NEURAL NETWORK SIMULATION

By: Spenser Van Horne,
Richard Rodriguez

INPUT LAYER

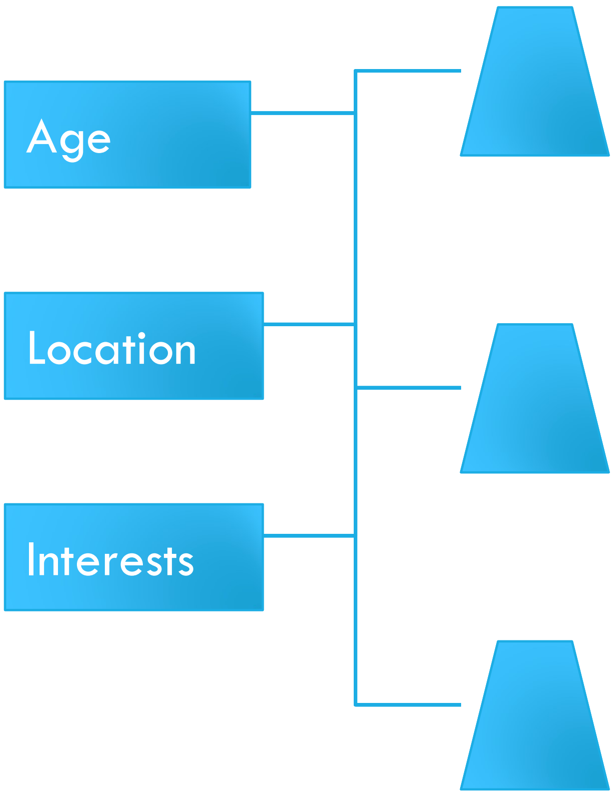
Age

Location

Interests

- The **first layer** of a neural network.
- Takes in raw data (e.g., images, text, numbers).
- Passes the information to the next layer without making changes.
- The number of neurons in this layer depends on the number of input features

HIDDEN LAYER 1



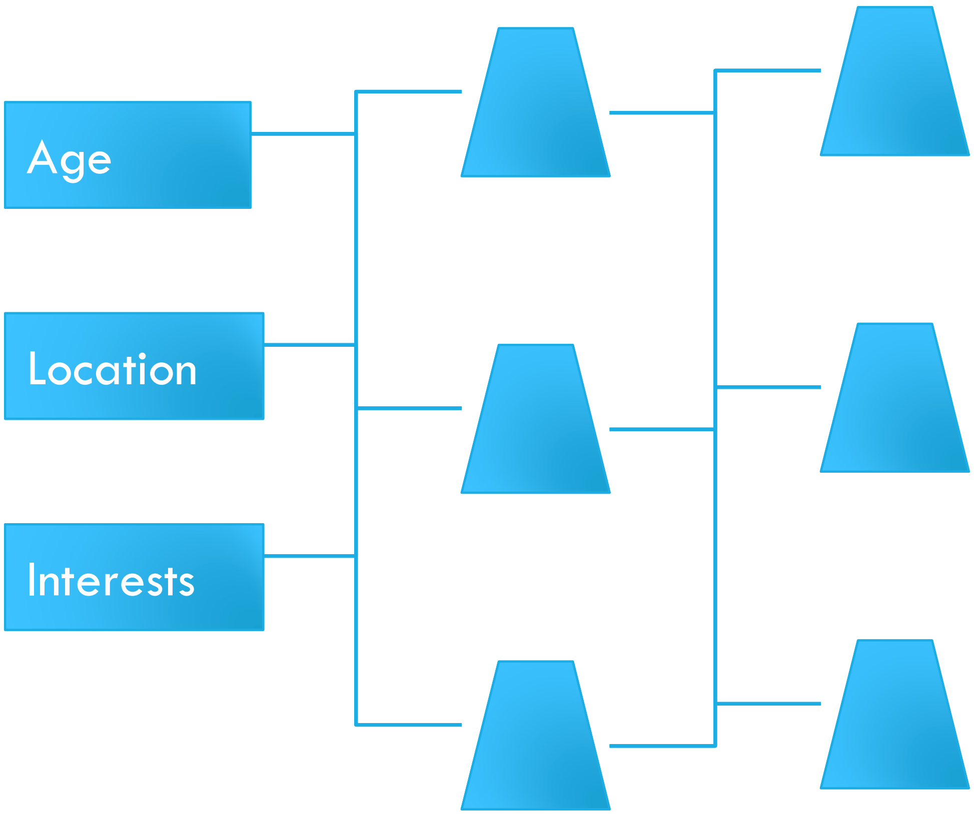
•The **first processing layer** of the network.

•Applies weights and biases to input data to detect simple patterns.

•Uses an **activation function** (like ReLU or Sigmoid) to introduce non-linearity.

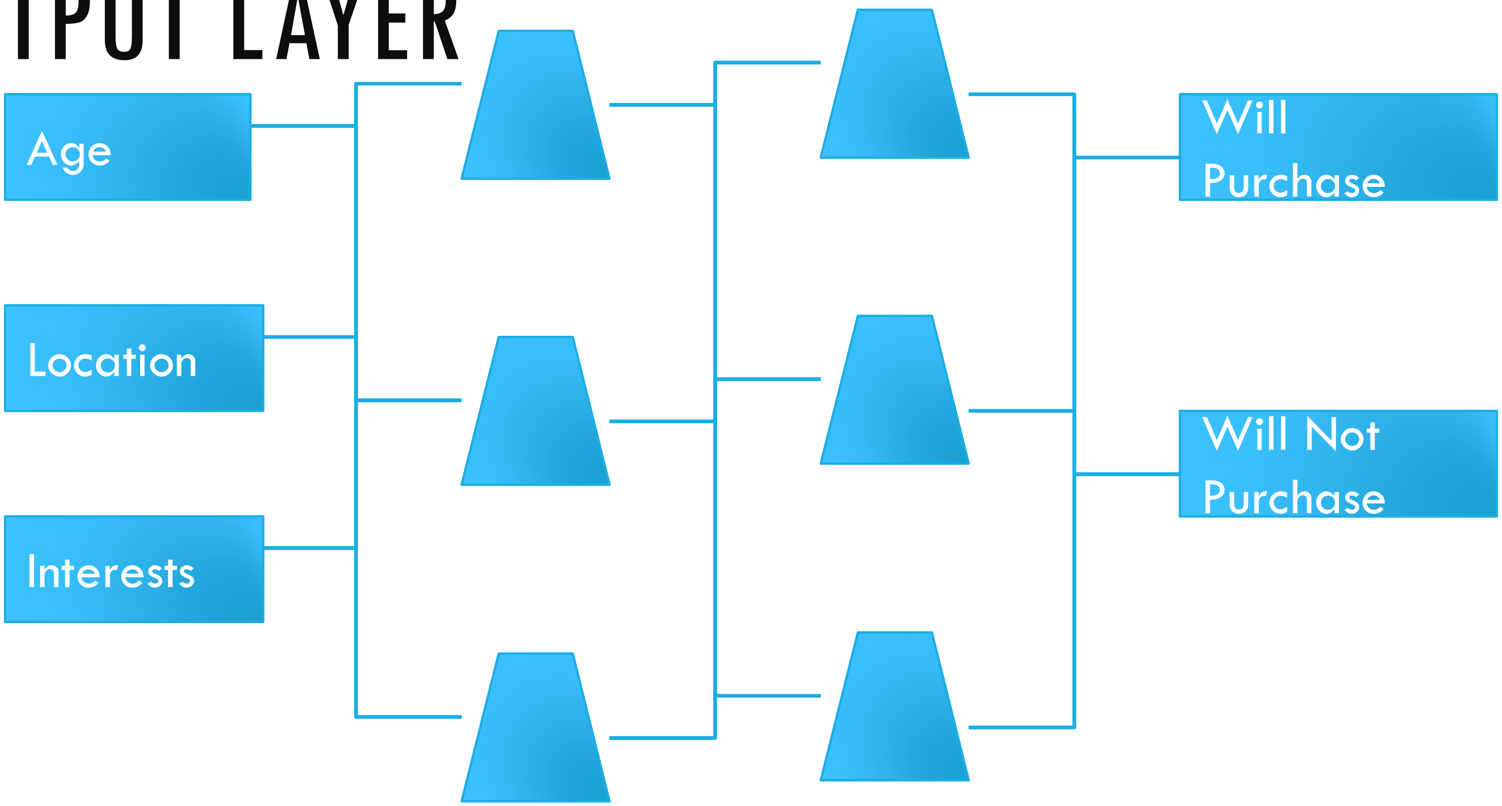
•Helps extract low-level features, such as edges in an image or key words in text.

HIDDEN LAYER 2



- Builds on the features detected in **Hidden Layer 1**.
- Identifies more complex patterns and relationships.
- Helps the network understand **higher-level** details, like facial features in an image.
- The more hidden layers, the deeper and more powerful the neural network.

OUTPUT LAYER



- The **final layer** that produces the result.

- Converts processed data into a prediction or classification.

- Uses an activation function (e.g., **Softmax** for multi-class classification or **Sigmoid** for binary classification).

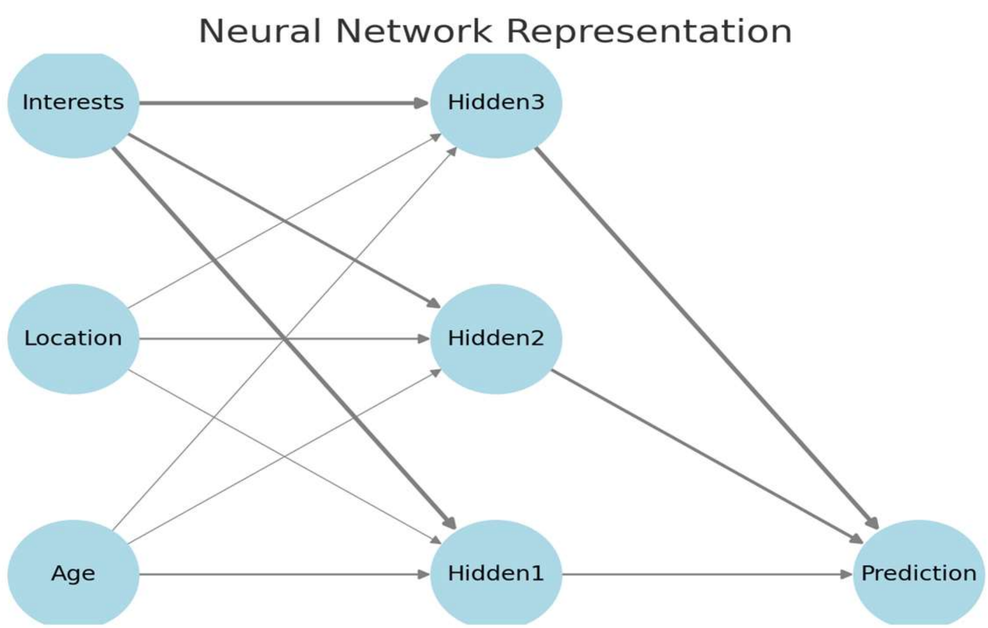
- The number of neurons in this layer matches the number of possible outputs

DATASET

Age	Location	Interests	Purchase Predections
25	New York	Technology, Music	Yes
34	California	Sports, Travel	No
42	Texas	Cooking, Reading	Yes
28	Florida	Fitness, Fashion	No

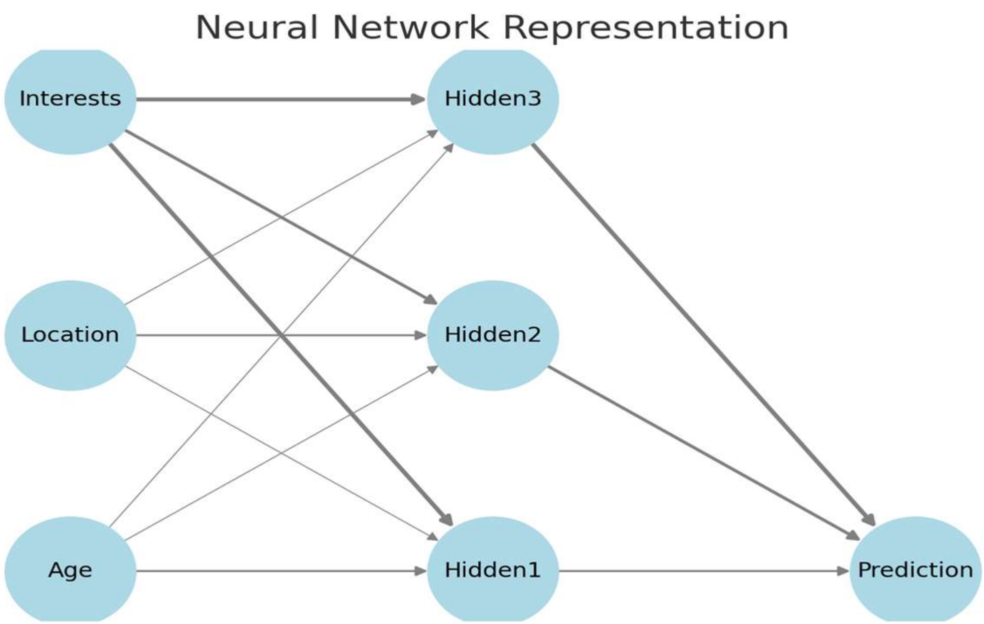
PROCESSING THROUGH LAYERS

Data flows through the neural network:
- Thicker lines for strong influences (Interests)
- Thinner lines for weaker influences (Age, Location)



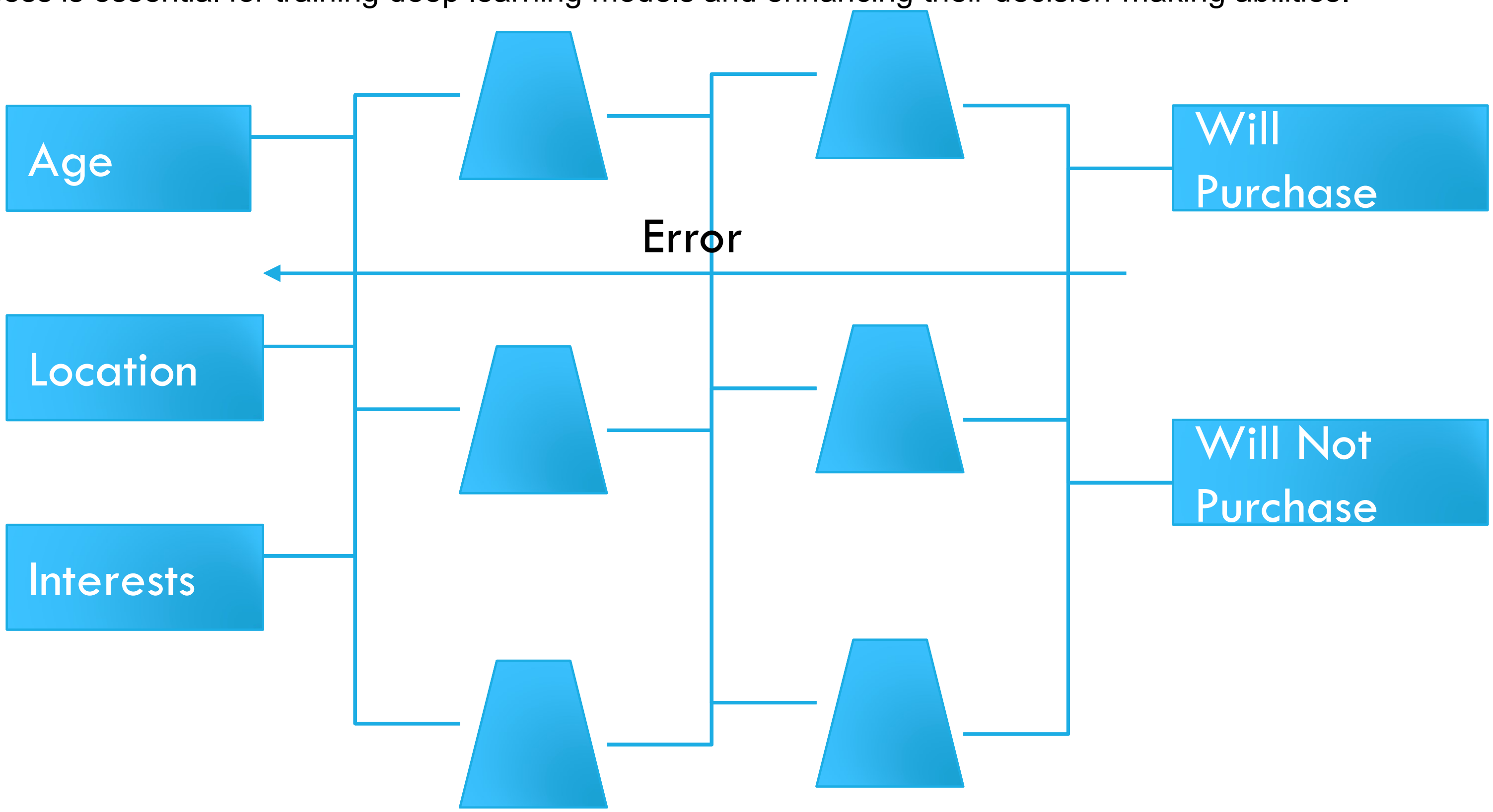
PREDICTION

Final Prediction:
- The model predicts that the user WILL PURCHASE based on inputs.



FEEDBACK LOOP - LEARNING FROM ERRORS

- Helps the network learn from errors and improve predictions.
- When a prediction is incorrect, an **error signal** is calculated by comparing the predicted result to the actual one.
- The error is sent **backward** through the network to adjust the connections between neurons.
- **Gradual adjustments** over time improve the network's accuracy.
- This process is essential for training deep learning models and enhancing their decision-making abilities.



INCORPORATING THEORETICAL FOUNDATIONS DECISION POINTS - I

Initializing Weights:
Weights are typically initialized using small random values to break symmetry and enable the neural network to learn diverse features. Methods like Glorot (Xavier) Initialization are commonly used.

Forward Propagation:
During forward propagation, inputs are passed through the network, layer by layer, to compute the output. Each neuron's output is a weighted sum of inputs passed through an activation function.

Activation Functions:
Activation functions introduce non-linearity to the model, allowing it to learn complex patterns. Common activation functions include ReLU (Rectified Linear Unit) and Sigmoid.

INCORPORATING THEORETICAL FOUNDATIONS DECISION POINTS - II

Loss Function:
The loss function measures the difference between the predicted output and the actual output. Common loss functions include Mean Squared Error (MSE) for regression tasks and Cross-Entropy Loss for classification tasks.

Backpropagation:
Backpropagation is used to update the weights of the network by computing the gradient of the loss function with respect to each weight and adjusting the weights using gradient descent.

Gradient Descent:
Gradient Descent is an optimization algorithm used to minimize the loss function by iteratively adjusting the model's parameters in the direction of the negative gradient.

REFLECTION ON ERRORS

- Errors differentiate between the network's prediction and the actual result.
- The error helps the network understand what went wrong.
- The network adjusts its settings (like weights and biases) to improve.
- This process is repeated, improving the network over time.
- Over time, the network learns to handle new data more effectively.
- Error reflection helps the network become more accurate and reliable.

REAL-WORLD AI APPLICATIONS

• **Image Recognition:** Used in facial recognition, object detection, and medical imaging to identify patterns in image

• **Speech Recognition:** Powers voice assistants like Siri and Alexa, convert spoken language into text.

• **Natural Language Processing (NLP):** Used in chatbots, translation services, and sentiment analysis to understar and generate human language.

• **Autonomous Vehicles:** Helps self-driving cars understand their environment, detect obstacles, and make driving decisions.

• **Recommendation Systems:** Powers personalized recommendations in platforms like Netflix, YouTube, and Amazon by analyzing user preferences.

• **Fraud Detection:** Detects unusual patterns in transactions to identify fraudulent activities in banking and e-commerce.

•**Healthcare:** Assists in diagnosing diseases, predicting patient outcomes, and personalizing treatment plans using medical data.

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