Quiz 9

1. Consider the languages L_1 and L_2 defined as follows:

$$L_1 = \{a^m b^n c^k : m, n, k \geq 0\}$$
$$L_2 = \{a^m b^n c^k : m, n, k \geq 0, m \neq k\}$$

Of the following statements, which one is FALSE?

(a) L_2 is context-free.

(b) The intersection $L_1 \cap L_2$ is context-free.

(c) The complement of L_2 is context-free.

(d) The complement of L_1 is context-free but not regular.

2. Deterministic context-free languages are closed under which operations?

   (a) Union

   (b) Intersection

   (c) Regular intersection (Intersection with regular languages)

   (d) All of the above

3. Which of the following are deterministic context-free languages?

$$L_1 = \{0^n 1^n : n \geq 0\}$$
$$L_2 = \{w2w^R : w \in \{0,1\}^*\} \qquad (w^R \text{ is the reverse of } w)$$
$$L_3 = \{ww^R : w \in \{0,1\}^*\}$$

(a) L_1 only

(b) L_2 only

(c) L_1 and L_2 only

(d) L_1, L_2, and L_3

4. Of the following languages, how many are context-free?

$$L_1 = \{a^n b^n a^n b^n : n \geq 0\}$$
$$L_2 = \{a^n b^n a^m b^m : n \geq 0, m \geq 0\}$$
$$L_3 = \{a^n b^n a^m b^m : n \geq 0, m \geq n\}$$
$$L_4 = \{a^n b^m a^n b^m : n \geq 0, m \geq 0\}$$

(a) 0

(b) 1

(c) 2

(d) 3

5. In the proof of pumping lemma for CFLs, the integer m is chosen to be so large in order to guarantee that for any string $w \in L$ with $|w| \geq m$, ...

   (a) some variable A repeats anywhere in the derivation of w.

   (b) some variable A repeats on a path from the root to a leaf of a derivation tree for w.

   (c) some state of a PDA for L repeats when w is processed.

   (d) the stack of a PDA for L is emptied when w is processed.