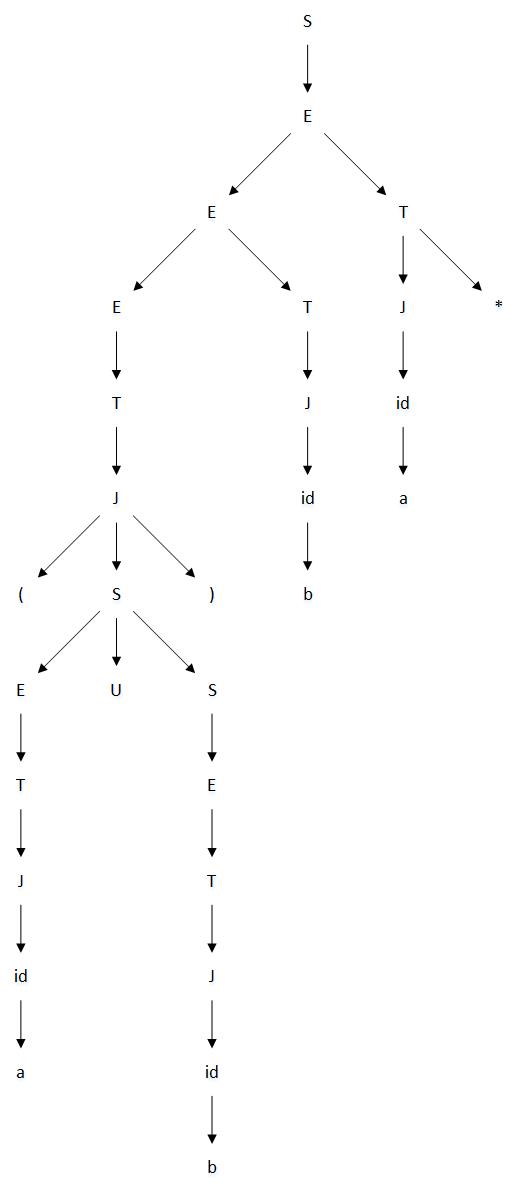
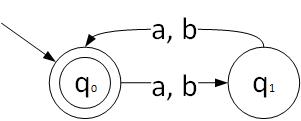
3331 Assignment 2

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1. Let
   1. Give an unambiguous context-free grammar that generates *L*. The grammar should
      1. Use the following precedence levels, from highest to lowest: (1) \* and + (equal precedence), (2) concatenation, and (3) and
      2. left-associate operators of equal precedence.
   2. Show the parse tree that your grammar produces for the string.  
      
2. For each of the following languages *L*, prove whether *L* is regular, context-free but not regular, or not context-free:
   1. .  
        
      This language is regular because it is a language that contains all the strings of even lengths. Which is proven to be regular by this FSM:  
        
      
   2. .  
        
      This language is not regular as it does not satisfy the pumping lemma. However, it is context-free as it can be represented by the following grammar:
   3. .  
        
      This language is not a context-free language as it does not satisfy the pumping lemma.  
        
      Proof:  
      Let, where and   
        
      since has to be more than 0, then every time is pumped into the expression, it will cause an imbalance in the expression which results into taking that expression out of the language. For example, if we pump we can get the expression or, which are outside the language. Therefore, this language is not a context-free language.
   4. .  
        
      The language is not context-free.  
        
      Proof by the pumping lemma:  
      Let, where and   
        
      since, then wherever we pump in this expression it will go out of the language. If the expression in pumped in b then. If the expression is pumped in between the a and b then. Therefore the language does not satisfy the pumping lemma.
3. Show that the following problem is decidable: Given a context-free grammar *G,* does *G* generate any even length strings?  
     
   Firstly, use the algorithm CFGtoPDAbottomup(G) to build a PDA, P, that takes in L(G). Secondly, construct a FSM, F, that accepts all even strings from L(G). Furthermore, use the intersectPDAandFSM(P, F) algorithm to generate a PDA P\* that accepts all the expressions that belong to the intersection of P and F. Finally, use the decideCFLempty(P\*) algorithm to determine whether the problem is decidable or not. If the CFL is empty then return false, else return true.