Today's topics

- Java
  - Arrays
- Upcoming
  - Functions
- Reading
  - *Great Ideas*, Chapter 3

Arrays

- Aggregate data type
- Deal with items of same type
  - Lists of words
  - Numbers
- Analogies
  - Mailboxes in post office
  - CD racks with slots
- Simplifies naming
  - What if you needed to come up with unique name for each data item?
- Allows use of loops
- Required for many mathematical and statistical problems
- Multiple elements or cells

Using arrays

- Use *subscript* or *index* to access an element
  - \( x[5] = 20; \)
  - foo.setText("Result is " + x[5]);
- First element is element 0, not 1!!!
- Often used in loops
  - \( int \ k = 0, \ sum = 0; \)
  - while \( (k < 10) \)
    - \{ \)
      - \( \sum = \sum + \text{measurements}[k]; \)
      - \( k = k + 1; \)
    - \}
- Note that subscript is a variable, \( k \)

Creating Arrays

- Declaration
  - `double weights[];`
- Definition
  - `weights = new double[50];`
- Combine declaration and definition
  - `double weights[] = new double[50];`

```java
define num[] = new int[6];

```
Arrays & Loops

```java
num[0] = 0;
int k = 2;
while (k < num.length)
{
    num[k] = k * k;
    k = k + 1;
}
```

- Subscript range errors!!!
  - Java checks (many languages do not)
  - Costs & tradeoffs

Array Examples

- Sum up elements in a list (4 ways to do same thing)

```java
int k = 0, sum = 0;
while (k < 10)
{
    sum = sum + data[k];
    k = k + 1;
}
int k = 9, sum = 0;
while (k >= 0)
{
    sum = sum + data[k];
    k = k - 1;
}
```

- Count occurrences of something
- Search for something
- Information retrieval

Hotel Program

```java
public class Hotel extends java.applet.Applet implements ActionListener
{
    TextField mInstruct, mHotelCensus;
    IntField gRoomNo, gNoGuests;
    Button bRegister;
    int k=0, totGuests = 0, noOccupied = 0, roomNo, noGuests;
    int room[];

    public void init()
    {
        room = new int[500];
        k = 0;
        while (k < 500)
        {
            room[k] = 0;
            k = k + 1;
        }
    }
```

Hotel Program.2

```java
mInstruct = new TextField(60);
mInstruct.setText("Enter room number, number of guests, then press Register");
gRoomNo = new IntField(6);
gNoGuests = new IntField(6);
bRegister = new Button("Register");
mHotelCensus = new TextField(60);
bRegister.addActionListener(this);
add(mInstruct);
add(gRoomNo);
add(gNoGuests);
add(bRegister);
add(mHotelCensus);
```
Hotel Program.3

```java
public void actionPerformed(ActionEvent event) {
    Object cause = event.getSource();
    if (cause == bRegister) {
        roomNo = gRoomNo.getInt();
        noGuests = gNoGuests.getInt();
        if (room[roomNo] != 0)
            mHotelCensus.setText("That room is occupied!");
        else {
            room[roomNo] = noGuests;
            totGuests = totGuests + noGuests;
            noOccupied = noOccupied + 1;
            mHotelCensus.setText("There are " + totGuests + " occupying " + noOccupied + " rooms.");
        }
    }
}
```

Simple Statistics

- What should a simple statistics program include?
  - Get data into array
    - One item at a time
  - Practical program would use files
  - Allow display of data
    - Display one item at a time
  - (Could have used TextArea to display all at once)
  - Actual computations
    - Maximum, Minimum, Mean, N
  - Control
    - Appropriate buttons

Simple Statistics

- How do we compute the Mean (Average)?
  - Sum
  - Count
  - Compute

- How do we find extrema?
  - Largest
  - Smallest

- Will package as functions (methods)

Stats Program

```java
public class ArrayStats extends java.applet.Applet implements ActionListener {

    TextField mInstruct, mAnswer;
    IntField iCount;
    double[] list[];
    Button bStore, bShow, bExtremes, bMean, bClear;
    int count, nextFree, nextUse;

    double mean(double[] list, int size) {
        int k = 0;
        double sum = 0.0;
        while (k < size) {
            sum = sum + list[k];
            k = k + 1;
        }
        return sum/size;
    }
}
```
### Stats Program.2

```java
double max(double[] list, int size)
{
    int k = 1;
    double largest = list[0];
    while (k < size) {
        if (list[k] > largest) {
            largest = list[k];
        }
        k = k + 1;
    }
    return largest;
}
```

### Stats Program.3

```java
double min(double[] list, int size)
{
    int k = 1;
    double smallest = list[0];
    while (k < size) {
        if (list[k] < smallest) {
            smallest = list[k];
        }
        k = k + 1;
    }
    return smallest;
}
```

### Stats Program.4

```java
public void init()
{
    list = new double[100];
    mInstruct = new TextField(70);
    mAnswer = new TextField(70);
    mInstruct.setText("Enter Value, then press Store button");
    iCount = new IntField(10);
    bStore = new Button("Store");
    bShow = new Button("Show");
    bExtremes = new Button("Extremes");
    bMean = new Button("Mean");
    bClear = new Button("Clear");
    nextFree = 0;
    nextUse = 0;
    bStore.addActionListener(this);
    bShow.addActionListener(this);
    bExtremes.addActionListener(this);
    bMean.addActionListener(this);
    bClear.addActionListener(this);
    add(mInstruct); add(iCount); add(bStore); add(bShow); add(bExtremes); add(bMean); add(bClear); add(mAnswer);
}
```

### Stats Program.5

```java
public void actionPerformed(ActionEvent event)
{
    int value, total;
    Object cause = event.getSource();
    if (cause == bStore) {
        value = iCount.getInt();
        list[nextFree] = value;
        nextFree = nextFree + 1;
        iCount.setInt(); // clear IntField
    }
    if (cause == bShow) {
        mAnswer.setText("The value in element "+nextUse+" is "+list[nextUse]);
        nextUse = (nextUse + 1)% nextFree;
    }
}
```
if (cause == bExtremes) {
    mAnswer.setText("The largest data item is 
      + max(list, nextFree) + " and the smallest data item is " +
      min(list, nextFree));
}
if (cause == bMean) {
    mAnswer.setText("The average is " + mean(list, nextFree));
}
if (cause == bClear) {
    nextUse = 0;
    nextFree = 0;
    mAnswer.setText("The old data has been cleared out");
}

---

New Stuff in Stats Program

- **Java Programming: Functions (Methods)**
  - Parameters/Arguments
  - Return statement
  - Return type on method header (not just void)

- **Control**
  - Entering and Displaying data

- **Algorithms**
  - Mean
  - Min
  - Max