

Math 229 Calculus Computer Lab Spring 15 Midterm 2b

Name: Solutions

- I will count your best 5 of the following 6 questions.
- You may only use julia during this exam. No calculators or cell phones or notes.

1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
	50	

Midterm 1	
Overall	

(1) Convert the following julia expressions to standard mathematical expressions. Use parentheses to clearly indicate the order of operations:

(a) $a+b/(a-c)$

$$a + \frac{b}{a-c}$$

(b) $x+z/2y-3$

$$x + \frac{z}{2y} - 3$$

	10	1
	10	2
	10	3
	10	4
	10	5
	10	6
	10	7
	10	8
	10	9
	10	0

(c) $\tan(x)^2/x/e^{2x*x}$

$$\frac{\tan^2(x) x}{x e^{2x}}$$

	10	1
	10	2
	10	3
	10	4
	10	5
	10	6
	10	7
	10	8
	10	9
	10	0

- (2) Is e^{-x^2} equal to $e^{(x^2)}$ or $(e^x)^2$? Write julia commands which show your answer is correct.

$$e^{-x^2} = e^{(x^2)}$$

$$e^{-\frac{1}{2}} = 2.718 \dots$$

$$e^{-1^2} = 2.718 \dots$$

$$(e^{-1})^2 = 7.389 \dots$$



$$f(x) = (x+1)^2$$

graph doesn't cross x-axis
 function has no interval where
 outputs were values with different signs

(3) Write julia commands to find the zeros of $f(x) = x^2 + 2x + 1$ using

(a) roots

using Roots
 $f(x) = x^2 + 2x + 1$

roots(f)
 -1.0
 -1.0

(b) fzeros

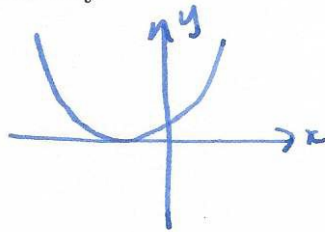
fzeros(f)
 -1.0

(c) The bisection method fzero

fzero(f, -10, 10)

The last one doesn't work - explain why.

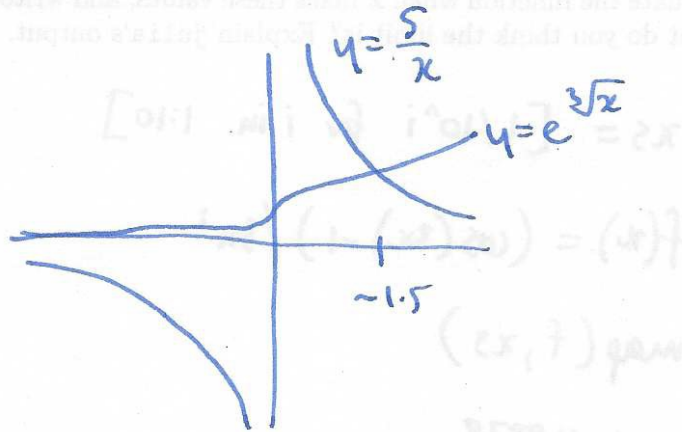
$f(x) = (x+1)^2$



graph doesn't cross x-axis,
 bisection needs an interval where
 endpoints have values with different signs.

(4) Consider the equation $e^{\sqrt[3]{x}} = 5/x$.

(a) Show there is a solution by plotting the graphs of these functions. Sketch the graphs below.



(b) Write julia commands to find a numerical approximation to the solution, and find the solution.

$$f(x) = x^{(x^{(1.0/3)})} - 5/x$$

$$fzero(f, (1, 2))$$

$$1.565\dots$$

(5) You wish to estimate

$$\lim_{x \rightarrow 0} \frac{\cos(3x) - 1}{3x^2}$$

Write julia commands to generate a list of numbers $\{10^{-1}, 10^{-2}, \dots, 10^{-10}\}$. Evaluate the function when x takes these values, and write down your results. What do you think the limit is? Explain julia's output.

$$xs = [1/10^i \text{ for } i \text{ in } 1:10]$$

$$f(x) = (\cos(3x) - 1) / 3x^2$$

$$\text{map}(f, xs)$$

$$-1.48878$$

$$-1.49989$$

$$-1.5$$

$$-1.5$$

$$-1.5$$

$$-1.49999$$

$$-1.4988$$

$$-1.4803$$

$$0.0$$

$$0.0$$

limit is -1.5

$\cos(3x) \rightarrow 1$ as $x \rightarrow 0$, so numerator is difference of two numbers close to 1. As float numbers have finite precision, if $\cos(3x)$ too close to 1, this gives 0.

(6) Find $\lim_{x \rightarrow 0} e^{-2/x^2}$ by any method. Write down the julia commands you use.

using SymPy

$$f(x) = \cancel{e^x} e^{(-2/x^2)}$$

limit(f, 0)

0