

CS 200 Algorithms and Data Structures

Written Assignment #1

Due on Jan. 27 at the beginning of the class

[Problem 1] 6pts

Consider the language that the following grammar defines:

$\langle S \rangle = @ | \langle W \rangle | @ \langle S \rangle$

$\langle W \rangle = xxy | xx \langle W \rangle y$

Write all strings that are in this language and that contain seven or fewer characters.

[Problem 2] 6 pts (2+3 pts)

Consider the language that the following grammar defines:

$\langle G \rangle = \text{empty string} | \langle E \rangle | \langle V \rangle \langle E \rangle | \langle E \rangle \langle G \rangle \langle V \rangle$

$\langle E \rangle = \& | \#$

$\langle V \rangle = W | A$

(a) Is string $\&W\#W$ in this language?

(b) Write pseudocode for a recursive method that determines whether the string w is in this language

[Problem 3] 6 pts

Use mathematical induction to prove that

$$1 * 1! + 2 * 2! + \dots + n * n! = (n + 1)! - 1$$

whenever n is a positive integer using mathematical induction.

[Problem 4] 3+3pts

(a) Find a formula for

$$\frac{1}{1 * 2} + \frac{1}{2 * 3} + \frac{1}{3 * 4} + \dots + \frac{1}{n(n+1)}$$

by examining the values of this expression for small values of n .

(b) Use mathematical induction to prove your conjecture in part (a) is true.

[Problem 5] 6 pts

A recursive algorithm for computing

```
power (a: nonzero real number, n: nonnegative integer)
  if (n = 0) then {
    power(a, n) = 1
  }else {
    power(a, n) = a * power(a, n - 1)
  }
```

Prove that above algorithm computes powers of real number, is correct. (use mathematical induction)