Building Generalized Linear Models Using Estimators

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Overview

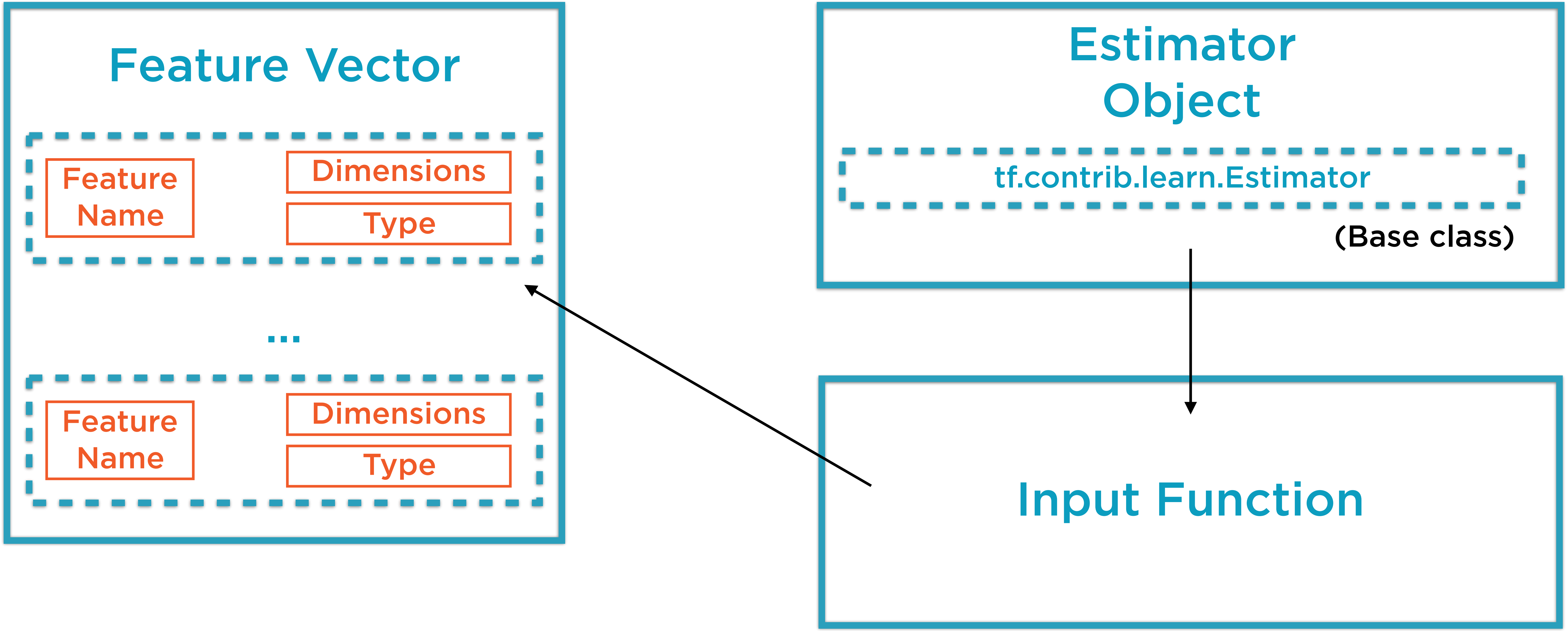
Estimators are cookie-cutter TensorFlow APIs for many standard problems

These high-level APIs reside in tf.learn and tf.contrib.learn

Estimators can be extended by plugging custom models into a base class

That extension relies on composition rather than inheritance

How Estimators Work



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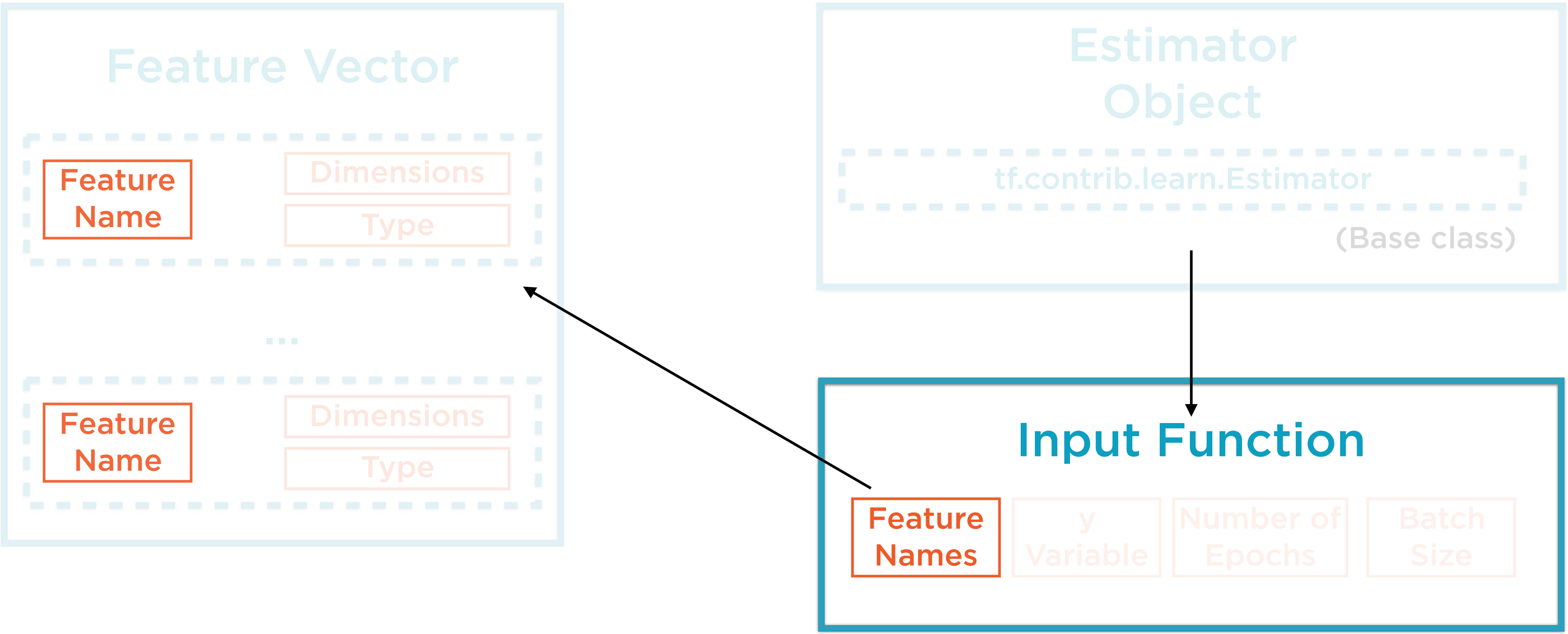

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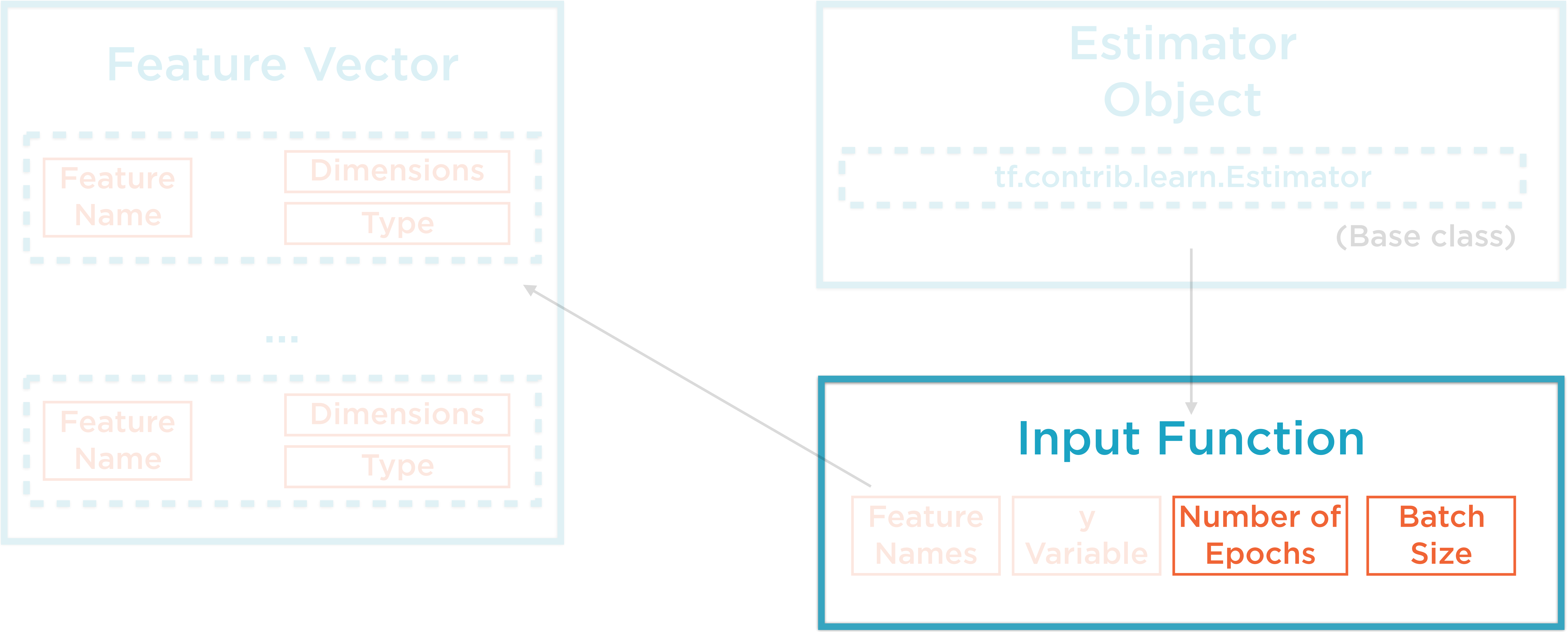

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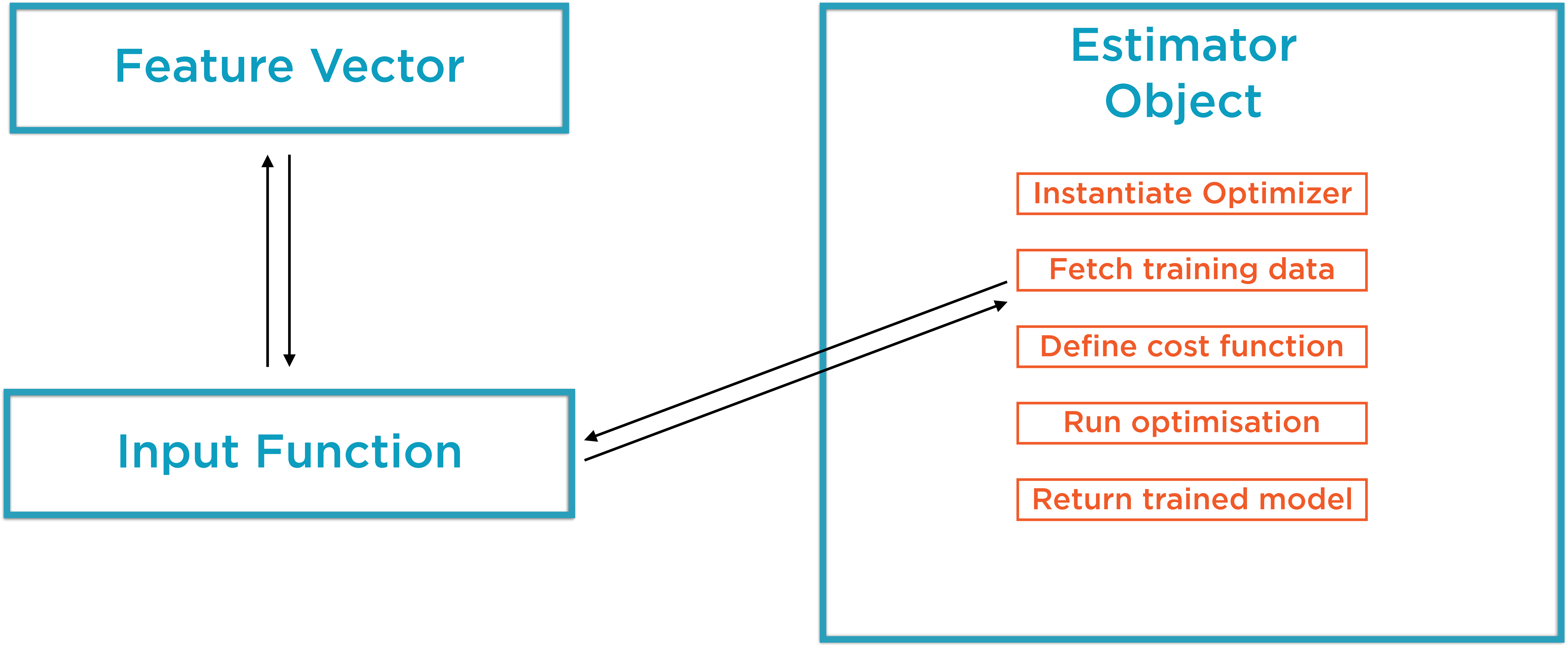

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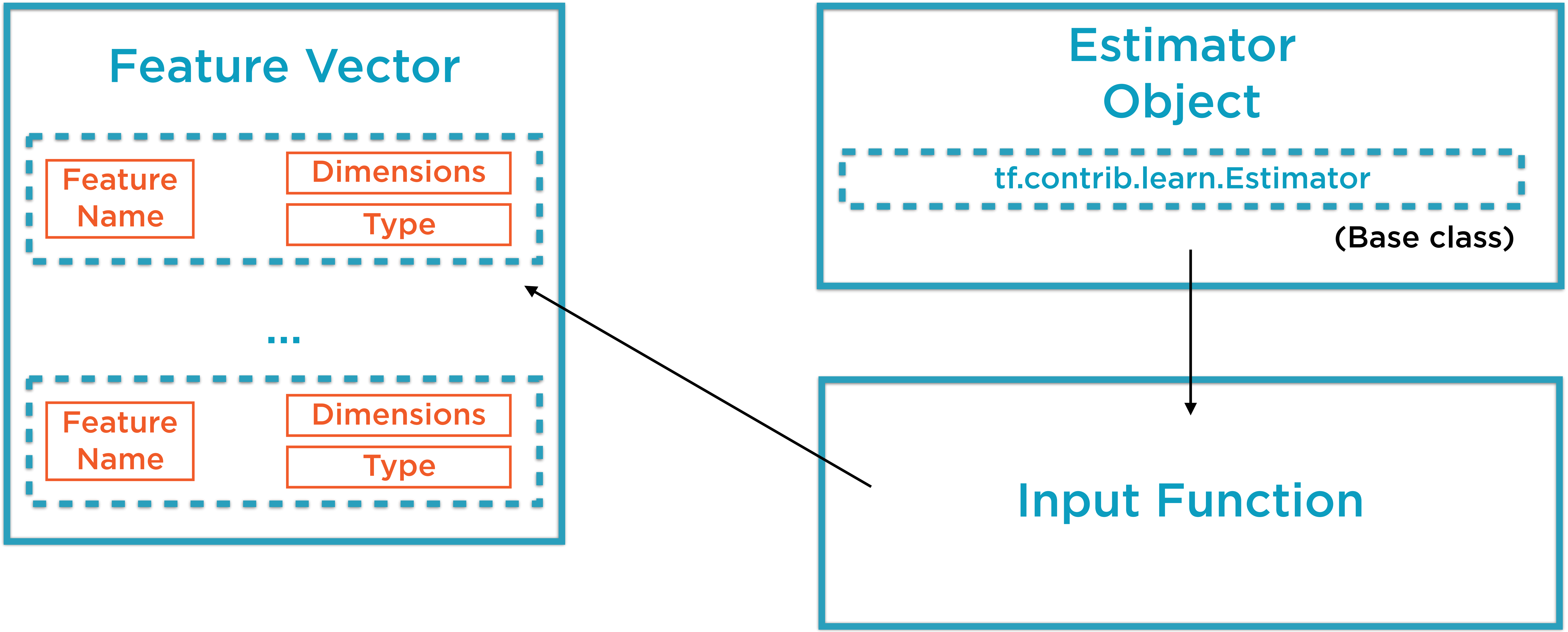

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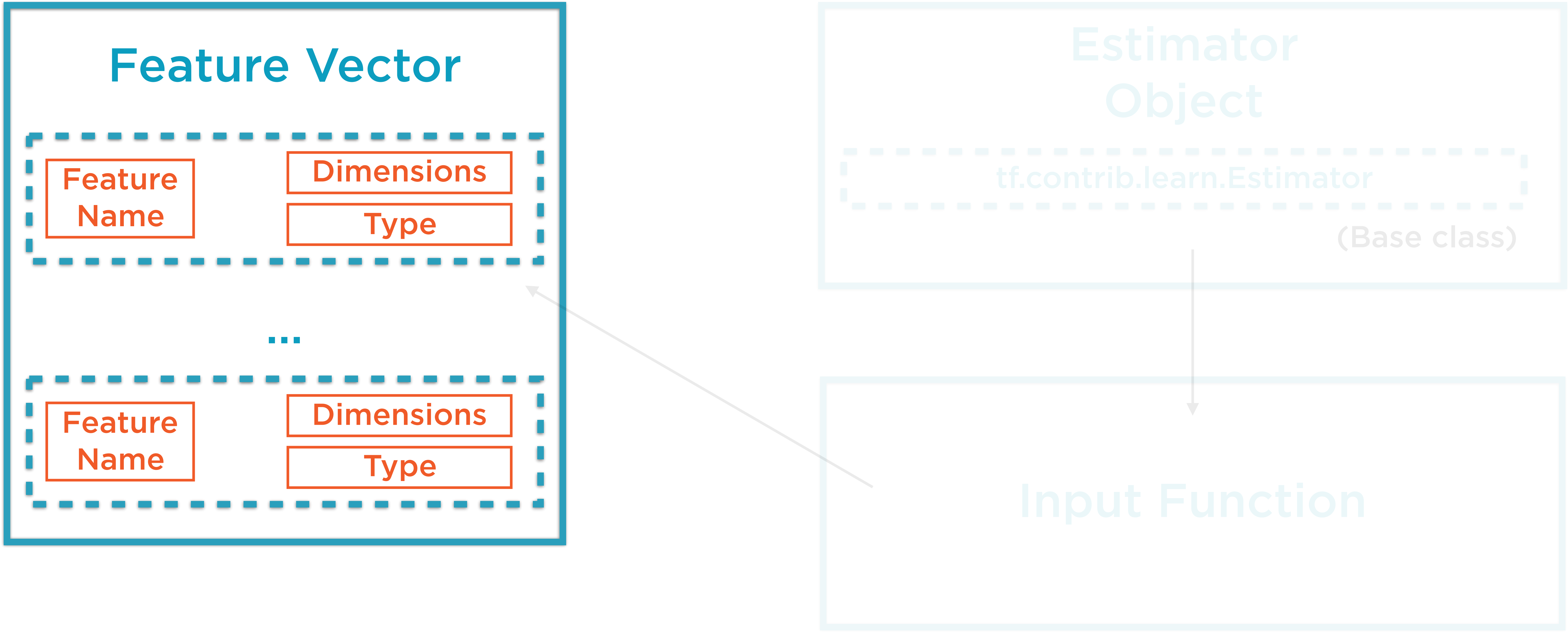
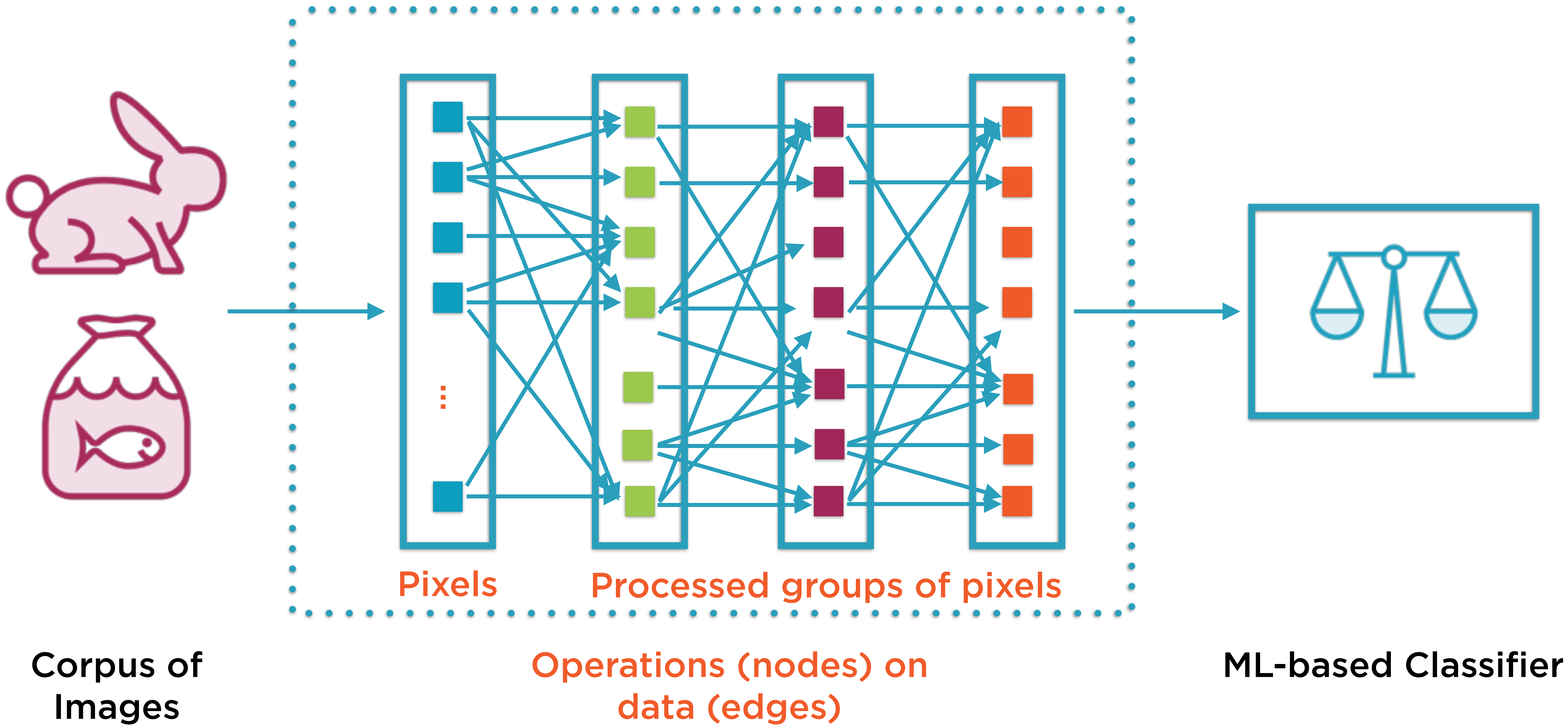
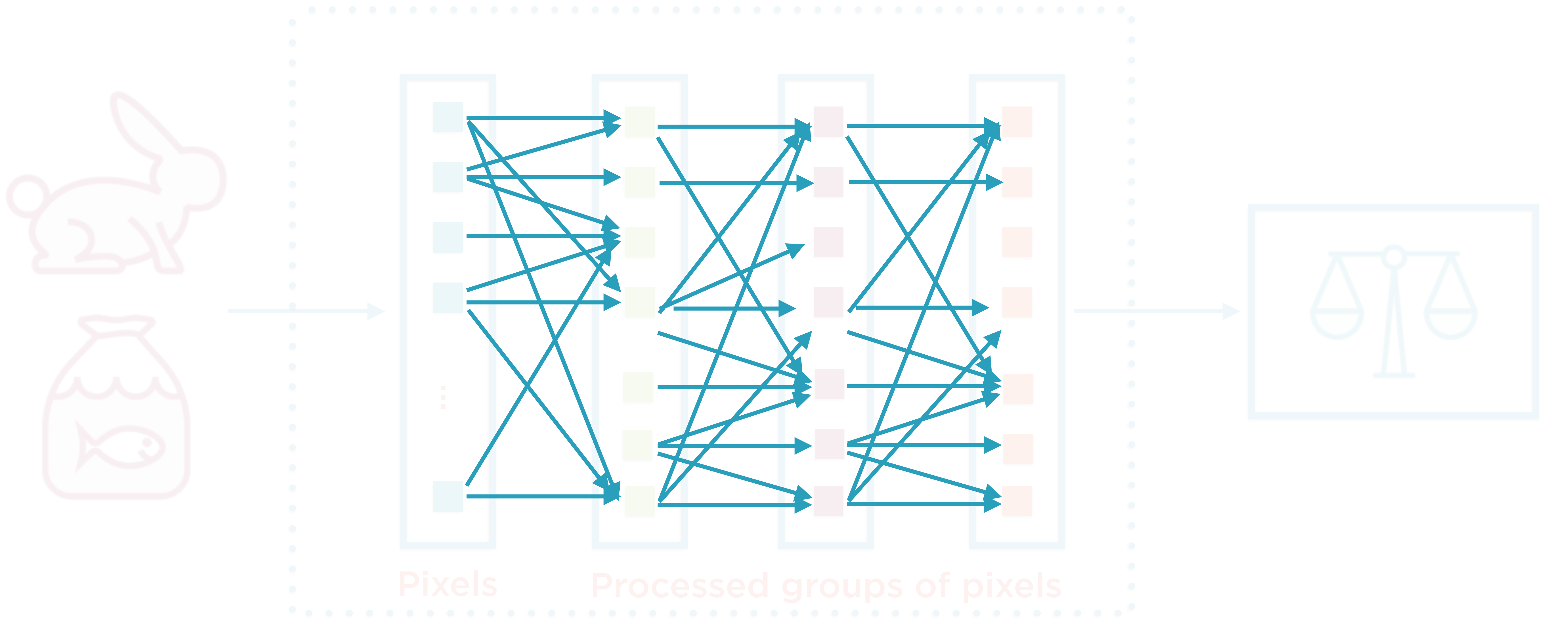


Complex Neural Networks

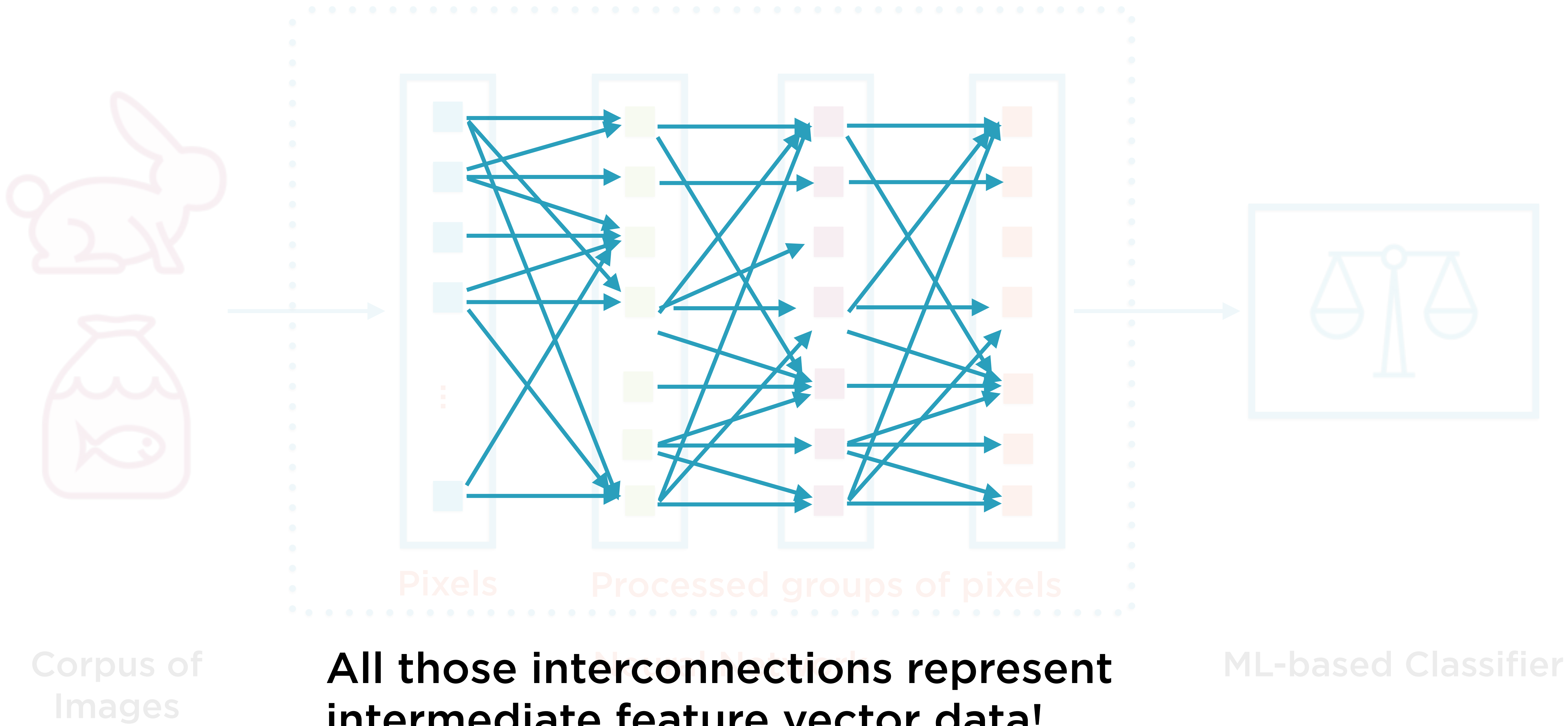


Complex Neural Networks



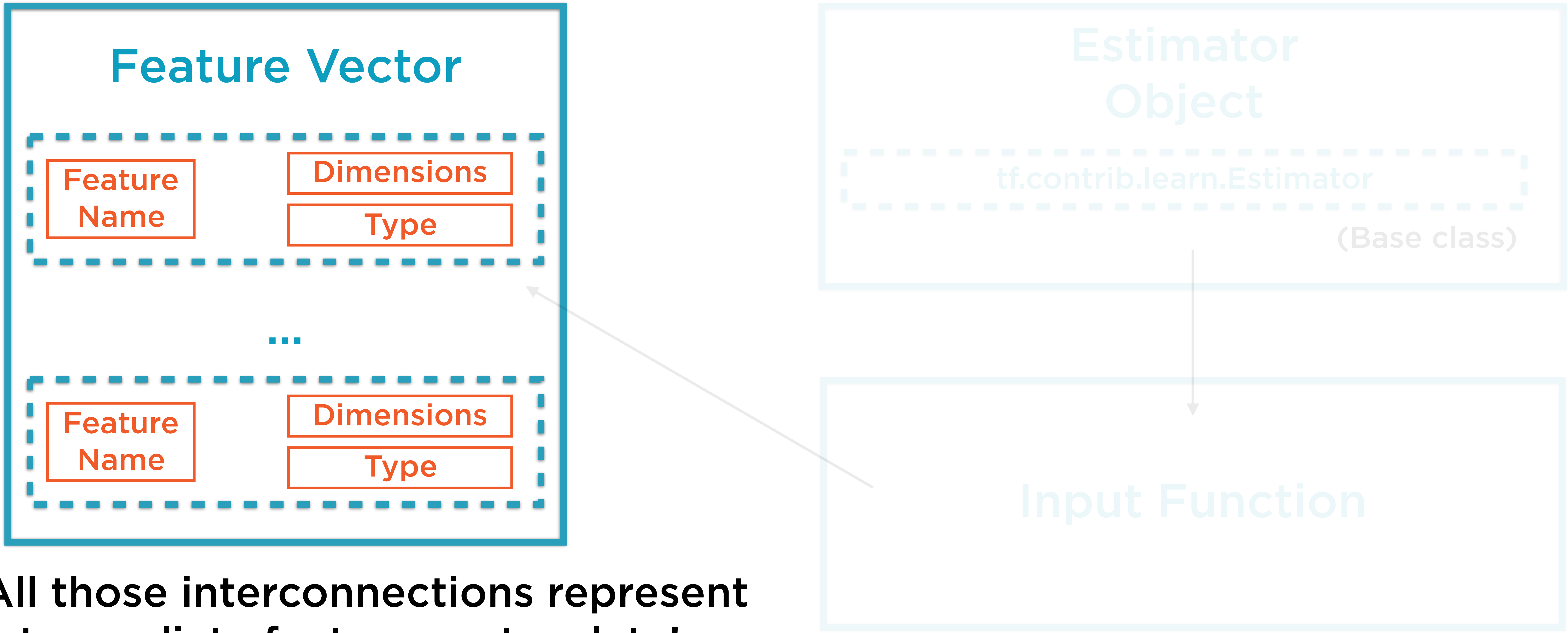
Neurons in a neural network can be connected in very complex ways...

Complex Neural Networks



All those interconnections represent intermediate feature vector data!

How Estimators Work



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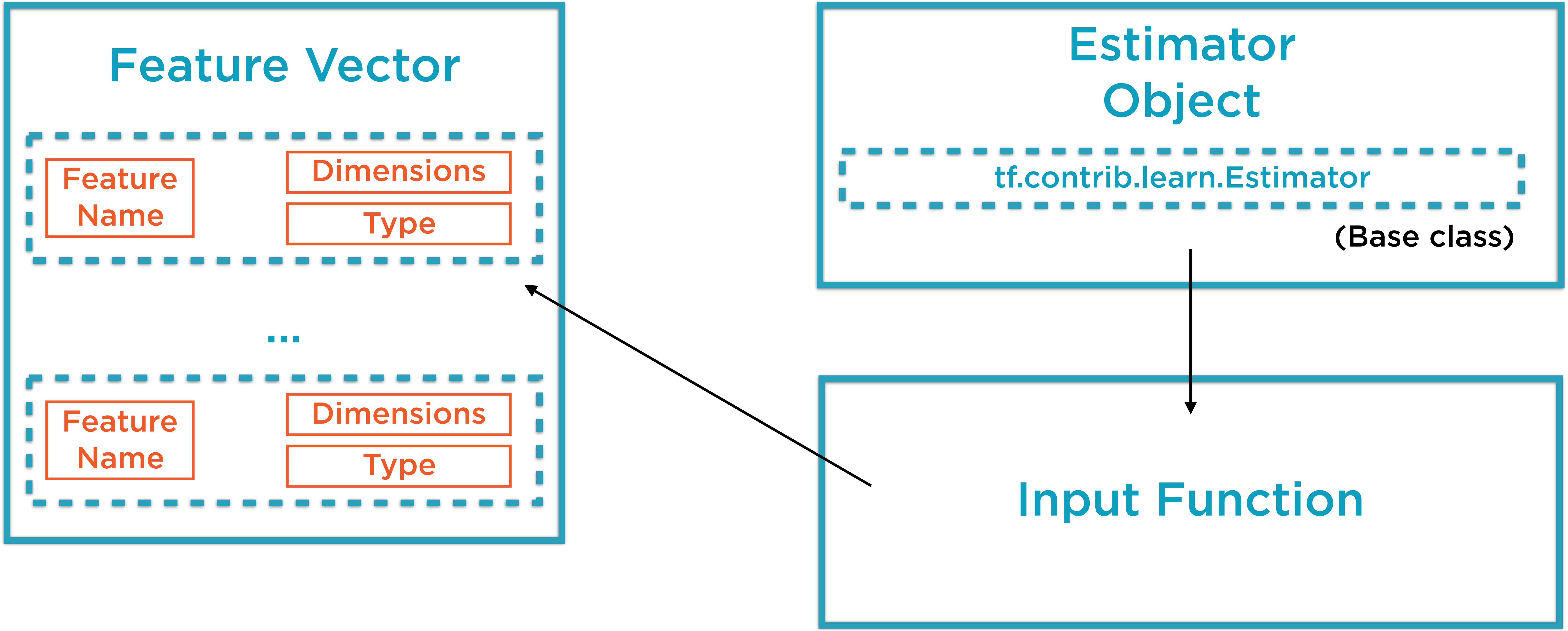

Linear Regression in TensorFlow

Baseline

Non-TensorFlow implementation

Regular python code

Computation Graph

Neural network of 1 neuron

Affine transformation suffices

Cost Function

Mean Square Error (MSE)

Quantifying goodness-of-fit

Optimizer

Gradient Descent optimizers

Improving goodness-of-fit

Training

Invoke optimizer in epochs

Batch size for each epoch

Converged Model

Values of W and b

Compare to baseline

Logistic Regression in TensorFlow

Baseline
Non-TensorFlow implementation
Regular python code

Computation Graph
Neural network of 1 neuron
Softmax activation required

Cost Function
Cross Entropy
Similarity of distribution

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Linear Regression with an Estimator

Baseline

Non-TensorFlow implementation

Regular python code

Instantiate Estimator

tf.contrib.learn.LinearRegressor

Abstracts cost and optimizer choices

Input Function

tf.contrib.learn.io.numpy_input_fn

Set up X, Y, batch_size, num_epochs

Fit

Returns trained model

Can re-specify number of training steps

Evaluate

Use trained model

Predict new points (test data)

Course Outline

Learning using Neurons

Linear Regression in TensorFlow

Logistic Regression in TensorFlow

Estimators

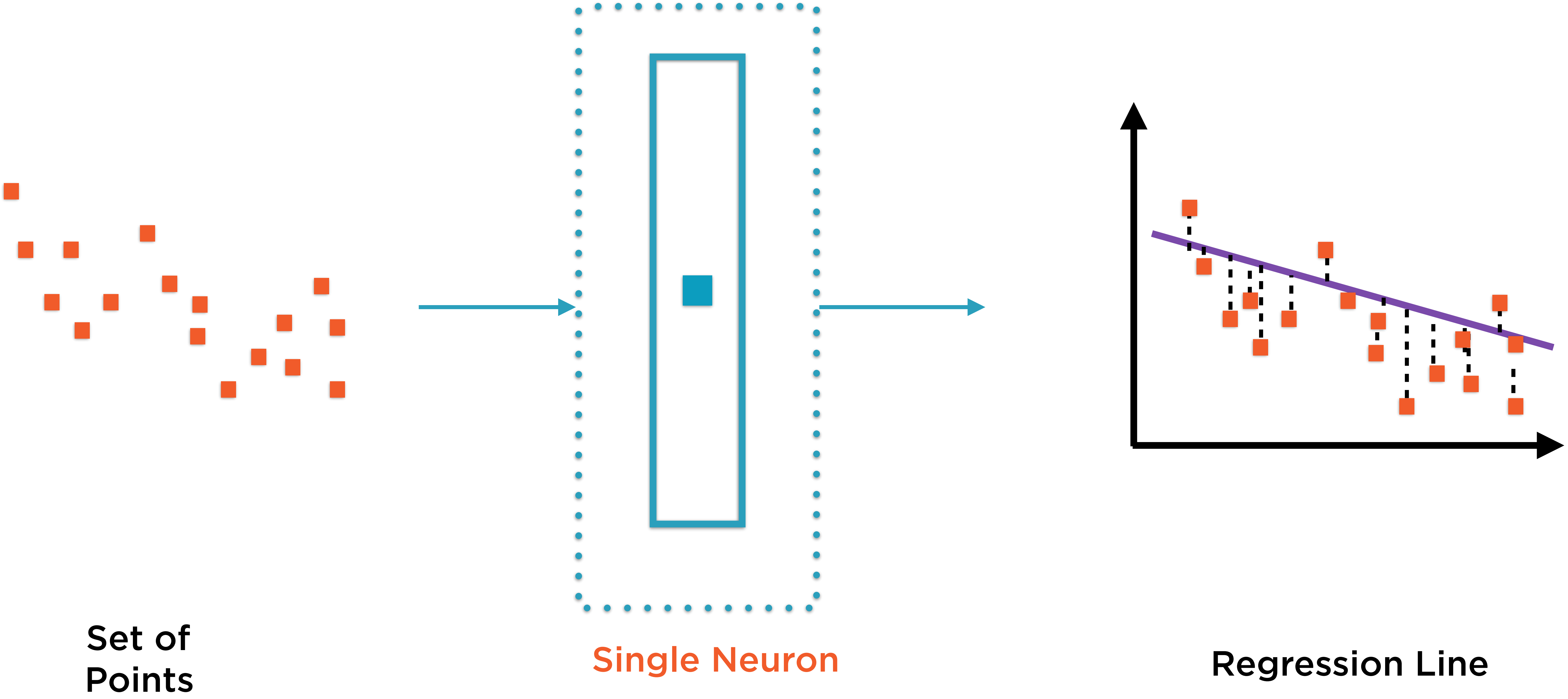
“Representation” ML-based systems figure out by themselves what features to pay attention to

```
y = Wx + b
```

“Learning” Regression

Regression can be reverse-engineered by a single neuron

Regression: The Simplest Neural Network

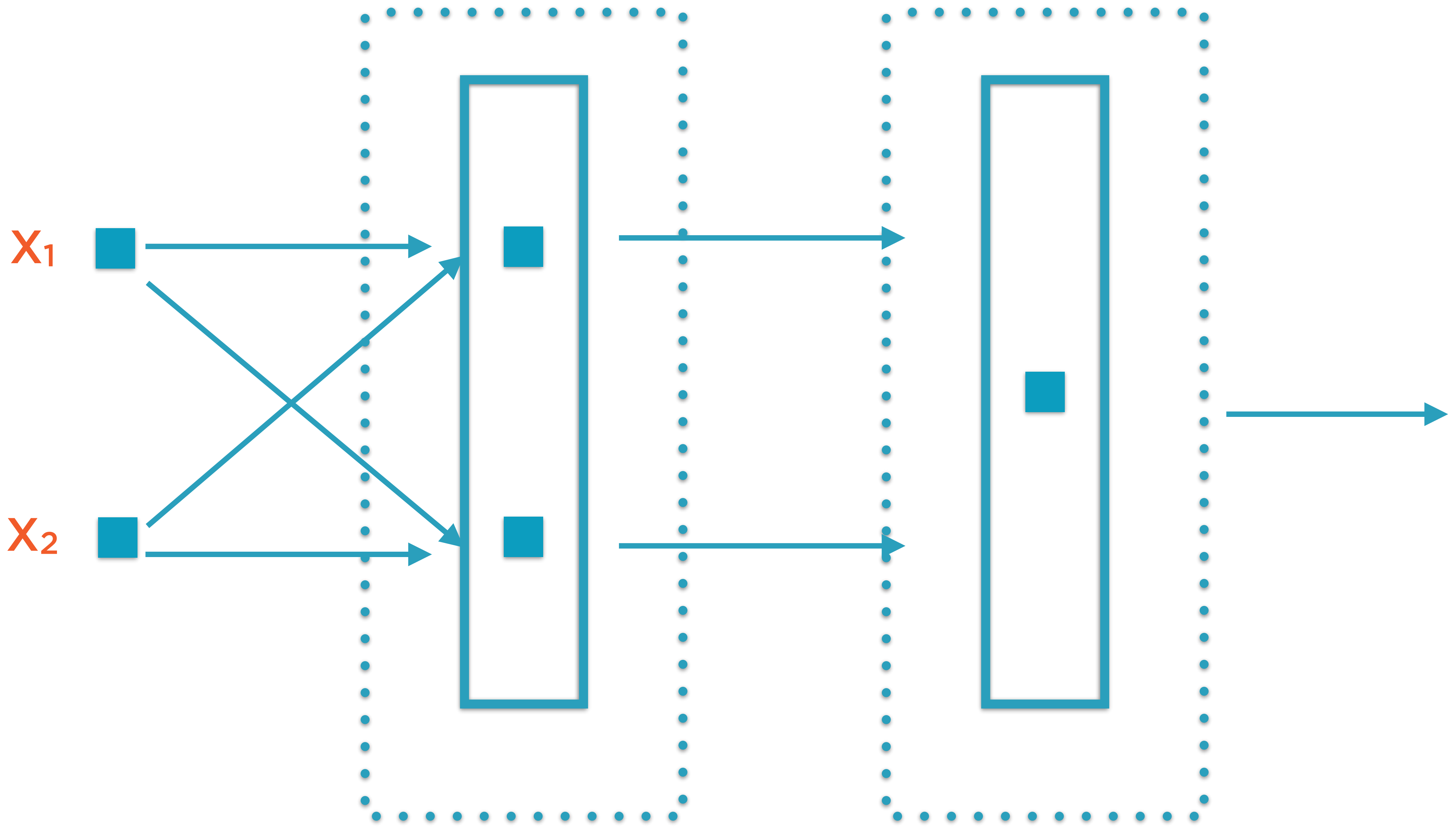


```
def XOR(x1,x2):
  if (x1 == x2):
     return 0
  return 1
```

“Learning” XOR

The XOR function can be reverse-engineered using 3 neurons arranged in 2 layers

XOR: 3 Neurons, 2 Layers



2 Inputs

Layer 1

Layer 2

X_1	X_2	Y
0	0	0
0	1	1
1	0	1
1	1	0

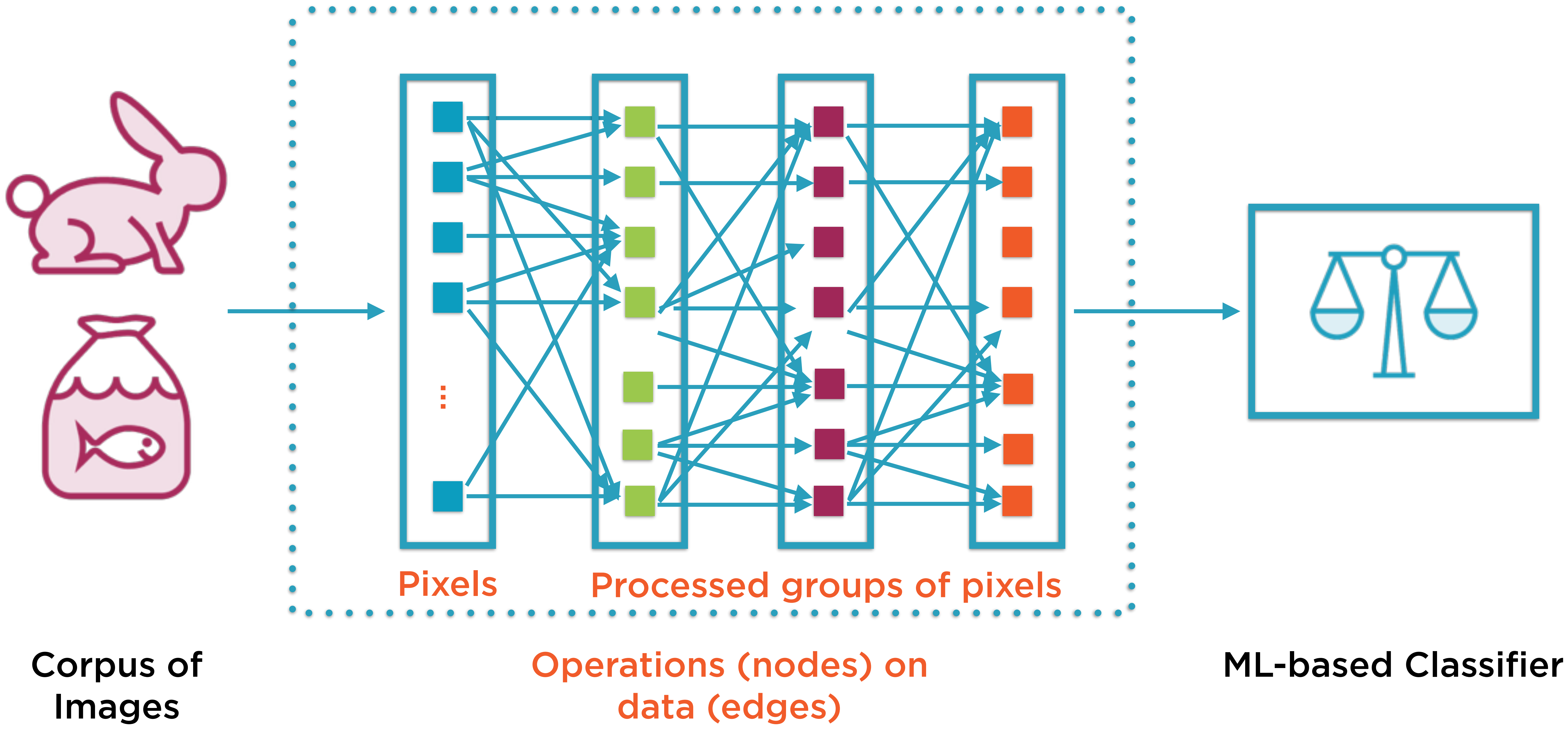
Output Truth Table

```
def doSomethingReallyComplicated(x1,x2…):
  …
  …
  …
  return complicatedResult
```

“Learning” Arbitrarily Complex Functions

Adding layers to a neural network can “learn” (reverse-engineer) pretty much anything

Arbitrarily Complex Function



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Logistic Regression Using Estimators