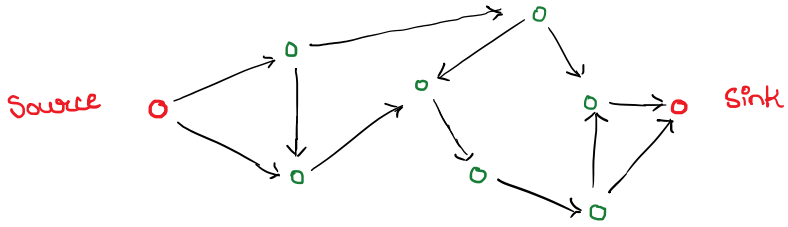
Flow Networks

Suppose that a Network consists of a Source, a Sink, and these two nodes are connected via switches. The bandwidth of each connection isn't the same. At the same time, each of the switch does cut-through switching without any Queue capacity.



This system can be modeled using a directed graph with two special nodes, the source and the sink.

Let the graph be $G(V,E)$, source be s and sink be t.

- By definition, no edge terminates at s and no edge begins at t.

Each edge has a capacity $c(e)$, which is the maximum possible capacity of that edge. We define $f(e)$, as the capacity of the edge in use currently.

$$\forall e \in E, \quad 0 \leq f(e) \leq c(e)$$

* Flow

Following the example, each bridge has a data stream flowing through it. As no data can be accumulated, Inward flow = Outward flow

(Similar to Kirchoff's law from electricity)

- The outwards flow for a node is represented by $f^{\rightarrow}(v)$, and is given by:

$$f^{\rightarrow}(v) = \sum_{\substack{u \in V \\ (u,v) \in E}} f((u,v))$$

The value of inwards flow is similarly defined, and is represented as $f^{\leftarrow}(v)$.

- Value of the flow $|f|$

The total amount of "data" flowing through the network. It is given by $|f|$, and is calculated as shown.

$$|f| = \sum_{\substack{v \in V \\ (s,v) \in E}} f(s,v) = f^{\rightarrow}(s) = \sum_{\substack{v \in V \\ (v,t) \in E}} f(v,t) = f^{\leftarrow}(t)$$