Introduction to Neural Networks

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Module 1.3: Modeling Considerations

My Brain, Your Brain

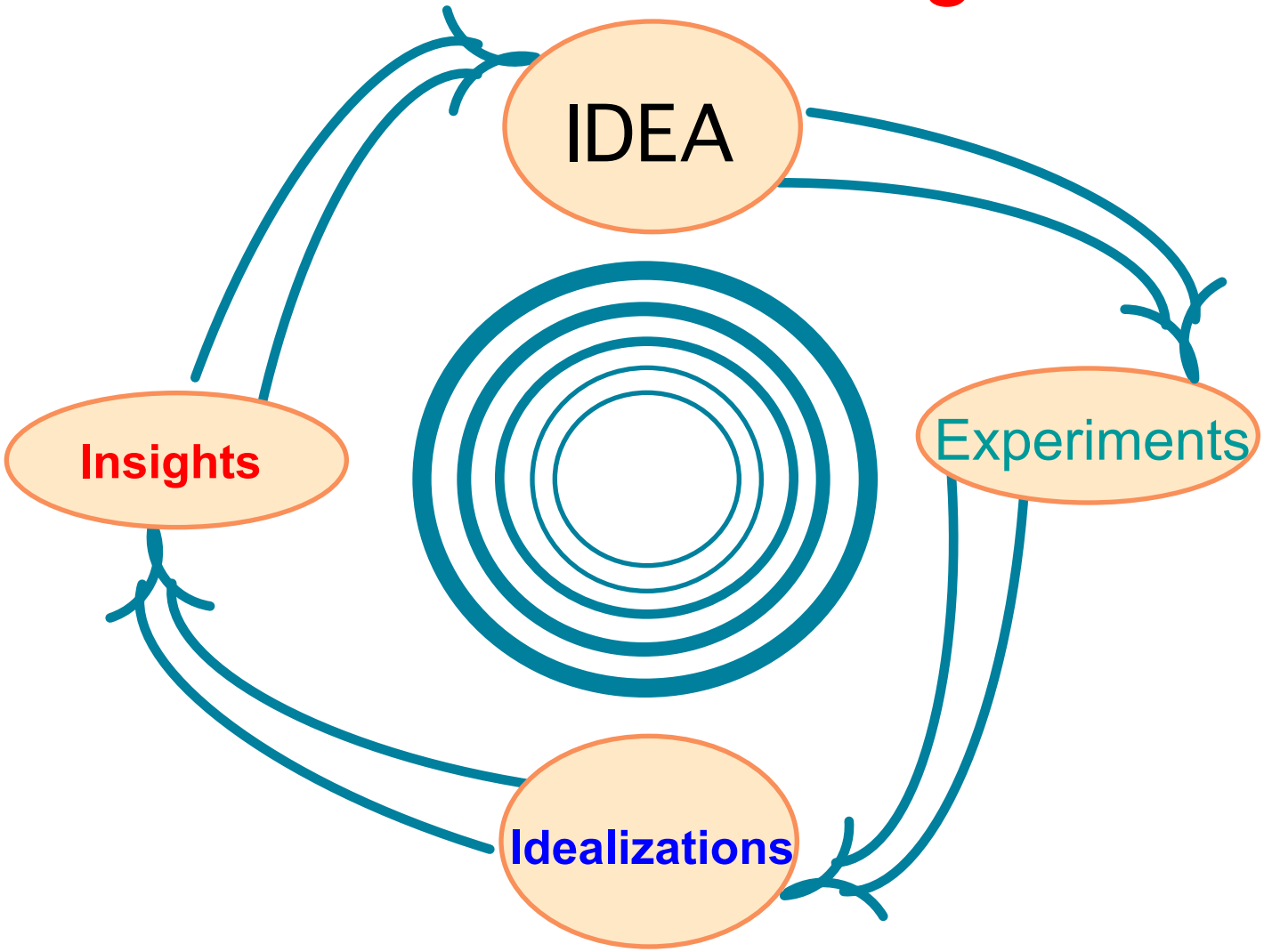
In this sub-module…

- We will cover some of the issues surrounding the art and science of modeling.
- These issues involve a tradeoff between detail and simplicity.
  - Want enough detail to capture important phenomena.
  - Want to keep things simple enough so that we can analyze our model and gain insight.

Modeling Reality

- Can't model all details. Too difficult and misses the mark.
- Don't want it too simple…also misses the mark.
- Have to strike a balance so that some interesting phenomena can be illuminated and possibly analyzed and studied.
- Capture the essential and interesting features.

The Vortex of Progress



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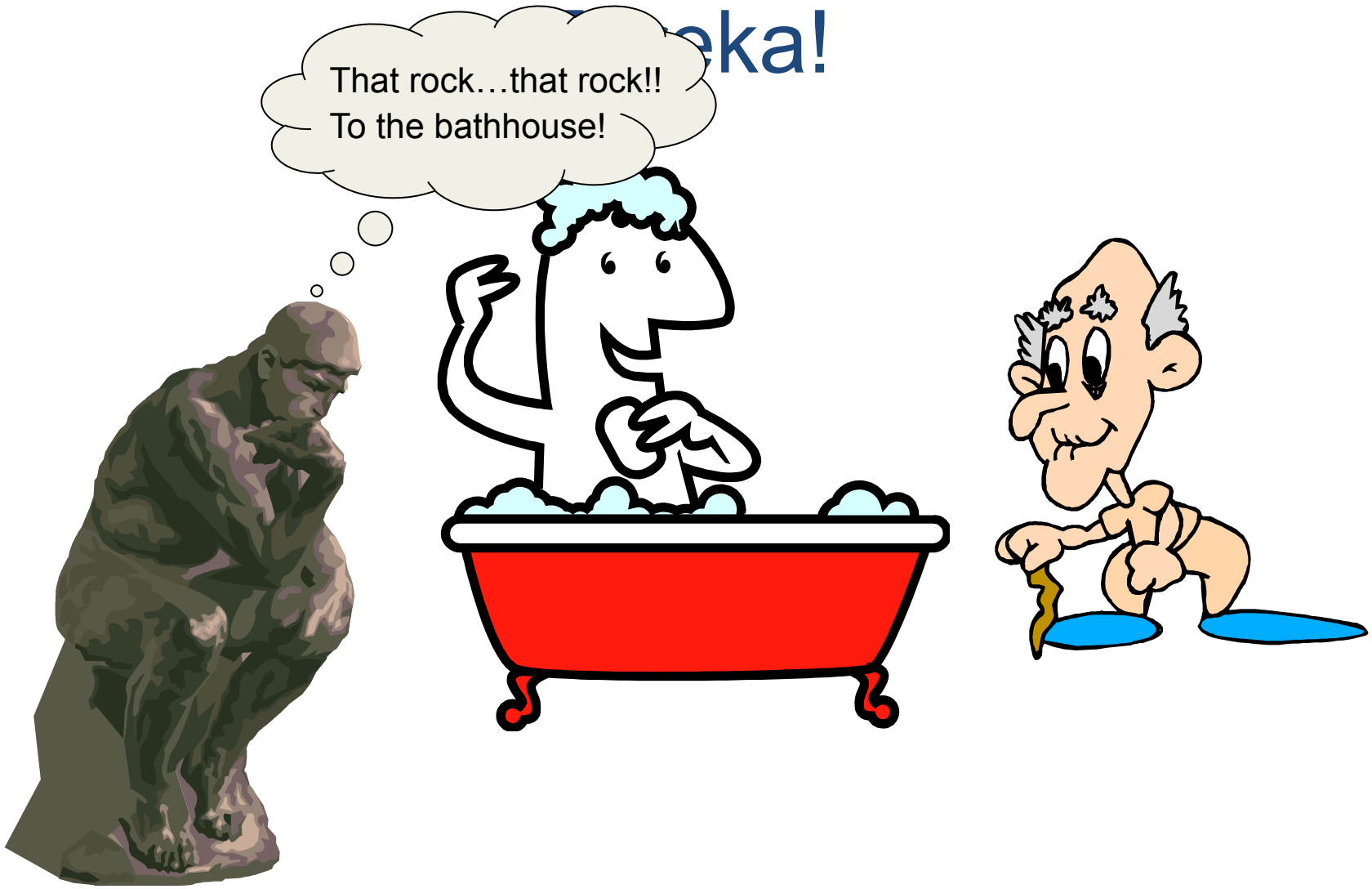
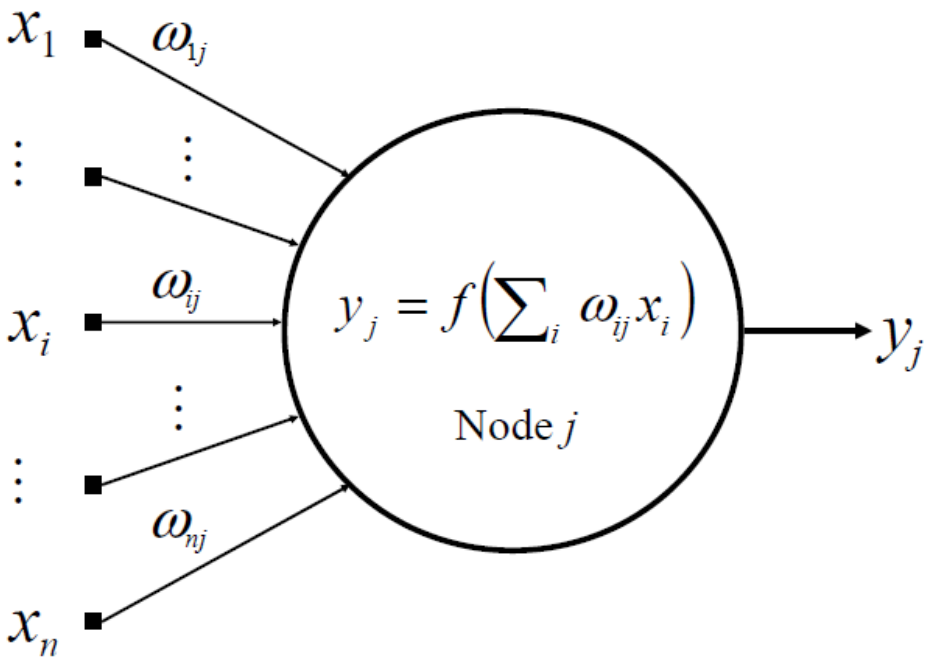
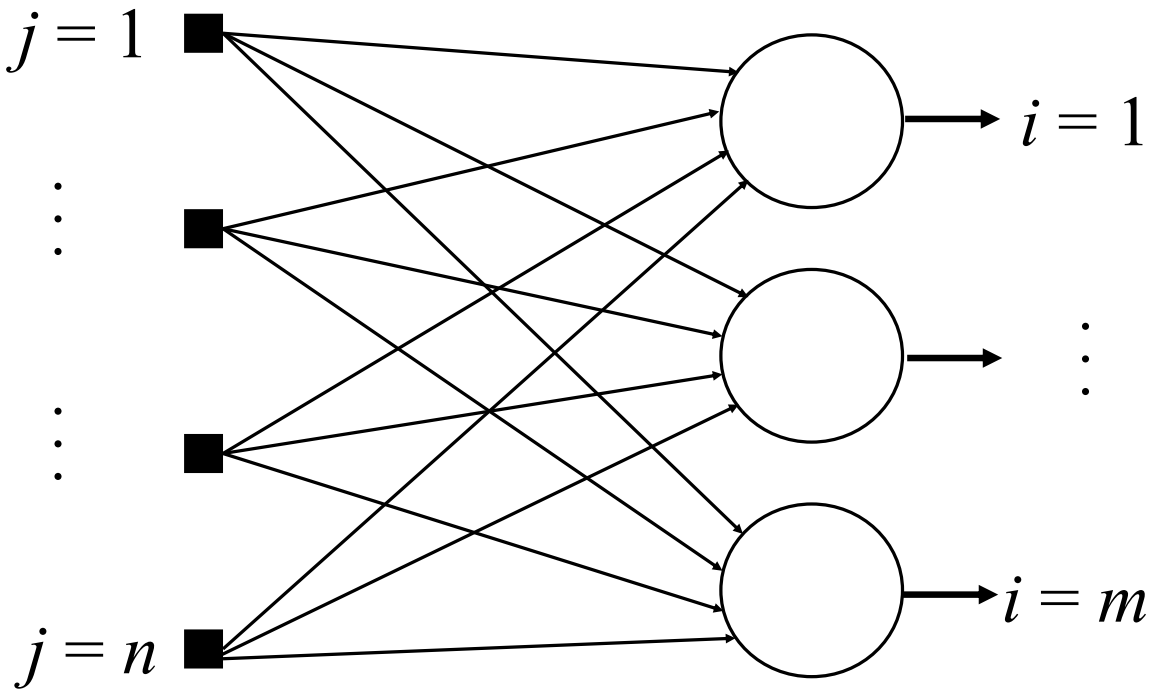


The Perceptron



The Multi-perceptron



The Activity Function

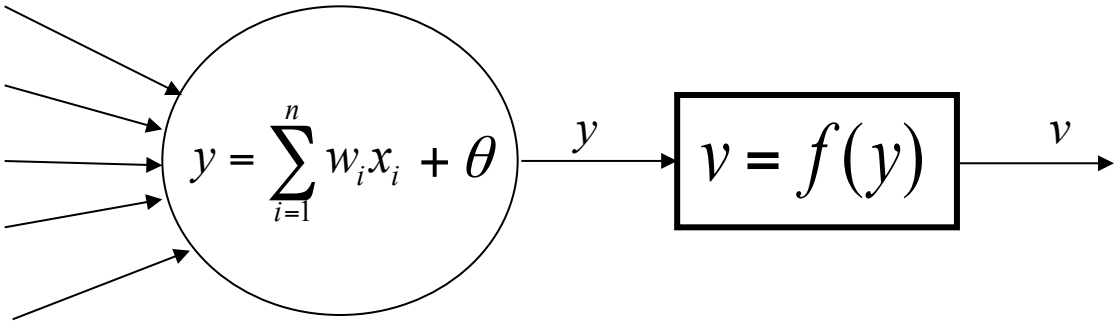
- The output of the Perceptron *y* is given by the equation:

$$y = \sum_{i=1}^{n} w_i x_i + \theta$$

  - This Activity Function is sometimes referred to as a *linear basis function*.

The Activation Function

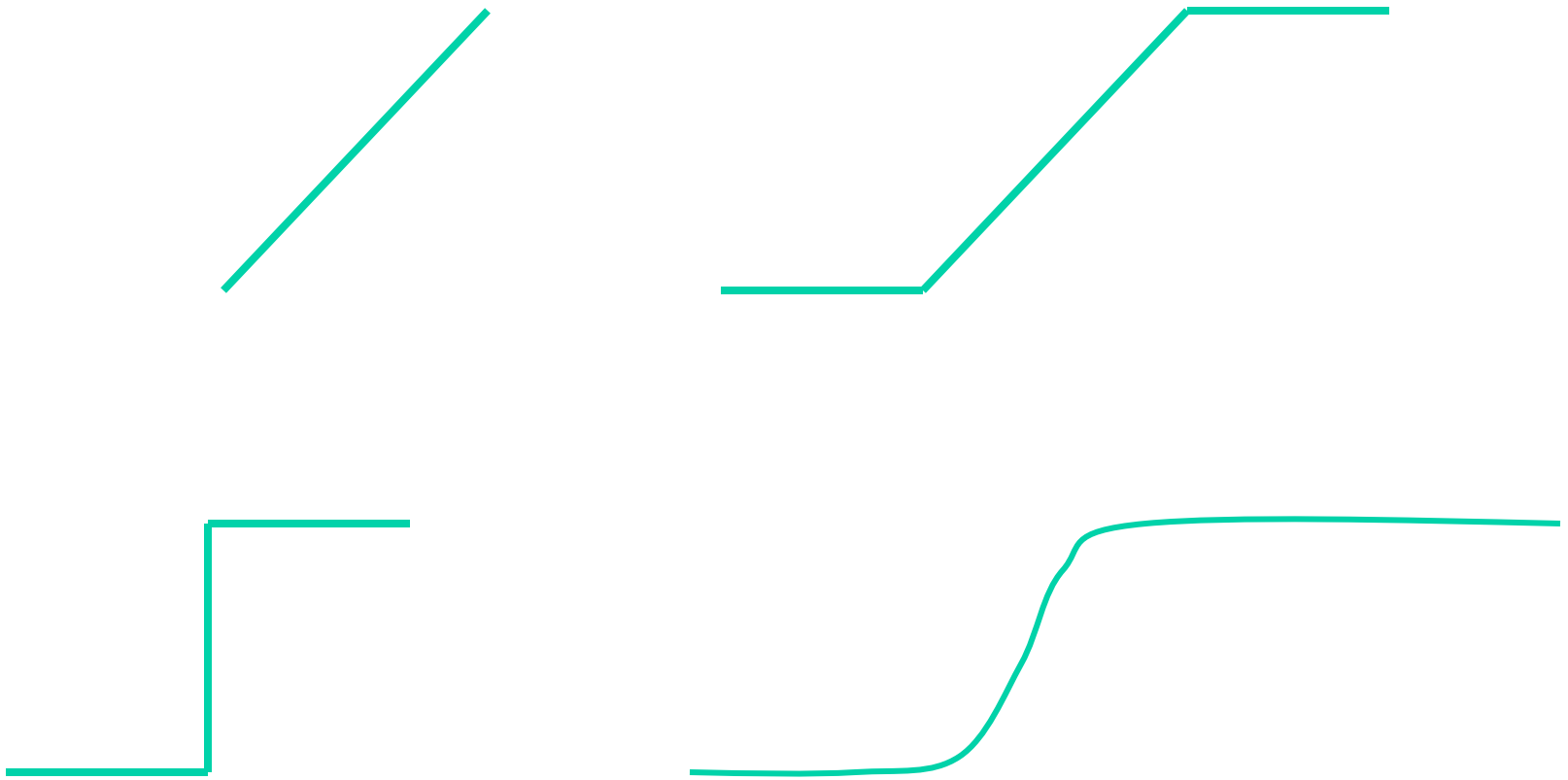
- The Activation Function provides a one to one mapping between the Activity Function as input and some value for the output.
- It attempts to provide further flexibility in modeling biological neurons.



Features of the Perceptron

- Weighted inputs --- correspond to synaptic inputs.
  - Can involve both positive and negative values.
  - Provides an analogy to excitation and inhibition.
- Activation function --- corresponds to action potential.
  - We have great flexibility in choosing the activation function.
  - We choose one that satisfies our needs.

Activation Functions



An Important Activation Function

The Sigmoid Function

$$v = \frac{1}{1+e^{-y}} = \frac{1}{1+e^{-\left(\sum_{i=1}^{n} w_i x_i + \theta\right)}}$$