Deep Learning

Deep Learning

Deep learning is a subset of machine learning that allows computers to learn from experience and understand the world in terms of a hierarchy of concepts.

Definition of Deep Learning

Connection to Machine Learning

Role of Experience in Learning

The Hierarchy of Concepts

Real World Examples

Why Deep Learning Matters

Real-world applications of deep learning include voice recognition, image recognition, natural language processing, self-driving cars, and more.

Impact on Various Sectors

Personal Assistants: Siri, Alexa

Social Media: Face and Object Recognition

Medical Field: Disease Detection

Autonomous Vehicles

Simplified View of Deep Learning

Deep Learning as the Human Brain: Conceptual understanding of neurons and how they connect to form a network.
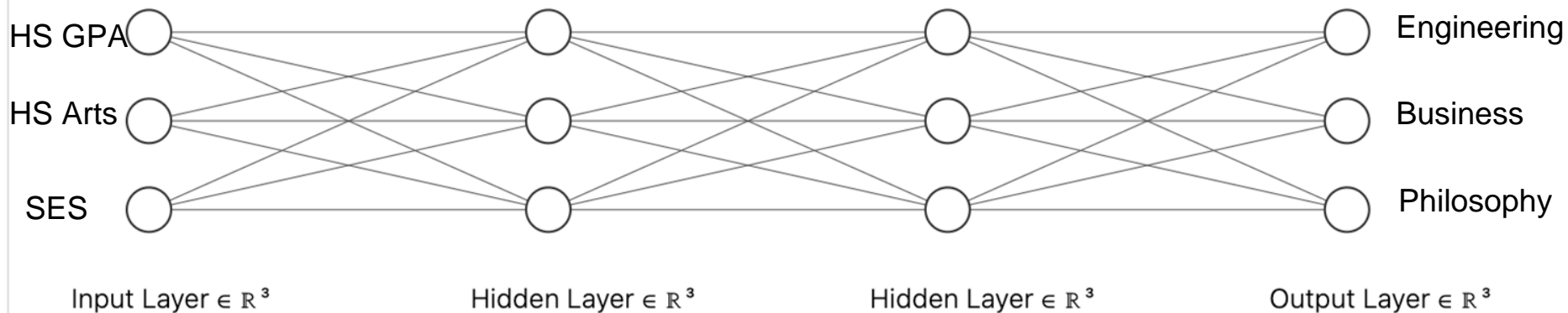
Comparison with Human Brain
Concept of Neurons
Connections and Networks
Learning from Data
Deep Learning Models

Simple Neural Network Example: Major Choice

HS GPA

HS Arts

SES

Engineering

Business

Philosophy

Input Layer ∈ ℝ³   Hidden Layer ∈ ℝ³   Hidden Layer ∈ ℝ³   Output Layer ∈ ℝ³

Concept of Labeling

Labeling: Defining what a data point represents, helping the model identify patterns and make predictions.

Explanation of Labeling

Importance in Pattern Recognition

Role in Predictive Models

Labels in Supervised Learning

Real World Examples

Labeling Example

Labeling in Practice: If we're teaching a model to recognize images of cats, we label a picture of a cat as 'cat'.

Practical Use Case: Image Recognition

Process of Labeling Images

Role of Labels in Learning

Training Data: Labeled Images

Testing Data: Verifying Predictions

What is a Neural Network?

Neural Networks: A series of algorithms that mirror the operations of a human brain to recognize relationships between vast amounts of data.

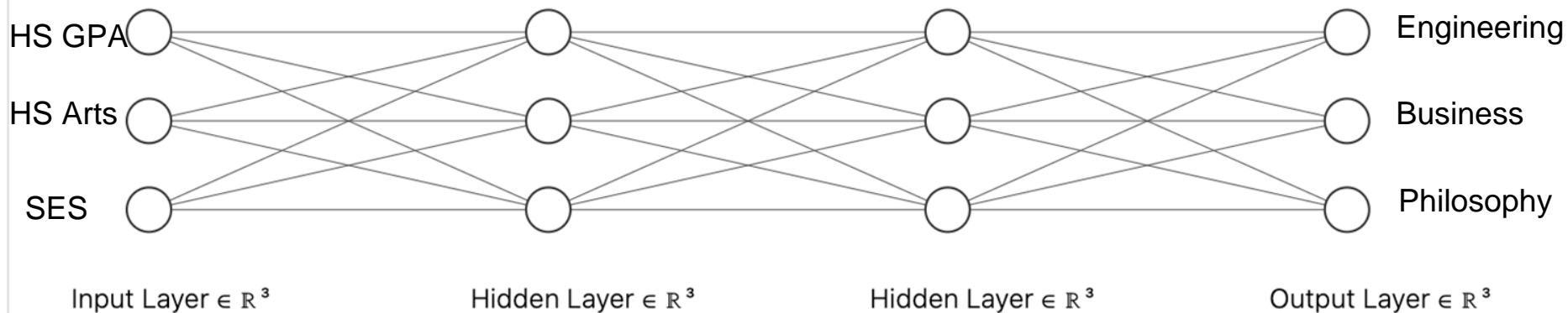Understanding Neural Networks
Connection to Human Brain
Recognition of Data Relationships
Structure: Layers and Nodes
Application Examples

Simple Neural Network Example: Major Choice

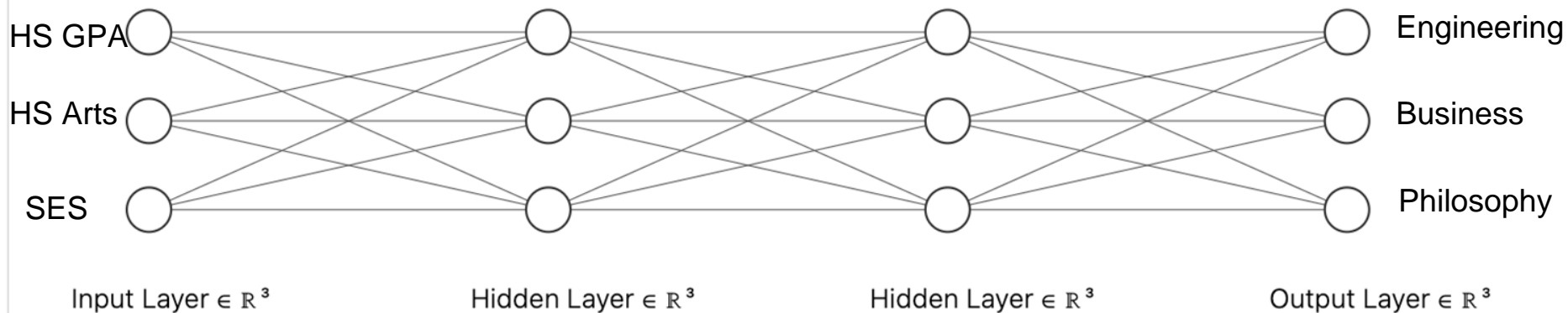# Structure of a Neural Network

Overview of the Structure

Input Layer: Receiving Data

Hidden Layers: Processing Data

Output Layer: Making Predictions

Biases and Weights

Simple Neural Network Example: Major Choice

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Input Layer ∈ ℝ³   Hidden Layer ∈ ℝ³   Hidden Layer ∈ ℝ³   Output Layer ∈ ℝ³

How Neural Networks Learn

Neural Network Learning Process: The network adjusts its weights and biases to better predict the output.

Understanding the Learning Process

Importance of Weights and Biases

Iterative Learning Approach

Accuracy Improvement over Time

Error Minimization

Introduction to Backpropagation

Backpropagation: The method we use to train our neural network by adjusting the model's parameters in response to the error it produced.

Definition of Backpropagation

Role in Training Neural Networks

Adjustments of Model Parameters

Response to Model Errors

Practical Examples

Backpropagation Simplified

Backpropagation in Practice: If our model predicts 'dog' when the label is 'cat', backpropagation helps adjust the model to reduce this error.
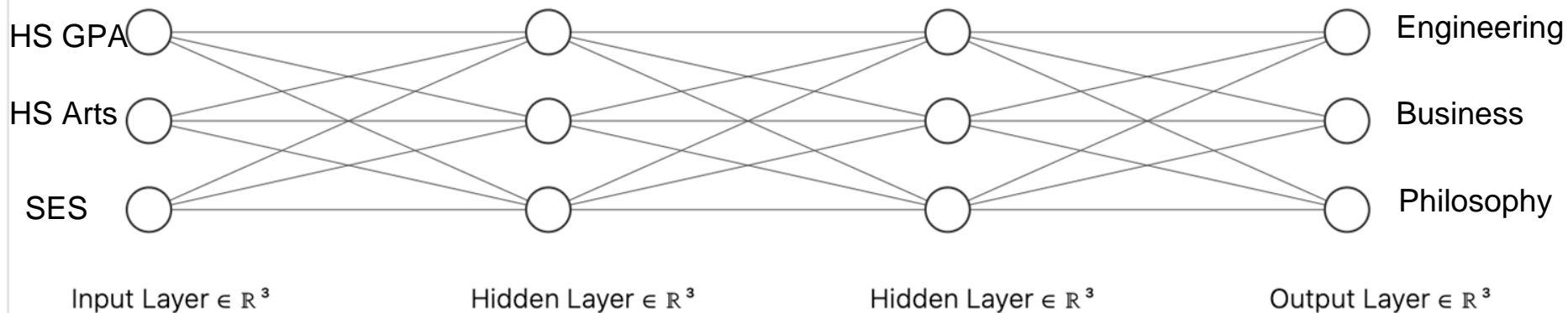
Practical Example: Major Choice
Role of Backpropagation in Error Reduction
Iterative Model Adjustments
Importance in Learning Process
Achieving More Accurate Predictions

Simple Neural Network Example: Major Choice

Image Classifiers

Image Classifiers: These are models that have learned to identify certain objects, places, people, etc., within images.

Understanding Image Classifiers

Learning to Identify Objects in Images
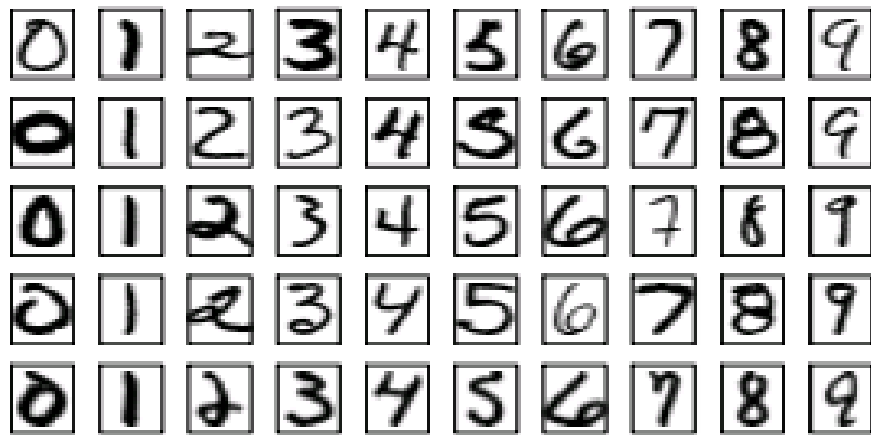
Uses in Social Media and Surveillance

Training Image Classifiers

Real-world Applications

Early Image Classifiers: Handwritten Digits

FIGURE 11.9. *Examples of training cases from ZIP code data. Each image is a 16 × 16 8-bit grayscale representation of a handwritten digit.*

Source: https://hastie.su.domains/ElemStatLearn/

How Image Classifiers Work

How does an Image Classifier Work: They look at an image as an array of pixels and learn patterns in those pixels.

Image as Array of Pixels
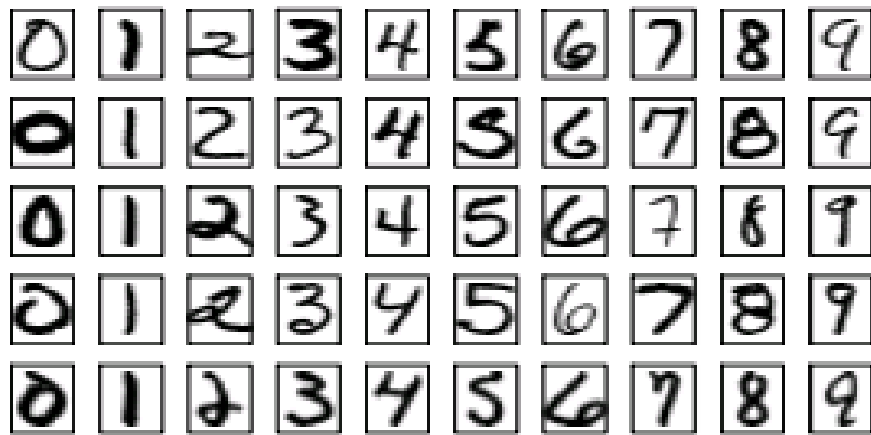Pattern Recognition in Images
Learning from Labelled Data
Improving Accuracy over Time
Examples of Image Classification

Early Image Classifiers: Handwritten Digits

404   Neural Networks

FIGURE 11.9. *Examples of training cases from ZIP code data. Each image is a 16 × 16 8-bit grayscale representation of a handwritten digit.*

Source:
https://hastie.su.domains/ElemStatLearn/

Real-world Example of Image Classifiers

Real-world Example: Facebook uses image classifiers to identify your face in *any* photo that's uploaded to their servers.

Facebook's Face Recognition Technology

Image Classification in Social Media

Privacy Concerns and Regulations

Benefits of Image Classifiers

Future Trends

Introduction to Large Language Models

Large Language Models: These are deep learning models trained to understand and generate human-like text.

Definition of Large Language Models

Understanding and Generating Text

Training on Large Amounts of Text

Examples: GPT-3 by OpenAI

Applications in Natural Language Processing

How Large Language Models Work

Training Process of Language Models
Prediction of Next Word
Understanding Context
Role in Natural Language Understanding
Applications in Chatbots and Virtual Assistants

Word Proximity

'Not for Machines to Harvest': Data Revolts Break Out Against A.I.

Fed up with A.I. companies consuming online content without consent, fan fiction writers, actors, social media companies and news organizations are among those rebelling.

Example of Large Language Models

Examples of Large Language Models

Chatbots in Customer Service

Virtual Assistants: Siri, Alexa

Translation Services: Google Translate

Future Trends and Applications

The Impact of Deep Learning

The Transformational Power of Deep Learning: Highlighting how these techniques are changing industries from healthcare to finance.

Impact Across Industries
Case Study: Healthcare
Case Study: Finance
Case Study: Autonomous Vehicles
Future Predictions

Conclusion

Conclusion: Recap of deep learning basics and their applications in real-world.

Recap of Deep Learning Basics

Understanding Neural Networks

Importance of Labeling and Backpropagation