CS5330: Assignment for Week 1

Due: Tuesday, 28th Jan 2020.

Please email your solutions to `arnabb@nus.edu.sg` by 30th August, 11:59 pm. I strongly encourage you to write your solutions using LaTeX.

You may discuss the problems with your classmates, though you should write up your solutions on your own. Please note the names of your collaborators in your submission.

1. Every evening, a man either visits his parents, who live northwards, or his friend, who lives southwards (but not both). In order to be fair, he goes to the bus stop every evening at a random time and takes either the northward or southward bus, whichever comes first. The two kinds of buses stop at the bus stop every 30 minutes with perfect regularity. Yet, he visits his parents only three times per month. Why?

2. (a) Suppose you have access to a subroutine `randbit()` which returns 0 or 1 with probability 1/2. Use this to design `randint(n)`, which takes input an integer n and returns an integer in the range $\{1, \ldots, n\}$ uniformly at random. **Hint:** First do this when n is a power of 2.

   (b) **Implement** the above algorithm in your favourite language – find out what is the equivalent of `randbit()` in it. Run your code with $n = 8$ a million times storing your answer in an array a. Lets call a pair of indices (i, j) a *streak* if the entries of a in this range are equal. Let $|j - i + 1|$ be the length of this streak. Write down the length of the longest streak in your array a.

3. **Implement** Karger's algorithm in your favourite language. Run it on the file provided in the website. The file is the adjacency matrix of an undirected graph. Each line is a row of the matrix and different rows are separated by new lines. What is the minimum cut size? How many iterations of the subroutine did you need to detect this?