Stellenbosch University Computer Science Assignment Declaration

I know that using another person's ideas (including written work and source code) and claiming them as my own constitutes plagiarism. I am aware that the potential penalties for this offence, as specified in the University's policy on academic integrity, may include expulsion from the University and other serious consequences.

1. This submission is entirely my own work, excepting the inclusion of resources explicitly permitted for this assignment, and assistance as noted in the following item. I have not used any generative AI technology or tools (such as ChatGPT), unless explicitly permitted in the assignment.

2. My submission acknowledges the source of all libraries and external sources used, and identifies any other students and/or staff (including demis, tutors, and lecturers) with whom I have discussed this assignment, as well as the extent of those discussions. Note that, unless explicitly stated otherwise, submissions or solutions to assignments in previous courses at this University or any other educational institution which even partly correspond to this assignment may not be used as external sources; in particular, do not look at or use solutions to assignments from previous years.

3. I have not allowed, and will not in the future allow, anyone to copy any portion of my work, or give them access to it in any way. In addition, I will not make my work publicly available in any way, including posting my code in public source code repositories or forums, unless explicitly permitted by the lecturer.

4. I have not and will not facilitate plagiarism, such as by distributing any written work or source code created by a fellow student.

5. I understand that any code I submit may be inspected for plagiarism detection (either manually or by automated systems) and be retained for detecting plagiarism in other courses.

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Signature / *Handtekening* | *[signature]*

Please fill out and submit a scan or photo together with your homework. Submissions without signed declaration will not be marked.

Question 1. Show whether the following regular expressions describe identical languages, by either giving a counter-example (i.e., a word matched by one expression, but not the other) or constructing and comparing the corresponding minimal DFAs.

1. $(a^* b^*)^* \stackrel{?}{\equiv} (b \mid a)^*$ **2.5 marks.**

2. $(a^* b^*)^* \stackrel{?}{\equiv} (b^* \mid a^*)^*$ **2.5 marks.**

3. $(a^* b^*)^* \stackrel{?}{\equiv} (b^* a^*)^*$ **2.5 marks.**

4. $a^* b^* (b^* a^*)^* \stackrel{?}{\equiv} ((a^+ b^+)^* b^* a^*$ **2.5 marks.**

Notes:
1. If you are showing equivalence, you must use the McNaughton/Yamada/Thompson construction and show the resulting NFA as well. You must also use the subset construction to convert this NFA into a DFA, and show the DFA before minimization as well.

Question 2.
Use the ANTLR system to write a lexer and parser for the ALAN language; more details of the language are contained in the ALAN Project Specification document on the sunlearn course page. You must implement the language as specified in Sections 3.1.1 to 3.1.4, Figure 3.1, and Table 3.1. You must also implement the length restrictions in Section 3.1.4, i.e., your grammar must reject programs with identifiers longer than 32 characters. You must not enforce the restriction on integer literals specified in Section 3.1.5.

Your grammar must have the name `alan` so it can work with the our driver program. You must submit all ANTLR grammar files, and all auxiliary sources (if any). Marks will be given for performance over a test suite and the general quality of the submission. Document your grammar and nicely layout your ANTLR files.

90 marks.

Notes:
1. The ANTLR system is available at `www.antlr.org`. Please use ANTLR v4 (preferably v4.13.1), *not* ANTLR v3 (which uses a different input notation).
2. Please use ANTLR's built-in Java target, and do not generate code for a different language.
3. There are several support tools and IDEs for ANTLR, including some IDE plugins, that are available `https://www.antlr.org/tools.html`.
4. You can merge lexer and parser specification into a single ANTLR grammar, or keep them apart.
5. You must use ANTLR's built-in mechanism to report errors to the user. You must not implement the specific error messages specified in Sections 3.2 and 4.3. You do not need to specify any advanced error recovery.
6. Grammars are software as well, so layout and documentation are important. Use the names from the language specification, as far as possible.

Submission:

1. Submission deadline is **March 7, 2024, 17:00**.
2. Please submit all files on your Gitlab repository. Please create a directory `assignment1` for this submission.
3. Please submit a pdf or jpeg image of your signed declaration statement.
4. For Question 1, you can submit a pdf scan or jpeg image of a handwritten solution.
5. For Question 2, please submit all *source* files that are required to build a running version; please don't submit any ANTLR jars or any generated Java files.
6. We will be using ANTLR v4.13.1 and Java 17 for marking.