Student ID: 1133317 Student Name: [illegible]

Course: Data Structures (CSE CS203A)

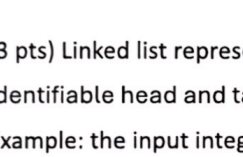
Assignment III: Linked List Selection Sort

Student Worksheet Companion

131

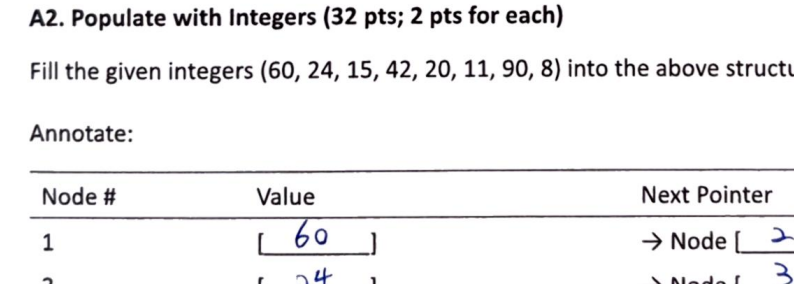
A1. Linked List Representation Drawing (5 pts)

a. (2 pts) Instructions: Draw a visual representation of a single node with next pointer that contains the initialized integer 10



b. (3 pts) Linked list representation with the given integers (Hint: For safety and clarity, include identifiable head and tail nodes)

Example: the input integers are (10, 20) and linked list representation will be [10 | •] → [20 | •] →



A2. Populate with Integers (32 pts; 2 pts for each)

Fill the given integers (60, 24, 15, 42, 20, 11, 90, 8) into the above structures.

Annotate:

Node #	Value	Next Pointer
1	[60]	→ Node [2]
2	[24]	→ Node [3]
3	[15]	→ Node [4]
4	[42]	→ Node [5]
5	[20]	→ Node [6]
6	[11]	→ Node [7]
7	[90]	→ Node [8]

Student ID: Student Name:

8	[8]	→ [NULL]

A3. Selection Sort – First Three Steps (45 pts; 15 pts for each step)

Step Trace Table (Linked list):

Step 1 is the example to help you to complete step 2 to 4.

Step 1 (i = head = 60): Traverse list to find minimum value 8 → call swap function Yes; swap (60, 8).

head → [8|•] → [24|•] → [15|•] → [42|•] → [20|•] → [11|•] → [90|•] → [60|NULL]

Step 2 (i = 24): Minimum value [11] → call swap function (Yes) / No; swap ([24], [11]).

head → [8|•] → [11 |•] → [15 |•] → [42 |•] → [20 |•] → [24 |•] → [90 |•] → [60 |NULL]

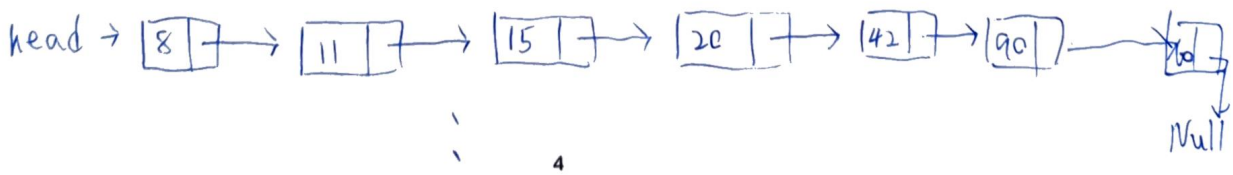
Step 3 (i = 15): Minimum value [15] → call swap function Yes / (No); swap ([____], [____]).

head → [8|•] → [11 |•] → [15 |•] → [42 |•] → [20 |•] → [24 |•] → [90 |•] → [60 |NULL]

Step 4 (i = 42): Minimum value [20] → call swap function (Yes) / No; swap ([42], [20]).

head → [8|•] → [11 |•] → [15 |•] → [20 |•] → [42 |•] → [24 |•] → [90 |•] → [60 |NULL]

step 5 i = 42 Minimum value = 24 swap (42, 24)



Student ID: 1133317 Student Name: 吴杰恩

A4. Discussion (68 pts)

Guiding Questions:

- How many swaps/exchanges are performed? 2
- How expensive is traversal for arrays vs. linked lists? O(1) for arrays and O(n) for
- What memory/overhead differences do you see? Linked lists need pointer, which linked lists require extra memory.
- Which representation is easier to visualize? arrays
- Which would you choose for implementing selection sort and why? linked lists, because its insert / delete time complexity is lower than arrays.

Time complexity comparison (14 pts, 1pt for each)

Aspect / Operation	Array	Linked List	Explanation
Access Element	(1)	(2)	Array allows direct indexing; linked list needs traversal.
Find Minimum	(3)	(4)	Both must scan all remaining elements/nodes.
Swap Operation	(5)	(6)	In array, swap by indices; in linked list, swap node values.
Traversal Between Elements	(7)	(8)	Linked list traversal requires pointer navigation.
Overall Time Complexity (Selection Sort)	(9)	(10)	Both involve nested traversal to find minima; linked list adds traversal overhead.
Space Complexity	(11)	(12)	Both sorts are in-place if swapping values, not nodes.
Implementation Overhead	(13) Low or Moderate	(14) Low or Moderate	Linked list needs pointer operations and careful null checks.

Student ID: 1133319 Student Name: 吳杰恩

(1)	Direct access O(1)	(2)	Sequential access only O(n)
(3)	O(n)	(4)	O(n)
(5)	O(1)	(6)	O(1)
(7)	O(1)	(8)	O(1)
(9)	$O(n^2)$	(10)	$O(n^2)$
(11)	O(1)	(12)	O(1)
(13)	Low	(14)	Moderate

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Student Name:

Characteristics (54 pts, 3 pts for each)

Aspect	Array	Linked List
Storage	(1)	(2)
Access	(3)	(4)
Extra Variables	(5)	(6)
Traversal	(7)	(8)
Overhead	(9)	(10)
Visualization	(11)	(12)
Swaps	(13)	(14)
Flexibility	(15)	(16)
Overall	(17)	(18)

(1)

Contiguous memory

(2)

Non-contiguous memory

(3)

Random access, O(1)

Student ID: 1133317 Student Name: 吳杰恩

(4)

Sequential access, O(n)

(5)

Minimal (typically only length)

(6)

Each node requires an extra pointer

(7)

By index; cache-friendly

(8)

By following pointers, not cache-friendly

(9)

Low memory overhead

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(10)

High memory overhead (due to pointers)

(11)

Simple (a linear block of cells)

(12)

Complex (nodes and arrows)

(13)

Simple and fast via index

(14)

Swapping value is simple; swapping nodes is complex

(15)

Fixed size → bad

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(16)

Dynamic size → good

(17)

Ideal for fast access and stable data size

(18)

Ideal for frequent insertion / deletions

-16