## COL100: Lab 13

April 16, 2017

## Part 1: Programming Questions

1. Compute $\int_{0}^{\pi} \sin (x) d x$ using trapezoidal rule (use $\mathrm{h}=0.1$ and $\mathrm{h}=0.01$ ) and compare with the exact result.
$\int_{a}^{b} f(x) d x=\sum_{k=0}^{n-1} 1 / 2 * h *\left[f\left(x_{k}\right)+f\left(x_{k+1}\right)\right]$
2. Solve the system:
$2 x-4 y=1$
$-2.998 x+6.001 y=2$
Compare the solution with the solution to the system obtained by changing the last equation to $-2.998 \mathrm{x}+6 \mathrm{y}$ $=2$. Is this problem stable?
3. Given a $\mathrm{N} x \mathrm{~N}$ matrix, determine the maximum K such that K x K is a submatrix with all equal elements i.e., all the elements in this submatrix must be same.
4. Which of the following are rounding errors and which are truncation errors (please check out the definitions from Wikipedia)?
(a) Replace $\sin (\mathrm{x})$ by $\mathrm{x}-\left(x^{3} / 3!\right)+\left(x^{5}\right) / 5$ ! . .
(b) Use 3.1415926536 for $\pi$.
(c) Divide 1.0 by 3.0 and call the result 0.3333 .

## Part 2: Practice Questions

1. Given a triangle, find the minimum path sum from top to bottom. Each step you may move to adjacent numbers on the row below. For example, given the following triangle
```
[
        [2],
        [3,4],
    [6,5,7],
    [4,1,8,3]
]
```

The minimum path sum from top to bottom is 11 (i.e., $2+3+5+1=11$ ). Note: Bonus point if you are able to do this using only $\mathrm{O}(\mathrm{n})$ extra space, where n is the total number of rows in the triangle. (You can store the solutions bottom, storing only one layer).
2. The standard deviation of a set of numbers $x_{1}, x_{2}, \ldots, x_{n}$ is defined as:
$\mathrm{s}=(1 / \mathrm{n}) \sum_{i=1}^{n}\left(x_{i}-\bar{x}\right)^{2}$
where $\bar{x}$ is the average. An alternate formula that is often used is
$\mathrm{s}=(1 / \mathrm{n}) \sum_{i=1}^{n} x_{i}^{2}-\bar{x}^{2}$
Discuss the instability of the second formula for the case where the $x_{i}$ are all very close to each other. Observe that s should always be positive. Write a small program to evaluate the two formulas and find values of $x_{1}, \ldots, x_{10}$ for which the second one gives negative results.

