

Homework 1

cs249
Fall 2001

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Due: Monday 17 September at the beginning of class.
The reading for this assignment is Chapters 1 and 2.
These problems are adapted from Faires and Burden, *Numerical Methods*.

1.1 Errors

1. Using a calculator or MATLAB, find the absolute and relative error of the approximation $22/7$ for the exact value π .
2. Evaluate each of the following expressions using three-digit rounding arithmetic. You can use a calculator or MATLAB, but you have to round off after every operation. For each result, compute the absolute and relative error.

(a) $\frac{4}{5} + \frac{1}{3}$

(b) $\frac{4}{5} * \frac{1}{3}$

(c) $\left(\frac{1}{3} - \frac{3}{11}\right) + \frac{3}{20}$

(d) $\left(\frac{1}{3} - \frac{3}{11}\right) - \frac{3}{20}$

1.2 MATLAB expressions

The sequence F_n described by $F_0 = 1$, $F_1 = 1$, and for $n \geq 0$, $F_{n+2} = F_n + F_{n+1}$, is called a Fibonacci sequence. Its terms occur naturally in many botanical species, particularly those with petals or scales arranged in the form of a logarithmic spiral.

The Fibonacci sequence can be approximated by the following expression:

$$F_n \approx \frac{1}{\sqrt{5}} \left[\left(\frac{1 + \sqrt{5}}{2} \right)^{n+1} - \left(\frac{1 - \sqrt{5}}{2} \right)^{n+1} \right] \quad (1)$$

1. Compute F_{10} by hand.
2. Use MATLAB to evaluate this expression for $n = 10$ and $n = 100$.
3. Write a script called `fibonacci1.m` that evaluates this expression for whatever the current value of `n` is. You should be able to invoke your script like this:

```
> n = 11
> fibonacci1
89
```

See the handout entitled, "Working with MATLAB" for detailed instructions on creating and turning in MATLAB scripts.

1.3 MATLAB math functions

Use MATLAB to check if the following equations hold. You should check the equations two ways: first, compute the value of both sides and see if they are the same (use the `format long` command to see all the digits); second, compute the difference between the right and left sides. You should check 1 or 2 values of x for each equation.

1. $\tan x = \sin x / \cos x$

2. $\sin^2 x + \cos^2 x = 1$

3. $\sinh \frac{x}{2} = \pm \sqrt{\frac{1}{2}(\cosh x - 1)}$

4. $\log_{10} x = \frac{\log_e x}{\log_e 10}$