Math 253N ASSIGNMENT 21 **Due at the start of class Monday, June 5th**

We can define the hyperbolic sine and hyperbolic cosine, denoted as $\sinh$ and $\cosh$, as follows:

$$\sinh x = \frac{e^x - e^{-x}}{2} \qquad \text{and} \qquad \cosh x = \frac{e^x + e^{-x}}{2}. \tag{1}$$

1. Use substitution into the series for e^x to determine the series for e^{-x}. Give your answer in summation form.
2. Use the series for e^x and e^{-x} to find a series representing $\sinh(x)$, again giving your answer in summation form. You might find it easiest to think of $\sinh x$ as $\frac{1}{2}(e^x - e^{-x})$.
3. Find a series representing $\cosh x$, giving your answer in summation form.
4. Using your series from Exercise 2, find the derivative of $\sinh x$. What other function is it?
5. Find the derivative of $\cosh x$ using definition (1). What is it?
6. Using definition 1, find $\cosh^2 x - \sinh^2 x = (\cosh x)^2 - (\sinh x)^2$. You will have to do some "FOILing!".
7. Using your series from Exercise 3, find $\cosh(ix)$, where $i^2 = -1$.

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