College of Engineering & Applied Sciences

CSPB 3702

Cognitive Science

Class Notes

Taylor Larrechea

2024

Sections

Mind And Machine 1A

Mind And Machine 1A

1.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Computing Machinery And Intelligence
- Minds, Brains, And Programs

1.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

1.0.3 Lectures

The lectures for this week and their links can be found below:

- 1.1 - The Lure, And Eeriness of Machine Life ≈ 18 min.
- 1.2 - The Turing Test ≈ 35 min.
- 1.3 - The Computational Metaphor of Mind ≈ 19 min.
- A Story of Automata ≈ 59 min.

Below is a list of lecture notes for this week:

- Mind And Machine Lecture Notes
- Metacognition Lecture Notes

1.0.4 Assignments

The assignment for this week is:

- Assignment 1 - Digital Automata

1.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 1 - Mind Machine 1A

1.0.6 Chapter Summary

Below is a summary of the reading assignment 'Computing Machinery And Intelligence'.

Computing Machinery And Intelligence

"Computing Machinery and Intelligence," published by Alan Turing in 1950, stands as a landmark in the realm of artificial intelligence and the philosophy of mind. Turing's paper is a thoughtful exploration of whether machines can exhibit human-like intelligence and consciousness. One of the central concepts he introduces is the "imitation game," a precursor to the now-famous Turing Test. This game involves a human interrogator, a human respondent, and a machine. Through written communication, the interrogator interacts with both the human and the machine, attempting to discern which is which. Turing suggests that the machine's ability to convincingly mimic human responses could be indicative of its intelligence.

Turing delves into the question of whether machines can truly "think." He argues that the question itself is ill-defined, advocating instead for an examination of whether machines can imitate human thinking sufficiently to deceive an observer. He contends that a machine's capacity to emulate human-like thinking, demonstrated through the imitation game, should be considered a valid criterion for attributing intelligence to the machine.

Addressing the objection that machines lack consciousness and, consequently, genuine thought, Turing counters that even human consciousness remains elusive to precise definition. He posits that the focus should shift from attempting to ascertain internal states of a machine to observing its behavior and its capacity to generate intelligent responses.

Turing introduces the notion of a "universal machine," which can simulate the functions of any other machine, including other universal machines. This idea underpins his argument that a machine able to effectively imitate human behavior in the imitation game essentially functions as a universal machine, thereby meeting the criteria for intelligence.

Turing also explores the concept of a "learning machine," one capable of modifying its responses based on feedback. He envisions that such a machine could be trained to enhance its performance in the imitation game, ultimately becoming more adept at imitating human-like behavior.

Throughout the paper, Turing preempts potential criticisms and objections. He addresses concerns that the imitation game may solely assess linguistic prowess and acknowledges the complexity of building a machine that can convincingly pass as human. He also engages with theological objections that attribute unique qualities, such as a soul, to humans, asserting that these objections lack empirical grounding and are unnecessary for the study of machine intelligence.

In essence, "Computing Machinery and Intelligence" ventures into the realm of machine intelligence, presenting the Turing Test as a means of evaluating machine behavior. It confronts objections, considers counterarguments, and contributes significantly to ongoing discussions about artificial intelligence, machine consciousness, and the prospect of machines attaining human-like thinking abilities.

We now examine 'Minds, Brains, And Programs' by John R. Searle.

Minds, Brains, And Programs

In the chapter "Minds, Brains, and Programs" within the book "Mind Design: Philosophy, Psychology, Artificial Intelligence," John R. Searle presents a compelling critique of strong artificial intelligence through a thought experiment known as the "Chinese Room Argument." This argument serves as a philosophical exploration into the nature of understanding and consciousness within computational systems.

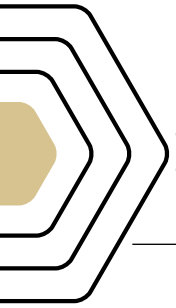
Searle's illustration revolves around an individual confined within a room, devoid of any understanding of the Chinese language. This person is provided with a set of instructions written in English, guiding them to manipulate Chinese symbols on slips of paper. These instructions enable the individual to generate responses in Chinese that appear grammatically correct and contextually appropriate. From an external perspective, it might seem as though the person comprehends Chinese.

Central to the Chinese Room Argument is the distinction between syntax and semantics. Searle contends that while the individual in the room is adept at manipulating the syntax of Chinese symbols, they lack a genuine grasp of the semantics—the meanings associated with those symbols. This discrepancy raises a fundamental question about whether symbol manipulation alone can yield true understanding or consciousness.

Searle's contention challenges the core premise of strong artificial intelligence, which posits that appropriately designed computer programs could achieve human-like cognitive capabilities, including understanding and consciousness. The Chinese Room Argument prompts us to question whether such systems genuinely comprehend the content they process or whether their responses are mere products of rule-based manipulation.

The underlying intuition of the argument is that understanding involves more than the mechanical manipulation of symbols. True understanding entails an intrinsic awareness of meaning and a subjective experience of that meaning. Searle suggests that this essential subjective aspect of cognition cannot be captured through formal algorithms or computational processes. Consequently, the Chinese Room Argument raises skepticism about the adequacy of computational models to fully replicate human cognitive processes.

In essence, the "Minds, Brains, and Programs" chapter, through the Chinese Room Argument, compels us to critically examine the foundations of artificial intelligence, the nature of understanding, and the potential limitations of solely computational approaches to cognition. It prompts a reconsideration of the complex interplay between syntax and semantics, mechanics and meaning, within the realm of intelligent systems and human consciousness.



Mind And Machine 1B

2.0.1 Assigned Reading

The reading assignments for this week can be found below:

- The Nature of Mental States

2.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

2.0.3 Lectures

The lectures for this week and their links can be found below:

- What Makes a Problem Hard? Part 1 $\approx$ 23 min.
- What Makes a Problem Hard? Part 2 $\approx$ 35 min.
- What Makes a Problem Hard? Part 3 $\approx$ 23 min.

Below is a list of lecture notes for this week:

- What Makes A Problem Hard Lecture Notes
- Why Can You Not Trisect An Angle? Lecture Notes
- Trisect An Angle With Origami Lecture Notes

2.0.4 Assignments

The assignment for this week is:

- Assignment 1 - Digital Automata

2.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 2 - Mind Machine 1B

2.0.6 Chapter Summary

Below is a summary of the reading assignment 'The Nature of Mental States'.

The Nature of Mental States

'The Nature of Mental States' by Hilary Putnam is a seminal essay that delves into the intricate relationship between mental states and their physical counterparts, touching on crucial themes in philosophy of mind, cognitive science, and the exploration of artificial intelligence. Published in 1967, this essay continues to resonate with contemporary discussions and remains a cornerstone in the study of the mind and its connection to the physical world.

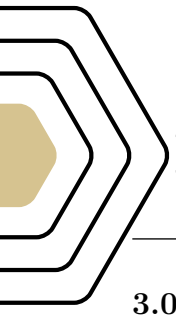
Putnam's central argument revolves around the concept of functionalism, which stands in contrast to the traditional 'type identity theory.' Type identity theory posits that mental states are directly identical to specific brain states—a viewpoint that Putnam challenges by presenting the thought experiment of the "brain in a vat." This provocative scenario prompts us to contemplate the possibility that our mental experiences might be disconnected from the external world, thereby raising questions about the nature of reality, knowledge, and consciousness.

Functionalism, as presented by Putnam, posits that mental states are better understood through their functional roles within cognitive systems and their relationships with other mental states. This approach allows for the possibility that different physical systems could give rise to identical mental states if their functional organizations match. This notion has far-reaching implications for the philosophy of mind, as it redefines the criteria for identifying and explaining mental states.

In the context of cognitive science, 'The Nature of Mental States' holds immense relevance. Cognitive science seeks to understand the mind's processes, its relationship to the brain, and the nature of human consciousness. Putnam's functionalist perspective aligns with cognitive science's focus on studying mental processes in terms of information processing, representation, and computation. The essay also touches upon the nature of artificial intelligence and how we might conceptualize the mental states of AI systems.

In the context of the 'Mind and Machine' module within cognitive science, this essay can provide a foundational understanding of the relationship between mental states and physical systems. The exploration of functionalism can shed light on how cognitive processes might be modeled and understood in both human minds and artificial systems. Additionally, Putnam's thought experiment can stimulate discussions on the boundaries of human cognition, the challenges of studying consciousness, and the implications of artificial intelligence for our understanding of the mind.

By engaging with 'The Nature of Mental States,' one will delve into the heart of questions that underpin cognitive science, including the nature of consciousness, the relationship between mind and body, and the potential for replicating cognitive processes in machines. This essay offers a thought-provoking journey into the intersection of philosophy, cognitive science, and the study of artificial intelligence, enriching one's understanding of the complexities of the mind and its connection to machines.



Mini Project 1

3.0.1 Lectures

The lectures for this week and their links can be found below:

- Digital Automata Project Overview ≈ 14 min.
- CoSpace Intro # 1 ≈ 17 min.
- CoSpace Intro # 2 ≈ 14 min.
- CoSpace Pro Features ≈ 10 min.

3.0.2 Assignments

The assignment for this week is:

- Assignment 1 - Digital Automata

Problem Solving 2A

4.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Recognizing, Defining, and Representing Problems

4.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

4.0.3 Lectures

The lectures for this week and their links can be found below:

- Solving Problems ≈ 25 min.
- Problems For Minds And Machines ≈ 32 min.
- Hard Problems For Computers ≈ 23 min.

Below is a list of lecture notes for this week:

- Problem Solving Lecture Notes

4.0.4 Assignments

The assignment for this week is:

- Assignment 2 - Problem Solving

4.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 3 - Problem Solving 1A

4.0.6 Chapter Summary

Below is a summary of the reading assignment 'Recognizing, Defining, and Representing Problems'.

Recognizing, Defining, And Representing Problems

The exploration of recognizing, defining, and representing problems stands at the forefront of cognitive psychology and problem-solving research. It delves into the intricate cognitive processes and strategies individuals employ when confronted with a wide array of challenges and predicaments. This field encompasses a multifaceted journey of understanding, beginning with problem recognition. In this initial phase, individuals discern the presence of a problem, often detecting disparities between their present state and an aspired one. Such recognition relies upon the capacity to spot discrepancies, irregularities, or hurdles that necessitate attention and resolution.

Once a problem is identified, the subsequent step involves problem definition, a pivotal stage where the problem must be clearly and explicitly articulated. This encompasses the delineation of the problem's nature, boundaries,

as well as the establishment of its objectives, constraints, and pertinent factors. Effective problem definition is of paramount importance, for it serves as the foundation upon which problem-solving strategies are constructed.

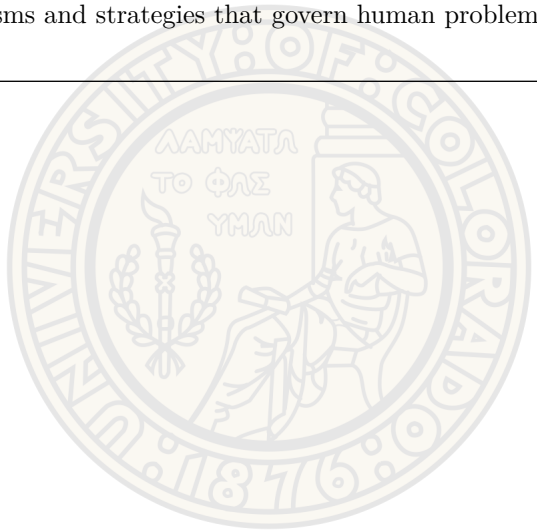
Problem representation follows, encompassing the mental structuring and organization of problem-related information. This cognitive process often entails the construction of mental models, diagrams, or frameworks, facilitating a comprehensive grasp of the problem's intricacies, components, and relationships. A well-crafted problem representation significantly streamlines the ensuing problem-solving endeavor.

With a meticulously defined and represented problem in place, individuals proceed to employ a spectrum of problem-solving strategies. These strategies span from systematic, algorithmic approaches, characterized by methodical, step-by-step procedures, to heuristic methods grounded in intuitive, rule-of-thumb decision-making. The selection of an appropriate strategy hinges upon the nature of the problem at hand and the individual's level of expertise.

Furthermore, the expertise possessed within a specific domain significantly influences problem recognition, definition, and representation. Experts tend to harbor more refined mental problem representations, often capable of recognizing elusive patterns or solutions that might elude novices. Creativity emerges as another vital component in this narrative, stimulating the generation of innovative problem definitions and representations.

Lastly, metacognitive skills occupy a central role. These skills involve the active monitoring and regulation of one's problem-solving processes. Through metacognition, individuals continuously evaluate the efficiency of their problem representations and strategies, making adjustments and refinements as deemed necessary.

In summation, the effective ability to recognize, define, and represent problems constitutes a fundamental facet of human cognition and the broader realm of problem-solving. It forms the bedrock upon which subsequent problem-solving efforts are constructed, profoundly influencing the quality and efficacy of the solutions derived. This intricate cognitive landscape continues to captivate researchers in cognitive psychology, propelling the exploration of the underlying cognitive mechanisms and strategies that govern human problem-solving capacities.



Problem Solving 2B

5.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Judgement Under Uncertainty - Heuristics And Biases
- Prospect Theory

5.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

5.0.3 Lectures

The lectures for this week and their links can be found below:

- 2.4 Machines And Logic ≈ 25 min.
- 2.5 Judgement And Decision Makeing ≈ 28 min.
- 2.6 Heuristics And Biases In Judgement ≈ 22 min.

Below is a list of lecture notes for this week:

- Heuristics Lecture Notes

5.0.4 Assignments

The assignment for this week is:

- Assignment 2 - Problem Solving

5.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 4 - Problem Solving 2B

5.0.6 Chapter Summary

Below is a summary of the reading assignment 'Judgement Under Uncertainty - Heuristics And Biases'.

Judgement Under Uncertainty - Heuristics And Biases

"Judgment under Uncertainty: Heuristics and Biases" by Amos Tversky and Daniel Kahneman represents a landmark in the field of behavioral economics and cognitive psychology. This influential paper dives deep into the intricacies of human decision-making when confronted with situations characterized by uncertainty and limited information.

At the heart of the paper are the concepts of heuristics and biases. Heuristics are the mental shortcuts or rules of thumb that individuals employ when faced with complex choices or judgments. These cognitive shortcuts help simplify decision-making processes, allowing people to make relatively quick assessments in situations where

exhaustive analysis would be impractical. While heuristics serve as valuable cognitive tools, Tversky and Kahneman's research reveals that they often lead to systematic cognitive biases—predictable patterns of irrational judgment.

The paper identifies and elucidates various cognitive biases that arise from heuristics. For example, the availability heuristic is a tendency to rely on readily available information when making judgments, often leading individuals to overestimate the likelihood of events based on their ease of recall. The representativeness heuristic involves making judgments based on how closely an object or event matches a prototype or stereotype, which can lead to errors in probabilistic reasoning. Additionally, the anchoring bias describes the phenomenon where individuals rely heavily on the first piece of information encountered (the anchor) when making subsequent judgments, even when the anchor is irrelevant or misleading.

These cognitive biases are not mere curiosities; they have profound implications for decision-making in various contexts. From finance to healthcare, from politics to personal choices, individuals regularly encounter situations where these biases influence their judgments and decisions. Recognizing these biases and understanding how they operate is crucial for improving decision-making processes, designing effective policies, and developing strategies to mitigate their impact.

"Judgment under Uncertainty" has played a pivotal role in reshaping how we view human decision-making. It challenges the traditional economic model of humans as perfectly rational agents and instead paints a more nuanced picture of cognitive limitations and the systematic errors we are prone to make. This paper's enduring legacy has led to a flourishing field of research in behavioral economics and cognitive psychology, inspiring numerous studies and practical applications aimed at helping individuals make better, more informed decisions in an uncertain world.

Below is a summary of the reading assignment 'Prospect Theory'.

Prospect Theory

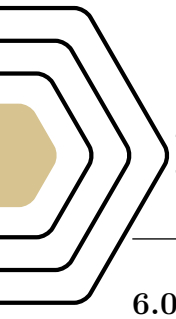
Prospect Theory, developed by Daniel Kahneman and Amos Tversky, represents a significant departure from traditional economic models, offering a more comprehensive and psychologically grounded framework for understanding human decision-making in situations involving risk and uncertainty. This theory challenges the conventional economic concept of "expected utility theory," which assumes that individuals make rational choices by maximizing expected outcomes. Instead, Prospect Theory introduces two fundamental behavioral elements: the reference point and loss aversion.

The concept of the reference point plays a central role in Prospect Theory, as individuals assess potential outcomes in relation to this point, often rooted in their current circumstances or the status quo. This reference point acts as a psychological anchor against which gains and losses are measured. For example, receiving a sudden windfall of $1,000 may be perceived differently depending on whether it elevates someone from financial hardship to security or simply adds to their existing wealth.

Another key tenet of Prospect Theory is loss aversion, which posits that individuals tend to be more averse to losses than they are inclined to value equivalent gains. In practical terms, this implies that the emotional impact of losing $100 is typically more significant than the pleasure derived from gaining an identical amount, leading to risk-averse behavior in scenarios involving potential losses.

Additionally, Prospect Theory introduces the notion of "diminishing sensitivity to gains and losses," suggesting that as individuals move farther from their reference point, their emotional responses to changes in wealth become less pronounced. For instance, the emotional contrast between gaining $1,000 and gaining an additional $1,000 is usually less substantial than the difference between gaining and losing $1,000.

The real-world implications of Prospect Theory are substantial, particularly in fields like finance, investment, and behavioral economics. It provides insights into various phenomena, including how loss aversion induces risk aversion, the disposition effect (the tendency to prematurely sell winning investments and hold onto losing ones), and the equity premium puzzle (the question of why people demand a premium for holding risky assets). By offering a more psychologically realistic lens through which to view human decision-making, Prospect Theory has deepened our understanding of how individuals navigate the intricate landscape of uncertainty and risk in practical scenarios.



Mini Project 2

6.0.1 Lectures

The lectures for this week and their links can be found below:

- Bridges ≈ 5 min.

6.0.2 Assignments

The assignment for this week is:

- Assignment 2 - Problem Solving

Vision 3A & 3B

7.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Vision

7.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

7.0.3 Lectures

The lectures for this week and their links can be found below:

- 3.1 Vision as a Computational Problem ≈ 19 min.
- 3.2 Finding Edges ≈ 31 min.
- 3.3 Depth Perception ≈ 36 min.
- 3.4 Object Recognition ≈ 37 min.

Below is a list of lecture notes for this week:

- Heuristics Lecture Notes

7.0.4 Assignments

The assignment for this week is:

- Assignment 3 - Pixel Spreadsheet

7.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 5 - Vision 3A & 3B

7.0.6 Chapter Summary

Below is a summary of the reading assignment 'Vision'.

Vision

Computer vision is a multidisciplinary field of artificial intelligence and computer science focused on enabling machines, particularly computers and robots, to interpret and understand visual information from the world, much like the way humans do with their vision. It aims to replicate and simulate human vision processes to enable machines to perceive and interact with the visual world effectively.

At its core, computer vision involves the development of algorithms and systems that can analyze and extract information from images or video data. This process includes tasks like object recognition, scene understanding, motion tracking, facial recognition, and more. The field has wide-ranging applications, including autonomous

vehicles, surveillance systems, medical image analysis, industrial automation, augmented and virtual reality, and even creative arts.

The relationship between computer vision and human vision is profound. Computer vision researchers draw inspiration from the human visual system, seeking to understand and replicate its mechanisms for processing and interpreting visual information. Key aspects of human vision, such as feature detection, pattern recognition, and depth perception, serve as foundational principles for computer vision algorithms. Additionally, computer vision systems are designed to mimic how humans perceive and understand the visual world, albeit in a more computational and systematic manner.

While computer vision has made significant strides, it still faces challenges in achieving the robustness and versatility of human vision. Human vision is highly adaptable, capable of recognizing objects in various lighting conditions, orientations, and cluttered environments. Achieving this level of flexibility and generalization in computer vision remains an ongoing research goal. Nonetheless, computer vision continues to evolve and contribute to a wide range of industries, promising innovative solutions to complex real-world problems.

Vision 3C

8.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Mental Imagery And The Visual System

8.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

8.0.3 Lectures

The lectures for this week and their links can be found below:

- Mental Imagery And The Brain ≈ 63 min.
- Mental Imagery And The "Turn Towards Neuroscience" ≈ 61 min.

Below is a list of lecture notes for this week:

- Mental Imagery Lecture Notes

8.0.4 Assignments

The assignment for this week is:

- Assignment 3 - Pixel Spreadsheet

8.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 6 - Vision 3C

8.0.6 Chapter Summary

Below is a summary of the reading assignment 'Mental Imagery And The Visual System'.

Mental Imagery And The Visual System

Mental imagery and the visual system are intricately connected aspects of human cognition and perception. Mental imagery refers to the ability of the mind to generate and manipulate visual representations of objects, scenes, or concepts without actual sensory input. This phenomenon plays a crucial role in various cognitive processes and is closely intertwined with the functioning of the visual system.

The visual system, encompassing the eyes and the brain's neural networks, is responsible for processing and interpreting visual information from the external world. However, mental imagery operates internally, allowing individuals to "see" images in their mind's eye without the need for external stimuli. Understanding the relationship between mental imagery and the visual system offers valuable insights into human cognition.

Research in this field explores how mental imagery is generated, its neural underpinnings, and the functional roles it serves. Studies using neuroimaging techniques like fMRI have identified brain regions associated with mental imagery, indicating that the same neural pathways involved in processing external visual stimuli are activated

during mental imagery. Moreover, mental imagery contributes to memory, problem-solving, and creative thinking, showcasing its significance in various cognitive domains.

The study of mental imagery and the visual system has practical applications in areas like psychology, education, sports, and rehabilitation. It can enhance learning and memory strategies, aid in therapeutic interventions, and even help athletes visualize and improve their performance. Overall, this topic bridges the realms of psychology, neuroscience, and cognitive science, shedding light on how the mind's eye interacts with the external world through the visual system.

Vision 3D

9.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Mind, Body, World: Foundations of Cognitive Science

9.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

9.0.3 Lectures

The lectures for this week and their links can be found below:

- Neural Networks: Perceptrons ≈ 47 min.
- Neural Networks 2: Multi-Layer Networks ≈ 25 min.
- Deep Learning - Object Recognition ≈ 27 min.

9.0.4 Assignments

The assignment for this week is:

- Assignment 3 - Pixel Spreadsheet

9.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 7 - Vision 3D

9.0.6 Chapter Summary

Below is a summary of the reading assignment 'Mind, Body, World: Foundations of Cognitive Science'.

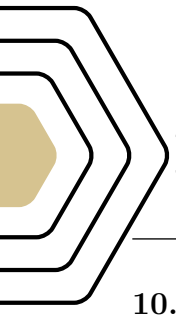
Mind, Body, World: Foundations of Cognitive Science

"Elements of Connectionist Cognitive Science" by Michael R. W. Dawson is a foundational book within the realm of cognitive science that delves deep into the principles and applications of connectionist modeling. Connectionism, a computational framework inspired by the neural networks in the human brain, is at the core of this exploration. Dawson introduces readers to the fundamental concepts of connectionism, emphasizing that cognitive processes can be seen as interactions among simple processing units connected through weighted links. These networks have the capacity to adapt and learn from experience, making them potent tools for modeling various aspects of human cognition.

The book covers different types of neural network architectures, including feedforward and recurrent networks, and elucidates how these structures relate to specific cognitive processes. Learning algorithms, particularly backpropagation, are discussed in detail. Backpropagation is a pivotal learning algorithm that enables neural networks to adjust their connection weights based on prediction errors, mirroring the process of learning and adaptation in the human brain.

Dawson demonstrates how connectionist models can be applied to simulate and understand diverse cognitive functions, ranging from memory retrieval and language processing to pattern recognition. Additionally, the book navigates the connections and distinctions between connectionism and other cognitive theories, such as symbolic and information-processing models, shedding light on the strengths and weaknesses of connectionist approaches and their potential to complement or challenge existing theories.

Moreover, "Elements of Connectionist Cognitive Science" explores the practical implications of connectionist cognitive science, notably its relevance to artificial intelligence and machine learning. Connectionist models have significantly influenced the development of neural networks in AI, contributing to their successes in various applications. In summary, this book provides an extensive and insightful exploration of connectionism as a framework for comprehending and modeling human cognition, making it a valuable resource for researchers, students, and anyone intrigued by the computational principles underpinning the intricate processes of the human mind.



Mini Project 3

10.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Pixel Tutorial

10.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

10.0.3 Lectures

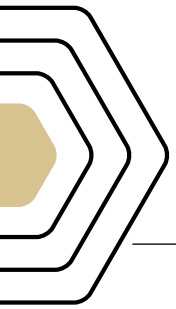
Below is a list of lecture notes for this week:

- Pixel Spreadsheet Images Lecture Notes
- Pixel Converter Lecture Notes

10.0.4 Assignments

The assignment for this week is:

- Assignment 3 - Pixel Spreadsheet



Games 4A

11.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Is Tit-for-Tat The Answer?

11.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

11.0.3 Lectures

The lectures for this week and their links can be found below:

- Multiple Deciding Agents - A Simple Model ≈ 23 min.
- Game Theory: Prisoner's Dilemma ≈ 36 min.
- Game Theory: Axelrod's Tournament ≈ 26 min.

Below is a list of lecture notes for this week:

- Multiple Deciding Agents Lecture Notes

11.0.4 Assignments

The assignment for this week is:

- Assignment 4 - Making A Teachable Machine

11.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 8 - Games 4A

11.0.6 Chapter Summary

Below is a summary of the reading assignment 'Is Tit-For-Tat The Answer?'.

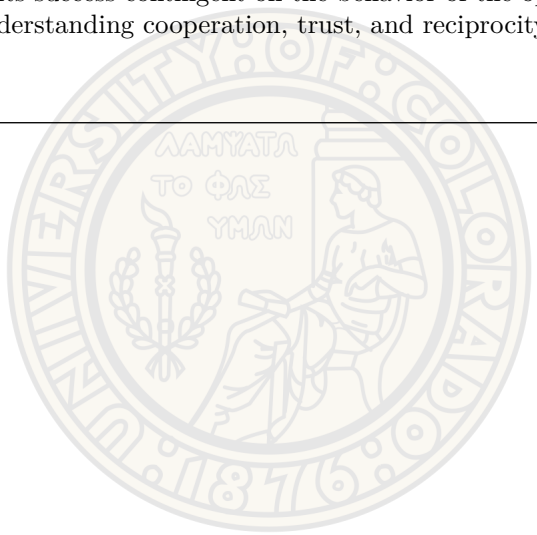
Is Tit-For-Tat The Answer?

Summary of Tit-for-Tat Strategy:

Tit-for-Tat is a cooperative strategy in which an individual initially cooperates with another individual or entity and subsequently mirrors their opponent's previous move. In other words, it responds to cooperation with cooperation and defection with defection. The strategy's key features include:

1. **Start with Cooperation:** Tit-for-Tat begins with a cooperative move, assuming goodwill and cooperation from the opponent at the outset of an interaction.
2. **Reciprocity:** It responds to the opponent's last move by reciprocating in kind. If the opponent cooperated in the previous round, Tit-for-Tat cooperates in the next round. If the opponent defected, Tit-for-Tat defects in response.
3. **No Retaliation:** Tit-for-Tat does not seek revenge or escalate conflicts. It merely reflects the opponent's behavior, maintaining a fair and balanced approach.
4. **Adaptive:** Tit-for-Tat adapts to the opponent's actions over time. If the opponent consistently cooperates, Tit-for-Tat continues to cooperate. If the opponent defects, Tit-for-Tat adjusts accordingly.

The Tit-for-Tat strategy has been studied extensively in the context of the Prisoner's Dilemma and other game scenarios. What makes it remarkable is its simplicity, effectiveness in promoting cooperation, and robustness in various competitive situations. It can lead to mutually beneficial outcomes in repeated interactions by fostering trust and encouraging reciprocation of positive behavior. However, it is not immune to exploitation by strategies that continuously defect, making its success contingent on the behavior of the opponent. Despite this, Tit-for-Tat serves as a valuable model for understanding cooperation, trust, and reciprocity in both human interactions and computer simulations.



Games 4B

12.0.1 Assigned Reading

The reading assignments for this week can be found below:

- The Evolution Of Institutions For Collective Action

12.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

12.0.3 Lectures

The lectures for this week and their links can be found below:

- Games "In the Large" ≈ 49 min.

Below is a list of lecture notes for this week:

- Games In The Large Lecture Notes

12.0.4 Assignments

The assignment for this week is:

- Assignment 4 - Making A Teachable Machine

12.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 9 - Games 4B

12.0.6 Chapter Summary

Below is a summary of the reading assignment 'The Evolution Of Institutions For Collective Action'.

The Evolution Of Institutions For Collective Action

Overview

"The Evolution of Institutions for Collective Action" is a seminal work by Elinor Ostrom that explores the development and functioning of institutions designed to facilitate collective action and manage common-pool resources. The summary of the key concepts and ideas in this work includes:

1. **Common-Pool Resources (CPRs):** Ostrom's research focuses on common-pool resources, such as fisheries, forests, and irrigation systems, where multiple individuals or groups have access and use rights. The challenge is to prevent overuse and depletion.

2. **Institutional Analysis and Design (IAD) Framework:** Ostrom presents the IAD framework, which provides a systematic way to analyze and design institutions for managing CPRs. It considers various factors, including the characteristics of the resource, the users, and the context.

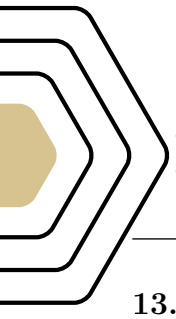
3. **Polycentric Governance:** Ostrom argues for polycentric governance, where multiple levels of authority and institutions coexist. This allows for flexibility and adaptation to local conditions, fostering sustainable resource management.

4. **Eight Design Principles:** Ostrom identifies eight design principles that successful CPR institutions tend to follow. These principles include clear boundaries, proportional costs and benefits, and collective-choice arrangements.

5. **Empirical Studies:** Ostrom's work is grounded in extensive empirical studies of real-world CPR management, challenging the conventional wisdom that CPRs are inevitably subject to the "tragedy of the commons."

6. **Policy Implications:** Ostrom's research has significant policy implications, suggesting that communities can effectively manage CPRs without centralized government control. Her work has influenced discussions on environmental and resource management.

"The Evolution of Institutions for Collective Action" contributes to our understanding of how communities can self-organize and govern common-pool resources effectively. It emphasizes the importance of context-specific solutions, collective decision-making, and the role of institutions in sustainable resource management.



Mini Project 4

13.0.1 Piazza

Must post / respond to at least **five** Piazza posts this week.

13.0.2 Lectures

The lectures for this week and their links can be found below:

- ML Pottery Demo PART 1 ≈ 5 min.
- ML Pottery Demo PART 2 ≈ 6 min.

13.0.3 Assignments

The assignment for this week is:

- Assignment 4 - Making A Teachable Machine

Evolution 5A

14.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Evolutionary Game Theory

14.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

14.0.3 Lectures

The lectures for this week and their links can be found below:

- Game Theory & Evolution Part 1 ≈ 26 min.
- Game Theory & Evolution Part 2 ≈ 30 min.
- Evolution & Cognitive Science ≈ 60 min.

Below is a list of lecture notes for this week:

- Evolution Cognitive Science Lecture Notes

14.0.4 Assignments

The assignment for this week is:

- Assignment 5 - Schelling Model

14.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 10 - Evolution 5A

Evolution 5B

15.0.1 Assigned Reading

The reading assignments for this week can be found below:

- Experiments In Synthetic Psychology

15.0.2 Piazza

Must post / respond to at least **five** Piazza posts this week.

15.0.3 Lectures

The lectures for this week and their links can be found below:

- Infant & Child Cognition ≈ 50 min.
- Embodied Cognition ≈ 42 min.
- Artificial Life ≈ 47 min.

Below is a list of lecture notes for this week:

- Infant Child Cognition Lecture Notes
- Embodied Cognition Lecture Notes
- Artificial Animals Lecture Notes

15.0.4 Assignments

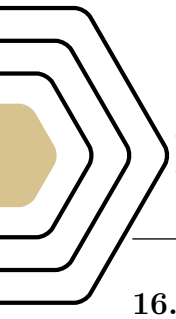
The assignment for this week is:

- Assignment 5 - Schelling Model

15.0.5 Quiz

The quiz's for this week can be found below:

- Quiz 11 - Evolution 5B



Mini Project 5

16.0.1 Piazza

Must post / respond to at least **five** Piazza posts this week.

16.0.2 Lectures

Below is a list of lecture notes for this week:

- Schelling Model Examples Lecture Notes

16.0.3 Assignments

The assignment for this week is:

- Assignment 5 - Schelling Model