Curtin University

Department of Computing

EXAMINATION SUMMARY

End of Semester 2, 2017

COMP3002 Theoretical Foundations of Computer Science

This paper is for Bentley Campus students

This is a CLOSED BOOK examination

Examination paper IS to be released to student

Examination Duration   3 hours

Reading Time   10 minutes

Notes in the margins of exam paper may be written by Students during reading time

Total Marks   100

Supplied by the University

1 x 16 page answer book

Supplied by the Student

No calculators are permitted in this exam

Instructions to Students

Attempt all sections. For each section, follow the instructions for that section.

Show your reasoning for all questions.

No marks will be awarded for answers that have no reasoning or justification.

For Examiner Use Only

Q	Mark
1	
2	
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Examination Cover Sheet

Total _____

Section 1 - Classification

Problems 1 to 6 in this section each describe a problem in English, set notation or in terms of strings. It is your task to do the following, where applicable, for each of these problems:

1. Classify the problem into the appropriate category; Regular, Context-Free, Turing Decidable, or Undecidable (T1-T4). **(2 marks)**
2. For a problem that is <u>Regular</u>, prove that this is the case by constructing either a DFA, a NFA, or a Regular Expression that accepts the language of the problem. **(4 marks)**
3. For a problem that is <u>Context-Free</u>, do both of the following:
    a. Prove that the problem is not Regular using the pumping lemma, and **(5 marks)**
    b. Prove that the problem is Context-Free by constructing either a PDA or CFG that accepts the language of the problem. **(5 marks)**
4. For a problem that is <u>Turing Decidable</u> do all of the following:
    a. Prove that it is not Context-Free using the pumping lemma for Context-Free grammars, and **(7 marks)**
    b. Prove that the problem is Turing Recognizable by constructing a Turing Machine, and **(7 marks)**
    c. Prove that the Turing Machine constructed is a decider. **(4 marks)**
    <u>Alternatively</u>, instead of a-c above you may choose to prove that a problem is <u>Turing Decidable</u> by reduction to and from a known Turing Decidable problem. **(18 marks)**
    <u>Also</u>, some problems don't lend themselves to Pumping Lemma proofs as required for a. above. In that case you can argue why the problem is not context free AND why a pumping lemma proof isn't appropriate.
5. For a problem that is <u>Undecidable</u>, prove this using reduction from A_{TM}. **(18 marks)**

Problem 1:
<redacted>

Problem 2:
<redacted>

Problem 3:
<redacted>

Problem 4:
<redacted>

Problem 5:
<redacted>

Problem 6:
<redacted>

END OF SECTION

Section 2 - Complexity.

Choose one of the problems in this section. For this problem, classify it as being a member of P, NP, NP-Complete or NP-Hard and then prove this classification. When proving membership of NP-Complete or NP-Hard by reduction, use SAT, 3-SAT or 3-COLOR as the problem to reduce to and/or from.

Attempt only one of the questions in this section. If you attempt more than one, only the first question attempted will be marked and any others will be ignored.   **(20 marks)**

Problem 1:

<redacted>

Problem 2:

<redacted>

END OF SECTION

Section 3 – Short Answer.

For each of the questions in this section, do the following:

- If asked whether a statement is <u>true</u> or <u>false</u>, state this clearly. You should specifically use one of these two words. If you believe that the statement is both (perhaps with conditions) write "both true and false" or if you believe that it is neither write "neither true nor false".

- If asked to give any other opinion or classification, state it clearly.

- Justify your answer or opinion. <u>Answers without justification will be awarded zero (0) marks.</u>

Question 1:

\<redacted\>

(3 marks)

Question 2:

\<redacted\>

(3 marks)

Question 3:

\<redacted\>

(4 marks)

END OF EXAMINATION