COSC364 Assignment 2

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Abstract

The following discusses ——- This was a joint work by George Drummond and Ryan Cox in accordance with the course requirements of COSC364-17S1 and is a result of **equal contribution (**50%/50%**).**

Contents

1 Problem formulation

We wish to formulate an optimization problem for generic values of X, Y and Z (with $Y > 3$) such that the load on all transit nodes is balanced.

1.1 decision and auxiliary variables

Let y_{ik} be the amount of flow on the link between a given source node S_i and transit node T_k. Likewise let z_{kj} be the amount of flow on the link between a given transit node T_k and destination node D_j.

Therefore, letting x_{ikj} be the part of the demand volume between source node S_i and destination node D_j that is routed through transit node T_k, we achieve

$$y_{ik} + z_{kj} = x_{ikj} \tag{1}$$

$\forall i \in [X], k \in [Y], j \in [Z]$.

1.2 objective function

The resulting *utilisation* on a link between a given source node S_i and transit node T_k is given by $\frac{y_{ik}}{c_{ik}}$. Similarly, the resulting utilisation on a link between a given transit node T_k and destination node $D_j$is given by $\frac{z_{kj}}{d_{kj}}$.

We therefore formulate our objective function as.

$$r = \max(\frac{y_{ik}}{c_{ik}}, \frac{z_{kj}}{d_{kj}}), \forall i \in [X], k \in [Y], j \in [Z] \tag{2}$$

That is, we wish to minimise the greatest link utilisation. We now note that r is piecewise linear in the next section when considering constraints.

1.3 ”splitting” requirement

We now turn our attention to the global requirement that each demand volume shall be split over exactly three different paths, such that each path gets an equal share of the demand volume.

1.4 additional constraints

Capacity:
$\forall i \in [X], k \in [Y], j \in [Z]$., we have,

$$y_{ik} \leq c_{ik}$$
$$z_{kj} \leq d_{kj}$$

Likewise, from out discussion in 1.2, we have the following constraints regarding our objective function,

$$y_{ik} \leq c_{ik} r$$
$$z_{kj} \leq d_{kj} r$$

Non-negativity:
$\forall i \in [X], k \in [Y], j \in [Z]$, we have,

$$x_{ikj} \geq 0$$
$$y_{ik} \geq 0$$
$$z_{kj} \geq 0$$
$$r \geq 0$$

2 Results

3 LP generation source file

```
import sys





def main():
      (X,Y,Z) = sys.argv[1:4]
      print("X = {}, Y = {}, Z = {}".format(X,Y,Z))




main()
```

4 References