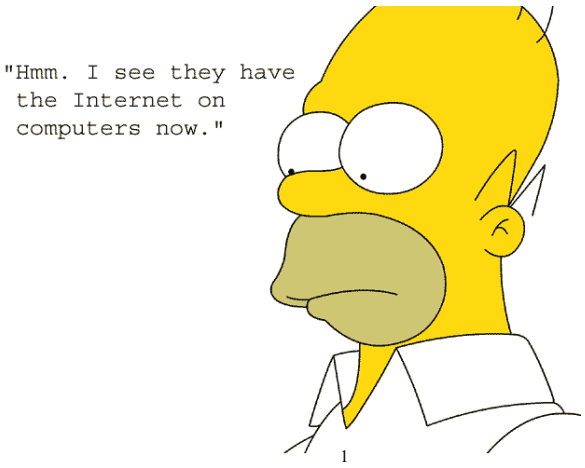
COMP 2121
DISCRETE MATHEMATICS

Lecture 1



[1]

The Rules of Sum and Product

Our study of discrete mathematics begins with two basic principles of counting: the rules of sum and product. In analyzing more complicated problems, one is often able to break down such problems into parts that can be solved using these basic principles. We want to develop the ability to "decompose" such problems and piece together our partial solutions in order to arrive at the final answer.

The Rule of Sum: *If a first task can be performed in **m** ways, while a second task can be performed in **n** ways, and the two tasks cannot be performed simultaneously, then performing either task can be accomplished in any one of **m** + **n** ways.*

Example 1. A computer science instructor has two colleagues. One of these colleagues has 3 different textbooks on the analysis of algorithms and the other has 5 such different textbooks. How many different books can instructor borrow from them?

The Rule of Product: *If a procedure can be broken down into first and second stages, and if there are **m** possible outcomes for the first stage and if, for each of these outcomes, there are **n** possible outcomes for the second stage, then the total procedure can be carried out, in the designated order, in **mn** ways*.

[1] Reference: http://www.codeproject.com/KB/vbscript/Steganography/homer2gifhta.gif

Example 2. a) How many 16 bit strings start with 1101?

b) How many 16 bit strings do NOT start with 1101?

Example 3. Consider the following program segment where `i and j` are integer variables. How many times is the print statement executed?

```
for i = 8 to 10 {
      for j = 3 to 4 {
                  print (i - j)
            }
      }
```

```
for i = 1 to n {
      for j = 3 to n {
                  print i*j
            }
      }

// assume n ≥ 3
```

Example 4. *Question from some past exam* A collection of four routers is to be connected in a point-to-point subnet. Between each pair of routers, the designers may put a high-speed line, a medium-speed line, a low-speed line, or no line. (Note that the topology with no line between each pair of routers is also a valid topology.) If it takes 1 μs of computer time to generate and inspect each topology, how long will it take to inspect all of them?