

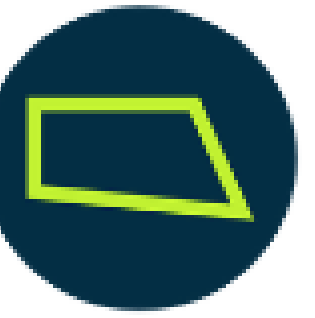
Machine Learning for Motor Control

BREAK
THROUGH
TECH

A yellow geometric graphic consisting of a parallelogram with a diagonal line, positioned to the right of the 'BREAK THROUGH TECH' text.

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Welcome back for our meeting!



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AI Studio Challenge Project Overview

CHALLENGE SUMMARY

Motor control is one of the core skillsets in robotics and electrification areas which are becoming more and more widely used in the industry. Currently, many industrial motor applications are driven by classical and robust control-based methods. In this project, you will implement **Machine Learning-based motor control methods** as an alternate pathway to overcome the real-world challenges.



Project Goals and Outcome

YOUR TEAM'S OBJECTIVE

Conventional control approaches are effective when the system can be modelled predictably. It can be difficult to predict system nonlinearities due to motor parameter changes caused by aging and temperature variation.

- Define application-specific pipeline: systems, data, controls and simulation
- Study machine learning models for classification and regression tasks
- Deploy ML models in close-loop systems (software and hardware)
- * Use of reinforcement learning in motor control applications

DESIRED OUTCOMES

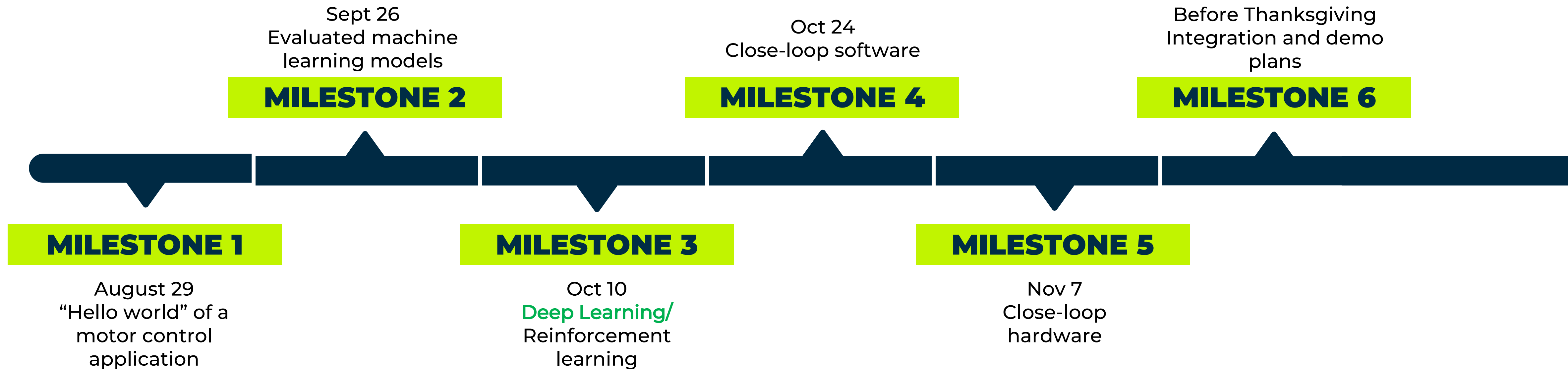
Develop and evaluate workflows that demonstrates controller design and optimization using classical control theory and machine learning-based approaches.





Project milestones and timeline

These are the milestones for your Challenge Project. They are roughly aligned to the [CRISP-DM](#) process you learned about in your ML Foundations course.



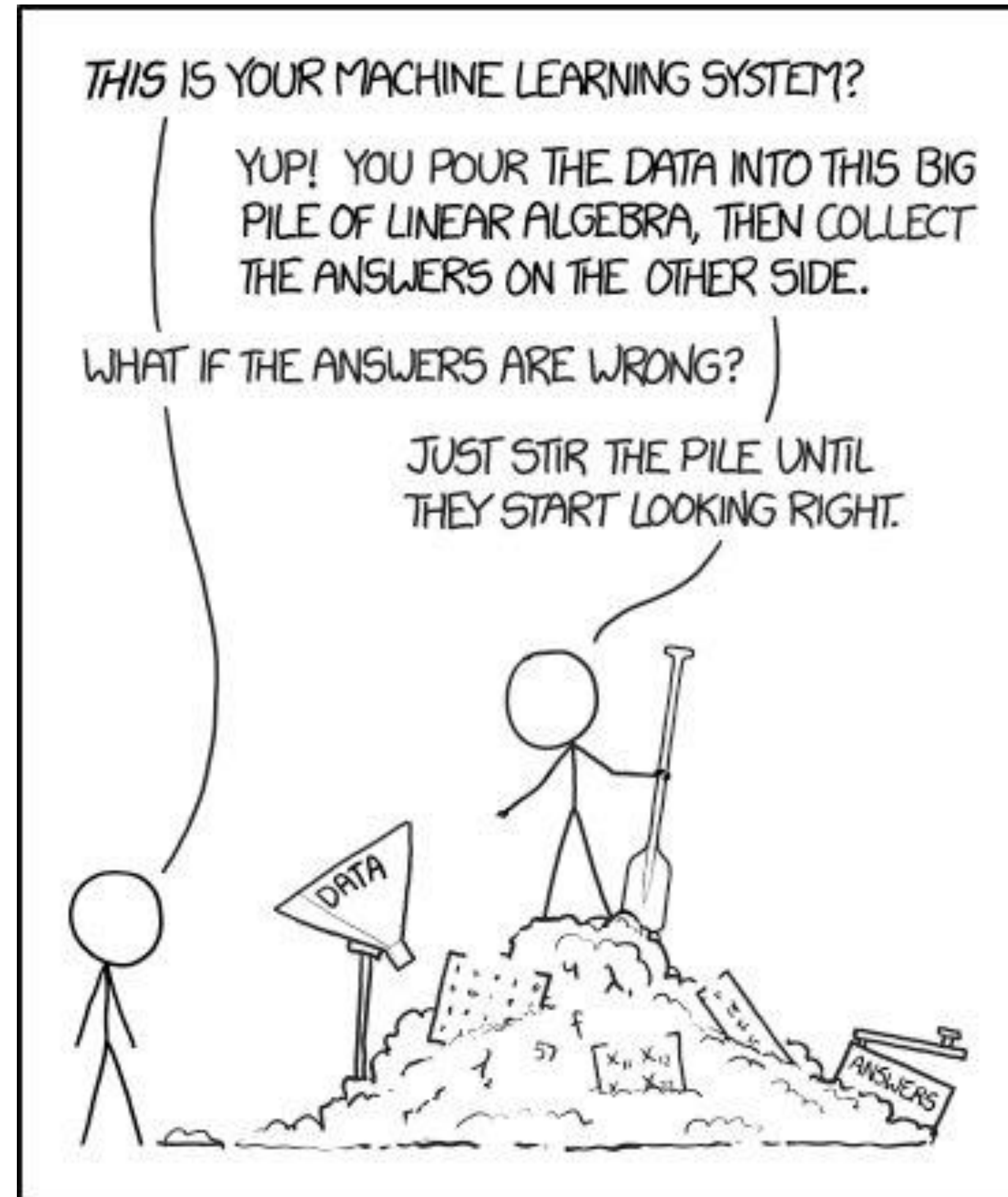
Check in with Milestone #2 items

- What questions would you ask your data?
- What features to choose?
- What pre-processing can help?
- What new models can you train?
- What new insights if we use the full dataset?
- **Deep learning models**

**Let's take a closer look
at the milestone 3**

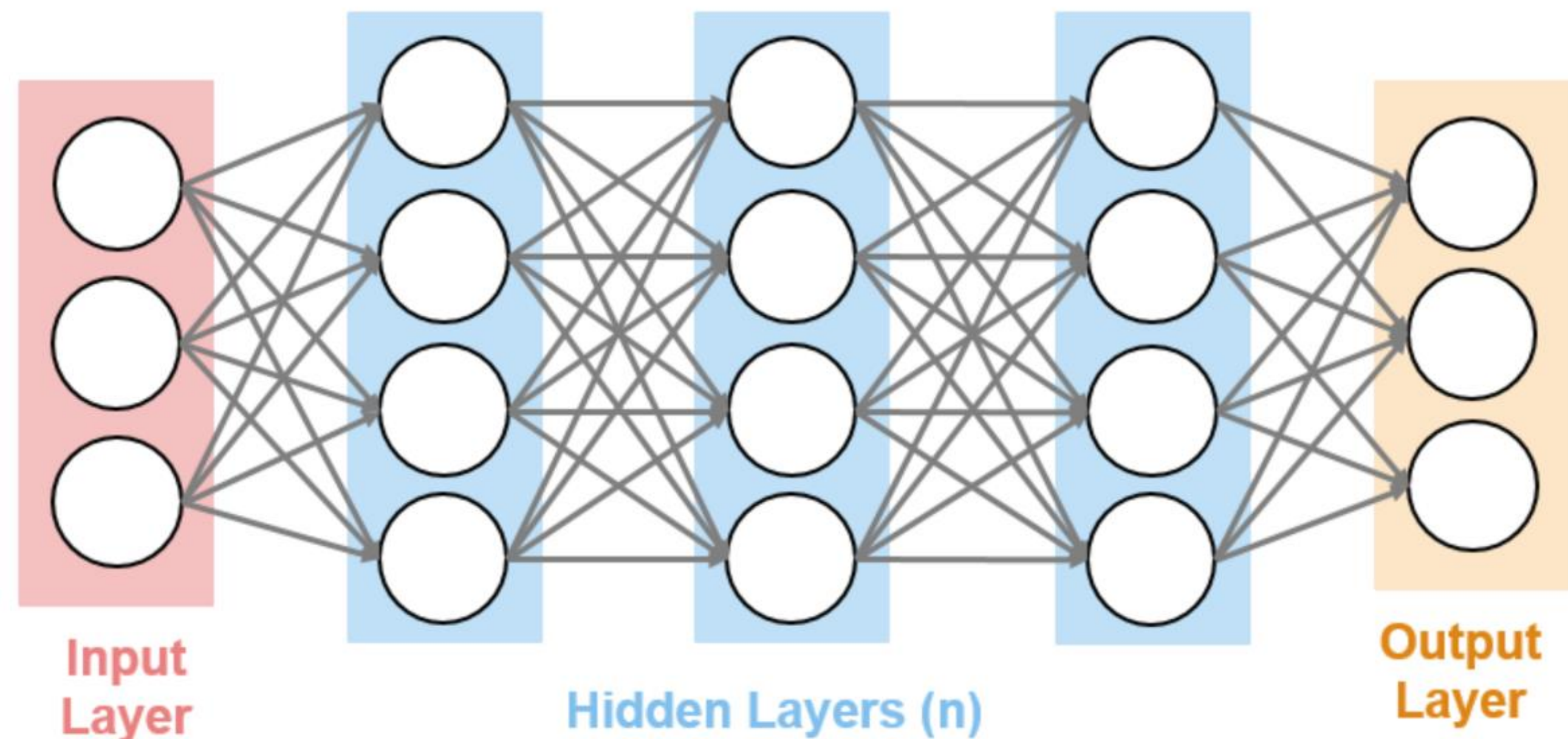
Data
System
Training
Feature selection
Validation
Trained Models

Have you figured out the **System** for Machine Learning/Deep Learning yet?



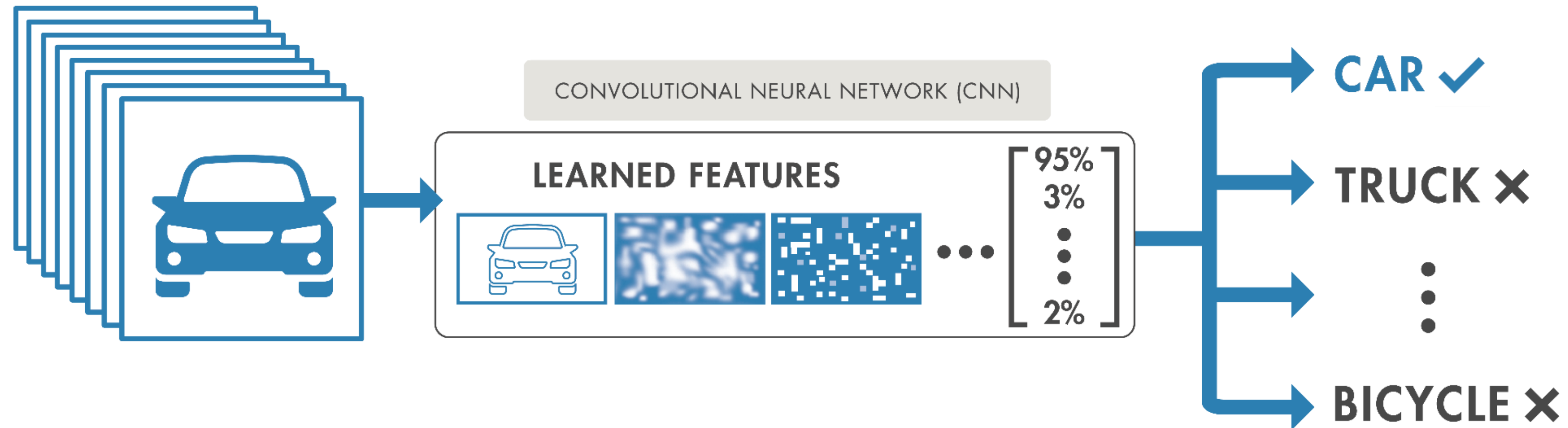
What is Deep Learning?

- Subset of machine learning which learns features and tasks directly from data
- Usually implemented using a **neural network architecture**.

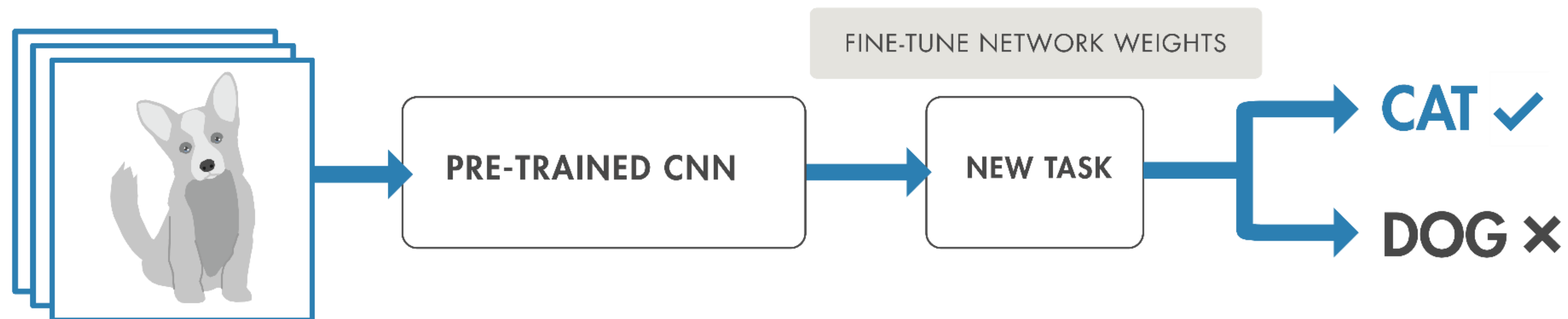


Two Approaches for Deep Learning

1. Train a Deep Neural Network from Scratch

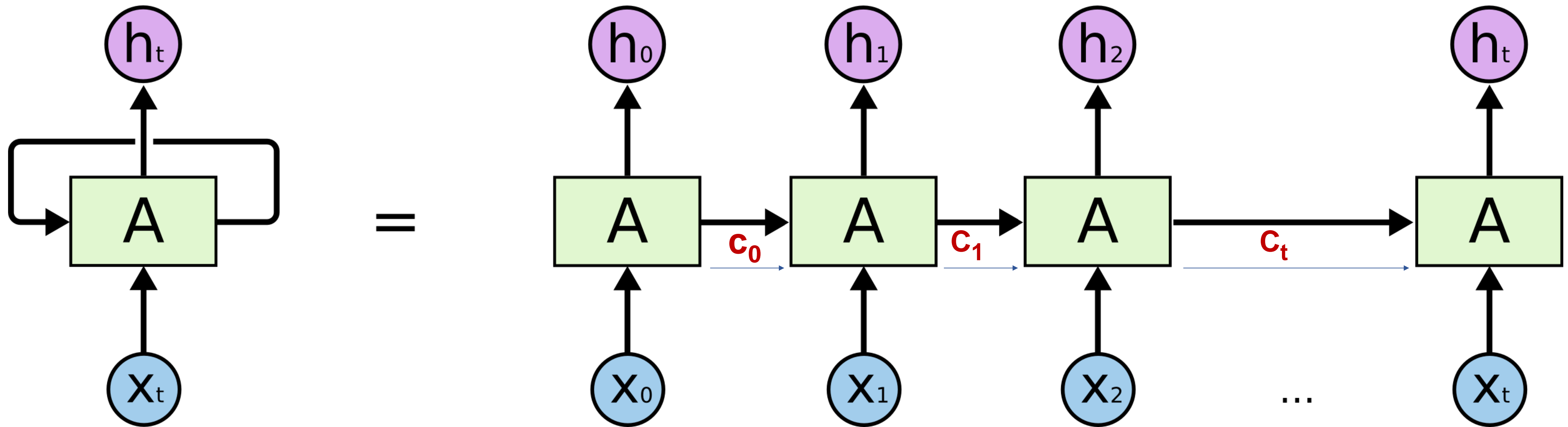


2. Fine-tune a pre-trained model (transfer learning)

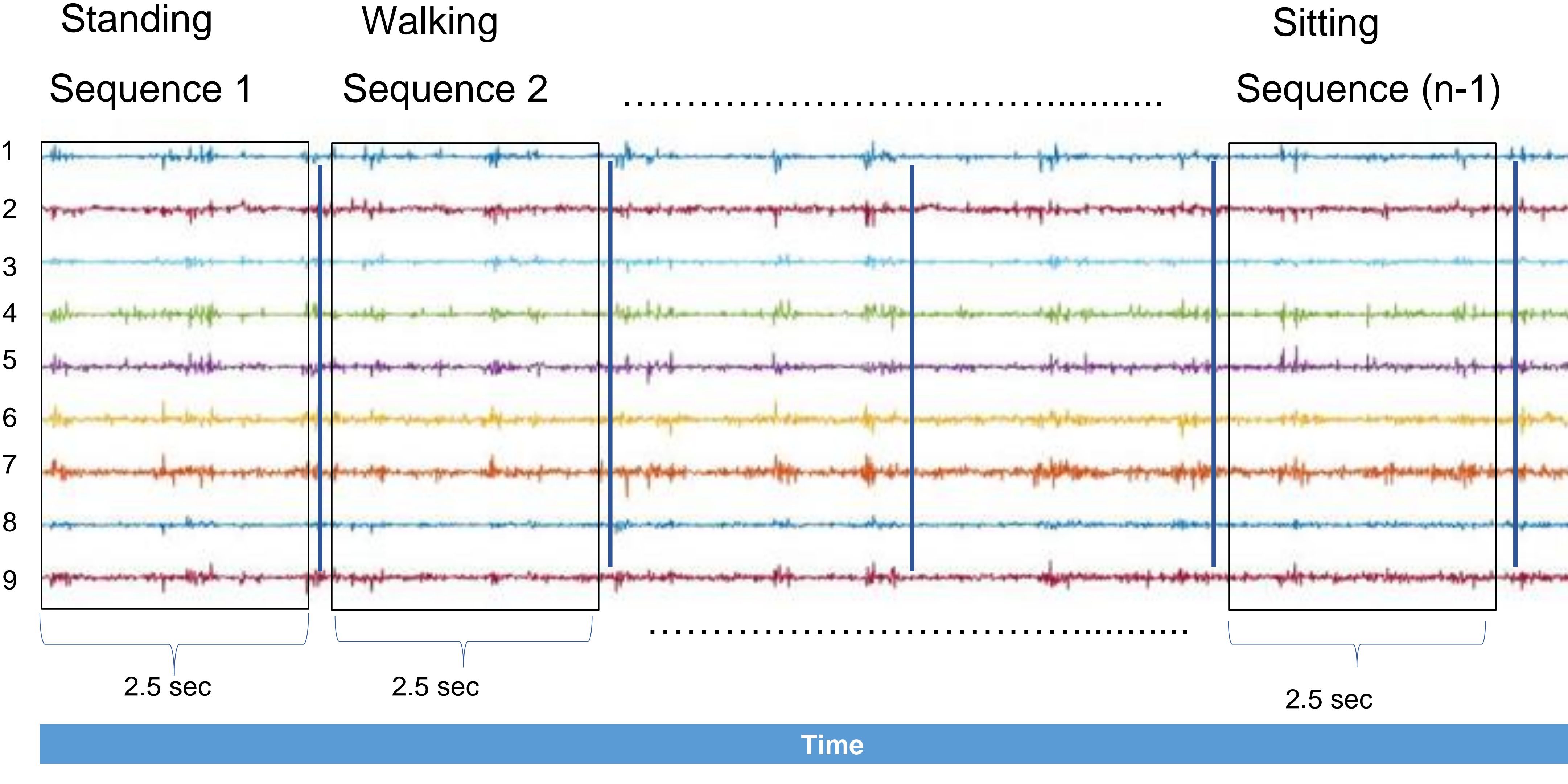


Long Short Term Memory Networks

Recurrent Neural Network that carries a memory cell throughout the process
Sequence Problems



LSTM sequences



Use LSTM or other deep learning network

Train LSTM network from scratch

<https://www.mathworks.com/help/audio/ug/acoustics-based-machine-fault-recognition.html>

Other use of LSTM approach

<https://www.mathworks.com/help/deeplearning/ug/classify-sequence-data-using-lstm-networks.html>

Example: Industrial Machinery Anomaly Detection

<https://github.com/matlab-deep-learning/Industrial-Machinery-Anomaly-Detection>

ML Pipeline that may work best

Access and Explore
Data

Preprocess Data

Develop Predictive
Models

Integrate Analytics with
Systems

Files



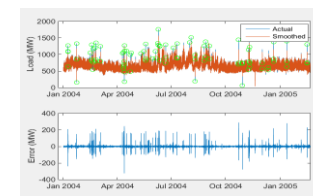
Databases



Sensors



Messy Data



Data Transformation



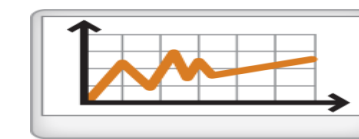
Feature Extraction



Model Creation



Parameter
Optimization



Model Validation



Desktop Apps



Enterprise Systems

MATLAB Excel
.NET C/C++
.exe Java .dll

Embedded Devices





Questions?



What questions do you have?

Anything I can help clarify?

What are you most excited about?

Anything you're unsure about?