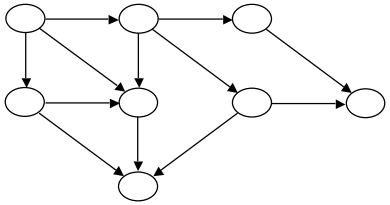
YO-YO

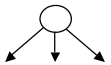
Election in arbitrary graphs:
simple but not optimal

Yo-Yo

DAG =
Directed Acyclic Graph



SOURCE:

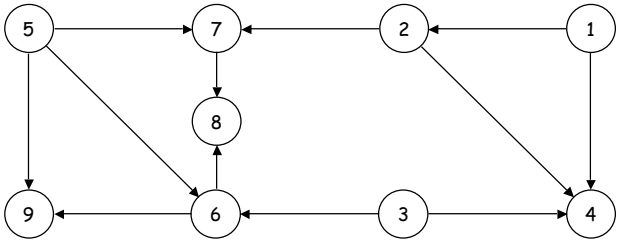


INTERNAL NODE:

SINK:

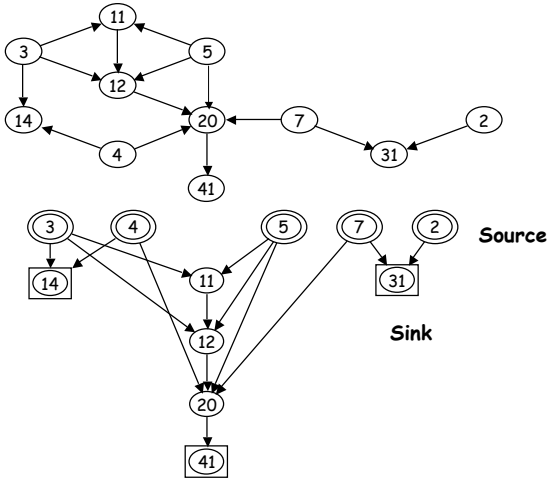
Initialization phase

Given an arbitrary undirected graph, smaller entities are directed towards bigger

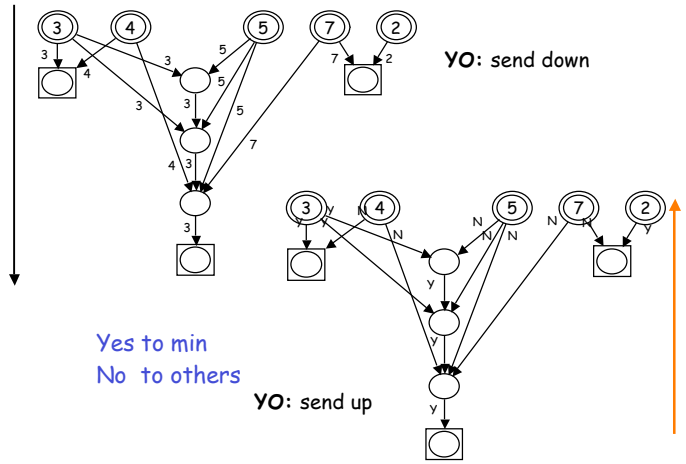


DAG

DAG

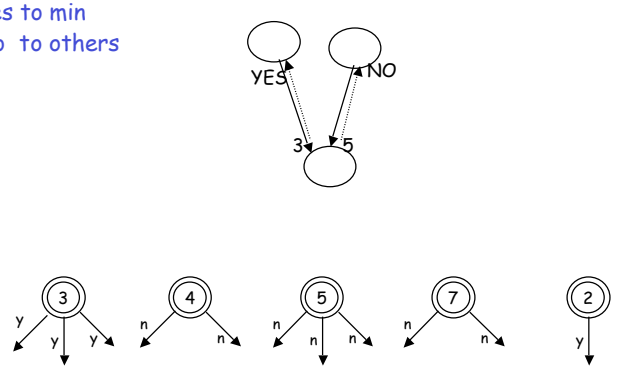


The protocol



The protocol

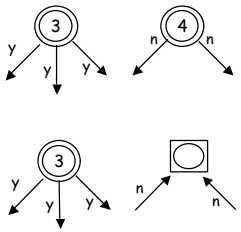
Yes to min
No to others



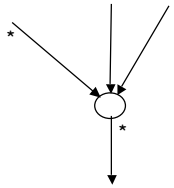
The protocol

The direction of the links with "NO" will be flipped

The sources with at least a "NO" will become sinks or internal nodes



1. At each step at least a source becomes either a sink, or internal

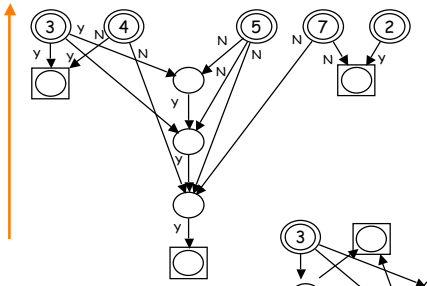


2. An internal node cannot become source after the flipping

3. A sink cannot become source after the flipping

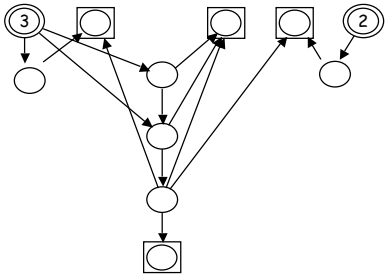
From 1. 2. and 3.:

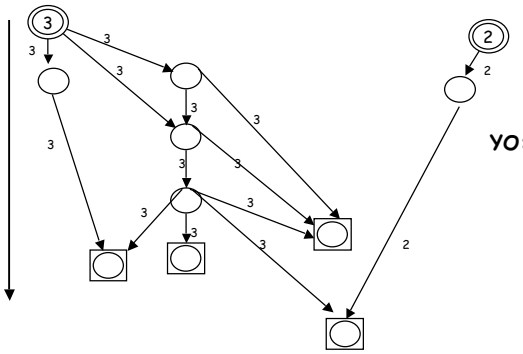
The number of sources is reduced monotonically



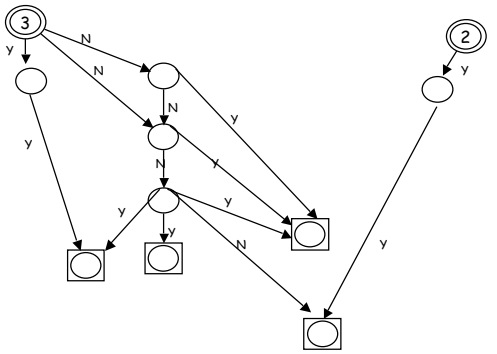
YO: send up

FLIP

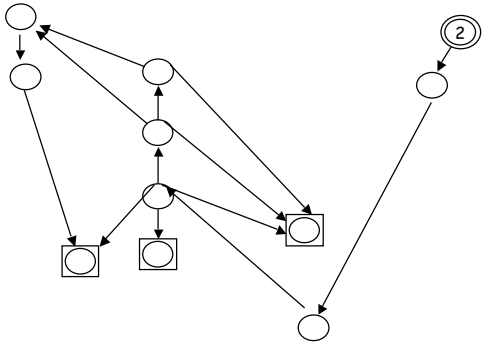




YO: send down



YO: send up



FLIP

Termination

?

PRUNING

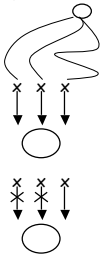
Pruning Rules

1)

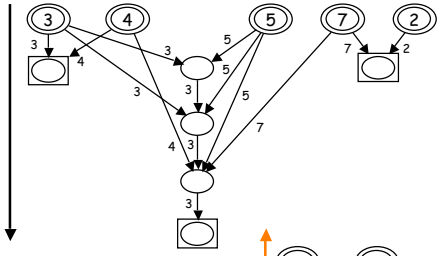
The sinks with one incoming link can be eliminated

(The decision of a sink is the same as the one of the parent)

2)

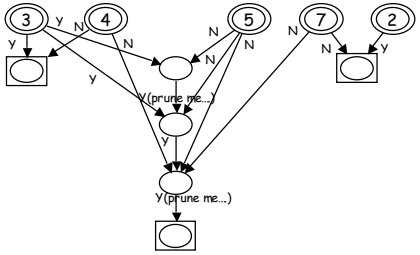


Nodes that receive several identical values:
All the links with the same value can be eliminated except one
(They come from the same source - the decision is the same)

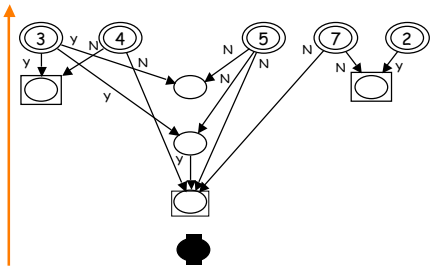


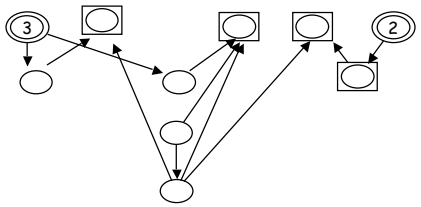
YO -down

YO - up + prune info

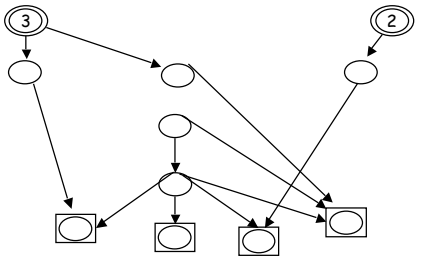


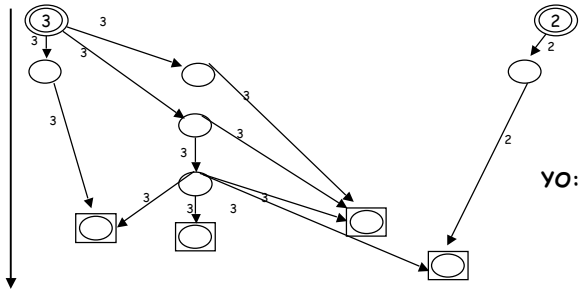
At the same time …. prune



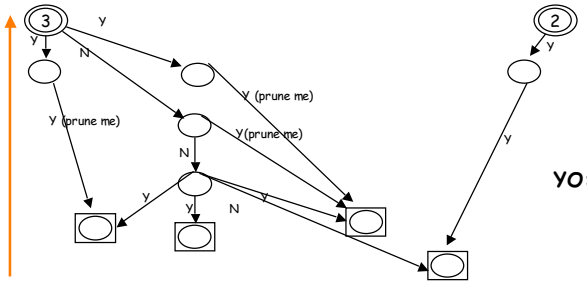


FLIP

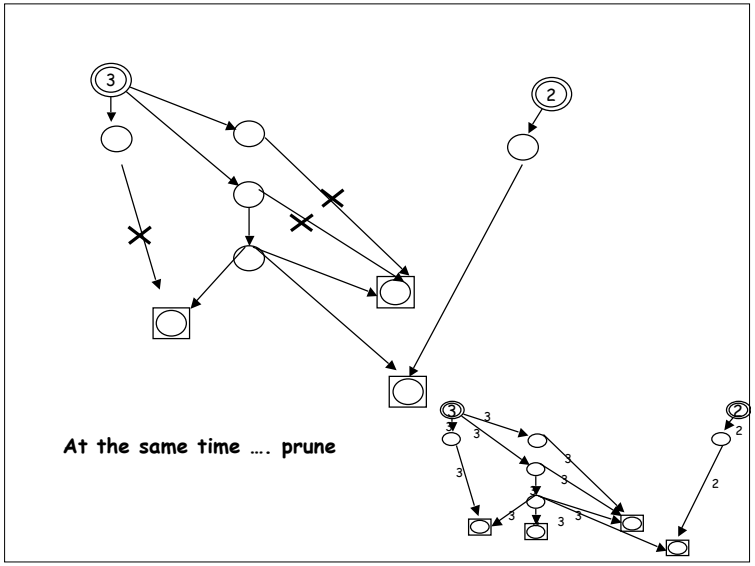


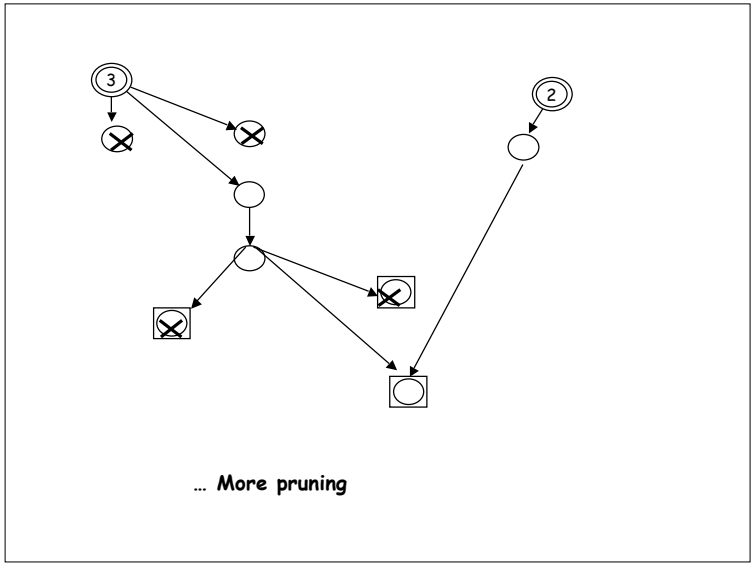


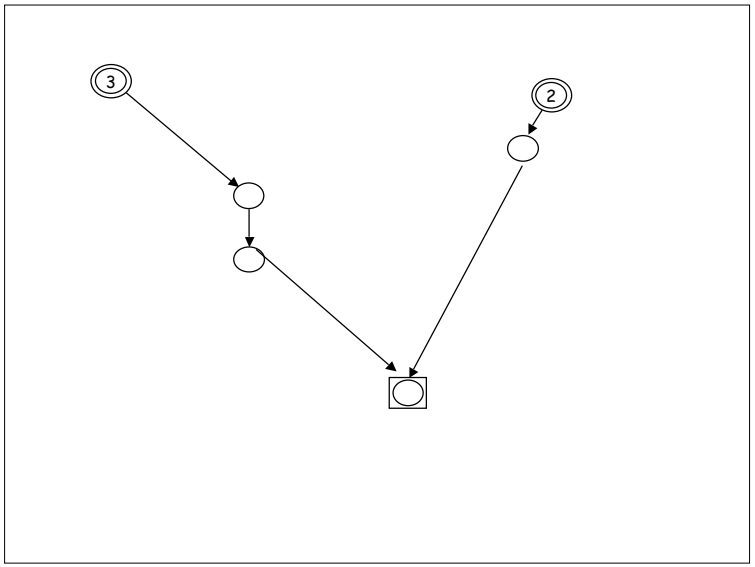
YO: send down



YO: send up


3
2
At the same time …. prune


3
2
… More pruning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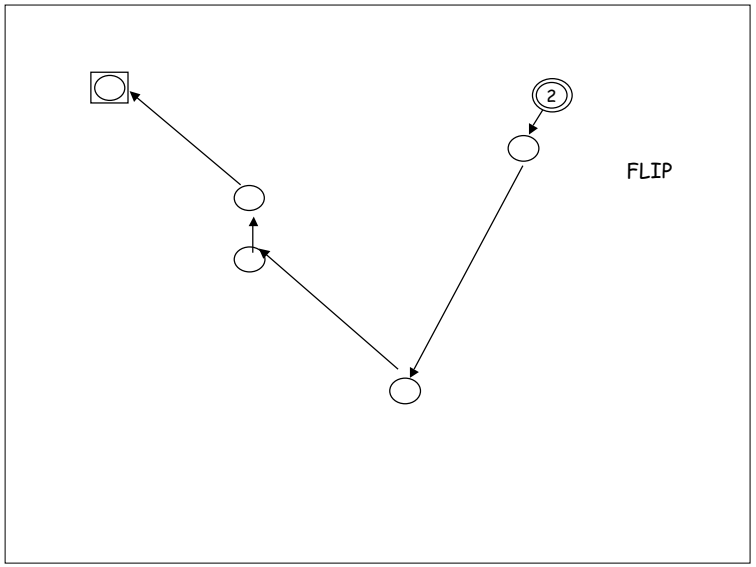
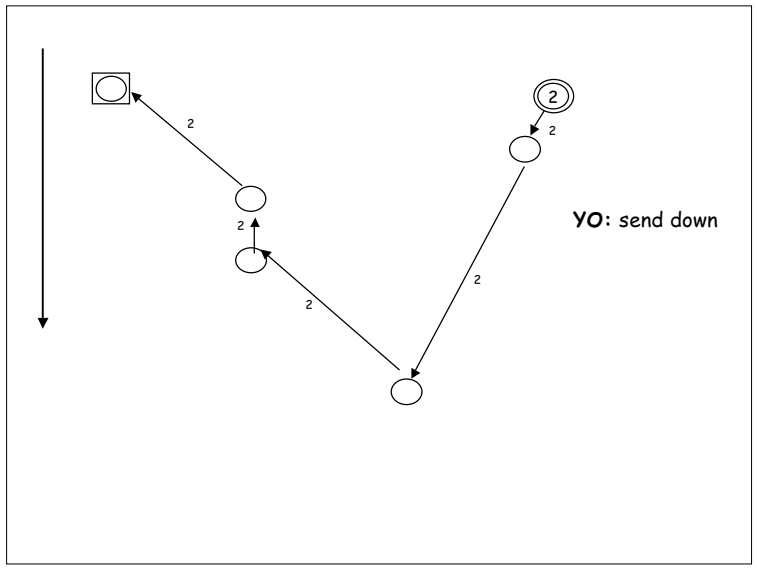

2
FLIP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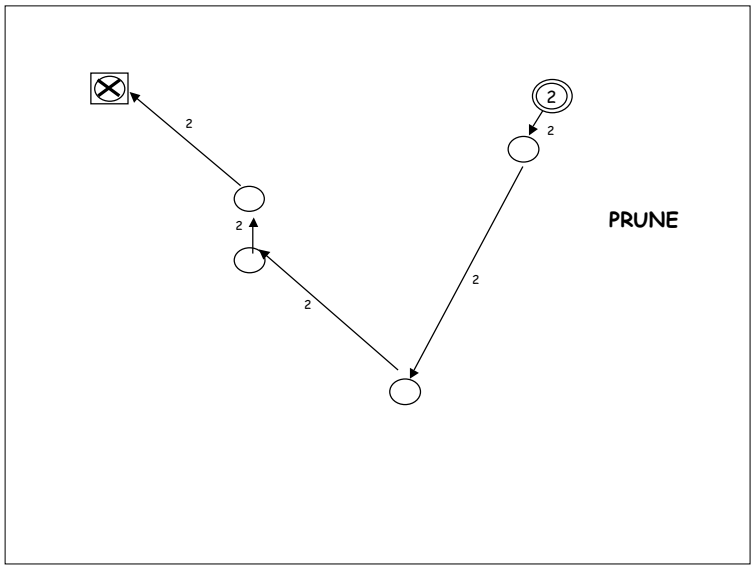
YO: send down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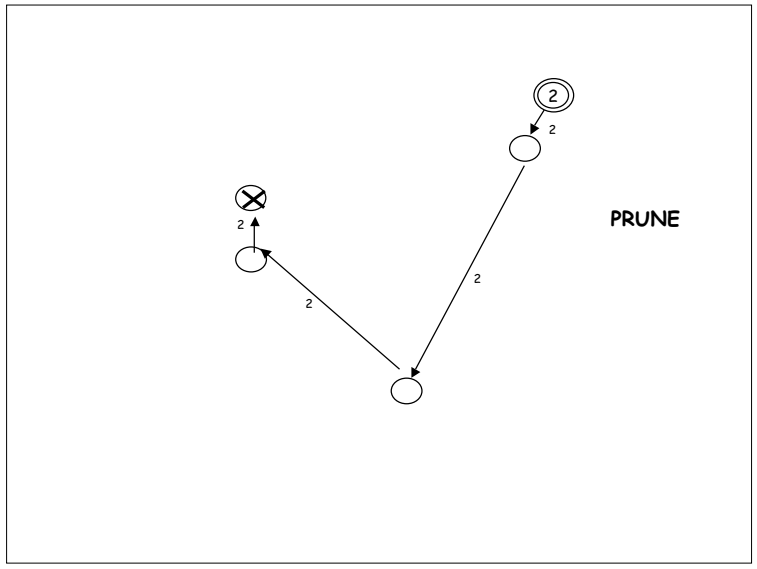
PRUNE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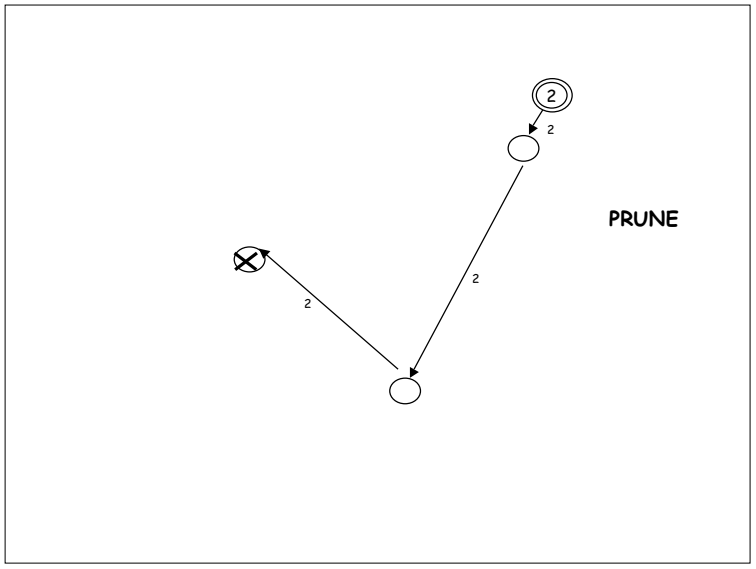
PRUNE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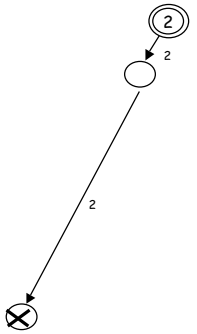
PRUNE



PRUNE

PRUNE

PRUNE

Complexity

Without Pruning

There are 2 messages for each link at each phase

- The number of phases is: log(# sources)

(s = # sources)

TOT: 2m log s

With Pruning: ?

Spanning Tree Construction and Election

n: number of nodes

m: number of edges

ST + O(n) ---> E

E + O(m) ---> ST

a) $E \leq ST + O(n)$

b) $ST \leq E + O(m)$

$E = \Omega(m + n \log n)$

$ST = \Omega(m + n \log n)$