Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

A: B, C; B: A, C

C: A, B, D; D: C

2.2

matrix: $V^2 = \mathbf{10^8}$ cells

list: about $V + 2E = 1.1 \times 10^5$ entries, so about 1000 times smaller

2.3

A, B

D, then C (C is D's first unvisited neighbour)

back to D, then E: A B D C E

2.4

A and B have no incoming edges: take A, then B

now C and E are free: take C, then E

then D: A B C E D

3.1

(a) B 1; A 3, through B; C 4, then T 7

(b) S, B, A, C, T; length $1 + 2 + 1 + 3 = 7$

(c) Dijkstra never changes a settled distance; C is settled at 4, but the path S–B–C would cost $1 - 5 = -4$, which is shorter, so the answer is wrong

3.2

(a) B 1, C 1; D 2, E 2, F 3

(b) BFS takes people from a queue in order of distance, so it reaches everyone at distance k before anyone at distance $k+1$; the first time a person is reached is by a shortest route

(c) $O(V + E)$

3.3

(a) e.g. CS1, CS2, Disc, DS, Algo, AI: every arrow points forward

(b) the longest chain is CS1, CS2, DS, Algo, AI: **5** semesters

(c) CS2, DS, Algo and AI never reach zero incoming edges, so they are never taken; fewer than 6 courses are output, which shows there is a cycle

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(d) DS → Algo (or CS2 → DS): it lies on the only 5-course chain; without it the longest chain is CS1, Disc, Algo, AI, which is 4 semesters, while removing Disc → Algo changes nothing