**COMS W3261 CS Theory: Homework 3. Assigned Oct 30, 2017.**
**Answers in PDF due Nov 10, 2017 on Courseworks/COMSW3261/Assignments.**

**Each problem is worth 20 points. You can discuss problems with others but your answers must be in your own words. Late assignments cannot be accepted.**

1. **Show that a one-tape Turing machine that never moves its tape head left is equivalent to a deterministic finite automaton.**

2. **Formally define a Turing machine $M$ that given a binary string on its input tape adds one to it and leaves the result on the input tape. Show the sequence of moves your Turing machine $M$ makes on the input 1011 starting off from the configuration $q_0 1011$ where $q_0$ is the initial state of $M$.**

3. **Show that there are potentially nine distinct ways of classifying a language $L$ and its complement $\overline{L}$ as being (a) recursive, (b) recursively enumerable but not recursive, and (c) not recursively enumerable. Which of these ways are actually possible?**

4. **Are the recursive languages closed under the Kleene star operator? Briefly justify your answer.**

5. **Is the language $L = \{w_i \,|\, M_i$ does not halt on $w_i\}$ recursively enumerable? Here $w_i$ is an encoding the $i^{th}$ input string and $M_i$ is an encoding of the $i^{th}$ Turing machine. Use reductions as needed to prove your answer.**

6. **Is the language $L = \{M \,|\, M$ does not halt on $\epsilon\}$ recursively enumerable? Here $M$ is an encoding of a Turing machine. Use reductions as needed to prove your answer.**

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