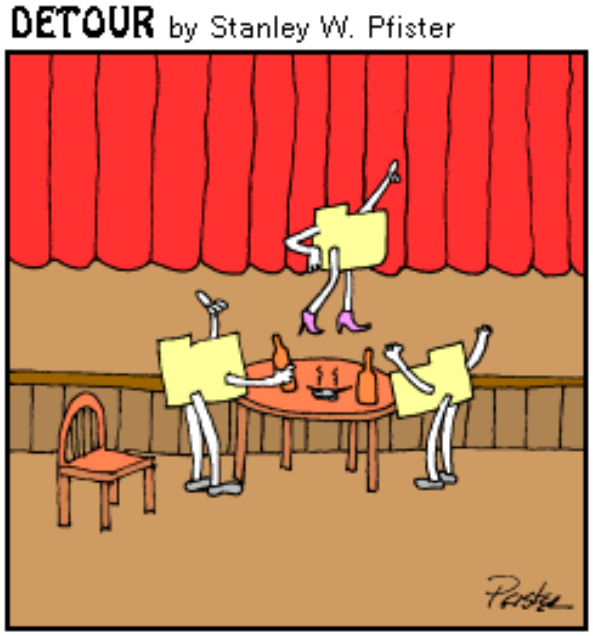
ORF 201

COMPUTER METHODS FOR PROBLEM SOLVING

Lecture 4

Simple Data Structures: Arrays and Classes



When files get corrupted...

A Mortgage Calculator

Given:

n - number of months to pay off a loan
a - loan amount
r - interest rate (monthly)

Compute:

p - monthly mortgage payment
b_i - current balance at the end of each month i

Formula for Payment:

$$p = \frac{ra}{1 - \frac{1}{(1+r)^n}}$$

Formula for Balance Reduction:

$$b_{i+1} = b_i - (p - rb_i)$$

In Java:

```
import myutil.*;
import ccj.*;
public class Mortgage
{
    public static void main(String[] args)
    {
        /*****************************************
        * Declare all variables
        *****************************************/

        int n;          // number of months (30 yrs)
        double amt;     // loan amount
        double r;       // interest rate (for one month)

        int i;          // a month counter
        double p;       // monthly payment
        double xi;      // principal in month i

        /*****************************************
        * Prompt user for data
        *****************************************/

        System.out.print("Enter number of years: ");
        n = Console.in.readInt();
        n *= 12;        // Convert to months

        System.out.print("Enter loan amount: ");
        amt = Console.in.readDouble();

        System.out.print("Enter ann. pct. rate (0.xxx): ");
        r = Console.in.readDouble();
        r /= 12;        // Convert to months
```

In Java - Continued

```
        /*****************************************
        * The formula for payment
        *****************************************/

        p = r*amt/(1-Math.pow(1+r,-n));

        System.out.print("Monthly payment: ");
        System.out.println(Format.floating(9,2,p));
        System.out.println("");

        /*****************************************
        * A loop to print out balances
        *****************************************/

        System.out.println("Balance    Interest  Principal ");
        xi = amt;
        for (i=0; i<n; i++) {
            System.out.print(Format.floating(10,2, xi));
            System.out.print("    ");
            System.out.print(Format.floating(7,2, r*xi));
            System.out.print("    ");
            System.out.println(Format.floating(7,2, p-r*xi));
            xi -= p - r*xi;
        }
        System.out.println(Format.floating(10,2,xi));
    }
}
```

Add Date Info

Classes as Containers

Outside everything, create a new class (it's not public):

```
class Date
{
    int year;
    int month;
    int day;
}
```

Inside **`main()`**, declare a variable **`d`** of type **`Date`**

```
Date d;
d = new Date();
```

Instantiate the variable:

These two lines can be (often are) combined:

```
Date d = new Date();
```

Access the individual data elements using the *dot* operator:

```
d.month = Console.in.readInt();
d.day   = Console.in.readInt();
d.year  = Console.in.readInt();
```

Error Checking

```
if (d.month < 1 || d.month > 12) {
    System.out.println("Invalid starting month");
    return;
}

if (d.day < 1 || d.day > 31) {
    System.out.println("Invalid starting day");
    return;
}

if (d.month==2) {
    if ((d.year%4==0 && d.day>29)||(d.year%4!=0 && d.day >28)){
        System.out.println("Invalid starting day");
        return;
    }
}

if (d.month==4 || d.month==6 || d.month==9 || d.month==11) {
    if (d.day>30){
        System.out.println("Invalid starting day");
        return;
    }
}
```

Update Date

Before balance loop, add a new heading:

This line is new.

```
System.out.print("Date            ");
System.out.println("Balance   Interest   Principal");
```

In update-balance loop, add

```
d.month++;
if (d.month>12) {
    d.month=1;
    d.year++;
}
System.out.print(d.month);
System.out.print("/"+d.day);
System.out.print("/"+d.year);
```

Prettier Dates

`Mar 11, 1998` looks nicer than **`3/11/1998`**.

Associate the *character string* **`Mar`** with the integer **`3`**.

`monthString` is an *array of strings*

`String` is a data type, like **`int`** and **`double`**.

```
String[] monthString = new String[13];
monthString[1]  = "Jan";
monthString[2]  = "Feb";
monthString[3]  = "Mar";
monthString[4]  = "Apr";
monthString[5]  = "May";
monthString[6]  = "Jun";
monthString[7]  = "Jul";
monthString[8]  = "Aug";
monthString[9]  = "Sep";
monthString[10] = "Oct";
monthString[11] = "Nov";
monthString[12] = "Dec";
```

Array indexing begins with 0, hence we need an array of size 13.

Change the output statements in the balance loop to:

```
System.out.print(monthString[d.month]);
System.out.print(" "+d.day);
System.out.print(", "+d.year);
```

Run It

```
java Mortgage
Enter number of years:  30
Enter loan amount:  200000
Enter annual percentage rate (0.xx):  0.065
Enter starting date…
  Enter Month (1-12):  6
  Enter Day (1-31):  1
  Enter Year:  1998
Monthly payment:    1264.14

Date           Balance       Interest      Principal
Jul 1, 1998    200000.0      1083.33        180.8
Aug 1, 1998    199819.2      1082.35        181.78
Sep 1, 1998    199637.42     1081.37        182.77
Oct 1, 1998    199454.65     1080.38        183.76
Nov 1, 1998    199270.89     1079.38        185.75
     .
     .
     .
Jan 1, 2028      7443.07       40.32        1223.82
Feb 1, 2028      6219.25       33.69        1230.45
Mar 1, 2028      4988.8        27.02        1237.11
Apr 1, 2028      3751.69       20.32        1243.81
May 1, 2028      2507.88       13.58        1250.55
Jun 1, 2028      1257.33        6.81        1257.33
       0.0
```