香 港 中 文 大 學
The Chinese University of Hong Kong

Course Examination 1st Term, 2009- 2010

Course Code & Title : **CSC3130: Formal languages and automata theory**

Time allowed   : **2 hours**

Student I.D. No.   : .... Seat No. : ....

Questions 1–2:   ....

Questions 3–4:   ....

Questions 5–6:   ....

Questions 7–8:   ....

Questions 9–10:   ....

Total: _____

The exam consists of 10 questions, worth 10 points each. In each of the questions you are given a statement with a true/false choice. Circle one of the choices and explain your answer. It is always to your advantage to circle a choice *and* explain your answer.

Possibly useful facts:

- A_{TM} = { $\langle M, w \rangle$: TM M accepts input w } is recognizable but not decidable.
- $SOME_{TM}$ = { $\langle M \rangle$: TM M accepts some input } is recognizable but not decidable.
- $\overline{A_{TM}}$ = { $\langle M, w \rangle$: TM M does not accept input w } is not recognizable.
- ALL_{CFG} = { $\langle G \rangle$: CFG G accepts all inputs } is not decidable.
- $CLIQUE$ = { $\langle G, k \rangle$: Graph G has a clique of size k } is NP-complete.

1. The following language is **regular** over alphabet $\Sigma = \{0, 1, 2\}$:

   $L = \{x : x$ contains at least one 0, at least one 1, and at least one 2$\}$.

   true   **false**

2. For every regular L, the minimal DFA for L has fewer states than the minimal DFA for L^*.

   true   **false**

3. If L is regular over $\Sigma = \{0, 1\}$, then $L' = \{uxv : x \in L, u, v \in \Sigma^*\}$ is also regular.

true   **false**

4. The CFG $S \rightarrow \mathtt{a}S\mathtt{b} \mid \mathtt{b}$ is $LR(0)$.

true   **false**

5. The CFG $S \rightarrow 00S1S \mid 0S1S0 \mid \varepsilon$ describes a **regular** language.

<div align="center">

true   **false**

</div>

6. The language $L = \{0^i 1^k 0^j 1^k : i, j, k \geq 0\}$ is **context-free**.

<div align="center">

true   **false**

</div>

7. The language $L = \{\langle M \rangle : \text{TM } M \text{ accepts some input of length 1}\}$ is **decidable**.

<div align="center">

true   **false**

</div>

8. The language: $L = \{\langle G \rangle : \text{CFG } G \text{ generates all strings except } \varepsilon\}$ is **decidable**. (Assume the alphabet of G is $\Sigma = \{0, 1\}$.)

<div align="center">

true   **false**

</div>

9. The language $L = \{\langle M \rangle : \text{TM } M \text{ accepts some input of the form } xx^R.\}$ is **recognizable**.

<div align="center">

true   **false**

</div>

10. The following language is **NP-complete** (i.e., it is in NP *and* it is NP-hard):

$$L = \{\langle G, k \rangle : G \text{ is a graph that has two or more cliques of size } k.\}$$

<div align="center">

true   **false**

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- End -

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