CS 2 Computational Thinking for Scientists
Winter Term 2015

Homework Assignment 05:

1. Describe the steps of the algorithm and give the value of `term` at each iteration for the following sum:

$$\frac{5\pi}{1536} = \frac{1}{1^5} - \frac{1}{3^5} + \frac{1}{5^5} - \frac{1}{7^5} + \cdots$$

2. It is known that the inverse of Euler's constant is approximated as by computing the following sum for a large integer n:

$$\frac{1}{e} \approx 1 - \frac{1}{2!} + \frac{1}{3!} - \frac{1}{4!} + \cdots + \frac{1}{n!}$$

   We are interested in computing the sum for a given n using an iterative Python function. Starting from `sum = 0`, at each iteration, we add each `term` value to `sum`. Give the expression for `term`.

3. Given the value of `term` at the ith iteration in the above, give an efficient method `term` for the next iteration.

4. The Wallis formula was a product expression for computing $\frac{\pi}{2}$. Another product formula was given by Euler:

$$\frac{\pi}{4} = \frac{3}{4} \cdot \frac{5}{4} \cdot \frac{7}{8} \cdot \frac{11}{12} \cdot \frac{13}{12} \cdot \frac{17}{16} \cdot \frac{19}{20} \cdot \frac{23}{24} \cdot \frac{29}{28} \cdot \frac{31}{32} \cdots$$

   where the numerators are prime numbers (starting from 3) and each denominator is the multiple of 4 nearest to the numerator.

   Can you give an iterative algorithm for computing this product? Explain, what the difficulties are.

5. Describe the steps of the algorithm for computing $\frac{2}{\pi}$ using Vieta's formula, and give the value of each `term` in iteration i, by using the previous `term`:

$$\frac{2}{\pi} = \frac{\sqrt{2}}{2} \cdot \frac{\sqrt{2+\sqrt{2}}}{2} \cdot \frac{\sqrt{2+\sqrt{2+\sqrt{2}}}}{2} \cdot \frac{\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2}}}}}{2} \cdots$$

Due 5pm Wednesday, February 11

Either, email an electronic copy to the Instructor (koc@cs.ucsb.edu) or the TA (zhijing@cs.ucsb.edu). Or, deliver a paper copy to the HW Box in HFH 2108. Electronic copy of your homework or lab report can be in Text, PDF or MS Word, or Open Office format. You could also scan/pdf your handwritten work; however, do not send phone-camera images under any circumstances!