

(b)[8pts] Give a basis for the nullspace of A_0 , and a basis for the left nullspace of A_0 .

The graph actually represents the network of corridors in the secret Australian lunar base (an important part of the secret Australian space programme). Moreover, parallel to corridor 2 is the re-oxygenization plant, which makes sure that the “oxygen pressure” at intersection 1 is 60 units greater than that at intersection 5. Suppose that the flow of oxygen along a given corridor is proportional to the difference in oxygen pressure at its ends, and further assume that we’ve chosen units in such a way that the proportionality constants are all 1.

(c)[3pts] Briefly give a reason why we can assume, for the sake of calculating the oxygen flow, that the oxygen pressure is 0 at intersection 6.

(d)[12pts] Making this assumption, give the relevant values for the matrices A , C , f and b of our framework.

(e)[8pts] Find (without solving them) 4 independent equations for the oxygen pressures at the intersections; these equations should not involve the variables for the flows in the corridors.

4.[17pts] Vladimir, an amateur astronomer, wants to work out approximately what the plane of the galaxy is. From his observations of 3 stars, he knows their heights above or below the North-South/East-West plane (of the place and time where he made the observations). Combined with the sun, this gives 4 data points, for which he wants the plane-of-best-fit, which will hopefully be a reasonable approximation to the plane of the galaxy. His data values (in hundreds of light years) are:

Star Name	EW position e	NS position n	Height above NS/EW plane h
The Sun	0	0	0
Beta Max	-1	1	1
Alpha Betical	-2	0	3
Beta Fastacheapa	-1	-1	4

Find the coefficients in the equation $h = c_1 + c_2e + c_3n$ for Vladimir's approximation of the plane of the galaxy, that is, the plane of best fit for these data points.