Announcements

Chapter 8 Embedded Problems due Wednesday
Programming Assignment Five due Friday
Chapter 8 OWL assignment due Monday
Extra credit sudoku-solver problem up soon!
Revisit arrays
public boolean majorityOld(Infant[] kiddo, int a) {
    // are strict majority in array older than age a?

    int old = 0; int young = 0;
    for (Infant k : kiddo) {
        if (k.getAge() > a) {
            old++; young++;
        } else young++;
    }
    return (old > young);
}
Topics for today:
Some more ambitious programs

Inverse Manhattan Problem
Word Frequency
Eratosthenes- Sieve for primes
The Manhattan Island problem

According to legend, the Indians who were living on Manhattan Island in 1626 sold the island to Dutch settlers for $24 worth of junk jewelry.

However, compound interest being what it is, $24 invested at - say 5% for 380 years - will generate a substantial sum of money.

The Inverse Manhattan problem: If the Island today is worth - let’s say - one trillion dollars, at what rate should the aboriginal peoples have invested so that they could buy back the island today?
public class CompoundInterest{

private double rate;
private double amount;
private double fee = 0.0; // yearly fee
private int years;
final double tolerance = 100.00; // for findRate

public double getAmount(){ return amount; } 
public double getFee(){ return fee; } 
public double getRate(){return rate; }

public void setFee(double fee){this.fee = fee; }
}
public CompoundInterest(double r, double start, int years){
    amount = start; rate = r;
    this.years = years;
}

public CompoundInterest(double r, double start, int years, double fee){
    amount = start;
    rate = r;
    this.fee = fee;
    this.years = years;
}

public CompoundInterest(){
    amount = 0.0;
    rate = 0.0;
    years = 0;
}
public double calcAmt()
{
    double amt = amount;
    for(int y = 0; y < years; y++)
        amt = (1 + rate)*amt - fee;
    return(amt);
}

public double calcAmt(double someAmt, int ys, double r)
{
    double amt = someAmt;
    for(int y = 0; y < ys; y++)
        amt = (1 + r)*amt - fee;
    return(amt);
}
The inverse Manhattan problem: 
Given a start amount, a target amount, a number of years -

What interest rate gets you from start to target?

For example: $10K -> $28K, 9 years
First panel: spread of 10% between mid and high
Second panel: spread of 5% between low and mid
Next try: 12.5%
public double findRate(double amt, double target, int years) {
    double low = 0.0;
    double high = findUpBound(amt, target, years);
    double mid = (high + low) / 2; // mid: middle rate
    double curRate = mid;
    double curAmt = calcAmt(amt, years, mid);
    while (Math.abs(curAmt - target) > tolerance) {
        System.out.println("current middle rate: " + mid);
        if (curAmt > target) {
            high = mid;
            mid = (mid + low) / 2;
        } else {
            low = mid;
            mid = (mid + high) / 2;
        }
        curAmt = calcAmt(amt, years, mid);
    } // end loop
    return mid;
}
public double findUpBound(
    double amt, double target, int years){
    final double increment = .10;
    // guess, up by 10% each yr
    double rate = increment;
    while(calcAmt(amt,years,rerate) < target){
        rate = rate + increment;
    } // loop
    return rate;
}
import java.util.Scanner;

public class CompoundTester2{

    public static void main(String[] args){
        Scanner scan = new Scanner(System.in);
        System.out.println("Enter a starting amount");
        double amt = scan.nextDouble();
        System.out.println("Enter target");
        double target = scan.nextDouble();
        System.out.println("Enter number of years");
        int years = scan.nextInt();
        CompoundInterest c = new CompoundInterest();
        double rate = c.findRate(amt,target,years);
        System.out.printf("rate required$%4.2f", rate);
    }
}
As text indicates:
$24
380 years
Target of one trillion dollars:
rate required: 0.0665 (6.65%)
Another application -
A simple word frequency program
Reads in multiple lines of text (end with empty line: 2<CR>s)

Break the lines into words (tokens)
Store words in an array, keeping track of word multiplicities

Five participating classes
StringTokenizer heads up..

Turns

“now is the time for all, all”

Into

now

is

the

time

for

all, [what about that pesky comma??] all
| the 4 | fox 1 | .................. | good 2 |

WordData objects in array in WordStore
Design -

• Get the data (driver)
• Process the data (driver, WordStore class)
• Report results (done in driver, work in WordStore)
import java.util.*;
public class WordDriver{
    public static void main(String[] args){
        WordStore store = new WordStore();
        Scanner scan = new Scanner(System.in);
        StringTokenizer str;
        String t = " "; String s;
        System.out.println("Enter lines, two returns to end");
        while(t.length() > 0){
            t = scan.nextLine(); // read next line
            t = t.toLowerCase(); // convert line to all lower case
            str = new StringTokenizer(t,"\t\n\r\f,.?!;: ");
            while(str.hasMoreTokens()){
                s = str.nextToken();
                store.updateWords(s); }
        }
        store.wordReport(); } }
public class WordData{
    private String word;
    private int count;
    public WordData(String w){
        word = w;
        count = 1; }

    public String getWord(){ return word; }
    public int getCount(){return count;}

    public void incCount(){count++;}
    public String toString(){
        return(word + " ---- " + count);
    }
}
public class WordStore{
final int LAST_WORD = 100;
private WordData[] words = 
    new WordData[LAST_WORD];
private int lastEmpty = 0;

public void updateWords(String w){
    int where = -1;  // -1 means: word not yet found
    where = findWord(w);
    if (where >= 0) words[where].incCount();
    else addWord(w);
}
public int findWord(String w){
    int ans = -1;
    for(int j=0; j < lastEmpty; j++){
        if (w.equals(words[j].getWord())){
            ans = j;
            break;
        }
    }
    return ans;
}

Why w.equals?? (why not ==)??
> String d1 = "dog";
> String d2 = "dog";
> d1 == d2
false  [cell model !!!]

BUT

> d1.equals(d2)
true

The sad truth - write your own equals
public void addWord(String w){
    if (lastEmpty == LAST_WORD)
        System.out.println("store full "+w+" not added");
    else{
        words[lastEmpty] = new WordData(w);
        lastEmpty++;
    }
}

public void wordReport(){
    for(int j = 0; j < lastEmpty; j++)
        System.out.println(words[j].toString());
}
The StringTokenizer class (in java.util)

It takes a String, chops it up into pieces - tokens

We would like to look at

Now is the time, comrades!

And get back, in succession

Now.. is.. the.. time, .. comrades!

or

Now.. is.. the.. time .. comrades
StringTokenizer does this for us.

Two key constructors, Two key methods:

If `str` is a StringTokenizer (associated with a particular String), then these methods:

- `hasMoreTokens()`
- `nextToken()`

will do the job

```java
while (str.hasMoreTokens()){
    System.out.println(str.nextToken());
}
```
import java.util.StringTokenizer;

public class TokenizerTest{
    public static void main(String[] args){
        StringTokenizer str;
        Scanner scan = new Scanner(System.in);
        System.out.println("enter a line of text");
        String s = scan.nextLine();
        str = new StringTokenizer(s);
        while (str.hasMoreTokens()){
            System.out.println(str.nextToken());
        }
    }
}
enter a line of text
now, yes now is the time!

now,
yes
now
is
the
time!
import java.util.*;
public class TokenizerTest{
    public static void main(String[] args){
        StringTokenizer str;
        Scanner scan = new Scanner(System.in);
        System.out.println("enter a line of text");
        String s = scan.nextLine();
        str = new StringTokenizer(s,", .");
        while (str.hasMoreTokens()){  
            System.out.println(str.nextToken());
        }
    }
}

The crucial line: notice 2nd argument
now, yes now is the time!

So StringTokenizer treats “,” as a sort of white space, but not “!”
So what’s a prime number?

2, 11, 13, 17, 19 - NO proper divisors

6, 15, 21, 51 (= 3×17!) are not primes

Old concept - Eratosthenes (275-195 BC) came up with a **Sieve** method for finding primes up to some number n.
Basic Idea of implementation:
An array of booleans.
“true” at cell j means: “ j is not a multiple of any earlier number”

Initially array is all true

First pass: all multiples of 2 (e.g. 4, 6, 8, …) set to false
Then: all multiples of 3 (e.g. 6, 9, 12, …) set to false (why 3: it’s first true after 2)

Then: 5 (skip 4: it’s already false-> mult of 2)
// we'll do primes < 100
public class SieveTester {
    public static void main(String[] args) {
        Sieve s = new Sieve(100);
        s.init(); // initialize row of numbers
        s.process(); // run sieve process
        s.report(); // report primes
    }
}
public class Sieve {
    int top;
    boolean[] nums;
    public Sieve(int cap){
        top = cap;
    }
    public void init(){
        nums = new boolean[top];
        for(int j = 0; j < top; j++) nums[j] = true;
    }
    // Note- sieve (array) size decided at run-time
public void process()
{
    for (int j = 2; j < top; j++)
        if (nums[j] == true) killMultiples(j);
}

public void report()
{
    for (int j = 2; j < top; j++)
    {
        if (nums[j]) System.out.println(j);
    }
}

public void killMultiples(int k)  // kills 2*k, 3*k etc
{
    for (int mult = 2; mult*k < top; j++)
    {
        nums[mult*k] = false;
    }
}