Lists and Analysis of Algorithms

10 8 2001

Opening Discussion

▌ What did we talk about last class?

▌ Function to sum elements of an array.

```
int sum(const int vals[],int length) {
    int ret=0;
    for(int i=0; i<length; i++) {
        ret+=vals[i];
    }
    return ret;
}
```

What is a List?

▌ One of the most fundamental data structures in programming is a list. They are very much like a list that you would use in normal life.

▌ In its most general form a list is just an ordered collection of elements.

▌ Lists can be implemented in many different ways. The array implementation we will look at today is only one of them.

Behaviors of a List

❚ When you work with a list there are only a few things that you can do.
  ❚ Search for items.
  ❚ Add items.
  ❚ Remove Items.
❚ Different types of lists are used for different things and you only have to give them functionality that is really needed.
  ❚ Does order matter? Can you insert? Etc.

Arrays as Lists

❚ We can implement a simple list using arrays with 3 pieces of data.
  ❚ An array of the proper type to store elements of the list.
  ❚ Two integers to track the size of the array and how many items are currently on it.
❚ There are a few functions we would want to write to make this work as a list.
  ❚ add, find, remove, insert

Analysis of Algorithms

❚ One of the major aspects of computer science is what is called analysis of algorithms. This is where we look at the way the runtime of a program changes with the input.
❚ Gives a relation between input size and number of operations the program performs.
❚ Related to how long it takes a program to run but not exactly run time.

Scaling of Algorithms

- In analysis of algorithms we are concerned with how the number of operations a program performs scales with the size of the input. Here are some examples.
  - Linear $O(n)$ Double the input and the number of operations doubles.
  - Quadratic $O(n^2)$ Double the input and the number of operations increase by 4x.
  - Exponential $O(e^n)$
- Called the order of an algorithm. Matters most for LARGE n.

Minute Essay

- What is the order of the delete method we looked at today? In this case we are talking about the average order. What is the input size here?
- Beginning tomorrow we will discuss searching and sorting of collections of data in detail. This will be our first real application of the programming structures we have introduced to real algorithms.