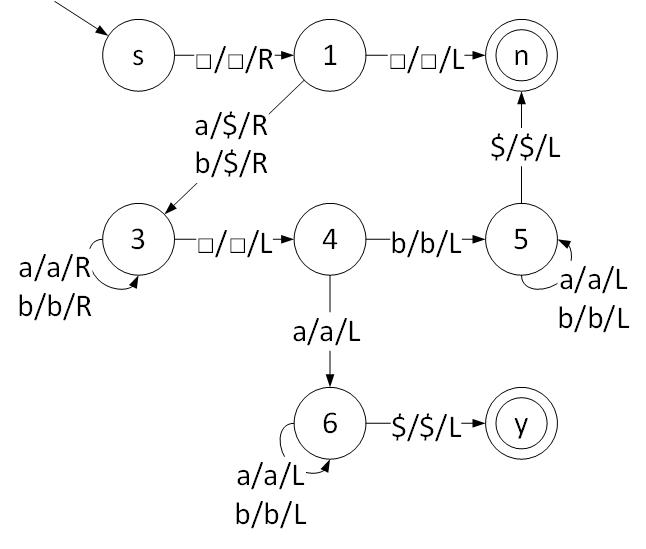
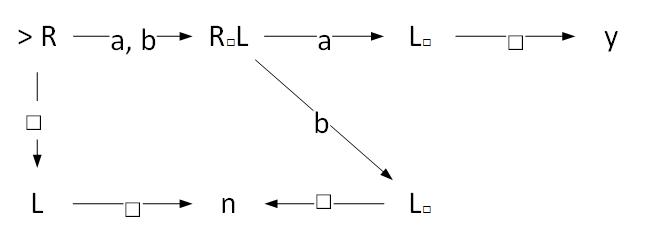
3331 Assignment 3

Zaid Albirawi  
250626065

1. Construct a deterministic Turing machine that decides the language  
     
    starts with the initial configuration and halts with the configuration, for the appropriate
   1. Describe in details using the directed graph whose edges are labelled by transitions (such as the one in Example 17.2, p. 368 of textbook).  
        
      
   2. Describe using the macro language (such as the one in Example 17.8, p. 376-377 of textbook).  
        
      
2. The universal Turing machine, on input, simulates the work of the Turing machine on input. Explain what does on input.  
     
   First, to differentiate between the different universal machines we rewrite the input to. The universal Turing machine will simulate the work of the Turing machine on the input. While the machine from that input will also simulate the work of machine on the input. Discussing this in further detail, since a universal Turing machines input must be in the following format,, we denote the input of the universal machine to be . This input is equal to. Furthermore, we do the same thing for the universal machine, let the input ofbe which is equal to. Hence, this is what that operations would look like,
3. Describe in clear English a Turing machine that semidecides the language  
     
     
   Let the Turing machine run the dovetailing algorithm to enumerate all lexicographically. Run the machine until two strings are found. If two strings are found, halt and go to accepting state. Else keep enumerating strings.
4. Prove that the set of decidable languages is closed under union and concatenation. (Clear English description of the necessary Turing machines is sufficient.)  
     
   **Closure under Union:** Let and be Turing machines that accept the decidable languages and respectively. Also, let be a Turing machine that simulates the work of and Therefore, will be able to decide since both language are decidable. The idea behind this is for the machines to put the and tapes on its tape and work on them simultaneously, if either of the tapes reach a halting state, then halt and accept.   
     
   **Closure under Concatenation:** For this proof we have a string that is a concatenation of two languages, and. The problem there is that we don’t know which part of the string belongs to which language. Therefore, we will need to a universal Turning machine that will simulate the work of the machines and that accept the languages and respectively. The idea is that we split into the prefix and postfix,. What we then need to do is, on all the prefixes of until it accepts, if there does not exists a prefix that halts on accepting, then reject. If the prefix is accepted by then, if accepts, then accept, else, reject and try the next prefix, if you run out of prefixes, reject. Since both languages are decidable, both the and machines will have to either accept or reject, which implies that machine will have to either accept or reject.