Organization of the brain

Mental processes and the brain

- Neurons: cells that signal each other
  - Make simple, yes/no decisions about whether to propagate an electrochemical signal
- With 100s of billions of neurons, the human brain can signal in complex ways
- Mental processes arise from coordinated signaling of neurons

Plan for today and next class

- Look at the organization of central nervous system and brain
- Look at examples of split-brain behavior
  - The examples tie together:
    - Localization of function
    - Projection areas
    - Contralateral organization
    - Areas for language and face processing
- Look at neural processing and examples involving sensation

Some key ideas

- Localization of function
  - Different brain areas process different information
- Projection areas
  - Specific cortical areas that receive sensory inputs or send outputs to muscles
- Contralateral organization
  - Projection areas communicate with the opposite side of the body from where they are located

Some key ideas

- Topographic (map-like) organization
  - Neighboring brain tissue maps to neighboring areas of space or the body

The central nervous system

- Thalamus (sensory switchboard)
- Brainstem (breathing, heart, stress response)
- Spinal cord (simple reflexes)
- Cortex (higher-level function)
- Limbic system (memory for events, locations, emotions)
- Cerebellum, little brain (movement, timing)
Limbic system

- Amygdala (memory for emotions)
- Hippocampus (memory for events, locations)
- Cingulate cortex
- Mamillary body
- Thalamus
- Hypothalamus

Contralateral organization: Vision pathways

- White matter (glia and axons)
- Gray matter (neurons)

Primary visual cortex

- (Tootell et al., 1982)

- Stimulus presented to monkey
- Topographic representation in right half of primary visual cortex

Cortical regions

- Superior (dorsal)
- Inferior (ventral)

- Central fissure
- Parietal lobe
- Occipital lobe
- Frontal lobe
- Temporal lobe

- Lateral fissure
- 7 = lateral fissure
- 9 = central fissure

Inferior aspect

- Lateral fissure
- Cerebellum
- Brainstem
- Spinal cord

- Thalamus and limbic system are hidden
Superior aspect

Corpus callosum (hard body)

Cortex (bark): ~3mm

Axons (neuron outputs)

Lateral vs. sagittal views

Sagittal = split along longitudinal fissure

Primary motor, somatosensory areas

Primary visual cortex

Key points to know

• Which projection area is which
• Topographic representation
  – Don’t need to know specific body parts
• More neural tissue means more precise sensation or control

Association areas

Those cortical areas other than projection areas integrate and connect information

Frontal lobes:
Thinking, planning, attending, working memory, inhibition, ...

Parietal lobes:
Long-term storage of images ("where" system)

Temporal lobes:
Long-term storage of meanings ("what" system)

Comparing brains across species

Motor areas
Sensory areas
Association areas
Language areas
Both hemispheres can interpret basic language
Language production is usually left-lateralized

Split-brain effects
(Figure 3.31)
The person is looking straight ahead
Motor control is contralateral

Asked to say out loud what he sees, the person says, “A fork”

Asked to use his left hand to pick up the object he sees, he picks up the spoon

Face recognition
Cerebellum
Fusiform face area
Spinal cord