CS 121 – Intro to Programming:Java - Lecture 8

Announcements

Diffy mini-project due Wed morning

Opoly game due Wed afternoon

Arrays homework due Friday

For next week: read ch 9!

Thoughts on exam, rest of term (exam avg: 75)
Last week and into this week we’ve been looking closely at an important statement-level structure in Java - the array.

Let’ just revisit for a moment the final example we considered last time:
public boolean majorityOld(Infant[] kiddo, int a){
    // are strict majority in array older than age a?
    int old = 0;
    for(int j = 0; j < kiddo.length; j++){
        if (kiddo[j].getAge() > a)
            old++;
        else old--;
    }
    return (old > 0);
}

Alternative ending:
    if (old > 0) return true; else return false;
This might get used in a School class:

```
isClassOld = mySchool.majorityOld(class3);
```
Topics for today:
Some more ambitious programs

Inverse Manhattan Problem
Dice in pictures (see book)
Word Frequency
Eratosthenes- Sieve for primes
Numerical Palindromes
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 void setFee(double fee){this.fee = fee; }
    public double getRate(){return rate; }
}
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( ) { // calcAmt is overloaded
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,rate) < target){
        rate = rate + increment;
    } // end loop
return rate;
}
import java.util.Scanner; import java.text.DecimalFormat;

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();
        DecimalFormat d = new DecimalFormat("0.0000");
        CompoundInterest c = new CompoundInterest();
        double rate = c.findRate(amt,target,years);
        System.out.println("rate required " + d.format(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\(<\text{CR}>s\))

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

Five participating classes
<table>
<thead>
<tr>
<th>the</th>
<th>fox</th>
<th>.................</th>
<th>good</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

WordData objects in array 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;
}
> 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 + 1) == 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!

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 (= 3x17!) 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

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;
    }
    // Notice 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;
    }
}
Numerical Palindromes

Example: • 152 (no)
  • 152 + 251 = 403 (no)
  • 403 + 304 = 707 (yes)

Example: • 552 (no)
  • 552 + 255 = 807 (no)
  • 807 + 708 = 1515 (no)
  • 1515 + 5151 = 6666 (yes)

196: -> a disaster --- goes on and on…
Write a program that accepts an int input, and repeatedly does this process until a numerical palindrome is found.

Classes? User-defined, library?
PalDriver  NumPal  Scanner
The general process:
Get start number
Make NumPal object
While this NumPal isn’t a palindrome:
    make a new NumPal object
Report final NumPal object (the palindrome)

(note: count iterations; quit at ~10??)
The NumPal class:
What are its attributes?
int n;

String nString;

int rev;

String revString;
Methods:

Constructor: NumPal(int k)

Accessors: getN, getRev, getNString, getRevString

isPal

nextPal

revString

StringToInt

IntToString
The Driver (to be gussied-up)

```java
int n = scan.nextInt();
NumPal p = new NumPal(n);
while(!isPal(p)){
    System.out.println(getNum(p));
    p = nextPal(p);
}
System.out.println(getNum(p));
```
How to cut off loop at 10

```java
int ctr = 0;

while(!isPal(p) && (ctr < 10)){
    System.out.println(getNum(p));
    p = nextPal(p);
    ctr++;
}

System.out.println(getNum(p));
```
> java NumPalDriver
991 reverse-=> 199
new sum: 991 + 199 = 1190
1190 reverse-=> 0911
new sum: 1190 + 911 = 2101
2101 reverse-=> 1012
new sum: 2101 + 1012 = 3113
final value: 3113
number of steps: 3
“Stream of Objects” method

Diffy

NumPal

Opoly