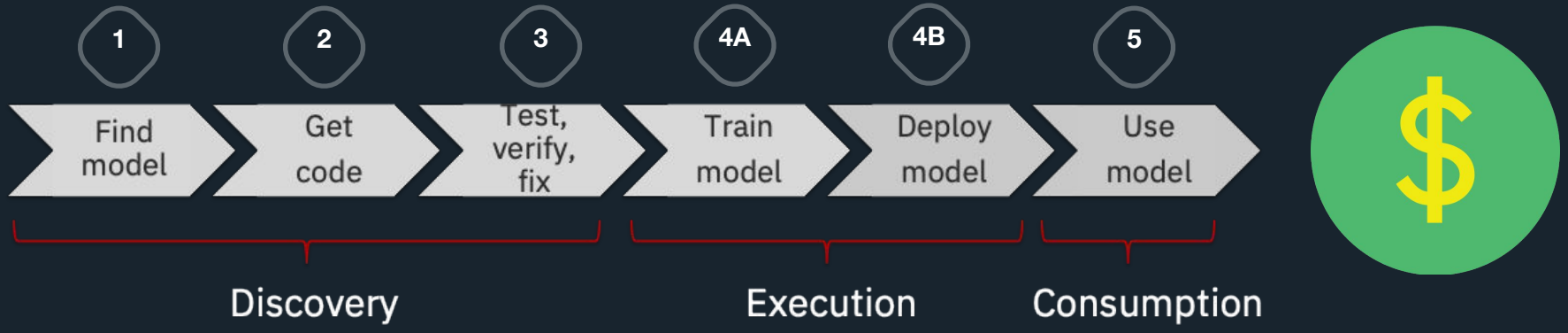


“toy" deep neural network

Applying Deep Learning: Perception



Applying Deep Learning: Reality

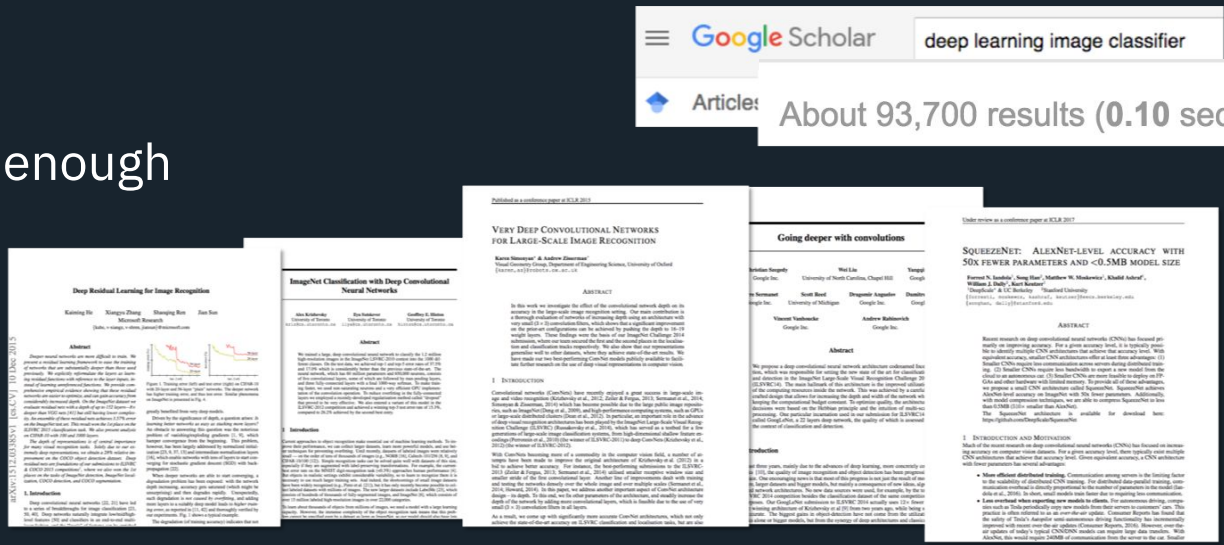


Step 1: Find a model

... that does what you **need**

... that is **free** to use

... that is **performant** enough



Step 2: Get the code

Is there a good **implementation** available?

... that does what you **need**

... that is **free** to use

... that is **performant** enough

TensorFlow code to build ResNet50 neural network graph

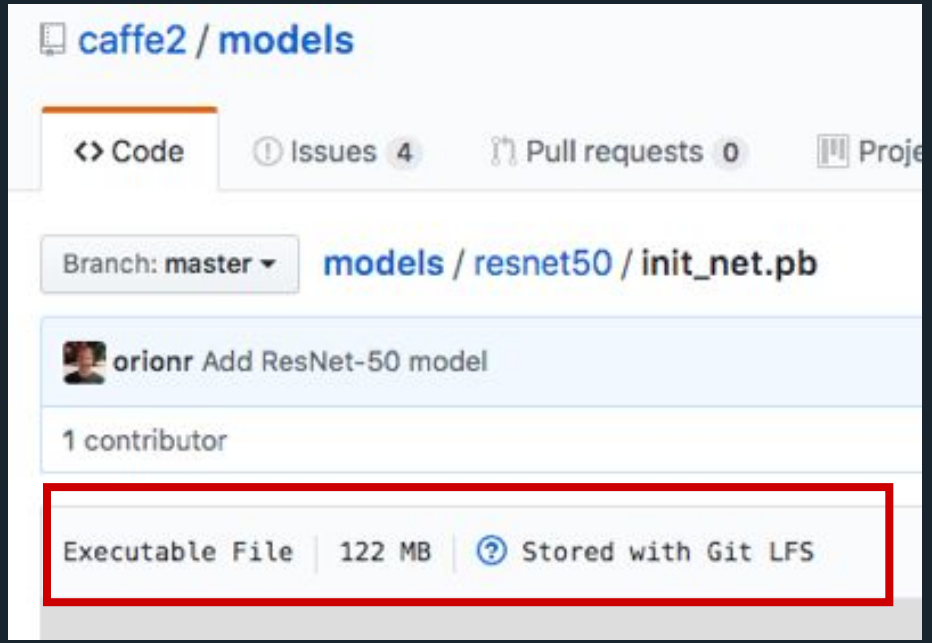
Or ... Step 2: Get the pre-trained weights

Is there a good **pre-trained** model available?

... that does what you **need**

... that is **free** to use

... that is **performant** enough



Step 3: Verify the model you found

Check ...

... that does what you **need**

... that is **free** to use (license)

... that is **performant** enough

(computation & accuracy)

Step 4 (a): Train the model

Step 4 (a): Train the model

Step 4 (b): Figure out how to deploy your model

... adjust **inference** code
(or write from scratch)

... **package** inference code and model code, and pre-trained weights together

... **deploy** your package

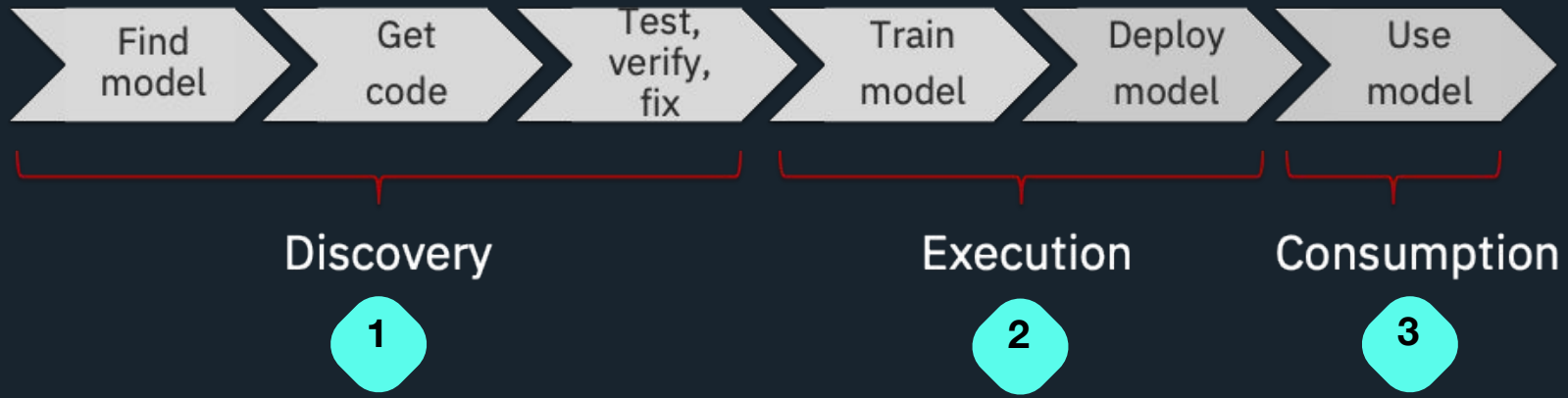
Step 5: Consume your model

... **plug in** into your application

Step 6: Profit

... hopefully

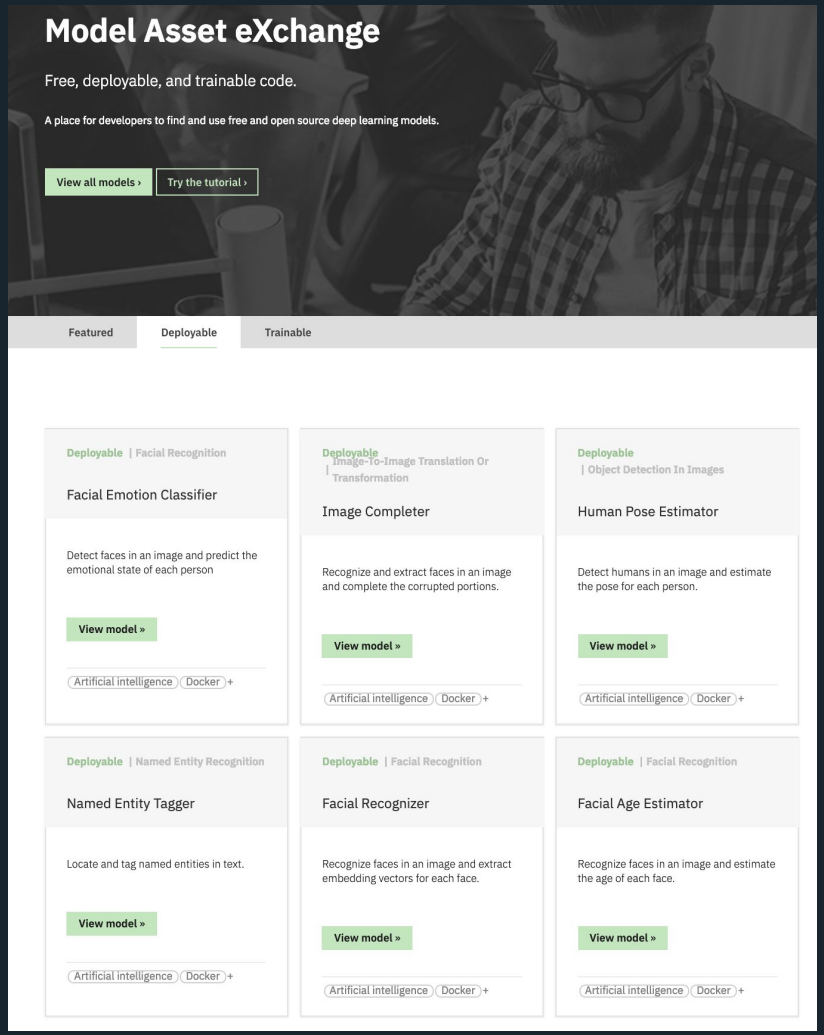
Applying Deep Learning: Reality



Model Asset eXchange

- A one-stop place for developers/data scientists to find and use **free** and **open source** deep learning models

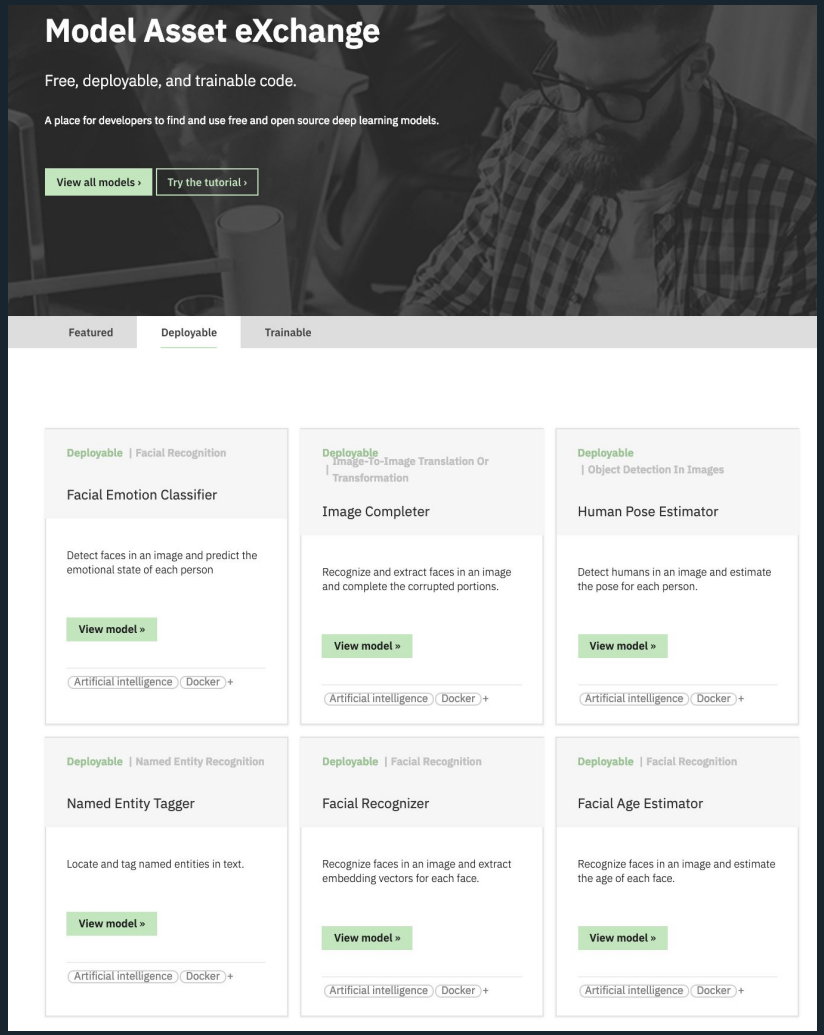
ibm.biz/model-exchange



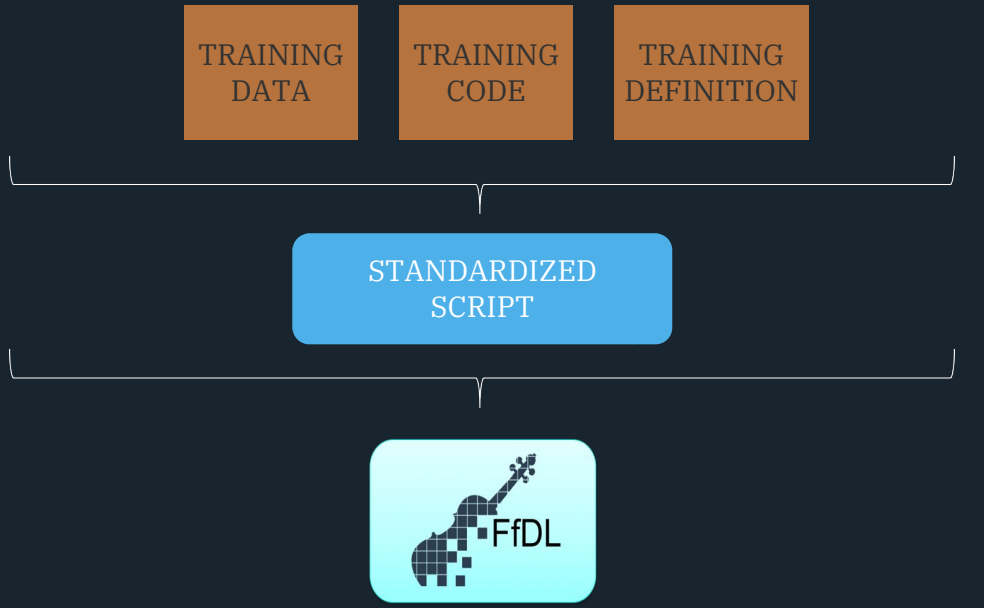
Model Asset eXchange

- Wide variety of domains (text, audio, image, etc)
- Multiple deep learning frameworks
- Vetted and tested code and IP
- Build and deploy a model web service in seconds
- Training on Fabric for Deep Learning (FfDL) or Watson Machine Learning in minutes

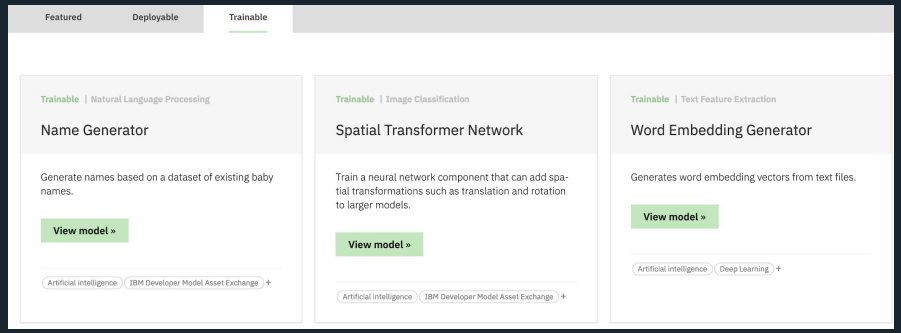
ibm.biz/model-exchange



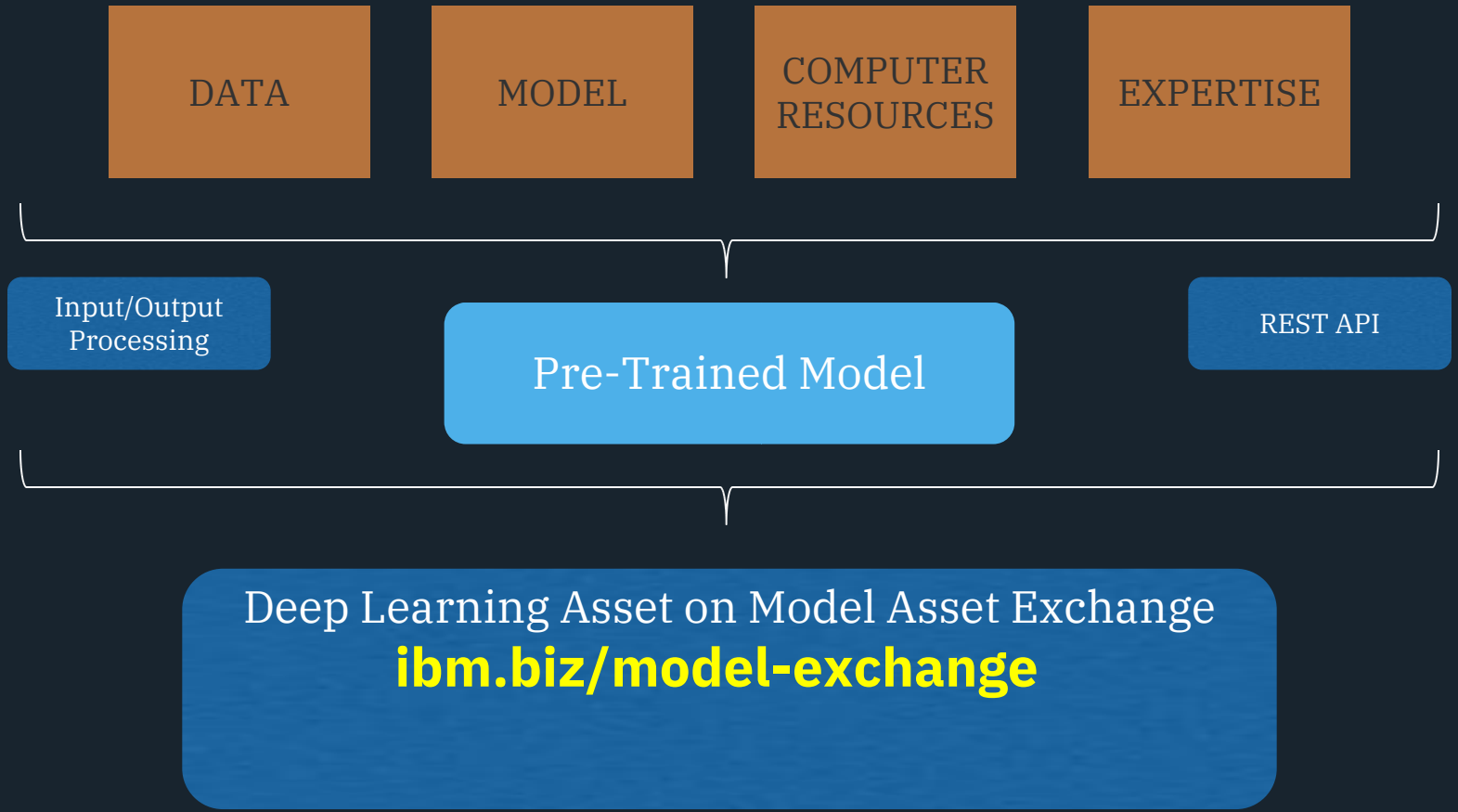
Trainable Models



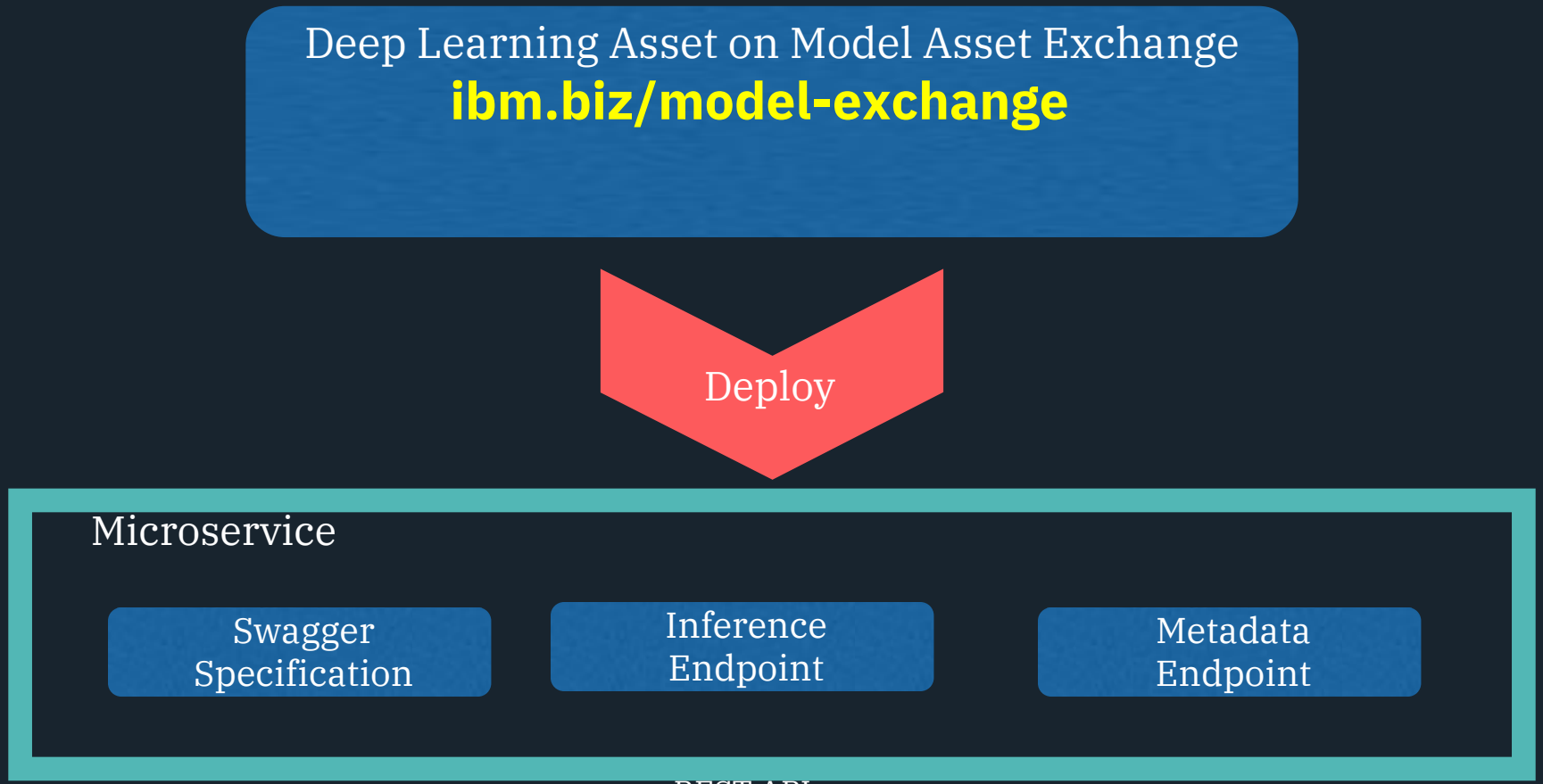
https://github.com/IBM/FfDL



Deployable Models



Deployable Models



OPEN SOURCE
&
FREE

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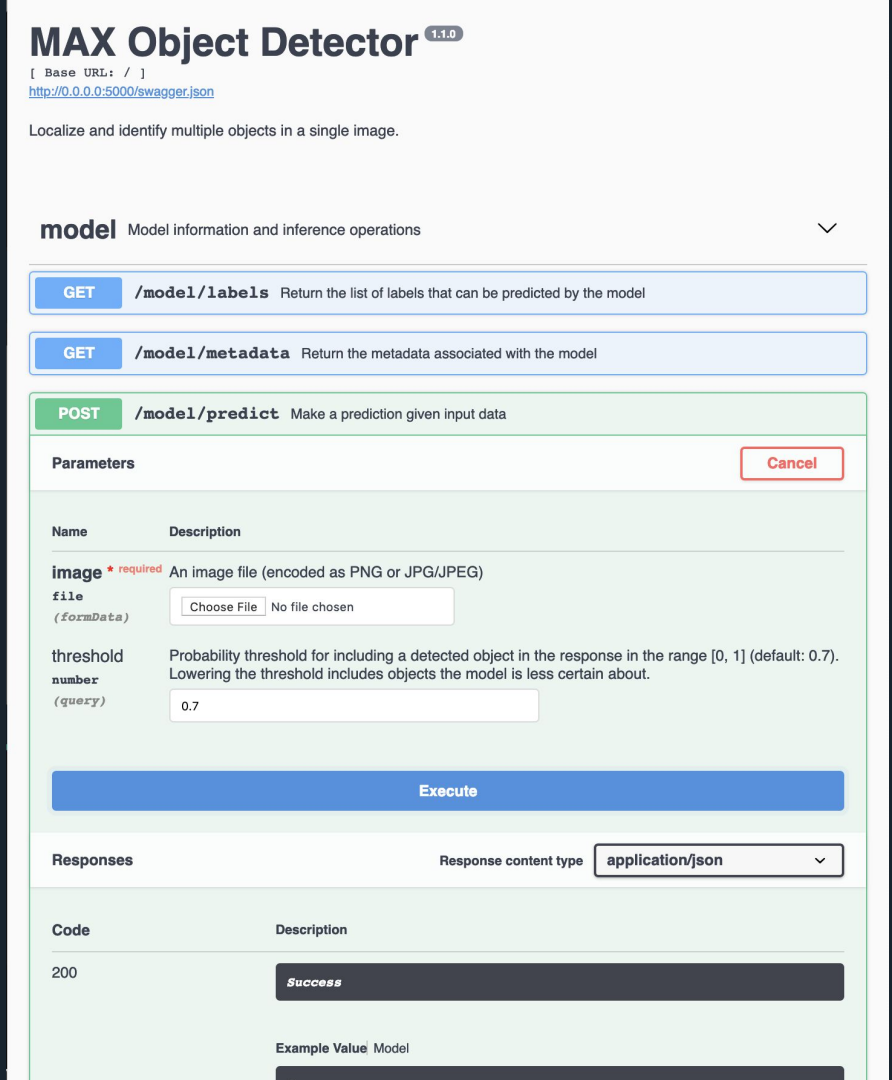
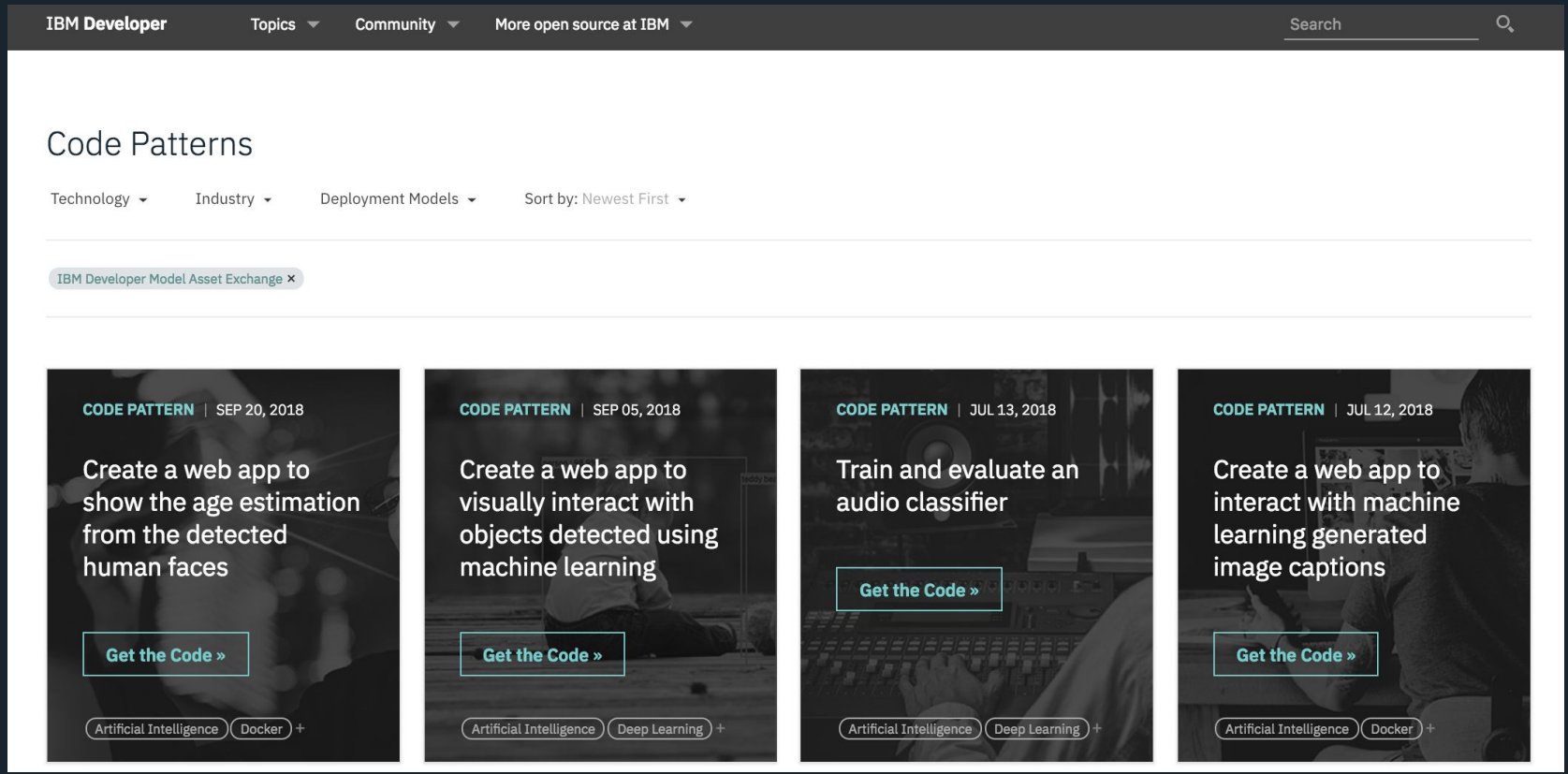
Highlights

- Image, audio, text, healthcare, time-series and more
- Pre- / post-processing & inference wrapped up in Docker container
- Generic API framework code - Flask RESTPlus
- Swagger specification for API
- One-line deployment locally and on a Kubernetes cluster



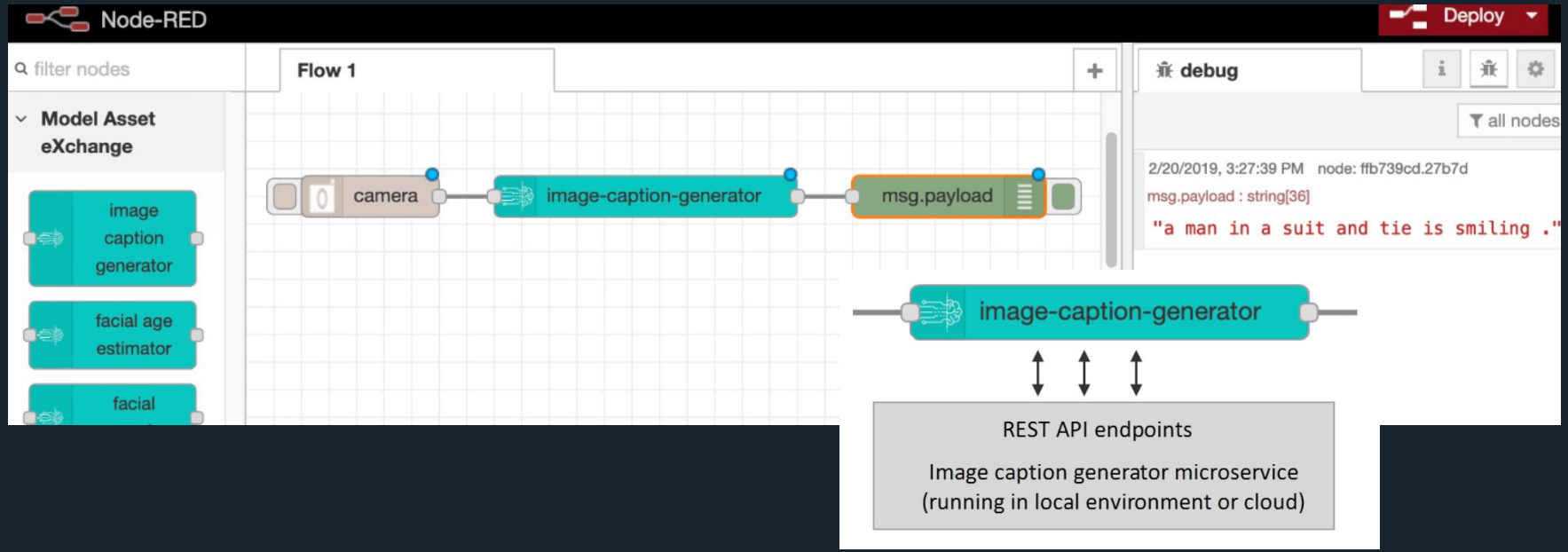
Code Patterns demonstrating how to easily consume MAX models



ibm.biz/max-developers

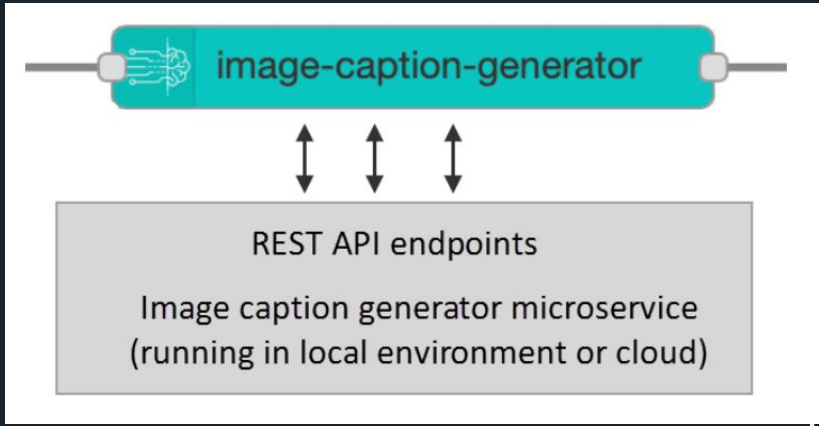
Leveraging MAX models in IOT scenarios

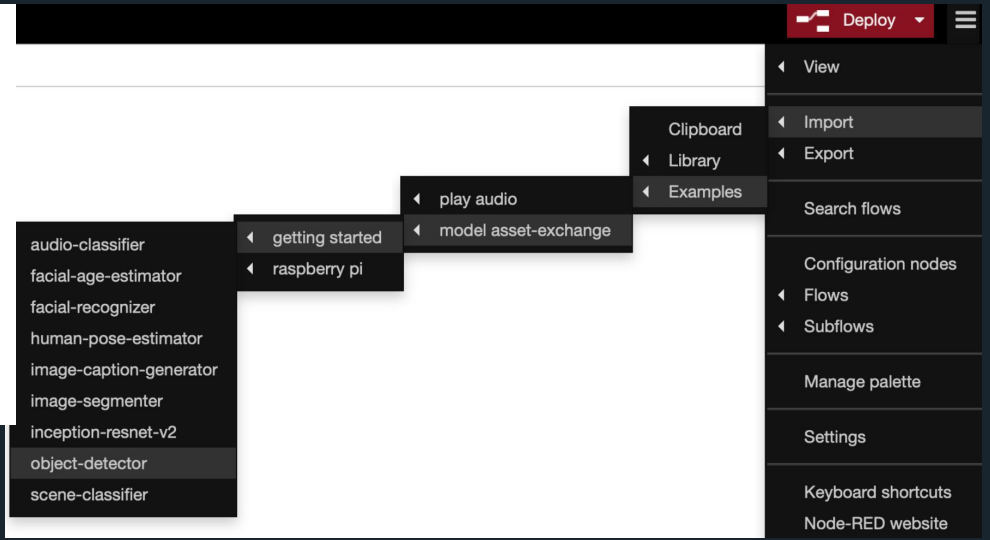
- Node-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways.
- The node-red-contrib-model-asset-exchange module adds support for MAX deep learning models.



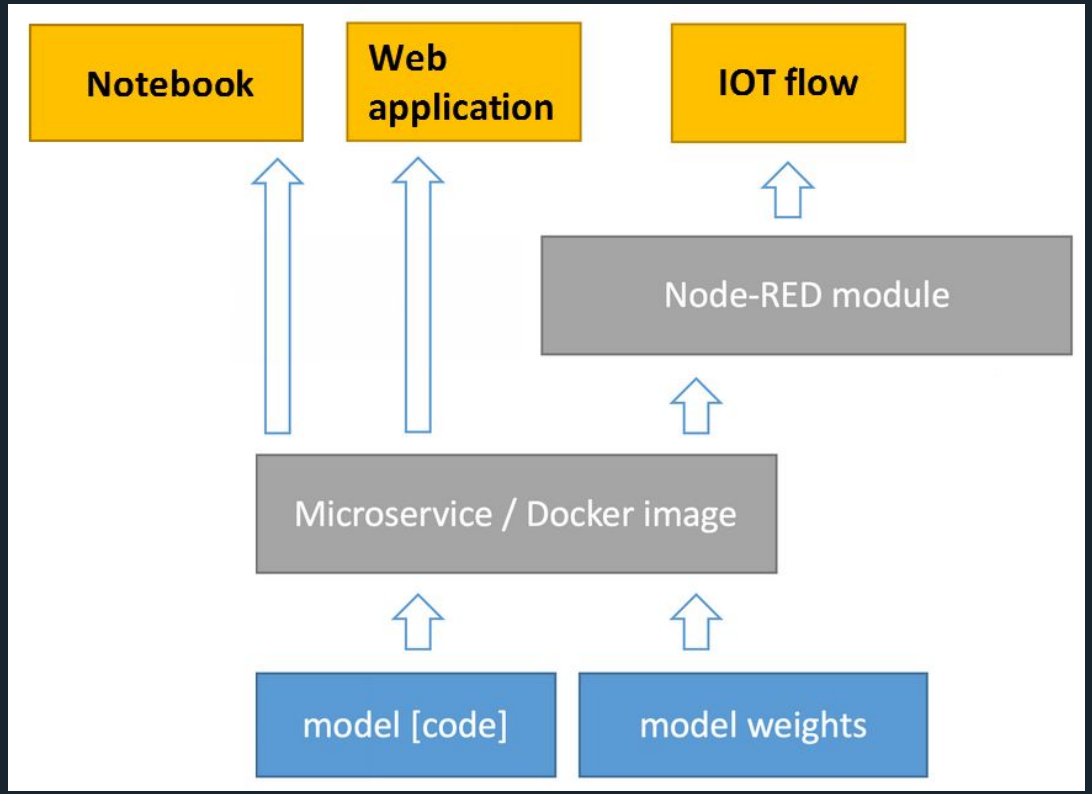
Leveraging MAX models in IOT scenarios

- MAX nodes communicate with the corresponding microservice
- Learn more: http://ibm.biz/max-for-node-red





Example consumption scenarios you can try today



Part 2: Hands-On

Getting Started with MAX

ibm.biz/model-exchange

Which Deep Learning models will we cover?

Object Detection

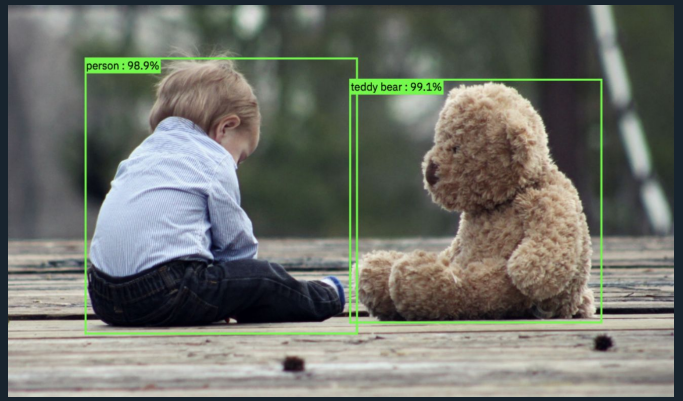
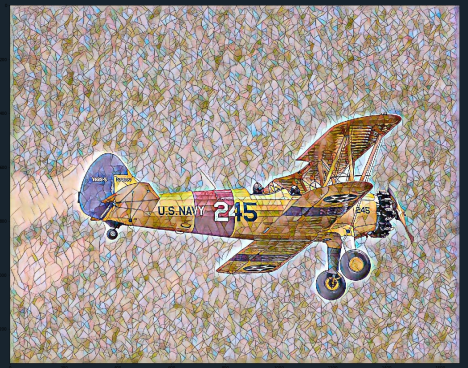


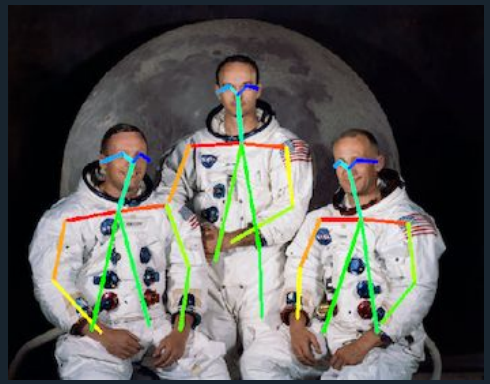
Image Style Transfer



Caption Generation

A man riding a wave on a surfboard

Pose Estimation



And many more!

Schedule

1. **Installing Docker and spinning up the MAX Object Detector (15 min)**

2. **Using the Object Detector WebApp (15 min)**

-- BREAK (10 min) --

3. **Integrating a Deep Learning model in your own WebApp**
   - Exploring other MAX models: querying the APIs (30 min)
   - Creating your own DL WebApp (30 min)

4. **(Optional) MAX models for IOT using Node-RED**

Please go to **ibm.biz/max-workshop**

WebApp Creation Flow

1. Clone the MAX tutorial repository

   git clone https://github.com/IBM/max-tutorial-app-python.git

2. Open app.py in an editor or IDE

3. Complete `TODO T1` and `TODO T2`

```
# TODO T1: replace model URL placeholder
model_url = args.ml_endpoint.rstrip('/') + '**TODO**'
```

Solution: `/model/predict`

```
# TODO T2: uncomment next line and replace placeholder
# result = output_data['**TODO**']
```

Solution: `predictions`