

07-131 Homework 3

Problem 1 Math

LaTeX is awesome for math! Let's look evaluating the value of m if $(m + 2) \times (3 + 4) = 21$ in two ways.

Using the initial equality:

$$\begin{array}{lll}
 & (m + 2) \times (3 + 4) = 21 & \text{(start)} \\
 \Rightarrow & (m + 2) \times 7 = 21 & \text{(evaluating } 3 + 4 = 7) \\
 \Rightarrow & m + 2 = \frac{21}{7} & \text{(dividing by 7 on both sides)} \\
 \Rightarrow & m + 2 = 3 & \text{(evaluating } \frac{21}{7} = 3) \\
 \Rightarrow & m = 3 - 2 & \text{(subtracting 2 on both sides)} \\
 \Rightarrow & m = 1 & \text{(evaluating } 3 - 2 = 1)
 \end{array}$$

Therefore:

$$m = 1$$

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Using the initial equality:

$$\begin{array}{lll}
 & (m + 2) \times (3 + 4) = 21 & \text{(start)} \\
 \Rightarrow & (m + 2) \times 7 = 21 & \text{(evaluating } 3 + 4 = 7) \\
 \Rightarrow & (m \times 7) + (2 \times 7) = 21 & \text{(using distributive property)} \\
 \Rightarrow & (m \times 7) + 14 = 21 & \text{(evaluating } 2 \times 7 = 14) \\
 \Rightarrow & m \times 7 = 21 - 14 & \text{(subtracting 14 on both sides)} \\
 \Rightarrow & m \times 7 = 7 & \text{(evaluating } 21 - 14 = 7) \\
 \Rightarrow & m = \frac{7}{7} & \text{(dividing by 7 on both sides)} \\
 \Rightarrow & m = 1 & \text{(evaluating } \frac{7}{7} = 1)
 \end{array}$$

Therefore:

$$m = 1$$

Problem 2 Induction

Induction becomes so much easier with LaTeX! Take a look:

Problem 2 Calculus

Those of you who enjoy calculus will have a blast!

Find $\lim_{x \rightarrow 2} \frac{x^2 + x - 6}{x^2 - 4}$.

$$\begin{aligned} \lim_{x \rightarrow 2} \frac{x^2 + x - 6}{x^2 - 4} &= \lim_{x \rightarrow 2} \frac{2x + 1}{2x} && \text{(by L'Hôpital's Rule)} \\ &= \frac{5}{4} \end{aligned}$$

Another one? Ok!

Given $f(x, y) = \frac{xy}{x+y}$ if $(x, y) \neq (0, 0)$ and $f(0, 0) = 0$.

For $(x, y) \neq (0, 0)$,

$$\begin{aligned} \frac{\partial f}{\partial x}(x, y) &= \frac{\partial}{\partial x} \left(\frac{xy}{x+y} \right) && \text{(by substitution)} \\ &= \frac{y(x+y) - xy(1)}{(x+y)^2} && \text{(by differentiation rules)} \\ &= \frac{y^2}{(x+y)^2} \end{aligned}$$

and

$$\begin{aligned} \frac{\partial f}{\partial y}(x, y) &= \frac{\partial}{\partial y} \left(\frac{xy}{x+y} \right) && \text{(by substitution)} \\ &= \frac{x(x+y) - xy(1)}{(x+y)^2} && \text{(by differentiation rules)} \\ &= \frac{x^2}{(x+y)^2} \end{aligned}$$

Alright, no more problems. Just two more equations.

$$\begin{aligned} \iiint_V (\nabla \cdot \mathbf{F}) \, dV &= \oint_{S(V)} \mathbf{F} \cdot \hat{\mathbf{n}} \, dS \\ \iiint_V (\nabla \times \mathbf{F}) \, dV &= \oint_{S(V)} \hat{\mathbf{n}} \times \mathbf{F} \, dS \end{aligned}$$

Problem 3 Programming

You can code in LaTeX too! Here's an intro to typesetting programs:

```
#include<stdio.h>
#include<iostream>

// My first program
int main(void)
{
    printf("Hello World\n");
    return 0;
}
```

You can also change languages really easily, like here:

```
(* My second program *)
fun map f xs = let
    fun m ([], acc) = List.rev acc
      | m (x::xs, acc) = m (xs, f x::acc)
in
    m (xs, [])
end
```

or here:

```
# My third program
def UncommonWords(A, B):
    # count will contain all the word counts
    count = {}

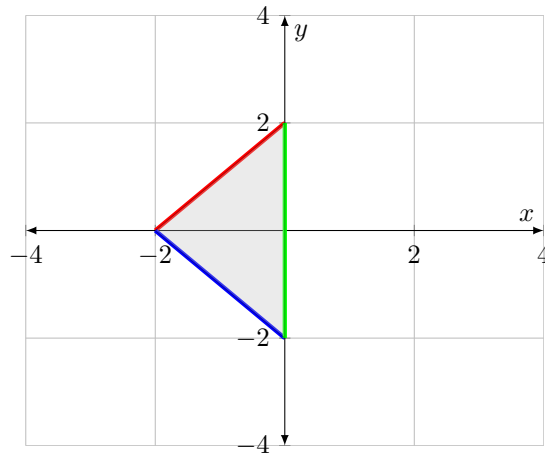
    # insert words of string A to hash
    for word in A.split():
        count[word] = count.get(word, 0) + 1

    # insert words of string B to hash
    for word in B.split():
        count[word] = count.get(word, 0) + 1

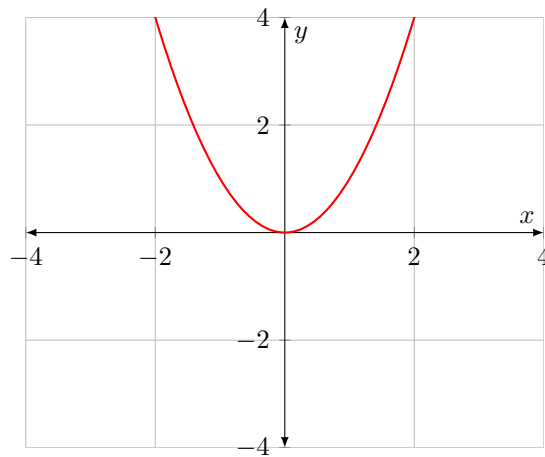
    # return required list of words
    return [word for word in count if count[word] == 1]
```

Problem 4 Graphing

Plotting in Latex is super fun! Here's a mini graph with some shading:



and here's a plot of $y = x^2$:



Problem 4 Images

You can make some really pretty images and figures in LaTeX too!

Carnegie Mellon University

Figure 1: CMU

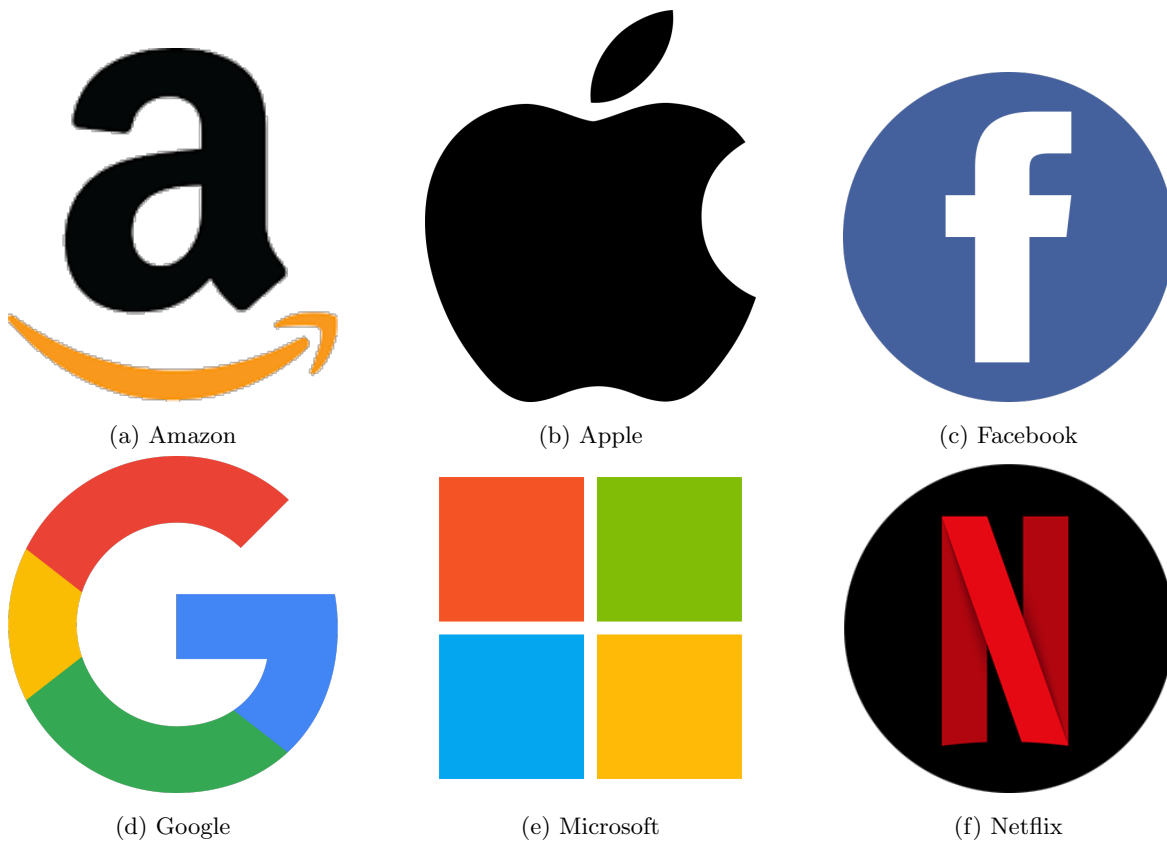


Figure 2: FAANG logos

and can reference back to them! Take me to [FAANG logos](#) or take me to [CMU](#).