2.3 ALGORITHMS · 2.3.1(C)(D)

Complexity & Big-O notation

Original practice questions · 30 marks · about 40 minutes · spec 2.3.1(c)(d)

Instructions. Answer all questions. Marks are shown in brackets [ ]. Give Big-O answers in the form O(...).

1

Total: 6 marks

(a) State what *Big-O notation* describes. **[2]**

(b) State the difference between *time complexity* and *space complexity*. **[2]**

(c) Give the complexity class of accessing an array element by its index. _____ **[1]**

(d) State why complexity is not measured in seconds. _____ **[1]**

2

Total: 6 marks

(a) Give the Big-O of a single loop that runs n times. _____ **[1]**

(b) Give the Big-O of two loops nested inside each other, each running n times. **[1]**

_____

(c) Give the Big-O of a binary search. _____ **[1]**

(d) Write $2n + 7$ in Big-O notation. _____ **[1]**

(e) Explain why two nested loops give a complexity of $O(n^2)$. **[2]**

3 **Total: 6 marks**

(a) Put these complexity classes in order from **best** to **worst**: $O(n^2)$, $O(1)$, $O(n)$, $O(\log n)$. **[2]**

(b) For `n = 1000`, give the approximate number of operations for an $O(n)$ algorithm and an $O(n^2)$ algorithm. _____ **[2]**

(c) Explain why an $O(\log n)$ algorithm is much better than an $O(n)$ one for very large data sets. **[2]**

4 **Total: 6 marks**

(a) A bubble sort has a time complexity of $O(n^2)$. Explain why. **[2]**

(b) A merge sort is $O(n \log n)$. State which of bubble sort and merge sort scales better for large lists, and why. **[2]**

(c) State one reason an $O(n^2)$ algorithm might still be acceptable for a small list. **[2]**

5 **Total: 6 marks**

Study the algorithm below.

```
01 found = False
02 for i = 0 to length(list) - 1
03   if list[i] == target then
04     found = True
05   endif
06 next i
```

(a) State the time complexity of this algorithm. _____ **[2]**

(b) Explain your answer. **[2]**

(c) State what *space complexity* measures. _____ **[1]**

(d) Name a complexity class worse than $O(n)$ but better than $O(2^n)$. _____ **[1]**

END OF QUESTIONS