

i206: Lecture 9: Intro to Data Structures

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Some slides courtesy Marti Hearst, John Chuang and others

Outline

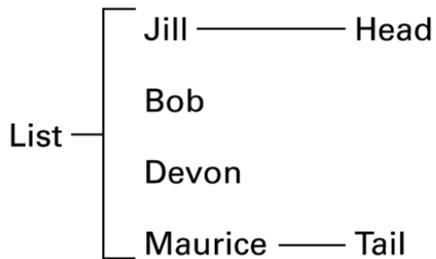
- What is a data structure
- Basic building blocks: arrays and linked lists
- Data structures (uses, methods, performance):
 - List, stack, queue
 - Dictionary
 - Tree
 - Graph

What is a Data Structure?

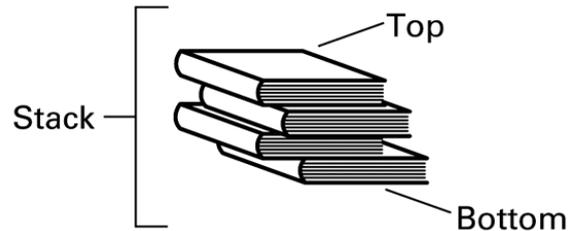
- A conceptual arrangement of data. (Brookshear)
- A systematic way of organizing and accessing data. (Goodrich & Tamassia)
- A way of storing data in a computer so that it can be used efficiently. Often a carefully chosen data structure will allow a more efficient algorithm to be used. (Wikipedia)
- Common data structures: array, list, stack, queue, dictionary, set, tree, graph, ...

List

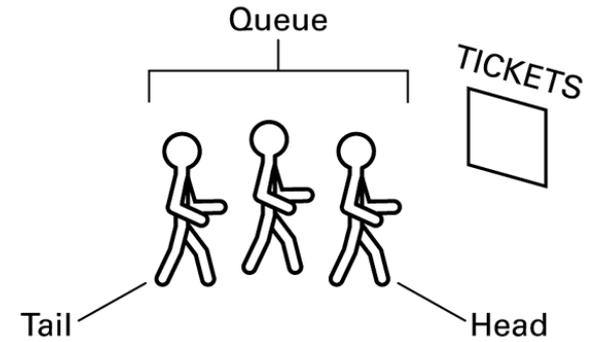
- An ordered collection of objects



a. A list of names



b. A stack of books



c. A queue of people

Set

- An unordered collection of non-repeated objects
- Example:

```
>>> basket = ['apple', 'orange', 'apple',  
'pear', 'orange', 'banana']  
>>> fruit = set(basket) # create a set without duplicates  
>>> fruit  
set(['orange', 'pear', 'apple', 'banana'])  
>>> 'orange' in fruit # membership testing  
True
```

Dictionary

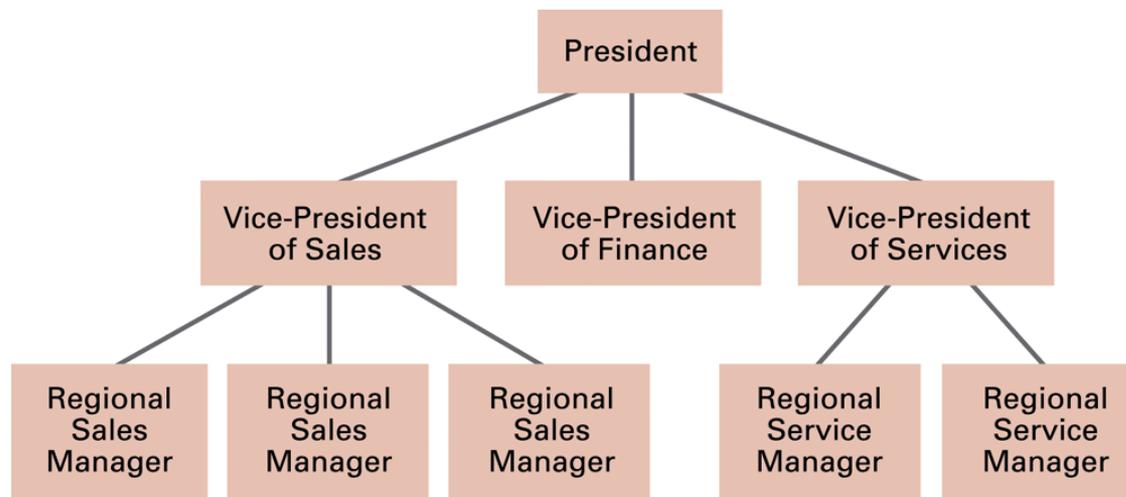
- Also known as associative array, lookup table, or map
- A searchable collection of key-value pairs
 - each key is associated with one value
- Example:

```
>>> fullname = { 'chuang' : 'John Chuang',  
                'i206' : '206 class mailing list' }
```

```
>>> fullname[ 'chuang' ]  
'John Chuang'
```

Tree

- A collection of data whose entries have a hierarchical organization



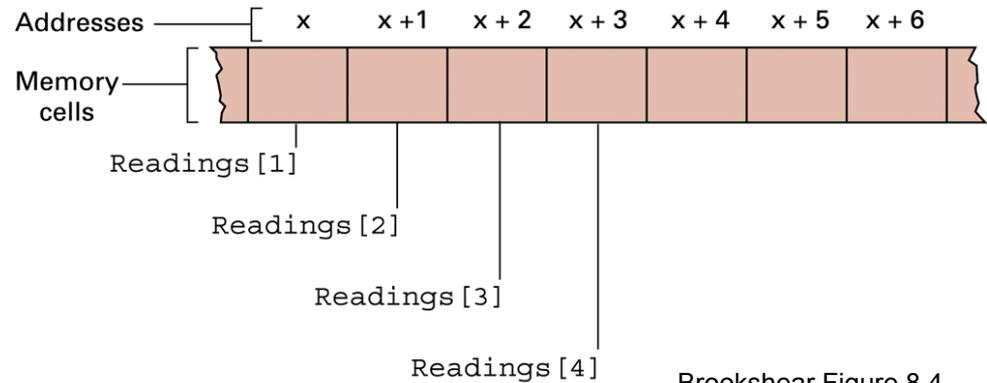
Brookshear Figure 8.2

Question

- How are these data structures implemented?
 - How are they stored in memory?

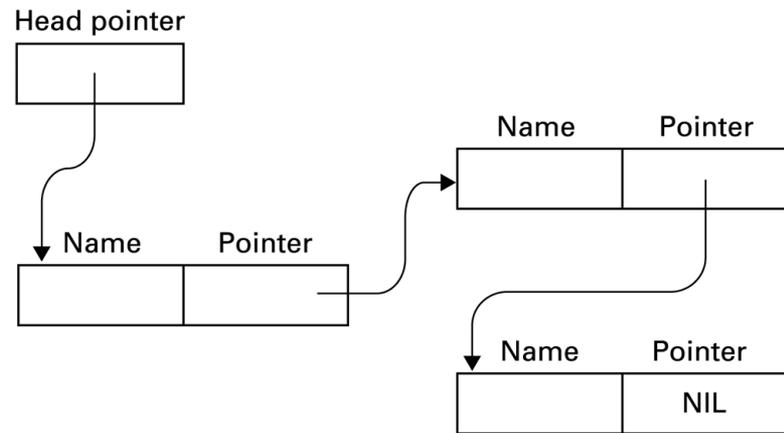
Basic Data Structures

- Array



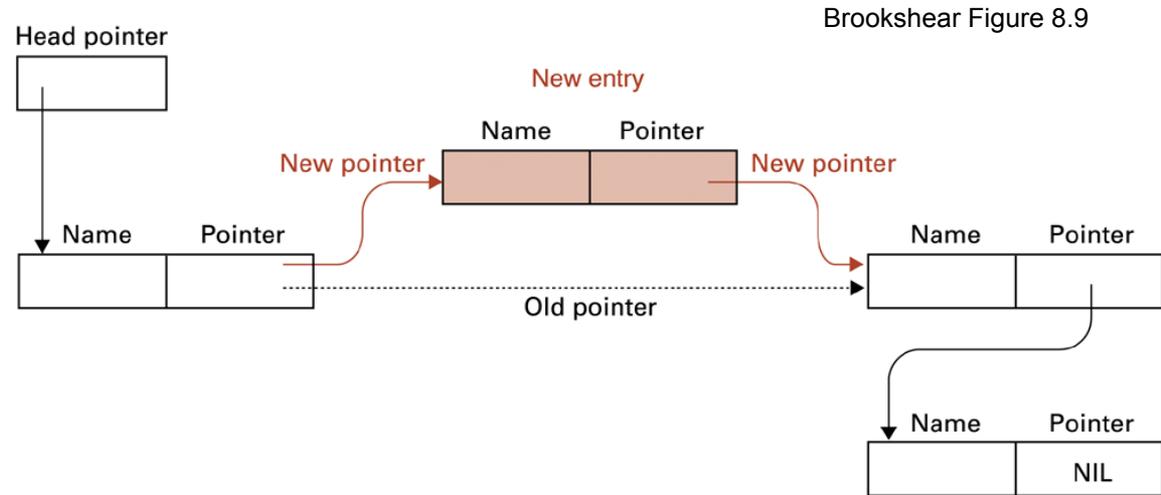
Brookshear Figure 8.4

- Linked list

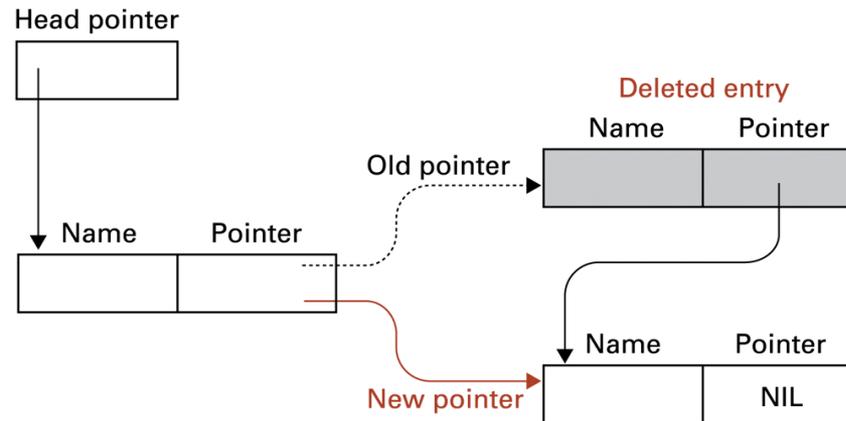


Linked List Operations

- Insertion



- Deletion



Array vs. Linked List

- Q: what are the tradeoffs?
 - Running time of insert, delete, lookup operations
 - Storage requirements
- Example: implement a UCB student directory

Python Activity

- Open up a Python window, and create list of letters

- `s = "That test was easy";`
- Play around with different ways of indexing the string (which is an array of characters)

```
s[2:]
```

```
a[:2]
```

```
a[0:]
```

```
a[-1]
```

```
a[-1:]
```

```
a[:-1]
```

```
a[len(a):]
```

- Convert the string to how you really feel about the test