mispellings

`speller.c`

1. calls `load` on the dictionary file
   - dictionary contains valid words, one per line
2. calls `check` on each word in the text file and prints all misspelled words
3. calls `size` to determine number of words in dictionary
4. calls `unload` to free up memory

TODO

- `load`
  - loads the dictionary
- `check`
  - checks if a given word is in the dictionary
- `size`
  - returns the number of words in the dictionary
- `unload`
  - frees the dictionary from memory

TODO

- [ ] `load`
- [ ] `check`
- [ ] `size`
- [ ] `unload`

`load`

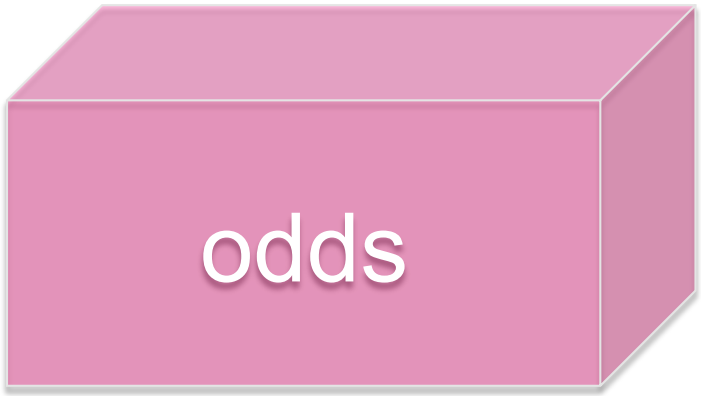
- for each word in the dictionary text file, store it in the dictionary's data structure
  - linked lists
  - hash tables
  - tries

hash tables

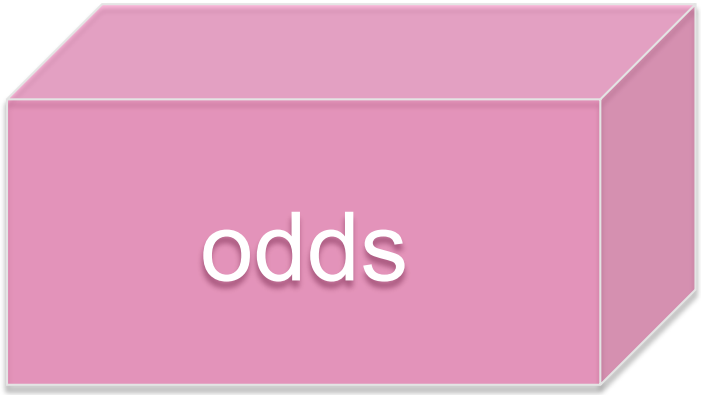
- an array of buckets
- hash function
  - returns the bucket that a given key belongs to

hash tables

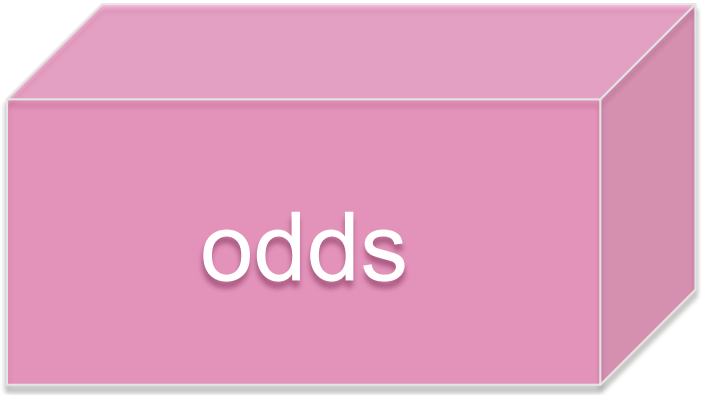
hash tables



hash tables

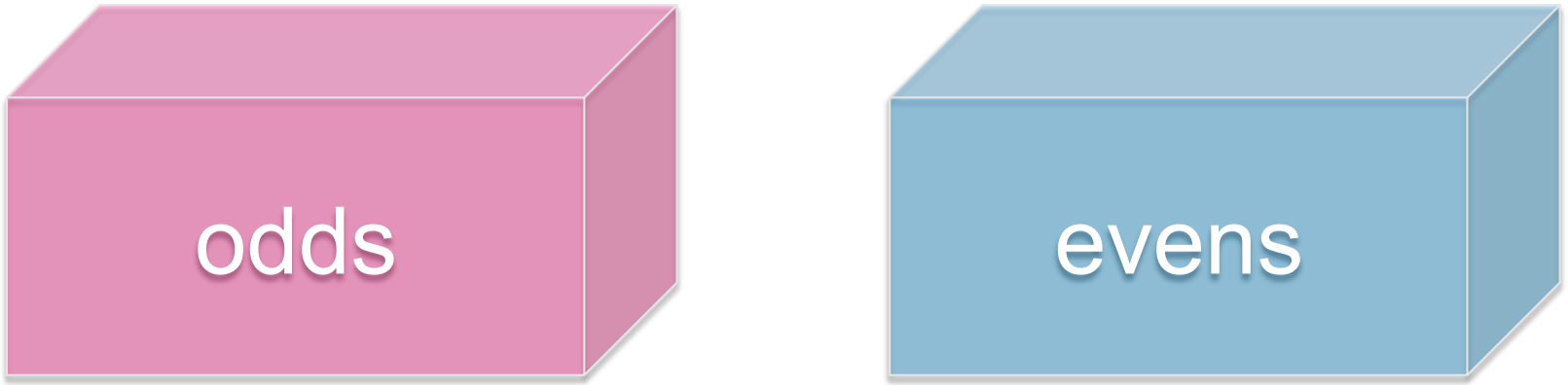


hash tables

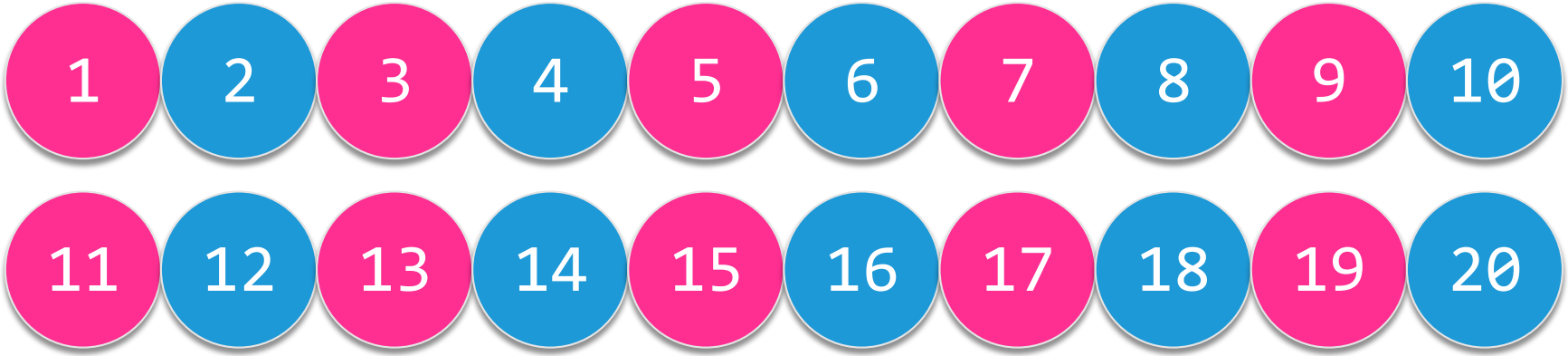


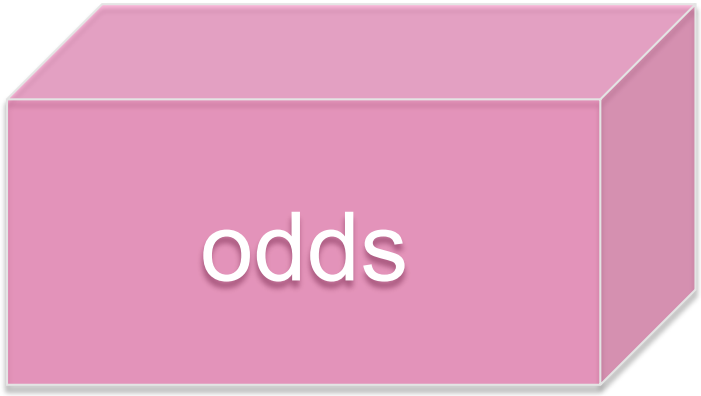
hash tables

- hash table: 2 buckets
- hash function: `if (n % 2 == 1), odd box else, even box`

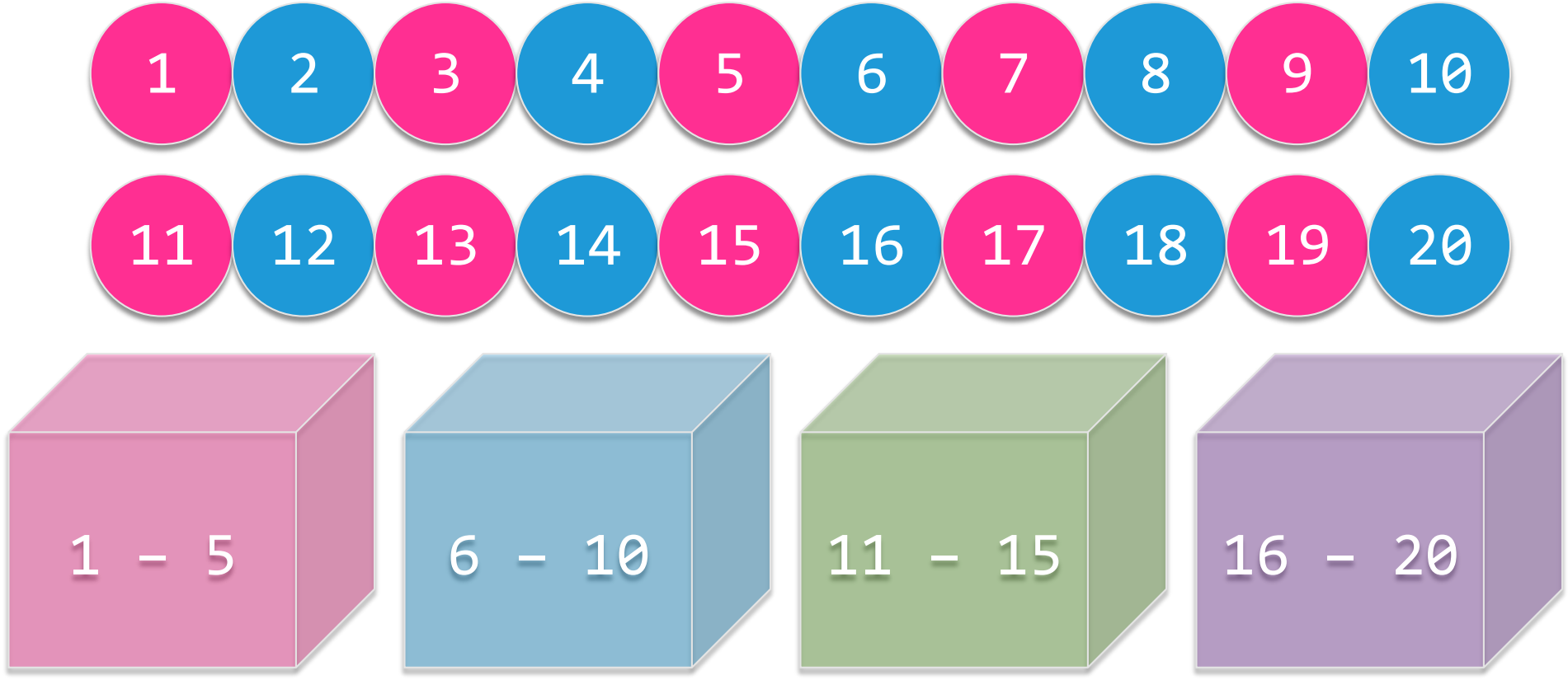


hash tables

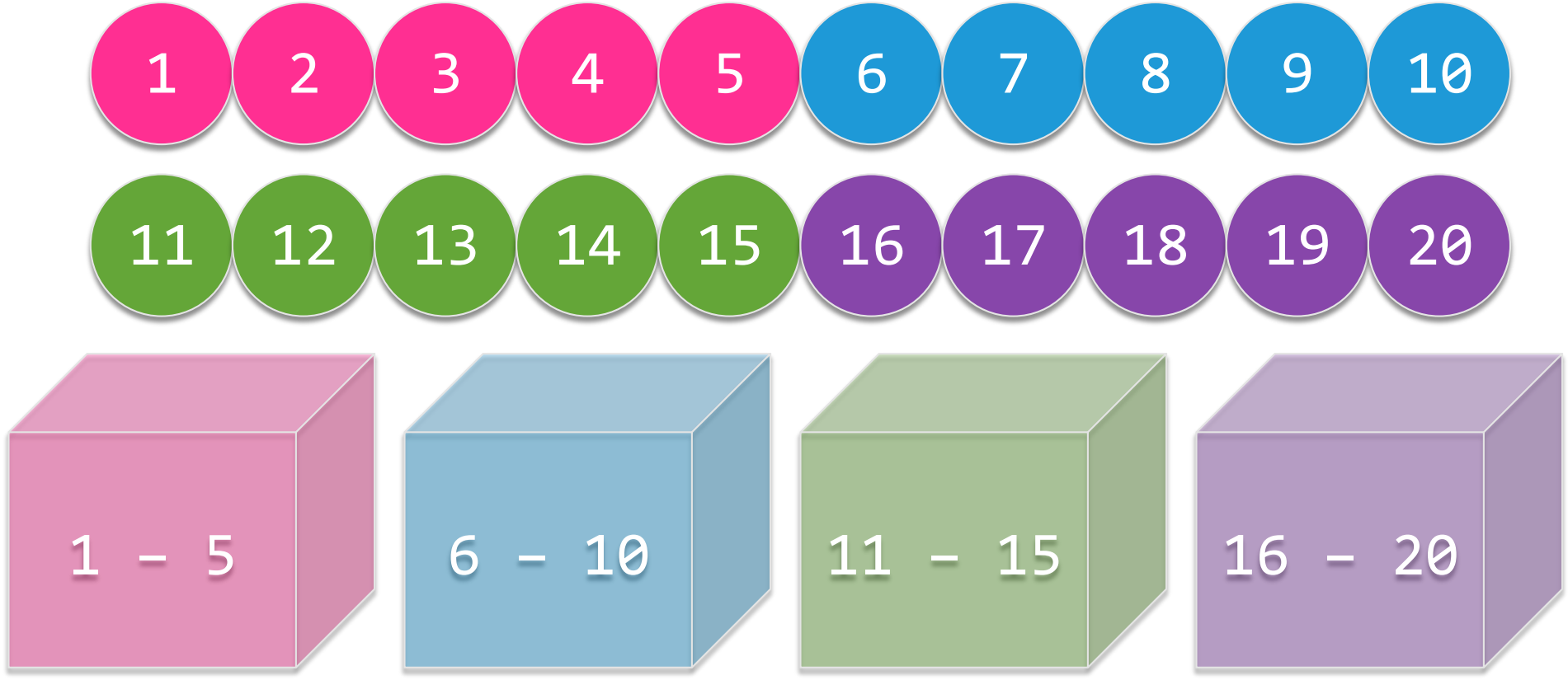




hash tables



hash tables



hash tables

- a hash table is an array of buckets
- each bucket is a linked list

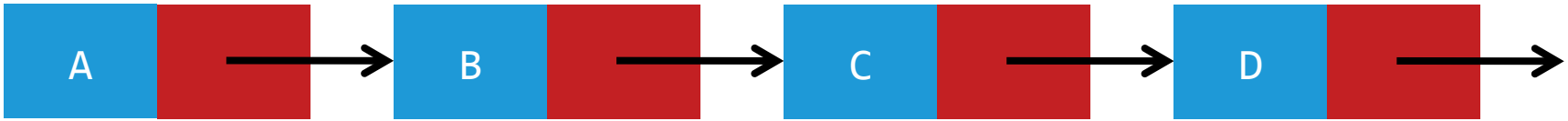
a hash table is an array of linked lists

nodes

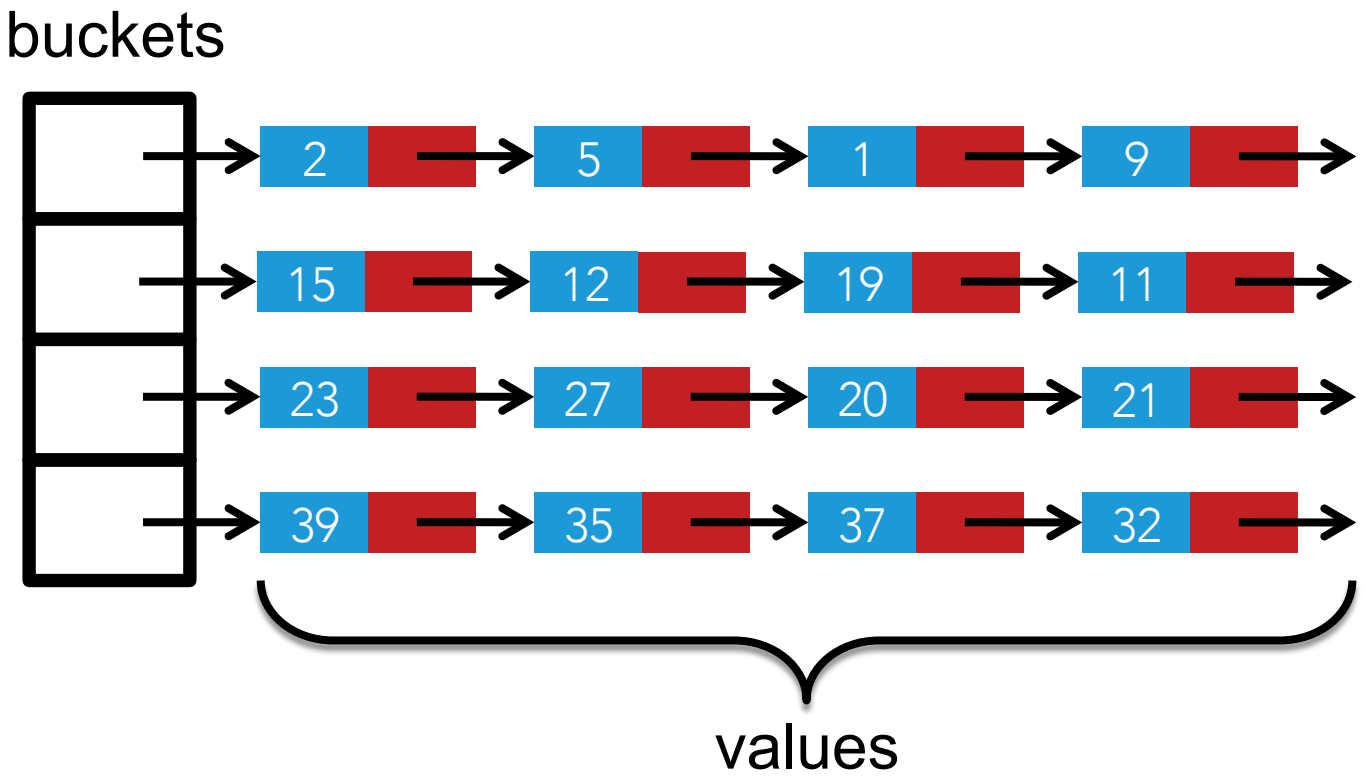
- each node has a value, as well as a pointer to the next node

linked lists

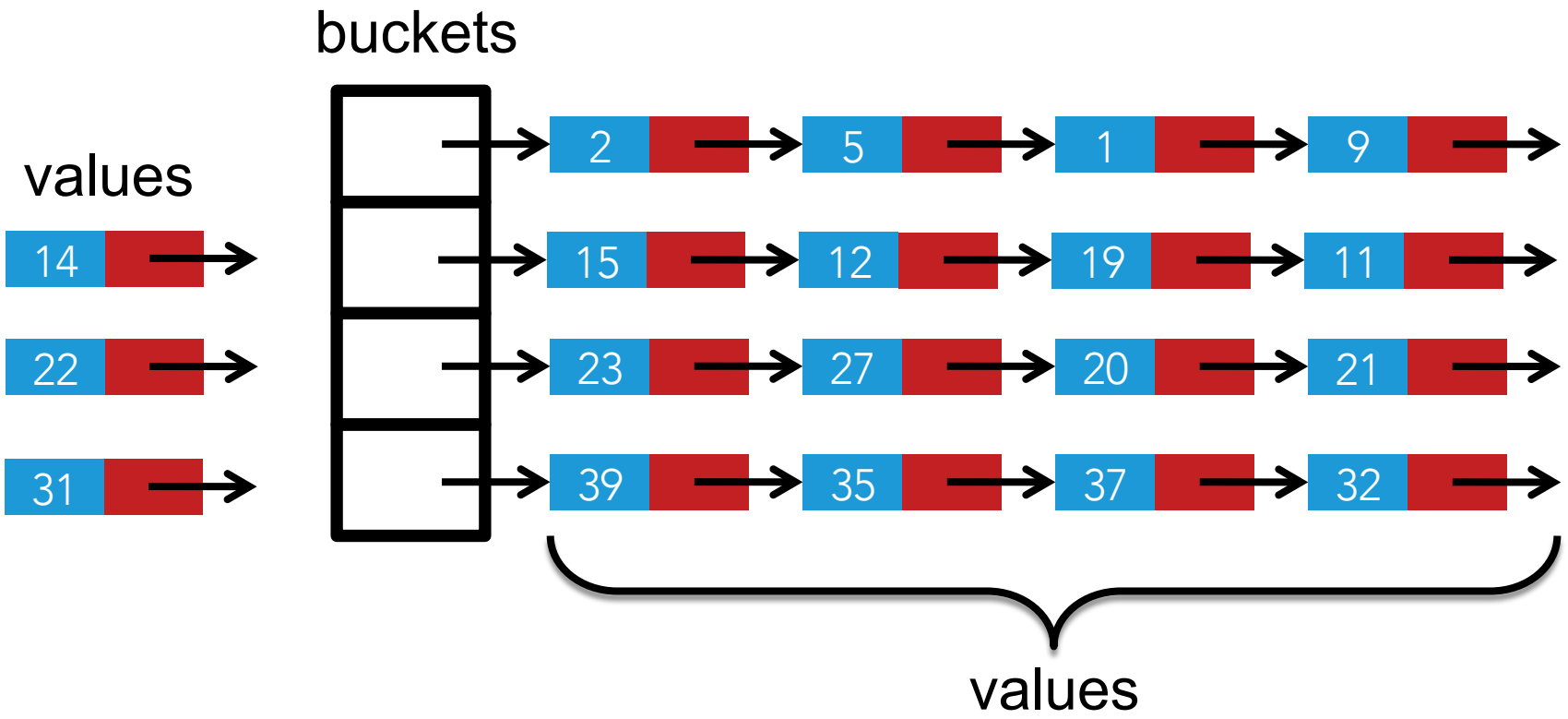
- important:
  - don’t lose any links!
  - last node points to `NULL`



hash tables



hash tables

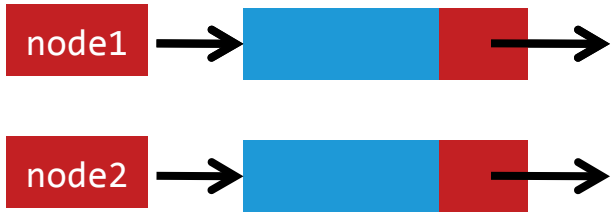

buckets
values
14
22
31
2
5
1
9
15
12
19
11
23
27
20
21
39
35
37
32
values

linked lists

```
typedef struct node
{
    char word[LENGTH + 1];
    struct node *next;
}
node;

node *node1 = malloc(sizeof(node));
```

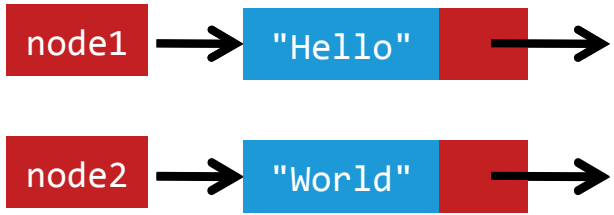
linked lists

```
typedef struct node
{
    char word[LENGTH + 1];
    struct node *next;
}
node;

node *node1 = malloc(sizeof(node));
node *node2 = malloc(sizeof(node));
```



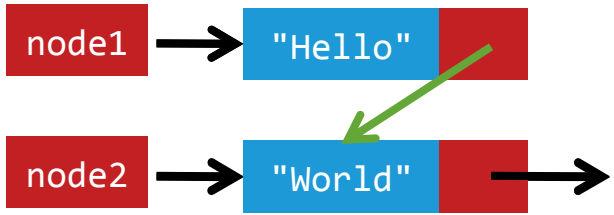
linked lists

```
typedef struct node
{
    char word[LENGTH + 1];
    struct node *next;
}
node;

node *node1 = malloc(sizeof(node));
node *node2 = malloc(sizeof(node));
node1->word = "Hello";
node2->word = "World";
```



linked lists

```
typedef struct node
{
    char word[LENGTH + 1];
    struct node *next;
}
node;

node *node1 = malloc(sizeof(node));
node *node2 = malloc(sizeof(node));
node1->word = "Hello";
node2->word = "World";
node1->next = node2;
```



linked lists

```
typedef struct node
{
    char word[LENGTH + 1];
    struct node* next;
}
node;
```


```
node *node1 = malloc(sizeof(node));
node *node2 = malloc(sizeof(node));
node1->word = "Hello";
node2->word = "World";
node1->next = node2;
```

a hash table is an array of linked lists

each element of array is a node *

hash table

```
typedef struct node
{
    char word[LENGTH + 1];
    struct node *next;
}
node;

node *hashtable[50];
```

a hash table is an array of linked lists

each element of array is a node *

make a new word

- scan dictionary word by word

```
while (fscanf(file, "%s", word) != EOF)
{
    ...
}
```

make a new word

- `malloc` a `node *` for each new word

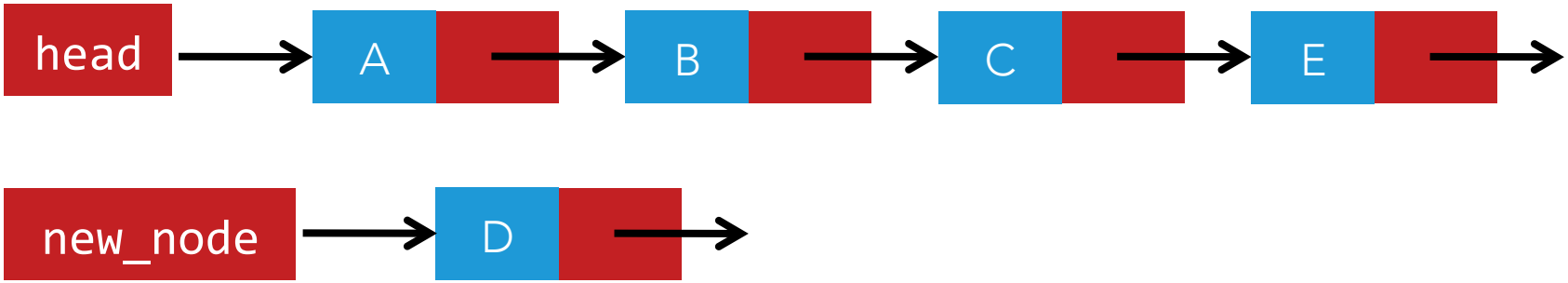
```
node *new_node = malloc(sizeof(node));
if (new_node == NULL)
{
    unload();
    return false;
}
```

make a new word

- copy word into node

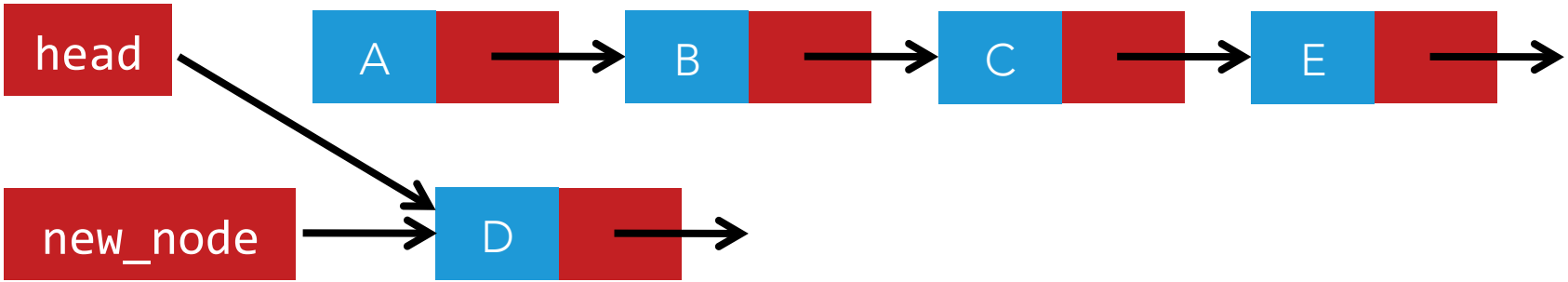
```
strcpy(new_node->word, word);
```

insert into a linked list: incorrect



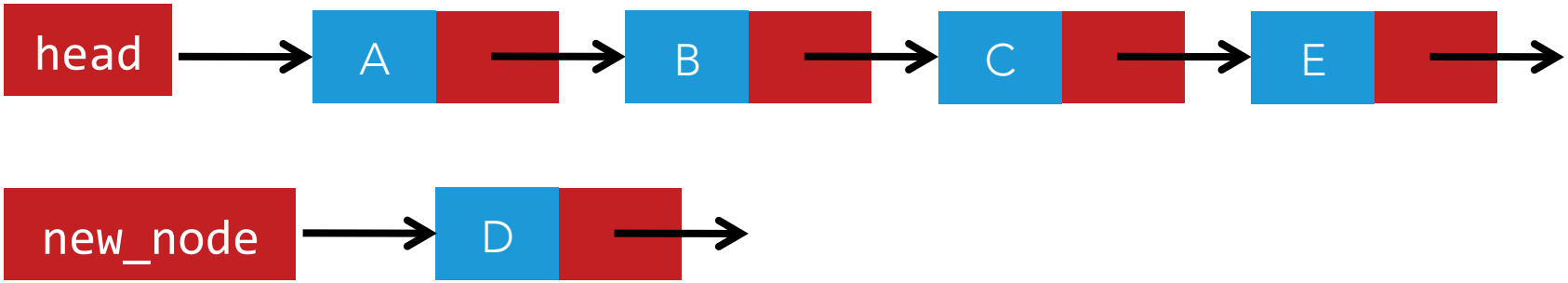

```
head = new_node;
```

insert into a linked list: incorrect



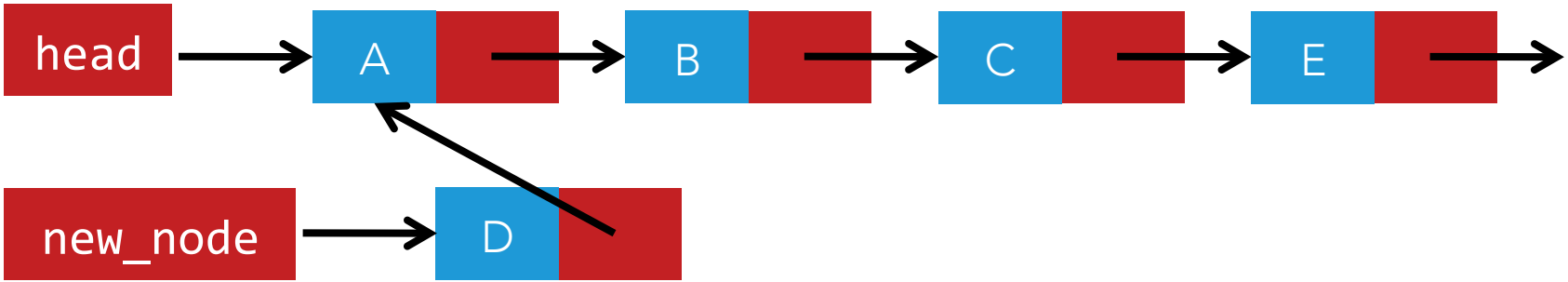

```
head = new_node;
```

insert into a linked list: correct



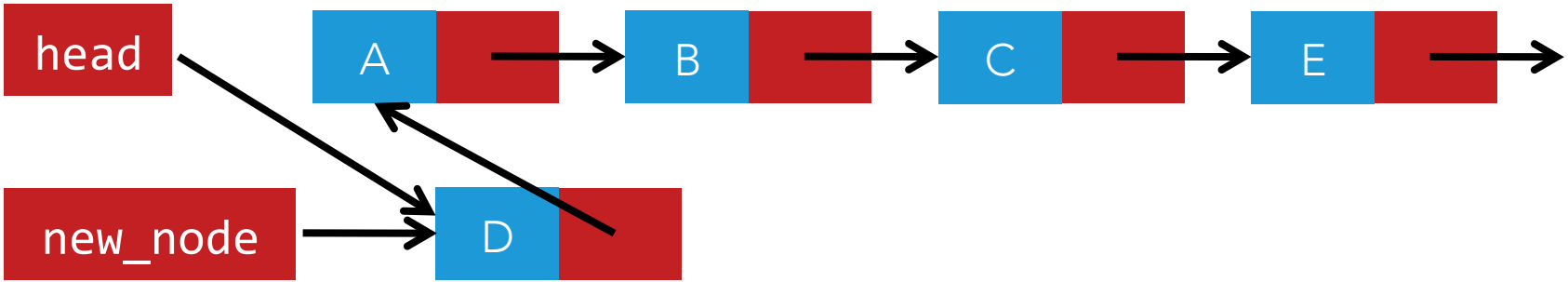

```
new_node->next = head;
```

insert into a linked list: correct




```
new_node->next = head;
head = new_node;
```

insert into a linked list: correct




```
new_node->next = head;
head = new_node;
```

hash function

- takes a string
- returns an index
  - index < the number of buckets
- deterministic
  - the same value needs to map to the same bucket every time

hash the word

- `new_node->word` has the word from the dictionary
- hashing `new_node->word` will give us the index of a bucket in the hash table
- insert into the linked list

a hash table is an array of linked lists

each element of array is a node *

tries

- every node contains an array of `node` pointers
  - one for every letter in the alphabet + `'\''`
  - each element in the array points to another `node`
    - if that `node` is `NULL`, then that letter isn't the next letter of any word in that sequence
- every node indicates whether it's the last character of a word

tries

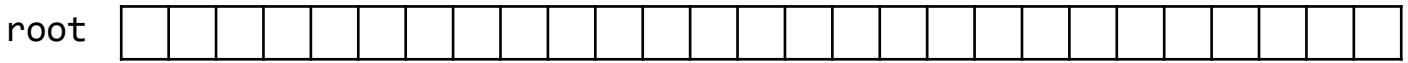
```
typedef struct node
{
     bool is_word;
     struct node *children[27];
}
node;

node *root;
```

load

- for every dictionary word, iterate through the trie
- each element in `children` corresponds to a different letter
- check the value at `children[i]`
  - if `NULL`, `malloc` a new node, have `children[i]` point to it
  - if not `NULL`, move to new node and continue
- if at end of word, set `is_word` to `true`

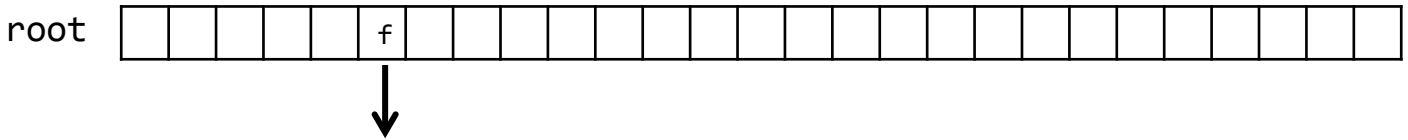
"fox"

`f: root->children[5]`



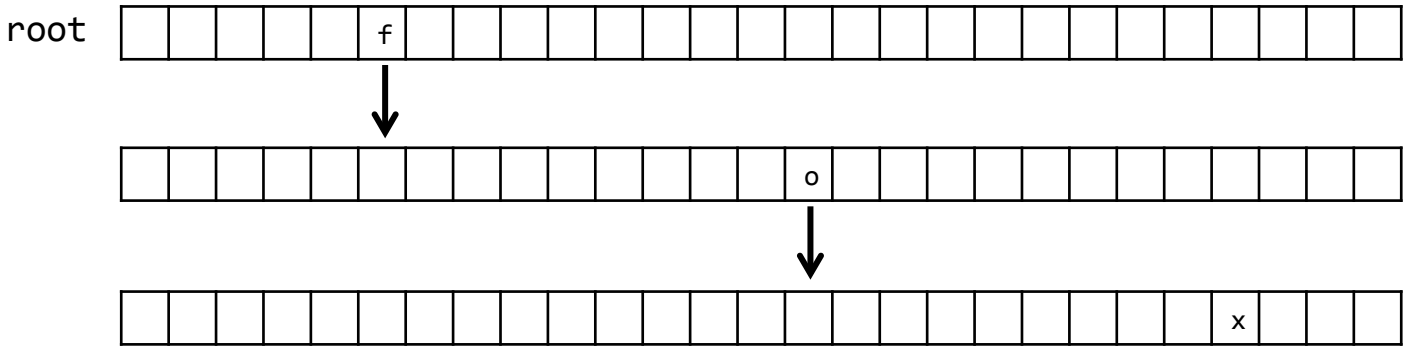
"fox"

`f: root->children[5]`



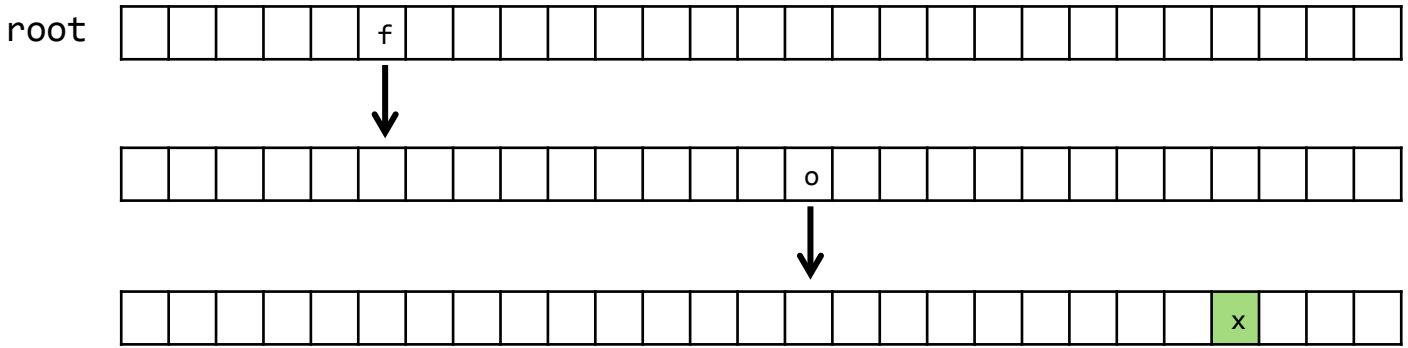
"fox"

```
f: root->children[5]
o: root->children[5]->children[14]
x: root->children[5]->children[14]->children[23]
```



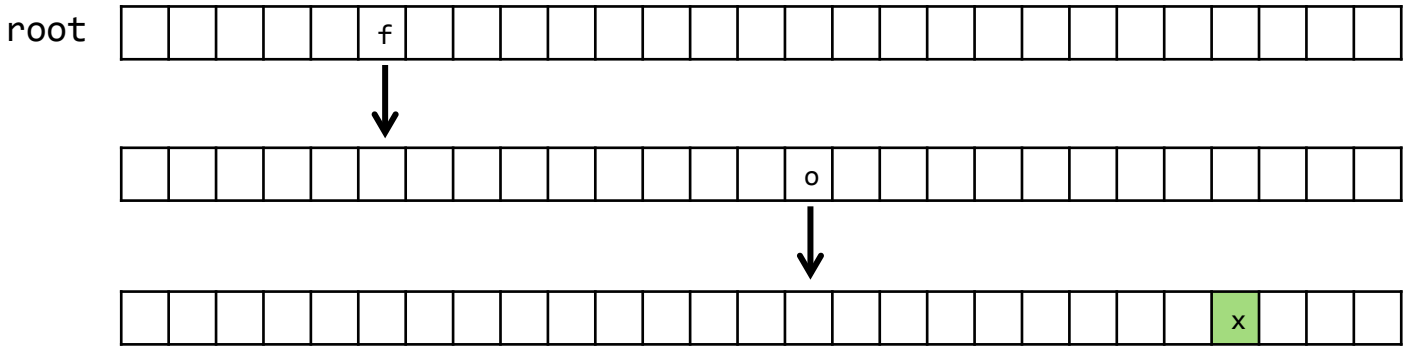
"fox"

```
f: root->children[5]
o: root->children[5]->children[14]
x: root->children[5]->children[14]->children[23]
```



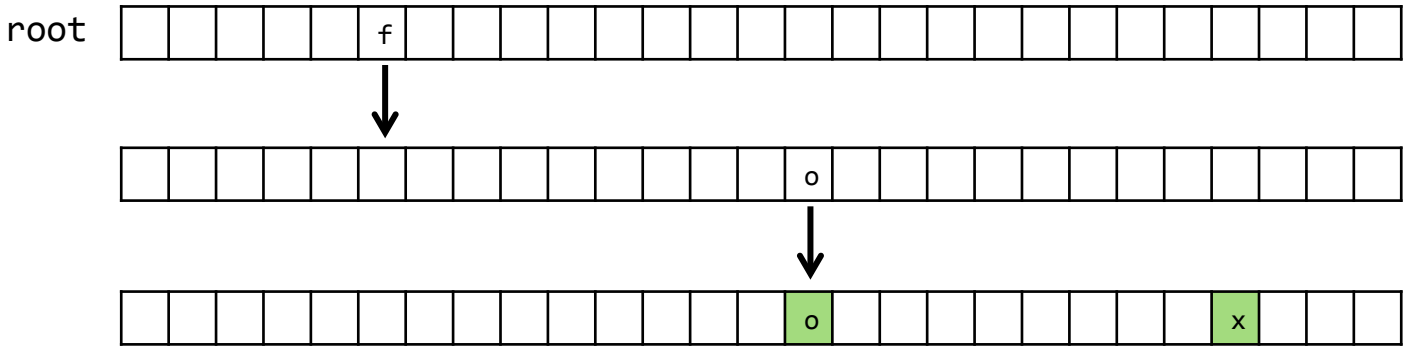
"foo"

```
f: root->children[5]
o: root->children[5]->children[14]
o: root->children[5]->children[14]->children[14]
```



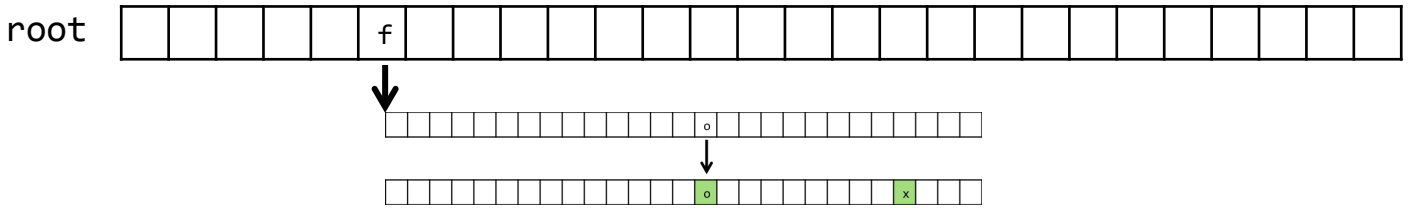
"foo"

```
f: root->children[5]
o: root->children[5]->children[14]
o: root->children[5]->children[14]->children[14]
```



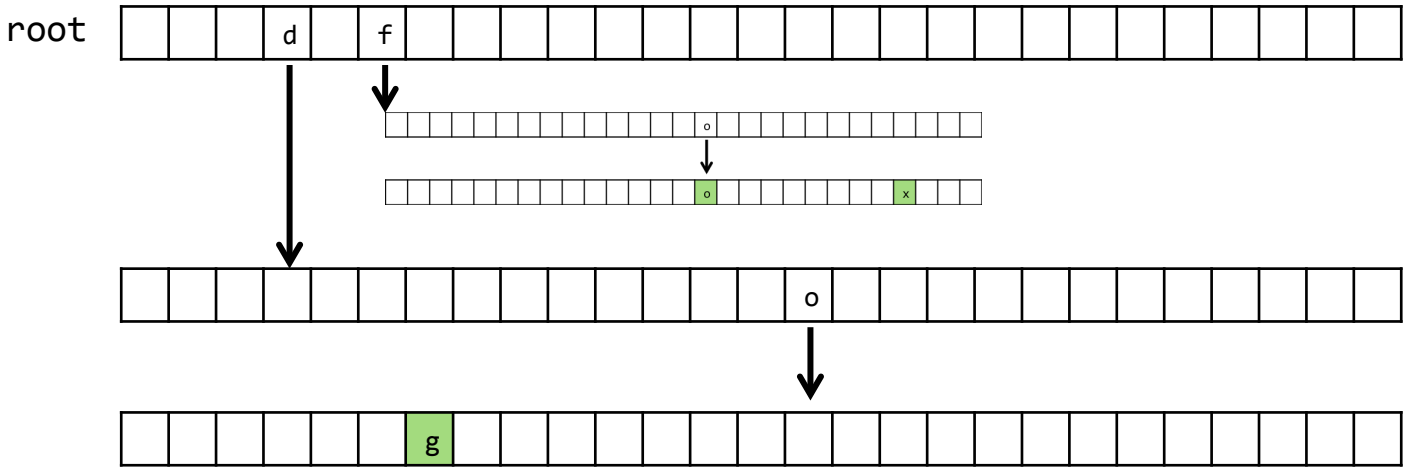
"dog"

d: root->children[3]



"dog"

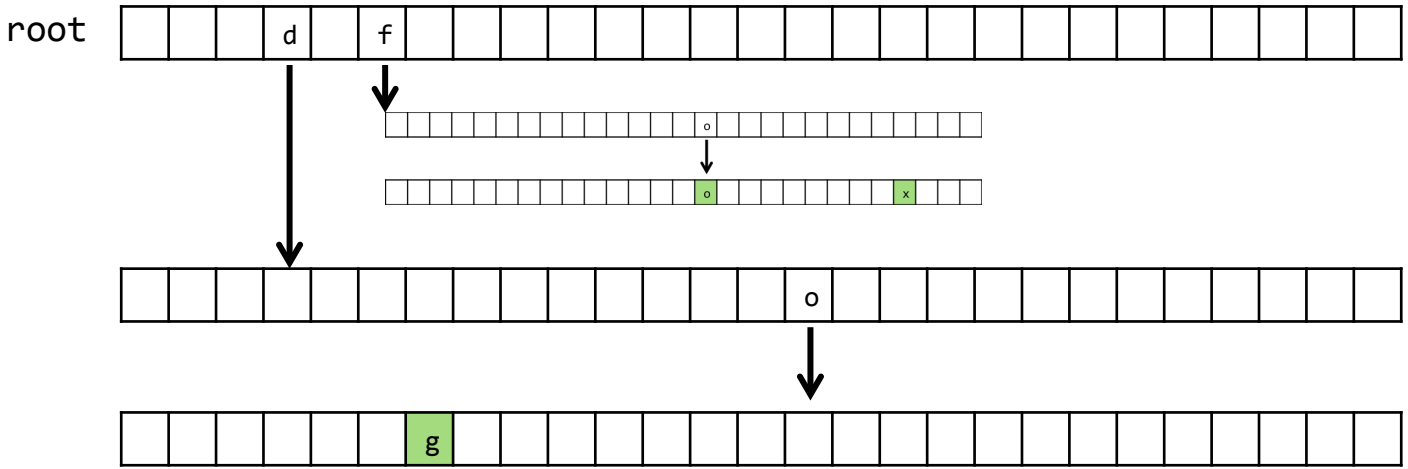
```
d: root->children[3]
o: root->children[3]->children[14]
g: root->children[3]->children[6]
```



"do"

d: root->children[3]

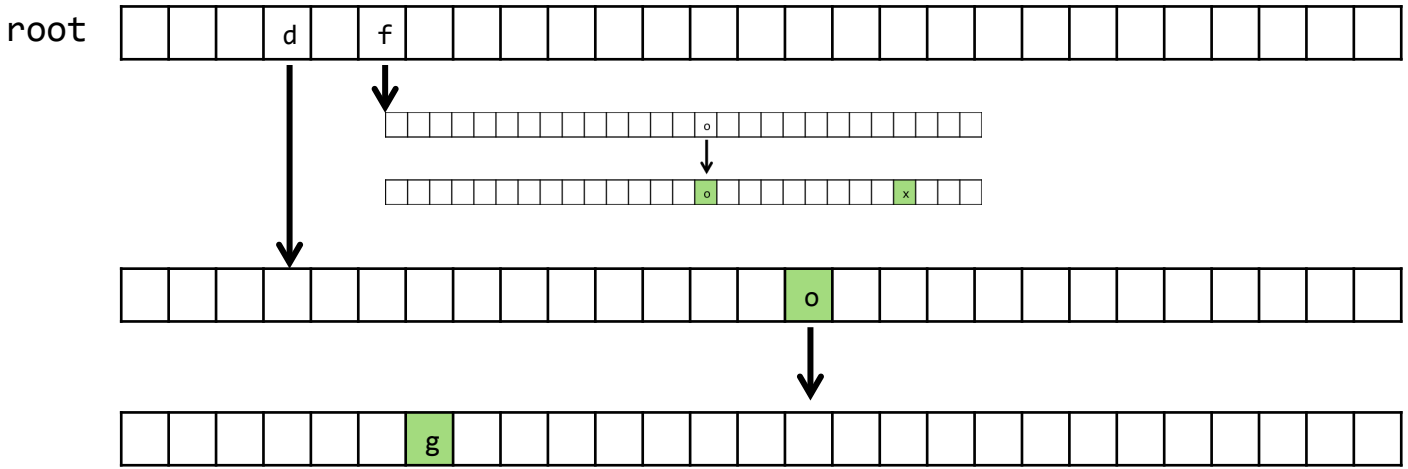
o: root->children[3]->children[14]



"do"

d: root->children[3]

o: root->children[3]->children[14]



TODO:

- ☑ `load`
- ☐ `check`
- ☐ `size`
- ☐ `unload`

check

- case-insensitivity
- assume strings with only alphabetical characters and/or apostrophes

check

- if the word exists, it can be found in the hash table
- which bucket would the word be in?
  - `hashtable[hash(word)]`

a hash table is an array of linked lists

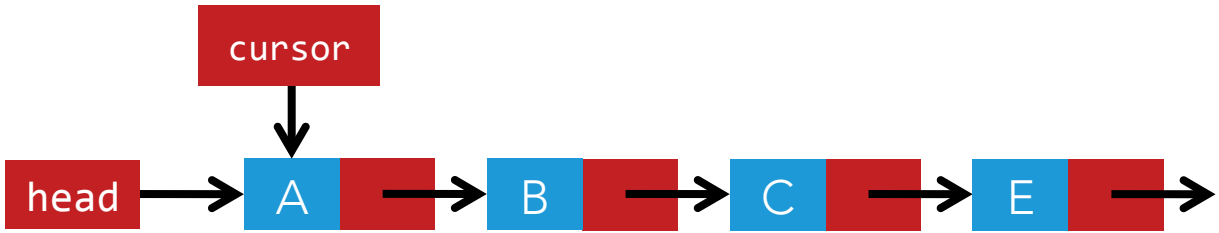
each element of array is a node *

check

- if the word exists, it can be found in the hash table
- which bucket would the word be in?
  - `hashtable[hash(word)]`
- search in that linked list
  - `strcasecmp`

traversing linked lists

```
node *cursor = head;
while (cursor != NULL)
{
    // do something
    cursor = cursor->next;
}
```



traversing linked lists

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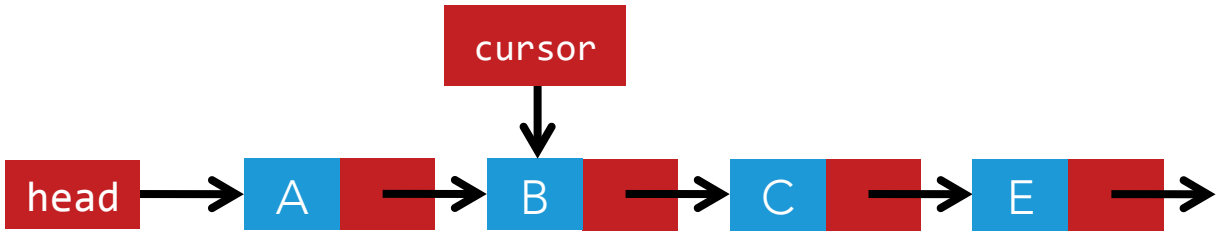

traversing linked lists

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}
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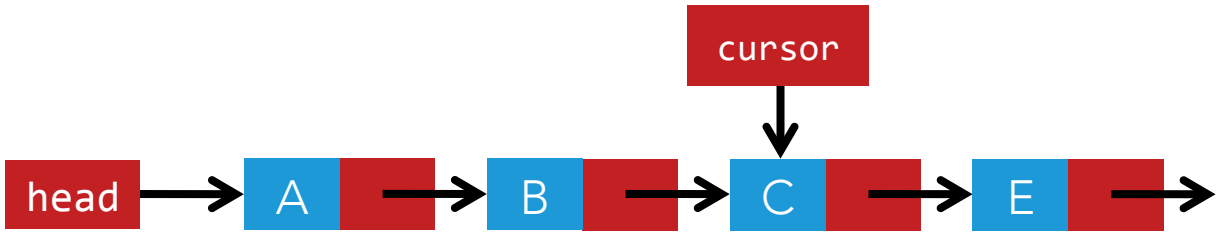

traversing linked lists

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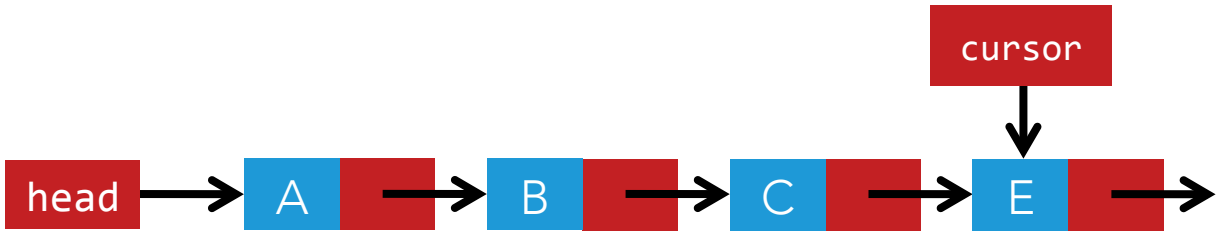

traversing linked lists

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}
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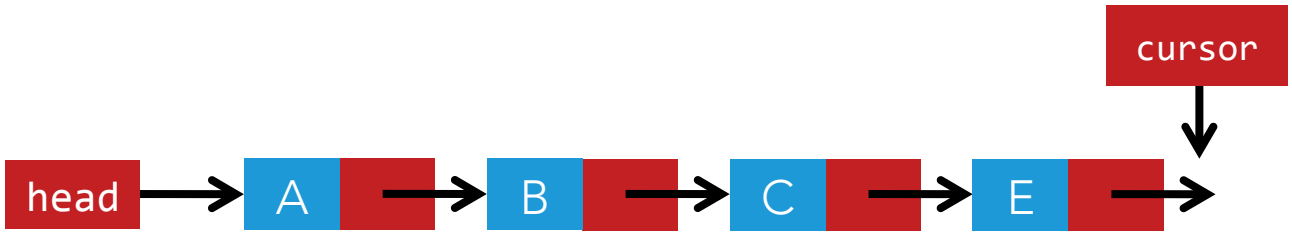


traversing a trie

for each letter in input word

- go to corresponding element in children
  - if `NULL`, word is misspelled
  - if not `NULL`, move to next letter
- once at end of input word
  - check if `is_word` is true

TODO

- ☑ load
- ☑ check
- ☐ size
- ☐ unload

TODO

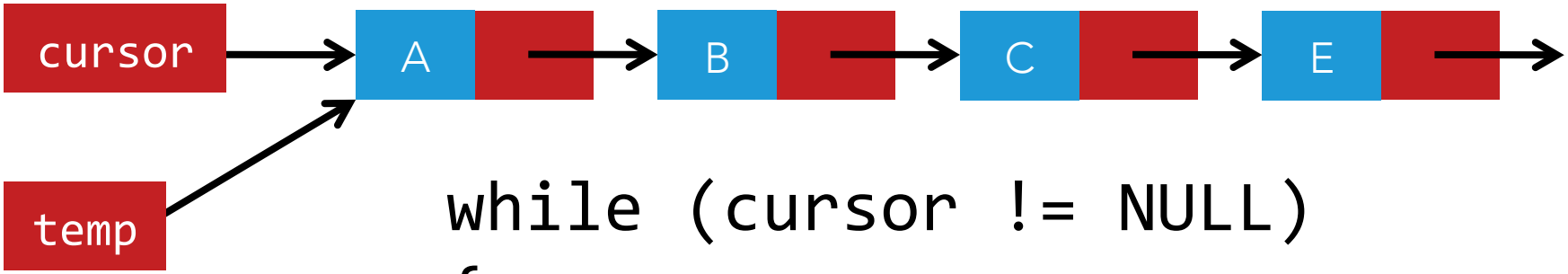
- ☑ `load`
- ☑ `check`
- ☑ `size`
- ☐ `unload`

freeing linked lists

```
node *cursor = head;

while (cursor != NULL)
{
    node *temp = cursor;
    cursor = cursor->next;
    free(temp);
}
```

DIY!




```
while (cursor != NULL)
{
    node *temp = cursor;
    cursor = cursor->next;
    free(temp);
}
```

a hash table is an array of linked lists

each element of array is a node *

`unload`

- unload from bottom to top
- travel to lowest possible node
  - free all pointers in `children`
  - backtrack upwards, freeing all elements in each `children` array until you hit root node
- recursion!

valgrind

```
valgrind -v --leak-check=full austinpowers.txt
```

TODO

- ☑ load
- ☑ check
- ☑ size
- ☑ unload

tips

- pass in a smaller dictionary
  - usage: `./speller [dictionary] text`
  - default: **`large`**
  - also try: **`small`**
  - make your own!
- pen and paper!

this was mispellings

traversing linked lists

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node *cursor = head;
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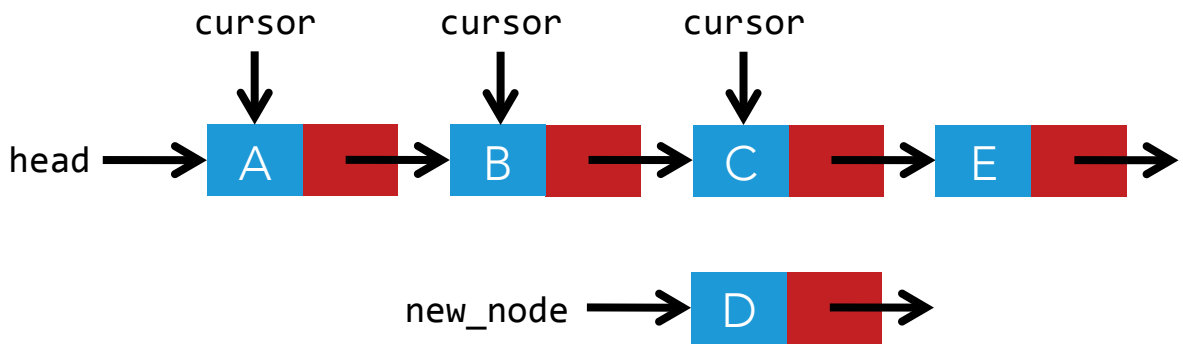
}
```



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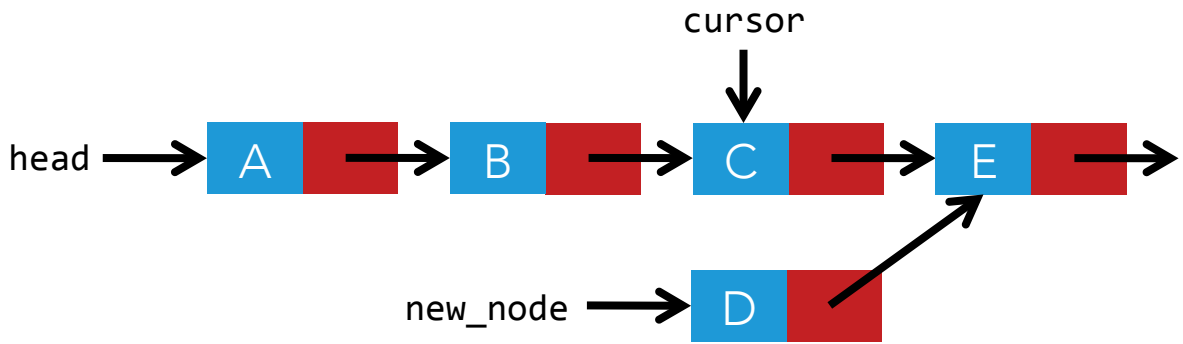

traversing linked lists

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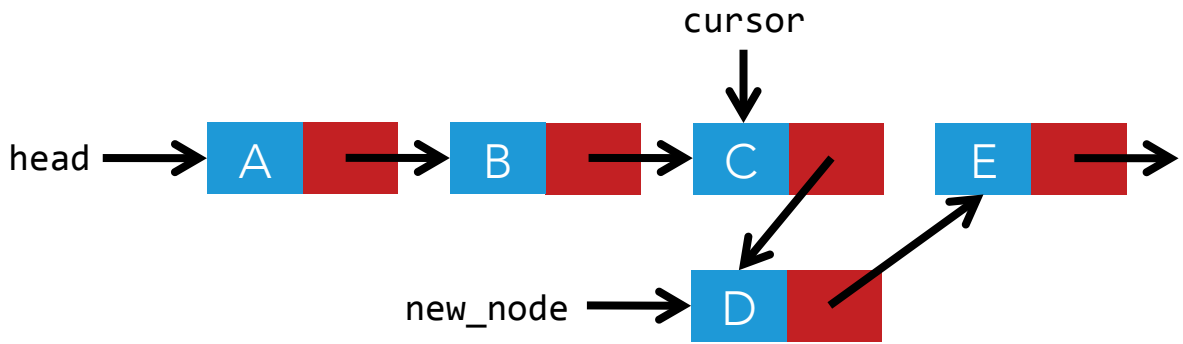

traversing linked lists

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```

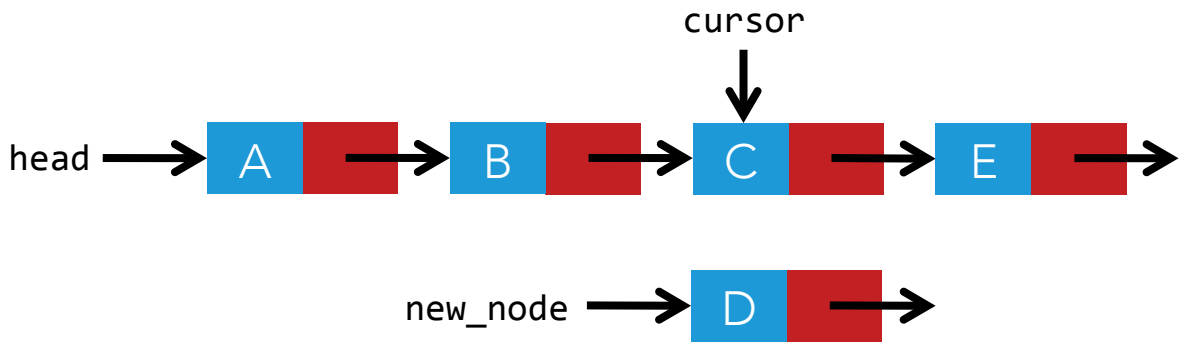

traversing linked lists

```
node *cursor = head;
while (cursor != NULL)
{
        // do something
        cursor = cursor->next;
}
```