

# CSCI3136

## Assignment 1

Instructor: Alex Brodsky

Due: 9:00am, Wednesday, May 24, 2019

1. Modern integrated development environments (IDEs) “automatic code completion” completion, gives the programmer a list of possible methods that they may wish to call as they are typing the current line of code. A good example of this can be found in Eclipse, the IDE for Java development.

- (a) **[3 marks]** Which parts of the compiler (compilation phases) would be needed to implement this functionality and why?

**The IDE would need to use the *lexical analysis*, *syntax analysis*, and *semantic analysis* phases of the compiler. [1]**

***Lexical analysis* (a scanner) would be needed to tokenize the source code and identify the various types of tokens, e.g., keywords, literals, etc. [1]**

***Syntax analysis* (a parser) would be needed to identify the (partial) method calls.[1]**

***Semantic analysis* would be needed to determine the class of the object the method is being called on, and look up all methods of the class.[1]**

- (b) **[2 marks]** Suppose you also wanted the auto completion to complete fields (attributes) as well as method calls. Which of the three phases would you need to adjust? Be sure to justify your answer.

**The *semantic analysis* [1] would need to be adjusted to look up partial fields in the corresponding class, [1] as the user types it in.**

2. For each of the following languages give the regular expression that matches the strings in the language. Note: You can use `.` to denote “any” character in the alphabet.

- (a) **[5 marks]** The language, over the English alphabet, of strings that start and end with vowels (assume ‘y’ is a vowel).

$(a|e|i|o|u|y) \cdot (a|e|i|o|u|y)$

- (b) **[5 marks]** The language of binary strings that do not contain the substring 10.

$0^* 1^*$

- (c) **[5 marks]** The language, over the alphabet of decimal digits, of strings that represent integers divisible by 4.

$4|8|(\cdot * ((0|2|4|6|8)(0|4|8)|(1|3|5|7|9)(2|6)))$

- (d) [5 marks] The language of binary strings that do not contain the substring 010.

$$1 * (00 * 111 * 00*) * 0 * 1*$$

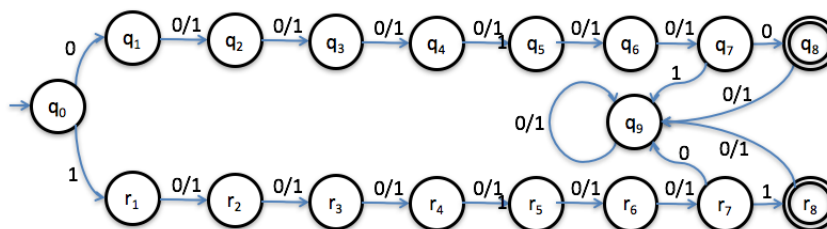
3. For each of the following languages,

- State whether the language is finite or infinite.
- State whether the language is regular or nonregular.
- If you claim the language is regular: give a DFA (graphical representation) that recognizes the language.
- If you claim that the language is not regular, describe the intuition for why this is so.

Consider the following languages:

- (a) [8 marks] The language of 8 bit binary strings that begin and end with the same digit.

**Finite and regular [1]**



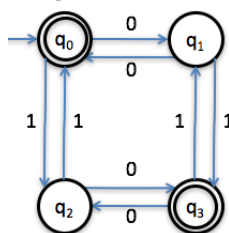
[Correct states: 4 marks, correct transitions 3 marks, Correct accepting state 1 mark]

- (b) [8 marks] The language of decimal strings such that the number of odd digits is equal to the number of even digits.

Infinite and not regular [2] mark] A DFA would need to keep track of the difference between the total number of even digits read and the number of odd digits read [2]. Since the difference can be arbitrarily large at any point during during a computation [2], a DFA would run out of states to keep track of the difference [2].

- (c) [9 marks] The language, of binary strings such that either both the number of 0s and 1s is odd, or both the number 0s and 1s is even.

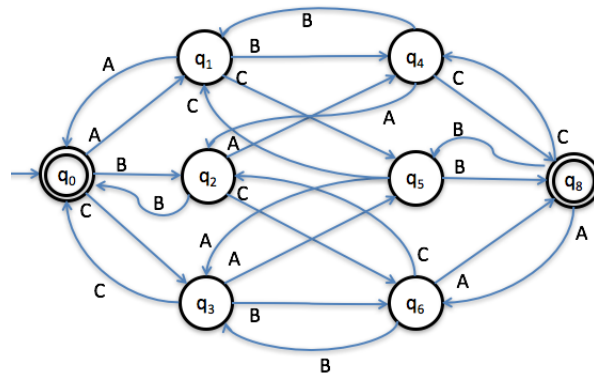
**Infinite and regular [1 mark]**



[Correct states: 4 marks, correct transitions 4 marks, Correct accepting state 1 mark]

- (d) [Bonus 5 marks]  $L = \{\sigma \in \{A, B, C\}^* \mid |\sigma|_A \equiv |\sigma|_B \pmod{2} \wedge |\sigma|_A \equiv |\sigma|_C \pmod{2}\}$

Infinite and regular [1 mark]



[Correct states: 2 marks, correct transitions 2 marks]

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Summer 2019

Student Name	Login ID	Student Number	Student Signature

	Mark
Question 1	/5
Question 2	/20
Question 3	/25
Bonus	/5
<b>Total</b>	<b>/50</b>

Comments:

Assignments are due by 9:00am on the due date before class and should include this cover page. Assignment *must* be submitted electronically via Brightspace. Please submit a PDF. You can do your work on paper and then scan in and submit the assignment.

Plagiarism in assignment answers will not be tolerated. By submitting their answers to this assignment, the authors named above declare that its content is their original work and that they did not use any sources for its preparation other than the class notes, the textbook, and ones explicitly acknowledged in the answers. Any suspected act of plagiarism will be reported to the Faculty's Academic Integrity Officer and possibly to the Senate Discipline Committee. The penalty for academic dishonesty may range from failing the course to expulsion from the university, in accordance with Dalhousie University's regulations regarding academic integrity.