CS 453 Introduction to Compilers	Midterm Examination
Spring 2015	March 2, 2015

50 minutes (maximum)

- You may use one side of one sheet (8.5x11) of paper with any notes you like.
- This exam has 8 pages, including this cover page and two mostly empty pages for extra work space. Do all your work on these exam sheets.
- Be specific and clear in your answers. If there is any question about what is being asked, then indicate the assumptions you need to make to answer the question.
- Show all your work if you wish to be considered for partial credit.

Question	Points	Score
1	10	
2	15	
3	15	
4	25	
5	10	
6	25	

Name: ____________________

Email: ____________________

DO NOT TURN TO NEXT PAGE TILL YOU GET PERMISSION

1. [10 points] Lexer for some keywords
   We need a lexer that can handle the "for" and "forall" keywords in the Chapel programming language being developed at Cray. (a) Write a separate NFA for each of those two keywords. (b) Then connect the two separate NFAs into a single NFA without redrawing the original separate NFAs.

2. [15 points] DFA
   Convert the combined NFA you created for question 1 into a DFA (deterministic finite state automata).

3. [15 points] Haskell lexer
   Write a lexer in Haskell that converts a String to a list of Tokens for the “for” and “forall” tokens.

4. [25 points] Haskell lexer

(a) Assume that you have to implement syntactic analysis (a parser) for the following language:

```
(1) prog       -> stmtlist EOF
(2) stmtlist   -> stmtlist stmt
(3)            |  epsilon
(4) stmt       -> EAT NUM mallow
(5)            |  SAVE NUM mallow
(6) mallow     -> PINK STARS
(7)            |  BLUE DIAMONDS
```

Assume that EAT, SAVE, NUM, PINK, BLUE, DIAMONDS, STARS, and EOF are all tokens. Show the Nullable property and FIRST and FOLLOW sets for all of the non-terminals in the above grammar. (DO NOT MODIFY THE GRAMMAR).

(b) Using the FIRST and FOLLOW sets, construct the predictive parsing table for the above grammar.

5. [10 points] LL(1)
   Why is the above grammar not in LL(1)? Fix the grammar so that it is in LL(1).

6. [25 points] Predictive Parser table (take 2)
(a) Show the Nullable property and FIRST and FOLLOW sets for all of the non-terminals in the fixed grammar from question 5. (b) Then construct the predictive parsing table.

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