Wave algorithms

A decide event is a special internal event.

In a wave algorithm, each computation (also called wave) satisfies the following properties:

- *termination*: it is finite;
- *decision*: it contains one or more decide events; and
- *dependence*: for each decide event e and process p, $f \prec e$ for an event f at p.

Wave algorithms - Example

In the *ring algorithm*, the initiator sends a token, which is passed on by all other processes.

The initiator decides after the token has returned.

Question: For each process, which event is causally before the decide event ?

The ring algorithm is an example of a traversal algorithm.

Traversal algorithms

A traversal algorithm is a *centralized* wave algorithm.

The initiator sends around a token.

- In each computation, the token first visits all processes.
- Finally, the token returns to the initiator, who performs a decide event.

Traversal algorithms build a spanning tree:

- the initiator is the root; and
- each noninitiator has as parent the neighbor from which it received the token first.

Tarry's algorithm (from 1895)

Consider an undirected network.

R1 A process never forwards the token through the same channel twice.

R2 A process only forwards the token to its parent when there is no other option.

The token travels through each channel both ways, and finally ends up at the initiator.

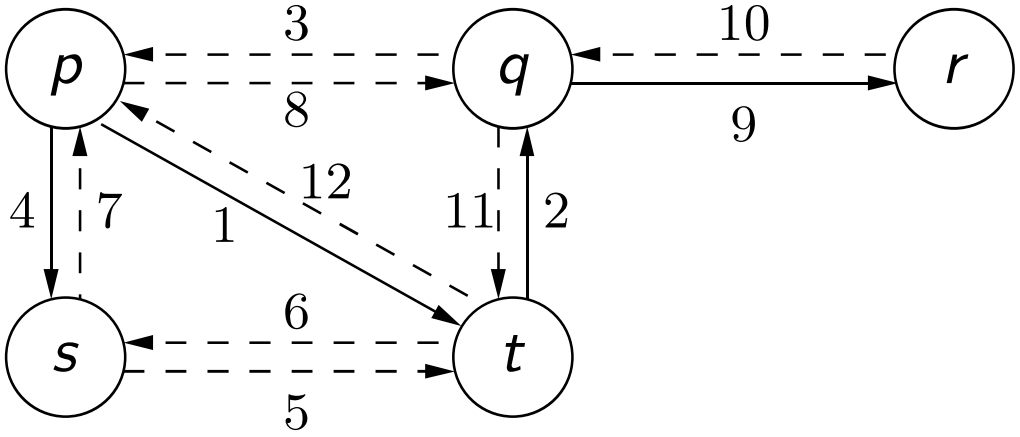
Message complexity: $2 \cdot E$ messages

Time complexity: $\leq 2 \cdot E$ time units

Gaston Tarry

Tarry's algorithm - Example

p is the initiator.



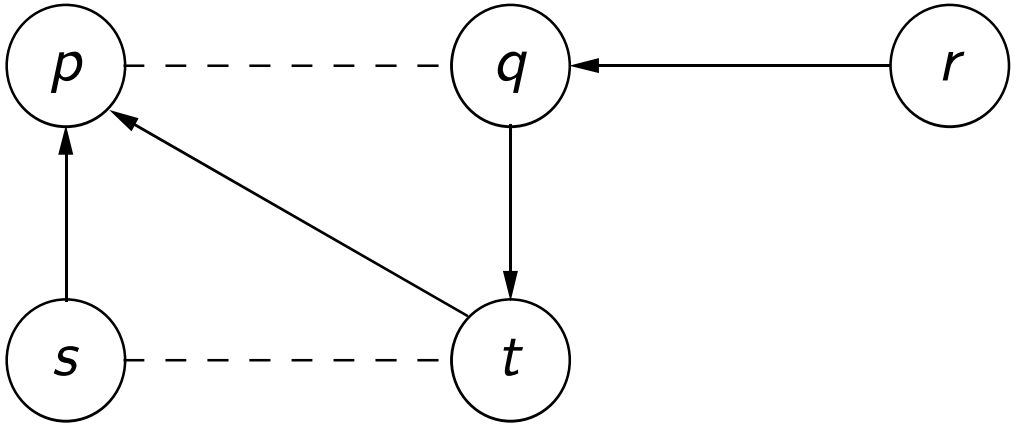
The network is undirected and unweighted.

Arrows and numbers mark the path of the token.

Solid arrows establish a parent-child relation (in the opposite direction).

Tarry's algorithm - Spanning tree

The parent-child relation is the reversal of the solid arrows.



Tree edges, which are part of the spanning tree, are solid.

Frond edges, which aren't part of the spanning tree, are dashed.