(draft) FIFO queues Model

Mattia Milani*
*Dept. of Information Engineering and Computer Science, University of Trento, Italy
mattia.milani@studenti.unitn.it

I. Main Idea

Take an already proven model that defines hard-state protocols and implement on it FIFO queues on the edges.

This document uses models and demonstration from [1].

This document assumes the knowledge of semirings as $(\mathcal{S}, \oplus, \mathcal{F}, \overline{0}, \overline{\infty})$ to model routing problems.

II. Goals

The goal of this document is to amplify what demonstrated in [1] introducing a FIFO queue on the edges.

The second goal of this work is to introduce an asynchoronus formalization of this fourth model.

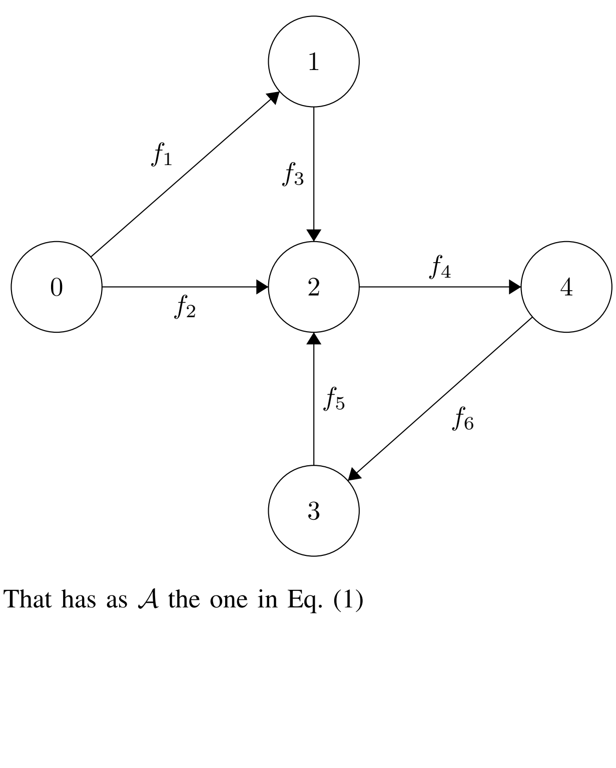
III. Network

A network is represented by a directed graph $\mathcal{G}(\mathcal{V}, \mathcal{E})$ where $\mathcal{V}$ is a set of n nodes $\mathcal{V} = \{0, 1, ..., n-1\}$ and $\mathcal{E}$ is a set of arcs. A configuration of $\mathcal{G}$ with respect to a routing algebra $(\mathcal{S}, \oplus, \mathcal{F}, \overline{0}, \overline{\infty})$ is a mapping from $\mathcal{E}$ to F.

Such mappings will be represented by an $n \times n$ adjacency matrix $\mathcal{A}$ where $\mathcal{A}_{ij} \in F$.

I assume the constant function $f_{\overline{\infty}} \in F$ exists that always returns the invalid weight, function used to represent missing edges.

For example we can have the following graph:



That has as $\mathcal{A}$ the one in Eq. (1)

$$\mathcal{A} = \begin{bmatrix} f_{\overline{\infty}} & f_1 & f_2 & f_{\overline{\infty}} & f_{\overline{\infty}} \\ f_{\overline{\infty}} & f_{\overline{\infty}} & f_3 & f_{\overline{\infty}} & f_{\overline{\infty}} \\ f_{\overline{\infty}} & f_{\overline{\infty}} & f_{\overline{\infty}} & f_{\overline{\infty}} & f_4 \\ f_{\overline{\infty}} & f_{\overline{\infty}} & f_5 & f_{\overline{\infty}} & f_{\overline{\infty}} \\ f_{\overline{\infty}} & f_{\overline{\infty}} & f_{\overline{\infty}} & f_6 & f_{\overline{\infty}} \end{bmatrix} \tag{1}$$

IV. Background

Brief recap of the models in [1].

In that document are formalized three new models that amplify what represent the basic high level model that is compleatly abstracted from network concepts. This model is represented by Γ_0. In this model the solution to the routing path problem is given by a matrix $\mathcal{X}$ where each element $\mathcal{X}_{ij}$ represent the best path from i to j. The solution is computed by iteratively appling the adjacent matrix $\mathcal{A}$ to the actual routing state $\mathcal{Y}$ (Every router synchrounously chose the best path extension from it's neighbourhood in state $\mathcal{Y}$).

$$\Gamma_0(\mathcal{Y}) = \mathcal{A}(\mathcal{Y}) \oplus \mathcal{I} \tag{2}$$

$$\mathcal{X} = \mathcal{A}(\mathcal{X}) \oplus \mathcal{I} \tag{3}$$

Equation (3) represent the solution to the routing problem using the high level model, one single round of the model is defined by Equation (2).

The

References

[1] p. M. van der Stoe, "An Agda Formalisation of a Hard-state Vectoring Routing Protocol," 2019.