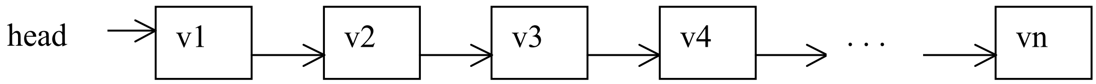
Counting in a linked list

Suppose we have a linked list of n unique items, unsorted. We wish to search for an element e.

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for (p=head; p!=null && p->data != e; p= p=>next) ;

if (p!= null) return p;
else return null;
```

We will approach this counting differently.

Example 1.
Suppose e is not in the list (worst case). In that case, we will have to step through the entire list plus one more to hit the end of the list. $T(n) \approx n = 1$.
$T(n)$ is $O(n)$.

Example 2.
Suppose e is in the list and any item in the list is equally likely to be the one requested. That means that the probability of a hit (successful find) on any element in the list is equally likely, i.e., probability $1/n$.
What is the average number of steps (average case) necessary to find the desired element?

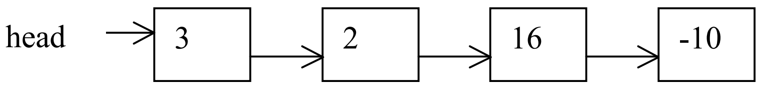
Suppose the desired item is the first one: # steps = 1.
Suppose the desired item is the k-th one: # steps = k

Calculate the average number of steps to get to a particular item in the list:

$$(1/n) \sum_{i=1}^{n} (i)$$
$$= (1/n)\,(n\,(n-1) / 2)$$
$$= (n-1)/2$$
is $O(n)$

Example 3.
Let's make a trivial but specific example to hammer this down.

Suppose we have 4 items in the list, with the probabilities of being the desired item in this order: 20%, 20%, 50%, 10%.



What is the average number of steps (average case count) needed to find an item that is in the list.

Compute the weighted average: $\sum_{i=1}^{n}$ (weight_i * (# steps to i))

Average T = .2 * 1 + .2 * 2 + .5 * 3 + .1 * 4 = 2 steps.

Example 4.

Suppose we have a singly linked unsorted on data lis of unique items. The probabilities of requesting the particular item orders the data in reverse order, so that the final data item is requested 90% of the time. The remaining data items are each requested and equal amount of the time (.10)/(n-1).

What is the average case cost?

STOP and do this problem.

$\sum_{i=1}^{n-1}$ (0.10 i /(n-1)) + 0.9 n

First n-1 items final item

T(n)) = 0.10/(n-1) * (n-1)(n-2)/2 + 0.9n = 0.95n - 0.1
T(n) is O(n)

Now suppose the dta are ordered in increasing probabilities. What is the average case?

STOP and do this problem.

I get T(n)) ≈ 0.05n + 0.9
T(n) is O(n)