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MATLAB with TensorFlow and PyTorch

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The following presentation is inspired by situations and questions from current **MATLAB and Python users**

Questions about **deep learning**
in situations such as…

Our data scientists use TensorFlow & PyTorch
Our engineers use MATLAB

How can our teams work together?

The latest models come out in TensorFlow & PyTorch first.

What support does MATLAB have for the latest models?

Deploying models into embedded systems
is time-consuming

Can MATLAB help us deploy to embedded systems quicker?

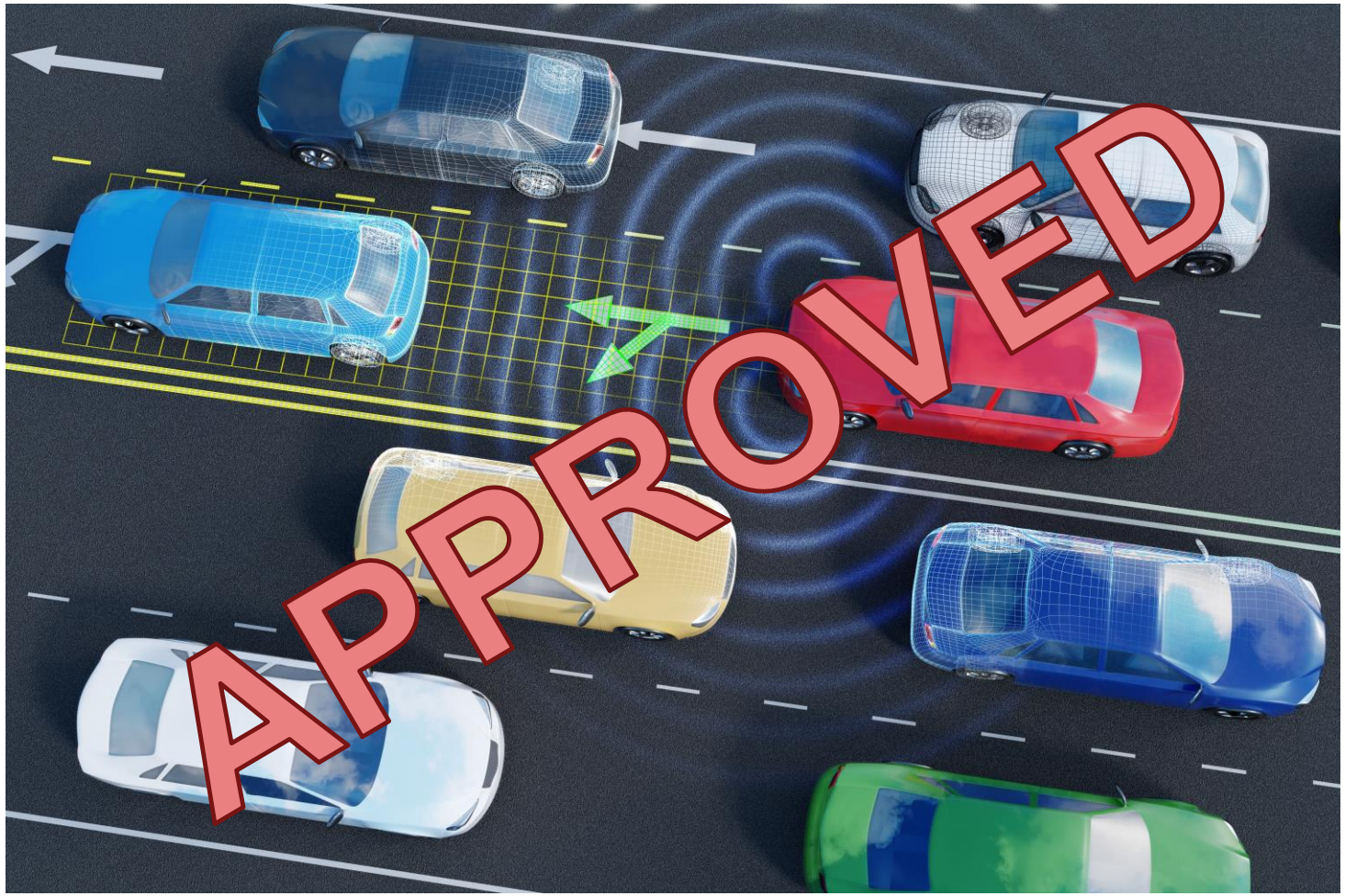
Our presenters will roleplay a scenario to answer these questions

David
The Project Manager

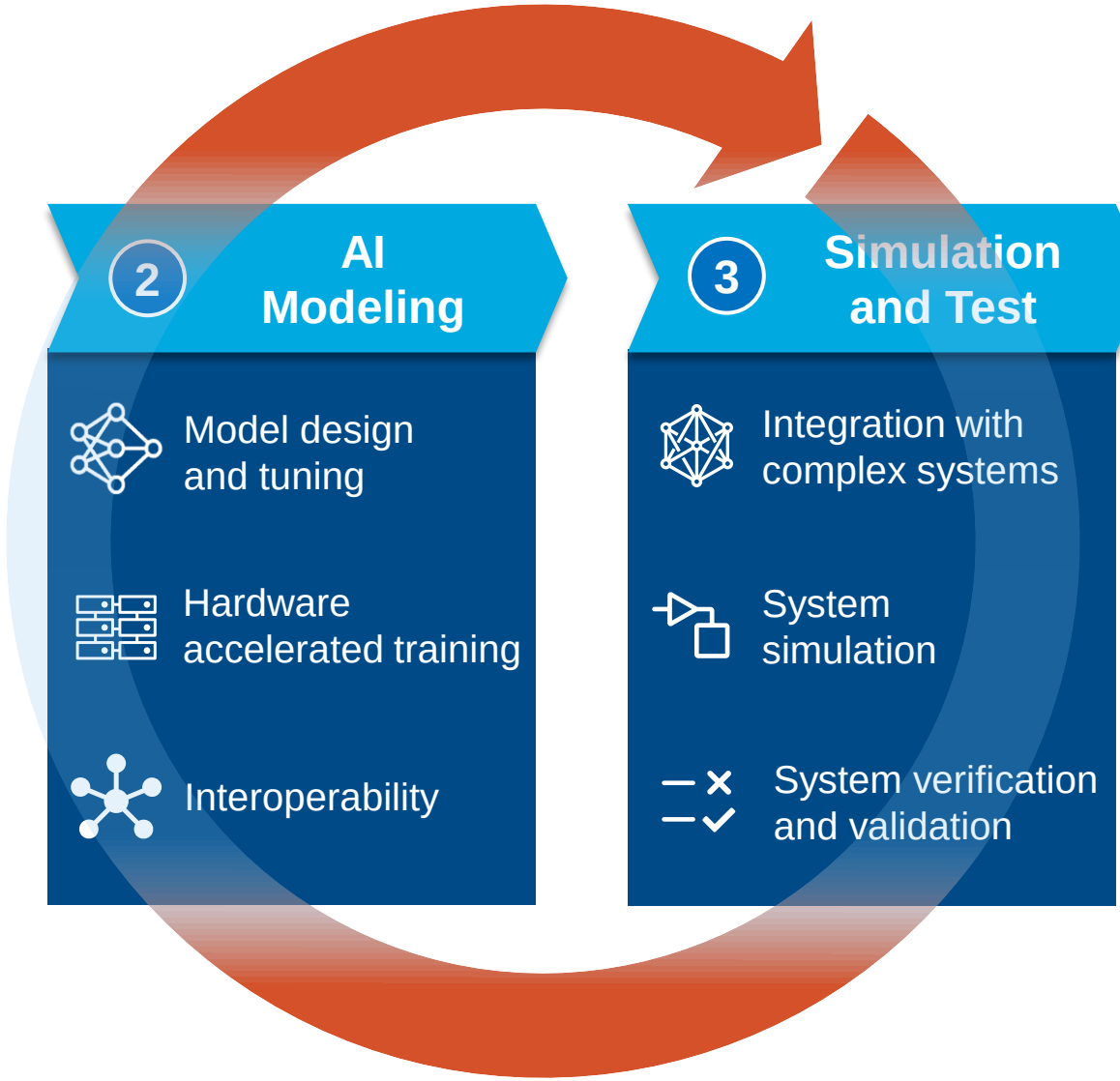
Sivylla
The Engineering Team Lead

Yann
The Data Science Team Lead

The AI enabled car project has been approved!



Our best results come from following the AI system design workflow



1 Data Preparation

- Data cleansing and preparation
- Human insight
- Simulation-generated data

2 AI Modeling

- Model design and tuning
- Hardware accelerated training
- Interoperability

3 Simulation and Test

- Integration with complex systems
- System simulation
- System verification and validation

4 Deployment

- Embedded devices
- Enterprise systems
- Edge, cloud, desktop

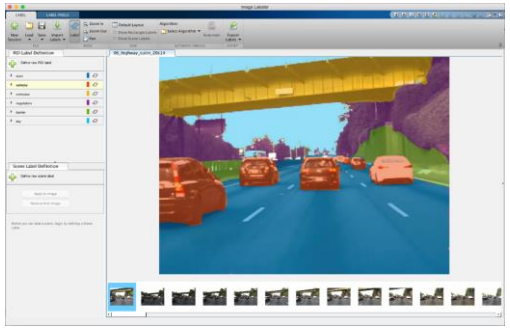
Here are the
higher-level project requirements

Data Preparation requirements

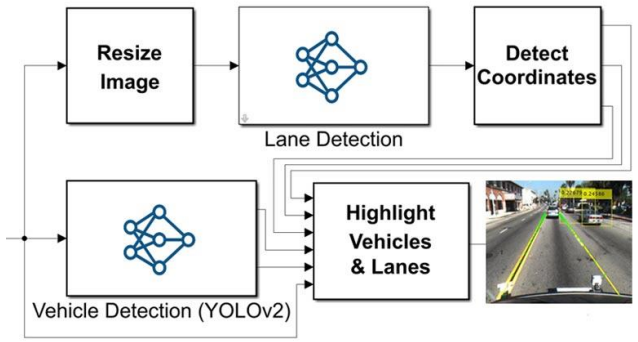
1 Data Preparation

- Data cleansing and preparation
- Human insight
- Simulation-generated data

- Add domain knowledge



- Make sure you have enough data
  - Generate synthetic data from system simulations



AI modeling requirements

2 AI Modeling

- Model design and tuning
- Hardware accelerated training
- Interoperability

- Find best model(s) for each application
- Don’t limit yourself to one tool

MATLAB

TensorFlow

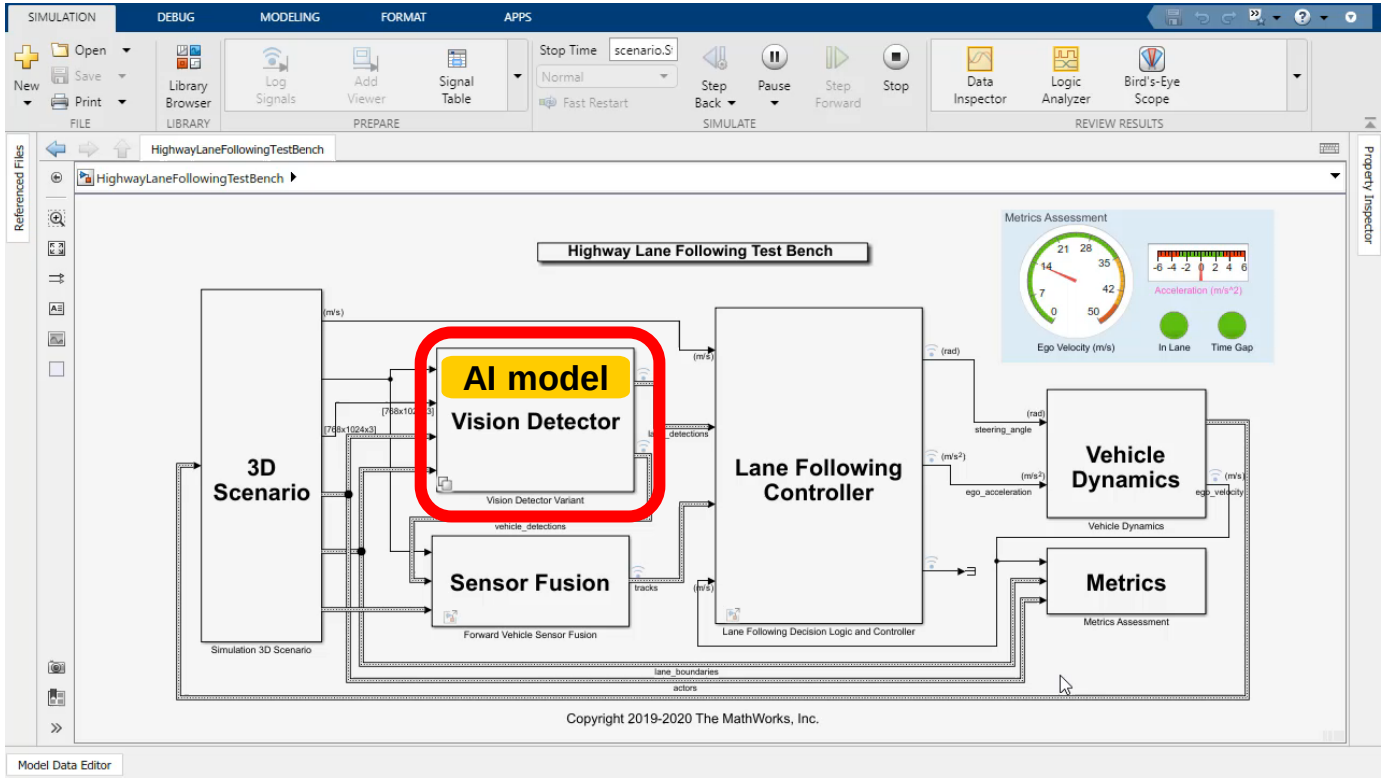
PyTorch

Simulation and Test requirements

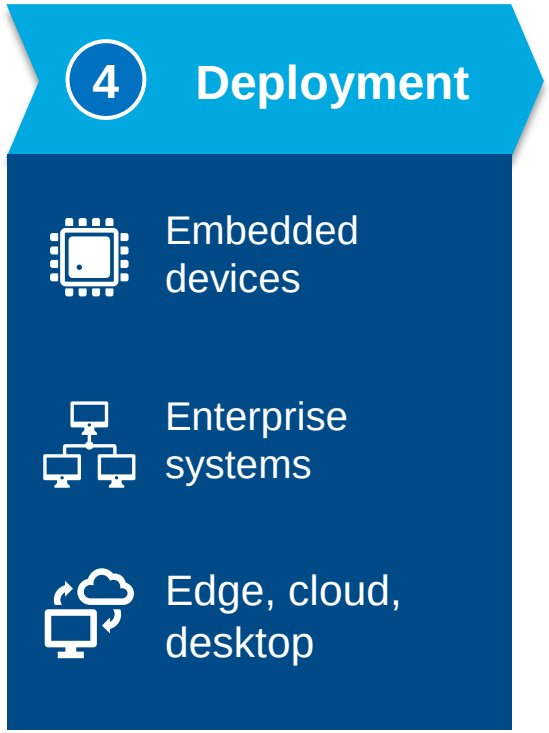
3 Simulation and Test

- Integration with complex systems
- System simulation
- System verification and validation

- You must test the model in the overall system
  - Requires integrating with system level simulations



Deployment requirements



- The aim is to target lowest cost, lowest power embedded devices available

CPU

intel inside XEON

GPU

NVIDIA

FPGA

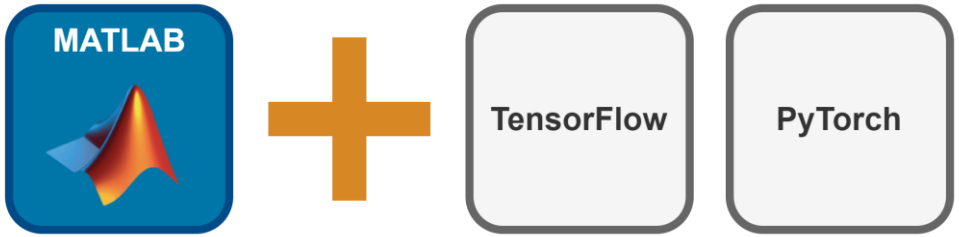
ZYNQ 7100

One last requirement…

Find the best way both teams can work together

Which tools should we use?

Why don’t we use the tools together?



Sivylla and Yann are having a friendly conversation
Discussing their options…

Mitsui Chemicals Deploys AI and

mathworks.com/company/user_stories/case-studies/mitsui-chemicals-deploys-ai-and-automation-systems-with-tensor-flow-a...

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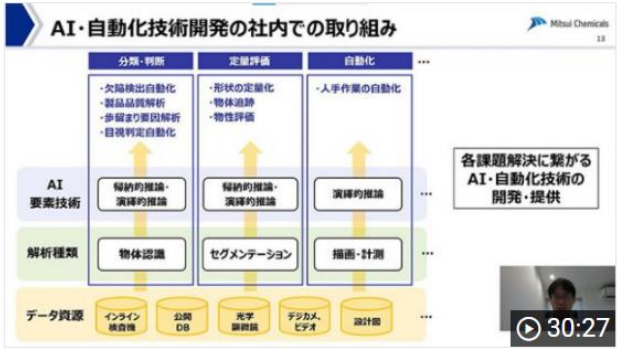
Mitsui Chemicals Deploys AI and Automation Systems with TensorFlow and MATLAB

> "MATLAB solved our problems on the field implementation and saved development time. That led to highly accurate development."
>
> — *Shintaro Maekawa, Mitsui Chemicals, Inc.*



Watch video (in Japanese)

Mitsui Chemicals develops factory automation solutions by applying AI, mainly machine learning.

At the beginning of development, Mitsui Chemicals used Python+Keras (TensorFlow) for automated visual inspection of sheet-shaped products on the production line. However, ease of use and maintenance were issues in implementing the trained models in the field.

Mitsui Chemicals engineers chose MATLAB® to create applications with easy-to-understand user interfaces. The model was imported using the Deep Learning Toolbox™ Importer for TensorFlow-Keras Models. The

Key Outcomes

- Reduced visual inspection time by 80%
- Effectively used models trained in other frameworks
- Deployed application with a user interface that anyone can use

Products Used

- MATLAB
- Deep Learning Toolbox
- MATLAB Compiler

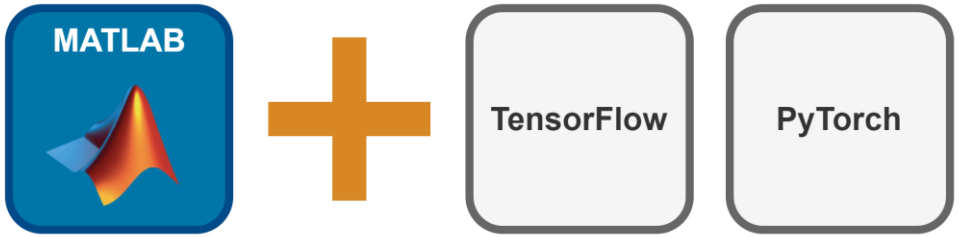
A short time later…

There are 3 ways MATLAB can work with TensorFlow & PyTorch

#	Option
1	Co-execution with TensorFlow or PyTorch
2	Model converters for TensorFlow & ONNX
3	MATLAB Deep Learning Model Hub

1. Co-execution with MATLAB, TensorFlow or PyTorch

- Requires MATLAB and TensorFlow / PyTorch
- Requires datatype conversion / reformatting
- Performance is impacted by data transfer between frameworks
- Allows testing of any model from TensorFlow / PyTorch in MATLAB

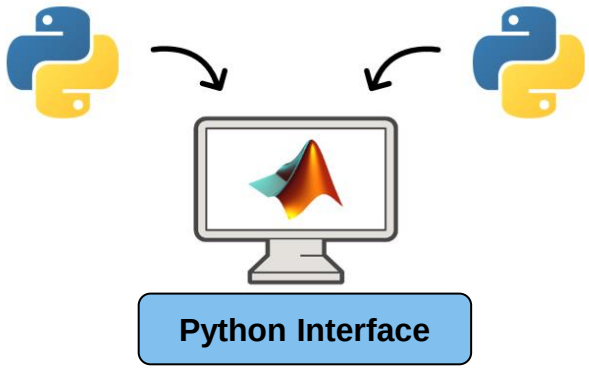


DEMO 1

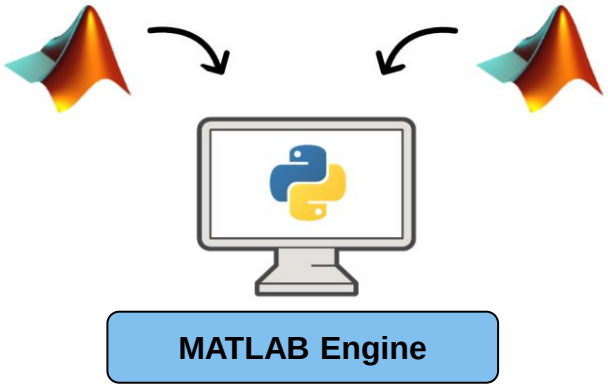
Co-execution allows:

- Calling Python from MATLAB to access any AI frameworks and networks
- Calling MATLAB from Python to reuse the domain specific processing

Calling Python from MATLAB

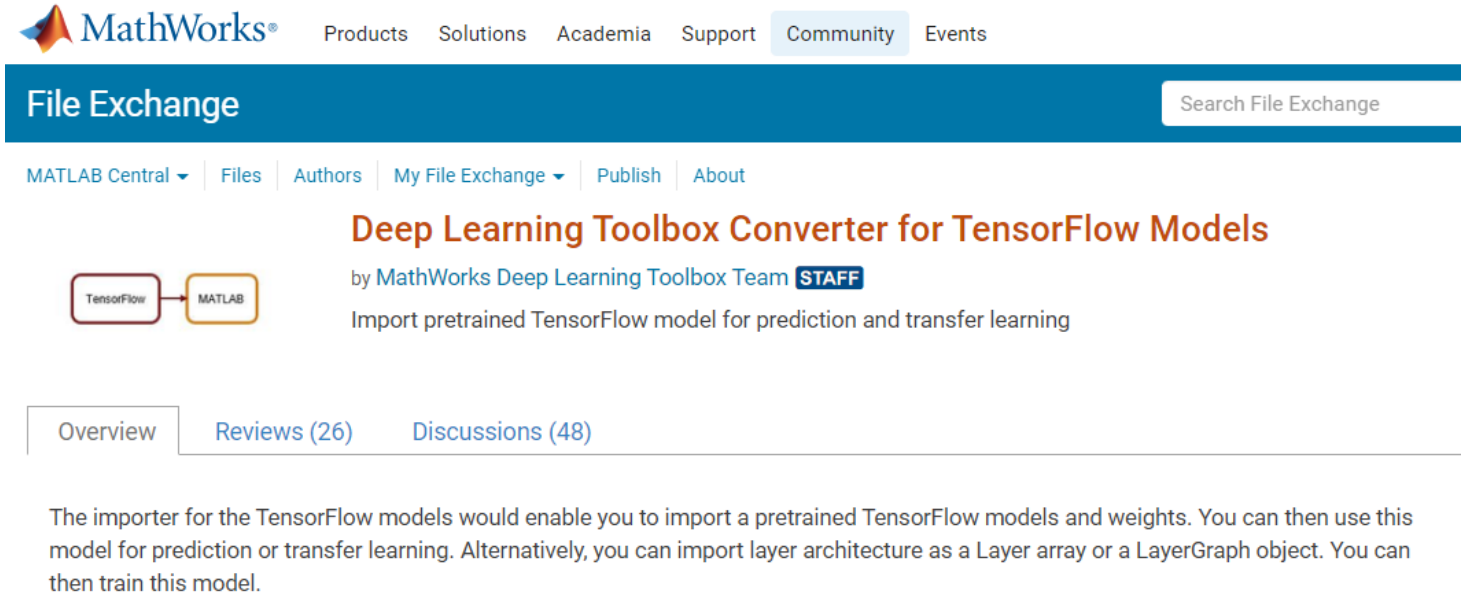


Calling MATLAB from Python



2. Model Import via TensorFlow & ONNX Converters

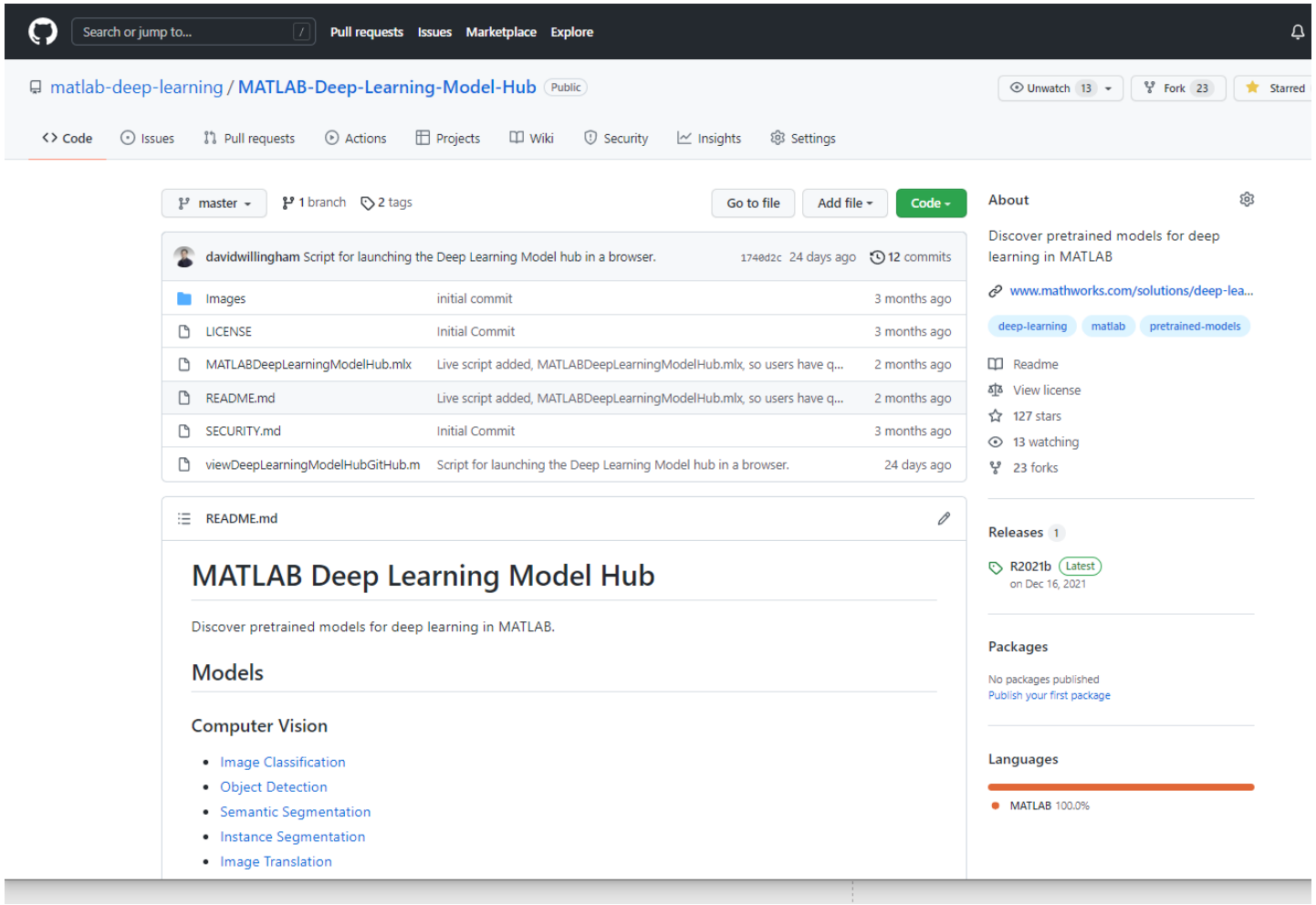
- Requires MATLAB only
- Import TensorFlow directly
- Import PyTorch via ONNX
- New features added each release



DEMO 2

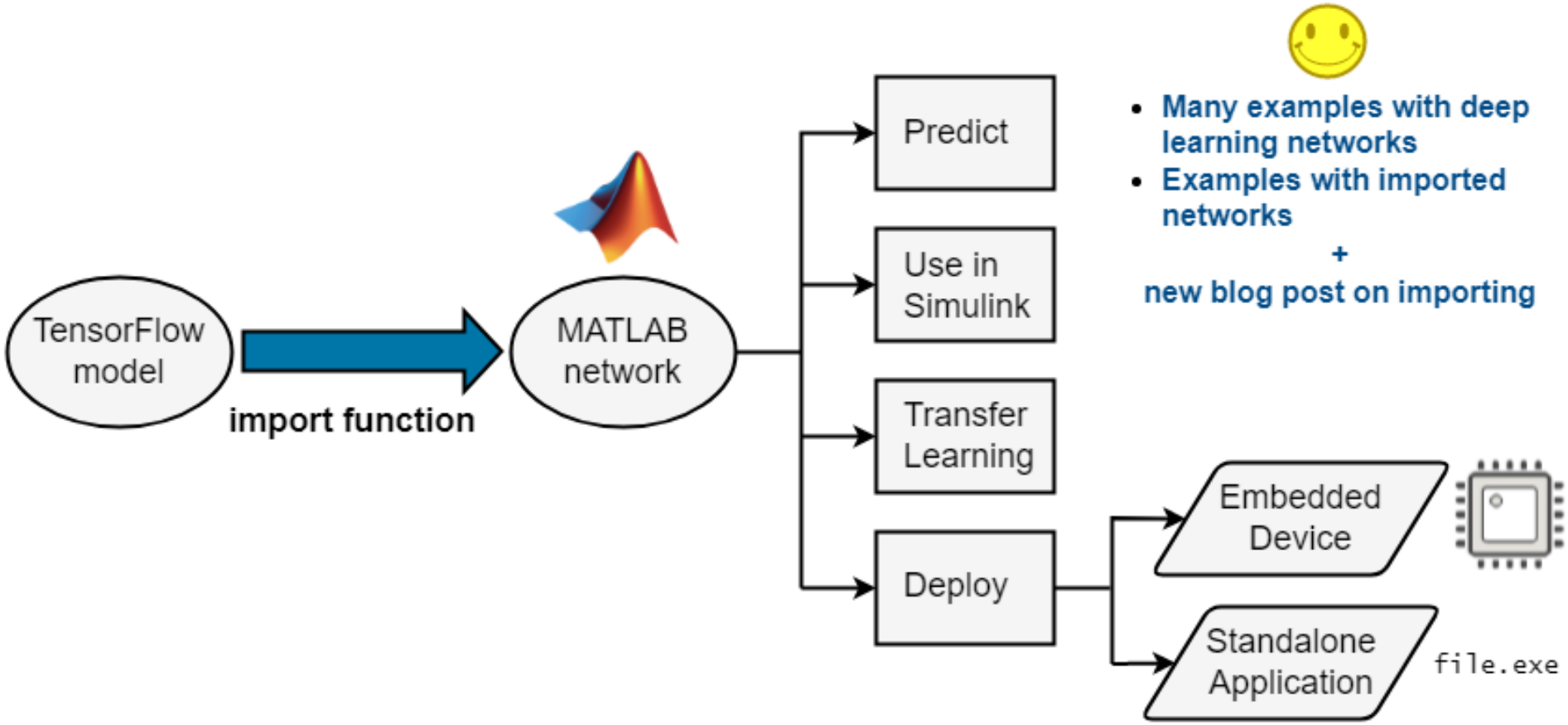
3. MATLAB Deep Learning Model Hub

- Requires MATLAB only
- Over 50 pretrained models
- Similar model collection with TensorFlow and PyTorch repositories



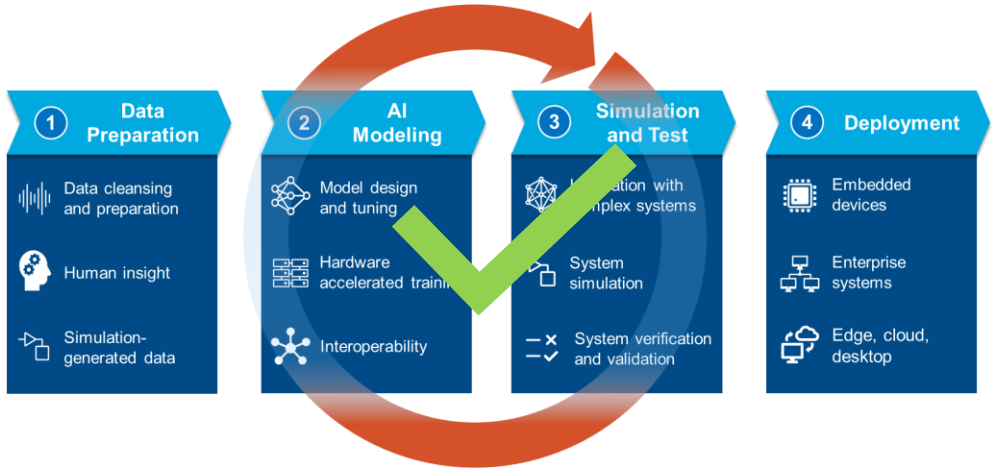
DEMO 3

Deep Learning Workflows with MATLAB Networks



Our key challenges and their solutions

#	Challenge	Approach
1	Find and test the best model	• Co-execution
2	Deploying to embedded targets	• Check if the model exists in the MATLAB Deep Learning Model Hub • Import into MATLAB using model converters



Let’s get this done!

This now concludes our presentation

Links from today's talk:

Co-execution between MATLAB and TensorFlow

Importing Models from TensorFlow, PyTorch, and ONNX

MATLAB Deep Learning Model Hub

MITSUI Chemicals User Story

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Thank you