Example Questions (made with AI)

Introduction

1. Define the terms "neuroscience" and "cognition" and explain how they are interconnected.

2. Discuss the historical context in which the field of cognitive neuroscience emerged. What were some of the key milestones?

3. Explain the phrase "cells that fire together, wire together". How does this relate to learning and memory formation?

4. Discuss the concept of "biomimicry". How does this apply to the fields of neuroscience and artificial intelligence

5. Explain the role of the Global Workspace Theory in our understanding of consciousness.

6. Discuss the significance of the Chinese Room thought experiment in the discussion of artificial intelligence and consciousness.

7. How has the understanding of the nervous system evolved over time? Discuss the contributions of key figures like Camillo Golgi and Charles Sherrington.

8. Discuss the influence of Edward L. Thorndike's Law of Effect on the field of cognitive psychology.

9. Explain the difference between the concepts of "hardwiring" and "learning" in the context of the brain's structure and function.

10. Discuss the relationship between the hardware (structure) and software (function) of the brain in the context of cognition and neuroscience.

The Nervous System: Anatomy and Physiology

1. Describe the concept of a Neural Circuit. How does it process specific types of information?

2. Explain the significance of divergence and convergence in the functioning of the nervous system.

3. What is the role of excitatory and inhibitory neurons in the nervous system? How do they influence the firing of postsynaptic neurons?

4. Discuss the structure and role of the peripheral nervous system (PNS).

5. Compare and contrast the somatic nervous system and the autonomic nervous system. How do they contribute to the body's functioning?

6. Describe the sympathetic and parasympathetic systems of the autonomic nervous system. How do they affect the body's response to stress and restoration of homeostasis?

7. Explain the physical structures that surround the central nervous system (CNS). What is their role?

8. Describe the role of the spinal cord in the central nervous system. How does it coordinate sensory and motor signals?

9. Discuss the role of the brain stem in regulating basic life functions. Why is damage to the brain stem life-threatening?

10. Describe the different components of the brain. What are their functions and how do they interact to regulate the body's functions?

Animal Reinforcement Learning and Pavlovian Learning

1. Define Pavlovian learning and its significance in the behavior of animals.

2. Discuss the process of association formation in Pavlovian learning using an appropriate example.

3. Explain the concept of the conditioned stimulus and conditioned response in the context of Pavlovian learning.

4. Define instrumental learning and differentiate it from Pavlovian learning.

5. Discuss Thorndike's Law of Effect and its significance in instrumental learning.

6. Describe how the nature of the outcome shapes behavior in instrumental learning.

7. Discuss the different partial reinforcement schedules in the context of instrumental learning.

8. Discuss how conditioned responses in Pavlovian learning are anticipatory and predictive.

9. Explain how Pavlovian learning can lead to protective behaviors in animals.

10. Discuss how Pavlovian learning is a flexible process.

Contiguity, Contingency and Surprise

1. Explain the concept of contiguity in the context of Pavlovian learning.

2. Discuss the importance of contiguity in instrumental learning.

3. Define contingency in the context of associative learning. Why is it crucial?

4. Explain why contiguity and contingency alone are not sufficient for learning. What else is needed?

5. Discuss the role of surprise in learning. Why do we only learn from surprising events?

6. Using an example, illustrate the difference between contiguity and contingency.

7. How does surprise impact the predictability or contingency between a conditioned stimulus and an unconditioned stimulus?

8. How does the timing of stimuli (contiguity) affect the learning process in classical conditioning?

9. Discuss an example where both contiguity and contingency were present, but no learning occurred due to a lack of surprise.

10. Explain how the principles of contiguity, contingency, and surprise can be applied in real-world learning scenarios.

Reward Prediction Error Hypothesis

1. Explain the concept of signed prediction errors and how they could be implemented in neurons. Describe how this relates to the reward prediction error hypothesis..

2. How does the reward prediction error hypothesis of dopamine neuron activity relate to processes such as motivation, learning, action-selection,

and decision-making?.

3. Discuss the role of prediction errors in reinforcement learning. How does this process allow cues or stimuli to acquire value through their predictive relationship with rewarding outcomes?.

4. Compare and contrast the Rescorla-Wagner model and the Temporal Difference (TD) learning model. How do they approach learning from different perspectives and incorporate different mechanisms?

5. Discuss the role of dopamine in reward prediction error processing. How does dopamine neuron firing change in response to prediction errors?

6. Explain how the phasic responses of dopamine neurons signal reward prediction errors, not the reward itself.

7. Describe how synaptic plasticity might be modulated via the neuromodulator dopamine as a mechanism for implementing learning algorithms.

8. Discuss the statement "predictions empower us to take control and influence our circumstances to achieve desired results." How does this relate to the reward prediction error hypothesis?

9. How does the reward prediction error hypothesis explain the phenomena observed in second-order conditioning trials?

10. Discuss how the Temporal Difference (TD) learning model provides a prediction for each time in the trial during which a CS is presented.

Systems for instrumental learning: habitual and goal-directed:

1. Define the two systems of instrumental learning: habitual and goal-directed.

2. Discuss the differences between habitual and goal-directed systems in the context of instrumental learning.

3. How does a habitual system learn to repeat previously successful actions?

4. Explain the concept of a goal-directed system in evaluating actions based on their specific anticipated consequences.

5. Provide examples of situations where a habitual system of instrumental learning is used versus a goal-directed system.

6. How does the transition from goal-directed to habitual actions occur in instrumental learning?

7. Discuss the neural substrates of habitual behavior in humans.

8. How does the amount of training influence the use of habitual versus goal-directed systems in instrumental learning?

9. Explain the concept of Thorndike's Law of Effect and its significance in instrumental learning.

10. Describe how the outcomes shape behavior in both the habitual and goal-directed systems of instrumental learning.