ECE 270 Computer Methods in ECE

Assignment #1: Math Review

August 28, 2022 / Instructor: Paul Watta

Please do a mathematical analysis for each of these problems. The problem here is to refresh your math, as well as practice your technical writing with Latex. The aim is to create a beautiful piece of technical writing.

Before starting, please read the materials posted in the *Getting Started* Module under the *Technical Writing* heading.

1. **Distance**. (a) How do you compute the distance between two points (x_1, y_1) and (x_2, y_2)? Distance formula

(b) How do you compute the midpoint between two points? Midpoint formula

(c) Given two circles with centers (cx_1, cy_1) and (cx_2, cy_2) and radii r_1 and r_2, draw a picture and label relevant quantities

(d) Write an expression for the distance d between the circle centers

(e) Under what conditions do the two circles intersect?

Note: Remember the condition in (e), as we will make use of it several times this semester!

2. **Quadratic Equation**. For the quadratic equation: $ax^2 + bx + c = 0$

(a) Write an expression for the general solutions: x_1 and x_2. Note: $x_{1,2}$ is not allowed here!

(b) Write an expression for the discriminant: d

(c) Use the discriminant to break the solution into 3 cases: (*i*) repeated roots (*ii*) real distinct roots and (*iii*) complex roots. Write an expression for x_1 and x_2 in each case.

3. **Polar Coordinates**. (a) Given a rectangular coordinate point (x, y), how do you compute the equivalent polar coordinates: (r, θ)?

(b) Given a polar coordinate (r, θ), how do you compute the equivalent rectangular coordinate: (x, y)?

(c) Suppose we are interested in the coordinates of the two sets of circles (yellow and blue) shown in Figure 1.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

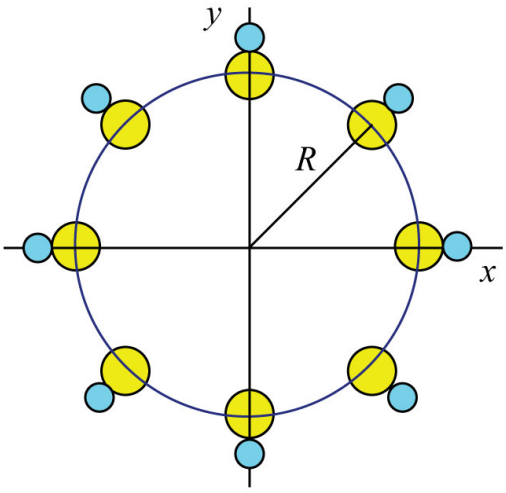

Figure 1. A circle of circles.

Create a table of the form shown below which shows the relevant angles in radians, as well as the coordinates of the two circles. In your expressions for x and y, write in terms of the symbolic theta and not the theta in radians.

Angle		Yellow Circles		Blue Circles	
θ (sym)	θ (rad)	x	y	x	y
θ_0					
θ_1					
θ_2					
θ_3					
θ_4					
θ_5					
θ_6					
θ_7					

(d) What if the circle is centered at the point (cx, cy) (and not the origin). How does the formula change?

4. **Complex Numbers**. Given a complex number $z = a + ib$

(a) Show a picture of z in the plane. Label a, b and $|z|$

(b) Compute the magnitude: $|z|$

(c) Given $z = a + ib$, show how to put in polar form: $z = |z|e^{i\theta}$ and vice-versa.

(d) Compute the complex conjugate: z^*

Given two complex numbers z_1 and z_2

(e) Compute the sum: $z = z_1 + z_2$

(f) Compute the product: $z = z_1 z_2$

(g) Show that $z^* z = |z|^2$

5. **You Choose**. Formulate and solve a math / physics / engineering problem of your choosing. Choose a problem that requires some math analysis. **Do not** formulate a simple plug-and-chug problem; for example:

Problem: Using $V = IR$, compute V if $I = 2$ A and $R = 100\Omega$.

Come up with something more involved and creative than that!

Note

Please do your solution write-up using LaTex (using the given template posted on Canvas). You do not need the Code section for this assignment. Use separate sections for each problem.

Upload to Canvas both the source LaTex folder (.zip), as well as the rendered pdf.

Please read and adhere to: Guidelines for Technical Writing

Due: Friday September 9, 2022