CS 321 Quiz 5 (20 min., 5 pts) November 6, 2015

Last Name = _____, First Name = _____

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1. (3 pts) Prove the following languages over $\Sigma = \{a, b\}$ are **not** regular, and write context-free grammars for them if possible, otherwise explain:

   (a) $A = \{a^n b^m \mid n \geq 2m, \text{ and } m \geq 0\}$.

   Proof: Assume A is regular, then there exists a pumping length p such that all strings $s \in A$ where $|s| \geq p$ can be decomposed into xyz where $|xy| \leq p$ and $|y| > 0$ so that $xy^i z \in A$ for all $i \geq 0$.

   Now pick $s =$

   context-free grammar or explain if impossible:

   (b) $B = \{w \in \{a, b\}^* \mid w \text{ has twice as many } a\text{'s as } b\text{'s}\}$.

   context-free grammar or explain if impossible:

2. (2 pts) Write context-free grammars (you only need to write rules) for

   (a) $\{a^{2n} b^n c^m d^{3m} \mid n \geq 0, m \geq 0\}$

   (b) palindrome bitstrings (e.g., 010, 11, 1001, 0); <u>not</u> the same as ww^R!