Grammar Worksheet
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Warm Up Exercises:

This exercise pertains to the tortoise and the hare from Aesop's Fables.

The next three exercises refer to the grammar with:

Start symbol S = sentence

Set of terminals T = {the, sleepy, happy, tortoise, hare, passes, runs, quickly, slowly}

Set of nonterminals N = {noun, phrase, transitive verb phrase, intransitive verb phrase, article, adjective, noun, verb, adverb}

Productions =

    sentence → noun phrase   transitive verb phrase   noun phrase

    sentence → noun phrase   intransitive verb phrase

    noun phrase → article   adjective   noun

    noun phrase → article   noun

    transitive verb phrase → transitive verb

    intransitive very phrase → intransitive verb   adverb

    intransitive verb phrase → intransitive verb

    article → the

    adjective → sleepy

    adjective → happy

    noun → tortoise

    noun → hare

    transitive verb → passes

    intransitive verb → runs

    adverb → quickly

    adverb → slowly

(1) Use the set of productions to show that these are valid sentences:

a) The happy hare runs

b) The sleepy tortoise runs quickly

c) The tortoise passes the hare

d) The sleepy hare passes the happy tortoise

(2) Find three additional valid sentences:

a)

b)

c)

(3) Show that "the hare runs the sleepy tortoise" is not a valid sentence:

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Additional Exercises:

(4) Let G = (V, T, S, P) be the grammar with V = {0, 1, A, B, S}, T = {0,1}, and set of productions P consisting of S → 0A, S → 1A, A → 0B, B → 1A, B → 1
a) What is the language generated by G?

b) Draw the derivation tree associated with this grammar in relation to the sentence 001:

(5) Let V = {S,A,B,a,b} and T = {a,b}. Find the language generated by the grammar (V,T,S,P) when the set P of productions consists of:
a) S → AB, S → aA, A → a, B → ba

b) S → AA, S → B, A → aaA, A → aa, B → bB, B → b

(6) Find the grammar for the language with the set of all bit strings containing an even number of 0s and no 1s:

(7) A palindrome is a string that reads the same backward as it does forward, that is, a string w, where $w = w^R$, where w^R is the reversal of the string w. Find that grammar that generates the set of odd length palindromes over the alphabet {a,b}: