1 221 Homework Assignments

- Homework assignments are assigned by \textit{chapter}, not by week. You’ll be able to tell, by looking at the problems, what you are responsible and not responsible for each week, simply by knowing what has been covered in class.

- There will be material presented in class that is not covered in Sipser; there is material in Sipser that will not be presented in class.

- You are responsible for all material presented in class.

- Quiz material covers all material presented in class, up to, and including, the last class.

1.1 ”Approximate” Quiz Topics

- Set Theory
- Functions
- Logic
- Relations and Graphs
- Closure of relations and recursive definition of languages
- Regular sets and regular expressions
- Deterministic FA
- NFA → DFA conversion
- NFA-\lambda → DFA conversion, DFA minimization
- FA → Re
- RL, RL → FA, FA → RL, CFG derivations
- RGs, CFGs
- PDAs, CGF → PDA conversion
- Turing Machines
1.2 Assignments

Homework is assigned as readings in the chapters from Sipser and as sets of problems which correspond to chapters and sections in the text. Selected answers will be handed out in class.
Math

Sipser Reading
Ch 0: read pp 1-25.

Sipser Problems
Do exercises 0.1-0.9.

Additional Resources:
Schaum’s
Chapter 1: Set Theory
Chapter 2: Relations
Chapter 3: Functions and Algorithms
Chapter 4: Logic and Propositional Calculus

Additional Problems:
1. Define set subtraction, \( X - Y \), using the set operations complement, union, and/or intersection.
   Hint 1: You need set complement. Hint 2: You need either union or intersection.

2. Let set \( S \) contain marbles of different colors and sizes. Several partitions of \( S \) can be constructed. If we divide the marbles up so that each pile (subset) of marbles has the same color, this is a partition of \( S \).
   (a) Show that these subsets of \( S \) satisfy the properties for a partition of \( S \).
   (b) Define the equivalence relation for this partition. Show that it is indeed an equivalence relation by showing that it satisfies the 3 properties of an equivalence relation.

3. Let \( A \) and \( B \) be sets defined as:
   \( A = \{0, 1, 2, 3\} \)
   \( B = \{-1, 0, 0.5, 1, 1.5, 2, 3, 4\} \)
   and \( f \) maps \( A \) to \( B \).
   Classify each of the following function mappings as as total, partial, onto, not onto, one-to-one, not one-to-one, or not a function at all:
   (a) \( f = \{(0, 1), (1, 2), (2, 3), (3, 4)\} \)
   (b) \( f = \{(0, 0), (1, .5), (2, 1), (3, 1.5)\} \)
   (c) \( f = \{(0, 0), (1, 1), (1, -1), (2, 3)\} \)
   (d) \( f = \{(0, 0), (1, 3), (2, 2)\} \)
   (e) \( f = \{(0, 0)\} \)

4. Let \( A \) and \( B \) be sets. If \( A \) is a finite set, is the intersection of \( A \) and \( B \) a finite set?
Regular Expressions and Finite Automata

Sipser Reading

Ch 0: read pp 13-14
Ch 1: read sections 1.1-1.3. Scan the proofs.

Sipser Problems

Ch 1 (pp83-88) Exercises 1.1, 1.2, 1.3, 1.4(a,b,c,d,e,f), 1.5(a,b,d,g), 1.16, 1.21(a,b)

Additional Problems:

1. Let X be the language \{pink,blue\} and Y be the language \{dog,cat\}. What are the strings in each of the following languages? For each, is the resulting language finite or infinite? For those resulting languages which are infinite, you need only give some strings in the language.

   - XY
   - X ∪ Y
   - X ∩ Y
   - X*
   - Y*
   - X*Y*
   - (XY)*
   - (X ∪ Y)*
   - (X ∩ Y)*
   - X* ∪ Y*
   - X* ∩ Y*

2. \(L = \{a^n cb^{2n} | n > 0\}\)
   
   (a) Give a recursive definition of L.
   
   (b) Using the recursive definition of L, prove or disprove: \(aacbbb \in L\)

3. Let \(X = \{a,aa,aba\}\) and \(Y = \{ab,bb,bbb\}\) be languages.
   
   True or False? (answers provided)

   - \(abab \in X^*\) (False)
   - \(aabb \in X \cup Y\) (False)
   - \(abab \in XY\) (False)
   - \(aaaabababb \in X^*Y^*\) (False)
   - \(abababa \in X^*\) (False)
   - \(abababa \in Y^*\) (False)
   - \(abababa \in (X \cup Y)^*\) (True)
   - \(ababbaab \in (XY)^*\) (True)
## Context-Free Languages and Pushdown Automata

Sipser Reading  
Ch 2: read pp 99-106, 109-119

Problems:  
Handouts, and Exercises (p128) 2.1, 2.2(a,b,c,d)

## Turing Machines

Sipser Reading  
Ch 3: 137-148, 154-159

Problems:  
Handouts, and Exercises 3.1, 3.2