CS 145: Scientific Programming

Review problems for Exam 2

1. Write code to determine the smallest number which is divisible by 11 and 19 whose square is greater than 100000000.

2. Suppose for the following problems that $x = -3$ and $y = [-4, 7, 1, 8, -2, 0]$. Give the output of the following matlab commands:

   (a) 8-12 | 6 + 6 / 2 & 2

   (b) $-5 < x < -1$

   (c) $y < 0$

   (d) $y(y < 6)$

3. The monthly payment M of a loan of amount P for N years and an annual interest rate r percent can be calcuated by the formula:

$$M = P\left(\frac{\frac{r}{100}}{1-(1+\frac{r}{1200})^{-N}}\right)$$

   Write a MATLAB function that calculates the monthly payment of a loan. For the function name and arguments, use M = amort(P,r,N), where P is the loan amount, r is the annual interest rate, N is the length of years in the loan, and M is the amount of a monthly payment.

4. Consider a vector x. Write a script which computes the average value in the array and then calculates how many of the values in x are less than or equal to that average value.

5. (a) Recall that if (x, y) is the Cartesian coordinates of a point in the plane, the polar coordinates of the same point are (r, θ), where $r^2 = x^2 + y^2$ and $\tan\theta = y/x$. Write a script to determine the polar coordinates of a point from the Cartesian coordinates. For the function name and arguments use [theta radius] = CartesianToPolar(x,y).

   (b) Write a script which calculates the polar coordinates for the points $(15, 3)$ and $(-4, 2)$.

6. Write code to plot the polynomial $2x^2 - 6x + 2$ and its derivative in the range $[-10, 10]$.

7. Suppose that a sequence of numbers $a_1, a_2, \ldots$ if defined as follows:

$$\begin{aligned} a_1 &= 5 \\ a_n &= 2a_{n-1} + 1 \text{ if } a_n \text{ is a multiple of 4} \\ a_n &= a_{n-1} + 1 \text{ if } a_n \text{ is not a multiple of 4} \end{aligned}$$

   Write code to calculate the first 100 values of the sequence.

8. Write a function that takes an array and calculates the standard deviation of its values. The standard deviation can be calculated using the following formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{N}(x_i - \bar{x})^2}{N}}$$

   where $\bar{x} = \frac{1}{N}\sum_{i=1}^{N} x_i$ is the average of the values.

9. Rewrite the following statement using a for loop:

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a(2:n-1) = b(1:n-2) + c(2:n-1) .* d(3:n);
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