

# Formal Languages and Automata Assessment Test December 4, 2019

Total 20 points

1. [2 points] Give an example of a language which is context-free but not regular.
2. [2 points] Give an example of a language which is recursive but not context-free.
3. [2 points] Give an example of a language which is recursively enumerable but not recursive.
4. [2 points] Draw an NFA with 4 states which accepts the language described by the regular expression  $(a + b)^*a(a + b)(a + b)$
5. [3 points] Suppose that, next year, someone finds a polynomial time algorithm for the Knapsack problem. What would be the consequences?

6. [4 points] Give two examples of decision problems (that is, 0/1 problems) that are known to be  $\mathcal{NP}$ -complete.

7. [5 points] Which of the following classes of languages are closed under intersection? (For each part, write “Yes” if that class is closed under intersection, “No” if it is not, and “Open” if it is not currently known whether that class is closed under intersection.)

- (a) Regular languages.
- (b) Context-free languages.
- (c)  $\mathcal{P}$ -TIME languages.
- (d) Recursive languages.
- (e) Recursively enumerable languages.