Informatics 1 Cognitive Science
Mock Exam 2024/25

Brief Notes on Answers

PART A

1. C. The grammar contains recursion in the rule NX $\longrightarrow$ Adj NX.

2. A. The expected utility of a bet with N outcomes $o_1, o_2, \ldots, o_N$ is $\sum_i^N P(o_i)U(o_i)$, where $P(O_i)$ is the probability of the outcome, and $U(o_i)$ is its utility. Here, U is the identity function, so the expected utility is: $0.1 \times 100 + 0.9 \times (-10) = 1$.

3. D. We use the same equation as in the previous question, but now the utility of a loss is weighted by a factor of 2: $0.1 \times 100 + 0.9 \times 2(-10) = -8$.

4. A. The output for each input vector is the weighted sum of the input, with a threshold of θ.

5. C. The no prior evidence means all hypotheses are equally probable, so $P(\mathcal{H})$ is a uniform distribution.

6. D. The lexicon is:

   1. toabstract 2. away 3. from 4. theidea 5. is 6. toimprove 7. further 8. us

   The encoding of the input is:

   1 2 3 4 5 6 4 7 2 3 8

   The description length is size(description) = size(lexicon) + size(data-encoding) = 45 + 11 = 56.

7. B. The combination of prototypes is not straight forward. For example, a gold fish is a typical pet fish, but not a typical fish.

8. B. The LIF model integrates input over time while the MCP model integrates input instantaneously.

9. A. The synaptic weight is increased when the activity of the pre- and postsynaptic neurons is correlated.

10. D. It can record activity in the whole brain.

11. A. Auto-associative memory is content-addressable, not address-based.

12. C. It is required for object recognition.

13. B. In the strengths of synaptic connections between neurons.

PART B

14. A listeme is a word as a lexical entry, a stretch of sound which has been memorized and cannot be produced by a rule.

15. To avoid generating two past tense forms for irregular verbs, the W&R model assumes blocking. This means that the regular past tense rule cannot be applied for verbs for which a stored lexical entry for the past tense form exists.

16. In the R&M model, the past tense of a new regular verb is generated by analogy with other regular verbs (with similar phonetic structure) that have been seen during training.

17. The factor x_i is there in the weight update rule because we want large inputs to lead to large changes in weight. This is because large inputs are responsible for a large proportion of the error $(t - o)$.

18. Fast mapping refers to the ability of children to quickly form a mapping between a word and an object, often based on a single observation.

19. We need a way of measuring the change in the two distributions. The Kullback-Leibler divergence $KL(P_1, P_2)$ would be a good way of doing that.

20. receptive field: area in visual field that a neuron responds to, ON and OFF cells

21. oriented edges, covers all orientations and positions and different scales (spatial frequencies)

22. edges are basic features of objects

23. Declarative memory: Memories of factual information, cortical, conscious, can be verbalised.

24. Supervised: learning with labels or feedback, e.g. learning to distinguish cats from dogs.
    Unsupervised: learning without feedback, e.g. learning to recognise faces.

25. Describe Marr's three levels:
    Computational: what is the goal of the computation
    Algorithmic: how can the goal be achieved, what is the strategy?
    Implementational: how can the strategy be implemented in the brain?
    Examples: many possible cognitive functions discussed in the course, expecting to see the concept applied consistently.