

Mid-Term Examination, CSE 477/Ling 549, Fall, 2003  
October 28 2003

This is a take home examination. The purpose of the examination is to give you experience with some of the material we have covered in the class as well as to get an evaluation of you so that I can give better advice to you.

This is an open book examination. You may consult any resources you wish as long as they are non-human. **Do not spend more than 6 hours total.**

**Due date: November 4 2003. You may leave your exam at the front desk at IRCS, 3401 Walnut, 4th Floor.**

**Problem 1 (15 points):**

Construct a finite state automaton  $M$  (i.e., the state diagram) with  $\Sigma = \{a, b\}$  and  $L(M) =$  the set of all strings that do NOT contain the strings  $aa$  and  $aaa$ . If  $M$  is nondeterministic then construct  $M'$  such that  $M'$  is deterministic and  $L(M) = L(M')$ .

**Problem 2 (15 points):**

Write a regular expression for the language accepted by the FSA,  $M$  in Figure 1.

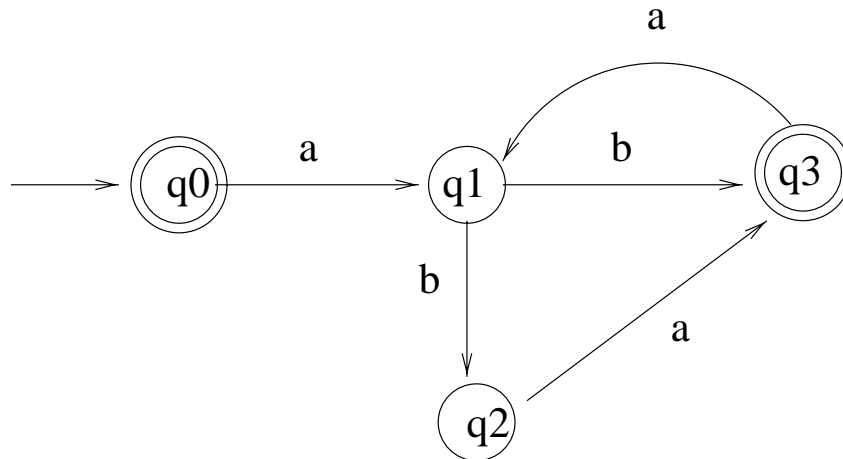


Figure 1: Finite State Automaton M

**Problem 3 (15 points):**

Which one of the following are true?

1.  $baa \in a^*b^*a^*b^*$
2.  $b^*a^* \cap a^*b^* = a^* \cup b^*$
3.  $a^*b^* \cap c^*d^* = \phi$

**Problem 4 (45 points)**

This problem is open ended in a sense. Parts of the problem have been done already in the notes distributed in the class. You may lift those parts from the notes if you wish or do them again in your own way and possibly improve them.

**Do the simple versions first and then as much more as you can in the given amount of time.** It will be more convenient to construct non-deterministic machines. **There is no need to convert them to deterministic machines.**

**Part 1:**

Construct a Finite State Machine for the simple noun phrases of English, i.e. phrases with a head noun, optional left modifiers and an optional determiner. Thus you will consider adjectives (ADJ), noun (N) modifiers, gerunds (Ving), and past passive participles (Ven). ADJ can have adverbs (ADV) as left modifiers. There can be predeterminers also.

**Part 2:**

Continue the previous part by considering right modifiers such as prepositional phrases (PP).

**Part 3:**

Construct a Finite State Machine for the verb clusters of English. Verb clusters are verbal sequences such as

*eats, ate, has eaten, has been eaten, will have eaten, wants to go, was persuaded to leave, may have been persuaded to leave, ...*

Note that

*wants John to leave*

will not be considered as a verbal sequence. It has two verbal sequences

*wants* and *to leave*

**Part 4:**

Construct a Finite State Transducer (FST) which will mark all simple noun phrases (corresponding to Part 1) in a sentence by enclosing the phrases between [ and ], for example, given the input

*The black cat scratched the very dirty mat.*

the output will be

[*The black cat*] scratched [*the very dirty mat*].

You may find it easier to do this part by scanning the input string from right to left.

**Part 5:**

Construct an FST for marking off the phrases corresponding to Part 2. Assume that phrases in Part 1 have already been marked off by [ and ].

**Part 6:**

Construct an FST for marking off the phrases corresponding to Part 3 by enclosing the phrases between { and }. Assume that phrases corresponding to Parts 1 and 2 have already been marked off.

I will use the following test sentence for Problem 4 above. You should use it also. Of course, you will test your machines with other sentences. Clearly, your machine should be far more general than a machine needed just for testing the sentence below.

**All the very dark brown cats in the house had been scratching the carpets.**

**Some notations**

all: predeterminer, PDET

the: determiner, DET

very: adverb, ADV

dark: adverb, ADV

brown: adjective, ADJ

cats: noun, N

in: preposition, P  
house: noun, N  
had: auxiliary verb: vaux  
been: auxiliary verb: vaux  
scratching: gerund: Ving  
carpets: noun, N

You need not treat – *had*, *been*, *scratching* –necessarily as I have indicated.