Welcome to the CoGrammar Revision: Neural Networks

The session will start shortly...

Questions? Drop them in the chat. We'll have dedicated moderators answering questions.

Data Science Session Housekeeping

- The use of disrespectful language is prohibited in the questions, this is a supportive, learning environment for all - please engage accordingly. **(Fundamental British Values: Mutual Respect and Tolerance)**
- No question is daft or silly - **ask them!**
- There are **Q&A sessions** midway and at the end of the session, should you wish to ask any follow-up questions. Moderators are going to be answering questions as the session progresses as well.
- If you have any questions outside of this lecture, or that are not answered during this lecture, please do submit these for upcoming Academic Sessions. You can submit these questions here: **Questions**

Data Science Session Housekeeping cont.

- For all **non-academic questions**, please submit a query: **www.hyperiondev.com/support**
- Report a **safeguarding** incident: **www.hyperiondev.com/safeguardreporting**
- We would love your **feedback** on lectures: **Feedback on Lectures**

Skills Bootcamp
8-Week Progression Overview

Fulfil 4 Criteria to Graduation

✅ Criterion 1: Initial Requirements

Timeframe: First 2 Weeks
Guided Learning Hours (GLH): Minimum of 15 hours
Task Completion: First four tasks

Due Date: 24 March 2024

✅ Criterion 2: Mid-Course Progress

60 Guided Learning Hours

Data Science - **13 tasks**
Software Engineering - **13 tasks**
Web Development - **13 tasks**

Due Date: 28 April 2024

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Skills Bootcamp Progression Overview

✅ Criterion 3: Course Progress

Completion: All mandatory tasks, including Build Your Brand and resubmissions by study period end
Interview Invitation: Within 4 weeks post-course
Guided Learning Hours: Minimum of 112 hours by support end date (10.5 hours average, each week)

✅ Criterion 4: Demonstrating Employability

Final Job or Apprenticeship Outcome: Document within 12 weeks post-graduation
Relevance: Progression to employment or related opportunity

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Revision: Neural Networks

June 2024

Important Notice

Please check your spam folders for any important communication from us. If you have accidentally unsubscribed, please reach out to your support team.

Learning Objectives

- Understand the fundamental concepts of neural networks.
- Understand the building blocks of neural networks.
- Grasp how we use Keras to build a neural network.
- Know and understand the different hyperparameters
- Understand how the process of hyperparameter tuning greatly influences model quality and performance

Revision: Neural Networks

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Neural Network Layers

- **Input layer:** number of neurons in the input layer is equal to the number of features in the data, sometimes one additional for bias.

- **Hidden layer/s:** intermediate layer/s between input and output layer where all the computation is done. If number of layers is
  - 0: Only capable of representing linearly separable data
  - **1 - 2:** Data is less complex and have fewer dimensions or features
  - More layers for optimum solution in large dimensions/many features

Most common

- **Output layer:** number of neurons depends on whether the model is a regressor (only one neuron) or classifier (one neuron for each class label).

Neural Network Layers

Number of neurons in hidden layers

- Few neurons in hidden layers can cause underfitting
- Too many neurons in the hidden layers may result in
  - Overfitting, limited training set cannot train all the neurons.
  - Training time increases with more neurons in the hidden layers.

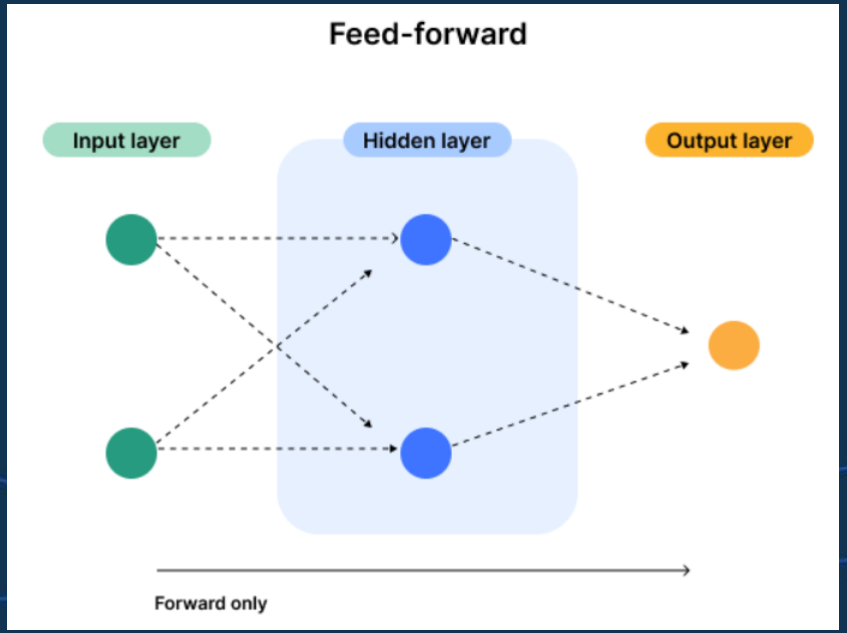
- **Number of neurons in the hidden layer** (generally)
  - should be between input and output layer sizes.
  - should be 2/3 the input layer size, plus the output layer size.
  - should be sqrt(input layer nodes * output layer nodes).
  - should keep on decreasing in subsequent layers to get more and more close to pattern and feature extraction and to identify the target class.

Introduction to Neural Networks with Java
Jeff Heaton

However, the optimum number of neurons is case dependent.

Feedforward Neural Networks

- **Feedforward Networks / Artificial Neural Networks (ANNs):** data moves from input to output in a single direction, with only input, hidden, and output layers, no feedback loops.



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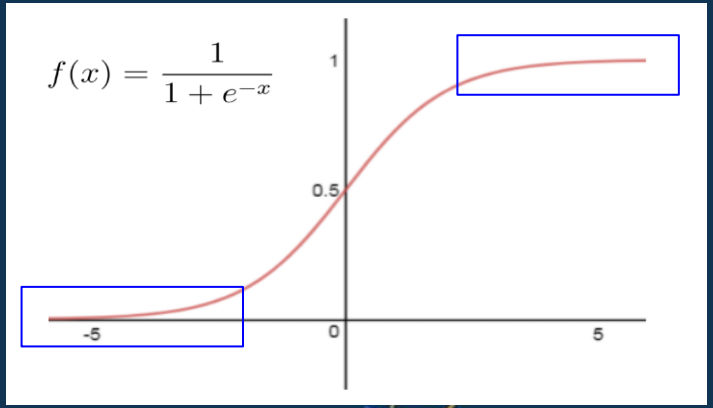
Sigmoid Activation Function

- **Sigmoid** is a smooth function and is continuously differentiable.
- Non-linear, ranges from 0 - 1
- Mostly used in **binary classification problems**
- However, activation of **neurons saturates** either near **0 or 1** (blue areas), **derivative** of the sigmoid function becomes very **small**



- Function outputs are **not zero-centered.** Training the neural network is more difficult and unstable.

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Tanh Activation Function

- E.g. **Inputs get multiplied by 3 at each node**

5	15	45	135	405
0,01	0,03	0,09	0,27	0,81
-0,5	-1,5	-4,5	-13,5	-40,5

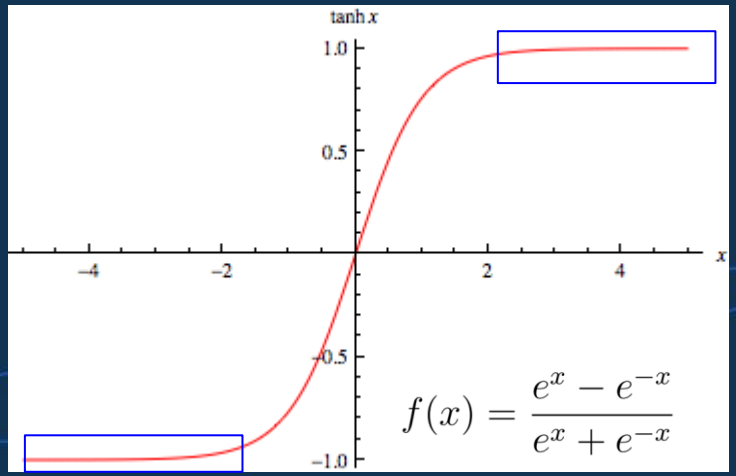
x*3

- Some values can explode and become astronomical, causing others to seem insignificant.

- **Tanh activation function** regulates values in **between -1 and +1**

tanh(x*3)

5	1	0,995	0,995	0,995
0,01	0,030	0,090	0,263	0,658
-0,5	-0,905	-0,991	-0,995	-0,995



- **Saturation issue** present, but **centered around zero**, preferred over Sigmoid

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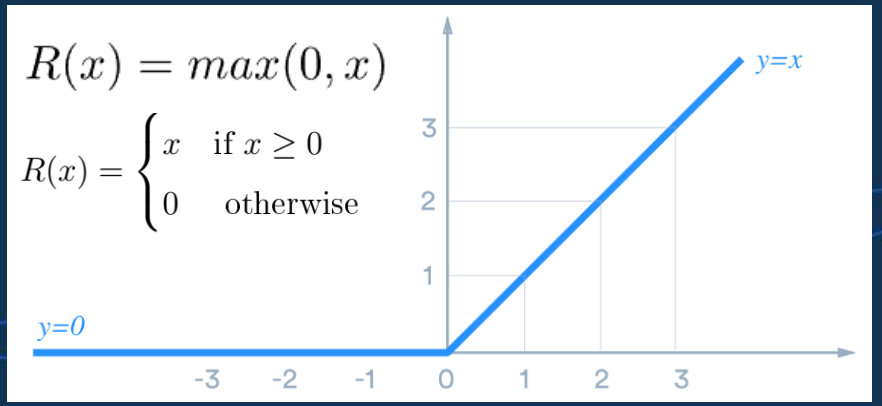
ReLU Activation Function

- **Rectified linear unit (ReLU):** most widely used activation function.
- Computationally cheap, less time to train, converges faster.
- Linearity ensures the slope does not plateau, or “saturate,” for large x
- No vanishing gradient problem suffered by other activation functions
- Downside: zero for all negative values - **“dying ReLU”,** a neuron is “dead” if stuck in the negative side and always outputs 0. Learning rate is too high or there is a large negative bias.



https://towardsai.net/

Further Resources

- https://developers.google.com/machine-learning/crash-course/introduction-to-neural-networks/playground-exercises
- https://nnplayground.com/
- https://cs.stanford.edu/people/karpathy/convnetjs/
- **Books:**
  - Machine Learning For Absolute Beginners by Oliver Theobald
  - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow by Geron Aurelien

Questions and Answers

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Thank you for attending

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