

Dt	 -p(2)
Pg	

(NOTE: I have assumed that any of the there is only one source and one sink in the graph, like in the guestian,

A general more general folo formulation would be :

Totaler and & fin - S fij = b;

A: (A, i) EE j: (inj) ex

where b; is the external suffly at nool i. But ignore b; here to keep things simple)

Lastly, the flow in each edge must not excludits rapacity, quein by A;

Thus, fij & Aij & (i,j) EE

Lostly, what we need to maximise is the total four in the network. This can be given by the total outstour out of the source nools, S.

our objective is

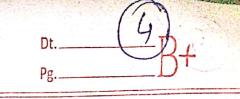
maximise Si fsp PJ: (s,p) EE fsp

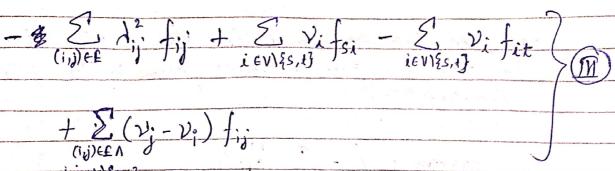
Maximis E for final frimal problem is p: (s,p) E for

st, O. E. fri - Siliper Sij = O + ieV \{s, T}

3 tij > D + (i,j) E£ Premium

(8)	Dt
The state of the s	il moderate
<u> </u>	DUAL PROBLEM: Min-Cut
	[4]
	We will formulate the Legrangian of this peoblem to get the dual.
	get the dual.
	Let f = [fij] lethe riertor containing of flows
	of all edges. Let $f \in \mathbb{R}^{ E XI}$ Let $A^{L} \in \mathbb{R}^{ E XI}$ $\geq A^{L} \in \mathbb{R}^{ E XI}$
	V ∈ IR le 3 \$ rectors 3+,
	A character than the company of the country of the
2	$\left(f,\lambda',\lambda^2,\gamma\right) = -\sum_{\mathbf{p}:(s,p)\in E} f_{sp} + \sum_{(i,j)\in E} \lambda_{ij}^{\perp} \left(f_{ij} - C_{ij}\right)$
X	
	$\frac{4}{4} + \sum_{(i,j) \in F} \frac{1}{2} \left(-f_{ij}\right) + \sum_{(i,j) \in F} \frac{1}$
	+ 5, V; (& f hi - & fij) i e V\{ s, t} h: (h, i) eE f hi j: (i, j) EE f ij)
	LEVIENTY JANATES
R	ASSO STATE OF THE
<u>v</u> 7×	PRIMAL PROBLEM flow I use formula tool
	PRIMAL PROBLEM that we just formulated. Note that $\lambda' > 0$ and $\lambda^2 > 0$
	-House,
2	$f(\lambda',\lambda',\gamma) = -\sum_{i:(s,i)\in E} f_{si} + \sum_{i:(s,i)\in E} \lambda_{ij} f_{ij}$
	A: (S,LCE
	+51+511:1:-571:(:)
	+ State + Sinjer And fig - Sinjer Aij Cinjer
	i,je M{s,t}
	Premium





1,jEV\{S, }}

Remark. D was merely broken into 3 separate summodion terms. For D, at we just separated the terminal and non-terminal modes to arrive at this arrangement

 $= \underbrace{\sum_{i \in V \mid \{s,i\}} (-1 + \lambda_{si}^i + \nu_i - \lambda_{si}^2) \int_{si}}_{i \in V \mid \{s,i\}}$

+ & (-A2) + V; -V; + Ay) fy 1,jeV\\$5,+3

+ E (\lambda_{it} - \lambda_{it} - \mathcal{V}_i) fit - E di Cij

Nour, ransides the dual function, i.e.

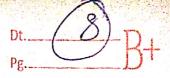
 $\mathcal{A}(\lambda',\lambda',\gamma) = \inf_{\gamma} \mathcal{A}(f,\lambda',\lambda',\lambda')$

= S-E dis Cij, if (die - die - 7) = 0 9 (-1+2si+2i-2si)=0 idextags = + ievissiti

Upper Nijevision

0/W

FLOW 2 (Assuming similar numbering for edges as in freceious flow. PRIMAL: naximise f, + f2 + f3 st, f///// * xxxx/.//// (1.50) (1-Kafacity of edgy) for necle A: fi + fo + fib - f4-f5= D for need B: f2-f+ 1/2-f7=0 for mode C: f3 + f7 + f1 - fe - fg - f10 = 0 forprede D: fs: + fin +fiz - fiz -fiz=0 for mode E: fy - f14 - f15 = D for nade F: fs -f18-f12-f18 = 0 for noale G: fg + f12 + f23 - f19 - f20 - f21 - f22 = 0 for woole H: frot fis +fis +fis - fix -fix = 0 for node I: fis + fro - fro - fro = 0 for node J: f21+f14+f26-f28-f29 =0 fi>,0 + 1< i<29



DUAL: minimise & & Cidi (Ci - cafacity of edger) st, 1: >0 + 1 \(i \le 29\) 1 + P > 1 1 + P > 1 11 + 2 > 1 14-8×4+ VE 70 1, - YA + YE >0 $\lambda_{6}^{\prime} - \gamma_{B} + \gamma_{A} > 0$ 1 - V + V = 70 13- 1 V + V >> 0 1'9 - Ye + Va > 0 110 - VC+VH70 11 - VD +VC>0 1,2 - VD + VC)/O 113-20+2470 A'14 - PE+ VD>0 1,5 - YE+YI>0 A1 - 2 + + VA > 0 117 - V + VD > D 218 - VF 7/0 λ'19 - Vc, +2y > 0 1 - VG + VI >0 1/21 - VG + VJ >/ O 1/2 - Ng 70 1123 - V4+V47,0 1/24 - VH+VJ >10 125 - V470 126 - VI + VJ >>0 11 - V2 7/0

Premium