CS2030 Programming Methodology
Semester 2 2019/2020

12 March 2020
Problem Set #7

1. Write a method `omega` with signature `IntStream omega(int n)` that takes in an `int n` and returns a `IntStream` containing the first n omega numbers.

   The i^{th} omega number is the number of distinct prime factors for the number i. The first 10 omega numbers are $0, 1, 1, 1, 1, 2, 1, 1, 1, 2$.

   The `isPrime` method is given below:

   ```
   boolean isPrime(int n) {
       return IntStream
           .range(2, n)
           .noneMatch(x -> n%x == 0);
   }
   ```

   ```
   IntStream omega(int n) {
     return IntStream
           .rangeClosed(1, n)
           .map(
             a -> IntStream
                 .range(2, a)
                 .reduce(0, (x, y) -> (isPrime(y) && a % y == 0)
                                 ? x + 1
                                 : x));
   }
   ```

2. Write a method that returns the first n Fibonacci numbers as a `Stream<Integer>`.

   For instance, the first 10 Fibonacci numbers are $1, 1, 2, 3, 5, 8, 13, 21, 34, 55$.

   Hint: Write an additional `Pair` class that keeps two items around in the stream

3. Write a method product that takes in two `List` objects `list1` and `list2`, and produce a `Stream` containing elements combining each element from `list1` with every element from `list2` using a `BiFunction`. This operation is similar to a Cartesian product.

   ```
   public static <T,U,R> Stream<R> product(List<? extends T> list1,
           List<? extends U> list2,
           BiFunction<? super T, ? super U, R> func)
   ```

   For example, the following program fragment

   ```
   List<Integer> list1 = new ArrayList<>();
   List<String> list2 = new ArrayList<>();

   Collections.addAll(list1, 1, 2, 3, 4);
   Collections.addAll(list2, "A", "B");

   product(list1, list2, (str1, str2) -> str1 + str2)
       .reduce("", (x, y) -> x + y + " ")
   ```

   gives the output

   ```
   1A 1B 2A 2B 3A 3B 4A 4B
   ```