

The fourth exam will be given in class on Monday, April 27. If you have an unavoidable conflict with the date of an exam, please see me as soon as possible (before the exam date!) to discuss options for rescheduling. Last minute rescheduling/extensions will not be accommodated for something known about in advance.

This exam covers the remainder of chapter 3 (section 3.7) and most of chapter 4 (sections 4.1–4.4). Section 4.6 (general grammars) will be covered on the next exam.

Many of the questions on the exam will be similar to problems on the homeworks. There may be some “short essay” questions that ask you to define something, or discuss something, or explain something, and so on.

Terms and ideas that you should be familiar with:

- the Pumping Lemma and showing that a language isn’t regular
- examples of languages that are not regular, such as:
 - $\{ a^n b^n \mid n = m \}$
 - $\{ a^n b^m c^k \mid k = n + m \}$
 - $\{ w \in \{a, b\}^* \mid w = w^R \}$
 - $\{ w \in \{a, b\}^* \mid n_a(w) < n_b(w) \}$
 - $\{ ww \mid w \in \{a, b\}^* \}$
 - $\{ a^n b^n c^n \mid n \in \mathbb{N} \}$
 - $\{ a^{n^2} \mid n \in \mathbb{N} \}$
 - $\{ www \mid w \in \{a, b\}^* \}$
- CFGs (Context-Free Grammars)
- production rules; non-terminal and terminal symbols; start symbol
- definition of a CFG as a list of 4 things, $G = (V, \Sigma, P, S)$
- derivation (of a string from the start symbol of a CFG)
- the language, $L(G)$, generated by a CFG G ; context-free language
- if L and M are context-free languages, then so are $L \cup M$, LM , and L^*
- every regular language is context-free
- examples of languages that are context-free but not regular, such as:
 - $\{ a^n b^n \mid n = m \}$
 - $\{ a^n b^m c^k \mid k = n + m \}$
 - $\{ w \in \{a, b\}^* \mid w = w^R \}$
 - $\{ w \in \{a, b\}^* \mid n_a(w) < n_b(w) \}$
- parsing
- parse tree
- left derivations and right derivations

- how a parse tree corresponds to a derivation
- pushdown automaton
- transition diagram of a pushdown automaton
- definition of a pushdown automaton as a list of six things $(Q, \Sigma, \Delta, q_0, \partial, F)$ and what each thing means
- what it means for a pushdown automaton to accept a language
- deterministic pushdown automaton
- deterministic context-free language

Tasks you could be asked to perform include:

- use the Pumping Lemma to prove that a language is not regular
- give a (left, right) derivation for a given string from a given CFG
- draw a parse tree for a given string from a given CFG
- describe the language generated by a given CFG
- find a CFG for a given language

- describe the language accepted by a given PDA
- draw a transition diagram for a PDA that accepts a given language
- show that a given language is deterministic context-free