Module 1 – Shyam Natarajan

1. Integers are also real numbers. Rational numbers are those that can be expressed in the form p/q, where p and q are coprime integers (i.e. they are in reduced form) and q =/= 0.

2. Yes there is a rational number between every 2 rational numbers which is the average of the two numbers.

3. Integers, natural numbers and rational numbers all represent countable infinities and hence have the same cardinality. A basic non-rigorous explanation of rational numbers being countable is by representing all rational numbers in an infinite matrix where one axis is the numerator and the other in the denominator. Naturally any rational number would be present here and we can create a bijection onto the set of integers by counting along a zig zag pattern (i.e. 1/1, ½, 2/1, 1/3, 3/1 … mapping to 1, 2, 3 … and similarly for negative numbers. We would not need to consider both negative numerator and denominators so for simplicity the sign can depend on just the numerator with the denominator always being positive.)

4. A modified check would f(a) \* f(m) >= 0. This condition would only be met if both f(a) and f(m) are the same sign, or one of them is 0.

5. A calculator gives the output 1.73205080757 while the program gives the output 1.734375. The accuracy can be improved by putting a smaller value on the right hand side of the conditional “Math.abs (f(m)) > 0.01”. This method can be written recursively by removing the while loop and instead of updating m, the new values for a and b can be passed to the same function with the value being returned once it is below the accuracy threshold. The efficiency of the program in this case would not improve since the number of computations and comparisons remains unchanged whether done iteratively or recursively.

6. As n increases, the value approaches 1.

7. The sum approaches (n+1)/2. The double method is closer to the approached value than the float method.

8.

9.

10. This sequence’s sum oscillates between positive and negative.