Neural Networks

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Study Abroad

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What to expect?

In this session we will discuss:

- Neural networks
- Gradient Descent
- Backpropagation

Tree-based methods

- Simple, intuitive and powerfiul for both regression and classification
- The method divides a feature space X into smaller regions and fit a simple prediction function for each region.

  Regression eg, take the mean of the training responses associated with the training features that fall in the specific region

  Classification eg, take the majority vote among corresponding response variables.

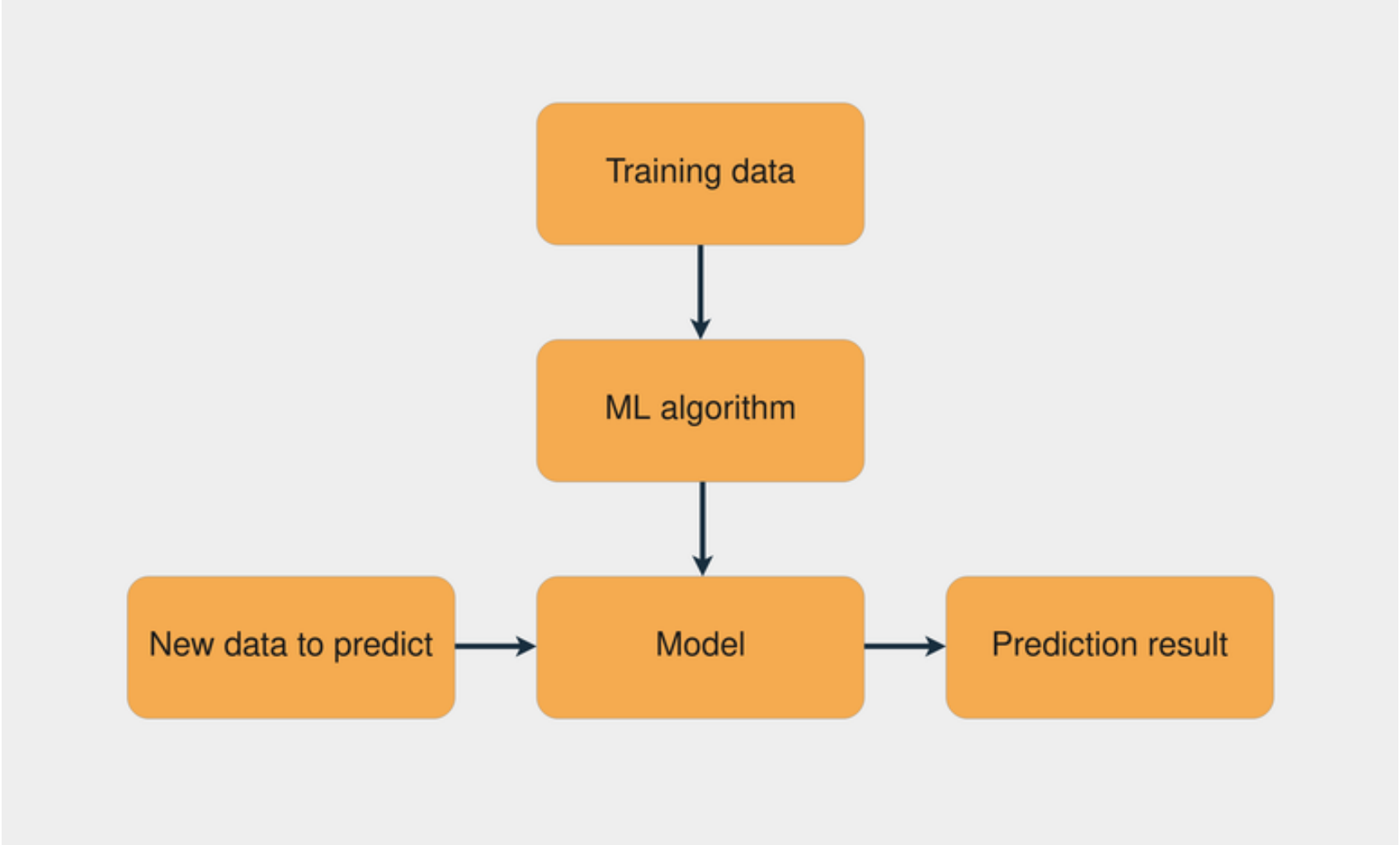


Figure 1: Workflow to train a model using supervised learning.

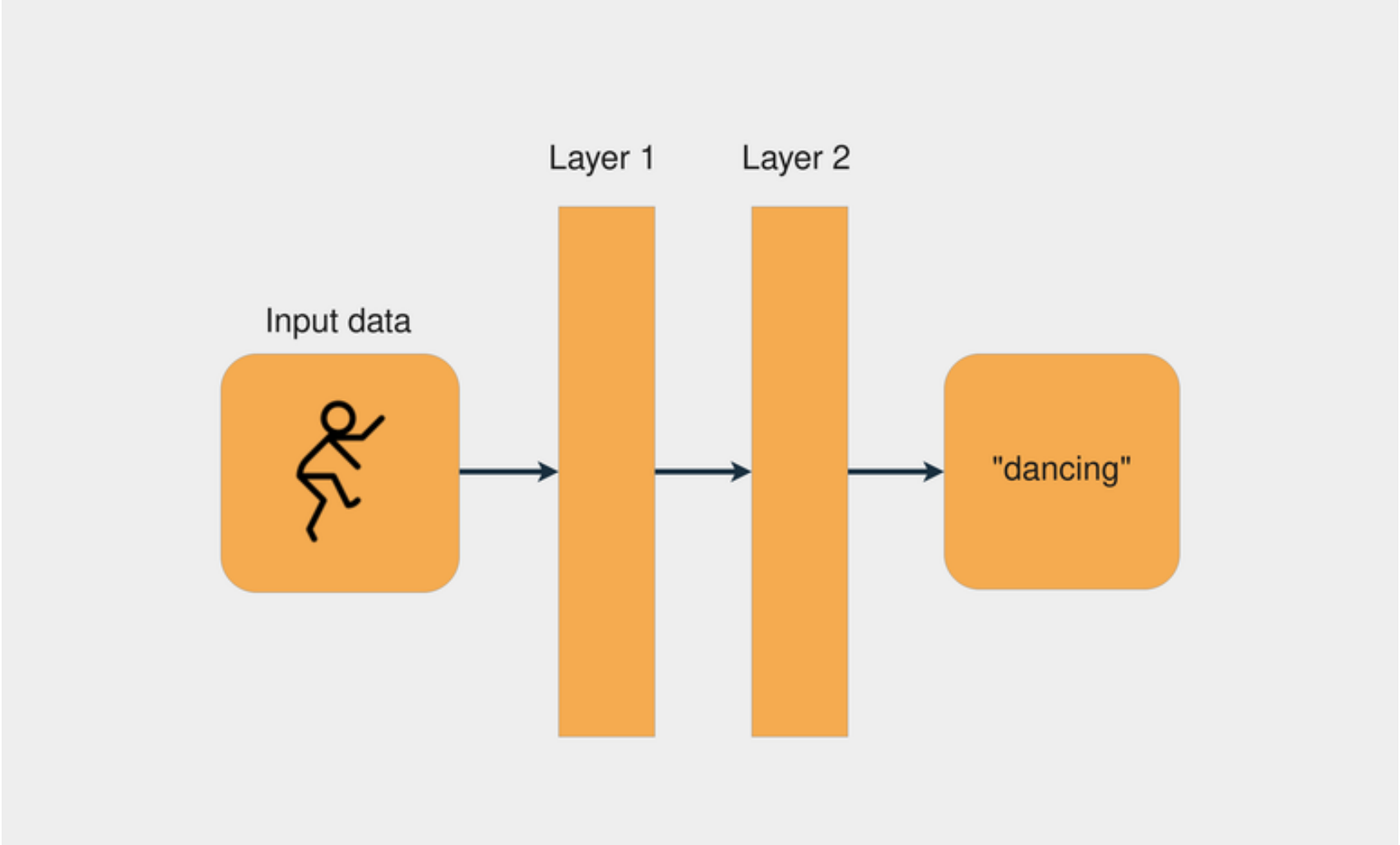


Figure 2: Feature engineering example.

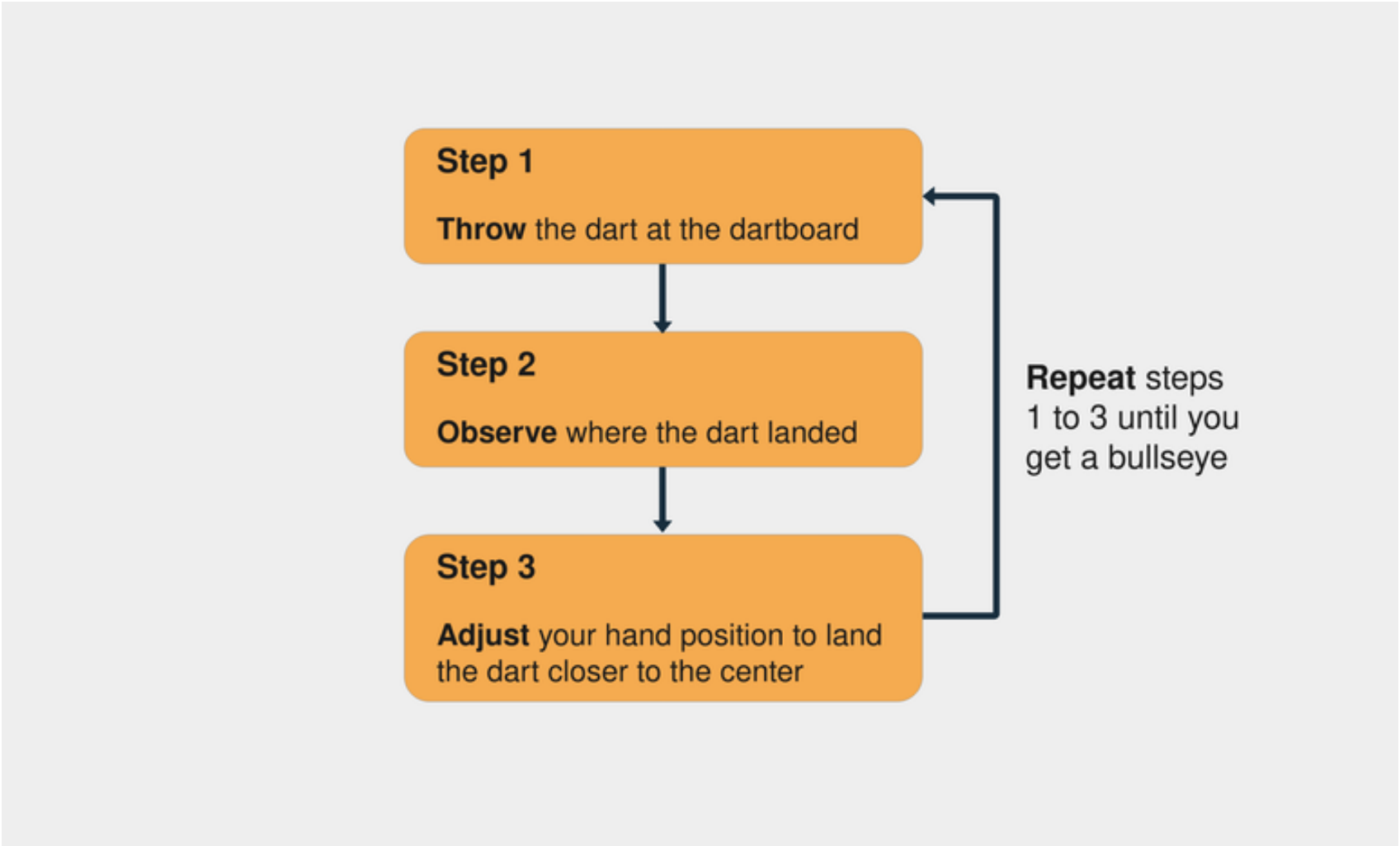


Figure 3: Steps for trying to hit the center of a dartboard.

Partitioning of feature space X

Example of classification (for categories "1" and "0") with a 2 layers NN.

- In the first layer we use a linear regression approach.
- The second layer includes the non-linearity through the use of a sigmoid function that decides whether the prediction is 1 or 0.

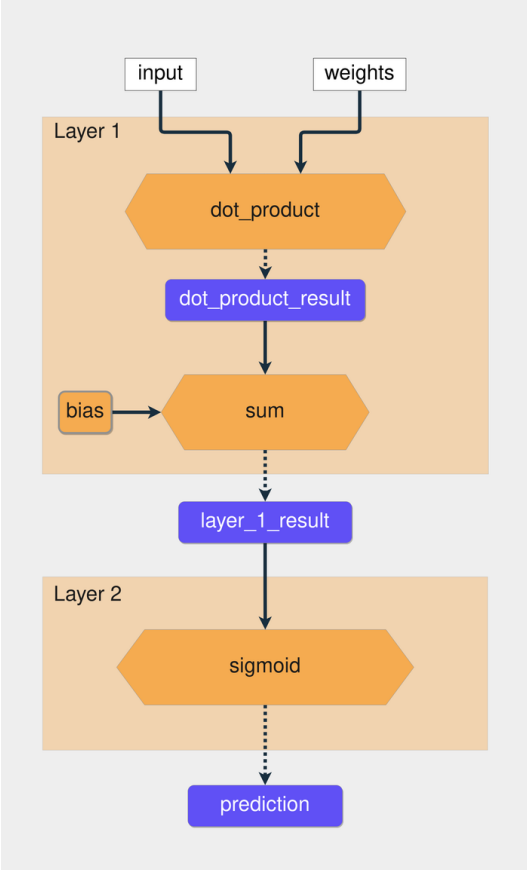
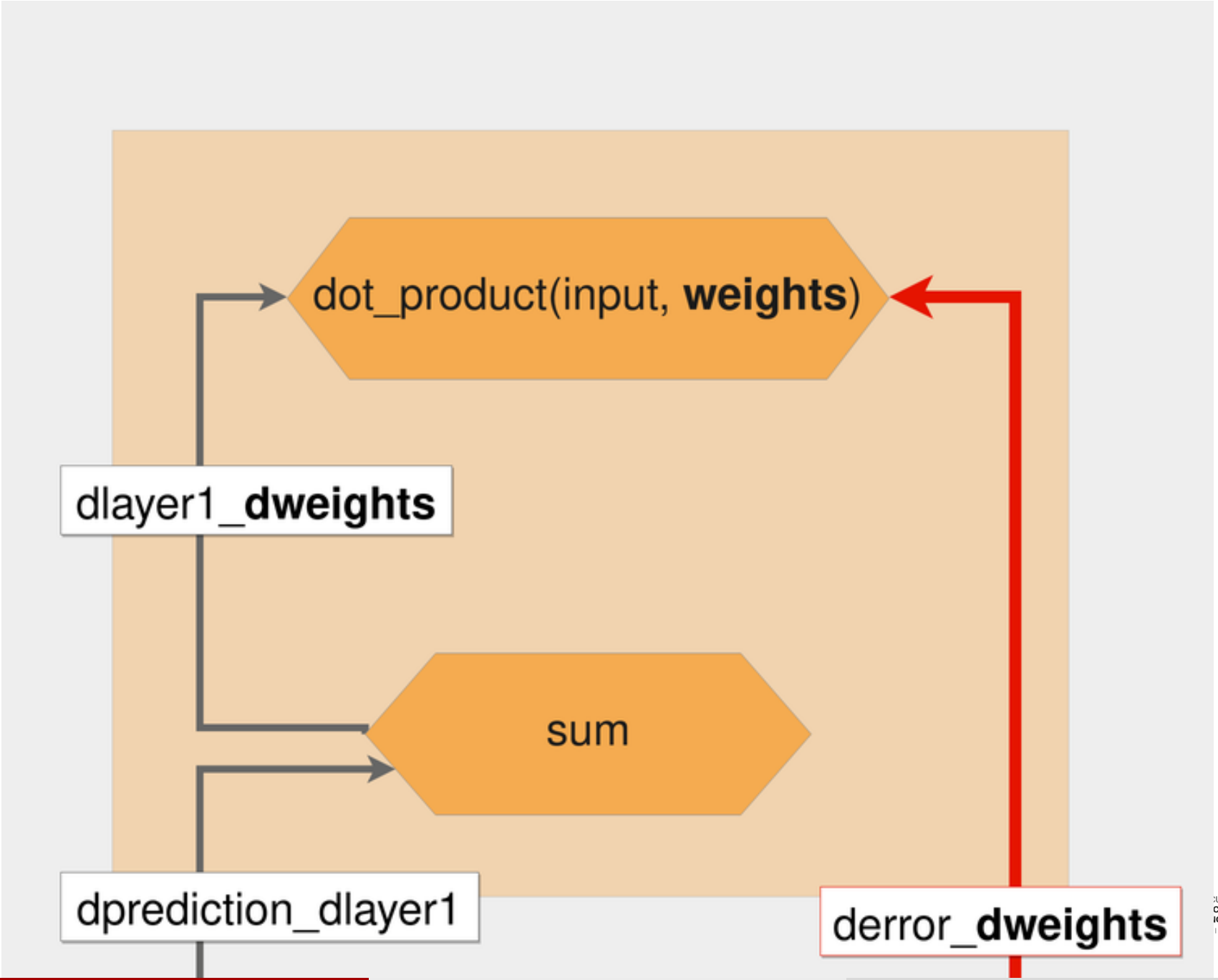
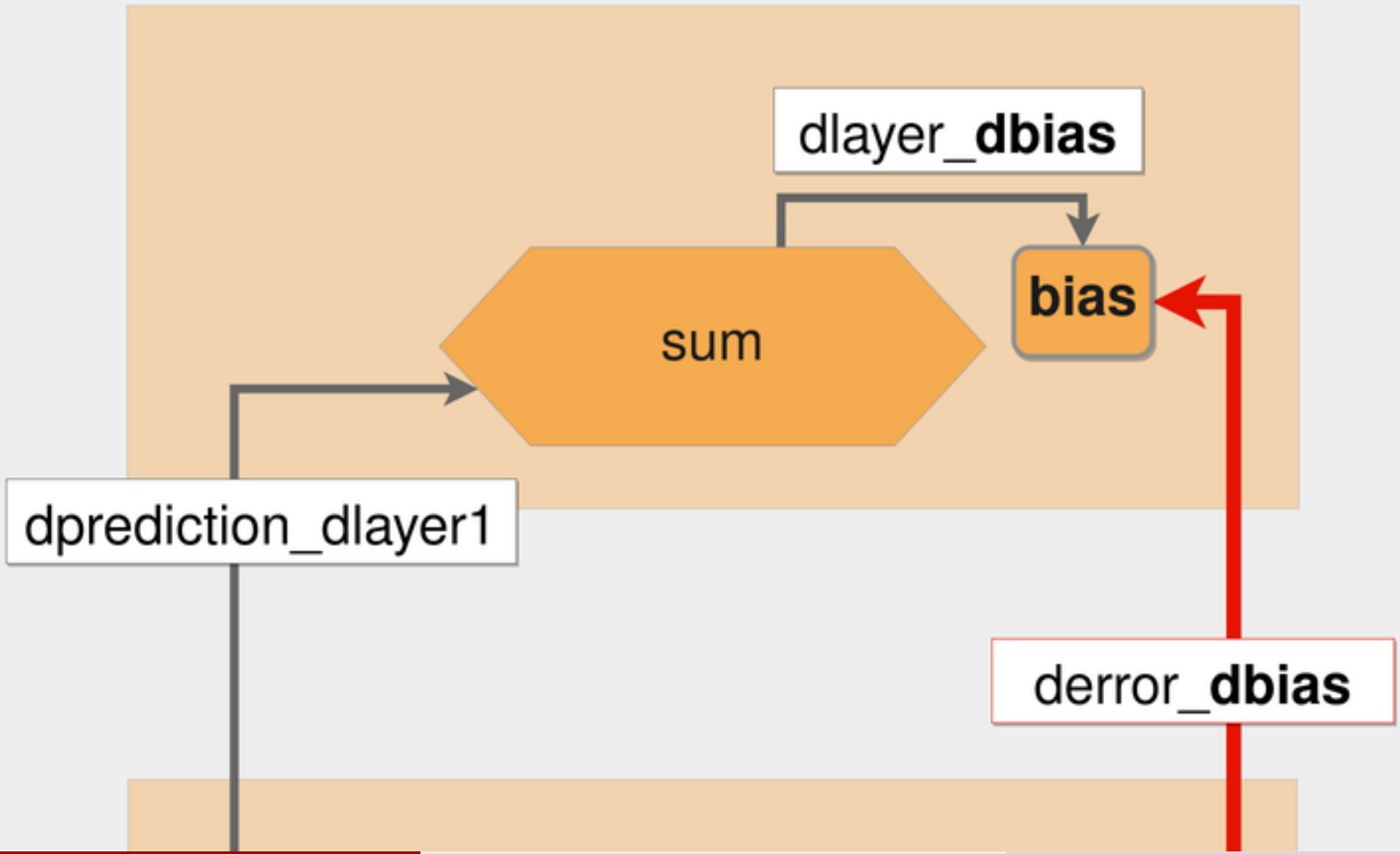


Figure 4: Training a two layer neural network.


dot_product(input, **weights**)
dlayer1_**dweights**
sum
dprediction_dlayer1
derror_**dweights**


dlayer_dbias
bias
sum
dprediction_dlayer1
derror_dbias

Exercise 1

Training loss Can you provide an example of the fact that any training set $\tau = \{(\mathbf{x}_i, y_i), i = 1, \dots, n\}$ can be fitted via a tree with sero training loss? (Hint: imagine classifying the students in the class based on their age in days).

Discuss on the predictability of such model. Can you consider it overfitted?

Dirk P. Kroese, Zdravko Botev, Thomas Taimre, and Radislav: Vaisman.

Data Science and Machine Learning: Mathematical and Statistical Methods.

Machine Learning & Pattern Recognition. Chapman & Hall/CRC, 2020.