Worth: 2% **Due:** By 8:59pm on Tuesday 3 March

Remember to write your *full name* and *student number* prominently on your submission.

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*Please read and understand the policy on Collaboration given on the Course Information Sheet. Then, to protect yourself, list on the front of your submission **every** source of information you used to complete this homework (other than your own lecture and tutorial notes). For example, indicate clearly the **name** of every student with whom you had discussions, the **title and sections** of every textbook you consulted (including the course textbook), the **source** of every web document you used (including documents from the course webpage), etc.*

*For each question, please write up detailed answers carefully. Make sure that you use notation and terminology correctly, and that you explain and justify what you are doing. Marks **will** be deducted for incorrect or ambiguous use of notation and terminology, and for making incorrect, unjustified, ambiguous, or vague claims in your solutions.*

The *Partially Conserved Maximum Flow* problem is similar to the maximum flow problem, except that:

- each vertex $u \in V - \{s,t\}$ has "conservation factors" $\alpha_u, \beta_u \in \mathbb{R}$ with $0 \leqslant \alpha_u \leqslant \beta_u$;
- for each vertex $u \in V - \{s,t\}$, $\alpha_u f^{\text{in}}(u) \leqslant f^{\text{out}}(u) \leqslant \beta_u f^{\text{in}}(u)$: the total flow out of u is between α_u and β_u times the total flow into u.

As before, individual edge flows must satisfy the capacity constraint ($0 \leqslant f(e) \leqslant c(e)$ for all $e \in E$) and we are looking for an assignment of flow values to every edge that maximizes $f^{\text{out}}(s)$.

Explain how to solve the partially conserved maximum flow problem using linear programming. Give a detailed description of your linear program and justify clearly and carefully that it solves the problem.