

Solutions

2.1 Pass 1: $5 > 1$ swap, $5 > 4$ swap, $5 > 2$ swap $\rightarrow 1, 4, 2, 5$. Pass 2: $4 > 2$ swap $\rightarrow 1, 2, 4, 5$. Pass 3: no swaps $\rightarrow$ sorted, stop. Final: 1, 2, 4, 5.

2.2 Pivot (position 4 of 7) = 5: less = 1, 3, 2; greater = 6, 7, 9, giving 1, 3, 2, **5**, 6, 7, 9. Sublist 1, 3, 2 (pivot 3): items less than 3, in order, are 1, 2 and none are greater, so the sublist becomes 1, 2, **3**; the pair 1, 2 (pivot 1) gives **1**, 2. Sublist 6, 7, 9 (pivot 7): less = 6, greater = 9 – already sorted. Final list: 1, 2, 3, 5, 6, 7, 9.

2.3 $5 \rightarrow b1$, $3 \rightarrow b1$ (8), $4 \rightarrow b2$, $2 \rightarrow b2$ (6), $6 \rightarrow b3$, $1 \rightarrow b2$ (7): bins (5,3), (4,2,1), (6) – 3 bins.

3.1 (a) First-fit (capacity 15): $9 \rightarrow b1$ (9), $4 \rightarrow b1$ (13), $6 \rightarrow b2$ (6), $2 \rightarrow b1$ (15 – exact fit), $8 \rightarrow b2$ (14), $5 \rightarrow b3$ (5), $3 \rightarrow b3$ (8), $7 \rightarrow b3$ (15): boxes (9,4,2), (6,8), (5,3,7) – 3 boxes. (b) Decreasing order 9, 8, 7, 6, 5, 4, 3, 2: $9 \rightarrow b1$, $8 \rightarrow b2$, $7 \rightarrow b3$, $6 \rightarrow b1$ (15), $5 \rightarrow b2$ (13), $4 \rightarrow b3$ (11), $3 \rightarrow b3$ (14), $2 \rightarrow b2$ (15): boxes (9,6), (8,5,2), (7,4,3) – 3 boxes. (c) Total weight $9 + 4 + 6 + 2 + 8 + 5 + 3 + 7 = 44$, and $\frac{44}{15} = 2.93\ldots$ so at least 3 boxes; both algorithms achieve exactly 3 here – the lower bound is met, so both packings are optimal.

3.2 (a) Pivot (position 4 of 7) = 4: less in order = 1, 3, 2; greater = 6, 8, 9, giving 1, 3, 2, **4**, 6, 8, 9. Sublist 1, 3, 2 (pivot 3): less = 1, 2; greater = none $\rightarrow 1, 2, \mathbf{3}$; then (1, 2) pivot 1: **1**, 2. Sublist 6, 8, 9 (pivot 8): less = 6; greater = 9 $\rightarrow 6, \mathbf{8}, 9$. Final: 1, 2, 3, 4, 6, 8, 9. (b) On large lists quick sort is generally much faster (fewer comparisons on average), because each partition splits the problem instead of moving items one position per comparison.

Local review guidance: pivots stated and partitions listed; placements shown item by item with running totals; lower-bound comparison quoted. This is authored classroom guidance.