

# Breadth Exam in Formal Language Theory

## Fall 2008

Duration: 90 Minutes

Format: Closed-book, Closed-notes, Closed-computers

### Question 1 (25 points)

Find a context-free grammar  $G$  such that  $L(G) = \{0^i 1^j 2^k 3^l \mid i, j, k, l \in \mathbb{N} \text{ and } i \neq j \text{ and } k \neq l\}$ .

### Question 2 (75 points)

Let  $X = \{w \in \{0, 1\}^* \mid \text{neither } 00 \text{ nor } 11 \text{ is a substring of } w\}$ .

(a) Find a DFA  $M$  such that  $L(M) = X$ . [25 points]

(b) Prove that your answer to Part (a) is correct. Make your proof as complete and rigorous as possible. [50 points]