The Human Nervous System and Brain Function

Computational Neuroscience Course homework 03

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I. THE HUMAN NERVOUS SYSTEM OVERVIEW

The human nervous system can be divided into two main parts: the central nervous system (CNS) and the peripheral nervous system (PNS).

A. Central Nervous System

The focus of this course is primarily on the CNS, which comprises:

- **Brain**: The control center of the body, responsible for processing sensory information, and facilitating cognitive functions.
- **Spinal Cord**: Plays a crucial role in:
  1. Local feedback control for reflex actions, enabling immediate responses to certain stimuli without the need for brain processing.
  2. Descending motor control signals, outlining the necessity of the spinal cord for initiating movement.
  3. Ascending sensory axons, which carry sensory information from the body to the brain.

B. Peripheral Nervous System

The PNS is divided into:

- **Somatic Nervous System**: Connects the CNS to muscles and sensory receptors.
  - Afferent Nerve Fibers: Carry information from the periphery to the CNS.
  - Efferent Nerve Fibers: Carry commands from the CNS to the peripheral effectors.
- **Autonomic Nervous System**: Regulates involuntary functions, such as heart rate and digestion.

II. SENSORY AND MOTOR PATHWAY

The pathway from sensory input to action follows the sequence: Peripheral → Spinal Cord → Brain → Spinal Cord → Peripheral → Action.

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III. BRAIN LOBES AND FUNCTION

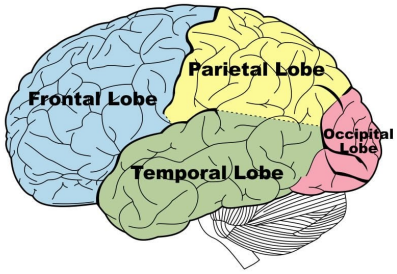

FIG. 1. Different Lobes

Input is processed by the Parietal, Occipital, and Temporal Lobes based on the type of information. This processed information is then represented in the Frontal Lobe for decision making, leading to action.

IV. UNIQUE HUMAN BRAIN FEATURES

The primary differences between the human brain and that of other mammals are attributed to the Frontal Lobe, especially in terms of neuron density. The non-smooth appearance of our neocortex allows for a higher neuron count.

V. CORTEX DETAILS

Approximately 30 billion neurons. Each neuron forms about 10^4 synapses, assuming synapses are directed. Contains six layers, though the exact number can vary based on the criteria used for differentiation. The universality of computational principles across the cortex remains an open question

VI. COMPARISON: HUMAN BRAIN VS. COMPUTER

	Human Brain	Computer
Device Count	10^{11} neurons	10^{10} transistors
Connections	10^4 per neuron	Sparse
Device Speed	100 microseconds	10 GHz
Computing	Parallel	Sequential (CPU)
Capability	Good at ill-posed problems	Good at Math

TABLE I. Comparing the Human Brain and Computers