CENG 216 – NUMERICAL COMPUTATION
Homework 1

March 3, 2017

Due Date: March 17, 2017

Exercise 1 Linear Independence

Exercise from G. Strang Prove that if any diagonal element of

$$T = \begin{bmatrix} a & b & c \\ 0 & d & e \\ 0 & 0 & f \end{bmatrix}$$

is zero than the rows are linearly dependent.

Exercise 2 Basis

Exercise from G. Strang Find two different bases for the subspace of all vectors in $\mathbb{R}^3$ whose first two components are equal.

Exercise 3 Orthogonality

Exercise from G. Strang Which pairs are orthogonal among the vectors and why?

$$v_1 = \begin{bmatrix} 1 \\ 2 \\ -2 \\ 1 \end{bmatrix}, v_2 = \begin{bmatrix} 4 \\ 0 \\ 4 \\ 0 \end{bmatrix}, v_3 = \begin{bmatrix} 1 \\ -1 \\ -1 \\ -1 \end{bmatrix}?$$

Exercise 4 Floating Point

If we have a format that matches the IEEE 754 standard but has 1 bit for the sign, 4 bits for the exponent, and 5 bits for the significand parts, then

a. What is the smallest positive subnormal number representable in this format?

b. What is the largest positive subnormal number representable in this format?

c. What is the smallest positive normalized number representable in this format?

d. What is the largest positive normalized number representable in this format?

e. What is the smallest number that is greater than 1?

f. What is the largest number that is smaller than 1?

Exercise 5 Summing Lots of Small Numbers

Write a C++ program that implements the Kahan Summation algorithm described at the end of the Chapter 2 of the textbook. Demonstrate that when summing a lot of small numbers, this algorithm is more precise than summing the numbers directly by generating a suitable set of numbers and using both versions to compute the sum. The output should be as shown below except the `???` are replaced with the actual numbers:

```
Correct Sum = ???
Direct Summation = ???
Kahan's Algorithm = ???
```

NOTE: There will be a small bonus for those submitting a homework prepared in LaTeX.