

# JuliaCon 2019

# Parallel Computing

# Workshop

Welcome!

# Machine Learning workshop

- Download JuliaPro version 1.1.1.1
  - <https://juliacomputing.com/products/juliapro>
- Install it!
- Download the workshop materials
  - [github.com/mbauman/MachineLearningWorkshop2019](https://github.com/mbauman/MachineLearningWorkshop2019)
- Open Julia Pro, go to File -> Add Project Folder... and select the downloaded folder

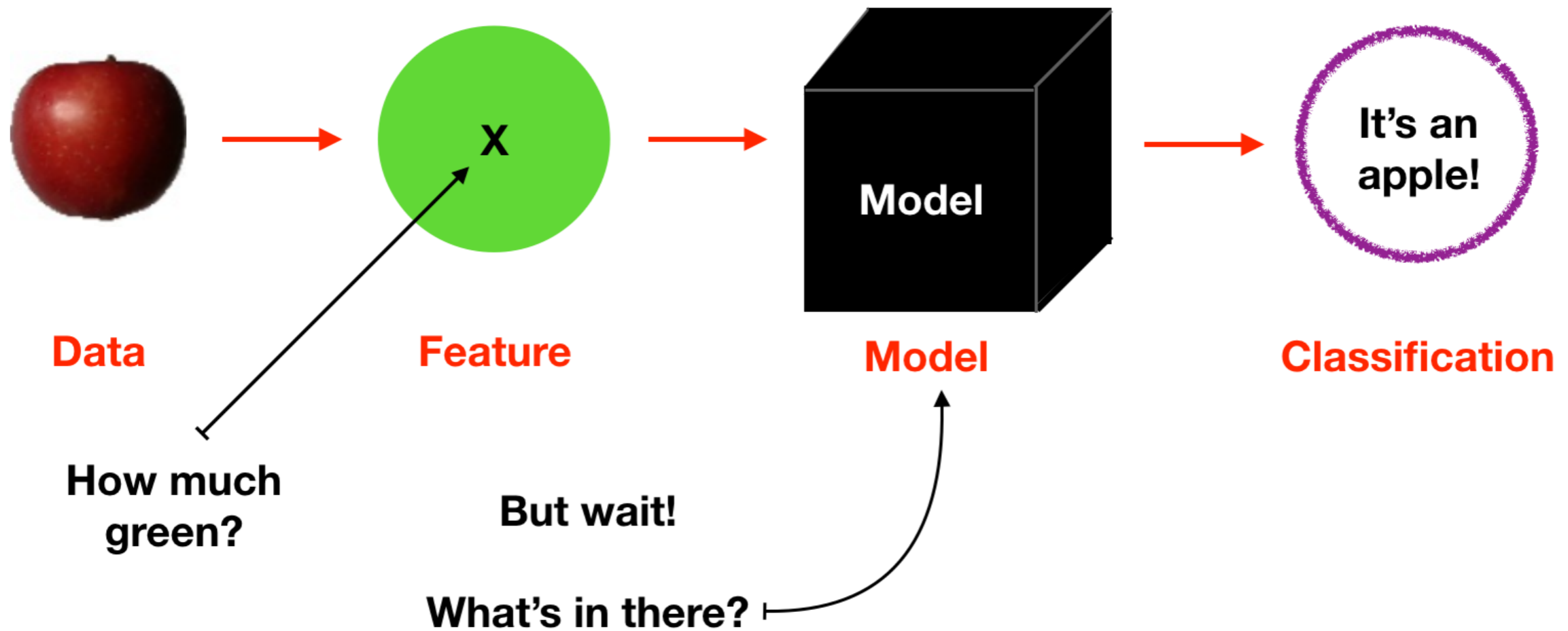
Demo: Express image  
classification!

# Building your own machine learning models with Flux

- The first task: classify images of fruit
- What should the computer use to distinguish images of apples from bananas?

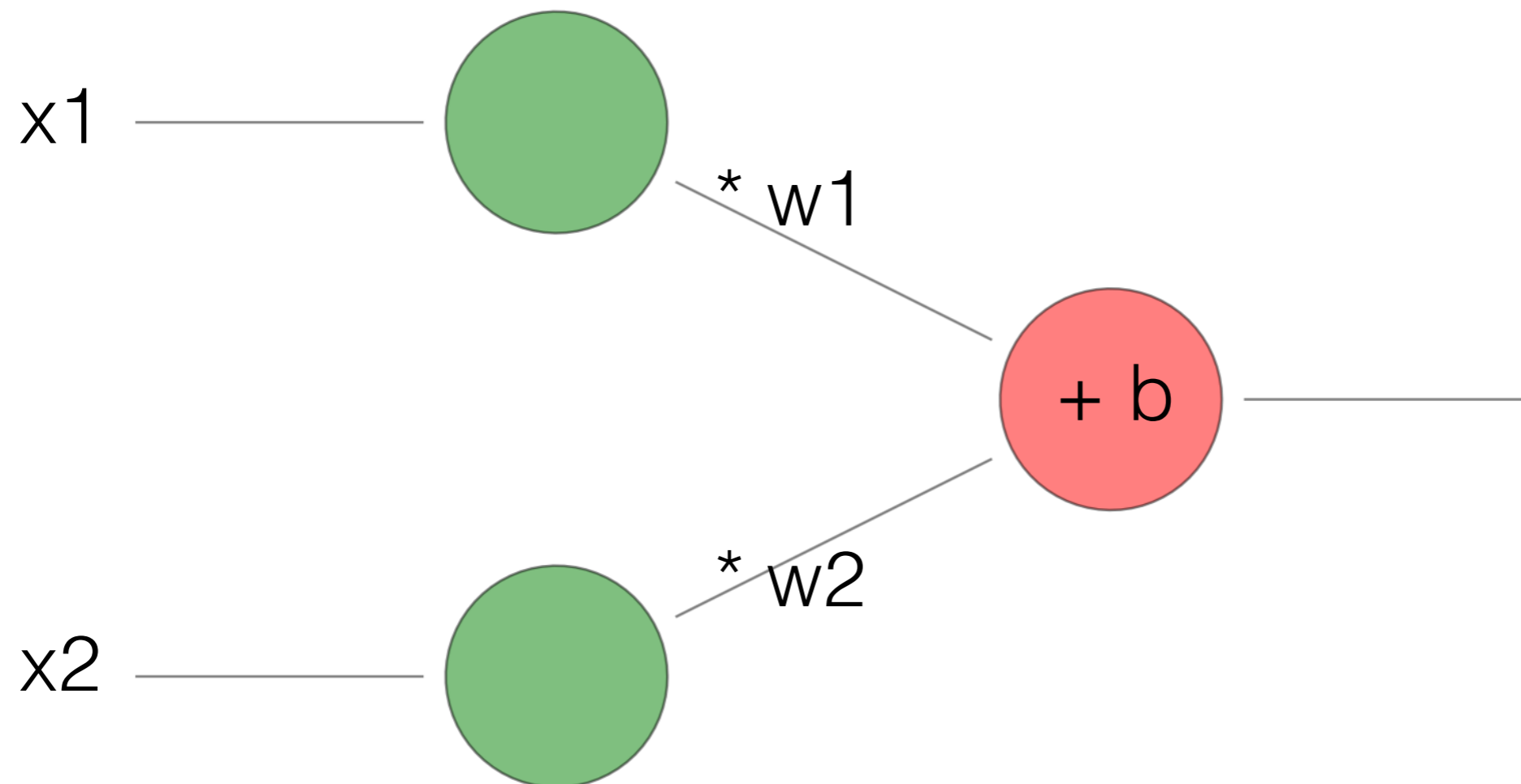


# Terminology



# Multiple inputs

- What if we want to use more than just one value?



# Multiple outputs



$$= [1, 0, 0]$$





$$= [0, 1, 0]$$




$$= [0, 0, 1]$$

# Multiple outputs

 = [1, 0, 0]

 = [0, 1, 0]

 = [0, 0, 1]

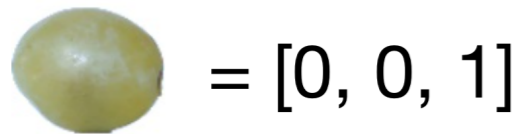
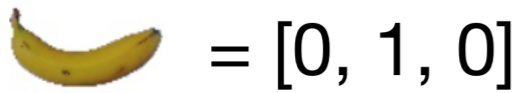
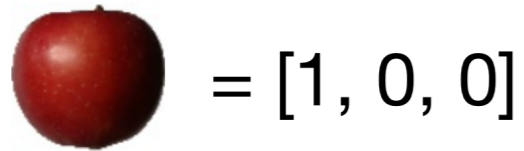
$$\sigma(x; w^{(1)}, b^{(1)}) := \frac{1}{1 + \exp(-w^{(1)} \cdot x + b^{(1)})};$$

$$\sigma(x; w^{(2)}, b^{(2)}) := \frac{1}{1 + \exp(-w^{(2)} \cdot x + b^{(2)})};$$

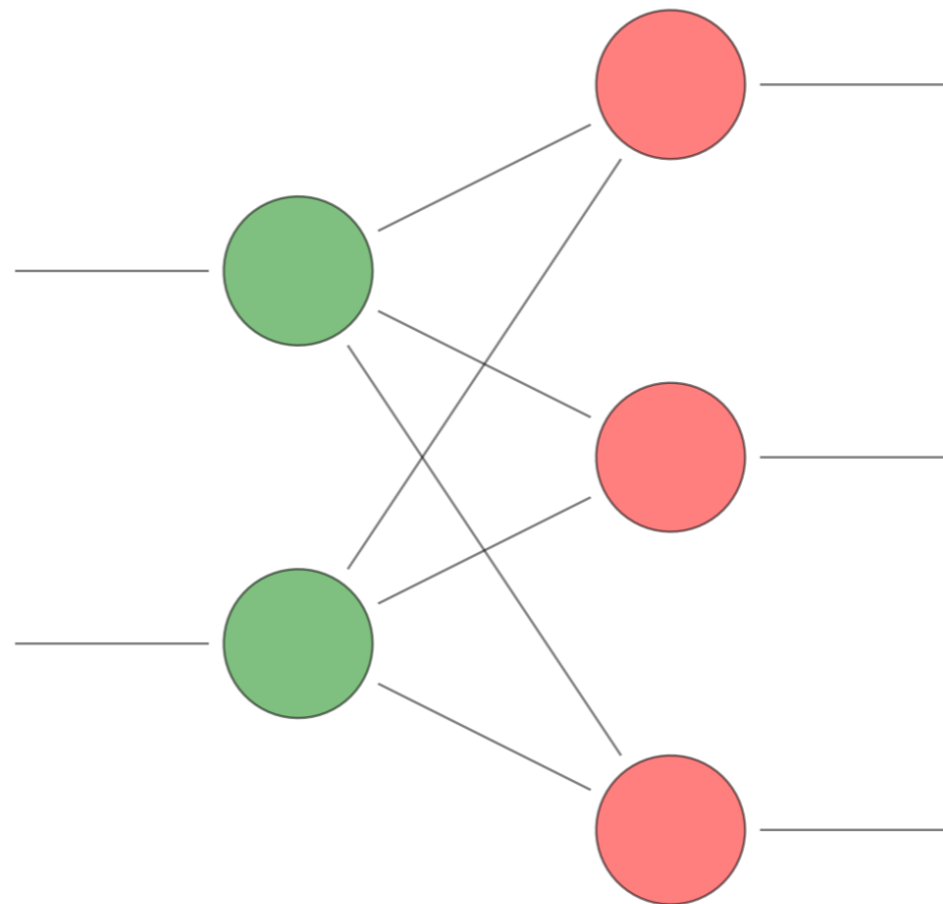
$$\sigma(x; w^{(i)}, b^{(i)}) := \frac{1}{1 + \exp(-w^{(i)} \cdot x + b^{(i)})}.$$



# Multiple outputs



$$\sigma(x; w, b) = \begin{bmatrix} \sigma^{(1)} \\ \sigma^{(2)} \\ \vdots \\ \sigma^{(n)} \end{bmatrix} = \frac{1}{1 + \exp(-Wx + b)}$$



# Multiple layers!

