Quiz 9

1. How many of the following languages are context free?

$$\{a^n b^n a^m b^m : n \geq 0, m \geq 0\}$$
$$\{a^n b^n a^m b^m : n \geq 0, m \geq n\}$$
$$\{a^n b^n a^m b^m : n \geq 0, m \leq n\}$$
$$\{a^n b^k a^\ell b^m : n, k, \ell, m \geq 0\}$$

(a) 1

(b) 2

(c) 3

(d) 4

2. How many of the following languages are context free?

$$\{a^n b^{5n} : n \geq 0\}$$
$$\{a^{n^2} b^n : n \geq 0\}$$
$$\{a^{n!} b^n : n \geq 0\}$$
$$\{a^{5n} b^{3n} : n \geq 0\}$$

(a) 1

(b) 2

(c) 3

(d) 4

3. Let $L_1 = \{c^n a^m b^m : n, m \geq 0\}$ and $L_2 = \{c^m a^m b^n : n, m \geq 0\}$. Then we have

   (a) L_1 is context-free but not deterministic context-free

   (b) L_2 is context-free but not deterministic context-free

   (c) $L_1 \cap L_2$ is context-free but not deterministic context-free

   (d) $L_1 \cap L_2$ is not context-free

   (e) None of the above

4. **Deterministic** context free languages are closed under:

   (a) Intersection

   (b) Union

   (c) Regular intersection

   (d) All of the above

   (e) None of the above

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

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

   (b) some variable repeats on a root-to-leaf path in the derivation tree of w

   (c) some state of a PDA repeats when the PDA is executed with w as input

   (d) stack of a PDA is emptied when the PDA is executed with w as input