Today’s topics

Java
  Looping
Upcoming
  Arrays in Java

Reading
  Great Ideas, Chapter 3

Loopying/Iteration/Repetition

- Much of power of computer comes from the ability to repeat
  - Can use “button pushing” for slow, controlled loop
  - Use language features for full-speed looping

- While-loop syntax
  
  while (logical expression)
  {
    statement;
    ...
    statement;
  }

- Repeat statements between braces as long as while logical expression is true

While statement

- Risk of infinite loop
  - Usually a serious error
  - Something in body of loop must alter logical expression

- Gauss summation
  
  int sum = 0;
  int k = 0;
  while (k < 100)
  {
    k = k + 1;
    sum = sum + k;
  }

- \( \text{sum} = n^2(n+1)/2 \)

Compound Interest

- Redo our compound interest example
  - Specify how many months to compute loan for
  - Don’t require the push of a button for each month

- Code:

```java
public class CompInterest extends java.applet.Applet
  implements ActionListener
{
  TextField mInstruct, mBalance;
  DoubleField gRate, gPrinc, gPay;
  Button bCompute;
  IntField gMonths;

double rate, princ, pay, balance;
int months, k;
```
Compound Interest.2

```java
public void init(){
  mInstruct = new TextField(80);
mInstruct.setText("Enter principal, rate, payment, #months; then press 'Compute'");
gPrinc = new DoubleField(10);
gRate = new DoubleField(10);
gPay = new DoubleField(10);
gMonths = new IntField(10);
bCompute = new Button("Compute");
mBalance = new TextField(80);
bCompute.addActionListener( this );
add(mInstruct); add(gPrinc); add(gRate); add(gPay); add(gMonths); add(bCompute); add(mBalance);
}
```

Compound Interest.3

```java
public void actionPerformed(ActionEvent event)
{
  Object cause = event.getSource();
  if (cause == bCompute) {
    princ = gPrinc.getDouble();
    rate = gRate.getDouble()/12;
    pay = gPay.getDouble();
    months = gMonths.getInt();
    balance = princ;
    k = 0;
    while (k < months){
      balance = balance*(1.0 + rate) - pay;
      k = k + 1;
    }
    mBalance.setText("After " + months + " months at " + 100*rate*12 + "% and payments of " + pay + " the balance is " + balance);
  }
}
```

Many uses for Loops

- **Can count up or down**
  - Previous example counts up, month by month
  - “Count-down” needs decrementing from 10, by 1
- **Don’t have to increment or decrement by 1**
  - Can change by any value
  - E.g., for even number: start at 0, increment by 2
- **Data dependent loop**
  - Logical expression my depend on data
  - Increment may depend on data
  - Data input may provide halting value: called sentinel
- **Whimsical example to draw a diamond**

Diamond Example

```java
public class Diamond extends java.applet.Applet implements ActionListener
{
  TextField tf;
  TextArea ta;
  Button bDraw;
  String stars = "*******************";
  String spaces = " ";
  int k;
  public void init()
  {
    tf = new TextField("Hello ");
    ta = new TextArea(22, 20);
    ta.setFont(new Font("Monospaced", Font.BOLD, 12));
bDraw = new Button("Draw");
bDraw.addActionListener(this);
    add(tf); add(bDraw); add(ta);
  }
```
Diamond Example.2

```java
public void actionPerformed(ActionEvent event) {
    Object cause = event.getSource();

    if (cause == bDraw) {
        tf.setText(“Goodbye”);
        k = 0;
        while (k < 10) {
            ta.append(spaces.substring(0,10-k) +
                      stars.substring(0,2*k+1)+”
”);
            k = k + 1;
        }
    }
}
```

Diamond Example.3

```java
k = 1;
while (k < 10) {
    ta.append(spaces.substring(0,1+k) +
              stars.substring(0,19-2*k)+”
”);
    k = k + 1;
}
```

Loop Exercises

- **How many times do the following loops loop?**
  ```java
  int k = 0, n = 10;
  while (k < n) {
      k = k + 1;
  }
  ```

- **How many times does the following loop loop?**
  ```java
  int k = 1, n = 10;
  while (k < n) {
      k = k + 1;
  }
  ```

- **How many times does the following loop loop?**
  ```java
  int k = 1, n = 10;
  while (k <= n) {
      k = k + 1;
  }
  ```

- **What is the value of n?**
  ```java
  A int s = 30, n = 0;
  B while (s > 0) {
      s = s / 2;
      n = n + 1;
  } 
  ```
Loop Exercises

- How many times does the following loop loop?
- What is the value of n?

A int s = 30, n = 0;
B while (s > 0){
C s = s / 2;
D n = n + 1;
E }

Need to trace the program:

<table>
<thead>
<tr>
<th></th>
<th>s</th>
<th>n</th>
<th>T/F</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>20</td>
<td>0</td>
<td>T</td>
</tr>
<tr>
<td>B</td>
<td>10</td>
<td>1</td>
<td>T</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>2</td>
<td>T</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>3</td>
<td>T</td>
</tr>
<tr>
<td>E</td>
<td>1</td>
<td>4</td>
<td>T</td>
</tr>
</tbody>
</table>

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