Finishing Linear Programming

4-11-2006

Opening Discussion

- What did we talk about last class?
- Do you have any questions about the test?

Multicommodity Flow

- This is another problem that we can do with linear programming that we haven't addressed with other methods. In fact, for this problem, the only known polynomial time algorithm is to use linear programming.
- Here we produce several products that we send out across a network and we want to see if we can meet a certain level of demand for each product.
- We have a source and a sink for each product as well as a flow. For the capacity we don't specify by product types so our constraints have the sum of product flows <= capacity.
- The objective function is 0. We only want a solution.

The Simplex Algorithm

- We convert the standard form to slack form and assume a “basic solution” where all the nonbasic variables are set to 0. This gives us values for the basic variables and the objective function.
- We pick one nonbasic variable with a positive coefficient in the objective function and we will swap it with a basic variable.
- To do this we find the basic variable that is most constraining for increasing the nonbasic variable. We solve for the nonbasic variable in terms of the other variables for that equation and plug that into all the equations.
- This is repeated until there are no terms in the objective function with positive coefficients.

Example

- Let's run through an example of applying the simplex algorithm properly. We need an objective function and a set of inequality constraints to start off with.
- We then convert that to slack form and run through the algorithm.
- Note that the algorithm will actually tell us if we have unbounded constraints.

Initialization and Feasibility

- We have to initialize the Simplex algorithm and part of that is to make sure that the problem is feasible. Initializing simply sets up the N and B sets the objective function to 0.
- If the basic solution isn't feasible we must make sure that there is a feasible solution. This is done by solving a slightly modified linear program with one extra variable x_0. If $-x_0$ is minimized to 0 then a feasible solution to the original linear program exists.

Reminders

- Test 6 is due next class.
- I have pushed back assignment #7, but it will be having you do linear programming. I just have to figure out what problems you will be solving with linear programming.