

COMP 3803 — Assignment 2

Due: Thursday October 21, 23:59.

Assignment Policy:

- Your assignment must be submitted as one single PDF file through Brightspace.

Use the following format to name your file:

LastName_StudentId_a2.pdf

- **Late assignments will not be accepted. I will not reply to emails of the type “my internet connection broke down at 23:57” or “my scanner stopped working at 23:58”, or “my dog ate my laptop charger”.**
- You are encouraged to collaborate on assignments, but at the level of discussion only. When writing your solutions, you must do so in your own words.
- Past experience has shown conclusively that those who do not put adequate effort into the assignments do not learn the material and have a probability near 1 of doing poorly on the exams.
- When writing your solutions, you must follow the guidelines below.
 - You must justify your answers.
 - The answers should be concise, clear and neat.
 - When presenting proofs, every step should be justified.

Question 1: Write your name and student number.

Question 2:

- Consider the language A consisting of all binary strings that end with an even, and non-zero, number of 0s. Give a regular expression that describes the language A . As always, justify your answer.
- What is the language described by the following regular expression:

$$(0 \cup 1)^*(00)^*00.$$

As always, justify your answer.

Question 3: Give regular expressions describing the following two languages. In both cases, the alphabet is $\{a, b\}$. Justify your answers.

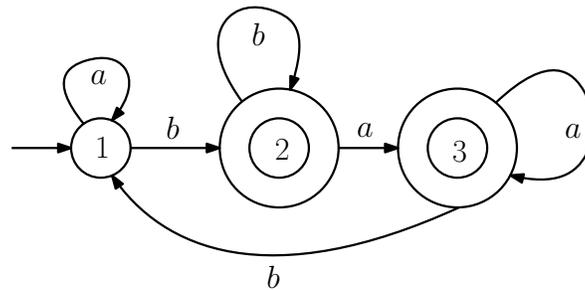
- $\{w : \text{the number of } a\text{'s in } w \text{ is a multiple of three}\}$.
- $\{w : w \text{ does not contain } aaa\}$.

Question 4: Use the construction given in class to convert the regular expression

$$(a \cup b)^* aa(a \cup b)^*$$

to an NFA. Do not simplify your NFA; just apply the construction rules “without thinking”.

Question 5: Use the construction given in class to convert the following DFA to a regular expression.



Question 6: Let A be a regular language with alphabet $\{a, b\}$, and let

$$B = \{uv : u \in A, v \in \{a, b\}^*, |v| = 2\},$$

where $|v|$ denotes the length of the string v . Prove that B is a regular language. Your proof must use the fact that a language is regular if and only if there exists a regular expression that describes the language.

Question 7: Prove that the following languages are not regular.

1. $\{a^n b a^m b a^{n+m} : n \geq 0, m \geq 0\}$.
2. $\{w \in \{a, b\}^* : w \text{ is not a palindrome}\}$.
(Remark: A string $w = w_1 w_2 \cdots w_n$ is a palindrome, if $w_1 w_2 \cdots w_n = w_n \cdots w_2 w_1$. For example, each of $abba$, ϵ , and b is a palindrome.)
3. $\{ucu : u \in \{a, b\}^*\}$. (The alphabet is $\{a, b, c\}$.)
4. $\{aba^2 ba^3 b \cdots a^n b : n \geq 0\}$.