The midterm will be held in class on Friday November 5. The exam will have space for your answers (no Blue Books needed). Although the exam is closed-book, closed-notebook, you may have one 3 × 5 card of notes written in your own hand (no photo-reduction, micro-fiche, smart paper or electronic storage of any form). Calculators are not allowed.

The topics I feel we have covered (and fair game for midterm questions) are listed below. This (roughly) corresponds to chapters 1 through 6, as well as the induction handout and the removing epsilon transition handout on the class web page. The midterm will probably have one proof by induction question. Sections 2.4, 3.2.2, 3.3, 3.4, 4.2.4, 4.2.5, and 5.3 were assigned reading, but not deeply covered in lecture, and there was no homework relating to Section 6.3 (equivalence between CFG and PDAs), so midterm questions on this material will be limited to short-answer rather than testing detailed understanding. The midterm will not cover material from Sections 5.4 and 6.4.

1. Proofs and proving equivalences of sets (or languages)
2. Induction, including: inductive hypotheses, IH(\(n\)); weak induction, strong induction, structural inductions (e.g. on the length of a string or number of productions in a derivation), and mutual induction.
3. General concepts: Alphabets, strings, languages, problems
4. DFA’s, NFA’s, \(\epsilon\)-NFA’s, their formal definitions and their differences
5. Transition diagrams, transition tables, and extended transition functions
6. Conversions between finite automata:
   (a) subset construction
   (b) removing \(\epsilon\)-transitions,
7. Regular expressions
8. building \(\epsilon\)-NFA from a regular expression
9. constructing a regular expression from a DFA (splicing paths)
10. Regular Languages
    (a) pumping lemma to show a language is not regular
    (b) basic closure properties: union, concatenation, Kleene-\(^*\), complement, reversal, the cross-product construction, intersection, difference,
    (c) tests for emptiness, infiniteness, equivalence, and containment of regular languages
11. The marking algorithm and how to find a minimum state DFA
12. Context Free Grammar definitions and basics, including: variables, terminals, productions, derivations, and left-most derivations
13. Parse trees, their yields, and relationships to derivations
14. Pushdown automata (PDA) basics: formal definitions, semantics, graphical notation
15. PDA instantaneous descriptions (IDs), ⊢, and ⊢∗
16. Acceptance by final state, acceptance by empty stack, and converting between them.
17. Equivalence of PDAs and CFGs (see comment above)