

Math 229 Calculus Computer Lab Spring 16 Sample Midterm 2

- You may only use `julia` during this exam. No calculators or cell phones.
- (1) Convert the following `julia` expressions to standard mathematical expressions. Use parentheses to clearly indicate the order of operations:
 - (a) `a+b/(b-1)`
 - (b) `cos(1/2x)^2/2*x`
 - (c) `(y-x)/2z+3`
 - (2) Find the location of the local minima of $f(x) = 1/x + e^{x/3}$ in $[0, \infty)$ to two decimal places.
 - (3) Find all solutions (to 3 decimal places) to the equation $11 \sin(2x) = -5x + 200$. Write down the `julia` command you use.
 - (4) Write `julia` commands to find the zeros of $f(x) = x^2 - 4x + 4$ using
 - (a) `roots`
 - (b) `fzeros`
 - (c) The bisection method `fzero`
The last one doesn't work - explain why.
 - (5) Let $f(x) = \sin(1/x)$.
 - (a) How many solutions to $f(x) = 0$ does `fzeros` find in the interval $[0.05, 1]$?
 - (b) Find all solutions to $f(x) = 0$ by hand. How many solutions are there in the interval $[0.05, 1]$?
 - (6) Consider the equation $e^{x/2} = 3/x$.

- (a) Show there is a solution by plotting the graphs of these functions. List the commands you use.
- (b) Write `julia` commands to find a numerical approximation to the solution, and find the solution.
- (7) In `julia` set `f(x) = x + 1 - x`. Then run `plot(f, -10.0^17, 10.0^7)`. Do you notice anything strange about the output?
- (8) Use `julia` to estimate $\lim_{x \rightarrow 0} \frac{\sin(3x)}{2x \cos(x)}$.
- (9) You wish to estimate

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

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.