ICE for Week 6

Problem 1

Write a function ***sumsteps2*** that calculates and returns the sum of 1 to n in steps of 2, where n is an argument passed to the function. For example, if 11 is passed, it will return 1 + 3 + 5 + 7 + 9 + 11. Do this using a **for** loop. Calling the function will look like this:

```
>> sumsteps2(11)
ans =
  36
```

Problem 2

Write a function called ***geomser*** that will receive values of r and n, and will calculate and return the sum of the geometric series:

$$1 + r + r^2 + r^3 + r^4 + \ldots + r^n$$

The following examples of calls to this function illustrate what the result should be:

```
>> geomser(1,5)
ans =
     6
>> disp(geomser(2,4))
     31
```

Problem 3

Create a 1×6 vector of random integers, each in the range from 1 to 20. Use built-in functions to find the minimum and maximum values in the vector. Also create a vector of cumulative sums using **cumsum**.

Problem 4

Write a program to compute the sum of the series $1^2 + 2^2 + 3^2 \ldots$ such that the sum is as large as possible without exceeding 1000. The program should display how many terms are used in the sum.

Problem 5

Use the Taylor series:

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots$$

to write a program to compute $\cos x$ correct to four decimal places (x is in radians). See how many terms are needed to get four-figure agreement with the MATLAB function cos. Don't make x too large; that could cause rounding error.

Problem 6

A person deposits $1000 in a bank. Interest is compounded monthly at the rate of 1% per month. Write a program which will compute the monthly balance, but write it only *annually* for 10 years (use nested `for` loops, with the outer loop for 10 years, and the inner loop for 12 months). Note that after 10 years, the balance is $3300.39, whereas if interest had been compounded annually at the rate of 12% per year the balance would only have been $3105.85. See if you can vectorize your solution.

Problem 7

A student borrows $10,000 to buy a used car. Interest on her loan is compounded at the rate of 2% per month while the outstanding balance of the loan is more than $5000, and at 1% per month otherwise. She pays back $300 every month, except for the last month, when the repay ment must be less than $300. She pays at the end of the month, *after* the interest on the balance has been compounded. The first repayment is made 1 month after the loan is paid out. Write a program which displays a monthly statement of the balance (after the monthly payment has been made), the final payment, and the month of the final payment.

Problem 8

A projectile, the equations of motion of which are given in Chapter 3, is launched from the point O with an initial velocity of 60 m/s at an angle of 50° to the horizontal. Write a program which computes and displays the time in the air, and horizontal and vertical displacement from the point O every 0.5 s, as long as the projectile remains above a horizontal plane through O.

Problem 9

When a resistor (R), capacitor (C), and battery (V) are connected in series, a charge Q builds up on the capacitor according to the formula:

$$Q(t) = CV(1 - e^{-t/RC})$$

if there is no charge on the capacitor at time $t=0$. The problem is to monitor the charge on the capacitor every 0.1 s in order to detect when it reaches a level of 8 units of charge, given that $V=9$, $R=4$, and $C=1$. Write a program which displays the time and charge every 0.1 s until the charge first exceeds 8 units (i.e., the last charge displayed must exceed 8). Once you have done this, rewrite the program to display the charge only while it is strictly less than 8 units.

Problem 10

A sound engineer has recorded a sound signal from a microphone. The sound signal was sampled, meaning that values at discrete intervals were recorded (rather than a continuous sound signal). The units of each data sample are volts. The microphone was not on at all times, however, so that data samples below a certain threshold are considered to be data values that were samples when the microphone was not on, and therefore not valid data samples. The sound engineer would like to know the average voltage of the sound signal. Write a script that will ask the user for the threshold and the number of data samples, and then for the individual data samples. The program will then print the average and a count of the valid data samples, or an error message if there were no valid data samples. An example of what the input and output would look like in the Command Window is shown:

```
Please enter the threshold below which samples will be
considered to be invalid:
3.0
Please enter the number of data samples to be entered:
7

Please enter a data sample: 0.4
Please enter a data sample: 5.5
Please enter a data sample: 5.0
Please enter a data sample: 2.1
Please enter a data sample: 6.2
Please enter a data sample: 0.3
Please enter a data sample: 5.4

The average of the 4 valid data samples is 5.53 volts.
```

Note: If there had been no valid data samples, the program would print an error message instead of the last line shown.

Problem 11

Create a vector of five random integers, each in the range from –10 to 10. Perform each of the following two ways: using built-in functions, and also using loops (with **if** statements if necessary):

- Subtract 3 from each element.
- Count how many are positive.
- Get the absolute value of each element.
- Find the maximum.

Problem 12

Create a 3×5 matrix. Perform each of the following two ways: using built-in functions, and also using loops (with **if** statements if necessary):

- Find the maximum value in each column.
- Find the maximum value in each row.
- Find the maximum value in the entire matrix.

Problem 13

Write a script that will print the following multiplication table:

```
1
2   4
3   6   9
4   8  12  16
5  10  15  20  25
```

Problem 14

The Wind Chill Factor (WCF) measures how cold it feels with a given air temperature T (in degrees Fahrenheit) and wind speed (V, in miles per hour). One formula for it is

$$WCF = 35.7 + 0.6T - 35.7(V^{0.16}) + 0.43T(V^{0.16})$$

Write a function to receive the temperature and wind speed as input arguments, and return the WCF. Using loops, print a table showing wind chill factors for temperatures ranging from –20 to 55 in steps of 5, and wind speeds ranging from 0 to 55 in steps of 5. Call the function to calculate each wind speed.

Problem 15

A vector *v* stores for several employees of the Green Fuel Cells Corporation their hours worked one week followed for each by the hourly pay rate. For example, if the variable stores

```
>> v
v =
    33.0000 10.5000 40.0000 18.0000 20.0000 7.5000
```

that means the first employee worked 33 hours at $10.50 per hour, the second worked 40 hours at $18 an hour, and so on. Write code that will separate this into two vectors, one that stores the hours worked and another that stores the hourly rates. Then, use the array multiplication operator to create a vector, storing in the new vector the total pay for every employee.

Problem 16

The mathematician Euler proved the following:

$$\frac{\pi^2}{6} = 1 + \frac{1}{4} + \frac{1}{9} + \frac{1}{16} + \ldots$$

Rather than finding a mathematical proof for this, try to verify whether the conjecture seems to be true or not. Note: There are two basic ways to approach this: either choose a number of terms to add, or loop until the sum is close to $\pi^2/6$.

Problem 17

Write a script *echoletters* that will prompt the user for letters of the alphabet and echo-print them until the user enters a character that is not a letter of the alphabet. At that point, the script will print the nonletter, and a count of how many letters were entered. Here are examples of running this script:

```
>> echoletters
Enter a letter: T
Thanks, you entered a T
Enter a letter: a
Thanks, you entered a a
Enter a letter: 8
8 is not a letter
You entered 2 letters
```

```
>> echoletters
Enter a letter: !
! is not a letter
You entered 0 letters
```

The format must be exactly as shown.

Problem 18

Write a script called *prtemps* that will prompt the user for a maximum Celsius value in the range from –16 to 20; error-check to make sure it's in that range. Then, print a table showing degrees F and degrees C until this maximum is reached. The first value that exceeds the maximum should not be printed. The table should start at 0 degrees F, and increment by 5 degrees F until the max (in C) is reached. Both temperatures should be printed with a field width of 6 and one decimal place. The formula is C = 5/9 (F – 32). For example, the execution of the script might look like this (the format should be exactly like this):

```
>> prtemps
When prompted, enter a temp in degrees C in range –16
to 20.
Enter a maximum temp: 30
Error! Enter a maximum temp: 9

  F             C
  0.0       –17.8
  5.0       –15.0
 10.0       –12.2
 15.0        –9.4
 20.0        –6.7
 25.0        –3.9
 30.0        –1.1
 35.0         1.7
 40.0         4.4
 45.0         7.2
```