

**MATH 113: DISCRETE STRUCTURES**  
**FRIDAY WEEK 3 HANDOUT**

*Problem 1.* Use induction to show that

$$2^0 + 2^1 + 2^2 + \cdots + 2^{n-1} = 2^n - 1$$

for  $n \geq 1$ .

*Problem 2.* Use induction to prove that the number of permutations of  $\underline{n} = \{1, 2, \dots, n\}$  is  $n!$ .

*Problem 3.* Use induction to prove that

$$\frac{1}{1 \cdot 2} + \frac{1}{2 \cdot 3} + \frac{1}{3 \cdot 4} + \cdots + \frac{1}{n(n+1)} = \frac{n}{n+1}$$

for  $n \geq 1$ .

*Problem 4.* Use induction to prove that a convex  $n$ -gon has  $n(n-3)/2$  diagonals.

*Problem 5.* Use induction to prove that

$$\binom{2n}{n} < 2^{2n-2}$$

for  $n \geq 5$ .