CS-542 Project (Fall 2016)

Due date: Tuesday, Nov. 29, noon

Transit Traffic Routing

Consider a network of four nodes *A, B, C,* and *D* interconnected with eight **unidirectional** links. The network configuration and link capacities are defined with a matrix specified in the accompanying **.txt* file. There are three source-destination pairs $A \rightarrow C$, $B \rightarrow D$, and $C \rightarrow A$ whose traffic flows have intensities $f_{AC}=4$, $f_{BD}=3$, and $f_{CA}=2$, respectively. There are no direct links between the sources and their corresponding destinations so e.g. traffic $A \rightarrow C$ can be routed only over two transit paths *{AB,BC}* or *{AD,DC}*. The "cost" u_{XTY} of a transit path *{XT,TY}* is equal to $u_{XTY}=u_{XT}+u_{TY}$, where u_{IJ} is the utilization of a link *IJ* given by $u_{IJ}=l_{IJ}/s_{IJ}$. l_{IJ} is the intensity of total traffic offered to link *IJ,* and s_{IJ} denotes capacity of this link (see the network matrix). For simplicity we assume that $u_{IJ} > 1$ is acceptable. All traffic flows using link *IJ* contribute to its offered traffic l_{IJ}, e.g. fractions of f_{BD} and f_{CA} routed over *{BC,CD}* and *{CD,DA}*, respectively, contribute to l_{CD}.

Each source selects for an incoming packet a transit path to the destination with the lowest "cost". Find:

- (1) numerical values of the traffic control variables $0 \le \alpha^{(XY)}_{T} \le 1$ that allocate traffic $f_{XY}\,\alpha^{(XY)}_{T}$ to the transit paths *{XT,TY}*. Note that there are two control variables for every source-destination flow, i.e. $\alpha^{(AC)}_{B}$ and $\alpha^{(AC)}_{D}=1-\alpha^{(AC)}_{B}$ for f_{AC}, $\alpha^{(BD)}_{C}$ and $\alpha^{(BD)}_{A}=1-\alpha^{(BD)}_{C}$ for f_{BD}, and $\alpha^{(CA)}_{D}$ and $\alpha^{(CA)}_{B}=1-\alpha^{(CA)}_{D}$ for f_{CA};
- (2) numerical value of the total traffic l_{IJ} offered to every network link *IJ* and its resulting utilization u_{IJ} corresponding to the traffic control variables $\alpha^{(XY)}_{T}$ found in (1);
- (3) numerical values of the "costs" u_{XTY} for all the transit paths in the network (i.e. two "costs" for every source-destination flow) implied by (1) and (2).

Submission guidelines

- Due date: Tuesday, Nov. 29, noon (Chicago time)
- It's the end of the semester so late submissions will NOT be accepted. 20% penalty for not following the remaining submission guidelines.
- Weight of this project is 20%.
- Max. 3 students/team.
- Only one submission per team. Do NOT submit multiple copies of your project (I will penalize this). It's very confusing.
- Your submission should consist of two items ONLY, i.e. your project report + a printout of your source code used to obtain numerical results. Do NOT submit 100 documents/files/attachments. Such submissions will be disregarded.

- Please put down your names (LAST, FIRST, MIDDLE - THE ORDER DOES MATTER), and student IDs on the front page of your project report.
- Note that not only your results will be evaluated. The format and organization of your report, and the way you express and communicate your ideas (clarity, coherence, logical reasoning, conclusions) affect your grade as well.
- Feel free to ask questions but do NOT send partial solutions with inquiries: “Is that what you expect?”
- How to submit your project report?

  - Live Section (01) and Local Online Section (02): HARD COPIES ONLY. Put them into my mailbox in the CS Dept. office or give directly to me e.g. after our class.

  - India Online Section (03): Upload your project reports (PDF format only) + a source code of your program to the Blackboard.