Math 229 Calculus Computer Lab Spring 15 Midterm 1a

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.

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\[
x (\frac{1}{x}) = 2
\]

\[
\frac{f}{x^2} - \frac{1}{x}
\]

| Midterm 1 |   |
|------------|
| Overall    |   |

1
(1) Convert the following Julia expressions to standard mathematical expressions. Do not simplify.

(a) \( a + \frac{b}{a-c} \)

\[ \frac{a + \frac{b}{a}}{a} - c \]

(b) \( \cos(x^2)/5x \)

\[ \frac{\cos(x^2)x}{5} \]

(c) \( (a-1/(a+b))/(c-b) \)

\[ a - \frac{1}{a+b} \]

\[ \frac{c-b}{a+b} \]
(2) Convert each of the following expressions to its julia equivalent:

(a) \( \frac{a + c}{b - c} \)

\[ \frac{(a+c)}{(b-c)} \]

(b) \( \frac{1}{x + \frac{y}{z+1}} \)

\[ \frac{1}{(x + y(\frac{z+1}{z+1}))} \]

(c) \( \frac{\sin^2(2x)}{2} + \frac{e^{\sqrt{x}}}{3} \)

\[ \frac{(\sin(2x)^2)}{2} + \left(\frac{e^{\sqrt{x}}}{3}\right) \]
(3) You want to compute a decimal approximate to $1/\sqrt{5}$. Explain what the following Julia commands compute, or why they give an error.

(a) $1/5^{1/2}$

order of operations: \( (5^1) = 5 \)

\[
1/5^{1/2} = \frac{1}{\frac{5}{2}} = \frac{1}{\frac{5}{2}} = \frac{1}{1.25} = 0.8
\]

(b) $1/(5^{1/2})$

order of operations: \( 5^1 = 5 \)

\[
1/(5^{1/2}) = \frac{1}{\sqrt{5}} = 0.4
\]

(c) $1/sqrt(5^{(-1)})$

error: \( 5 \) is an integer type, can't take it to a negative power.

Write down a Julia command which produces a decimal approximate to $1/\sqrt{5}$. Explain how to check your result.

\[
1/sqrt(5) \text{ or } 5^{(-0.5)}
\]

check: multiply answer by itself and take reciprocal
(4) Plot the function \( f(x) = \frac{\sin(10x)}{e^x} \) on the interval \((\pi, 5)\).

(a) Sketch the graph.

(b) What is the number of local minima for the function? (Exclude endpoints)

3.
(5) Write down Julia commands to define two functions $f(x) = \frac{1 + 2x}{3}$ and $g(x) = \sin^2(\frac{1}{2x})$, and compute $f(g(1))$.

$$f(x) = \frac{1 + 2x}{3}$$

$$g(x) = \sin^2 \left( \frac{1}{2x} \right)$$

$$f(g(1)) = 0.48656...$$
(6) Write down Julia commands to define a function $f(x)$ which has value 1 for $1 \leq x \leq 3$ and 0 for other values of $x$, and plot its graph to check you are correct.

```julia
function f(x)
    if 1 <= x <= 3
        return 1
    else
        return 0
    end
end
```

$$f(x) = \begin{cases} 
1 & 1 \leq x \leq 3 \\
0 & \text{otherwise}
\end{cases}$$