MA/CS 321:001 Instructor: Russell Brown
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In the syllabus, the first exam is scheduled for Friday, 1 October 2004. This is also the date of our fall break. The exam will be rescheduled for Wednesday, 29 September.
As I mentioned in class, a listserv is maintained for this class by the University. Messages sent to ma321-001@lsv.uky.edu will be distributed to most of the class. For those who are not on this listserv, you may read the archives at
http://lsv.uky.edu/archives/ma321-001.html. If you ask a question about homework that might be of interest to other class members, I will circulate the answer to the class. If you would like more information about this service (source of spam?), you may visit
http://lsv.uky.edu.
The following exercises are due on Monday, 13 September 2004.
The example files can be found at www.math.uky.edu/∼rbrown/courses/ma321.f.04

1. (a) Find the distance ϵ between 1 and the next largest machine number by running the m-file `epsilon.m`.

   Use this value of ϵ and the `log2` function in matlab to estimate the number of binary digits that your machine uses.

   (b) Using the function `myexp` as an example, write a function that approximates $\sin x$ using Taylor polynomials.

   To understand the function `myexp`, you might find it helpful to read about evaluation of polynomials by nested multiplication (see page 2 of the text).

   (c) Use Taylor's theorem with remainder to estimate how many terms of Taylor's series you will need to approximate $\sin x$ for x in $[-\pi, \pi]$ with an error at most the value ϵ found in part 1.

   (d) Plot the error $|\texttt{mysin}x - \sin x|$ for x in $[-\pi, \pi]$. See the example file which plots `myexp`.

   Does the error you found more or less agree with the predictions of Taylor's theorem?

2. Use mathematical induction to carefully prove the formula for the nth derivative of $f(x) = \ln(1 + x)$,
$$f^{(n)}(x) = \frac{(-1)^{(n+1)}(n-1)!}{(1+x)^n}.$$

   Use this to write out the nth Taylor polynomial for $\ln(1 + x)$.

3. (a) How many terms of the series for $\ln(1 + x)$ must we use to estimate $\ln 2$ with an error of at most 10^{-8}. Use the alternating series test.

(b) Recall that $\ln 2 = -\ln(1/2)$. Use Taylor's theorem with remainder to estimate the number of terms that we will need to compute $-\ln 1/2$ (and hence $\ln 2$)with an error of at most 10^{-8}.

(c) Write a simple matlab program to compute the nth Taylor polynomial for $\ln(1 + x)$. Use this program to numerically evaluate $\ln(2)$ using the methods from part a) and b).

Which method is more efficient?

Please consider the programming suggestions from the text.

4. §2.1 pp. 52–53, # 7, 13.

5. §2.2 pp. 68–69, #13, 23, 28, 36, 41.