

CMSC 491: Neural Eng Assignment 1

Q1. Fig. 1 shows 12 different parts of the human brain. Describe their (some may have multiple) functions in a brain.

1. Cingulate gyrus [1]:

- a. It is mostly involved in emotion processing and behavior regulation.
- b. Additionally, it regulates the autonomic nervous system.
- c. A key component of emotional processing is the coordination of sensory input and emotions, the regulation of aggressive behavior, and parental bonding and decision-making.

2. Corpus callosum [2]:

- a. The corpus callosum is responsible for the integration and transfer of sensory, motor, and cognitive information across both cerebral hemispheres.
- b. Motor movements and cognitive functions are refined by the corpus callosum as the brain matures and white matter develops [3].
- c. According to additional studies, the corpus callosum acts as an inhibitor, preventing alien-hand syndrome and uncoordinated hand-motor activities [4].

3. Fornix [5]:

- a. Fornix transmits information from hippocampal nuclei to mammillary bodies and anterior nuclei of the thalamus.
- b. There are several aspects of memory in which it plays an important role, including the recall of long-term memories, and the regulation of episodic memories.

4. Mamillary body [6]:

- a. It is one of the main components of the Papez Circuit that aids in the consolidation and storage of spatial and episodic memory.

- b. The mammalian bodies also have a role in assisting emotion- and reward-driven as well as goal-directed behaviors.
- 5. Olfactory bulb [7]:
 - a. The processing of olfactory information is mostly carried out by the olfactory bulb (OB).
- 6. Thalamus [8]:
 - a. The transmission of the various sensory impulses is carried out by the thalamus.
 - b. The control of sleep and wakefulness is another function of the thalamus.
- 7. Hippocampus [9]:
 - a. The regulation of memory encoding, memory consolidation, and spatial navigation is critically influenced by the hippocampus.
 - b. Additionally, it also plays an important role in flexible and goal-directed behavior.
- 8. Dentate gyrus [10]:
 - a. It is in charge of how our episodic memory develops as well as how we discover new environments.
- 9. Amygdala [11]:
 - a. The amygdala's primary function is to control emotions like fear and anger.
 - b. Our memories are given emotional significance via the amygdala.
- 10. Parahippocampal gyrus [12]:
 - a. The PHC is specifically engaged in visuospatial processing, which includes scene perception, spatial representation, and navigation, as well as episodic memory, which includes associative memory, source memory, and recollection.

- b. However, the diversity of findings in the PHC includes the processing of emotional cues, low-level visual processes like differentiating the center from the periphery, and even the selective processing of high spatial frequencies.

11. Basal ganglia [13]:

- a. A set of subcortical nuclei collectively known as the "basal ganglia" play a variety of activities, including those related to motor learning, executive behaviors, and emotions in addition to being principally in charge of motor control.

12. Hypothalamus [14]:

- a. It takes in a variety of signals from different parts of the brain and responds by releasing and suppressing hormones. These hormones then work on the pituitary gland to control the functioning of the thyroid, adrenal, and reproductive organs as well as growth.
- b. Additionally, it has a role in the non-endocrine processes of hunger control, autonomic nervous system regulation, and temperature management.

Q2. Explain brain white and gray matters and their covered areas. [15]

=> **Gray matter:** Gray matter consists of nerve cell bodies, axon terminals, dendrites, and all nerve synapses. It covers 40% of the brain. The cerebellum, cerebrum, and brain stem contain a great deal of this brain tissue. By the time a person reaches their 20s, it has completely developed. Information is conducted, processed, and sent to various parts of the body by it. Sensory information is sent to the brain via ascending nerve signals by the posterior part of gray matter, also known as the dorsal gray horn.

White matter: Axons are bundles of fibers found in the white matter of the brain and spinal cord. Myelin, a coating of proteins and lipids that helps carry nerve signals and safeguards the axons, is present on these axons. Conducting, processing, and transmitting nerve signals up and down the spinal cord is the function of white matter. Your ability to move, use your senses, or respond

appropriately to outside stimuli can all be impacted by damage to your brain's or spinal cord's white matter. Deficits in reflexive reflexes occur in some patients with white matter injury.

Q3. Identify a total of 7 different gyrus (gyri) or sulcus (sulci) of a brain and try to point out their functions in a brain.

=> [16] 7 different types of gyrus present are:

1. Precentral gyrus - Serves as the brain's main region for motor control.
2. Inferior frontal gyrus - It is involved in the production of speech
3. Anterior paracentral lobule - Motor and sensory innervations of the oblique lower extremities are under the direction of the paracentral lobule. Control of defecation and urination is another function of it.
4. Gyrus rectus/orbital gyri - Although its purpose is unknown, it may contribute to higher cognitive function (such as personality).
5. Postcentral gyrus- The body's different somatic sensations, such as touch, pressure, warmth, and pain, are all perceived by this area.
6. Superior parietal lobule - Plays a role in visuospatial perception, comprising the representation and manipulation of objects, as well as components of attention.
7. Inferior parietal lobule
 - a. Supramarginal gyrus: takes part in integrating sensory data.
 - b. Angular gyrus: receives visual information.

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