CSC2200: Computer Science II
Homework 1
Winter 2021

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Problem 1

Use mathematical induction to prove that $1 \cdot 1! + 2 \cdot 2! + \cdots + n \cdot n! = (n+1)! - 1$ whenever n is a positive integer.

Solution:
Base Case:
$(1+1)! - 1 = (2)! - 1 = (2 \cdot 1) - 1 = 2 - 1 = 1$
$1 \cdot 1! = 1 \cdot 1 = 1$
$1 \cdot 1! + 2 \cdot 2! + \cdots + n \cdot n! = (n+1)! - 1$
$n = k; 1 \cdot 1! + 2 \cdot 2! + \cdots + k \cdot k! = (k+1)! - 1$
$n = k + 1$
$1 \cdot 1! + 2 \cdot 2! + \cdots + k \cdot k! = (k+1)! - 1$
$((k+1)+1)! - 1 = (k+2)! - 1$
$k = 1; (1+2)! - 1 = (3)! - 1 = (3 \cdot 2 \cdot 1) - 1 = 6 - 1 = 5$
$= (k+1)!$

Problem 2

Use mathematical induction to prove that $\sum_{i=1}^{n} \frac{1}{2^i} = (2^n - 1)/2^n$ whenever n is a positive integer.

Solution: write your solution here
$\sum_{i=1}^{1} \frac{1}{2^1} = (2^1 - 1)/2^1$
$0.5 = (1)/2$
$0.5 = 0.5$
$n = k; \sum_{i=1}^{k} \frac{1}{2^k} = (2^k - 1)/2^k$
$n = k + 1; \sum_{i=1}^{k+1} \frac{1}{2^{k+1}} = \frac{2^{k+1}-1}{2^{k+1}}$

Problem 3

a) Simplify the expression: $\log 3xy^2 - \log 27xy$
b) Solve for x: $\log 4x + \log 3 = \log 12$
The logarithms in a) and b) are base 2.

Solution: write your solution here

Problem 4

Write a recursive function that counts the number of times the integer 1 occurs in an array of integers. Your function should have as arguments the array and the number of elements in the array.

Solution: write your solution here
Example: how to write code in LaTeX

```
int f(int array[], numElements)
{
int count;
if (numElements == 0){
return count;
}
else if (x == 1) {
count++;
return f(array[], numElements - 1);
}
else
return f(array[], numElements - 1);

}
```