

ADSSE Re-exam

23 August 2019

Model answers

Question 1

- a) False
- b) True
- c) True
- d) False
- e) True
- f) False
- g) True
- h) True
- i) False
- j) True

[1 mark for each correct part]

Question 2

- a) $T(n) = \Theta(n^3\sqrt{n})$
- b) $T(n) = \Theta(\sqrt{n})$
- c) $T(n) = \Theta(n^2)$
- d) $T(n) = \Theta(n \log_2 n)$
- e) $T(n) = \Theta(n^3)$

[2 marks for each correct part]

Question 3

- a) (1,3,5) [6 marks]
- b) Max subarray problem [2 marks]
- c) $O(n)$ or $\Theta(n)$ [2 marks]

Question 4

- a) $\Theta(n)$. Occurs when all the data is hashed to the same slot.
- b) $O(1)$. Occurs when the hash function is chosen so that we have simple unified hashing and the chains are all approximately the same length.
- c) $O(n)$. Occurs when the searched element is not present in the list.
- d) n/m
- e) Simple unified hashing is when any given element in the data is equally likely to be hashed to any of the slots in a hash table. In this case, the expected length of a chain on a slot is equal to the load factor.

[2 marks for each correct part]

Question 5

- a) Lines 27-29.
- b) Lines 30-31.

- c) Line 33
- d) Lines 6-9 (or 7-8).
- e) 5.

[2 marks for each part]

Question 6

- a) Supervised learning models predict labels based on labeled training data; unsupervised learning models identify structure in unlabelled data. [2 marks]
- b) Classification and regression. [2 marks]
- c) Use Bayes' law: $P(M|S) = P(S|M)P(M)/P(S) = 0.0002$ [4 marks]
- d) i, ii, iv. [2 marks]

Question 7

- a) Kernel trick is a when a function is used to map a low dimensional dataset that is not easily separable onto a higher dimensional space in which it is easily separable. See lecture for an example. [4 marks]
- b) (1) Train an SVM for each class vs. the others; test by applying each SVM to the test sample and assigning it to the class of the SVM that returns the highest decision value. (2) Train an SVM on each pair of classes; each SVM votes for a class to which to assign the test sample. [4 marks]
- c) When dimensionality increases, volume of space increases so fast that data becomes sparse, making it more and more difficult to achieve statistical significance. This means that as the number of dimensions increase, an enormous number of training samples becomes necessary in order to ensure that you have several samples with each combination of values. [2 marks]

Question 8

- a) A pooling layer is used to make a CNN more robust to small changes in translation. Usually done with a MAX pooling operation, taking the largest value in a neighbourhood or an average pooling layer which takes the average over the neighbourhood. [3 marks]
- b) A fully connected layer is one where there is full connection between neurons and the previous layer. It is used to combine information from previous layer into more high-level features. [3 marks]
- c) Highest learning rate is yellow; lowest is blue. [2 marks]
- d) The blue curve. [2 marks]

Question 9

- a) i. Factory method is creational. ii. Singleton is Creational. iii. Decorator is Structural. [3 marks]
- b) Where a client sends messages to objects whose types are as high up in the inheritance hierarchy as possible. It is then easy to define new subclasses that a client can use without having to change the client, which reduces coupling between components. [3 marks]
- c) Inheritance is where objects of a subclass inherit functionality from superclasses; composition is where an object gains functionality by virtue of having a member of a class that provides that functionality. Inheritance is sometimes called "white-box reuse" because the subclass knows something about the internals of its superclasses. Composition is generally considered preferable because inheritance breaks encapsulation and increases coupling, whereas composition does not. [4 marks]

Question 10

- a) Individuals and interactions, Working software, customer collaboration, responding to change. [2 marks]
- b) Any four from the following diagram:



[4 marks]

- c) i. The product owner. ii. 2-4 weeks. iii. 15 minutes per day + sprint planning event, spring review. iv. The Scrum master. [4 marks]