**Last name** _____

**First name** _____

**LARSON—OPER 731—CLASSROOM WORKSHEET 21**
**The Primal-Dual Algorithm**

**Concepts**

- (Sec. 3.1) *dual LP*, *Weak duality theorem.*
- (Sec. 4.3) *complementary slackness*, cone, *cone of tight constraints.*
- (Sec. 5.1) *primal-dual algorithm.*

1. What is the *set cover* problem?

2. What is the *edge cover* problem? How is it an instance of the set cover problem?

3. What is the relationship between the vertex cover problem and the vertex packing problem?

4. The authors claim that the vertex cover problem is an instance of the set cover problem. Is it?

**Algorithm 5.6** Primal–dual algorithm for set-cover

**Input:** Elements $\mathscr{U}$, sets $\mathscr{S}$, costs $c_S$ for all $S \in \mathscr{S}$.

**Output:** A collection $\mathscr{C} \subseteq \mathscr{S}$ such that $\mathscr{U} \subseteq \cup_{S \in \mathscr{C}} S$, and a feasible dual $y$ for (5.2).

1: $y = 0$, $\mathscr{C} = \emptyset$
2: **while** $\exists\, e \in \mathscr{U}$ that is not covered by any set in $\mathscr{C}$ **do**
3: Increase $y_e$ as much as possible, maintaining feasibility of $y$ for (5.2)
4: Let $S$ be a tight set cover $e$
5: Add $S$ to $\mathscr{C}$
6: **end while**
7: **return** $\mathscr{C}$ and feasible dual $y$

5. Try this algorithm on our set cover example.

6. What is *Farkas's Lemma*?