

BMEEn 2401 – Programming for Biomedical Engineers – Problem Set 1

Due Tuesday, 11 September 2018

A1. (10 – 2 pts each) My kids play a game called 24, in which one flips over four playing cards (A-10) and, using only addition, subtraction, multiplication, division, and parentheses, one must use the four numbers to make 24. For example, 4,5,6,9 could be $4+5+6+9 = 24$, and 1,1,4,8 could be $(1+1)*(4+8) = 24$ or $1*(4-1)*8 = 24$. For the following sets of numbers, write an appropriate expression *in appropriate Matlab format*. I recommend that you type your expression into Matlab to be sure that it is correct.

a. 1,2,3,4 b. 2,4,6,8 c. 1,3,5,7 d. 3,3,3,3 e. 4,4,4,4

(Zero-point bonus: a friend of mine says that 3,3,7,7 and 1,3,4,6 are the hardest sets, in case you want more of a challenge.)

A2. (40 – 5 points each). What are the values of x and y at the end of each of these scripts? You are welcome to type them into Matlab and see, or you can work it out. Either way is fine.

a. `x = 5;`
`y = 4;`
`x = x - y;`

b. `x = 5;`
`x = 4;`
`x = x - x;`

c. `x = 1;`
`y = 2;`
`x = x + y;`
`x = x - y;`
`x = x * y;`
`x = x / y;`

d. `x = 1;`
`y = 2;`
`x = x + y;`
`y = x - y;`
`x = x * y;`
`y = x / y;`

e. `x = 1;`
`y = 2;`
`z = x;`
`x = y;`
`y = z;`

- f. $x = 125;$
 $y = 25;$
 $y = \log(x*y)/\log(x/y);$
 $x = \sqrt{x/y};$
- g. $x = \pi/2;$
 $y = \pi/3;$
 $x = \sin(x)*\cos(y) + \cos(x)*\sin(y);$
 $y = (\tan(x*\pi + y))^2;$
- h. $x = \pi/3;$
 $y = \pi/2;$
 $x = \sin(\text{abs}(x-y)) / \tan(x-y) / \cos(x-y);$
 $y = \sqrt{x};$

A3. (50 - 10 points each). For each of the following calculations, the given script contains three errors. Identify and correct the errors, and record the outcome of the script when executed.

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| a | The line $y = 3x$ and the curve $y = x^2 - 10$ intersect at two points, which we will call (x_1, y_1) and (x_2, y_2) . Find the distance d between two points. (HINT: You know that $3x = x^2 - 10$ at each point.) | $x1 = (3 + \sqrt{3^2 - 4*1*(-10)})/(2*1);$ $y1 = 3 * x1;$ $x1 = (3 - \sqrt{3^2 - 4*1*(-10)})/(2*1);$ $y2 = 3 * x2;$ $d = \sqrt{(x1-x2)^2 + y2-y1^2};$ |
| b | For any positive number k , if one guesses a_0 as a possible square root of k , then updates according to the recurrence formula $a_{j+1} = 0.5(a_j + k/a_j)$, the sequence should eventually converge to a good estimate of \sqrt{k} . For $k = 5$ and $a_0 = 2$, calculate a_4 and calculate the absolute error $ a_4 - \sqrt{k} $. | $k = 5;$ $a0 = 2;$ $a1 = 0.5(a0 + k/a0);$ $a2 = 0.5 * (a1 + k / a1);$ $a3 = 0.5 * (a1 + k / a2);$ $a4 = 0.5 * (a3 + k / a3);$ $E = \text{abs}(a4 - \sqrt{a0});$ |
| c | <p>If a triangle has sides a, b, and c and semiperimeter $s = (a+b+c)/2$, then the area of the triangle is given by the formula</p> $A = \sqrt{s(s-a)(s-b)(s-c)}$ <p>what is the area of a triangle with sides 8, 17, and 22?</p> | $a = 8;$ $b = 17;$ $c = 22;$ $s = (A + b + c) * 2;$ $A = \sqrt{s(s-a)*(s-b)*(s-c)};$ |
| d | The radius of the circle circumscribed around a triangle is given by the product of all three sides abc divided by the quantity given by four times the triangle's area. If a triangle has sides 8, 17, and 22, what percentage of the area of the circumscribed circle does it cover? <i>The script at right is designed to run after the script for part c has run correctly.</i> | $R = a*b*c/4*A;$ $\text{pct} = a / (\pi * R^2);$ $\text{pct} = \text{pct} / 100;$ |

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| e | <p>The cross product of the vector $v_1 = [x_1 \ y_1 \ z_1]^T$ and vector $v_2 = [x_2 \ y_2 \ z_2]^T$ is given by</p> $v_1 \times v_2 = \begin{bmatrix} y_1 z_2 - y_2 z_1 \\ z_1 x_2 - z_2 x_1 \\ x_1 y_2 - x_2 y_1 \end{bmatrix}$ <p>and the area of a triangle defined by three points (x_a, y_a, z_a), (x_b, y_b, z_b), and (x_c, y_c, z_c) is given by one half the magnitude of the cross product of the vector pointing from a to b and the vector pointing from a to c. Suppose that a triangle has vertices at (0,0,0), (1,1,1), and (1,-1,2). What is the area of the triangle?</p> <p>Note: Anything from a % sign on is ignored by Matlab and exists only as a comment for the user. There are no errors in any comments.</p> | <pre>% Define vectors x1 = 1; y1 = 1; z1 = 1; x2 = 1; y2 = -1; z2 = 2; % Calculate cross product c1 = (y1 * z2 - y2 * z1); c2 = z1 * x2 - z2 * y1; c3 = x1 * y2 - y1 * x2; % Calculate area A = 0.5 * SQRT (c1^2 + c2^2 + c3^2);</pre> |
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