

## Sections 8.1-3: Complexity

These exercises reflect material from our text, *Introduction to the Theory of Computation*, by Michael Sipser, PWS Publishing Co., 1997..

### Basic Concepts

Define the following concepts:

- (a) Space complexity
- (b)  $SPACE(f(n))$
- (c)  $NSPACE(f(n))$
- (d)  $PSPACE$
- (e)  $NPSPACE$
- (f)  $PSPACE$ -complete

### Complexity Classes

Solve the following exercises from Sipser's Chapter 8: 1, 2, 3, 4, 6

Show that  $SAT \in PSPACE$ .

Show that  $E_{NFA} \in PSPACE$ .

State Savitch's Theorem.

Prove the chain of inequalities

$$P \subseteq NP \subseteq PSPACE = NPSPACE \subseteq EXPTIME.$$

*Hint:* An appeal to Savitch's Theorem might be useful.

Name two examples of  $PSPACE$ -complete languages. Give precise definitions of your two named examples.

Construct the generalized geography game corresponding to the formula  $\phi$  of Sipser's Figure 7.11, page 261.

An industrious *AI* student proposes to get rich by selling his recently constructed text, "All the Best Chess Moves." Basically, this manuscript is a two-column table containing every possible chess configuration for a regulation 8x8 chess board and the corresponding best move to make for each of the two players. How big is the table if it is to be printed in Computer Modern 10 point font? The publisher suggests printing the table on a plastic pocket-sized card. What size font should be used for the pocket-sized version? If, instead, they market a "smart card" containing a Turing machine which can calculate this table, how much tape should come with the machine?