Quiz 4

1. Recall that for a language L the shift of L is defined as $shift(L) = \{vu | u, v \in \Sigma^*, uv \in L\}$. For which of the following languages, does it hold that $shift(L) = L$?

   (a) $\{a^n b^n : n \geq 0\}$

   (b) $\{ww^r : w \in \{a, b\}^*\}$

   (c) $\{a^n b a^m : n, m \geq 0\}$

   (d) $\{(ba)^n : n \geq 0\}$

2. When we prove the pumping lemma, we apply the pigeonhole principle to a DFA executed on a sufficiently long string. What are pigeons associated with and what are holes associated with?

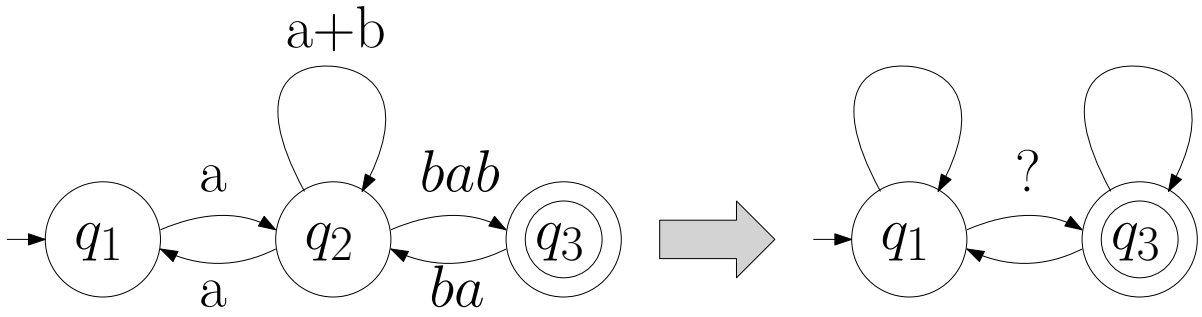
   (a) pigeons are transitions and holes are accepting states

   (b) pigeons are states and holes are transitions

   (c) pigeons are transitions and holes are states

   (d) pigeons are states and holes are symbols of the alphabet

3. Eliminating state $q2$ from the following GTG using the procedure from the class, what regular expression will be on the arrow from q_1 to q_3?



(a) $a(aa)^*(a+b+bab+ba)^*bab$

(b) $aa^*(a+b)^*(babba)^*$

(c) $a(a+b+bab)^*ba$

(d) $a(a+b)^*bab$

4. Which of the following languages is regular?

(a) $\{a^{n!} : n \geq 0\}$

(b) $\{a^{2^n} : n \geq 0\}$

(c) $\{a^{n^2} : n \geq 0\}$

(d) $\{a^{2n} : n \geq 0\}$

5. What is the language generated by the grammar below?

$$S \to aaaA$$

$$A \to aA|B$$

$$B \to bbC$$

$$C \to bC|\lambda$$

(a) $\{a^n b^m : n \geq 0, m \geq 0\}$

(b) $\{a^n b^m : n \geq 4, m \geq 3\}$

(c) $\{a^n b^m : n \geq 3, m \geq 2\}$

(d) $\{a^n b^m : n \geq m \geq 2\}$