Midterm #1 (10%)

CS3330 Scientific Computing, Instructor: Cheng-Hsin Hsu

Department of Computing Science, National Tsing Hua University, Taiwan

1:20 p.m. – 3:10 p.m., Oct. 30th, 2015

- **Please create a new latex document, write your solution (no need to copy the questions, but please clearly mark the question numbers in order) into it, typeset it, and submit both your .tex and .pdf files before you leave the classroom. No partial credits will be given to students who fail to submit his/her .pdf file.**
- **You are allowed (actually encouraged) to search online for tips.**
- **You are not allowed to copy and paste source codes from the Internet. Furthermore, you cannot exchange (online/offline) messages with any of your peers during the exam. These are considered as academic dishonesty, which automatically leads to zero point. Furthermore, we will have no choice but report this incident to the university.**

1) (2%) Please reproduce the following formula in Latex.

$$\sum_{i=-\infty}^{\lceil \frac{n}{2} \rceil} \binom{x_{i,i+1}^{\sqrt{i}}}{\lfloor \frac{i+3}{3} \rfloor} \frac{\sqrt{\nu(i)^{\frac{\pi}{2}}(i^2-1)}}{\sqrt[3]{\sigma(i)+2}+\sqrt[3]{\sigma(i)-1}} + \sum_{i=\lfloor \frac{n}{2} \rfloor}^{\infty} \binom{x_{i,i+1}^{i^2}}{\lfloor \frac{i+3}{3} \rfloor} \frac{\sqrt{\mu(i)^{\frac{3}{2}}(i^2-1)}}{\sqrt[3]{\rho(i)-2}+\sqrt[3]{\rho(i)-1}}$$

Please pay absolute attentions, even minor difference will lead to partial credits.

2) (2%) A sorting algorithm re-arranges a list of elements in a well-defined order. Consider a list of N positive, finite integers, please design a sorting algorithm to sort them in the ascending order: $n_1, n_2, \ldots, n_N$, where $n_i \leq n_{i+1}\ \forall i = 1, 2, \ldots, N-1$. Type your algorithm (any sorting algorithms will work) as pseudocode (not C, Java, nor Python code). Briefly explain what does each line do in a paragraph, e.g., you may say: The for-loop between lines 8-11 checks if $x > y$ and swap x and y if that's true. You will only get partial credits if you fail to explain your pseudocode.

3) (2%) Plotting a figure often helps us to get a better view on the problems in hand. Consider the following function $f(x) = \frac{A}{1+e^{-K(x-Y)}}$, where A, K, and Y are real-number system parameters. Use SageMath to create one or multiple figures with different A, K, and Y values. Then, include the figure(s) in your Latex file with proper captions. Last, write a paragraph to explain your observations on how each of the parameters affects the shape of the curves. (Hint: you probably need three subfigures, because changing all three parameters at the same time would probably confuse you and readers in no time).

4) (2%) OSX's terminal application gives you BSD-style shell prompt, and OSX includes many popular UNIX tools. For example, we can use 'man *command*' to get the manual of *command* in the shell prompt. This question asks you to create a Latex floating table with the round-trip time measurement results to the 6 most popular Pikachu websites. First, do a Google search on *pikachu* and write down the first 6 host names appear in the search results (skip the repeated ones, please). Then use the *ping* tool to measure the round-trip time from your OSX to each of the hosts (servers). Configure ping to send 10 ICMP packets to each host. Last, report minimum, average, maximum, and standard deviation of each host in a Latex table. Write a short paragraph to present your table to the readers.

5) (2%) From time to time, you may have to type very complicated equation systems, where the *subequations* environment becomes handy. Please recreate the following equation system using subequations. Make sure that you get identical symbols, alignment, equation numbers (Hint: you may need to reset the equation numbers), and so on.

$$PG: \quad \Phi^* = \arg\min_{\Phi} \sum_{s=1}^{S} D(p_s, r_s, V) \tag{1a}$$

$$\text{s.t.} \quad \sum_{s=1}^{S} b_s \leq B(\cdot); \tag{1b}$$

$$s = 1, 2, \ldots, S. \tag{1c}$$