

BIOE/BIOP/MCB/NEUR 419
EXAM II (20 pts total)
Spring 2007

Name: _____ Key _____

(Provide the best response to each question. 20 questions, 1 point per question)

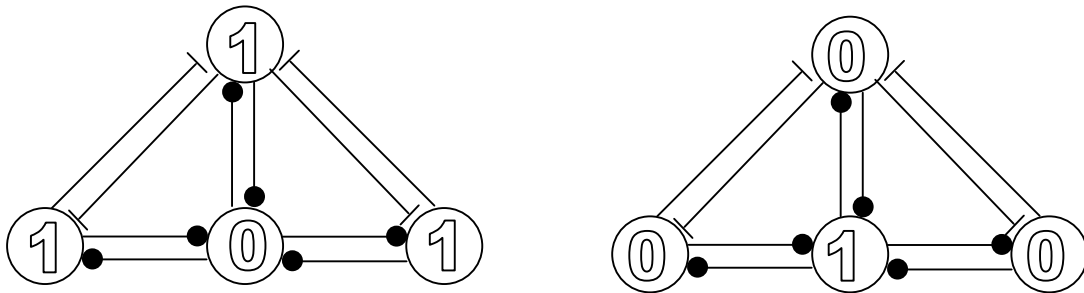
1. In an area-restricted search experiment, *C elegans* is exposed to three different patches (#1-#3). Patches #1 and #3 are empty and patch #2 contains food. The worm spends 30 minutes on empty patch #1, then spends 5 minutes on patch #2 containing food, then is transferred to empty patch #3. Would the frequency of high-angle turns likely be greater during:

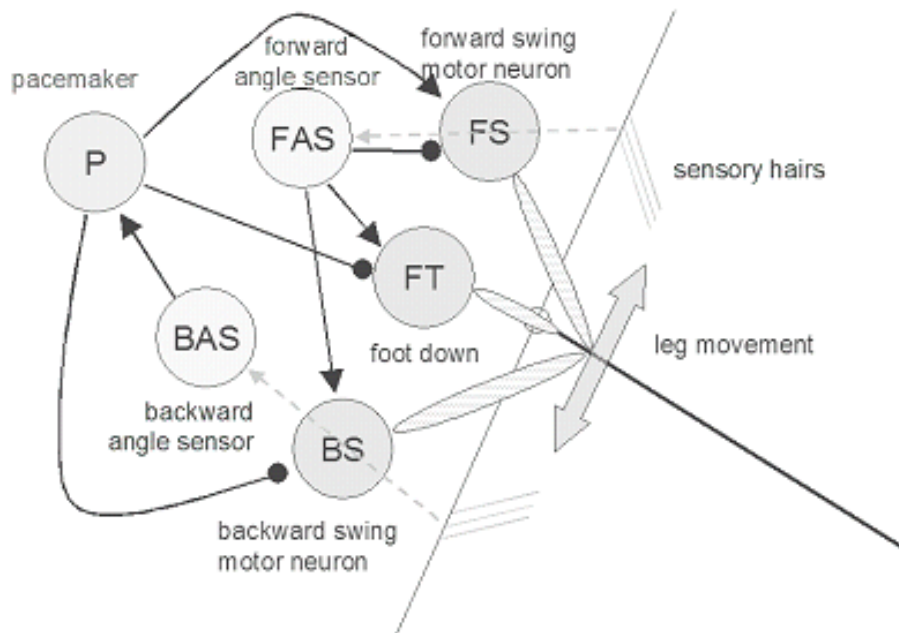
a) the last 5 minutes on empty patch #1

b) the first 5 minutes on empty patch #3

2. Dopamine is thought to play a role in mediating the area-restricted search behavior described in question 1. On which patch (#1, #2 or #3) would dopamine-releasing sensory neurons be receiving the most sensory stimulation? 2

3. The network below uses reciprocal excitation and reciprocal inhibition to organize its output patterns. Excitatory connections end in a “T” and inhibitory connections end in a filled circle. Neurons are either active (1) or inactive (0). Fill in 1s and 0s in the ‘neurons’ below to illustrate the two stable output patterns of this network.





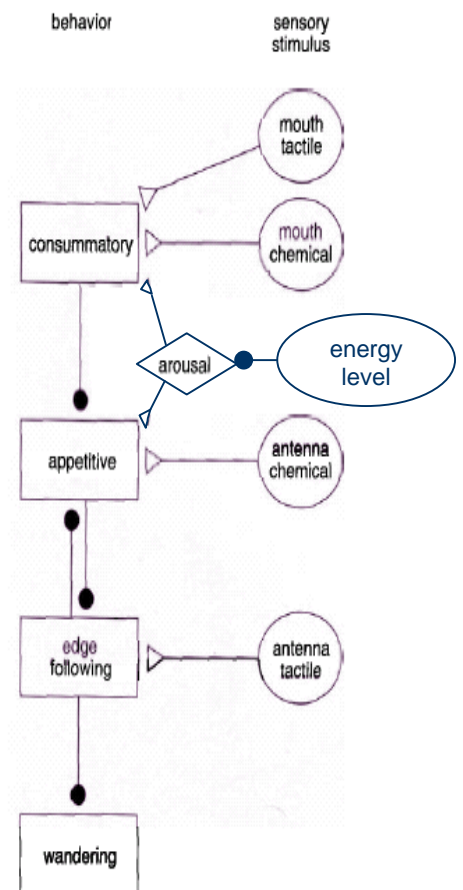
4. Based on Beer's cockroach leg controller diagram above, briefly describe ONE way in which sensory feedback is used to help organize leg movements.

Answer 1: When the leg reaches its forward extreme, signals from the sensory hairs activate FAS, which inhibits further forward motion by inhibiting FS and initiates backward motion by exciting BS.

Answer 2: When the leg reaches its backward extreme, signals from the sensory hairs activate BAS, thus the pacemaker, which inhibits further backward motion by inhibiting BS and FT, and initiates forward motion by exciting FS.

5. In Beer's model of action selection shown to the right, what behavior would be selected if the insect had a very high energy level, a strong antenna tactile input, a weak antenna chemical input, and received no other sensory stimuli ?

Edge- following



Questions 6-7 refer to a ‘house robot’ that can detect fire, detect humans, recognize family members, vacuum the carpet, and recharge its own batteries. The programming team has produced two questionable versions of the action selection code in Matlab. Assume the robot can only issue one ‘action’ command per time step.

VERSION A	VERSION B
<pre> if(nearFire) action = extinguish_fire; elseif(detectFire) action = taxis_to_fire; elseif(detectHuman) action = use_stun_gun; elseif(detectFamilyMember) action = say_hello; elseif(detectDirt) action = clean_carpet; elseif(batteryIsLow) action = taxis_to_charger; elseif(atCharger) action = recharge_battery; elseif(batteryIsDead) action = annoying_beep; else action = chase_cat; end </pre>	<pre> if(batteryIsDead) action = annoying_beep; elseif(atCharger) action = recharge_battery; elseif(batteryIsLow) action = taxis_to_charger; elseif(detectFamilyMember) action = say_hello; elseif(detectHuman) action = use_stun_gun; elseif(nearFire) action = extinguish_fire; elseif(detectFire) action = taxis_to_fire; elseif(detectDirt) action = clean_carpet; else action = chase_cat; end </pre>

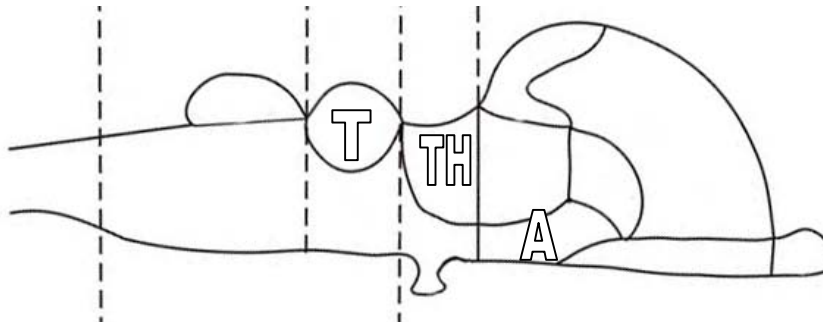
6. Which version is likely to use the ‘stun gun’ on a family member?

A / B / neither / both

7. Which version will continue to vacuum the carpet while the house is on fire?

A / B / neither / both

8. In the generalized diagram of the vertebrate brain shown below, label the tectum with the letter “T”, the thalamus with “TH” and the amygdala with the letter “A”.



9. List three similarities between the rat defense system and Brooks’ subsumption architecture.

1) Distributed, layered control 2) Behavioral decomposition
 3) Increasing ‘levels of competence’ 4) Incremental construction
 5) Conflict resolution by subsumption 6) Minimal reliance on ‘internal models’

For questions 10-12, select the single best response from the following list:

amygdala, basal ganglia, cortex, hindbrain, tectum, thalamus

10. Some neurons in this area of the toad’s brain normally respond better to elongated ‘antiworm’ stimuli than to elongated ‘worm’ stimuli. This region is often considered to be an intermediate sensory processing station for signals going to other regions

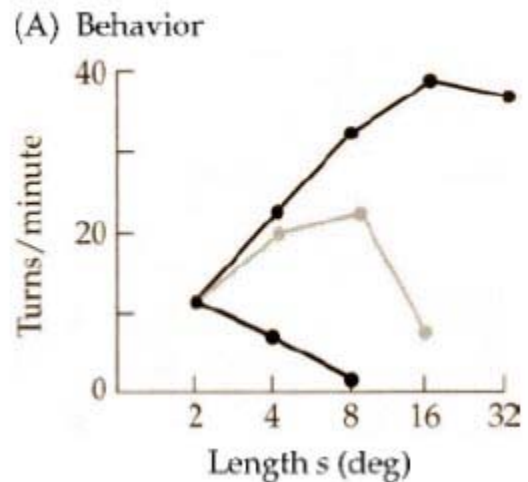
_____Thalamus_____

11. Some neurons in this region of the toad’s brain generally respond better to elongated ‘worm’ stimuli than to elongated ‘antiworm’ stimuli. This region is generally associated with orienting responses to species-specific stimuli.

_____Tectum_____

12. Individuals with obsessive-compulsive disorder (OCD) often repeat behaviors multiple times. If this reflects a problem with action selection circuitry, a reasonable hypothesis would be that OCD might involve the _____Basal Ganglia_____.

13. On the graph to the right, sketch and label the typical toad orienting response profiles for WORM, ANTI-WORM, and SQUARE stimuli.



14. Give ONE example of an association that might be useful for an animal to form using Hebbian learning; for your chosen example, describe why it might be beneficial for this association to be learned rather than genetically ‘hard-wired’.

Example: learning to associate food with light or dark region of the environment.
Benefit: This would need to be learned if the correlation between food/light changed over the organisms lifetime or was not consistent over evolutionary time.

15. List THREE types of information that a foraging honeybee needs to store via learning and memory mechanisms, in order to forage efficiently:

1) Which flower colors are most productive. 2) How to get from the hive to the flowers. 3) How to get back to the hive 4) Orientation with respect to sun 5) Distance to food patch

16. Bees can learn to associate color with reward, as shown in experiments where the bee lands on a disk with a colored light and receives a sugar reward. What is the time window of opportunity during which the light should be on for optimal learning?

a) during a 10 second interval prior to the bee landing the disk

b) during an interval from 3 s before landing to 2 s after landing

c) during a 5 second interval after the bee has begun feeding on the sugar

d) during a 10 second interval as the bee is flying away from the disk after feeding

17. For the honeybee proboscis extension reflex to odor, identify the stimulus or response associated with each of the following classical conditioning terms:

unconditioned stimulus: Sucrose
 unconditioned response Proboscis extension
 conditioned stimulus: Odor
 conditioned response Proboscis extension (to odor)

18. Consider the honeybee proboscis extension reflex to odor. For each of the following anatomical regions, indicate whether it is associated with the conditioned response pathway (C), the unconditioned response pathway (U), both (B) or neither (N).

antennal lobe C / U / B / N
 lateral protocerebrum C / U / B / N
 mushroom bodies C / U / B / N
 optic lobes C / U / B / N
 subesophageal ganglion (SOG) C / U / B / N

19. In a stochastic model of color choice selection, a bee must choose between blue and yellow flowers on each trial. The probability for selecting a blue flower $P[b]$ is given

by $P[b] = \frac{1}{1 + \exp(-\beta(r_b - r_y))}$ where r_b and r_y are the expected reward for blue and

yellow, respectively. What is the probability for selecting a yellow flower?

a) $P[y] = 1 / P[b]$

b) $P[y] = 1 - P[b]$

c) $P[y] = P[b] // 2$

d) $P[y] = P[b] / (1 + P[b])$

20. A large value of β in the model described above favors **exploration / exploitation**