

2.2 PROGRAMMING TECHNIQUES · 2.2.2(D)–(F)

Divide & conquer, backtracking, heuristics — Mark scheme

30 marks · spec 2.2.2(d)–(f)

AO key: AO1 = knowledge · AO2 = application. Accept any valid alternative; do not award the same point twice.

Q	ANSWER	AO	MARKS
1(a)	Repeatedly breaking a problem into smaller sub-problems of the same type, then combining results (1); example: binary search / merge sort / quicksort (1). (2)	AO1	2
1(b)	A rule-of-thumb approach (1); that gives a good-enough solution quickly without guaranteeing the best (1). (2)	AO1	2
1(c)	Exploring solutions step by step (1); undoing the last choice at a dead end and trying another (1). (2)	AO1	2

Q	ANSWER	AO	MARKS
2(a)	It partitions the list around a pivot into smaller sub-lists (1); and recursively sorts each sub-list (same type of problem) (1). (2)	AO2	2
2(b)	The list must already be sorted. (1)	AO1	1
2(c)	It checks the middle item (1); discards the half that cannot contain the target (1); repeats on the remaining (smaller) half until found / not found (1). (3)	AO2	3

Q	ANSWER	AO	MARKS
3(a)	(i) backtracking (1); (ii) data mining (1); (iii) heuristic(s) (1). (3)	AO2	3
3(b)	Searching large data sets for hidden patterns/trends/relationships (1) + (1) for the idea of "not obvious / large data"; valid example e.g. finding products often bought together (1). (3)	AO1	3

Q	ANSWER	AO	MARKS
4(a)	When an exact method would take too long / is impractical (1); a heuristic gives an acceptable answer quickly (1). (2)	AO1	2
4(b)	It uses a rule of thumb / shortcut rather than checking all possibilities (1); so it may miss the optimal solution and only find a near-optimal one (1). (2)	AO1	2
4(c)	Valid situation (1) + reason (1), e.g. sat-nav routing — too many routes to check exactly, a fast near-optimal route is good enough. (2)	AO2	2

Q	ANSWER	AO	MARKS
5(a)	Starting the next instruction/stage before the previous one has finished (1); so different stages run at the same time (like an assembly line) (1). (2)	AO1	2
5(b)	Pipelining overlaps the stages of one sequence (1); parallel processing runs separate/independent tasks at the same time on multiple cores (1). (2)	AO1	2
5(c)	Makes patterns/trends easy for humans to see / aids understanding & communication. (1)	AO1	1
5(d)	Predicting how a system will behave under different conditions without building/ testing it for real. (1)	AO1	1

Total for paper: 30 marks