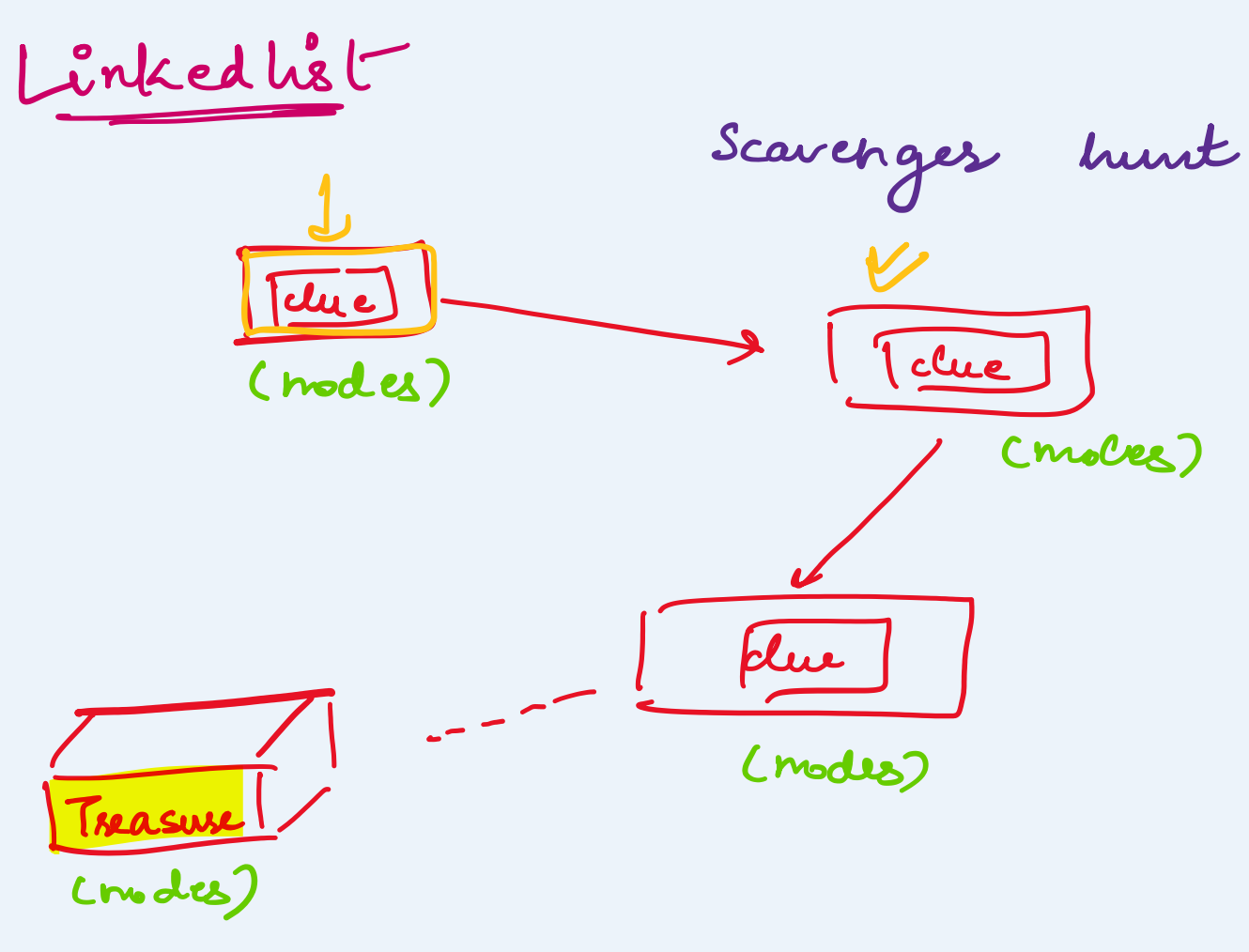
Linked list

Example : Scavenger hunt



A linked list is a linear data structure that includes a series of connected nodes.

→ each node store the data and the address of the next node.

data	next

Why do we need linked list when we already have arrays ??

→ Arrays store data in contiguous memory location

2	3	5	1	
0	1	2	3	4 ...

× → flexible or dynamic in nature

→ add at front operation is expensive.

6	2	3	5	1

head → [10 | 200] → [20 | 50] → [30 | 150] → [40 | null]
(addresses: 100, 200, 50, 150)

→ Address of the first node is given a special name called head.

non contiguous memory locations.

Types of linked list

1. Singly linked list
2. Doubly linked list
3. Circular linked list

Representation of a linked list

```
class node {
    int data;
    node next;
}
```

operations of a linked list

1. Traverse | Display the elements of a linked list → O(n)

head → 1 → 2 → 3 → 4 → 5 → ×
(temp ↑ moving along the list)

```
print(temp.data);
temp = temp.next;
```

2. Insertion

(a) Insertion at first → O(1)

head → (7) → 1 → 2 → 3 → 4 → 5 → ×

AddAtfirst(7);

(b) Insertion at last → O(n)

head → 1 → 2 → 3 → 4 → 5 (temp) → (8) → ×

add Last(8)

(c) Insertion At Index (3, 9) → O(k)
(index = 3, value = 9)

head → 1 → 2 → 3 (temp) → 4 → 5 → ×
(indices 0, 1, 2, 4, 5; (9) inserted between 3 and 4 at index 3)

2. Deletion

(a) Deletion at front → O(1)

1 → (2) → 3 → 4 → 5 → ×
(1 removed ×, head moves to 2)

deleteAtfront(1);

(b) Deletion at end → O(n)

head → 1 → 2 → 3 → 4 → × [5 → ×] removed
(t ↑ under each node)

temp.next = null

(c) Deletion at (3); → O(k)

head → 1 → 2 → 3 → 4 → 5 → ×
(3 linked past 4 to 5; t ↑ under 1, 2, 3)

3. Search

1 → 2 → 3 → 4 → 5 → ×

find(3);

Disadvantages of linked list

1. No random access
2. Extra space required.

→ **Doubly linked list**

head → 1 ⇄ 2 ⇄ 3 ⇄ 4 ⇄ 5 → ×

```
class Node {
    int data;
    Node next;
    Node prev;
}
```

Circular linked list

→ A circular linked list is a variation of a linked list in which last node points to the first node, completing a full circle of nodes.

head → 1 → 2 → 3 → 4 → 5 (5 points back to 1)

Ques : Given a singly linked list, reverse the linked list.

Eg: 1 → 2 → 3 → 4 → 5 → ×

output 5 → 4 → 3 → 2 → 1 → ×