

Understanding the Foundations of TensorFlow

INTRODUCING TENSORFLOW



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Overview

Introduce TensorFlow(TF), a language for numerical computations

Understand the basics of machine learning, deep learning and neural networks

Learn why TF is slowly becoming the default library for ML

Install and set up TensorFlow on your local machine

What You Need in Your Toolkit



Prerequisites

Familiarity with the command line on a Mac, Linux or Windows machine

Comfortable with writing programs in Python



Install and Setup

The latest version of TensorFlow 1.2rc0

A compatible version of Python, version 2.7 and 3.x

A Mac, Linux or Windows machine on which TensorFlow can be installed



Course Overview

Introduction to TensorFlow, install and set up

Basics of TensorFlow, computation graphs, tensors, sessions and TensorBoard

Fundamentals of TensorFlow, placeholders, variables, the feed dictionary

Working with images, representing RGB and grayscale images, image operations

Machine Learning with TensorFlow, identifying handwritten digits in the MNIST dataset using the nearest neighbors algorithm

Understanding Machine Learning

Machine Learning



**Work with a huge
maze of data**



Find patterns



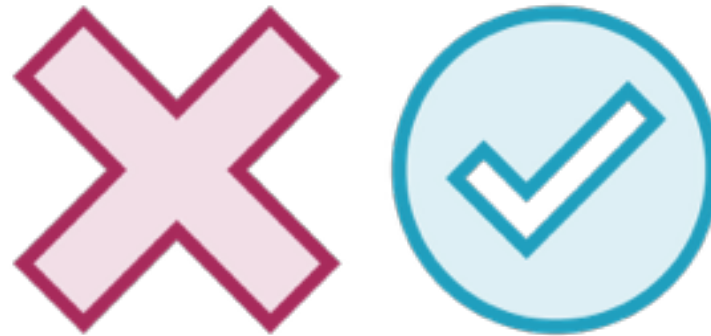
**Make intelligent
decisions**

A machine learning algorithm is an algorithm that is able to learn from data

Machine Learning



Emails on a server

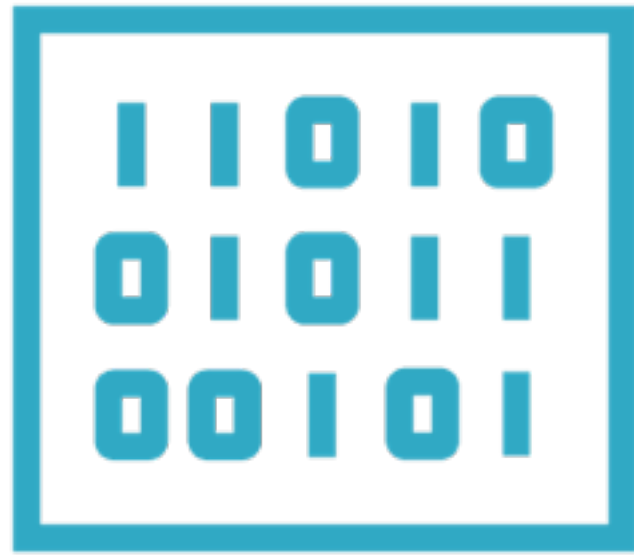


Spam or Ham?



Trash or Inbox

Machine Learning



Images represented
as pixels



Identify edges,
colors, shapes



A photo of a
little bird

Types of Machine Learning Problems



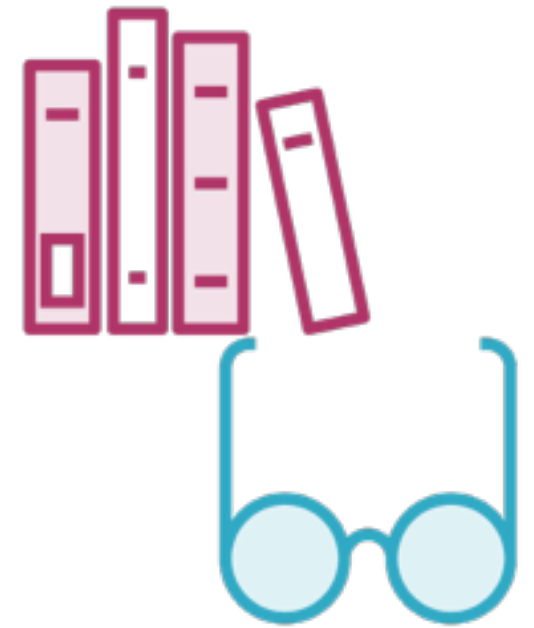
Classification



Regression



Clustering

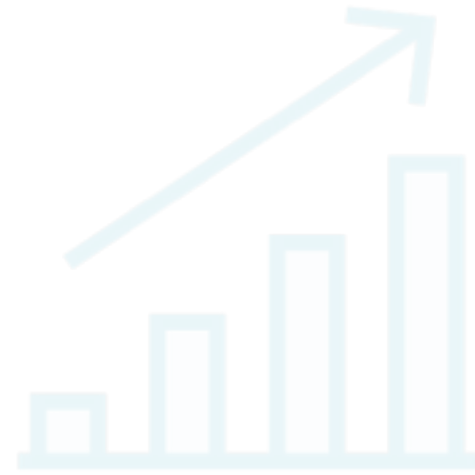


Rule-extraction

Types of Machine Learning Problems



Classification



Regression

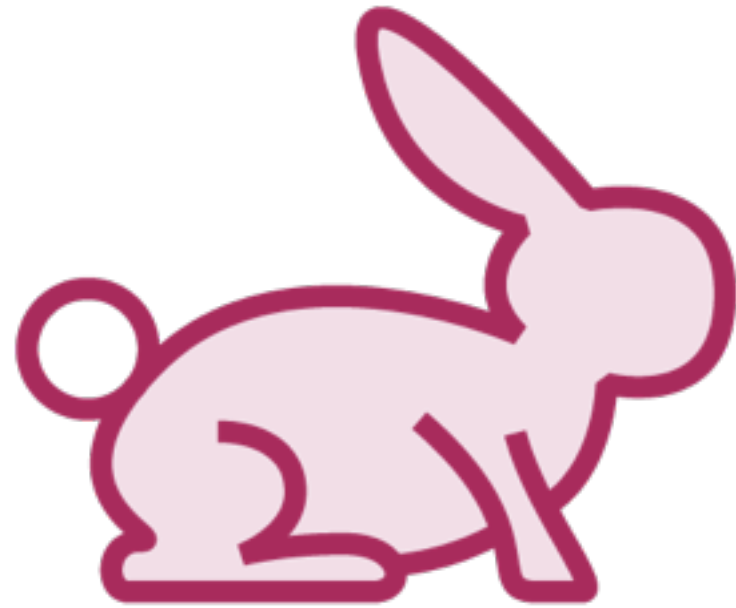


Clustering



Rule-extraction

Whales: Fish or Mammals?



Mammals

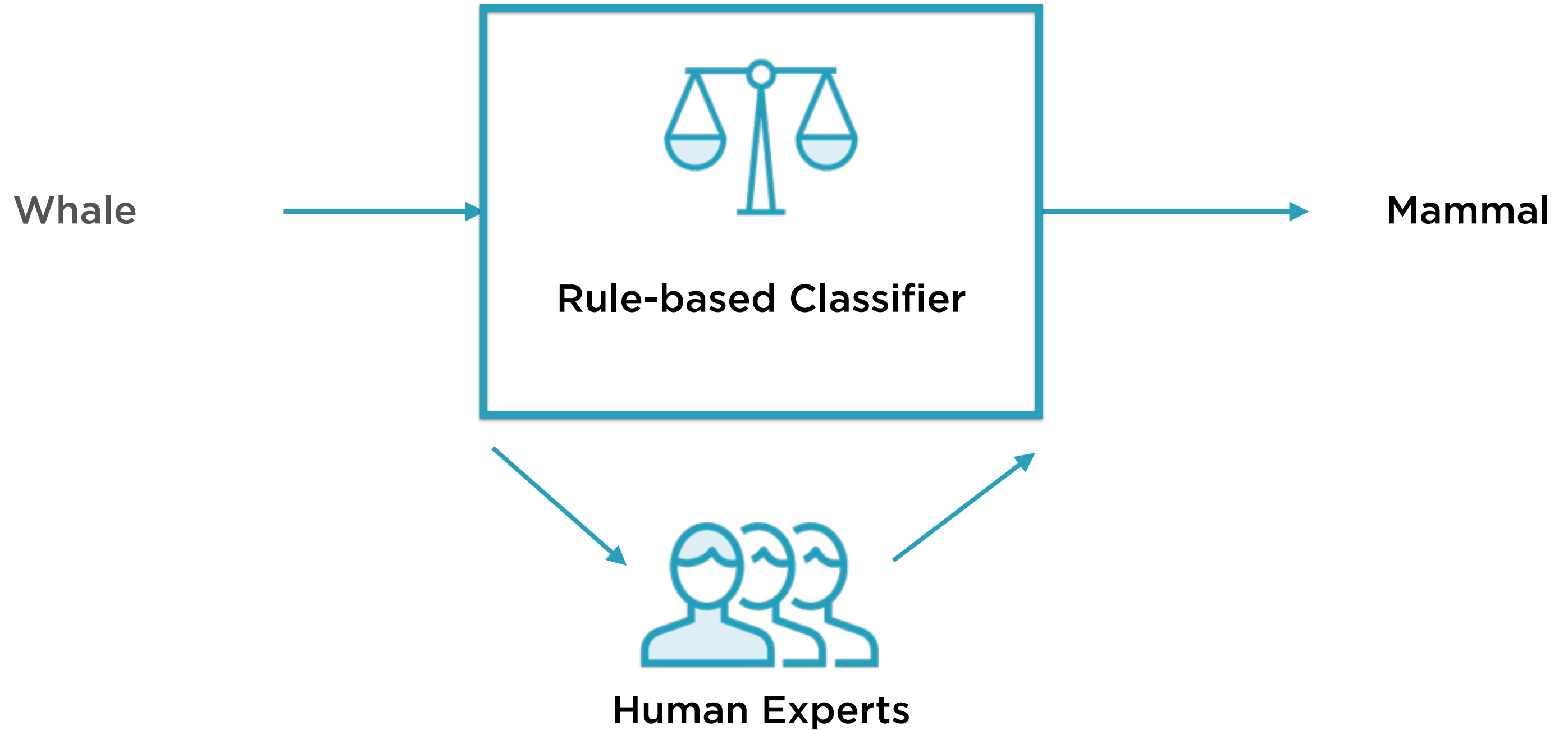
Members of the infraorder
Cetacea



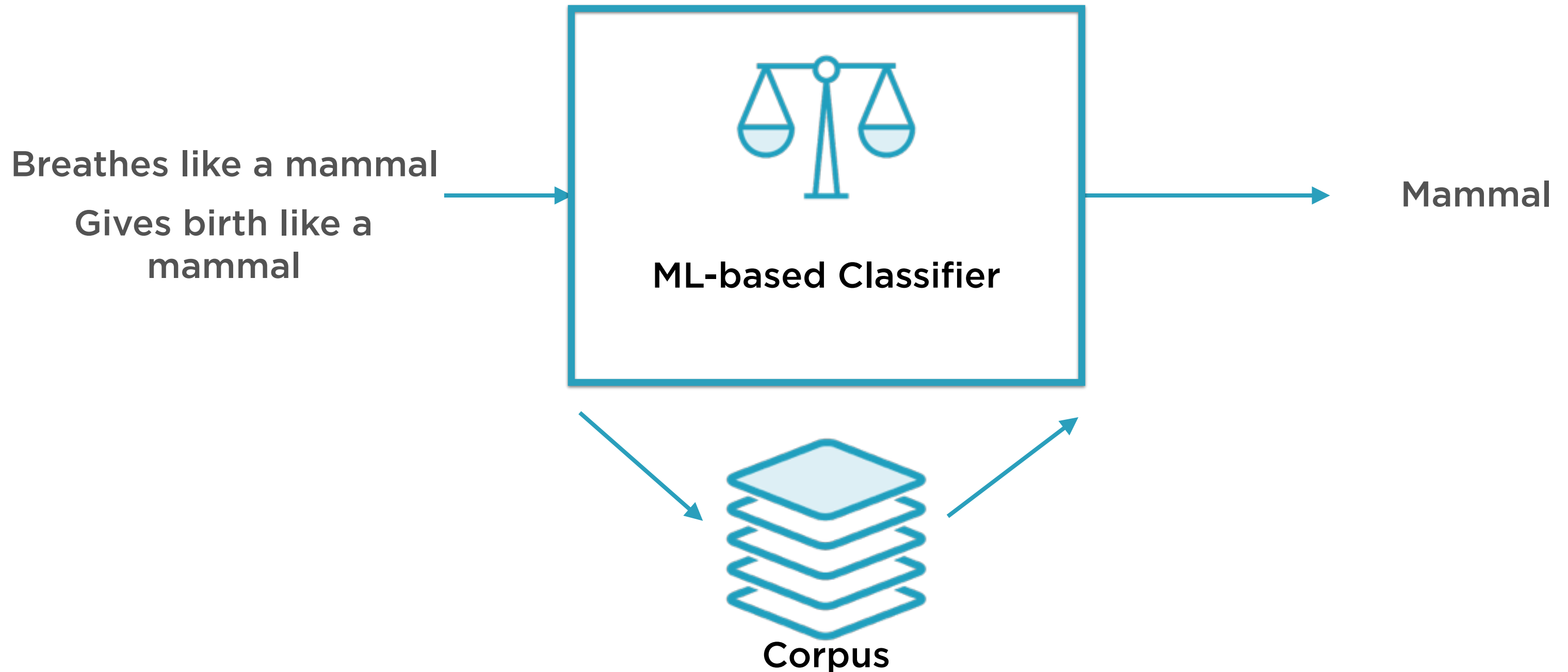
Fish

Look like fish, swim like fish,
move with fish

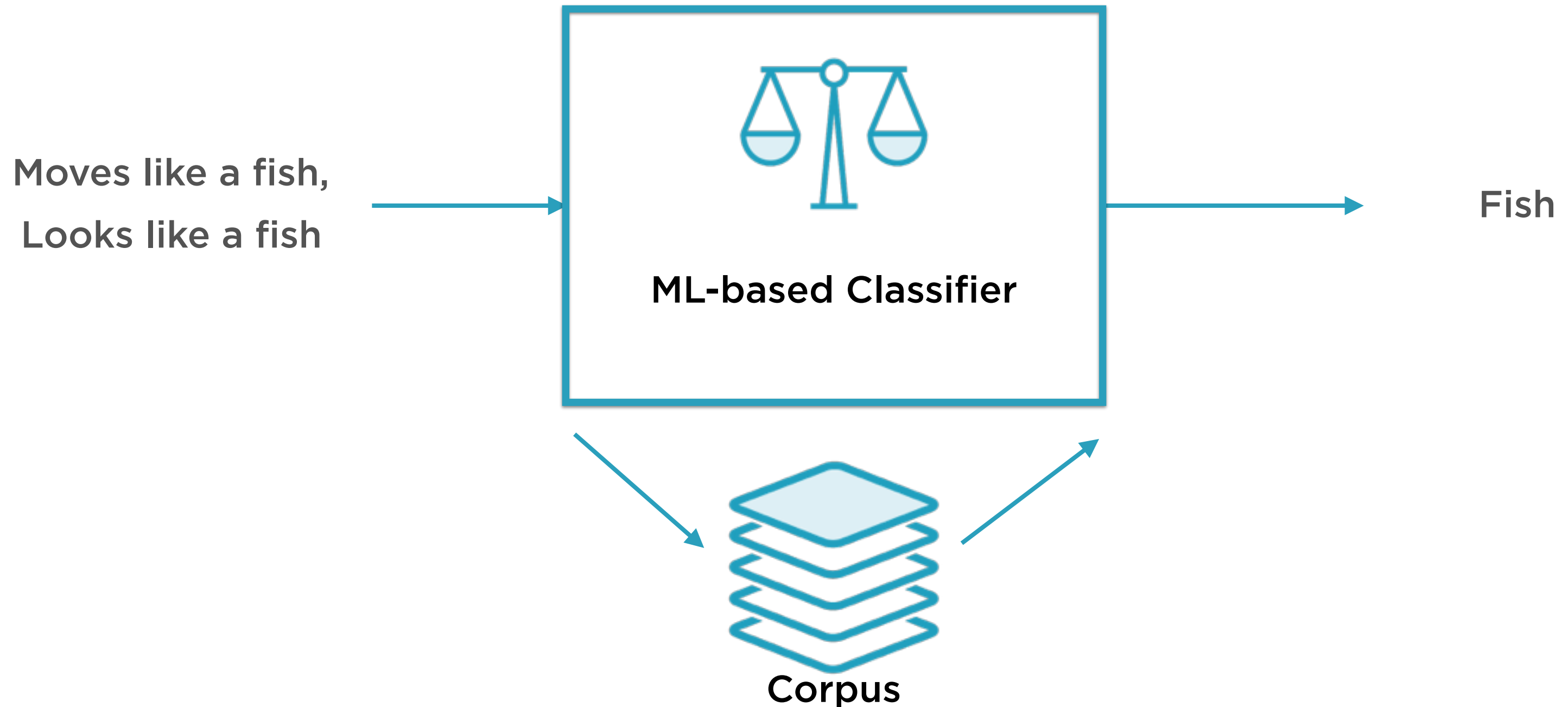
Rule-based Binary Classifier



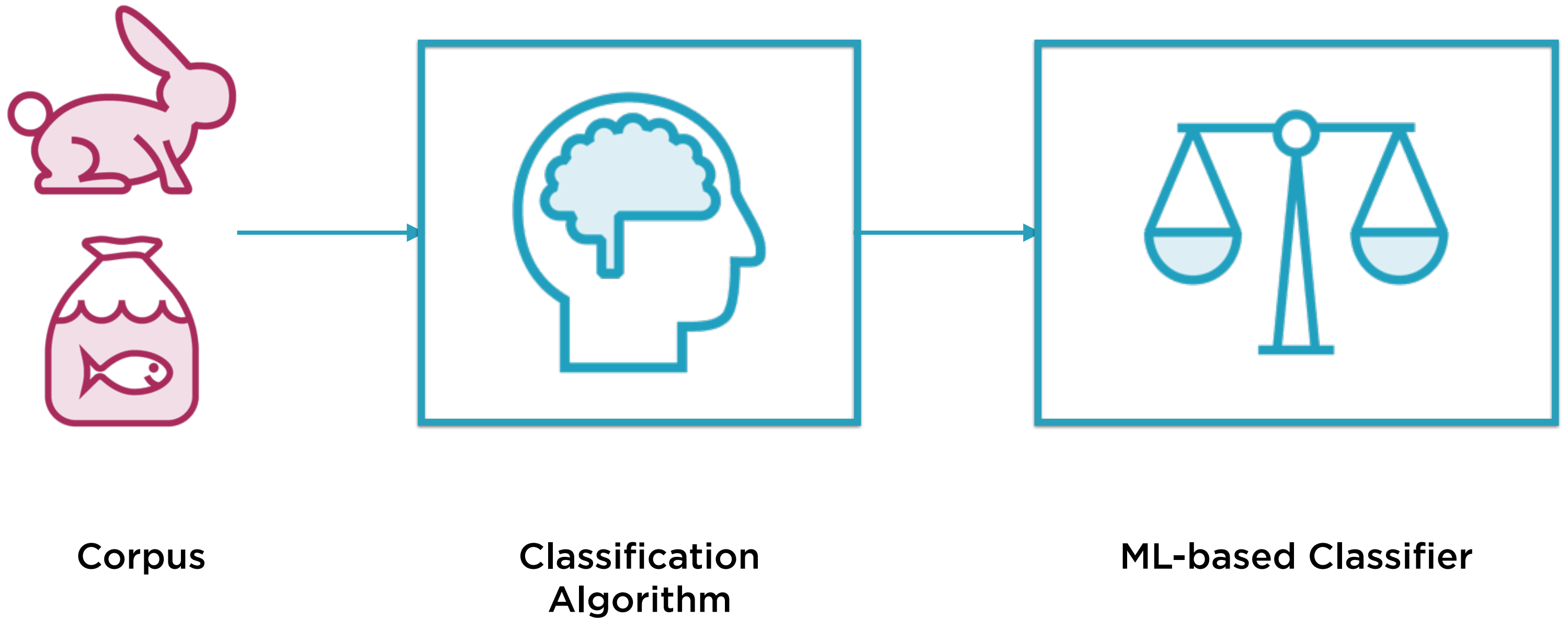
ML-based Binary Classifier



“Traditional” ML-based Binary Classifier



ML-based Binary Classifier



ML-based Binary Classifier

ML-based

Dynamic

Experts optional

Corpus required

Training step

Rule-based

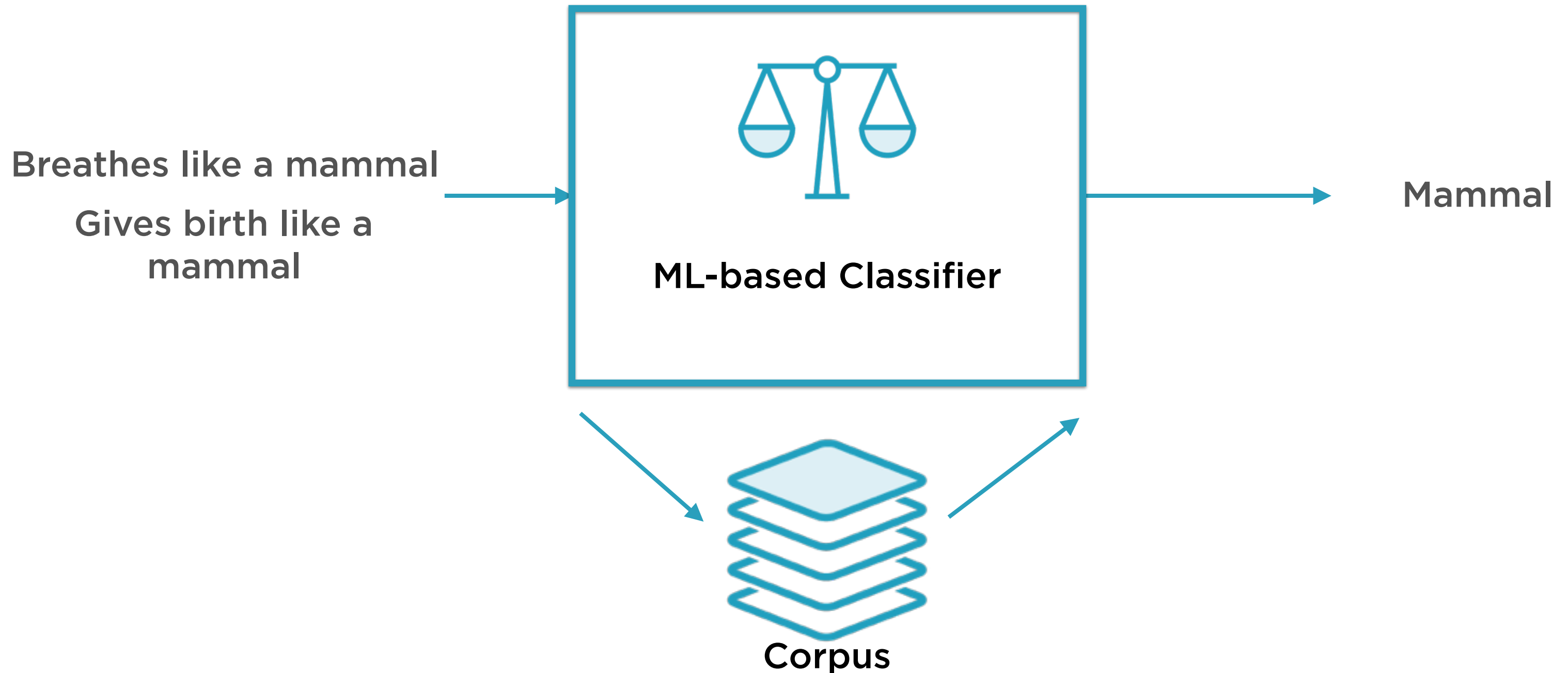
Static

Experts required

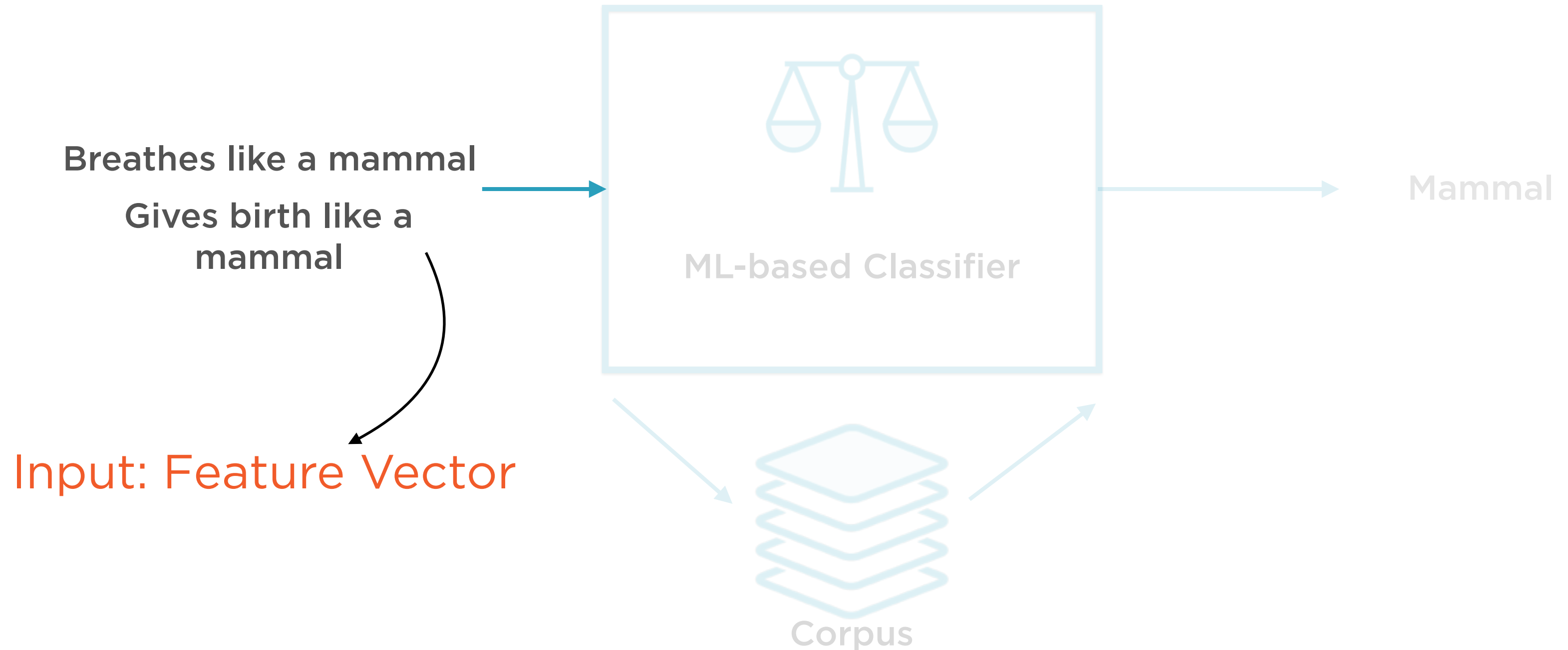
Corpus optional

No training step

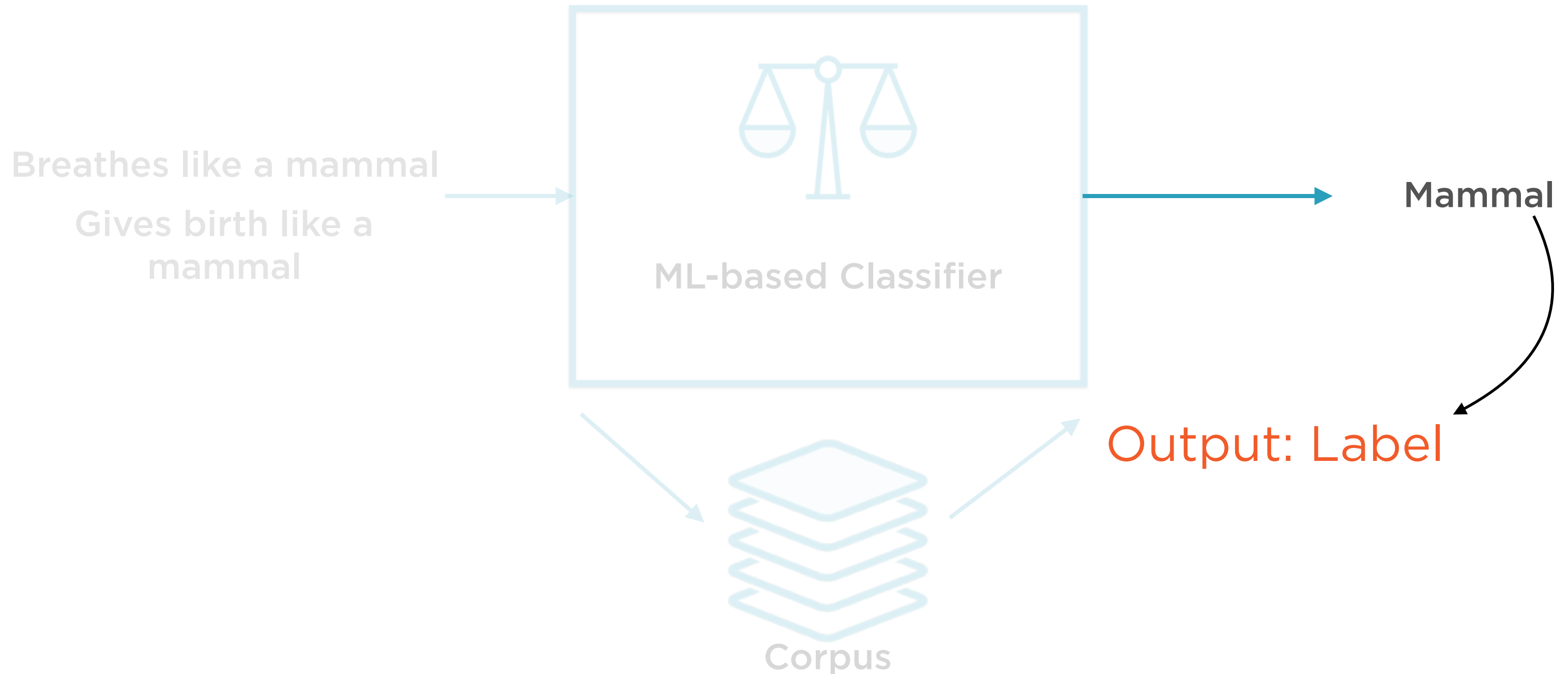
“Traditional” ML-based Binary Classifier



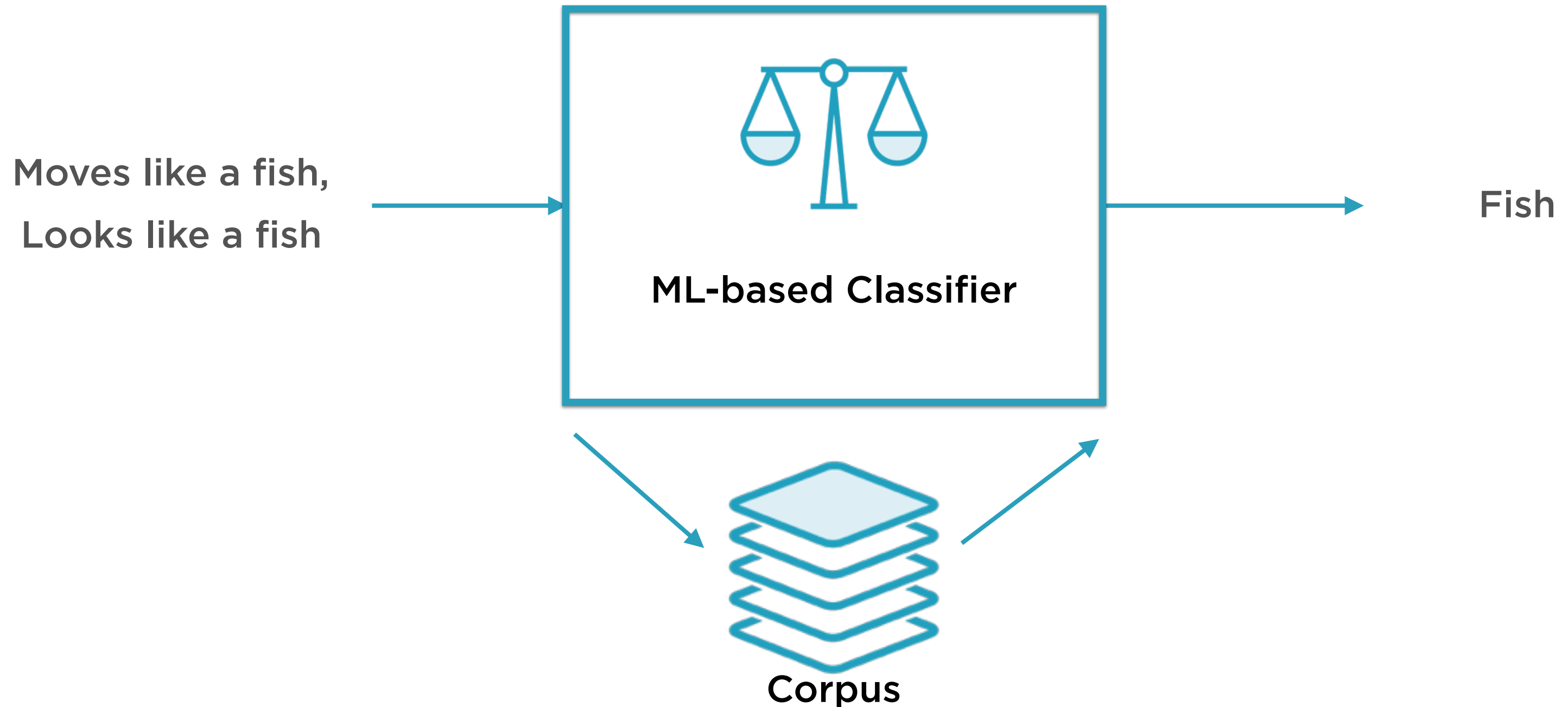
“Traditional” ML-based Binary Classifier



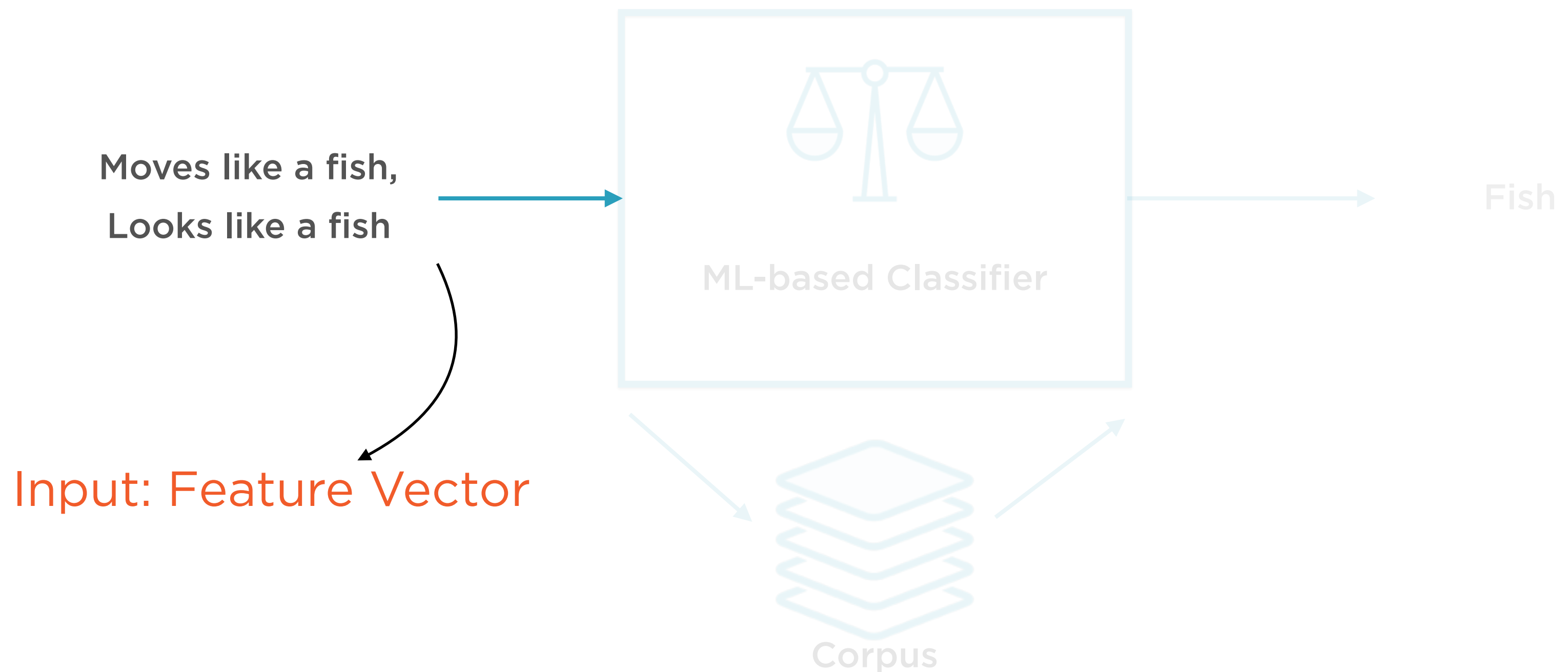
“Traditional” ML-based Binary Classifier



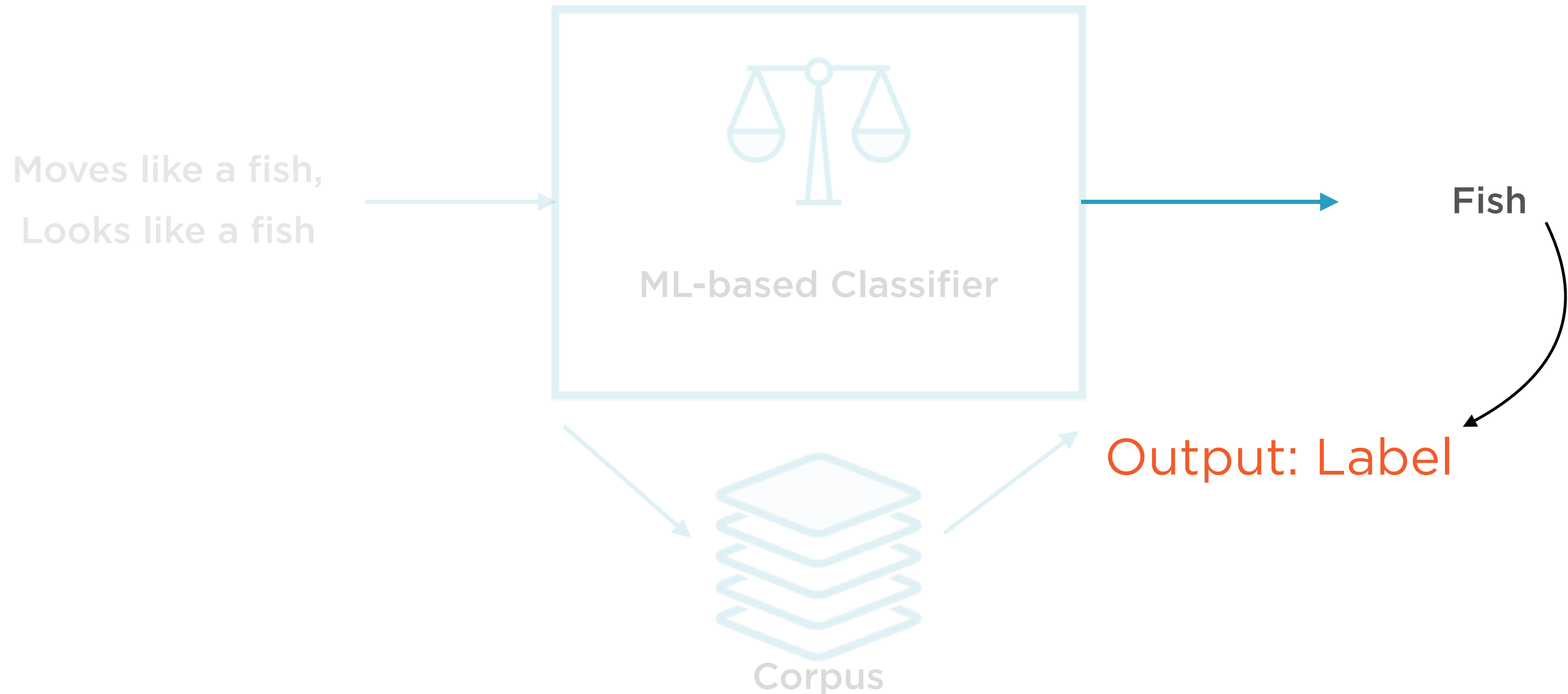
“Traditional” ML-based Binary Classifier



“Traditional” ML-based Binary Classifier



“Traditional” ML-based Binary Classifier



Feature Vectors

The attributes that the ML algorithm focuses on are called **features**

Each data point is a list - or **vector** - of such features

Thus, the input into an ML algorithm is a **feature vector**

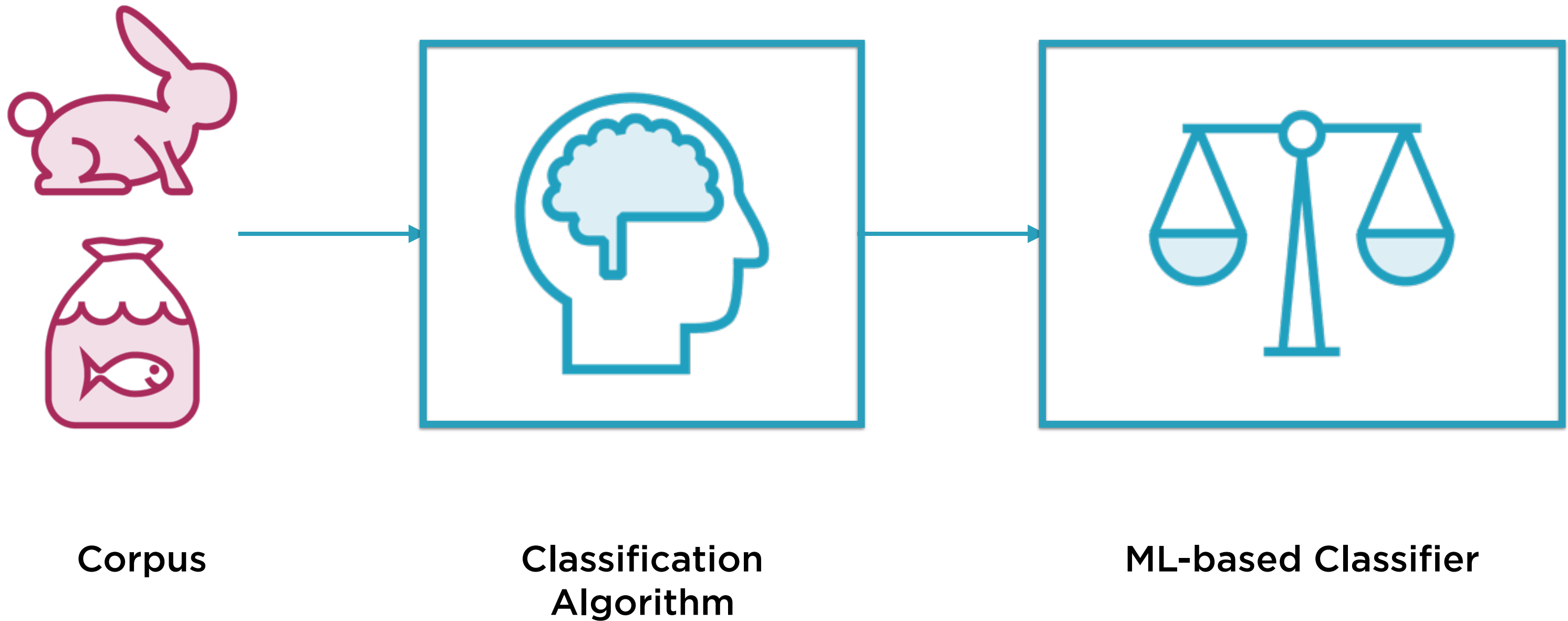
“Traditional” ML-based systems still
rely on experts to decide what
features to pay attention to

“Representation” ML-based systems figure out by themselves what features to pay attention to

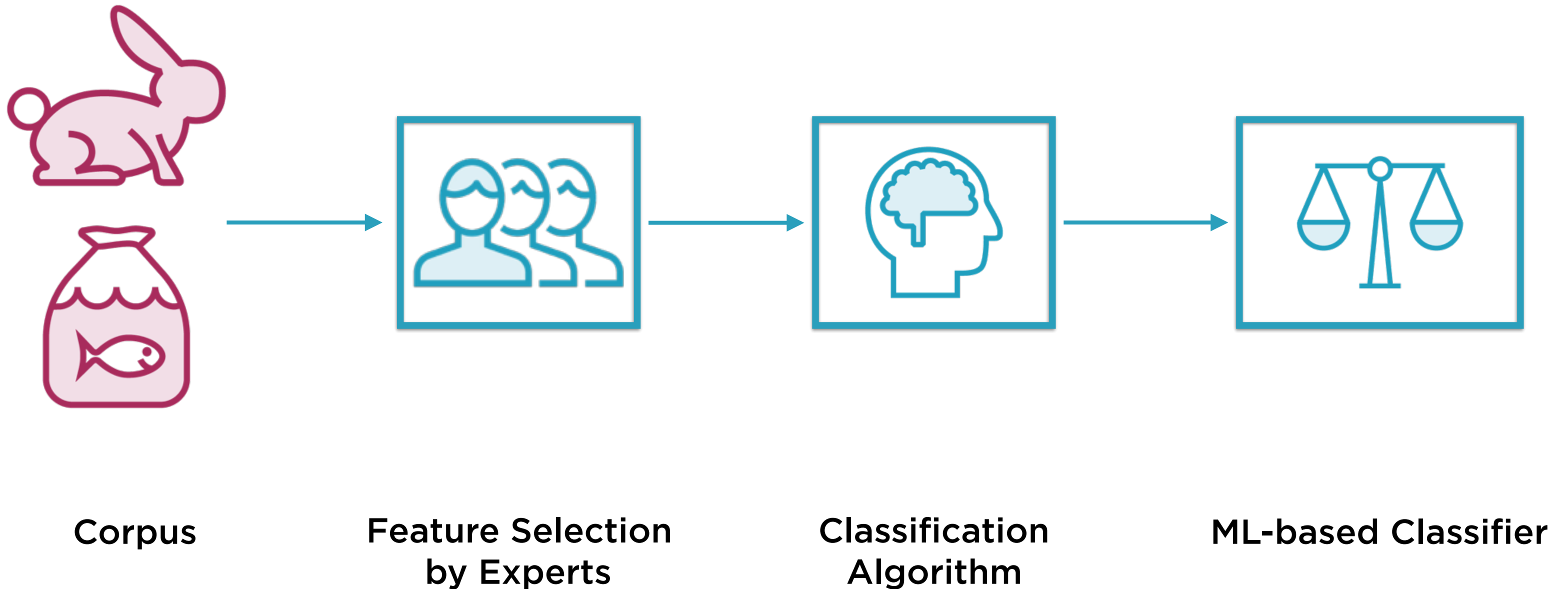
Understanding Deep Learning

“Representation” ML-based systems figure out by themselves what features to pay attention to

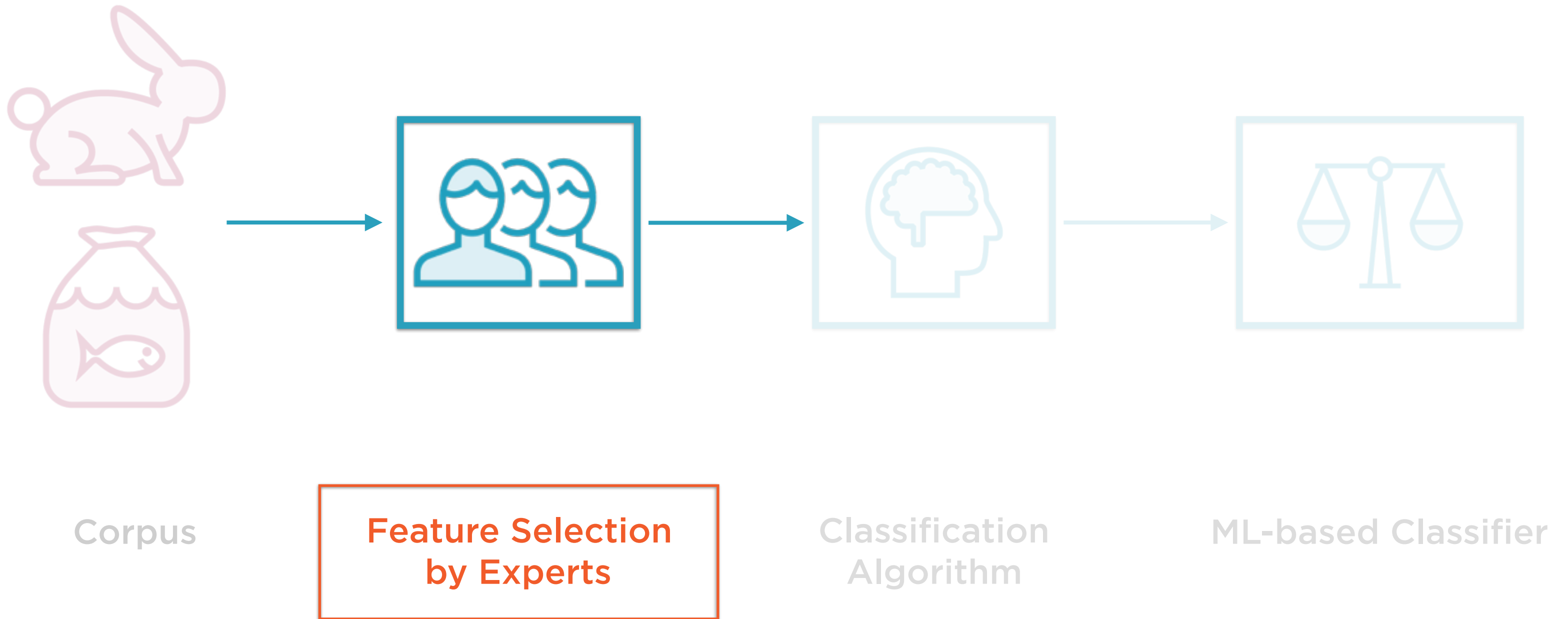
“Traditional” ML-based Binary Classifier



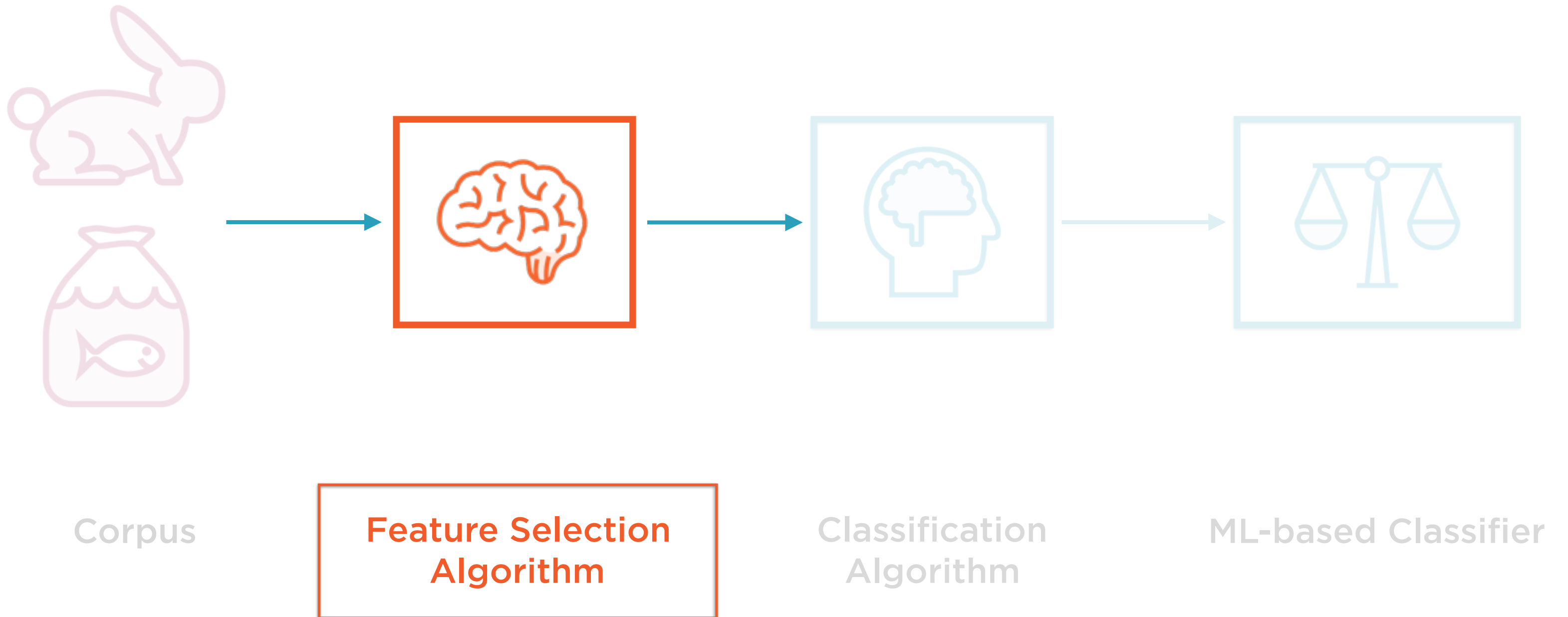
“Traditional” ML-based Binary Classifier



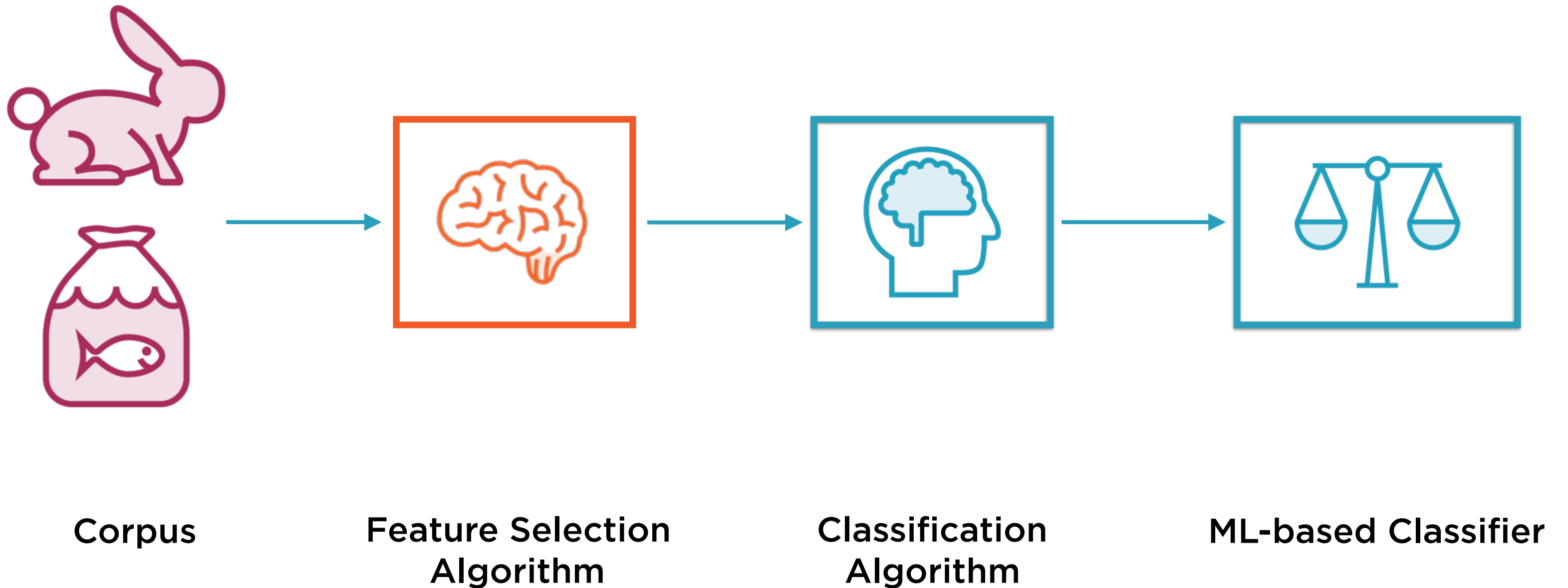
“Traditional” ML-based Binary Classifier



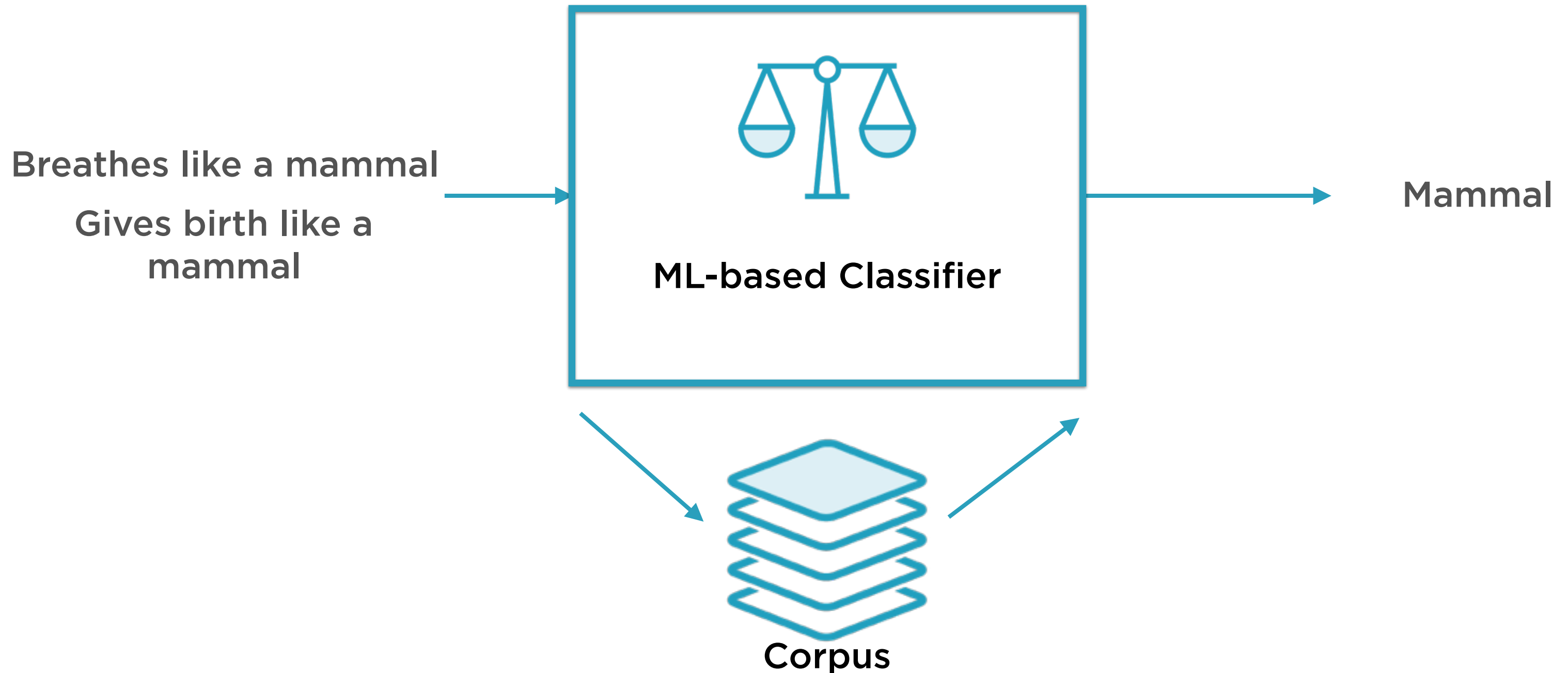
“Representation” ML-based Binary Classifier



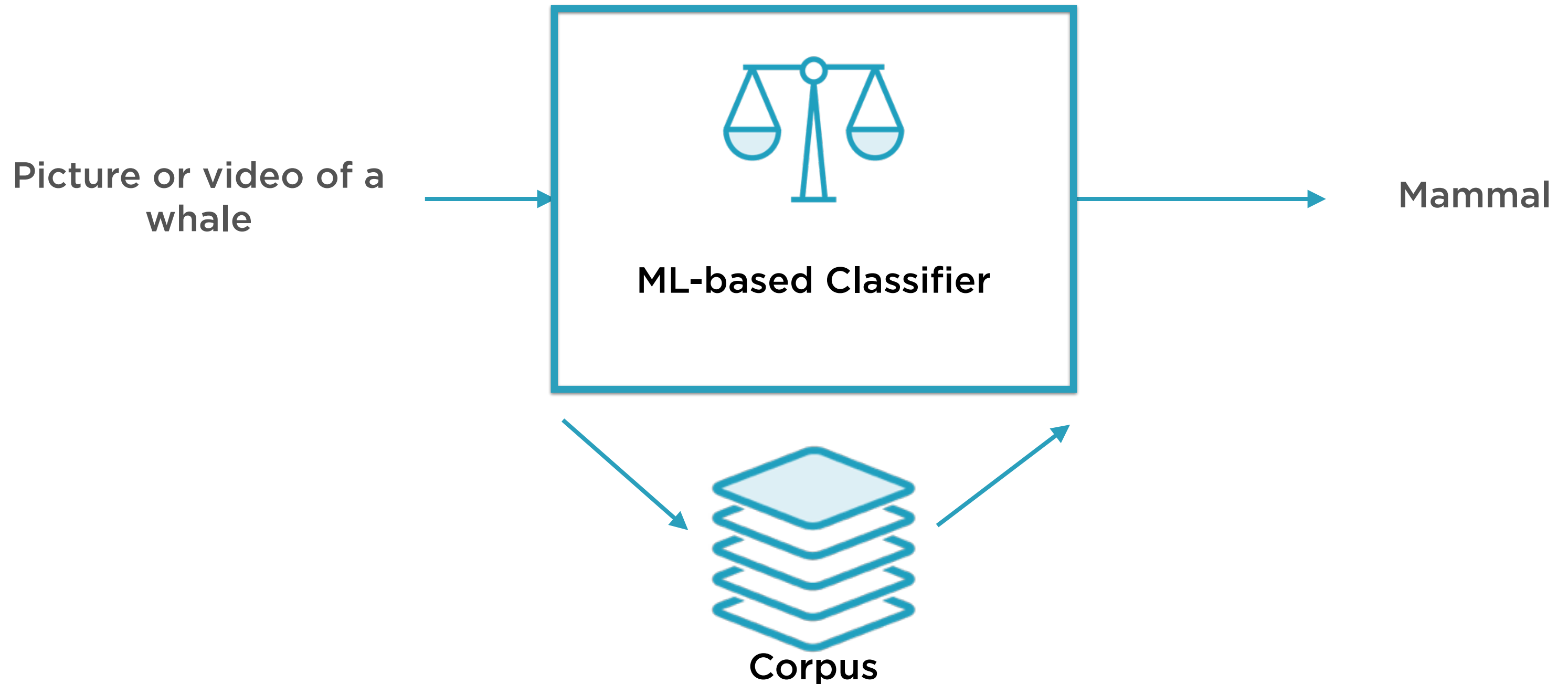
“Representation” ML-based Binary Classifier



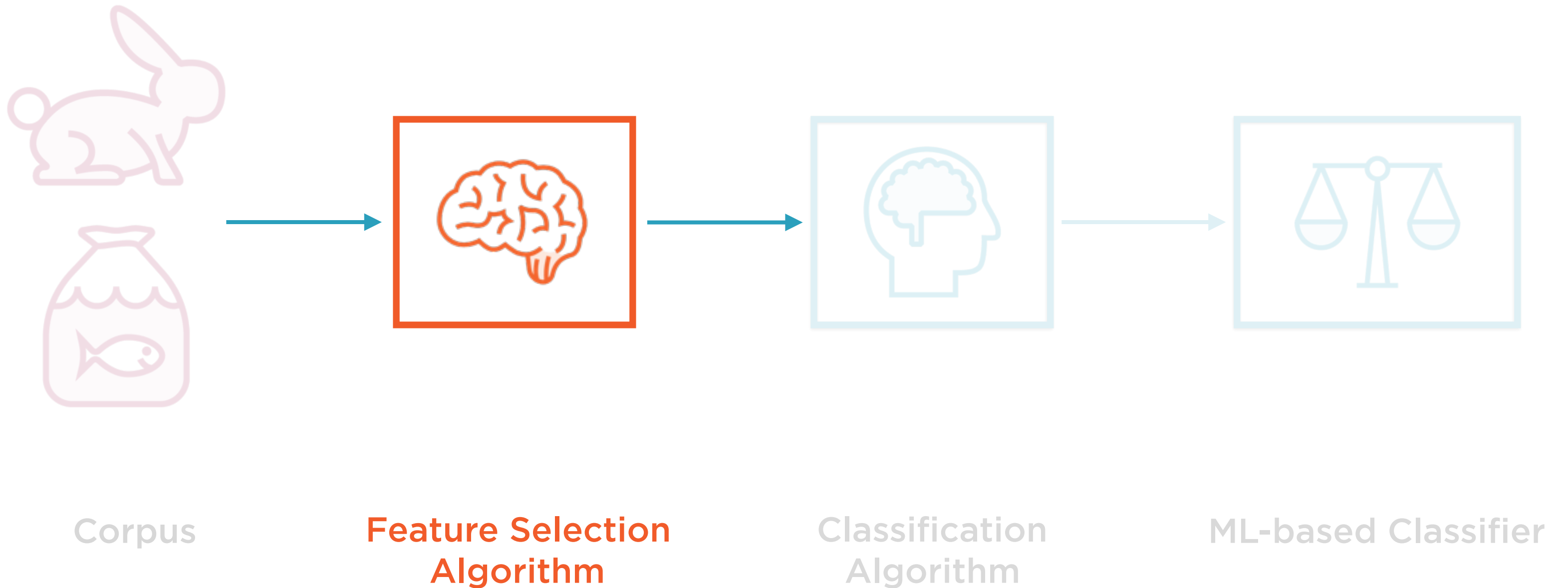
“Traditional” ML-based Binary Classifier



“Representation” ML-based Binary Classifier



“Representation” ML-based Binary Classifier



“Deep Learning” systems are one type of representation systems

Deep Learning and Neural Networks

Deep Learning and Neural Networks

Deep Learning

Algorithms that learn
what features matter

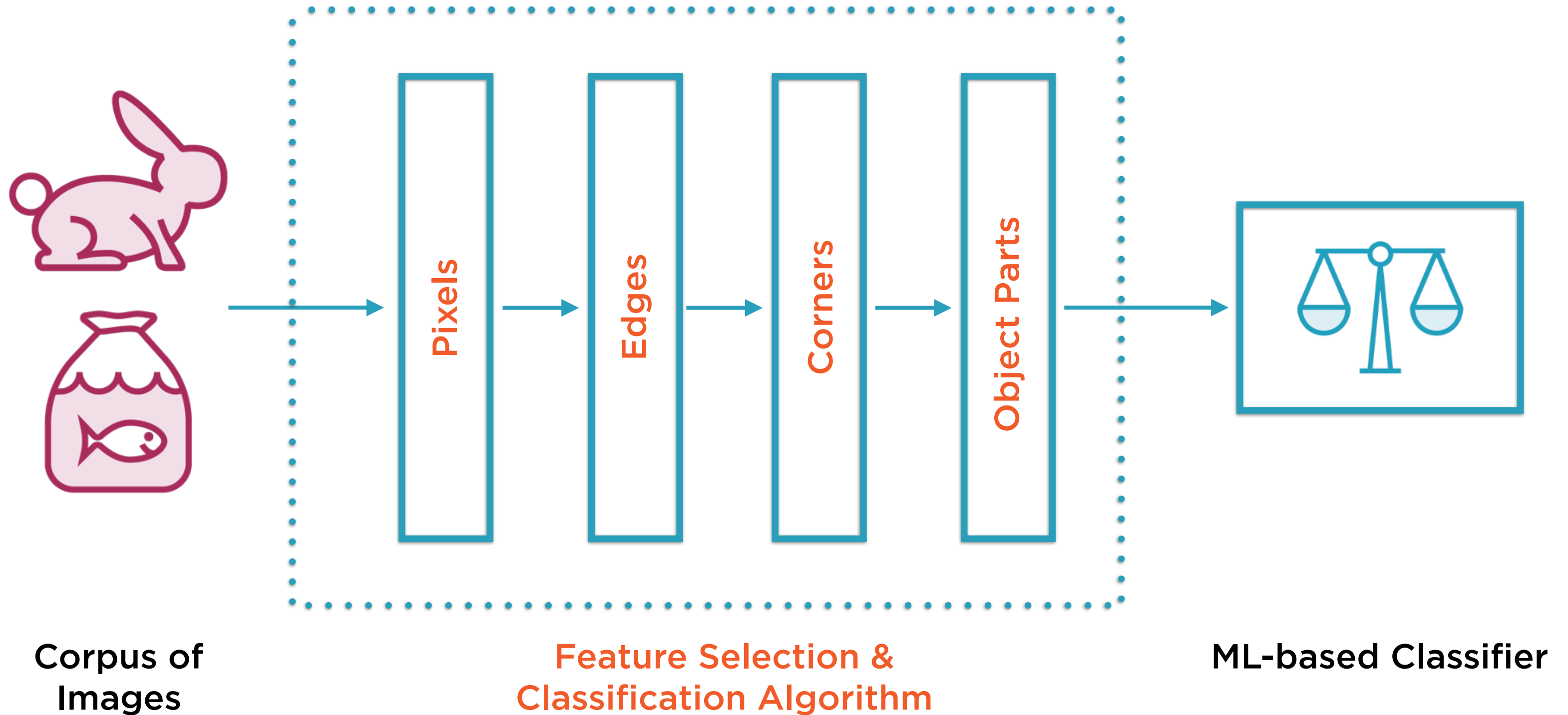
Neural Networks

The most common class
of deep learning
algorithms

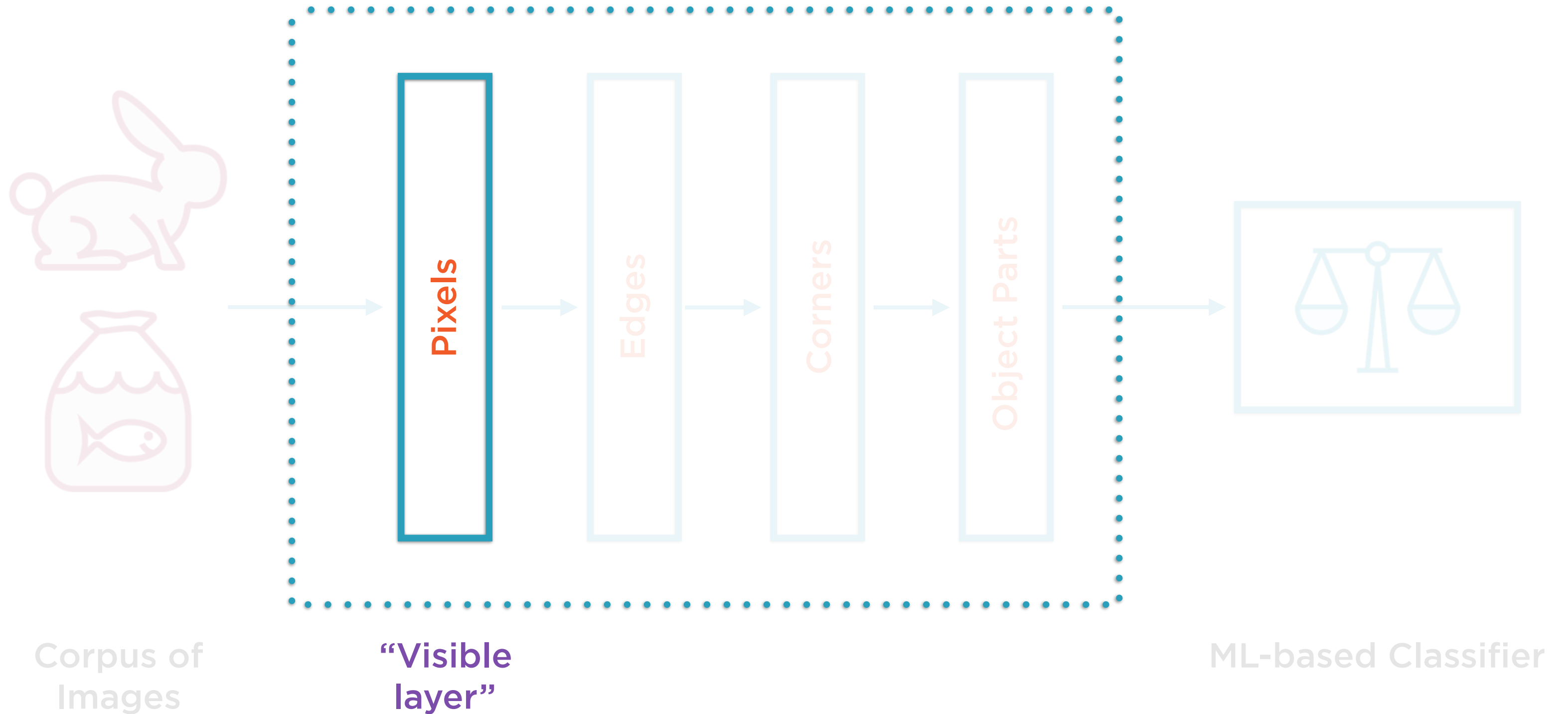
Neurons

Simple building blocks
that actually “learn”

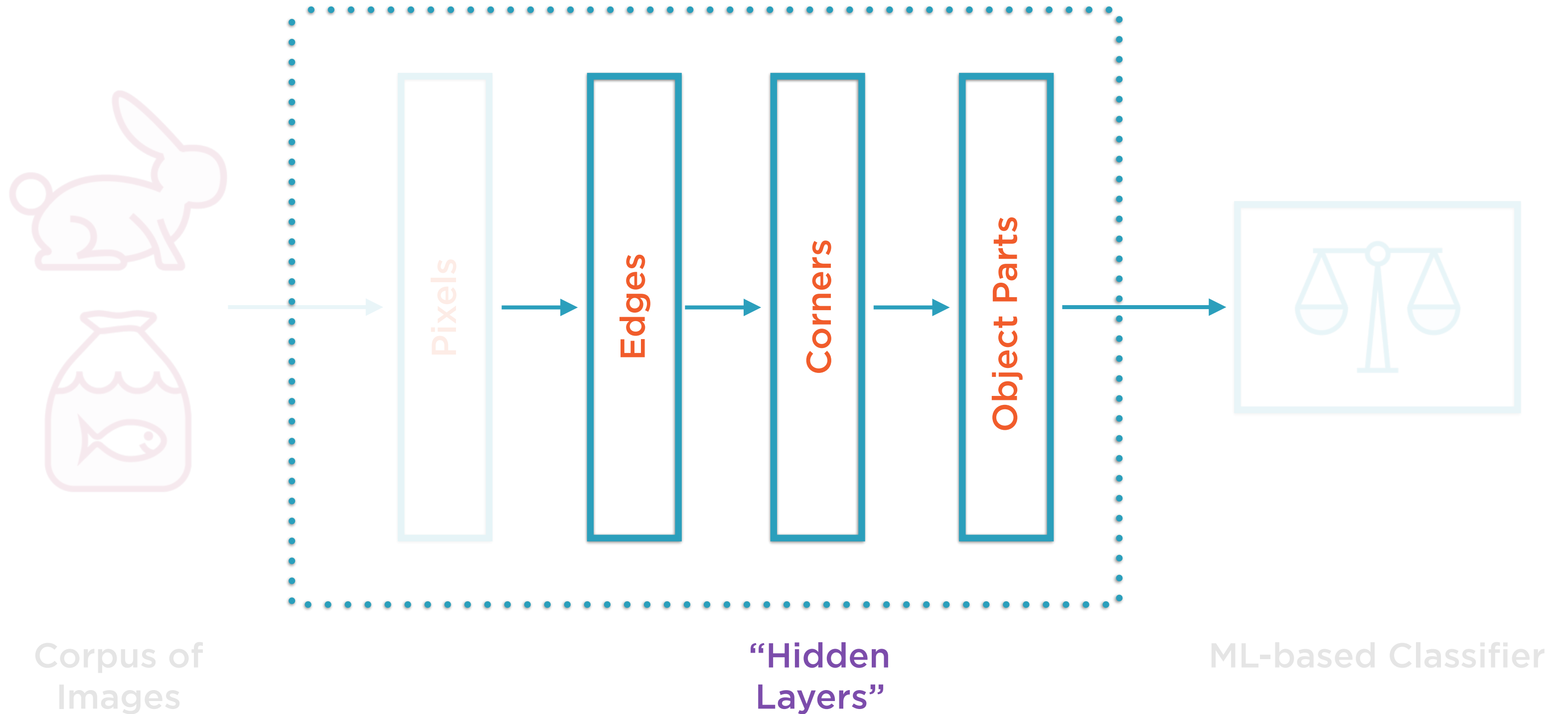
“Deep Learning”-based Binary Classifier



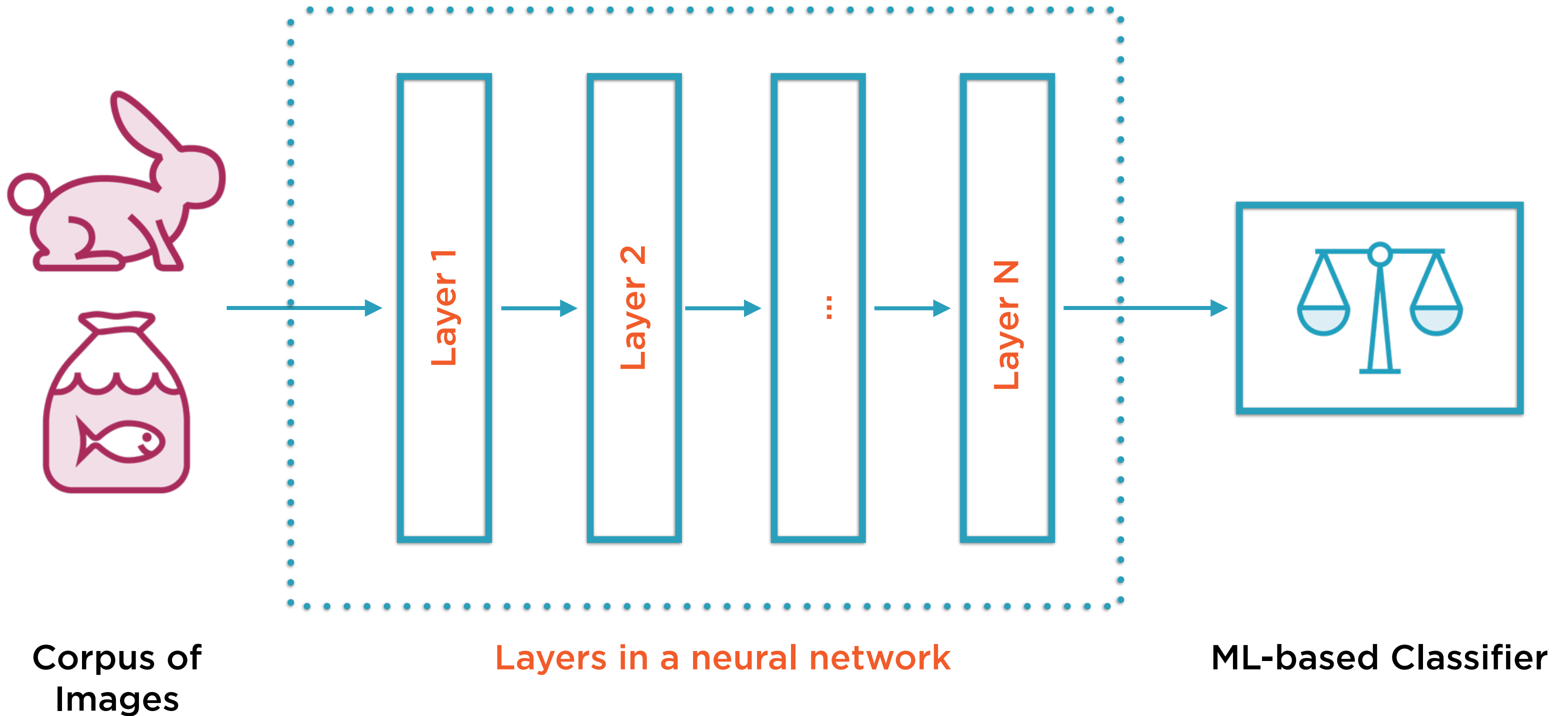
“Deep Learning”-based Binary Classifier



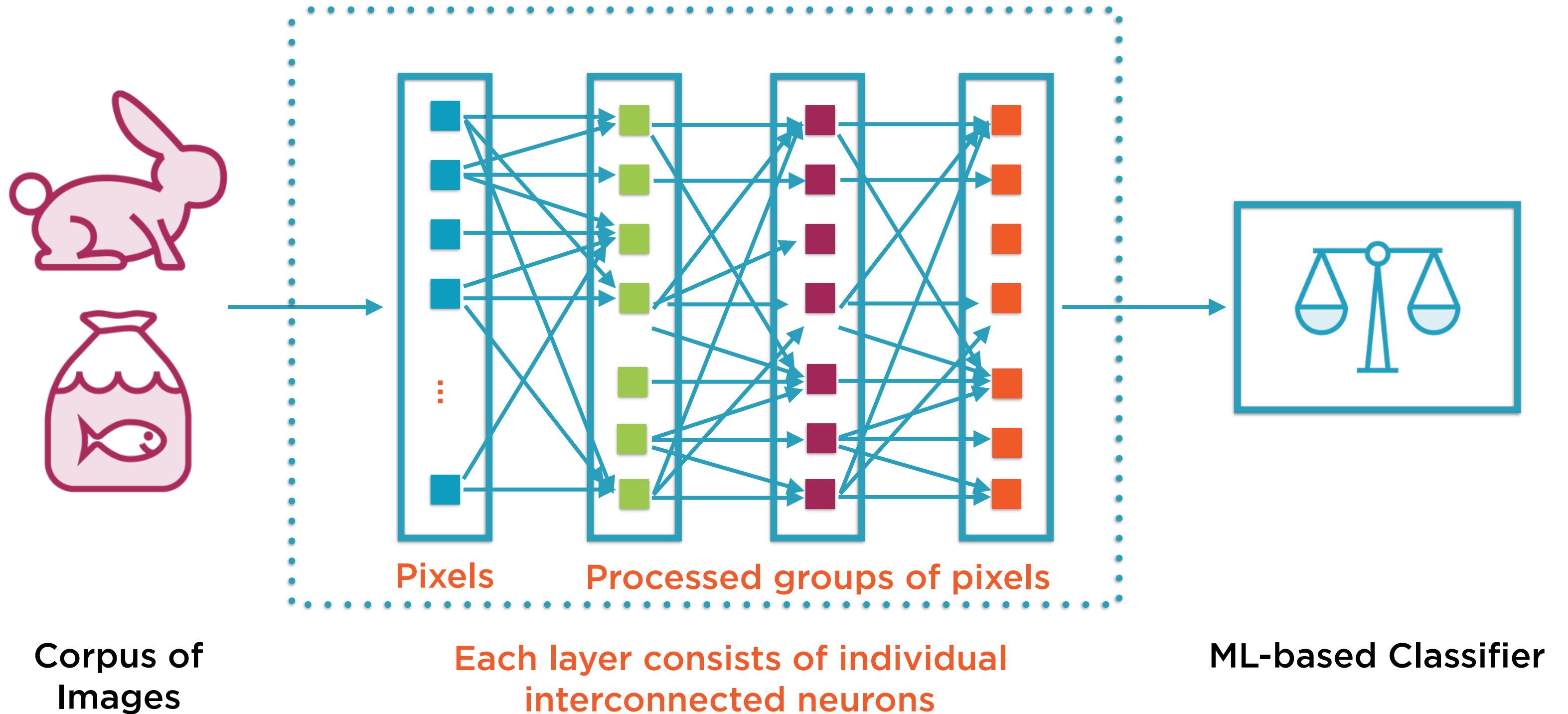
“Deep Learning”-based Binary Classifier



Neural Networks Introduced



Neural Networks Introduced



Neural networks help find unknown
patterns in massive data sets

TensorFlow for Machine Learning

TensorFlow

TensorFlow™ is an open source software library for numerical computation using data flow graphs.

<https://www.tensorflow.org/>



TensorFlow

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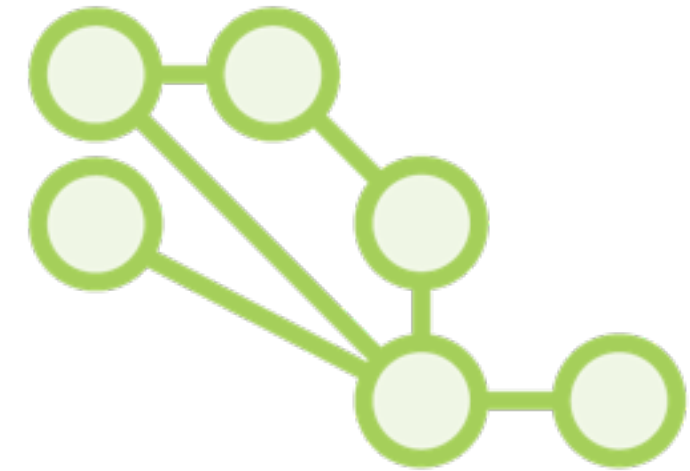
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TensorFlow

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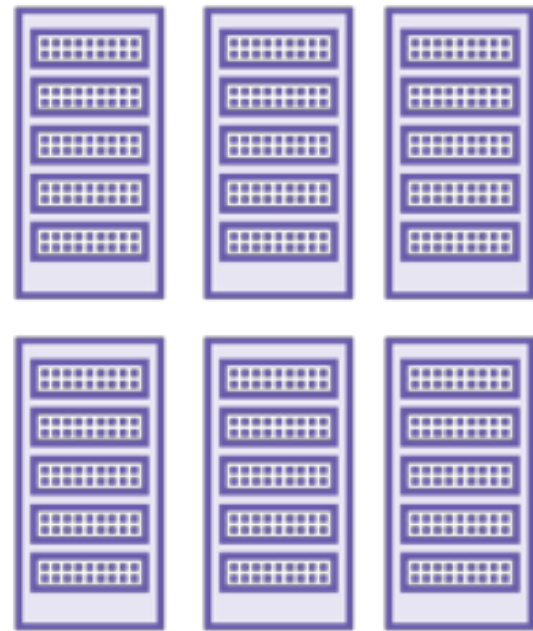


TensorFlow

TensorFlow™ is an open source software library for numerical computation using **data flow graphs**.

<https://www.tensorflow.org/>

Advantages of TensorFlow



Distributed

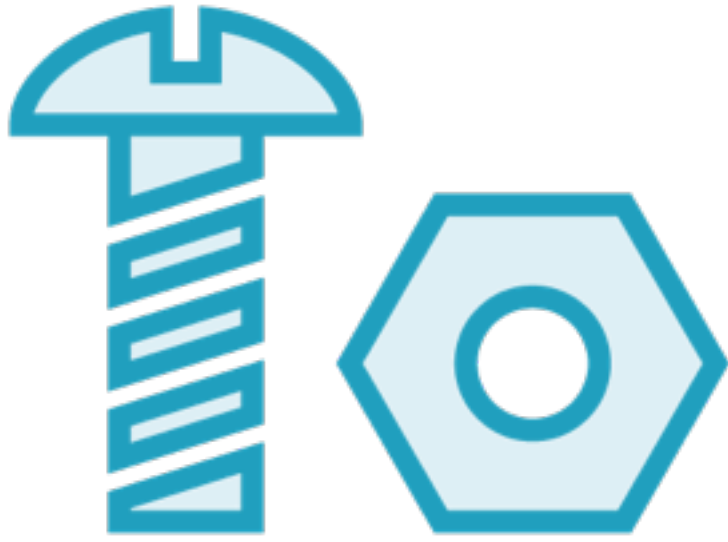
Runs on a cluster or machines or multiple CPUs/GPUs on the same machine



Suite of software

**TensorFlow,
TensorBoard,
TensorFlow Serving**

TensorFlow



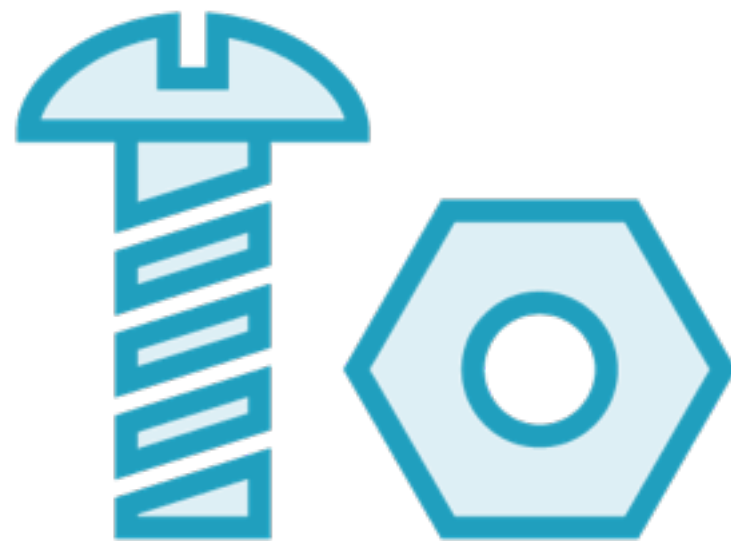
Uses



Strengths



Challenges



Uses

Research and development of new ML algorithms

Taking models from training to production

Large scale distributed models

Models for mobile and embedded systems



Strengths

Easy to use, stable Python API

Runs on large as well small systems

Efficient and performant

Great support from Google

**Additional tools like TensorBoard
and TensorFlow serving**



Challenges

Distributed support still has a ways to go

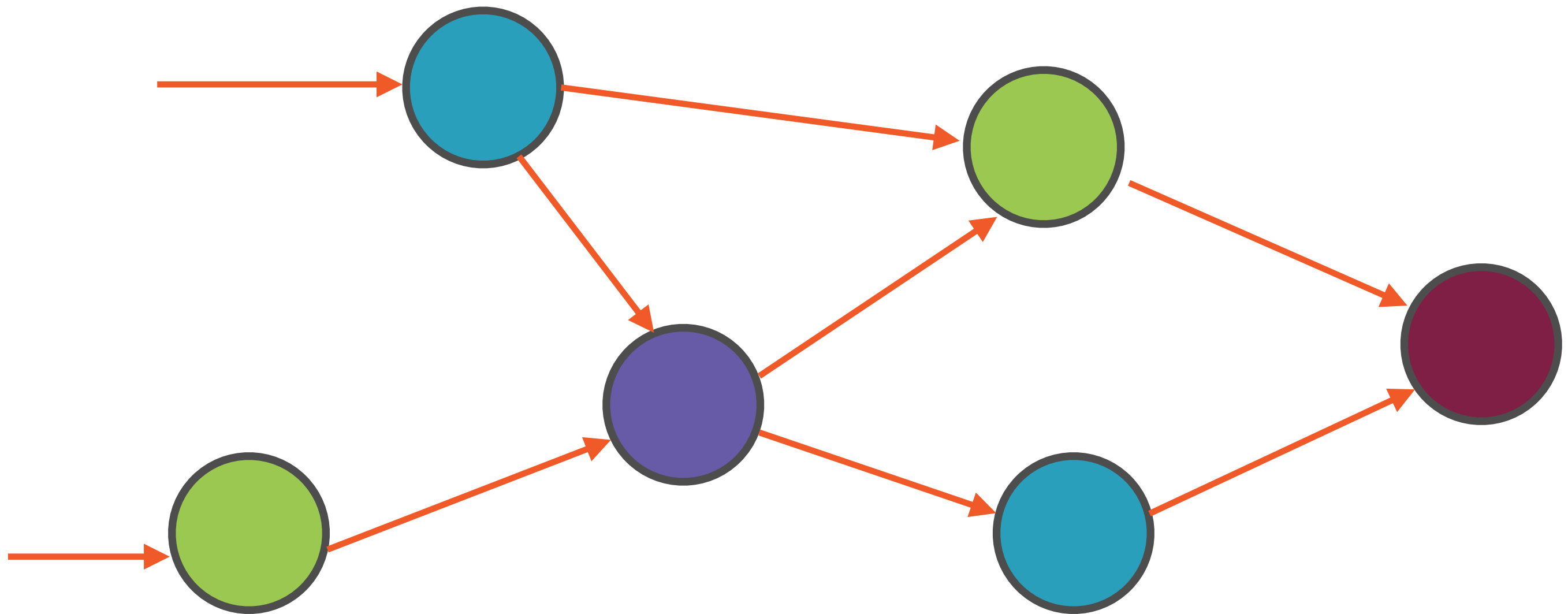
Libraries still being developed

Writing custom code is not straightforward

TensorFlow is on its way to
becoming the default library for
machine learning

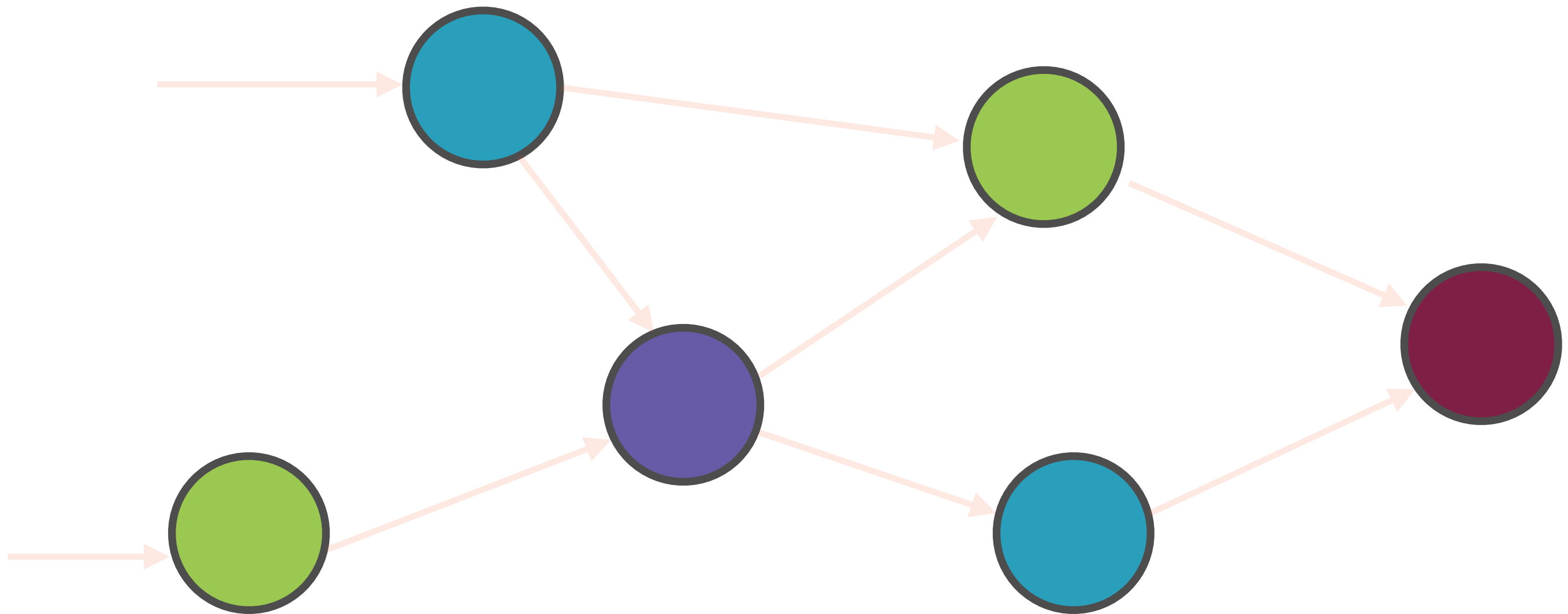
The TensorFlow World

Everything is a Graph



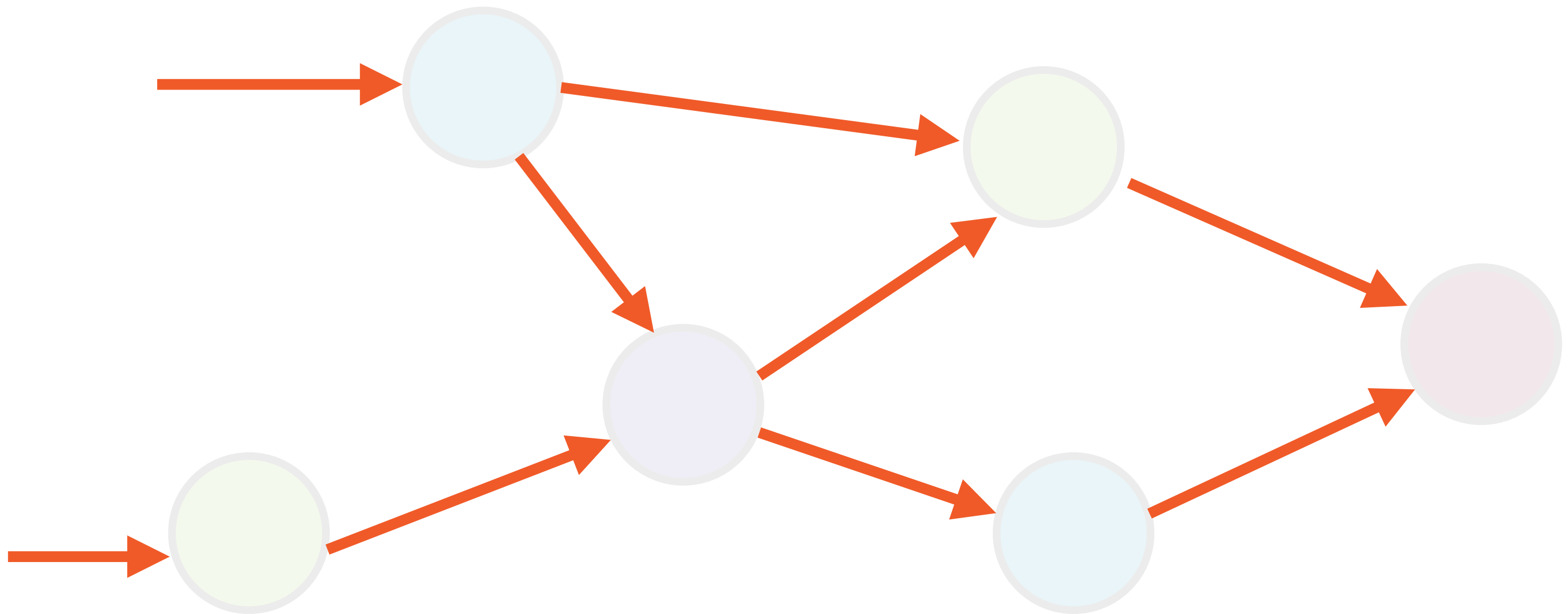
A network

Everything is a Graph



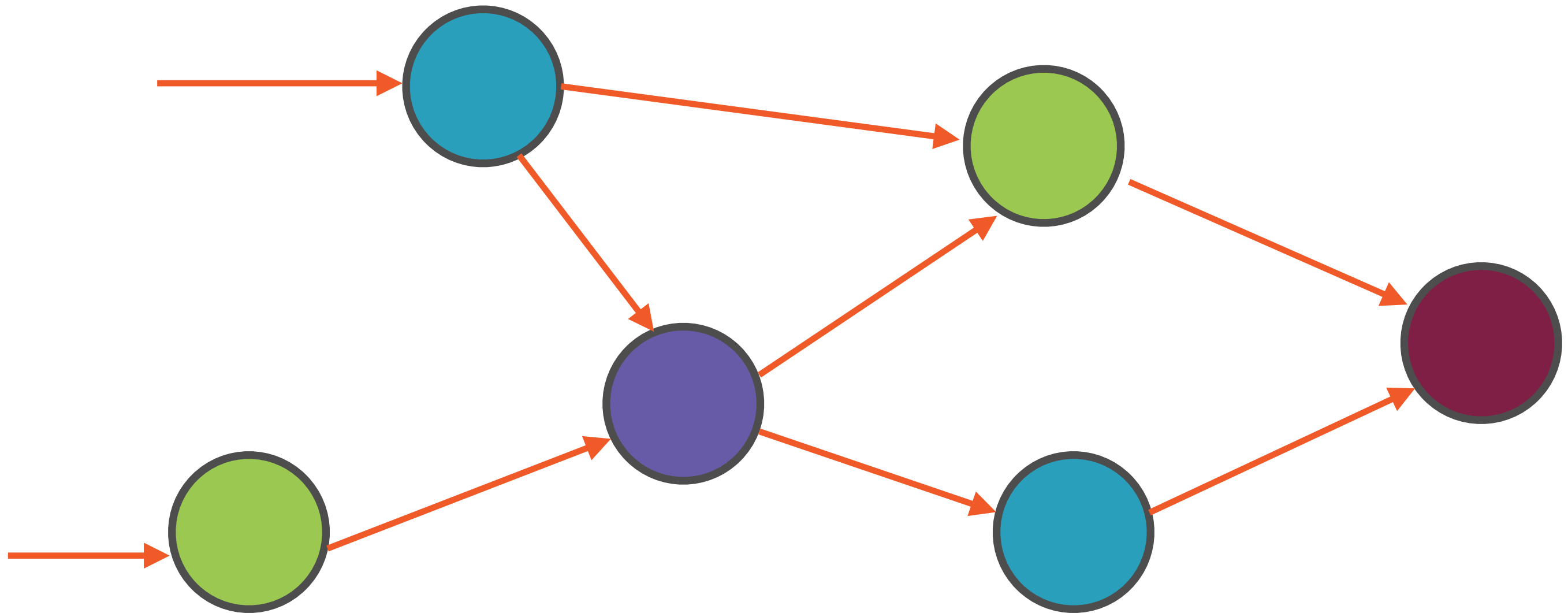
Computations

Everything is a Graph



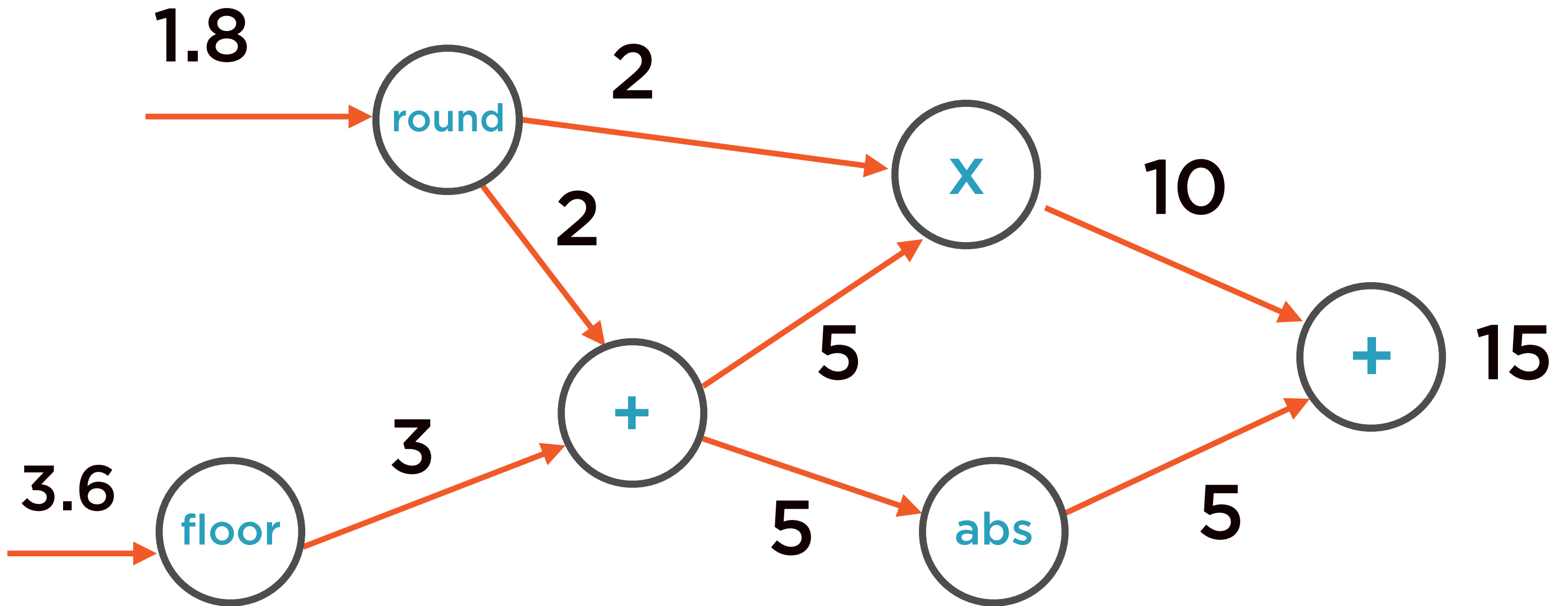
Tensors

Tensors Flow Through the Graph



...and get transformed along the way

Tensors Flow Through the Graph



TensorFlow

Demo

Download and install TensorFlow on your local machine

Validate that the TensorFlow libraries work and can be referenced

Summary

Learnt the basics of machine learning, deep learning and neural networks

Understood the strengths and challenges of using TensorFlow for ML

Understood the modeling of problem as a computational graph

Got TensorFlow up and running on your local machine