Name: Key **CS301 Q8**

1. Consider the proof that every multitape Turing machine has an equivalent single-tape Turing machine.

   (a) **(__ /2 pts)** How does the simulation machine first format its tape given the input string $w = w_1 w_2 \ldots w_n$?

   $\# \dot{w}_1 w_2 \cdots w_n \# \dot{\sqcup} \# \dot{\sqcup} \# \cdots \#$

   (b) **(__ /2 pts)** Describe how the simulation machine handles the situation where there is no room on a simulated tape to write a new next symbol.

   All symbols on the simulation's tape to the right of (and at) that location are copied one space to the right. Think: array insertion.

2. Consider the proof that every nondeterministic Turing machine has an equivalent deterministic Turing machine.

   (a) **(__ /2 pts)** Briefly describe the purposes of the three tapes used in the simulation machine.

   input tape: stores and preserves input string. Never changes.
   simulation tape: acts as the tape used on a single branch of nondeterminism
   address tape: describes which branch of nondeterminism is being simulated.

   (b) **(__ /2 pts)** Describe what the simulation address of |1|3|2| means.

   Each element of $Q \times \Gamma \times \{L, R\}$ is labeled as 1, 2, 3, 4, ..., b.
   132 tells the simulation machine to choose the branch of nondeterminism which follows the transition function's output labeled as 1, then 3, then 2 (if possible).

3. **(__ /2 pts)** Describe a reasonable encoding $\langle G \rangle$ for directed graphs G with labeled edges.