Comments: Please see the attached.
General Remarks

There were 186 students who sat the exam. The median mark was 39 out of 60, with the mean mark 38.5. There were 21 students with a mark below 40%, 9 of these being below 30%. Some of these students may be able to pass the unit with suitable coursework marks. The lowest mark achieved was 7. There were 82 students who achieved first class marks (70% or above) in the exam.

Answers were distributed as follows: 181 answered Q1, 184 answered Q2, 122 answered Q3 and 68 answered Q4. Table 1 below gives an overview of the performance across questions, along with a breakdown corresponding to degree classifications (fail, third, lower and upper second and first).

<table>
<thead>
<tr>
<th>Question</th>
<th>Attempts</th>
<th>&lt;7</th>
<th>8–9</th>
<th>10–11</th>
<th>12–13</th>
<th>14+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>181</td>
<td>32</td>
<td>17</td>
<td>20</td>
<td>22</td>
<td>90</td>
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<tr>
<td>Q2</td>
<td>184</td>
<td>12</td>
<td>5</td>
<td>12</td>
<td>31</td>
<td>124</td>
</tr>
<tr>
<td>Q3</td>
<td>122</td>
<td>44</td>
<td>11</td>
<td>8</td>
<td>16</td>
<td>43</td>
</tr>
<tr>
<td>Q4</td>
<td>68</td>
<td>16</td>
<td>2</td>
<td>4</td>
<td>9</td>
<td>37</td>
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<tr>
<td>Overall</td>
<td>186</td>
<td>21</td>
<td>20</td>
<td>28</td>
<td>35</td>
<td>82</td>
</tr>
</tbody>
</table>

Table 1: Performance breakdown

Section A

Question 1

The overall performance on Question 1 was good, with a mean of 12.5 (62.7%) and median score of 13 (65%). Nearly half the students scored 14 or over.

1 a) An overall observation here was that there was a lack of consistency between the answers. In many cases, the languages defined by the regular expression in part i), the DFA in part ii) and the grammar in part iii) were different. The most common mistake was to not include a clause in the regular expression to match words of the form \(aab, aabb, aaba, \ldots\). The DFAs given, however, \textit{did} tend to recognise these strings. The answers here were marked leniently, giving credit where appropriate for consistency between answers or answering the question correctly.

There were only a small number of correct answers given to part iv) – this part would have required students to have worked through the Appendix.
The mean mark for 1 a) was 5.5 out of 9 (61%).

1 b) Part b) was answered well. A significant number of students gave an automaton directly without any obvious working. This is a dangerous strategy though – incorrect answers with no obvious working were penalised heavily, while incorrect answers that exhibited understanding of the algorithms were given partial credit.

The mean mark for 1 b) was 5.6 out of 8 (70%).

1 c) This was the least well answered part of Question 1. Many answers failed to address the actual question, which was asking for a description of how one would produce a regular expression which was the intersection of two given regular expressions. There was confusion about the notion of intersection – some answers described concatenation or union.

The mean mark for 1 c) was 1.4 out of 3 (48%).

**Question 2**

Question 2 was answered well, with a mean of 14.7 (73.4%) and mode of 15 (75%). The question was similar to those set in previous years, suggesting that this year’s cohort have an improved grasp on this material. Regrettably, the question paper included errors – this has been factored into the marking process.

2 a) Most students answered this question correctly. Marks were generally lost for inadequate explanations as to why the languages were regular or not. For example, just stating that the language is regular because we can find a regular expression (or DFA) that defines the language was not enough to gain the additional mark – this is just re-stating the definition of a regular language. The regular expression or automaton should be given.

The mean mark for 2 a) was 3.3 out of 4 (83%)

2 b) Again, this question was answered well. Marks were generally lost for failing to justify answers – for example not supplying a word with multiple parse trees when showing the ambiguity of the grammar.

The mean mark for 2 b) was 5.1 out of 6 (85%)

2 c) This question contained an error in the diagram. Most students tackled the amended question, although the algorithm taught during the course unit can be applied successfully to an NFA. Approximately one third of the answers identified the correct regular expression, either through guesswork or application of the algorithm. Marks were lost for incorrect (expressions matching words not recognised by the automaton) or incomplete (expressions not matching words recognised by the automaton) solutions. If the algorithm was recalled correctly, but with a single error in its execution, a mark was lost. Further marks were lost for additional errors. Similarly, if the algorithm was recalled incorrectly, but intermediate steps were applied appropriately, a small penalty was applied.

The mean mark for 2 c) was 3.5 out of 5 (70%)

2 d) Answers were reasonable here, but this was the least well tackled part of Question 2. In some cases it was unclear whether the answer was stating that a simulation existed or not. There were a large number of answers that correctly identified that a simulation can be defined from Automaton B to Automaton A, but gave an incorrect simulation. The most common mistake was to pair states (2, C). State 2 has an a transformation to state 3, while state C has no a transformation. This pair should thus not appear in the simulation. Similarly, (4, D) was included erroneously in a number of answers.

The mean mark for 2 d) was 2.8 out of 5 (55%)

**Section B**

It may seem surprising, but attending the lectures in the second half of the course turns out to make a big difference to whether you get lots of marks or next to none. As Dave advised in the lectures – for those of
you who weren’t there – “if you attempt two of my questions and one of Sean’s then you are likely to do very well”. And so it transpired that of the five people who did more than just the bookwork in Section B, four got 100% in both questions, and the fifth candidate got 100% in Q4 and 60% in Q3.

Q3

Question 3 had a mean mark of 11.2 (56%).

3 a) A lot of people just told us how the program executes, what will help you is to spot that this is floor(sqrt(x)).

3 b) Generally well done.

3 c) Again generally well done.

3 d) A surprising number of people committed to explain the final part (linear-time). Another common mistake was to talk about Big Omega and Big-Theta.

3 e) If attempted this was done well.

3 f) Considering this is a tricky question, many good attempts were received.

Q4

Question 4 had a mean mark of 13.5 (67%).

4 a) Once more, usually correct. Although many candidates omitted to explain what a characteristic function is.

4 b) Usually well done. One candidate used Church-Turing here, which makes their solution rather better than the model answer! Well done!

4 c) This is tricky. The main point to observe is that in this case p(x) has to return true, and f(x) has to be computable. We do not care about g(x).

4 d) This discursive question was generally well done.

4 e) Again, most serious attempts at this question achieved high marks.