Homework 4
CSE 215: Foundations of Computer Science
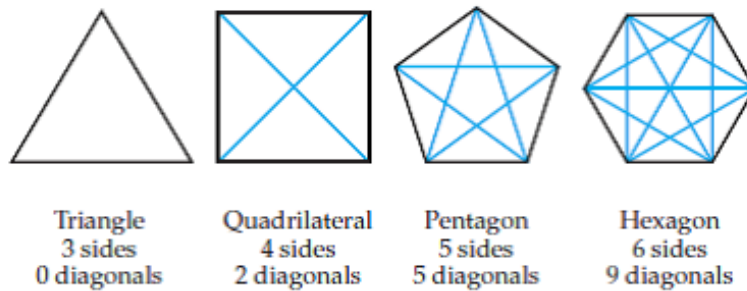State University of New York at Stony Brook
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Total points = 95. Total questions = 3. Total pages = 2.
Questions are from our course textbook, **Brief Edition**.

Problem 1. [50 points]

Ordinary mathematical induction.

(a) [5 points] Exercise Set 5.2, Problem 11

(b) [5 points] Exercise Set 5.2, Problem 14

(c) [5 points] Exercise Set 5.2, Problem 17

(d) [5 points] Exercise Set 5.3, Problem 10

(e) [5 points] Exercise Set 5.3, Problem 17

(f) [5 points] Exercise Set 5.3, Problem 21

(g) [5 points] Exercise Set 5.3, Problem 22

(h) [5 points] Exercise Set 5.3, Problem 29

(i) [5 points] Prove that in an n-sided regular polygon, where $n \geq 3$, the number of diagonals is $n(n-3)/2$.

Triangle
3 sides
0 diagonals

Quadrilateral
4 sides
2 diagonals

Pentagon
5 sides
5 diagonals

Hexagon
6 sides
9 diagonals

(j) [5 points] Prove that the number of permutations of the set $\{1, 2, \ldots, n\}$ with n elements is $n!$, for natural number $n \geq 1$. As an example, the permutations of $\{1, 2, 3\}$ are $\{[1, 2, 3], [1, 3, 2], [2, 1, 3], [2, 3, 1], [3, 1, 2], [3, 2, 1]\}$.

Problem 2. [30 points]

Strong mathematical induction.

(a) [5 points] Exercise Set 5.4, Problem 8

(b) [5 points] Exercise Set 5.4, Problem 9

(c) [5 points] Exercise Set 5.4, Problem 25(b)

(d) [5 points] Exercise Set 5.4, Problem 30

(e) [5 points] Exercise Set 5.5, Problem 30

(f) [5 points] Let f be a function on whole numbers satisfying
$$f(n) = \begin{cases} 0 & \text{if } n = 0, \\ 4f(n/2) & \text{if } n > 0 \text{ and even,} \\ f(n-1) + 2n - 1 & \text{if } n > 0 \text{ and odd.} \end{cases}$$
Prove that $f(n) = n^2$ all $n \geq 0$.

Problem 3. [15 points]
Recursion.

(a) [5 points] Exercise Set 5.5, Problems 28, 29

(b) [5 points] Exercise Set 5.6, Problem 2(b,d)

(c) [5 points] Exercise Set 5.6, Problems 9, 14, 15