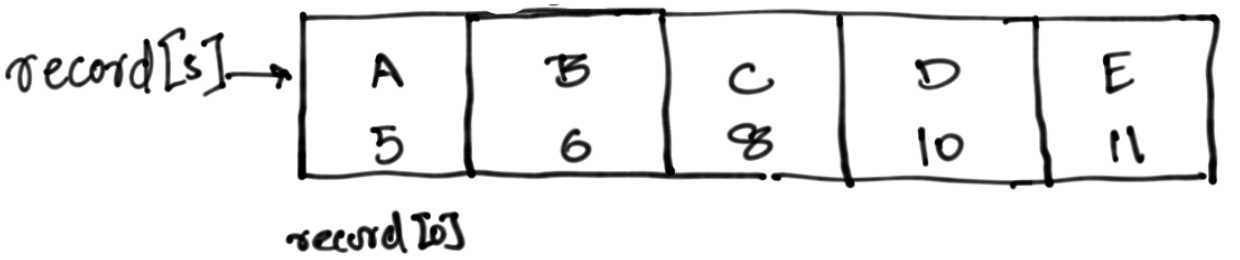
Data - Structure Question

(1) Assume that you are the owner of a company that has 5 employees.

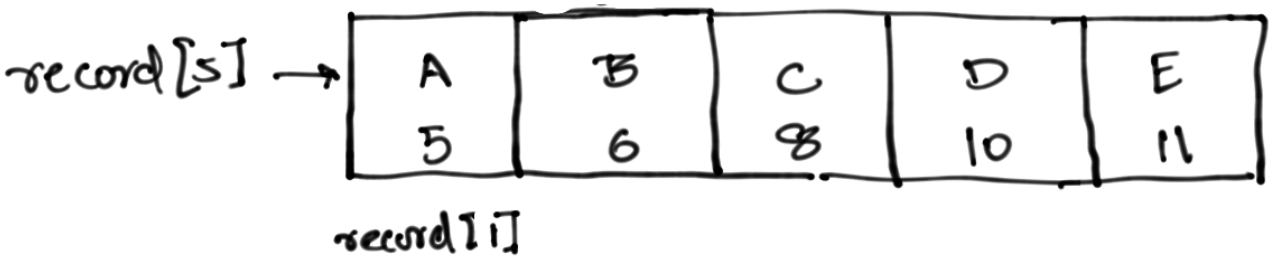
(2) Each employee is represented by {name, salary}

Which data-structure (that you know) will you use to represent these 5 employees?

Arrays

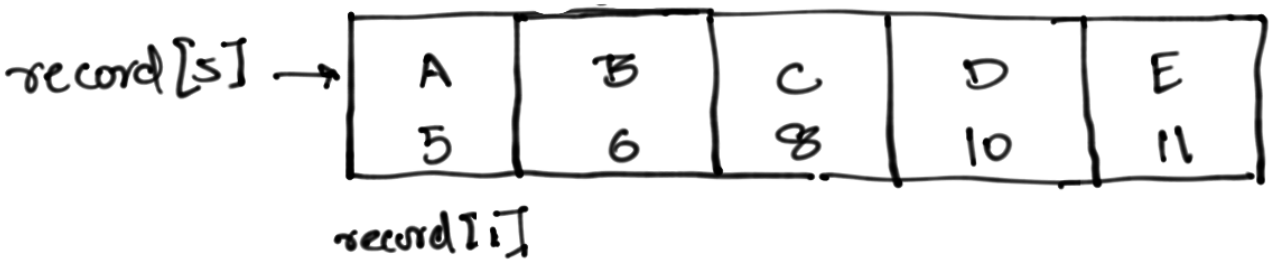


Arrays



Suppose a new employee {F, 10} joins the company. How will you update your data-structure?

Arrays



Suppose a new employee {F, 10} joins the company. How will you update your data-structure?

Add {F, 10} @ record[6]

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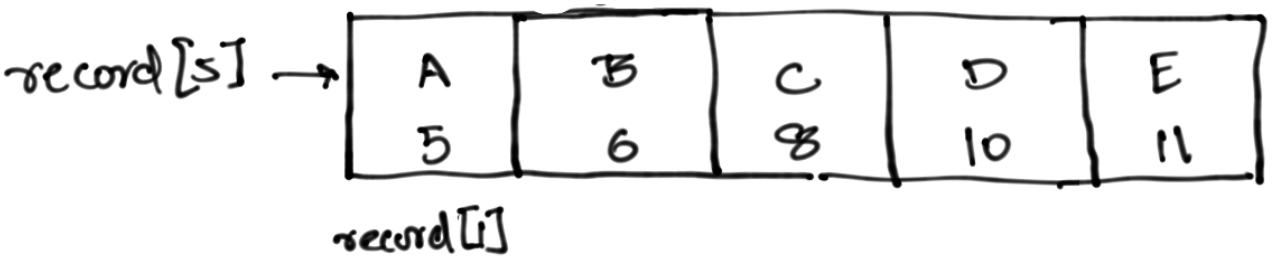

Suppose a new employee {F, 10} joins the company. How will you update your data-structure?

⚠ Add {F, 10} @ record[6]

😞 But record[6] does not exists. The array record is of size 5 only.

Now what will you do?

(1) Make a new array newrecord of size 6

(2) Copy the five records from record to newrecord.

(3) Add {F, 10} @ newrecord[6]

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A: O(n) if there are n records in record array.

When an employee leaves

Suppose employee B leaves, so we have to remove the record of employee B.

Q: How would you do that?

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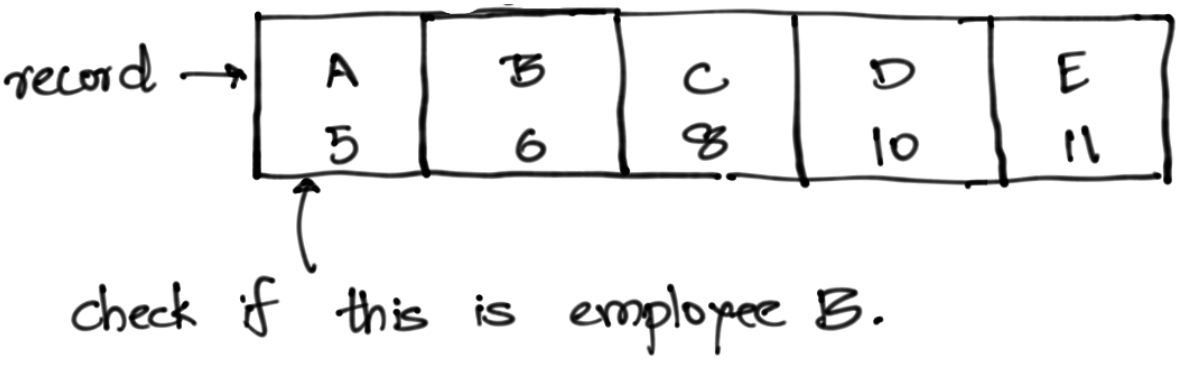

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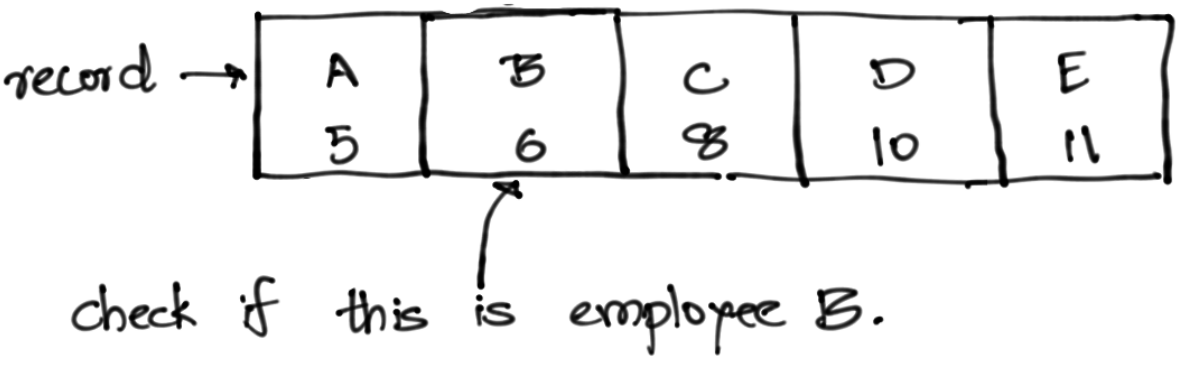

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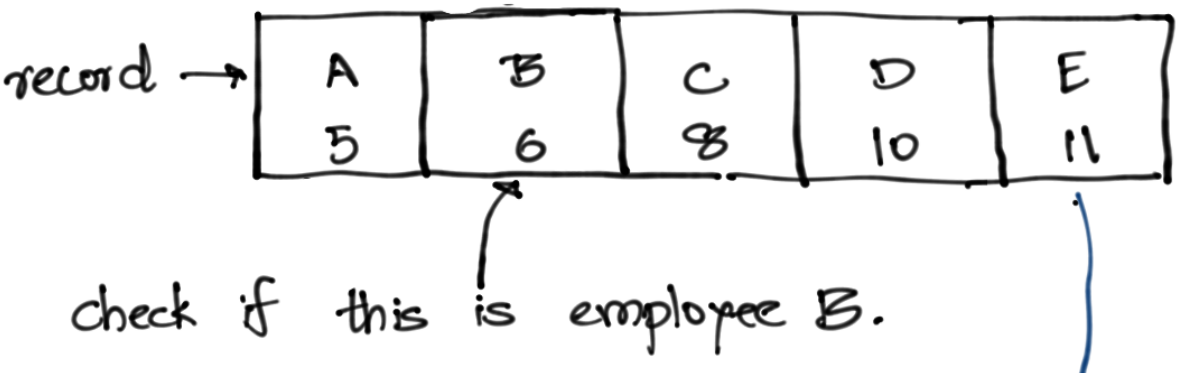

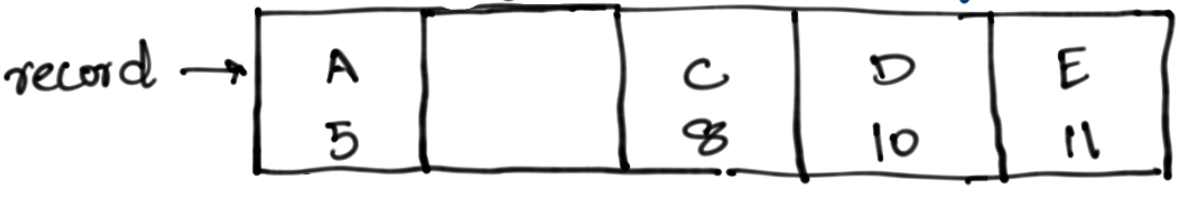

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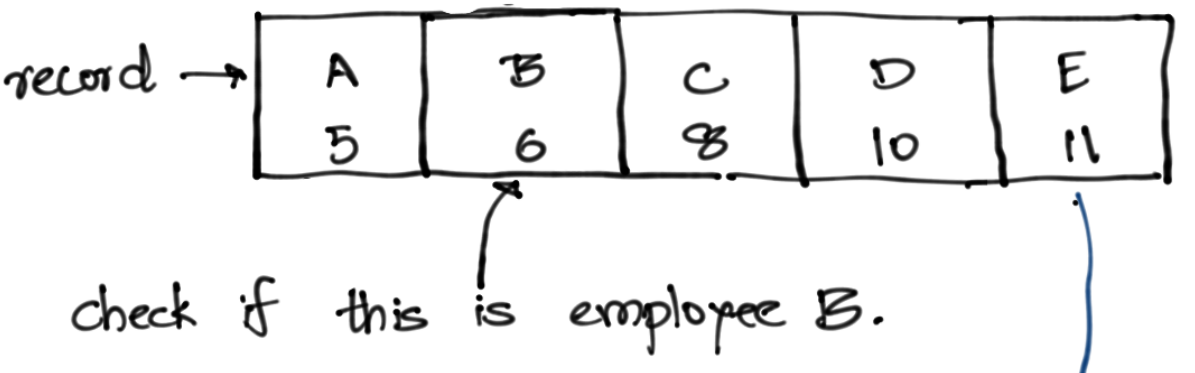

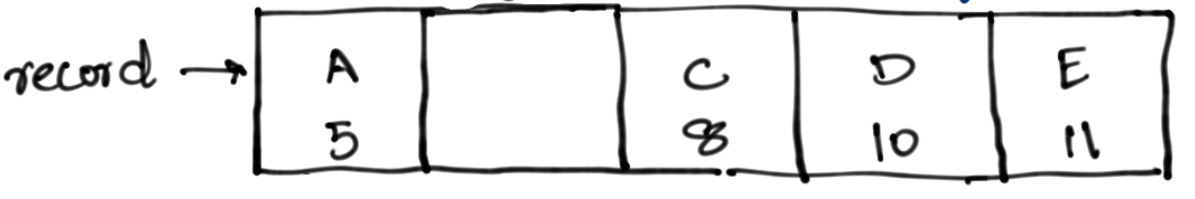

Q: What is the running time of this method?

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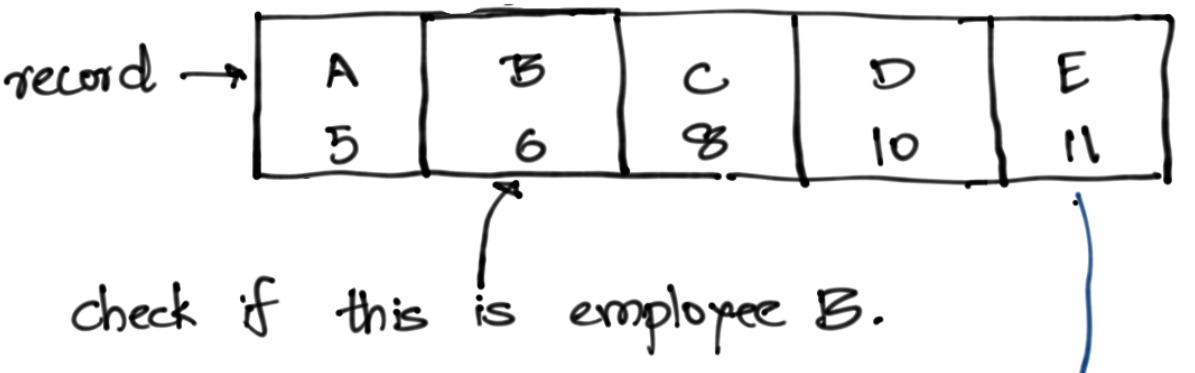

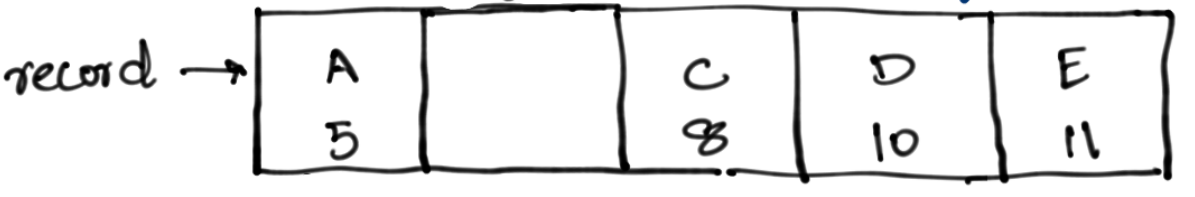

Q: What is the running time of this method?

A: O(n) if there are n records.

Q: Is there any other problem with the deletion procedure?

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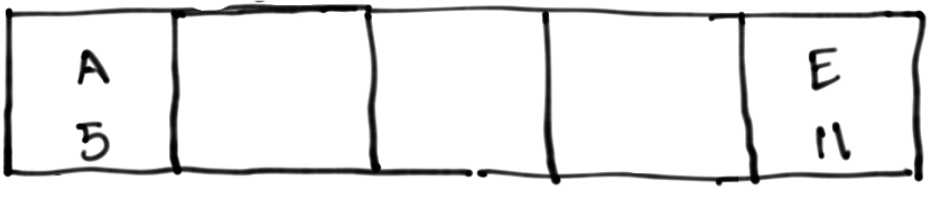

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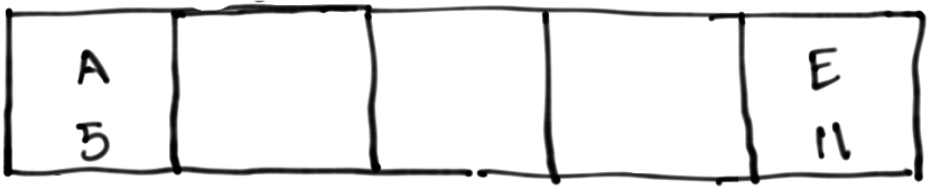

Holy Grail for data-structure

The space taken by your data-structure should be proportional to the number of current employees in the company.

Performance of Arrays.

Insert	O(n)
Deletion	O(n)
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So, array nearly always give worst case performance.

Q: Where are arrays good ?

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A : Give me the 5th element of record array.

return record[5]

Running Time = ??

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Running Time = O(1).

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Insert	$O(n)$
Deletion	$O(n)$
Search	$O(n)$
Get the k^{th} element	$O(1)$.

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Mimics arrays.

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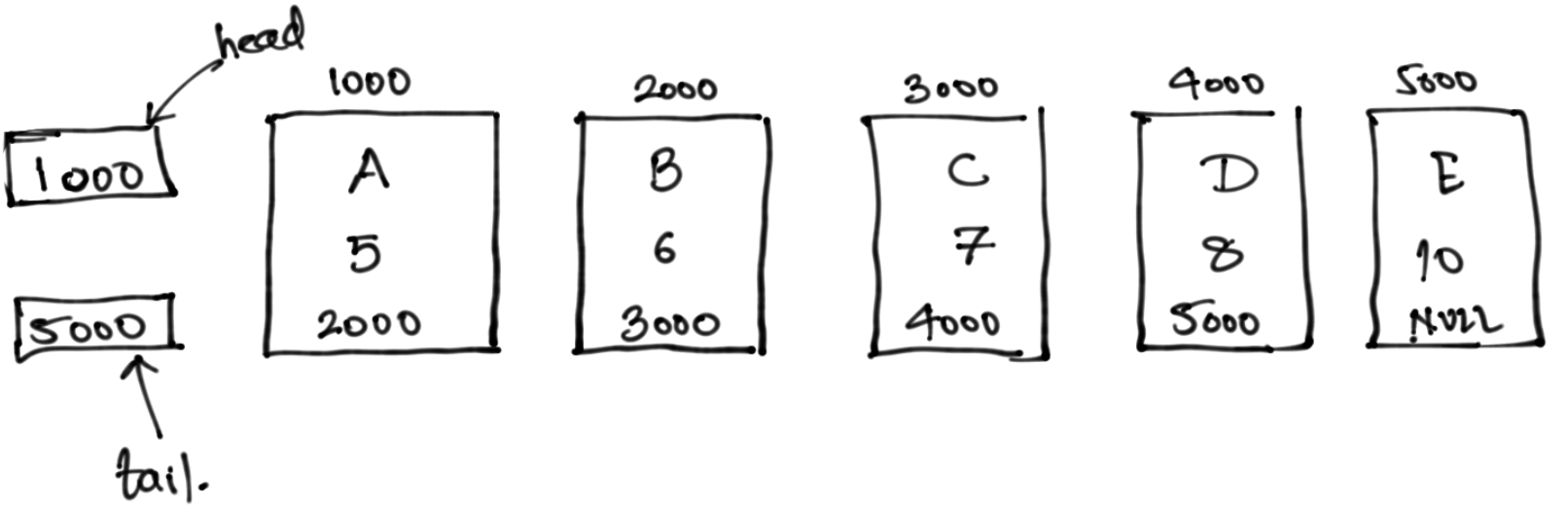
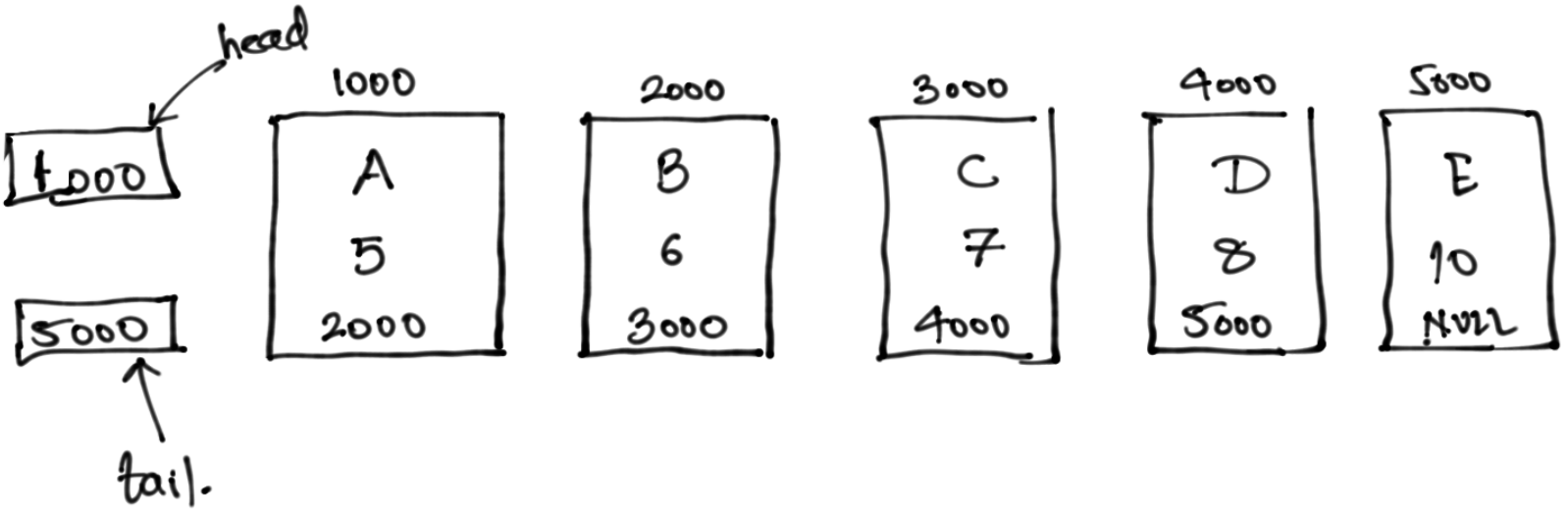
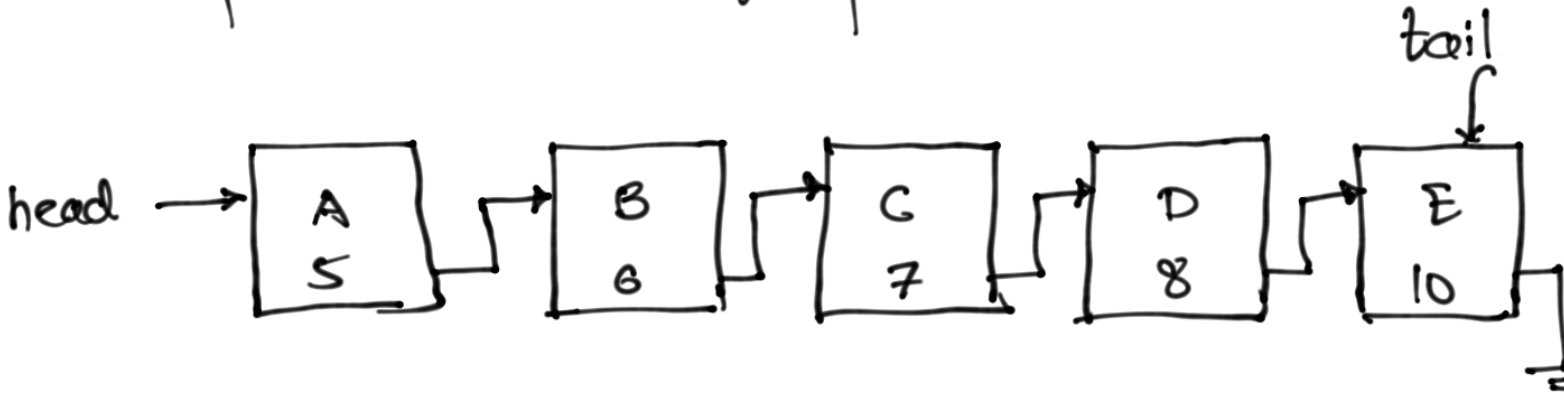

head
1000
5000
tail.
1000
A
5
2000
2000
B
6
3000
3000
C
7
4000
4000
D
8
5000
5000
E
10
NULL



However, we will have a simpler pictorial view of pointers.



Insert {F. 10}.

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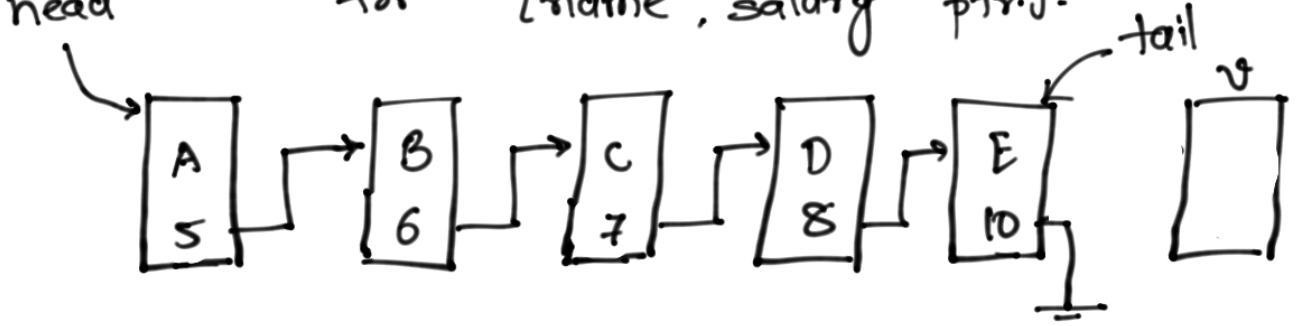
① v ← Request the OS to allocate enough space for {name, salary ptr.}.



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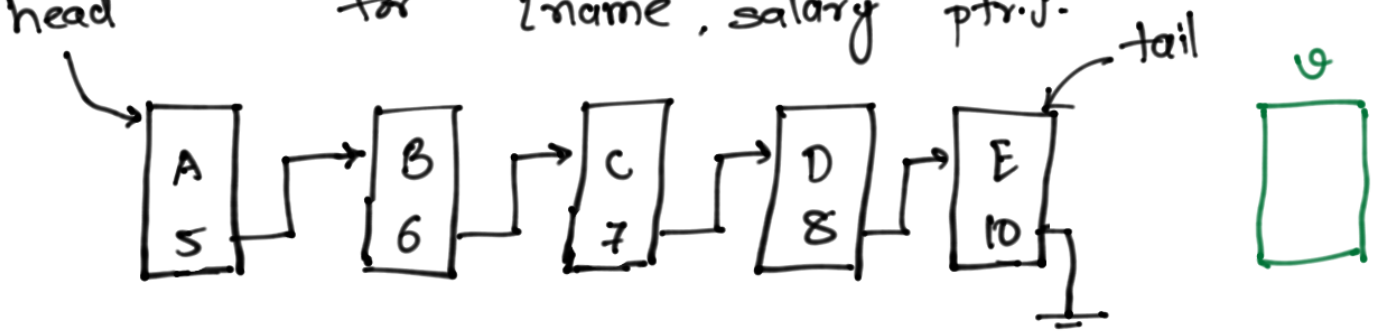
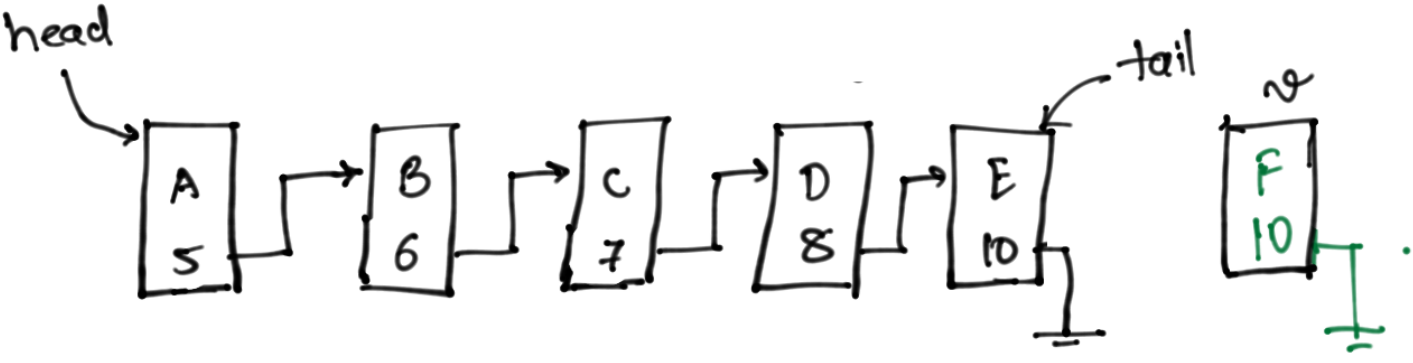


② v.name ← F ;
v.salary ← 10;
v.ptr ← NULL



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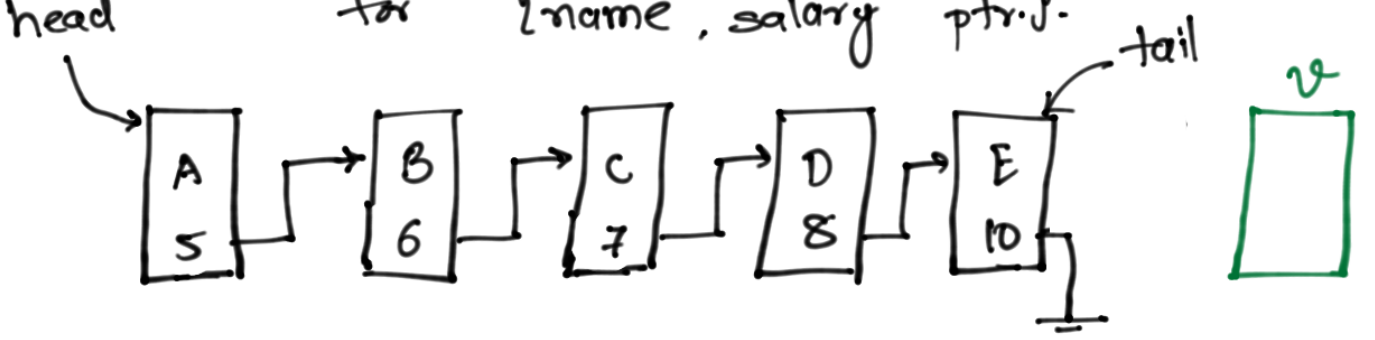

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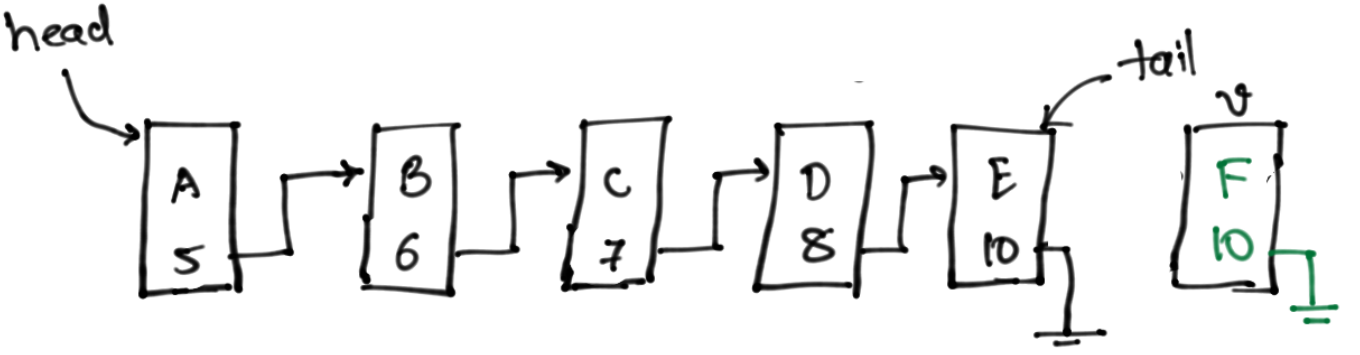
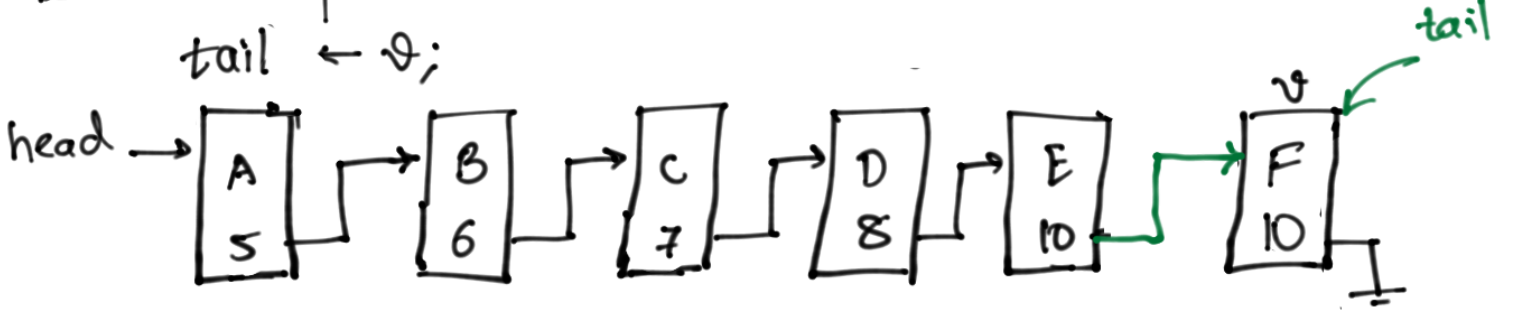


③ tail.ptr ← v ;
tail ← v;



```
Insert (name, salary)
{
    v ← allocate me a new memory location;
    v.name ← name;
    v.salary ← salary;
    v.ptr ← NULL;

    if (head is NULL).
    {
```

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Insert (name, salary)
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    v ← allocate me a new memory location;
    v.name ← name;
    v.salary ← salary;
    v.ptr ← NULL;

    if (head is NULL).      // list is empty
    {
        head ← v;
        tail ← v;
    }
    else
    {
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}
```

Q: What is the running time of this procedure ?

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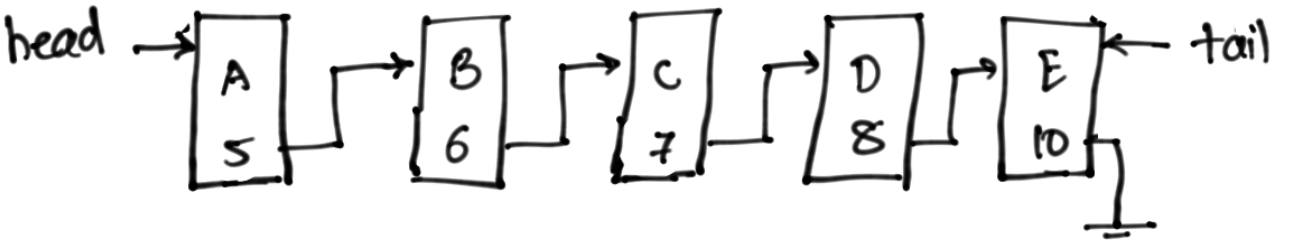
Q: What is the running time of this procedure?

A: O(1).

delete Employee C



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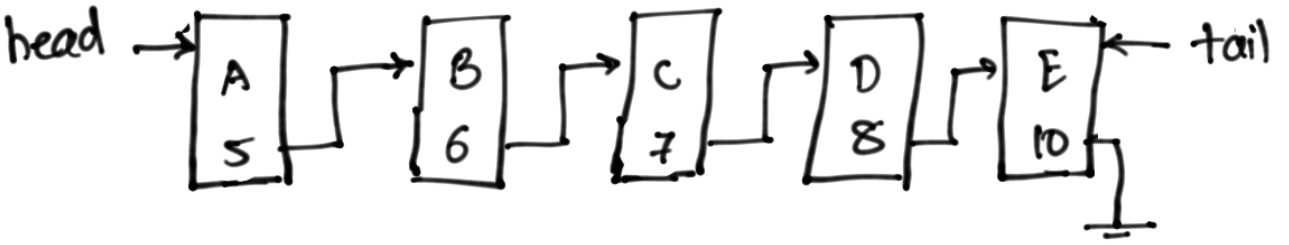

① $v \leftarrow$ head (start with the head).

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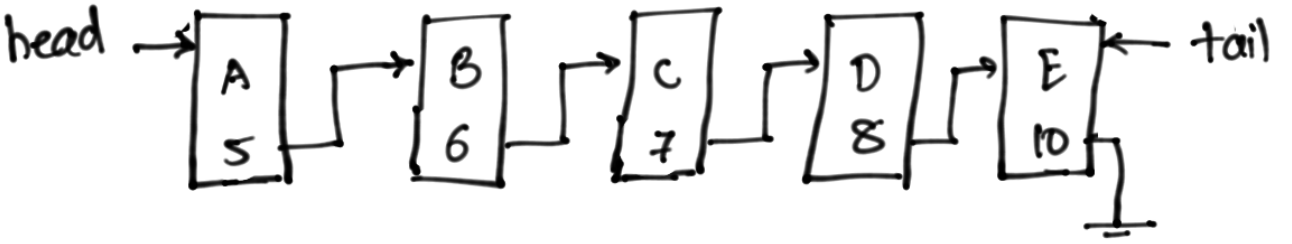
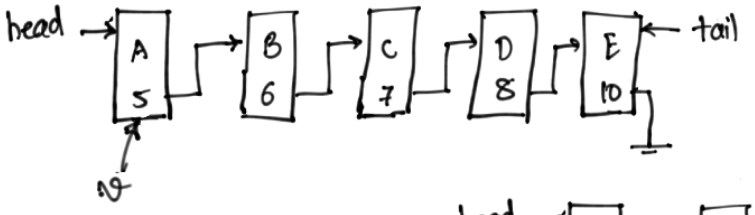
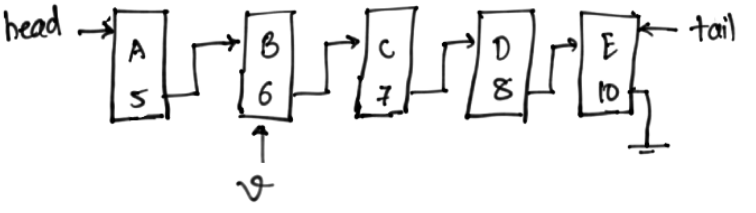
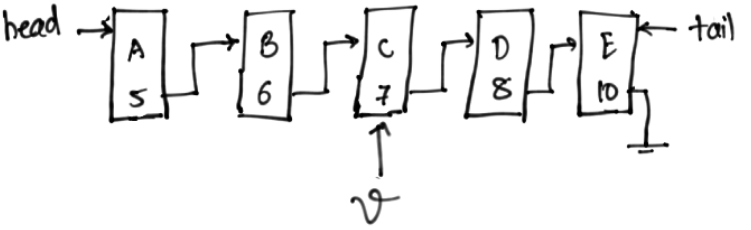


① $v \leftarrow$ head (start with the head).

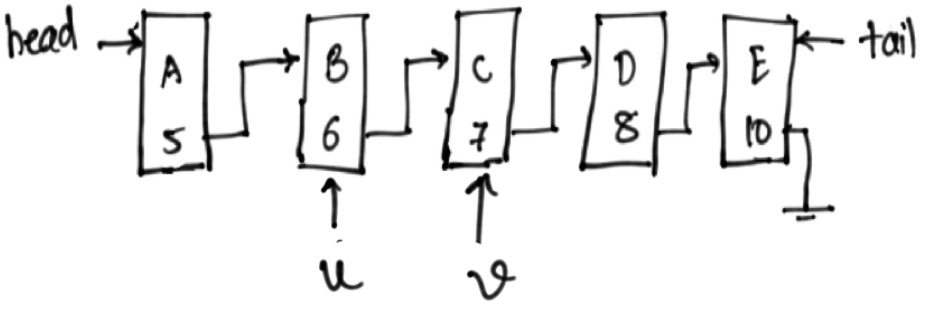
② Move through the list (using pointers) till you hit employee C





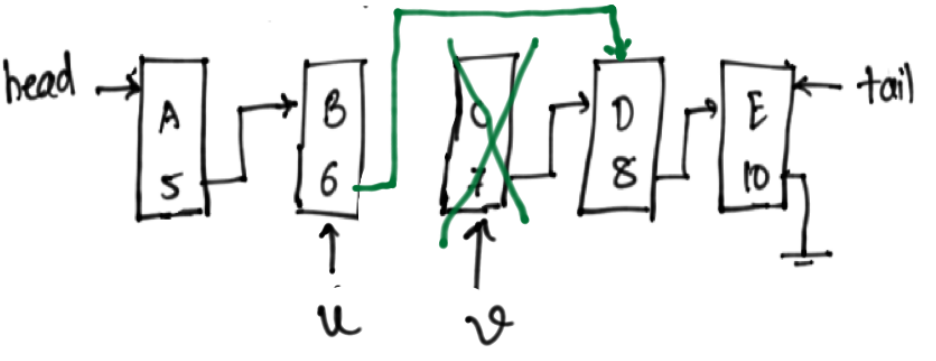


③ Maintain a ptr that follows v, say u.



④ $u.ptr \leftarrow v.ptr$

deallocate the memory associated with record



```
Delete(name)
{
        if ( head is NULL)
            return;
```

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    if (                    )
    {

    }
    else
    {   v ← head.ptr
        u ← head;
        while ( v is not NULL)
        {
            if (v.name = name)
            {   u.ptr ← v.ptr
                deallocate the memory allocated
                                to record v;
            }
            else
            {   u ← v;
            }   v ← v.ptr
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Q: What is the running time of Delete(·)

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A $O(n)$

Performance of Linked List

Insert	O(1)
Delete	O(n)
Search	?!

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But the most important thing:
Holy Grail for data-structure

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Q: When is linked list worse than arrays?

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Query: Get me k^{th} record.

Time taken by linked list = ?!

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Performance of Arrays.

Insert	O(n)
Deletion	O(n)
Search	O(n)
Get the k^{th} element	O(1).

Performance of Linked List

Insert	O(1)
Deletion	O(n)
Search	O(n)
Get the k^{th} element	O(k)