Initial State

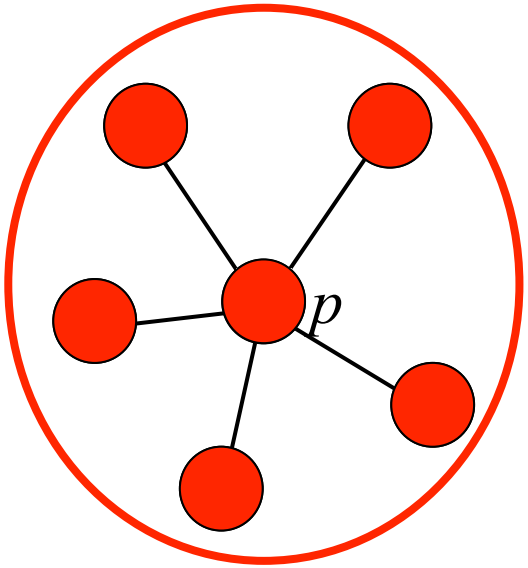
① Incorrect messages in channels

② Incorrect values in variables

Starting from any initial configuration, the system eventually reaches a configuration from with its behavior is correct.
Dijkstra 1974

State Model

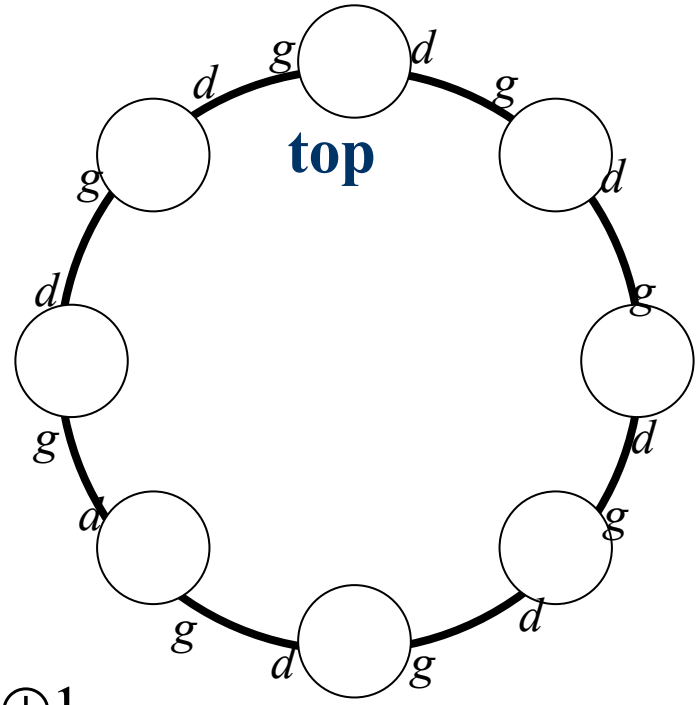
<Gard> → <Action>



Anneau à jeton

Spécification

- ***Sûreté* : *Au plus un jeton dans le système***
- ***Vivacité* : *Chaque processeur obtient le jeton infiniment souvent***



p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus 1$

p ≠ top

TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

Anneau à jeton

Auto-stabilisant ?

Spécification

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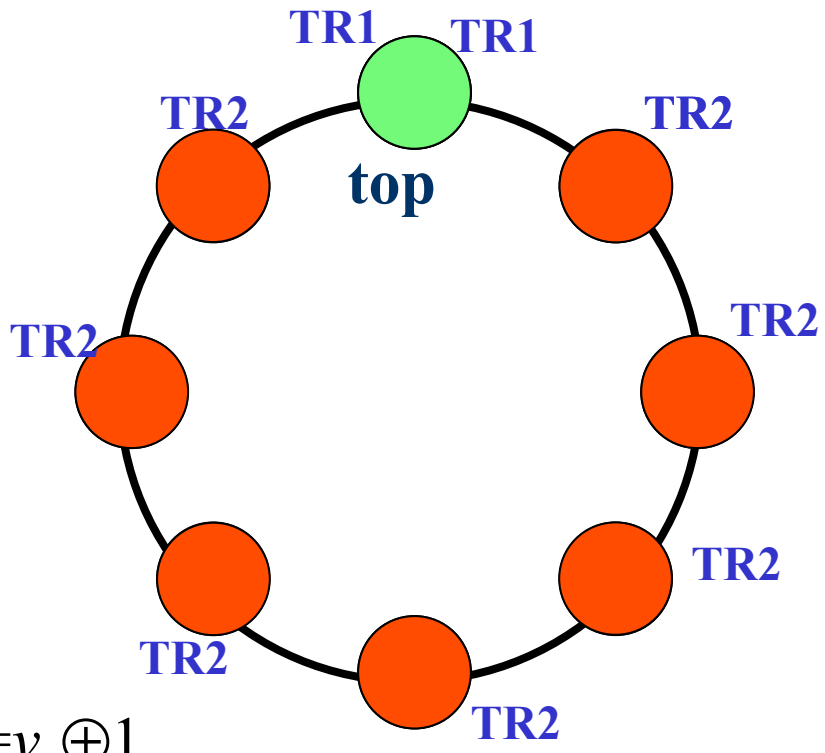

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Anneau à jeton

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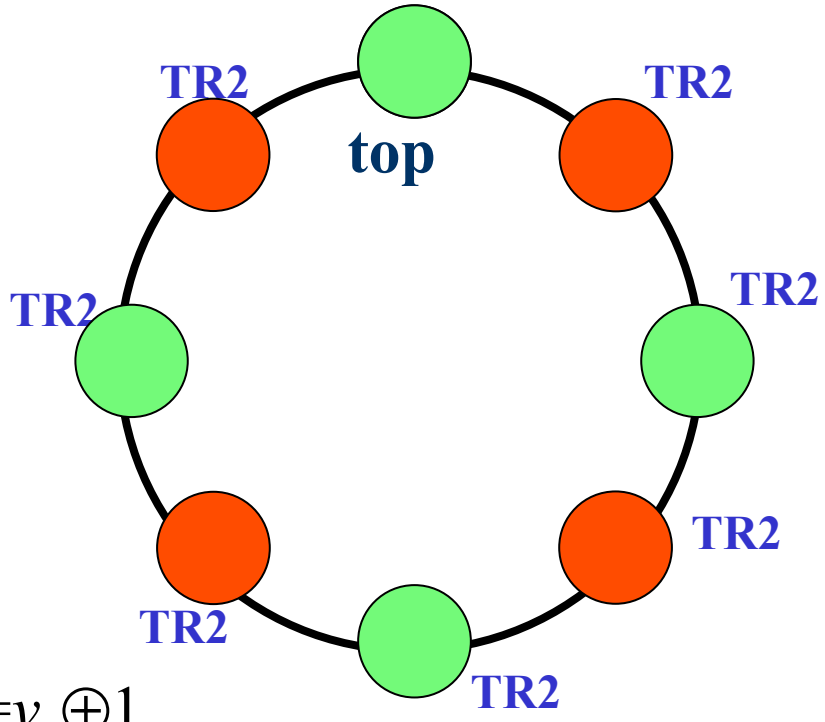

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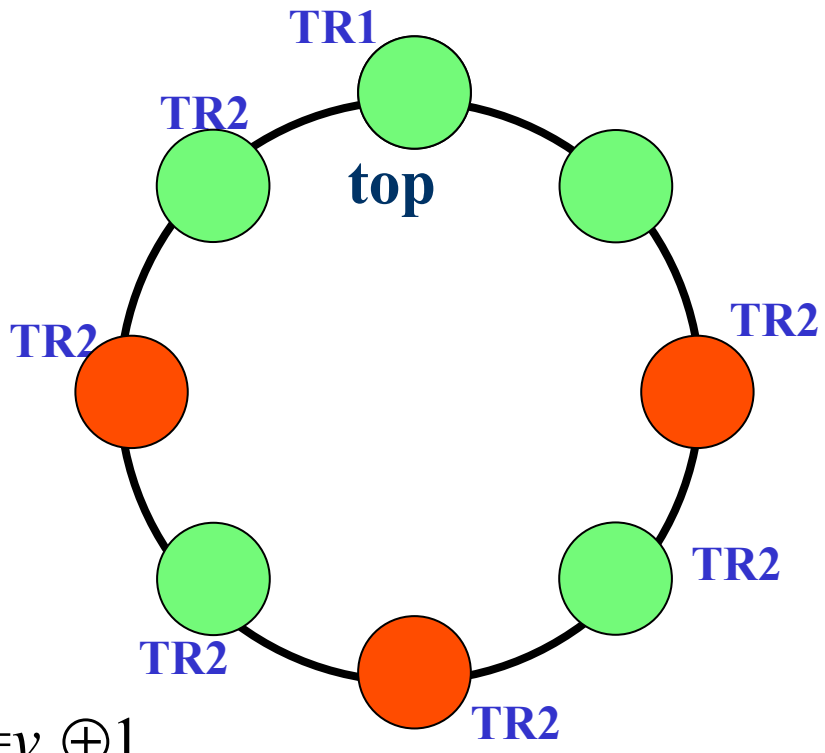

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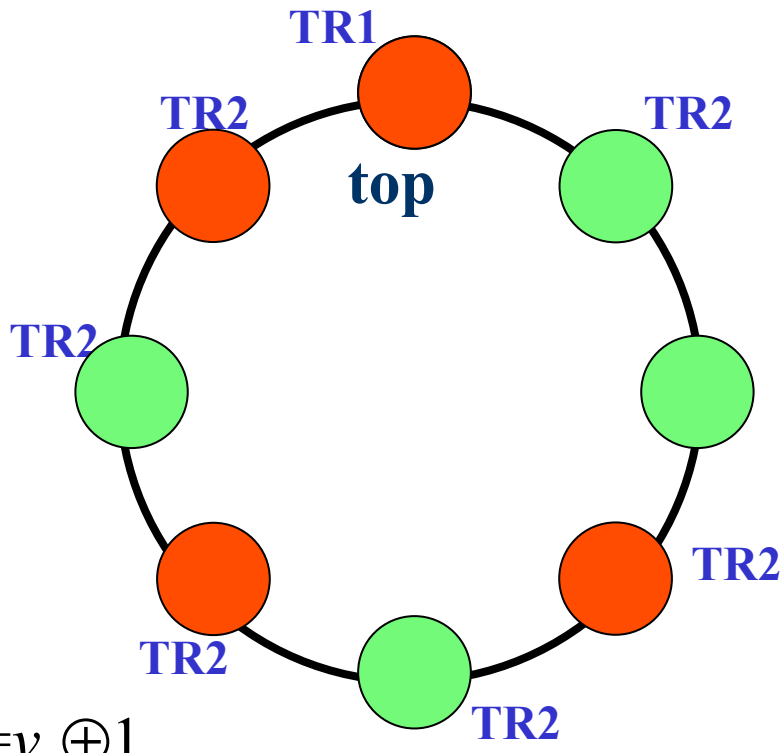

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TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

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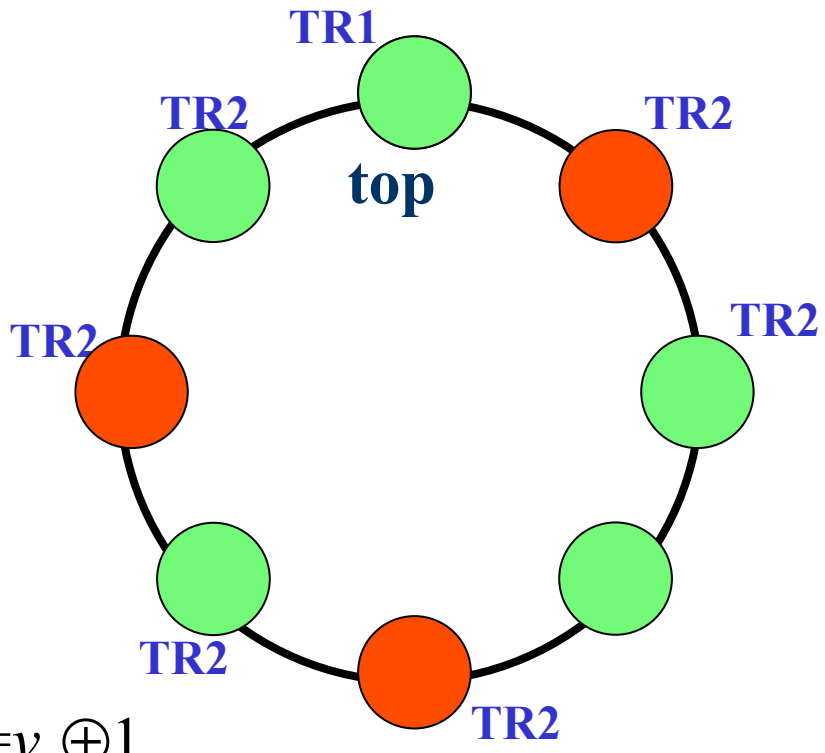

p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus 1$

p ≠ top

TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

Anneau à jeton

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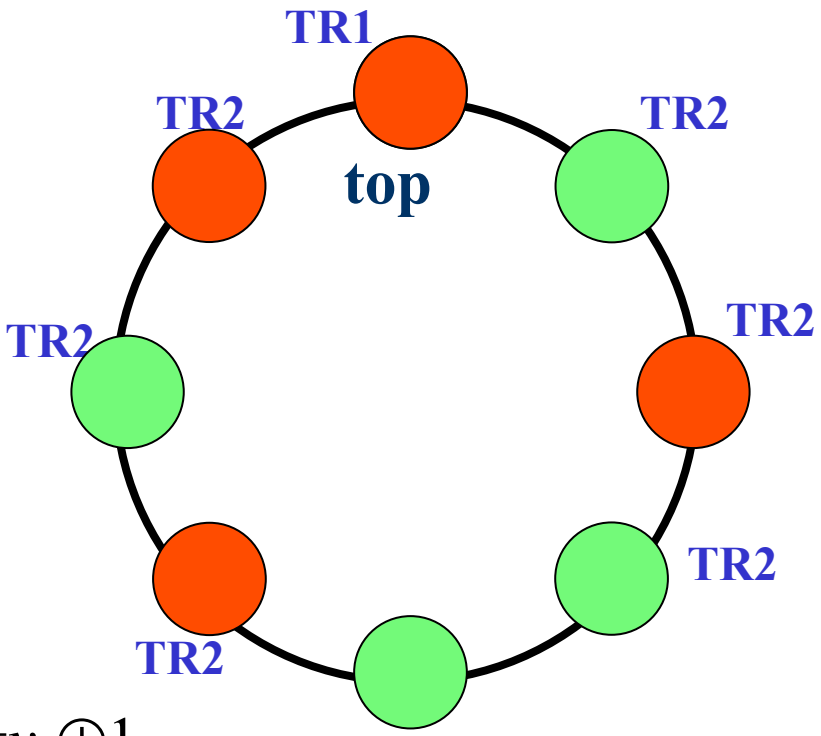

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Anneau à jeton

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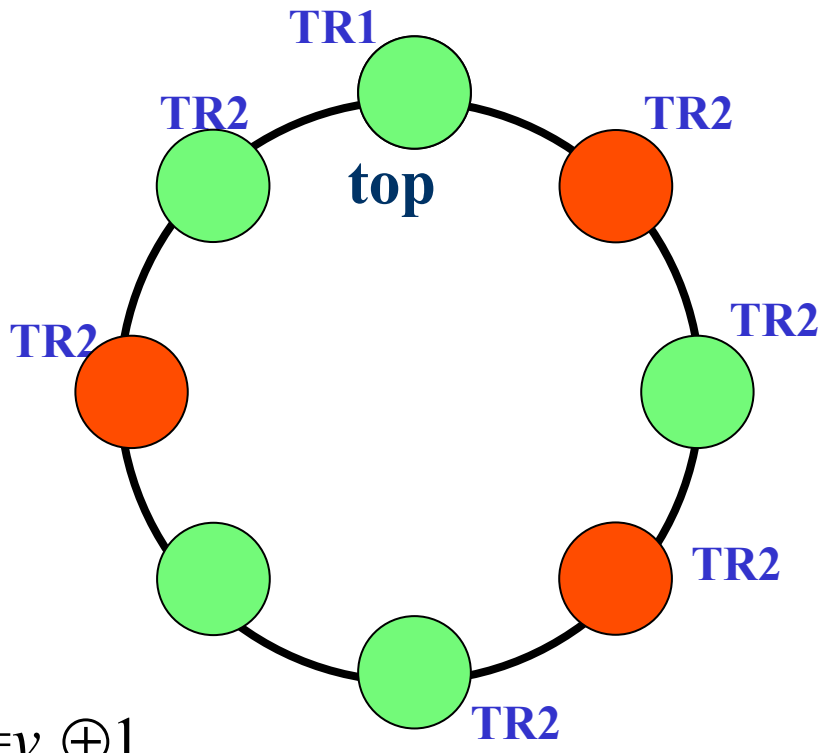

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Anneau à jeton

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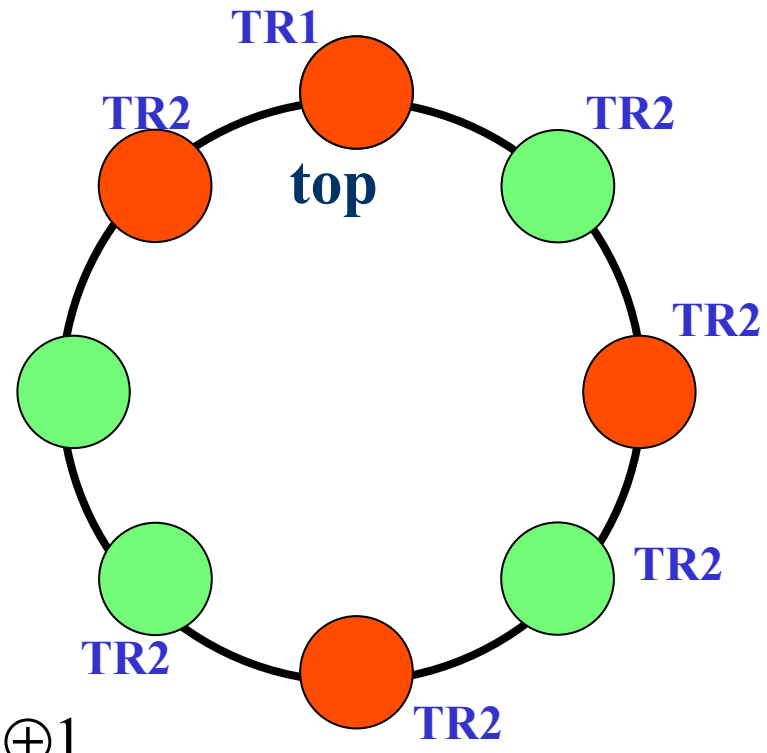

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TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus 1$

p ≠ top

TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

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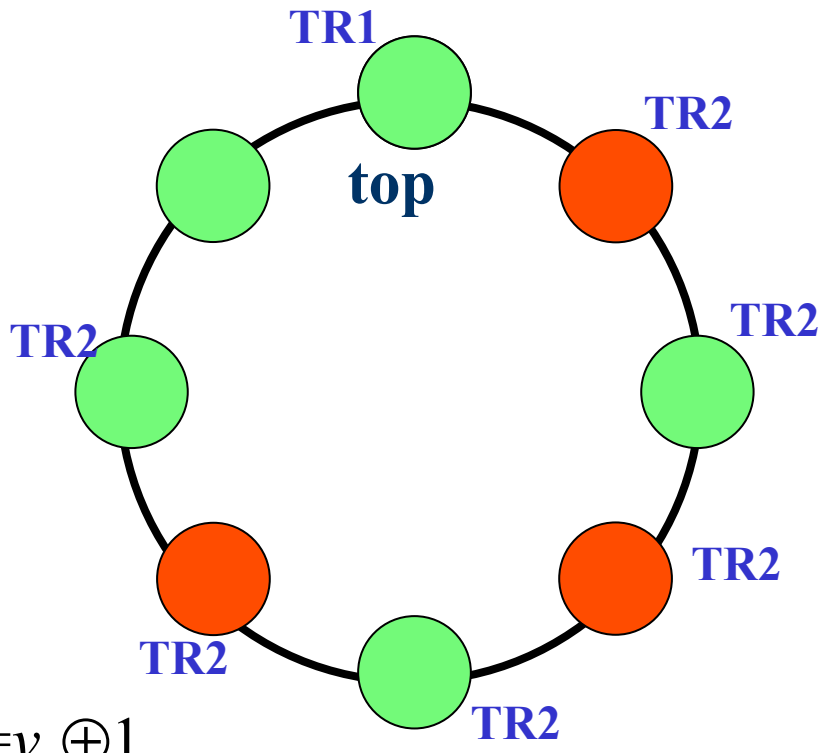

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TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

Anneau à jeton

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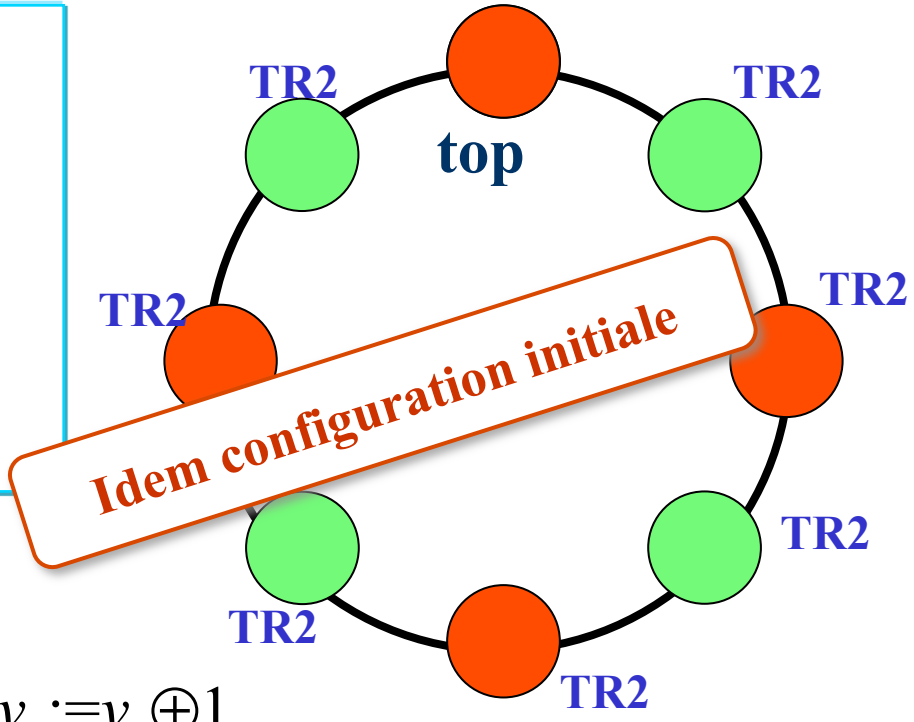

p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus 1$

p ≠ top

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Anneau à jeton

Spécification

- ***Sûreté*** **:** ***Au plus un jeton dans le système***
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Exercice : Montrer qu'il se produit la même chose avec un nombre impair de processeurs.

p = top

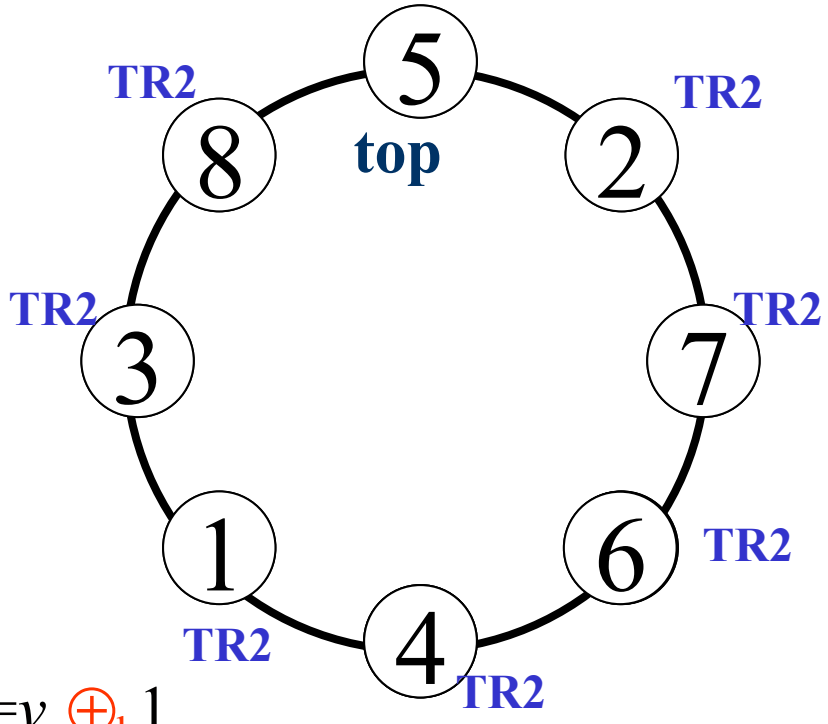
TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus 1$

p ≠ top

TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



p = top

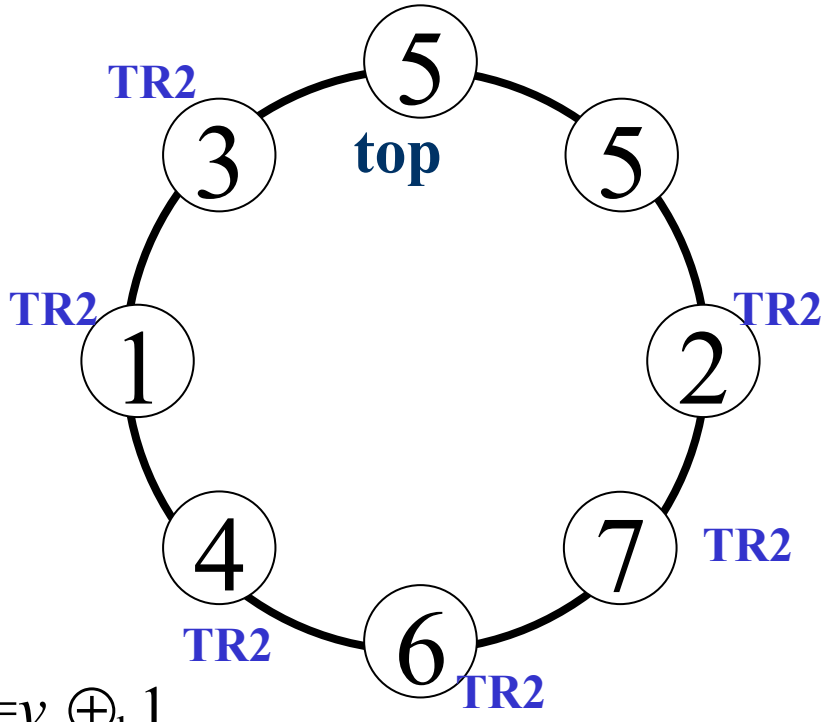
TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

p ≠ top

TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

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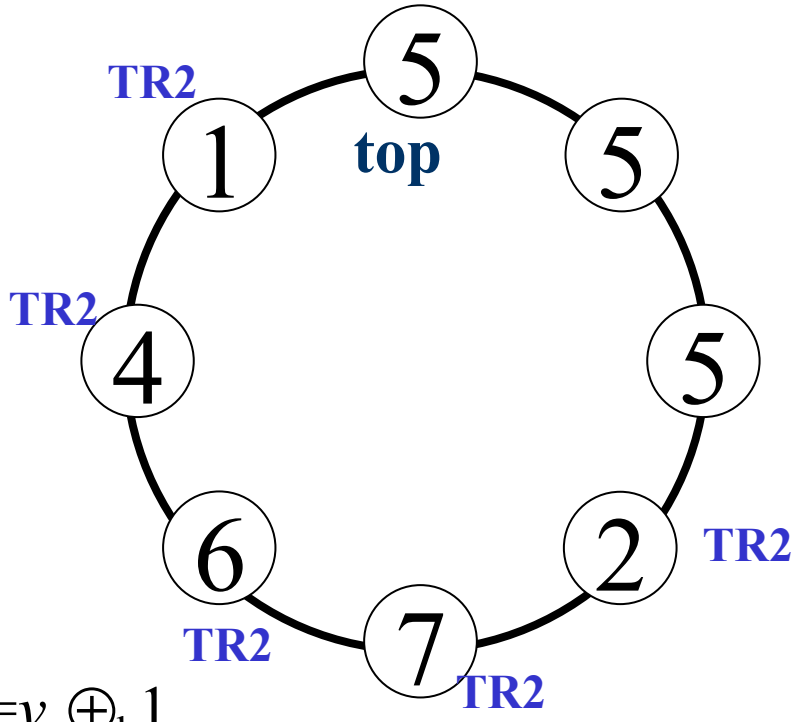
Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

p ≠ top

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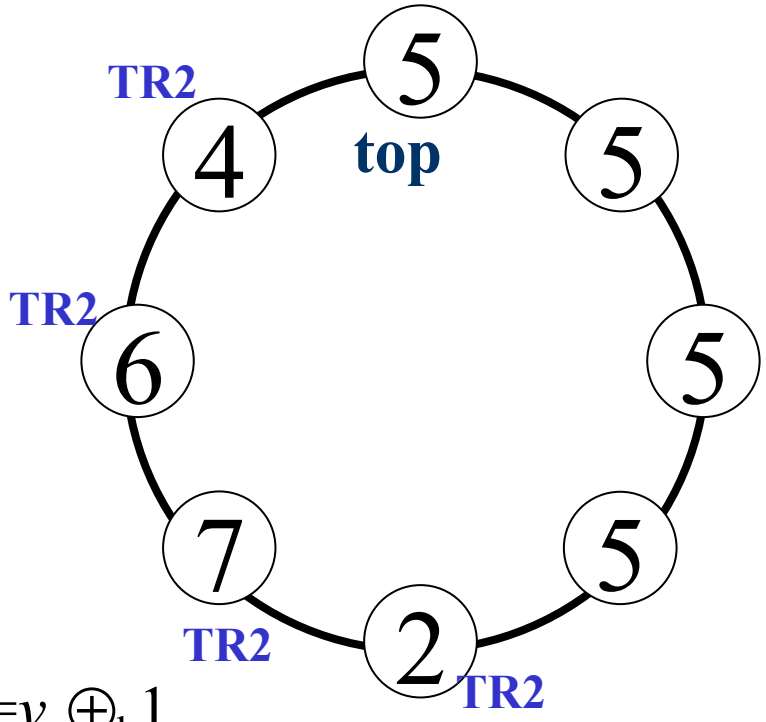
Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



p = top

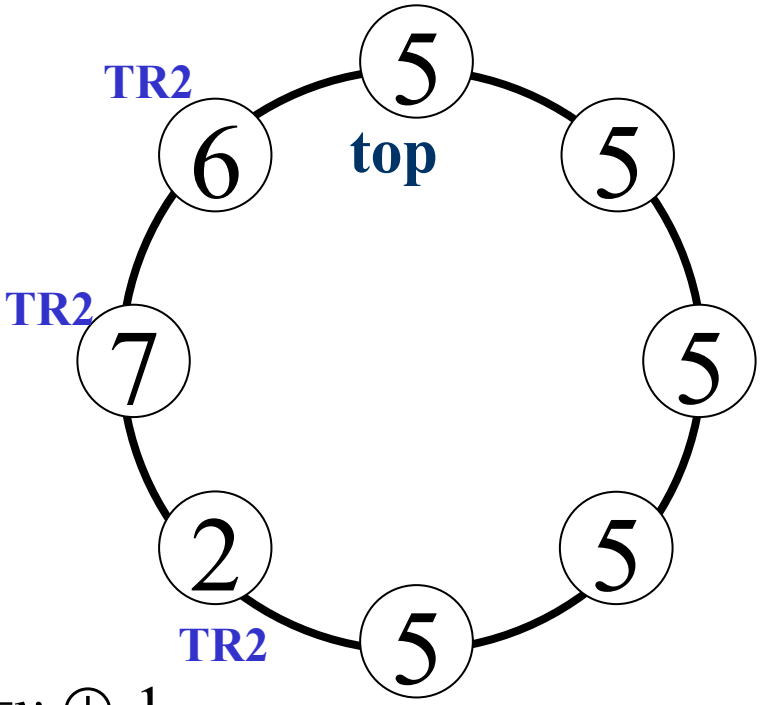
TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

p ≠ top

TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



p* = *top

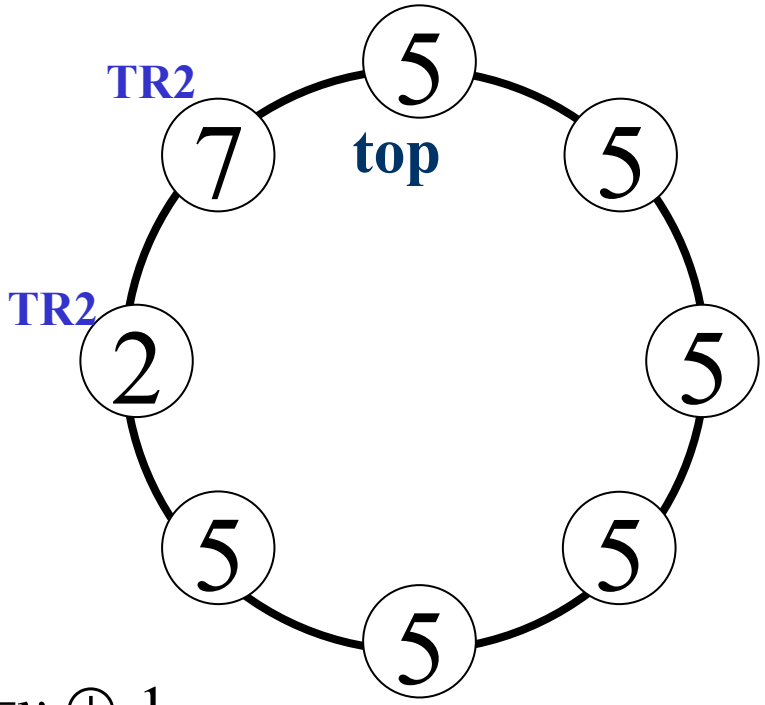
TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

p* ≠ *top

TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

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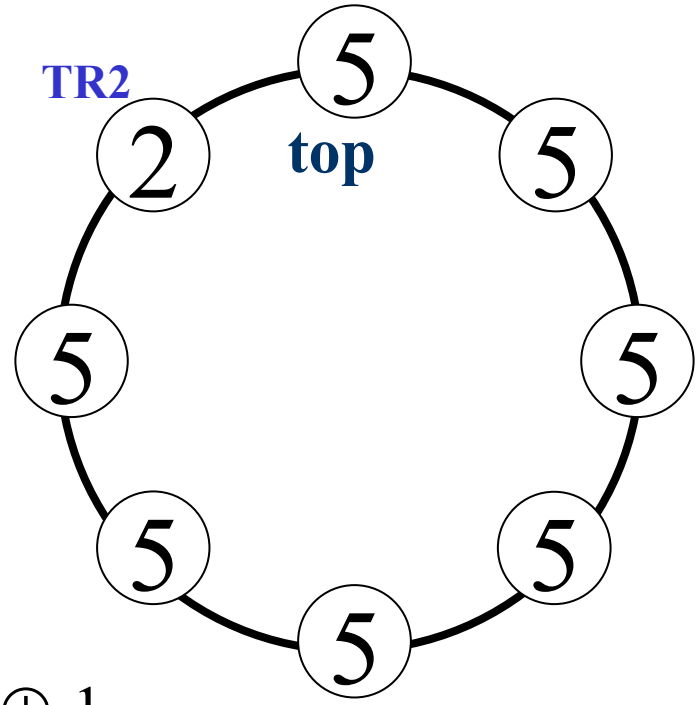
Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



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TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

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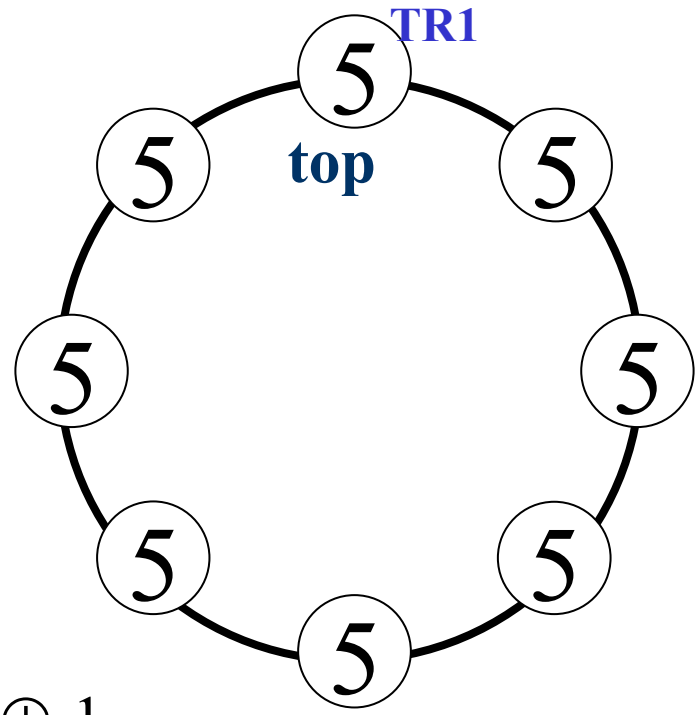
Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

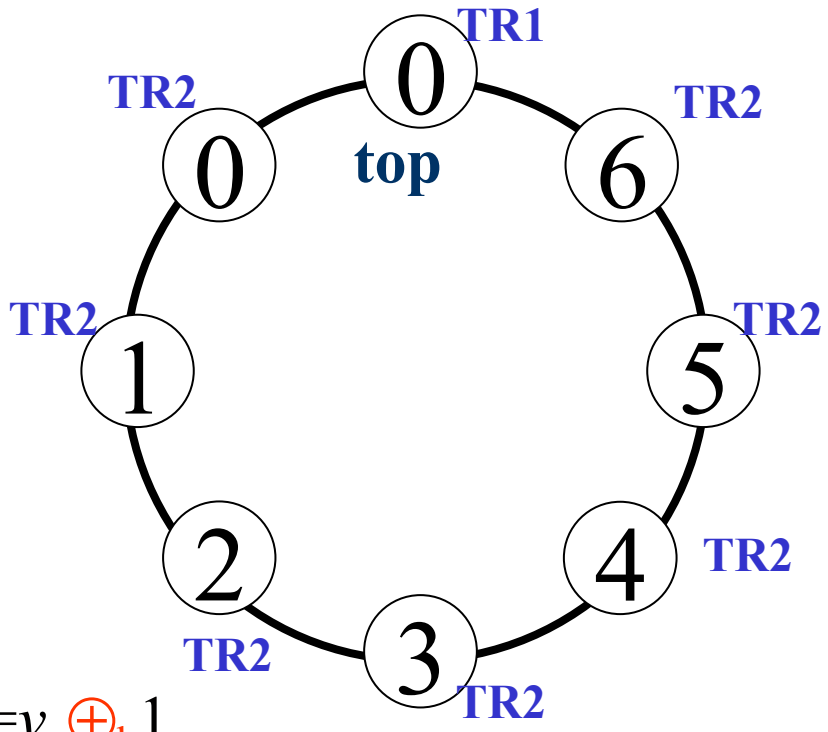
p ≠ top

TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

Valeur de k ?

Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

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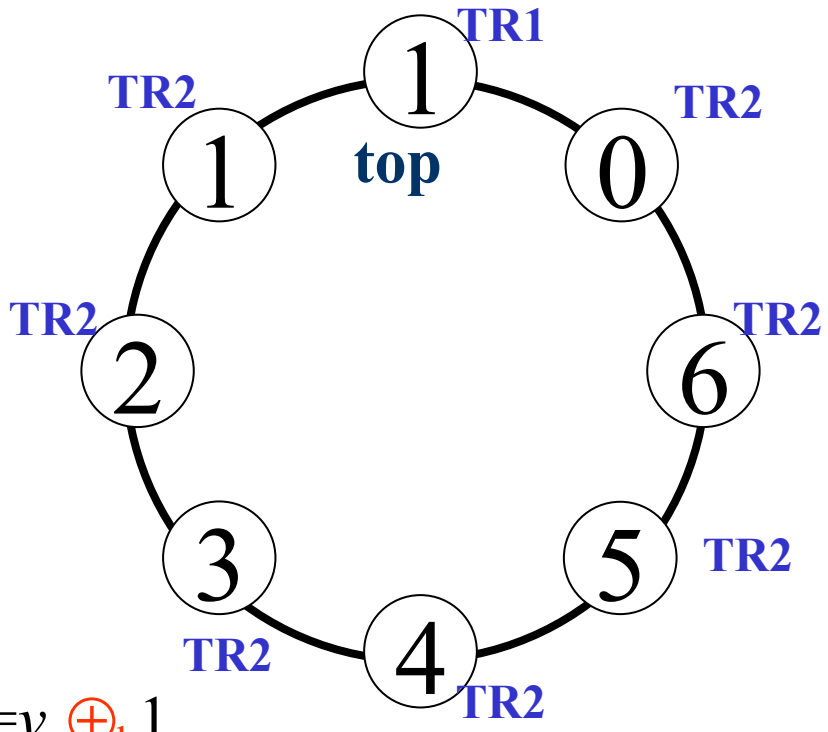
Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



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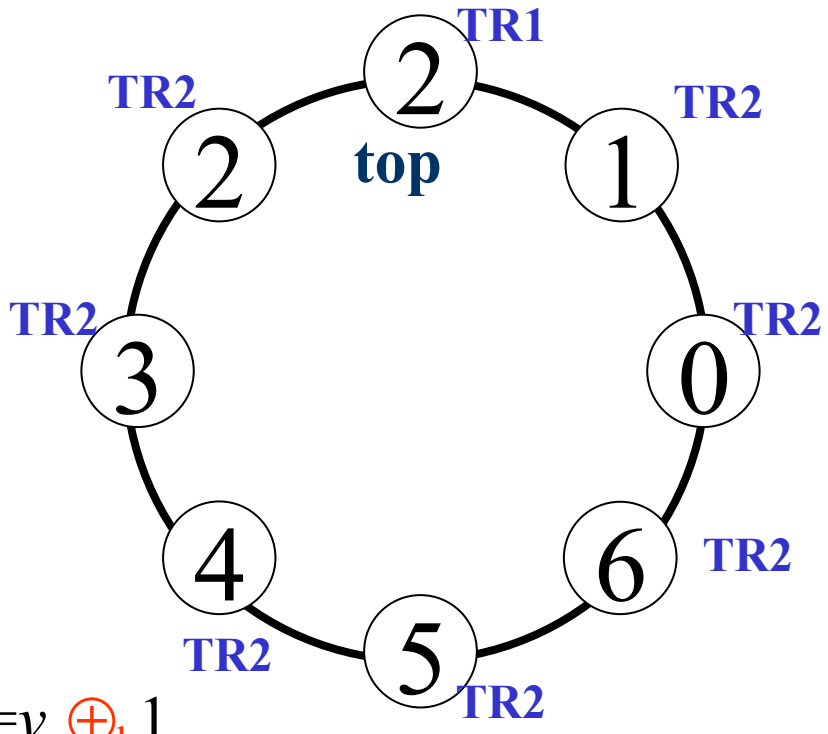
Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



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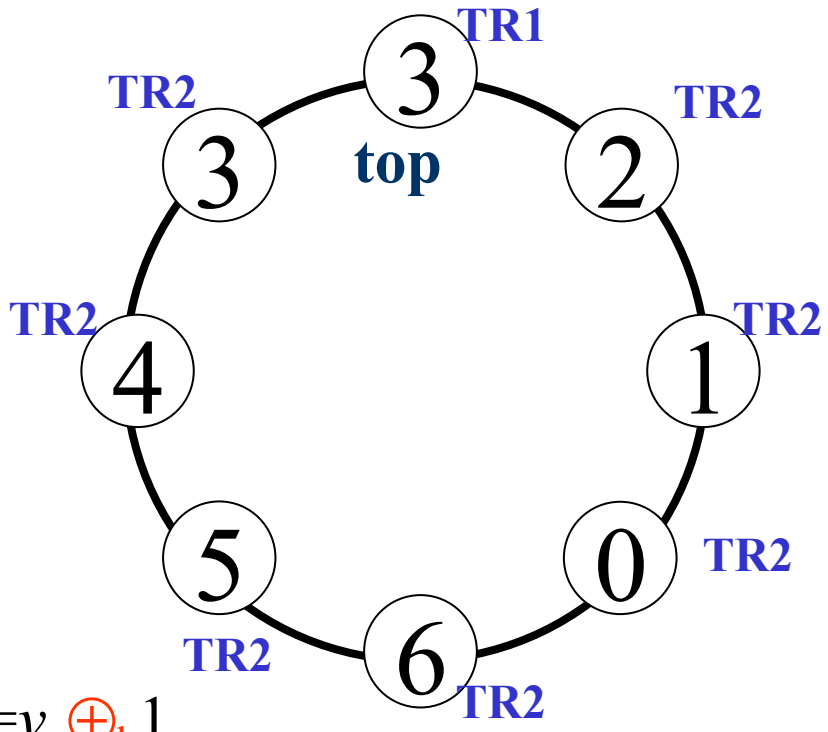
Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



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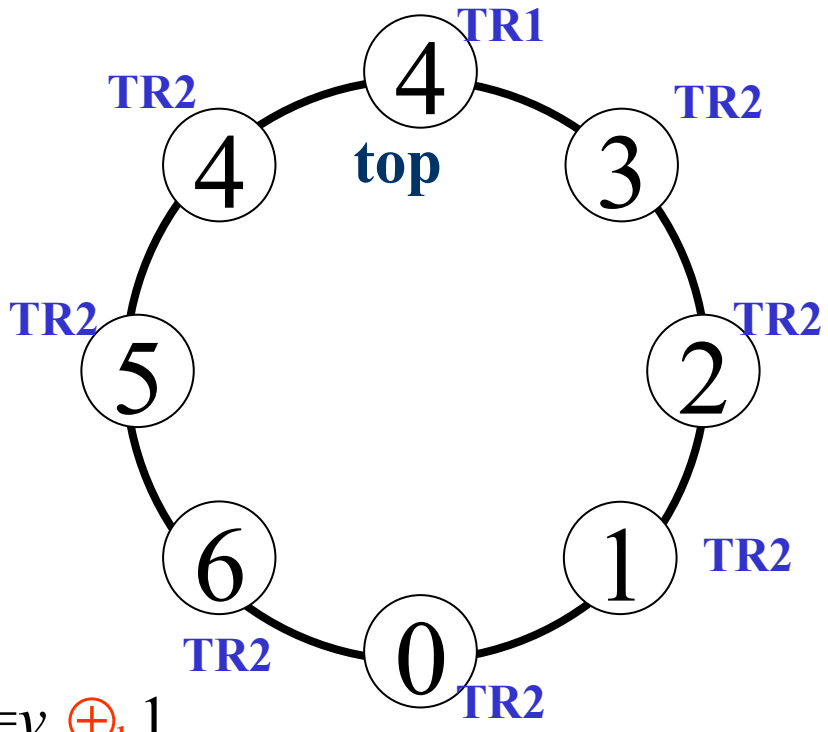
Anneau à jeton

Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



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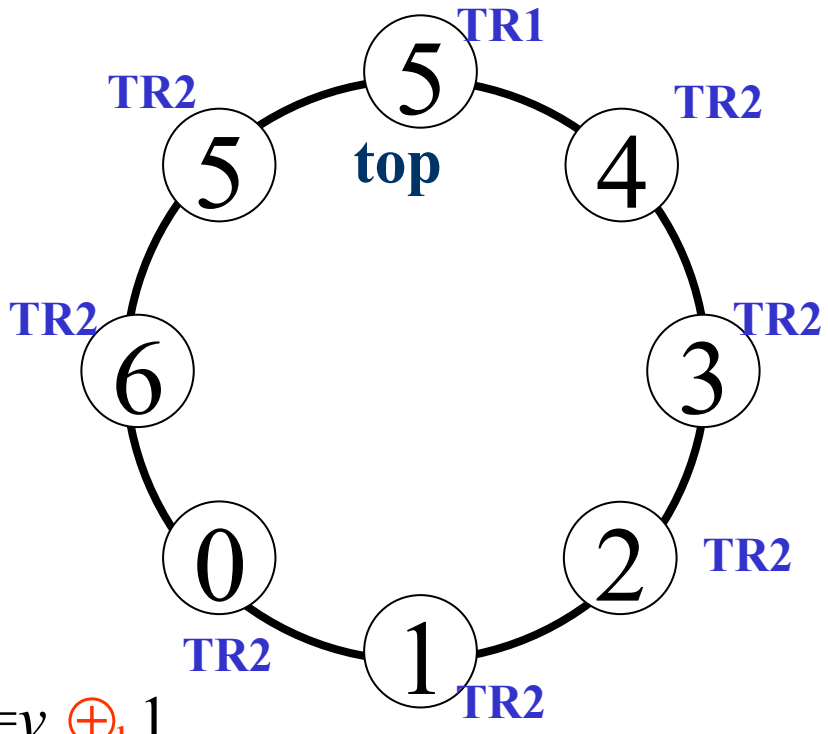
Algorithme Auto-stabilisant de circulation de jeton de Dijkstra



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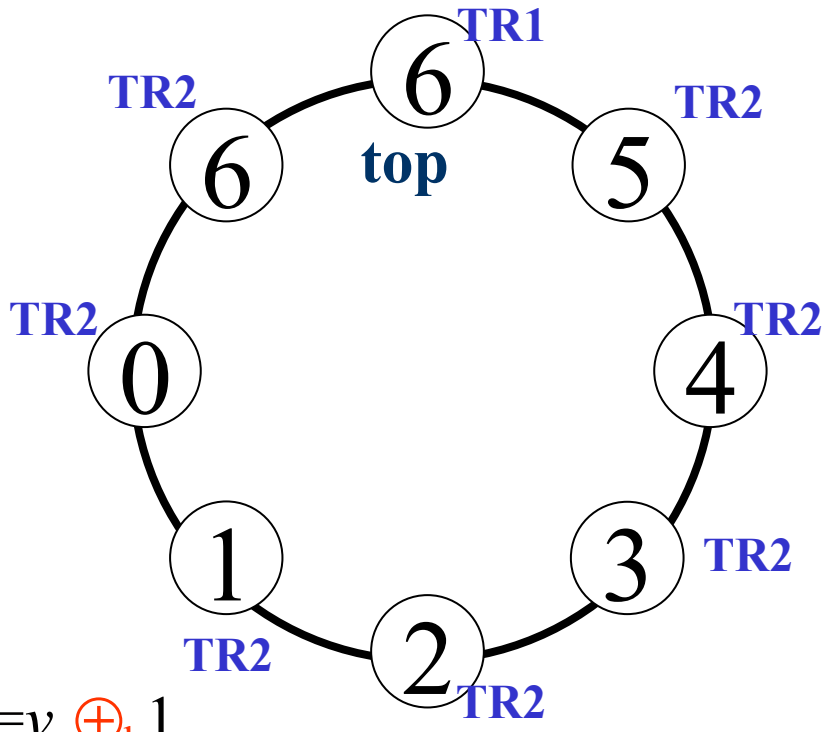

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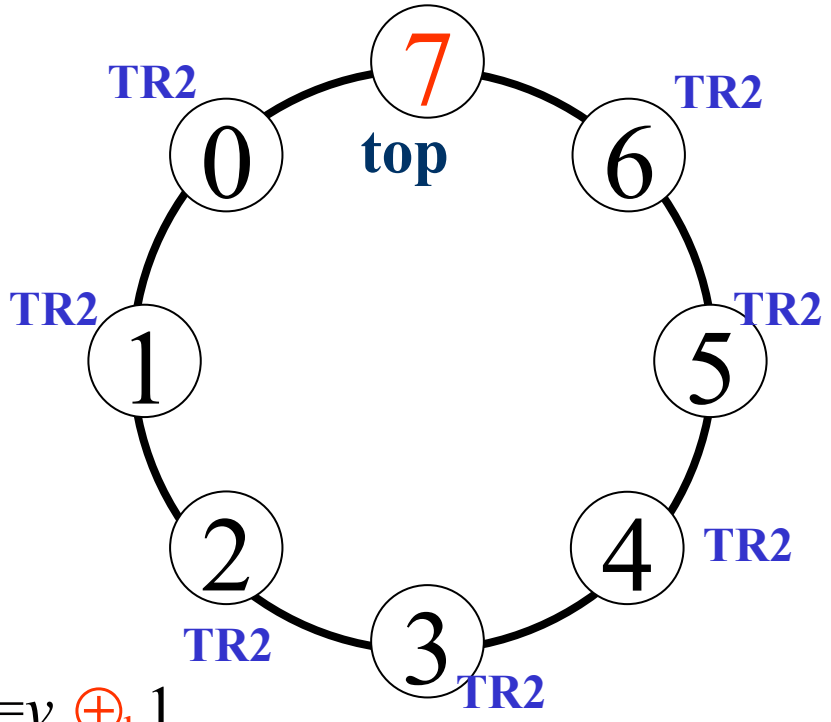

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Anneau à jeton

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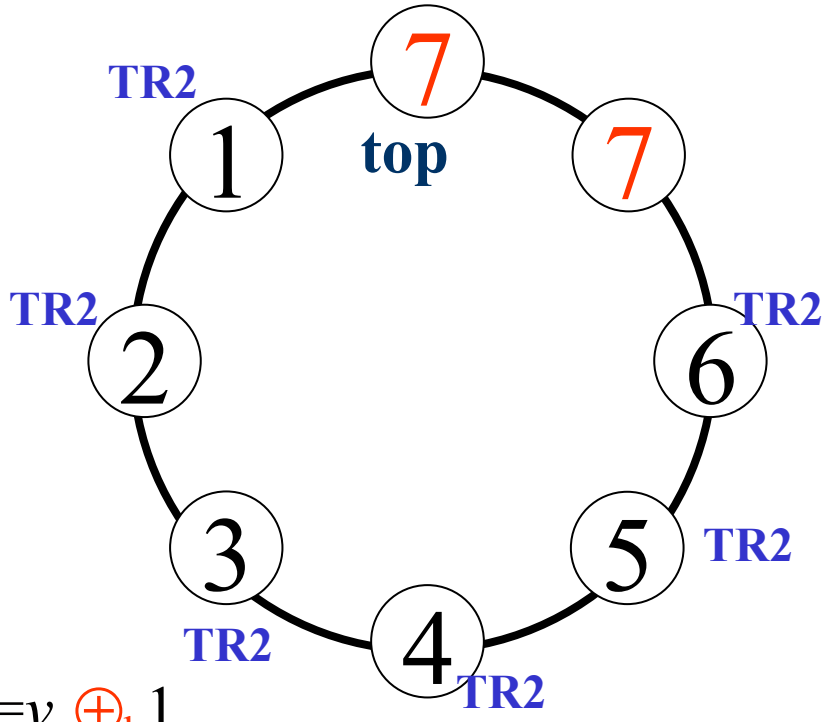

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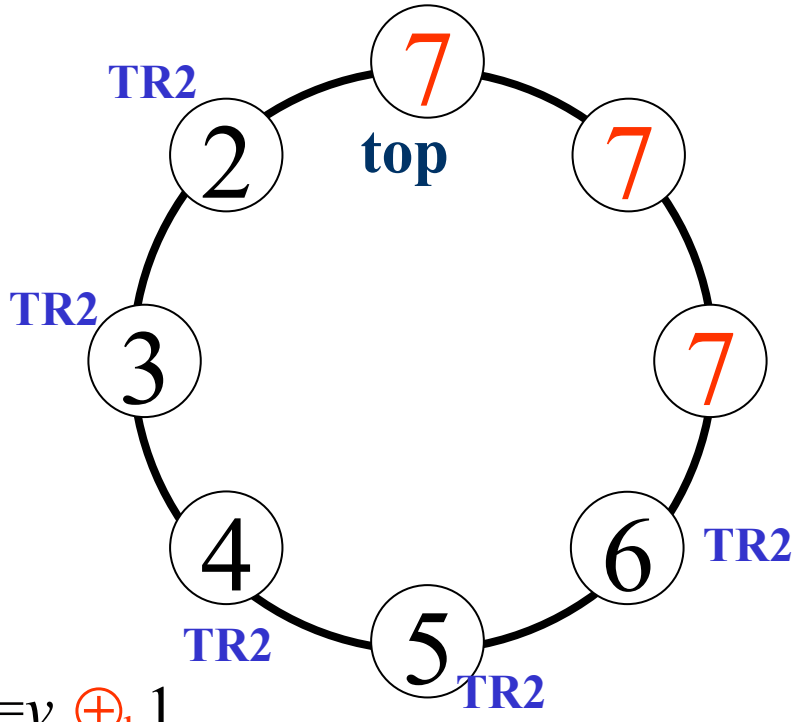

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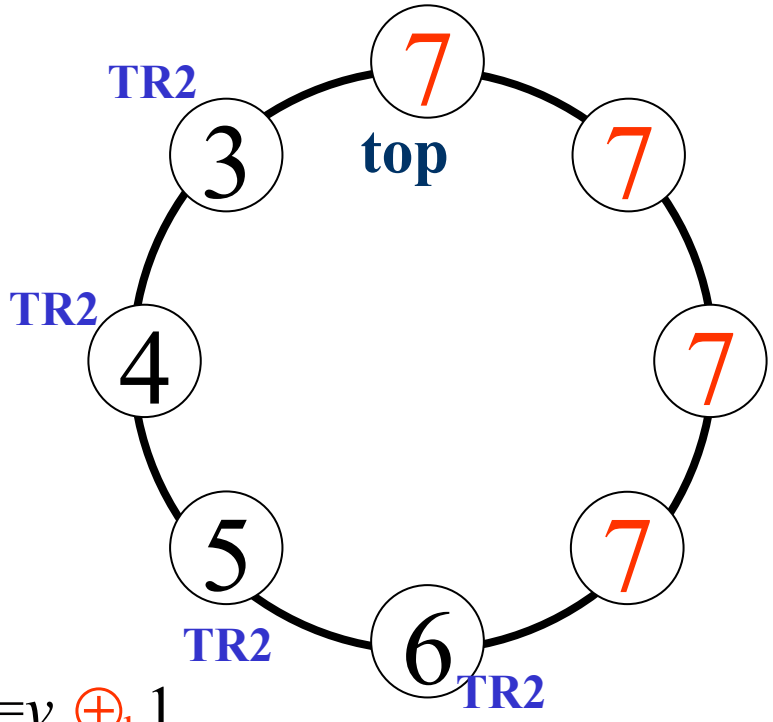

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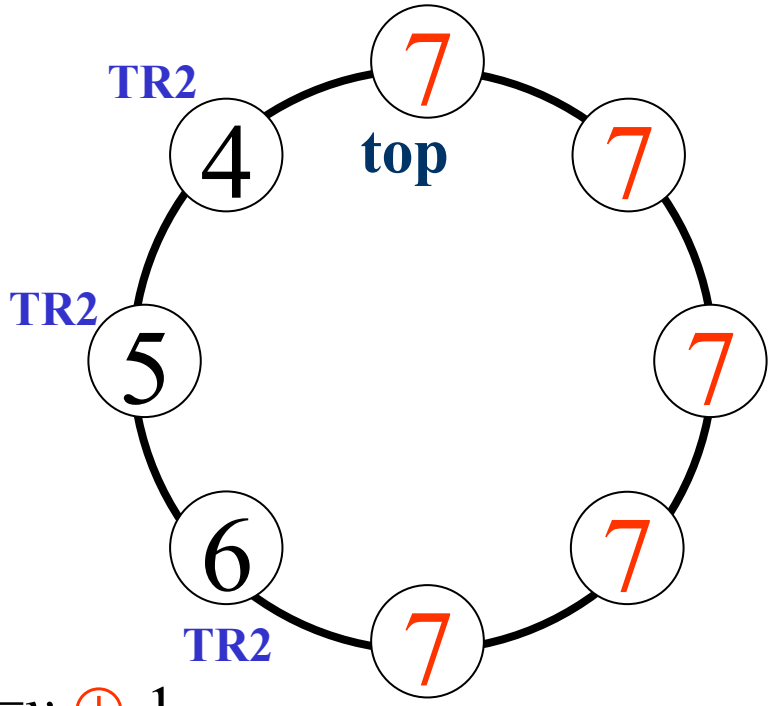

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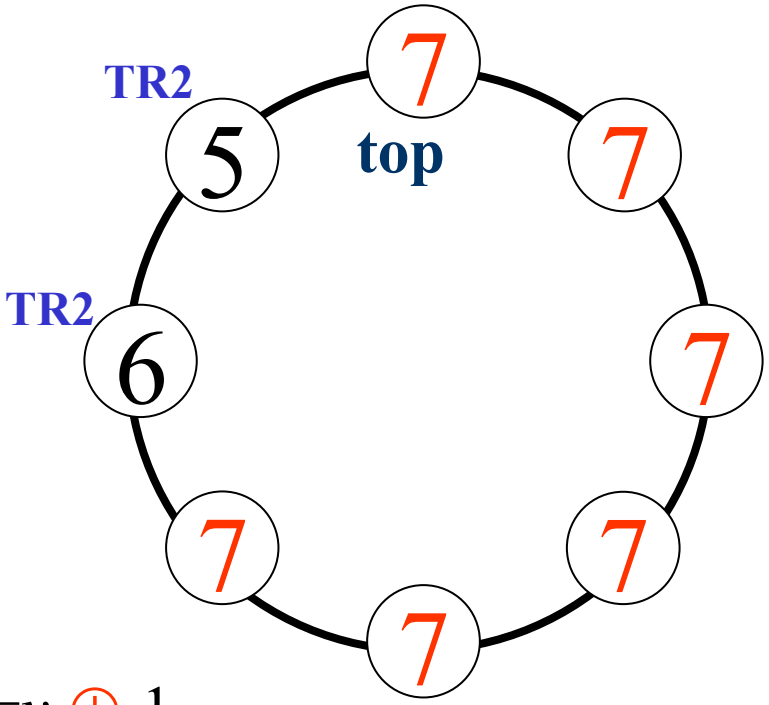

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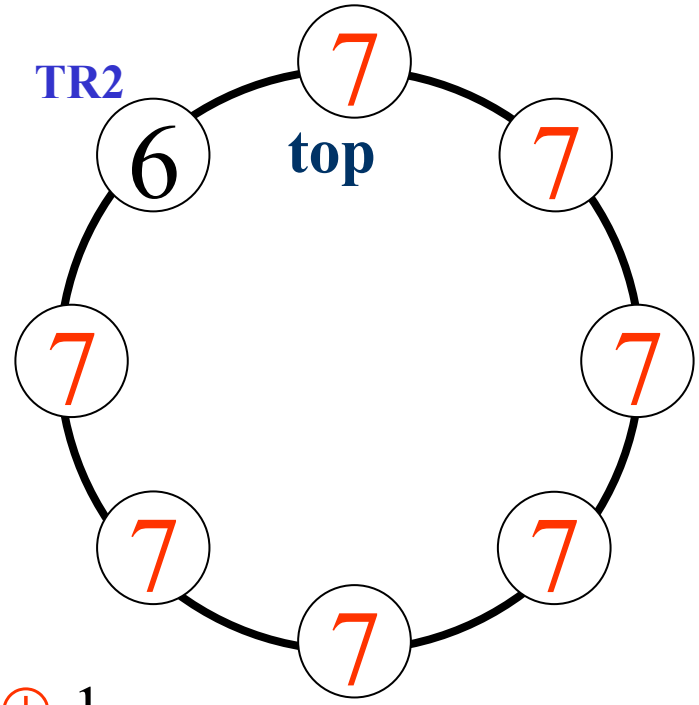

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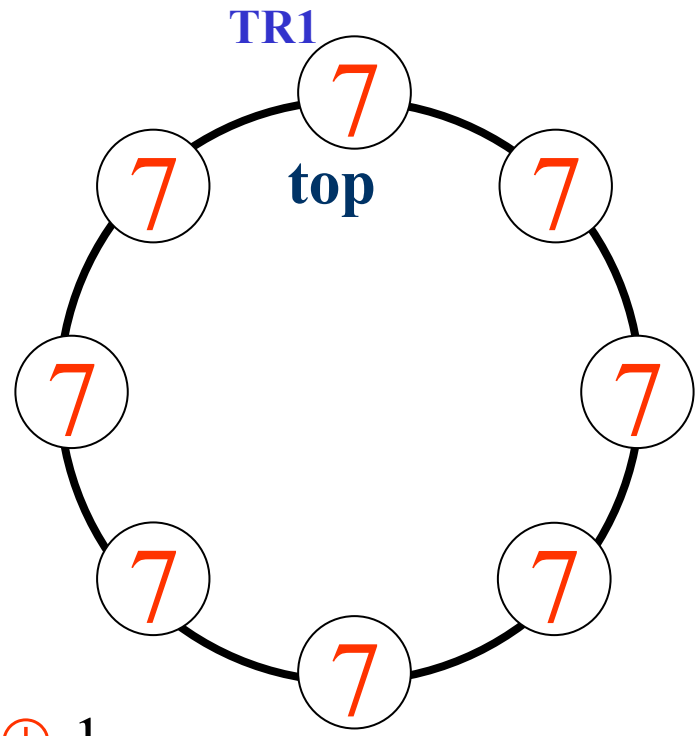


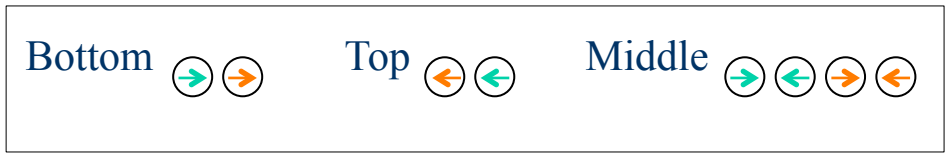
p = top

TR1 : $(v_p = v_g)$ → $v_p := v_g \oplus_k 1$

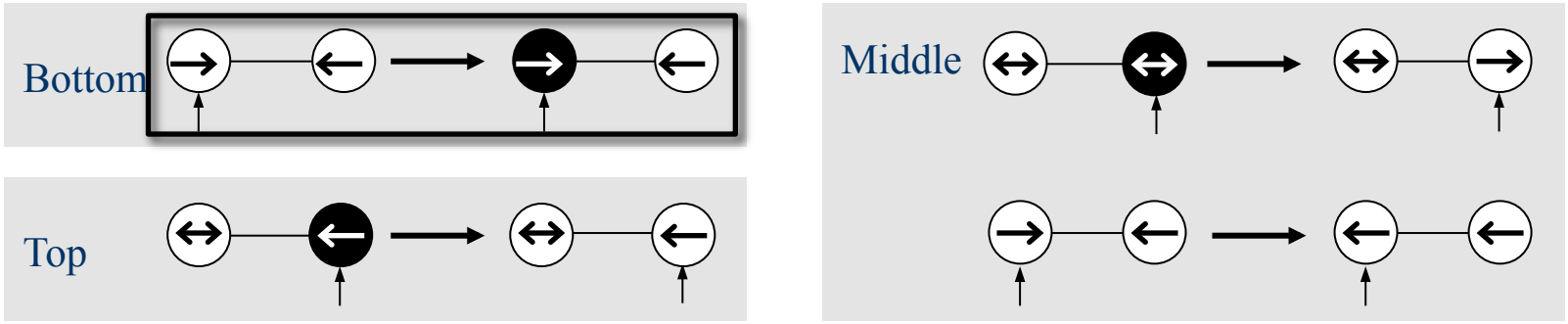
p ≠ top

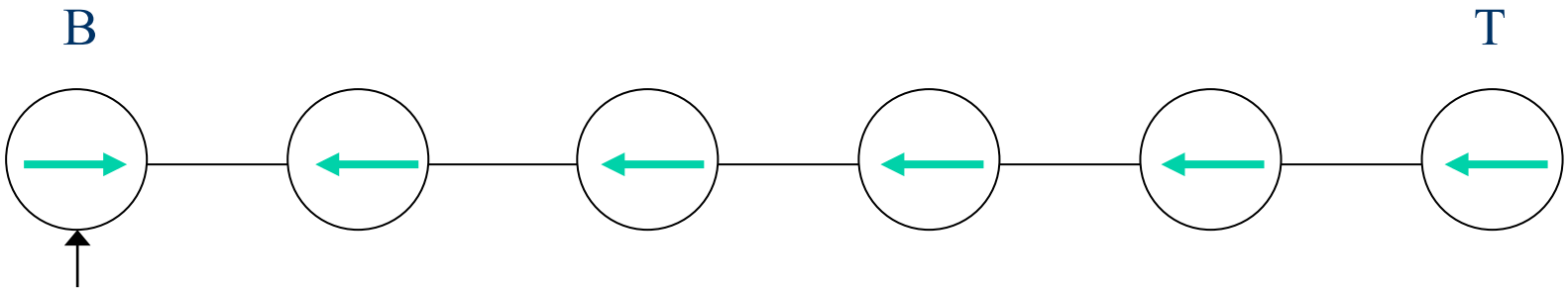
TR2 : $(v_p \neq v_g)$ → $v_p := v_g$

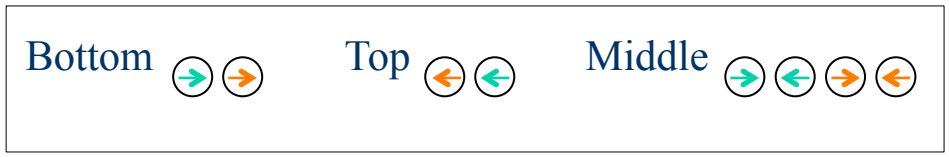
Temps de Stabilisation : *O(n)*



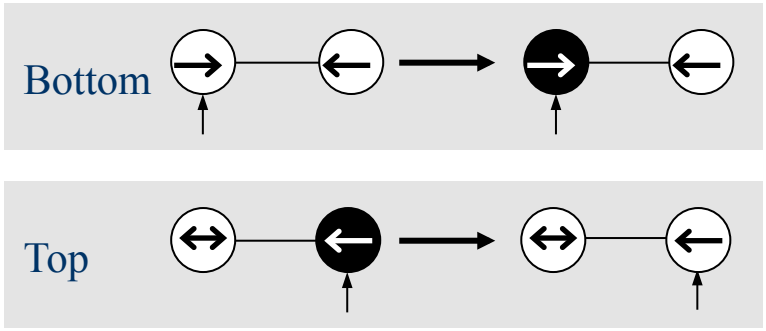
[Dijkstra 74]

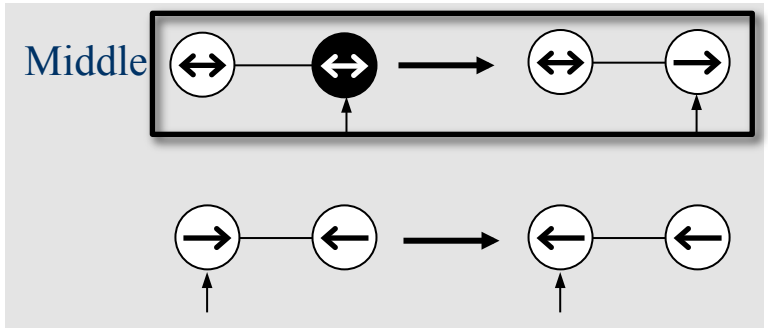


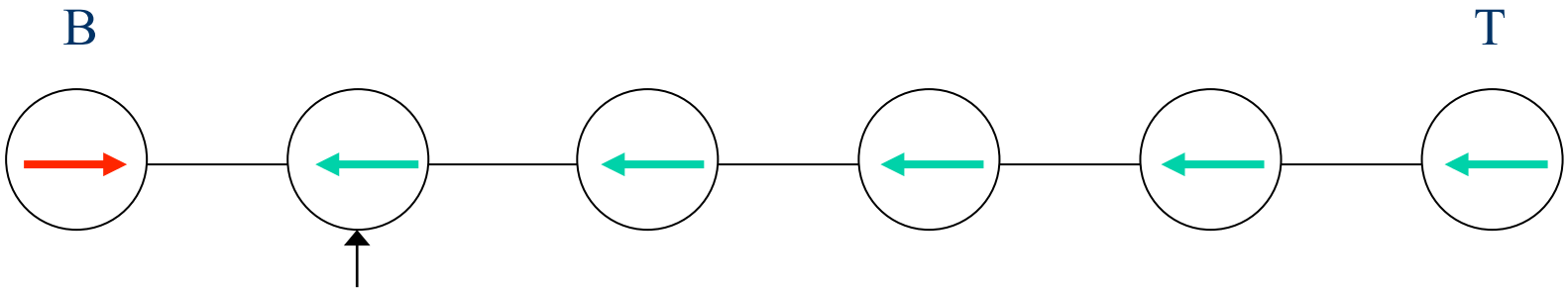


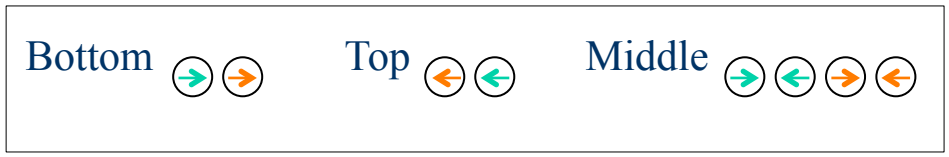


[Dijkstra 74]

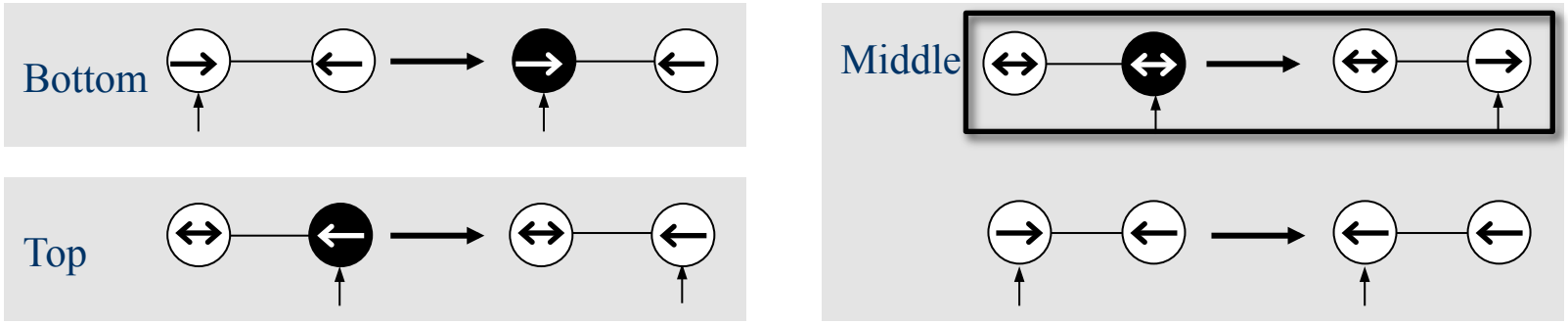


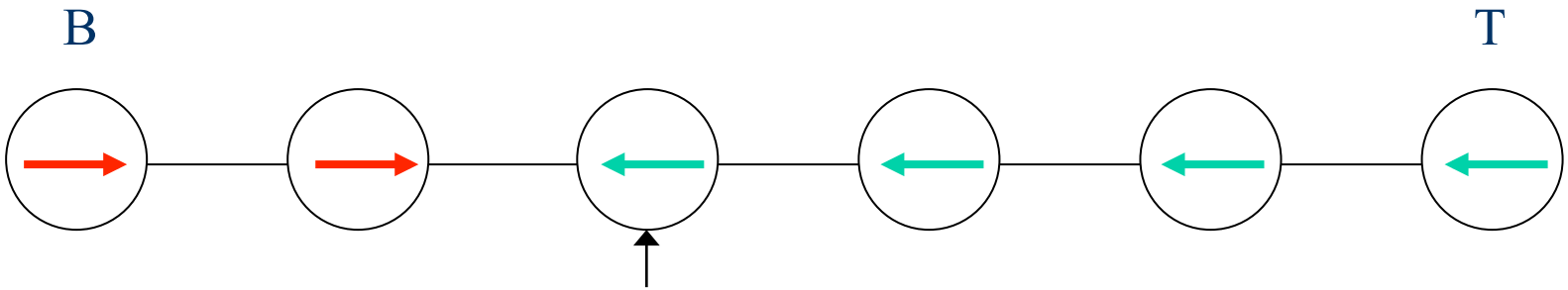


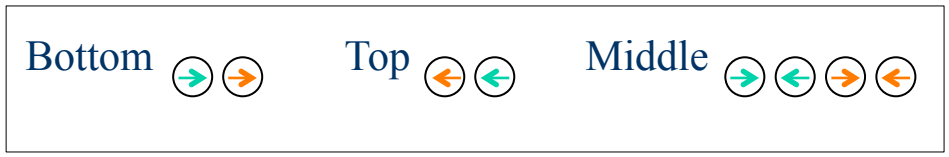




[Dijkstra 74]







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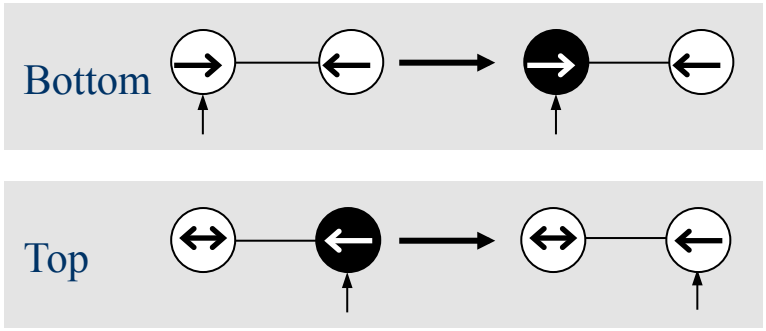

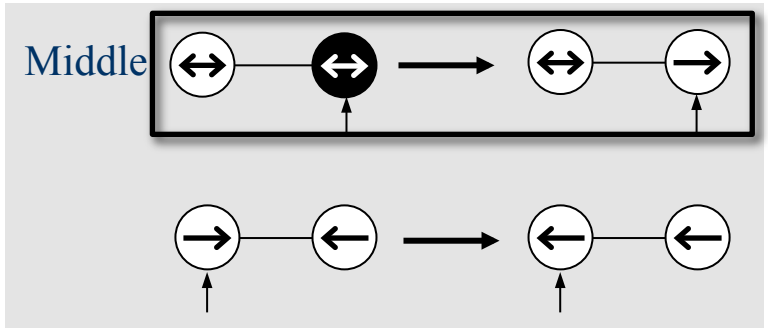

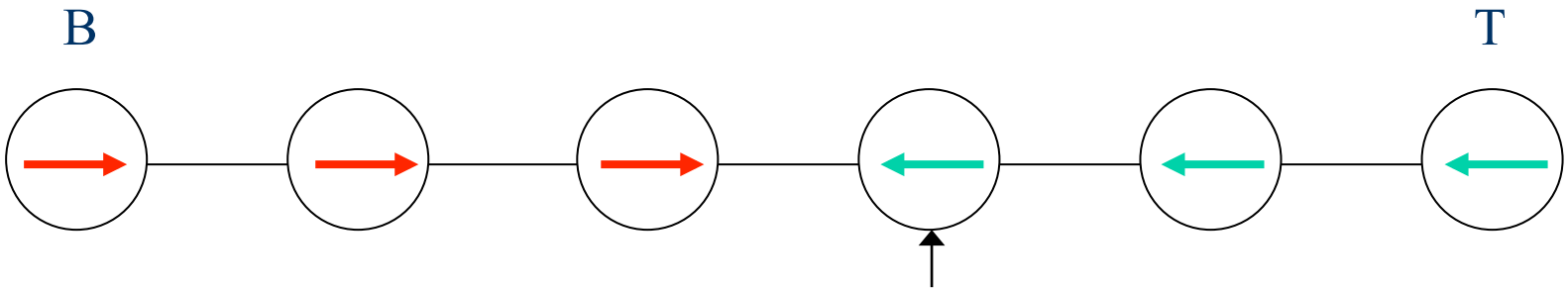

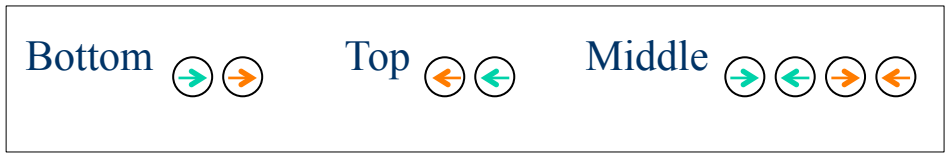

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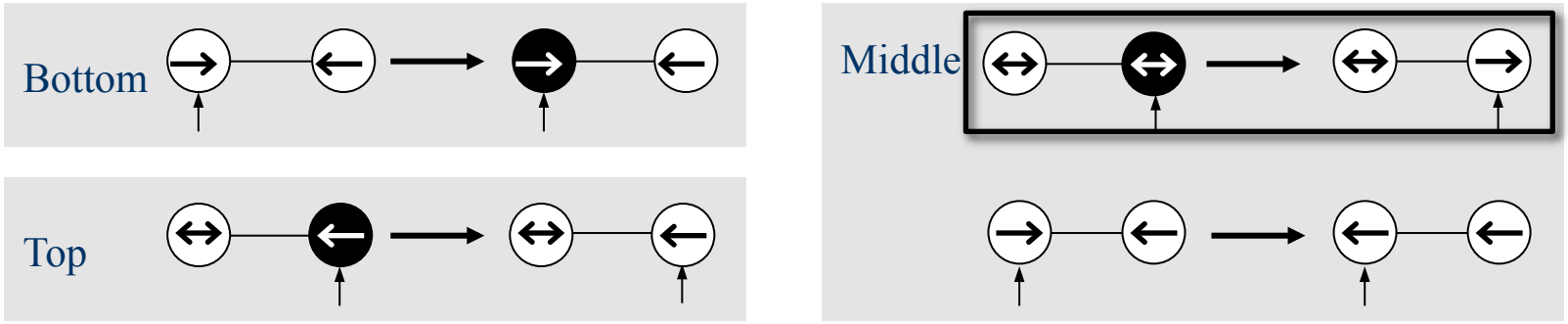

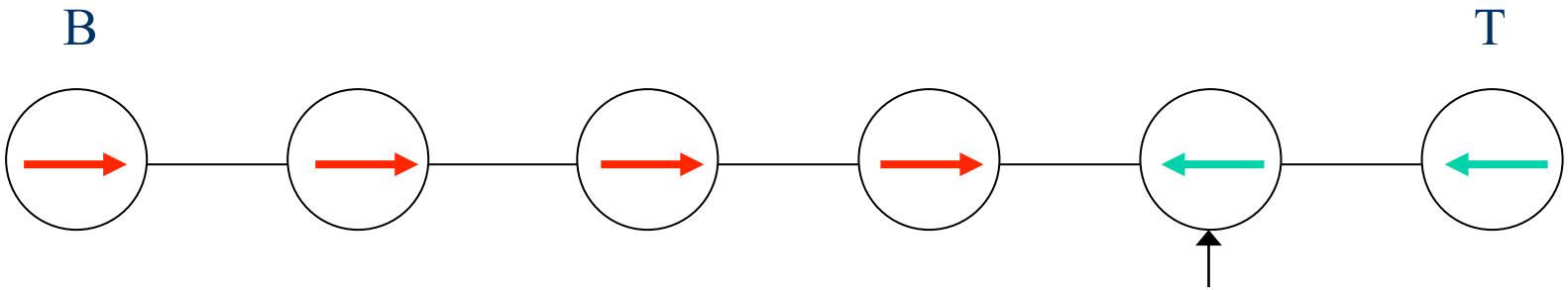

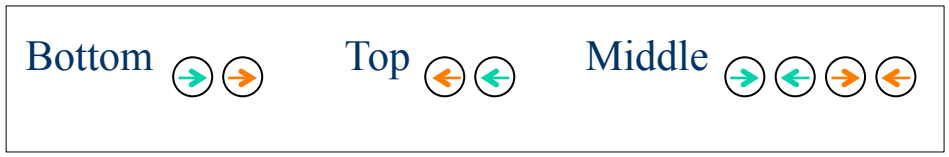

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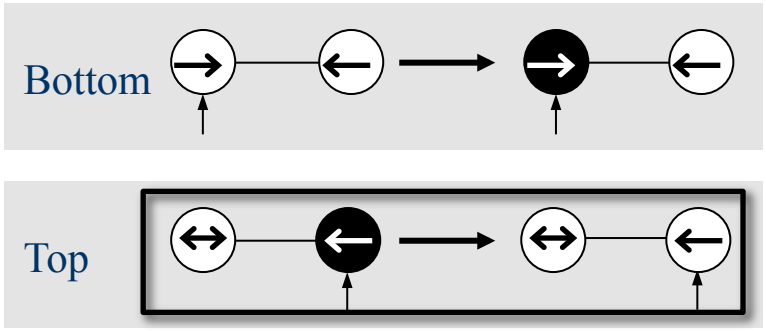
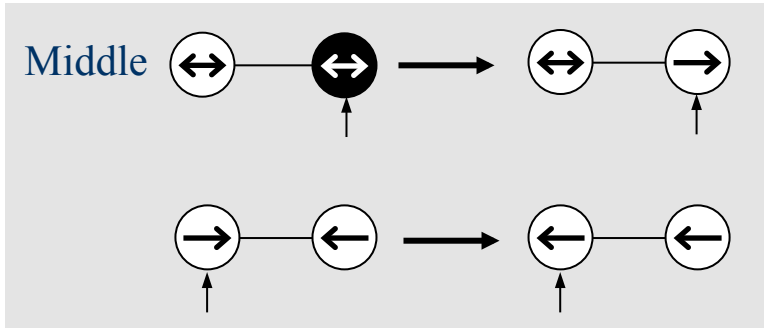
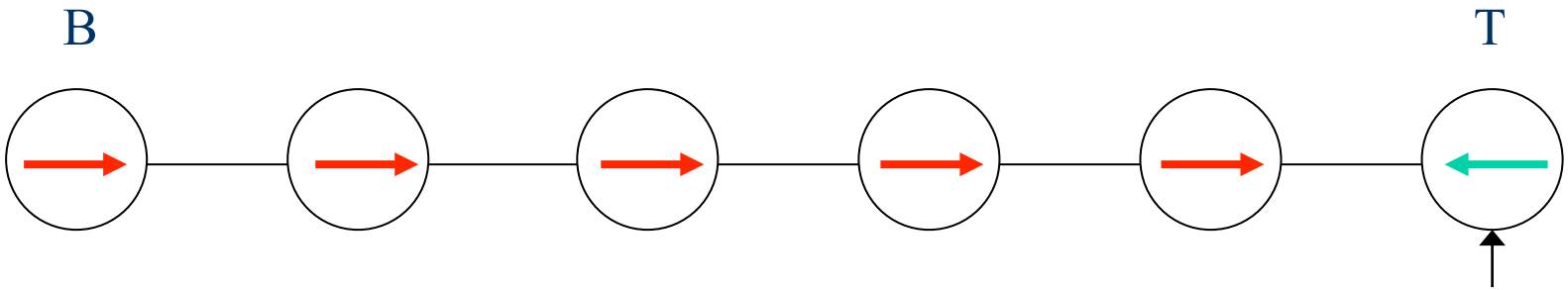
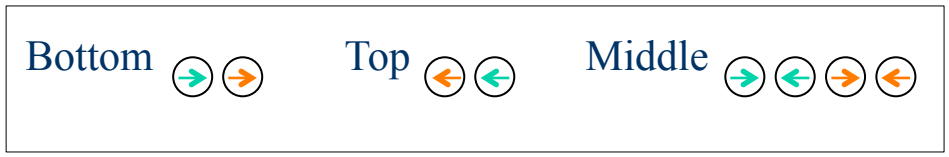
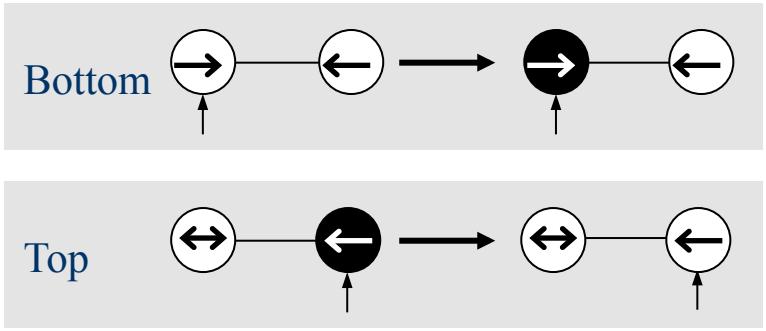


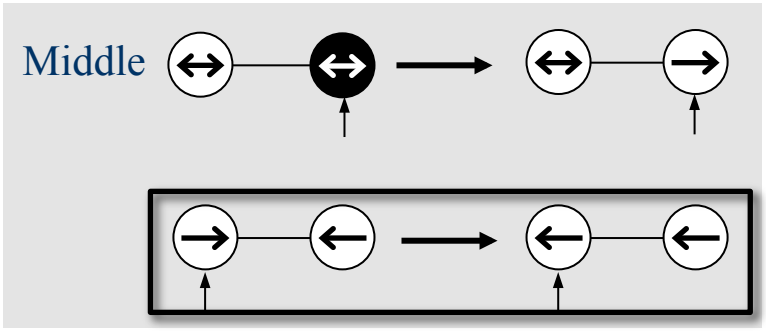


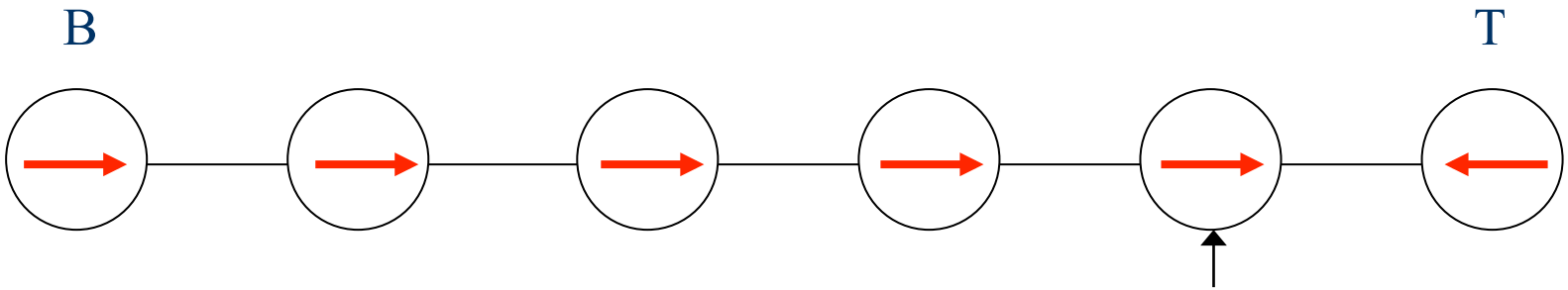


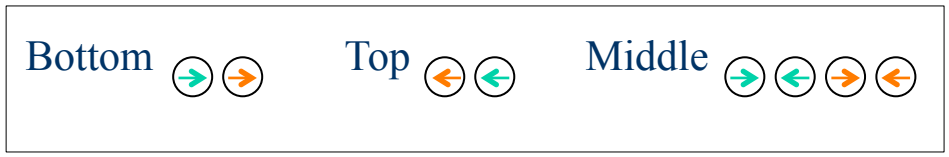


[Dijkstra 74]









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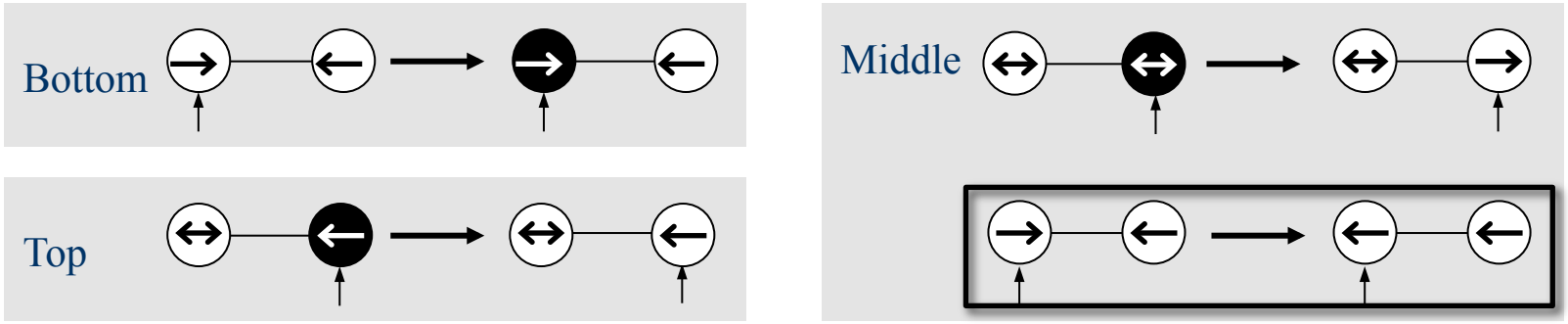
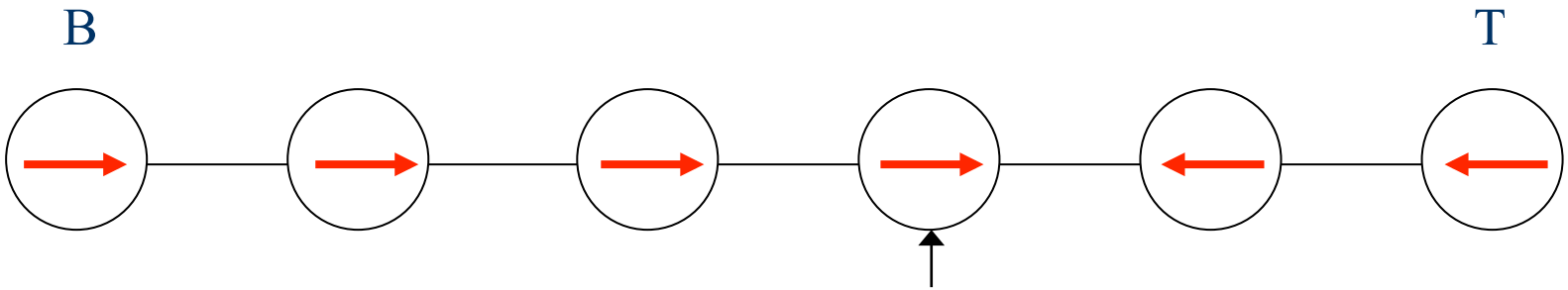
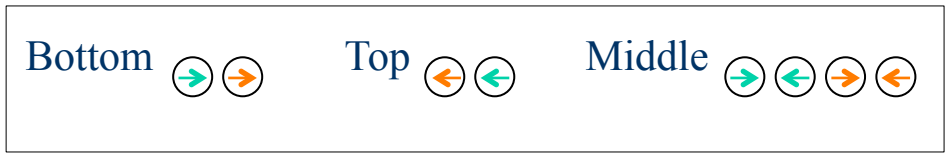
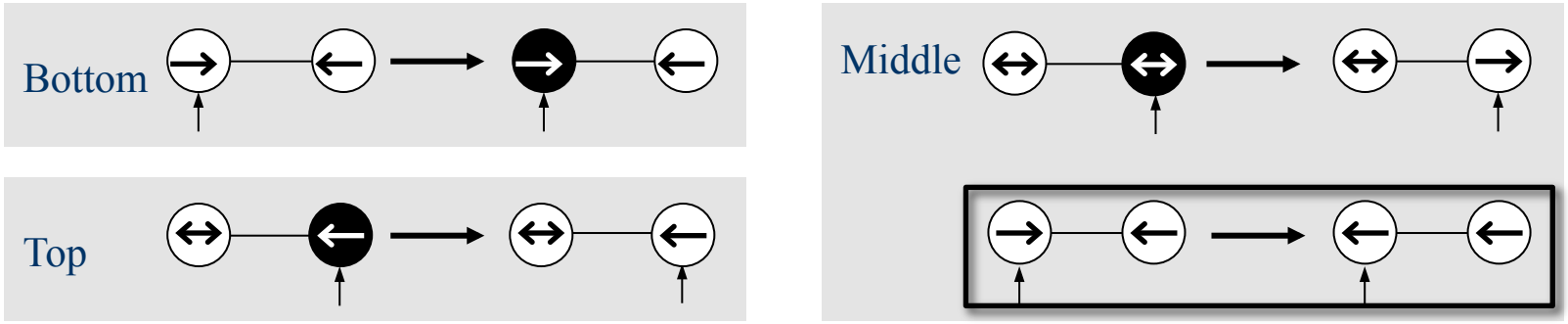
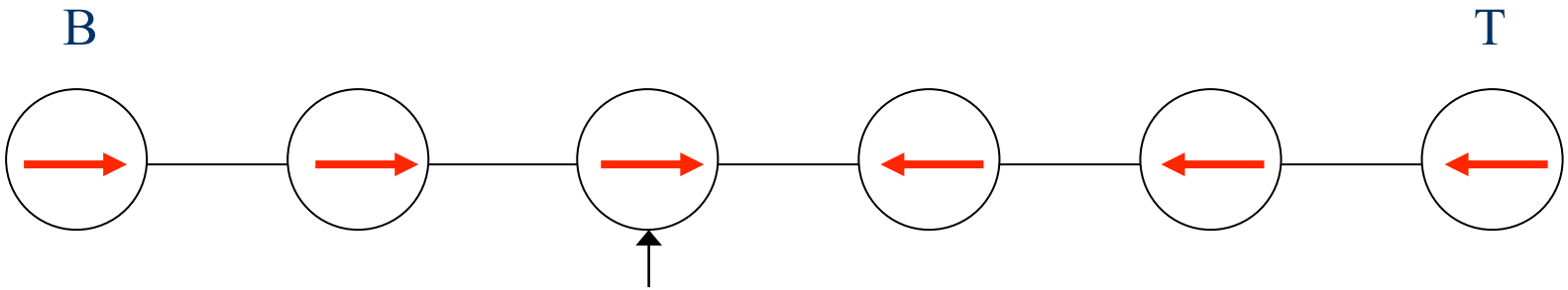


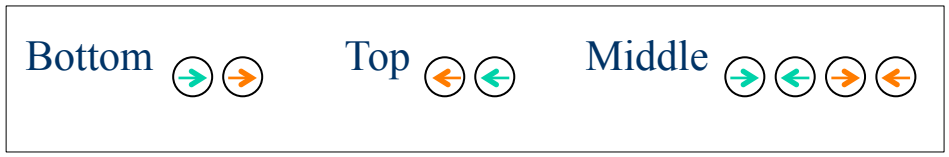




[Dijkstra 74]







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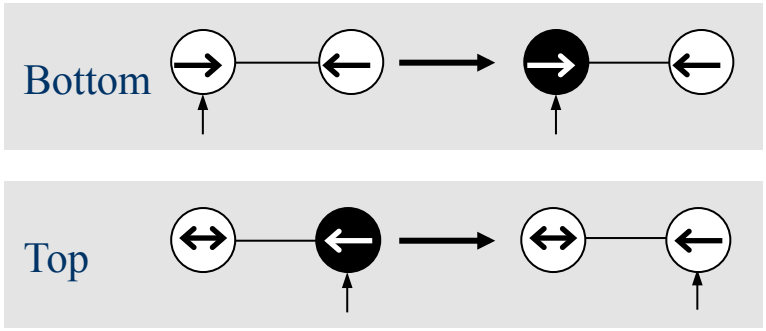

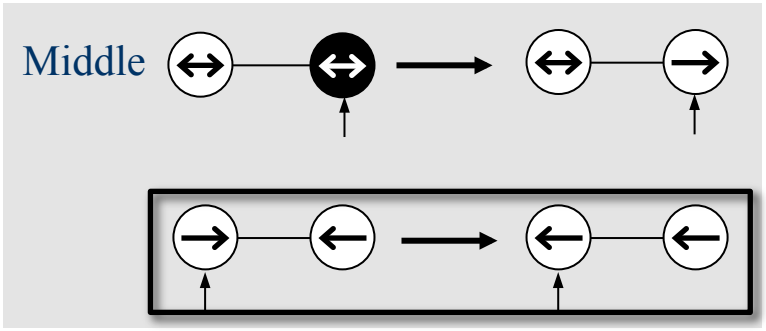

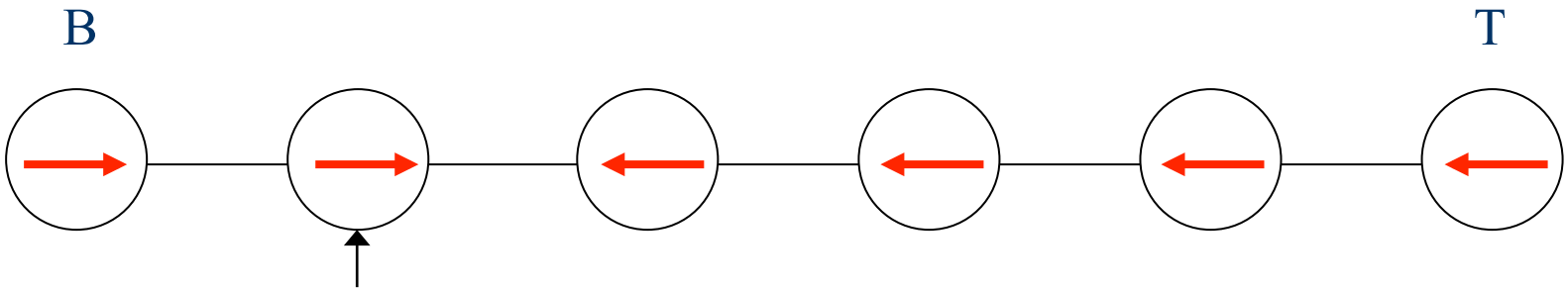

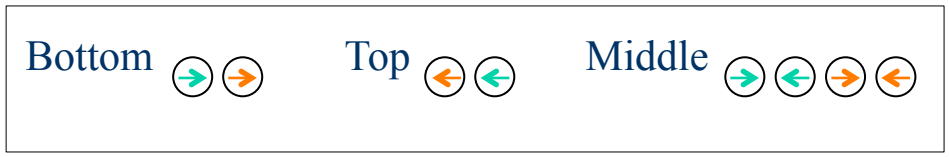

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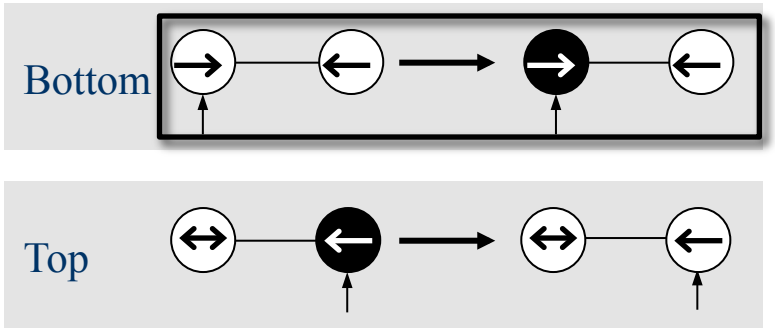

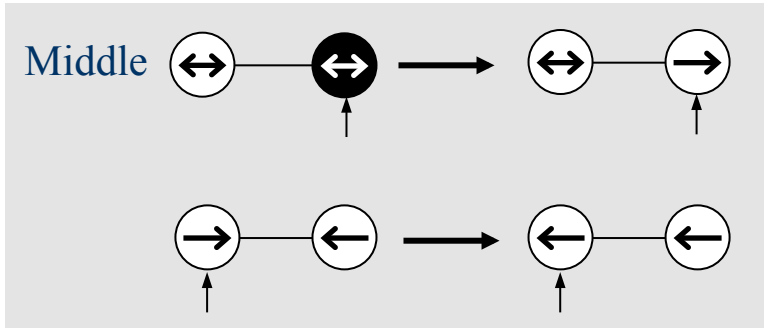

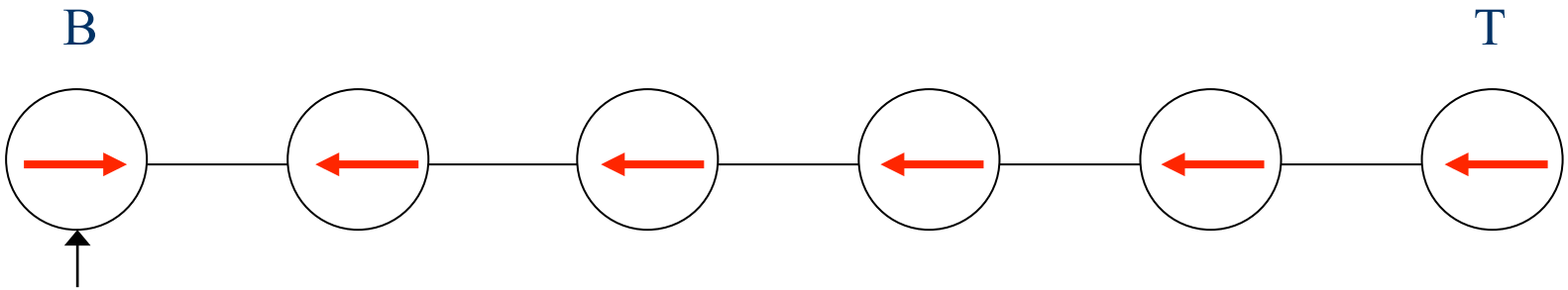

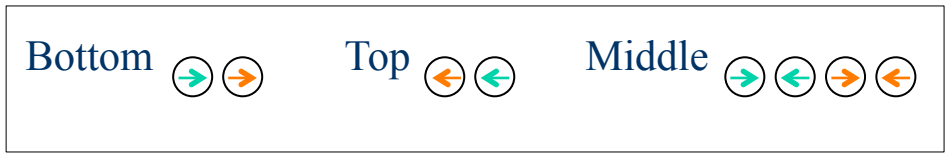

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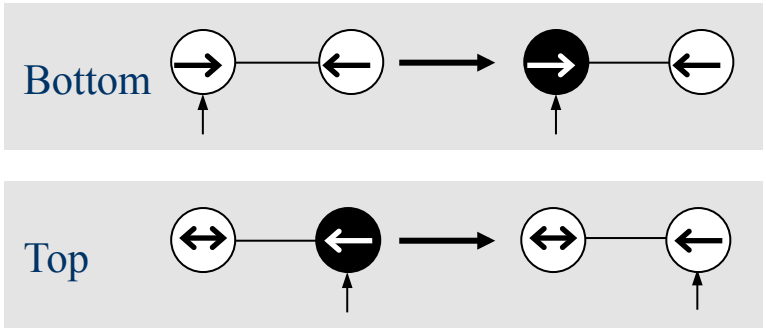

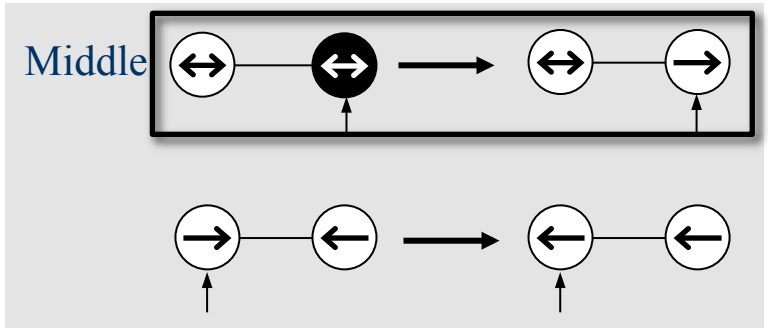

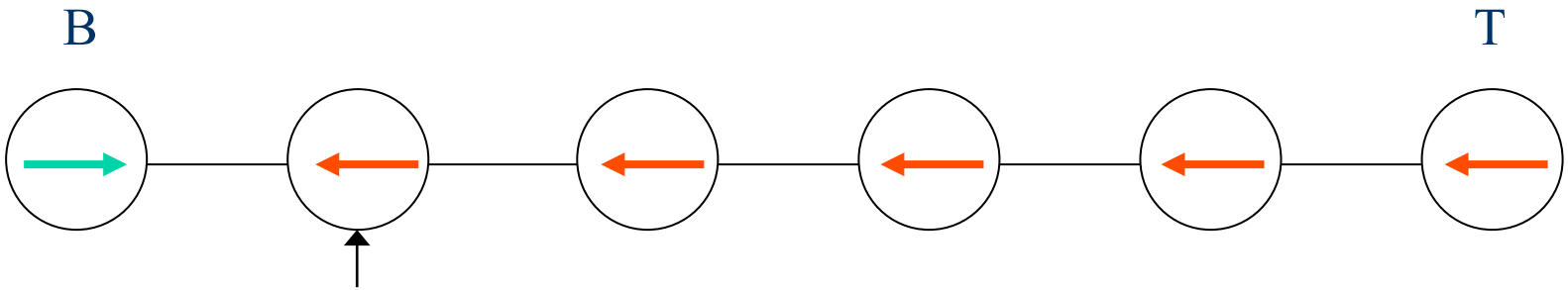

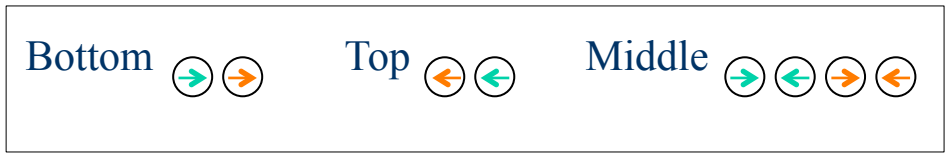

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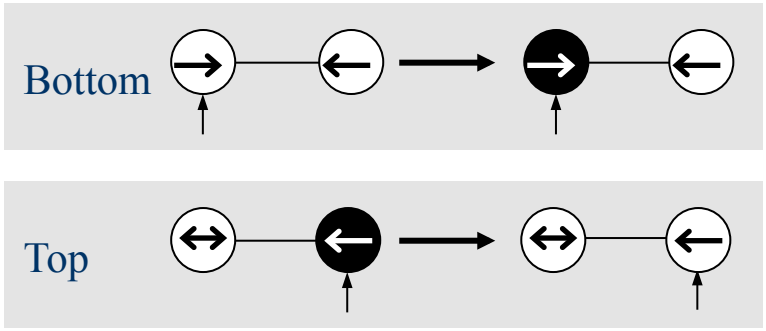

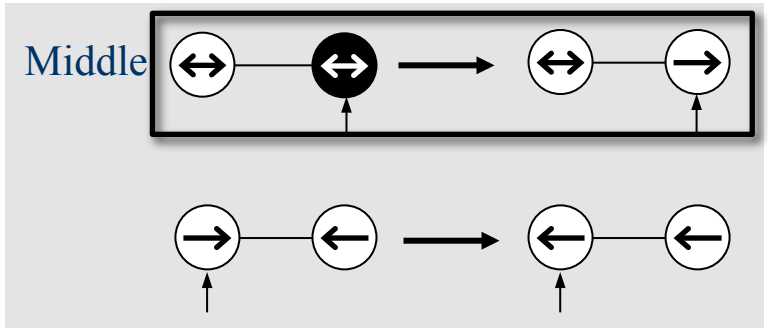

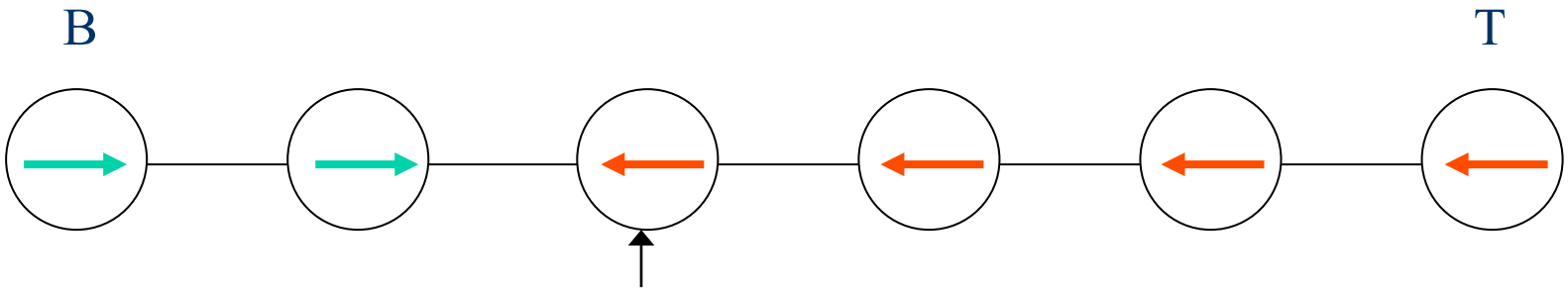

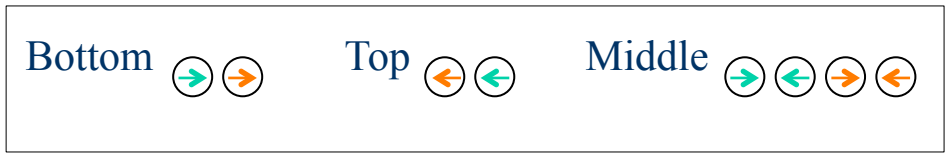

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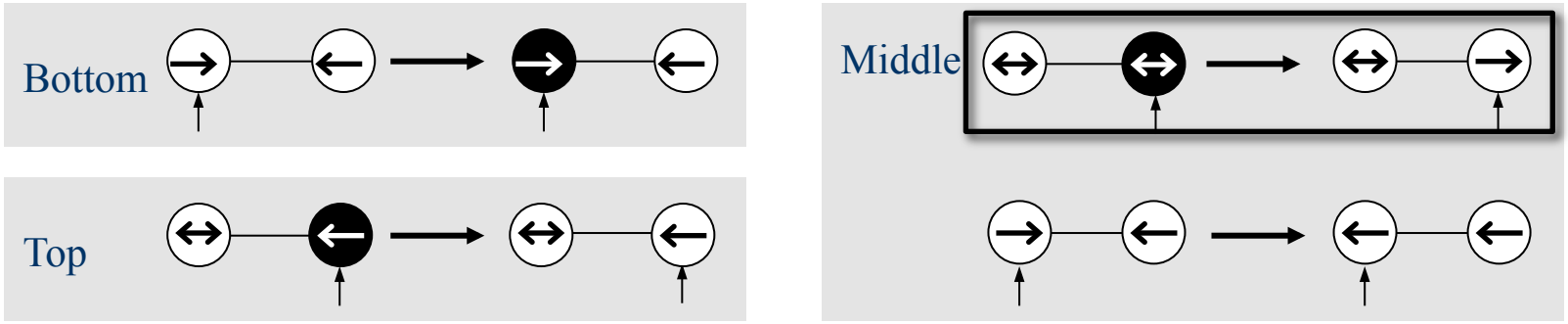

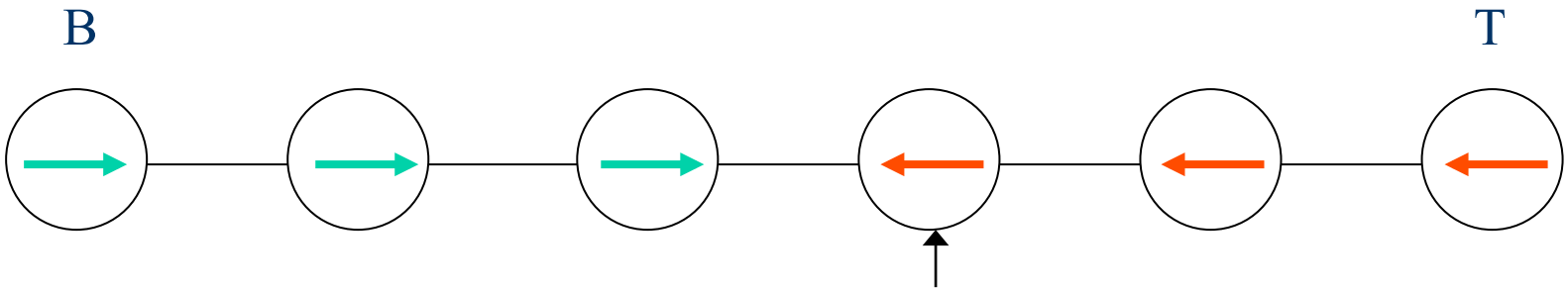

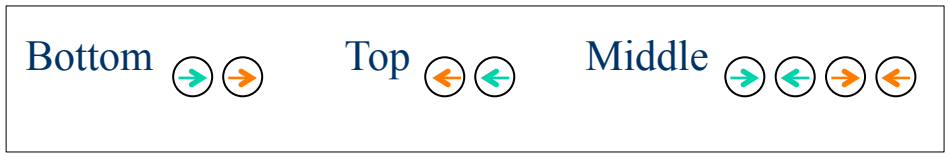

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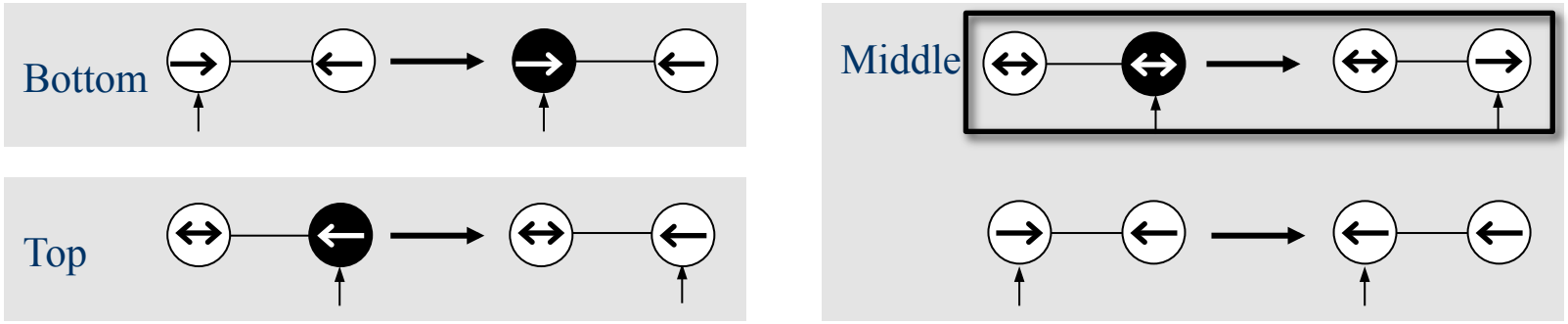

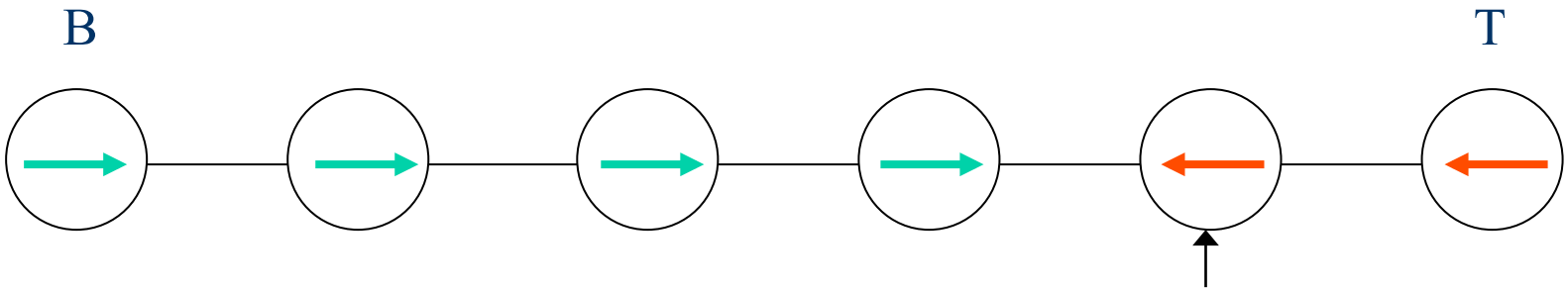

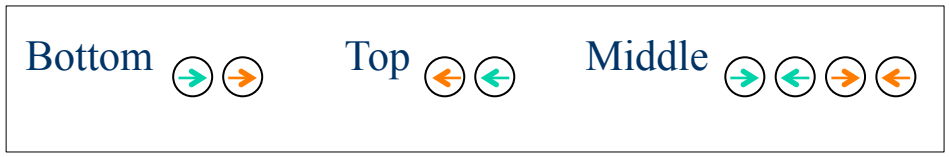

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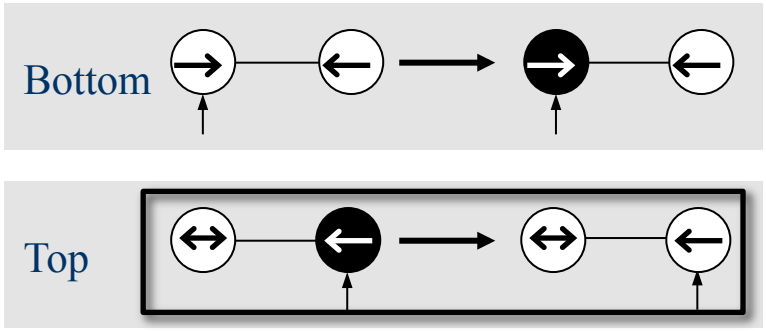

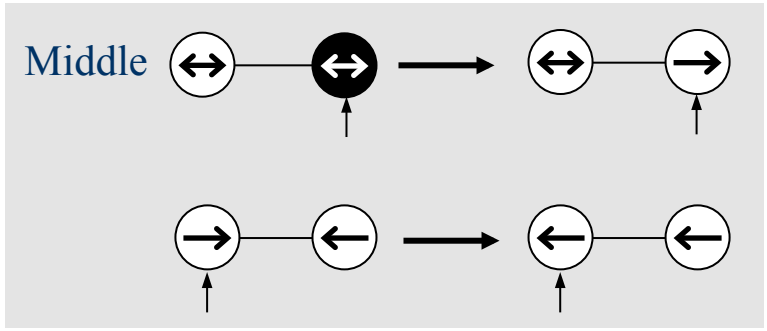

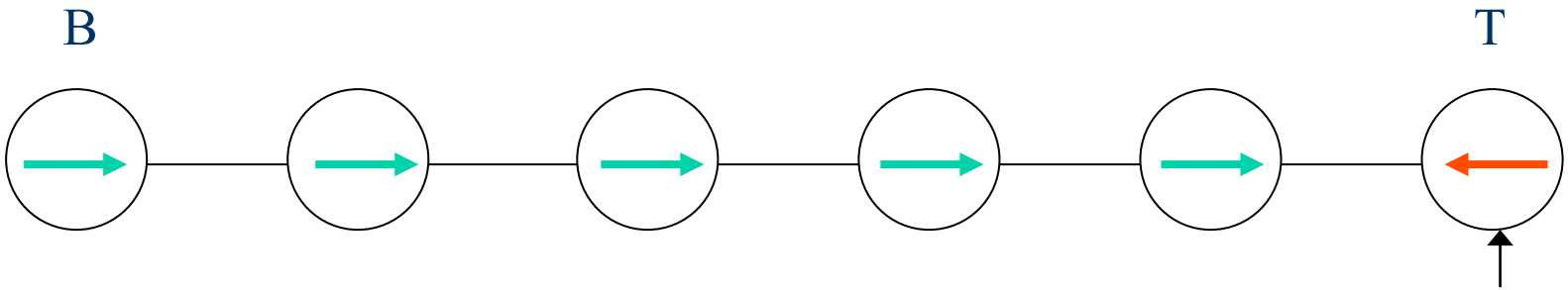

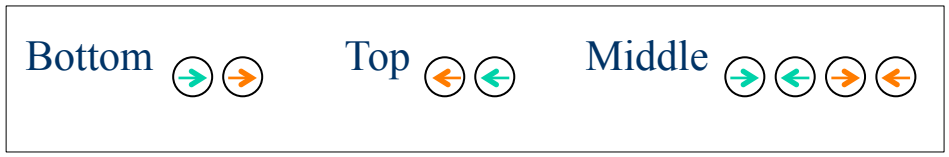

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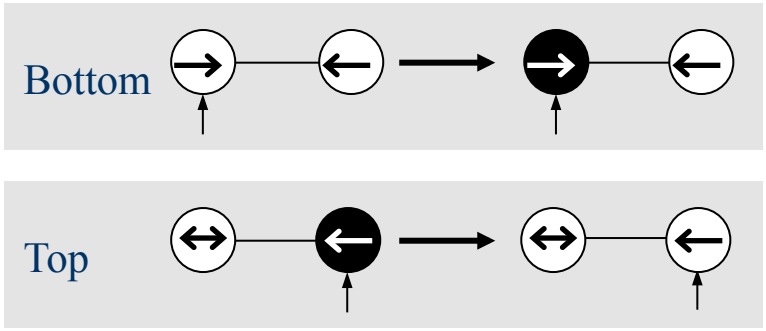
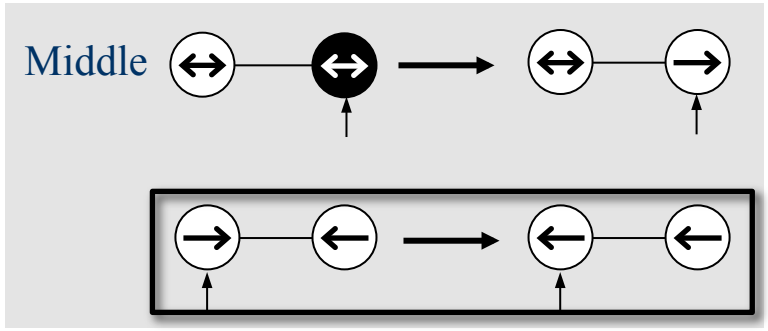
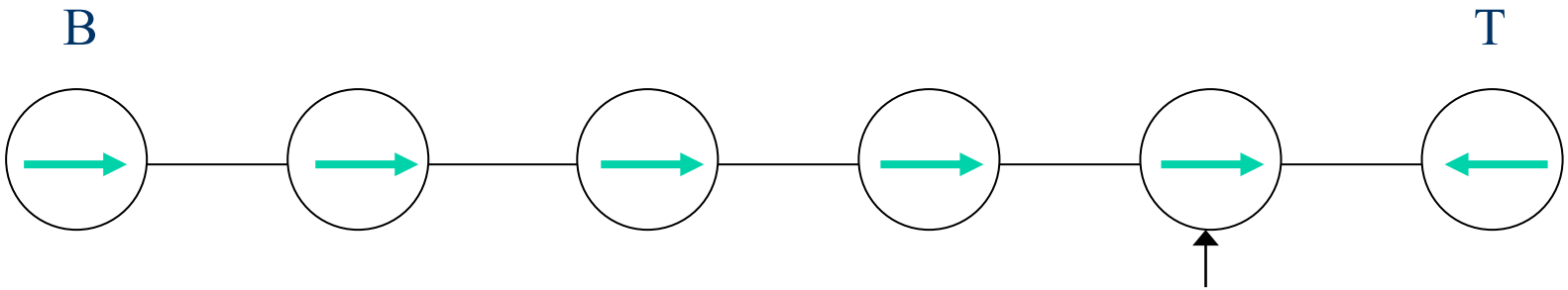
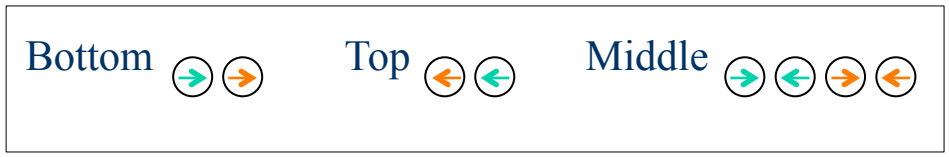
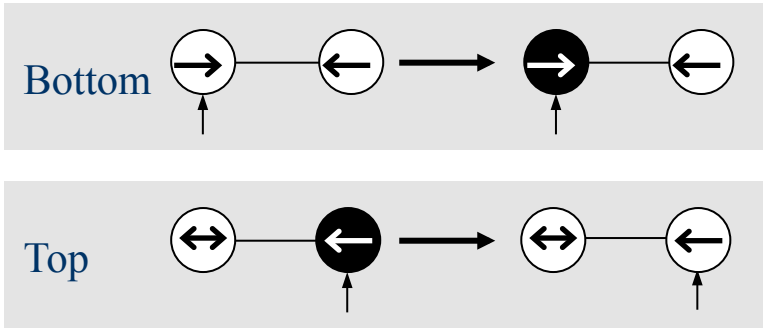


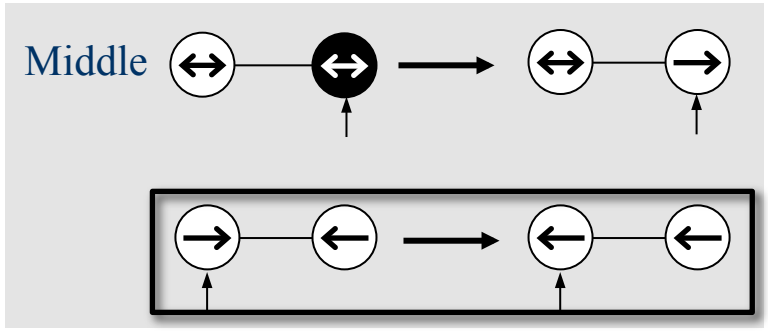


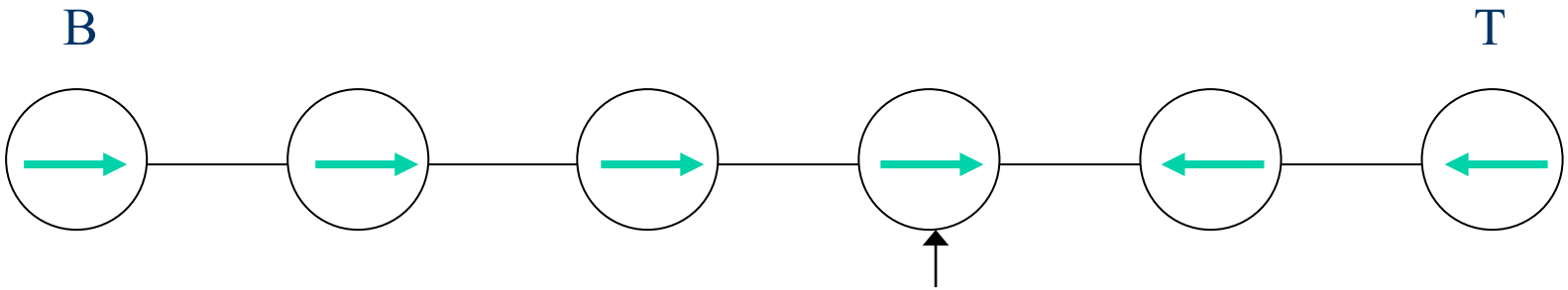


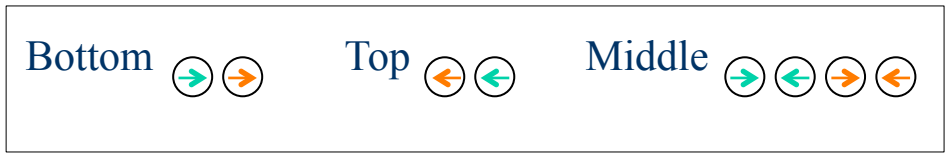


[Dijkstra 74]

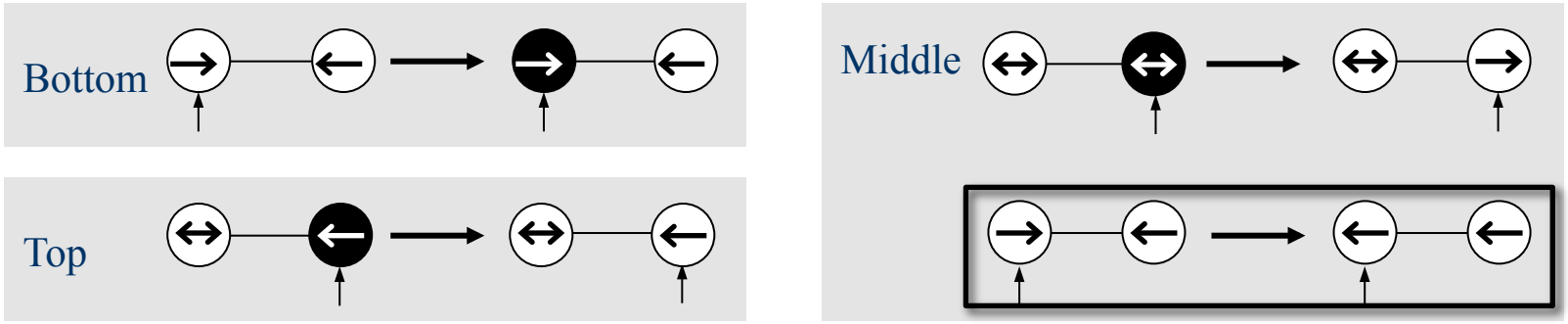


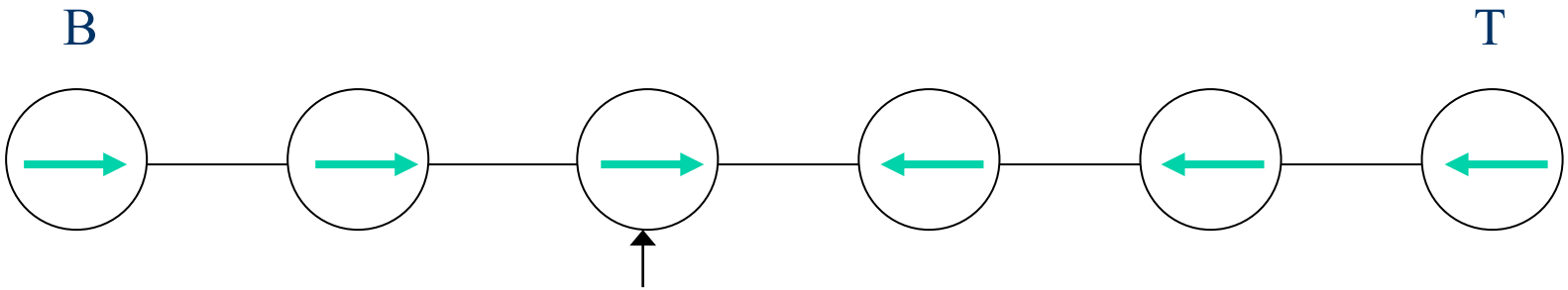


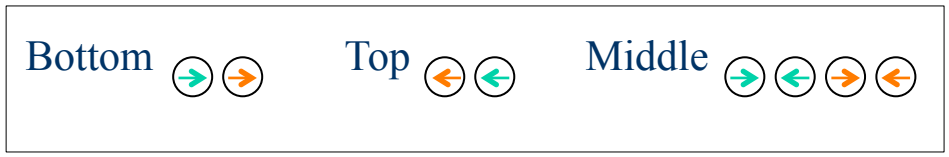




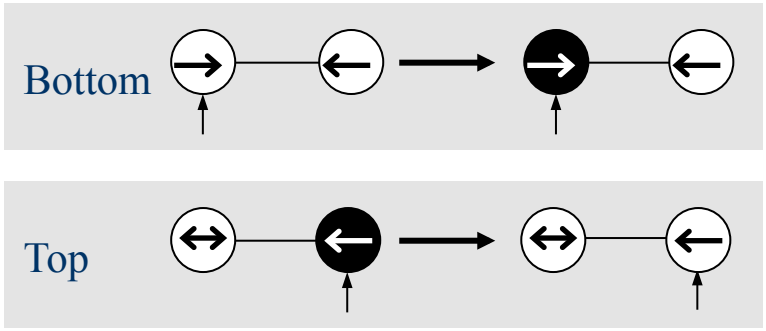
[Dijkstra 74]

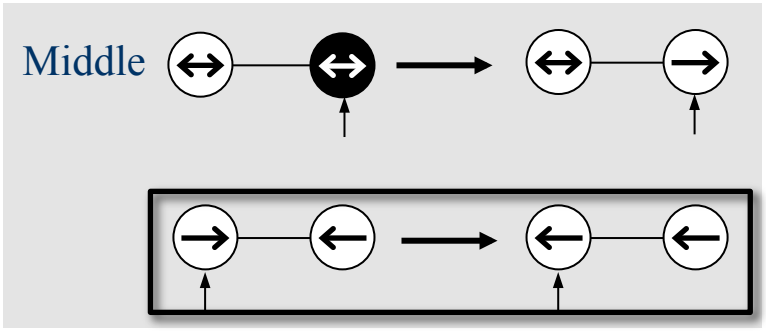


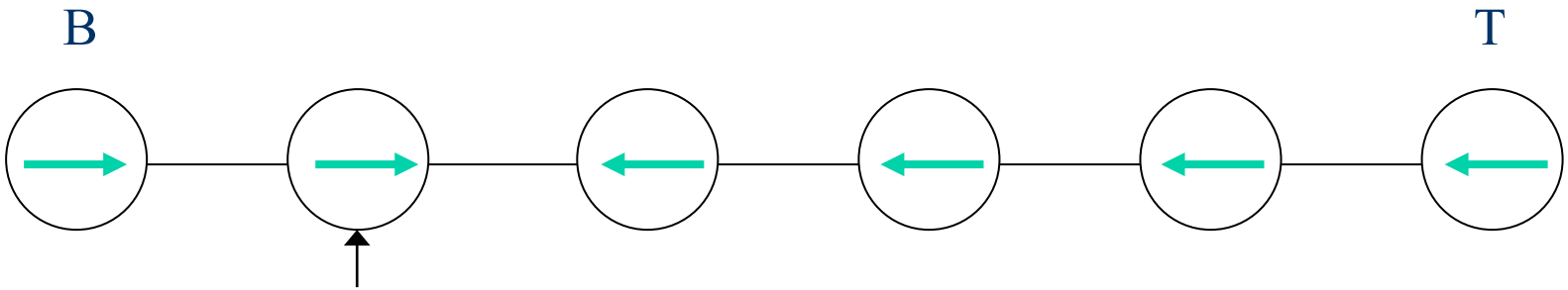


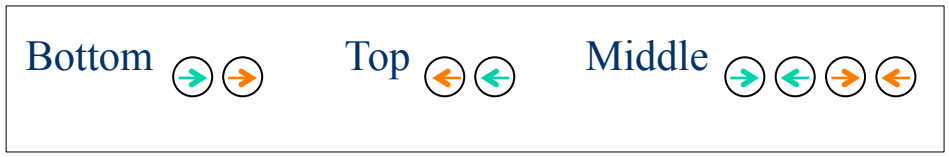


[Dijkstra 74]

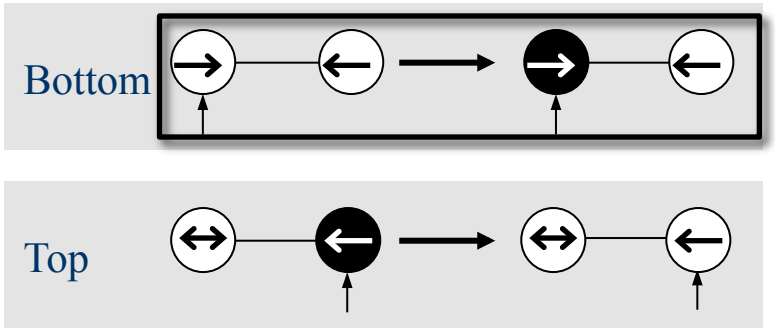


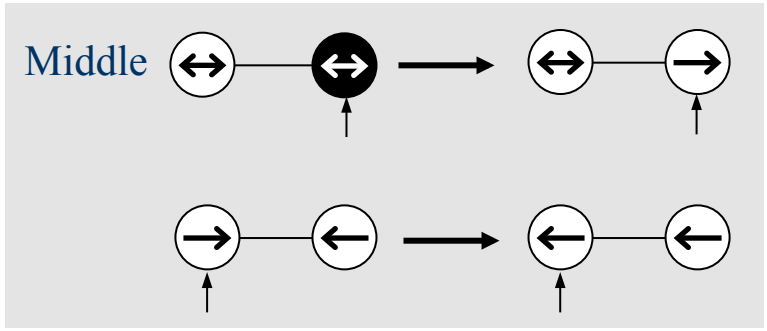


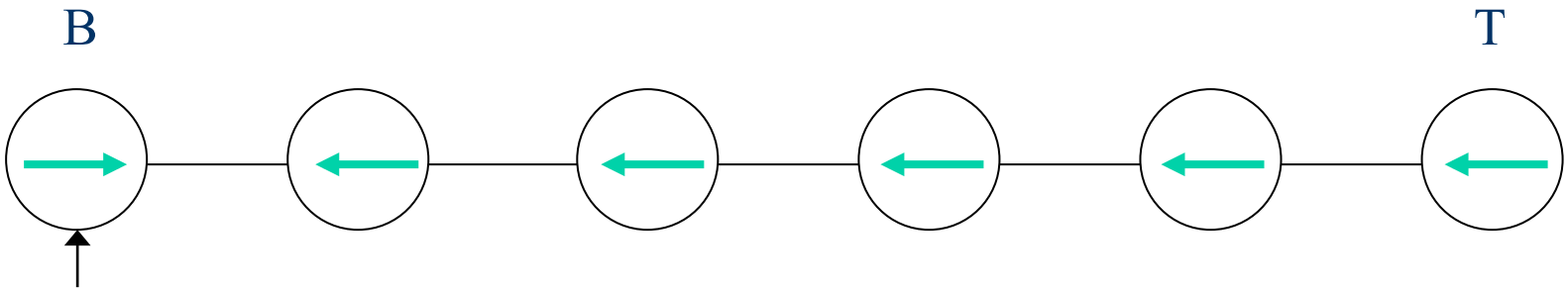




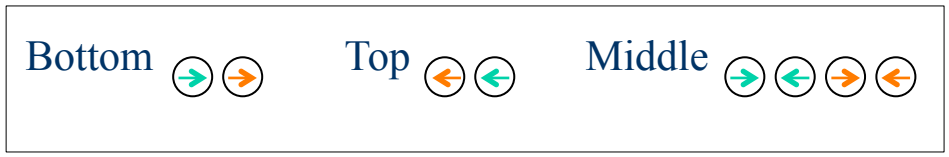
[Dijkstra 74]



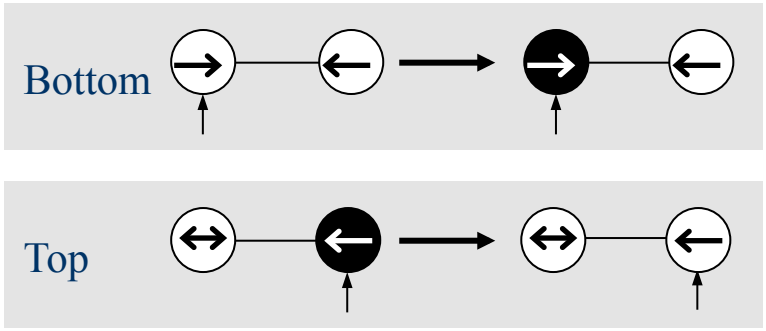


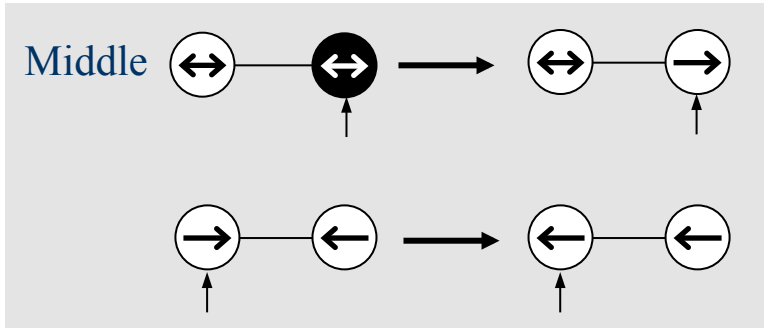


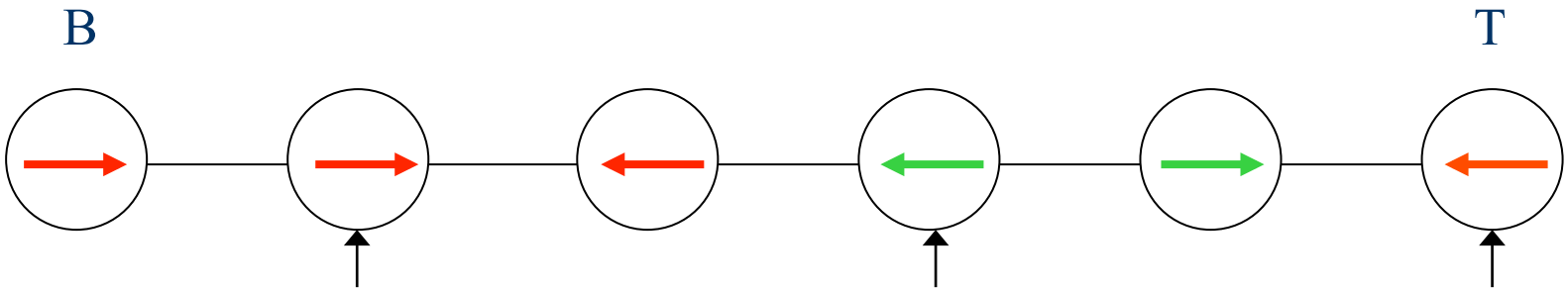
Auto-stabilisation ?

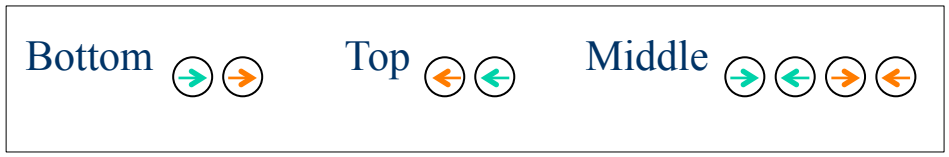


[Dijkstra 74]

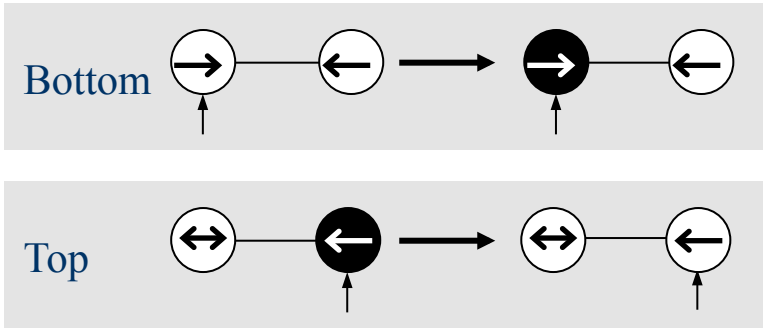


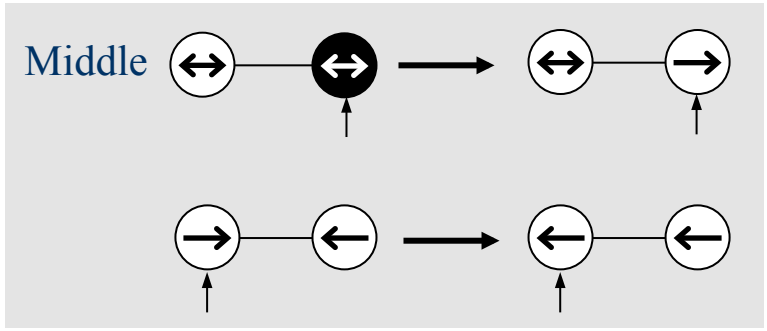


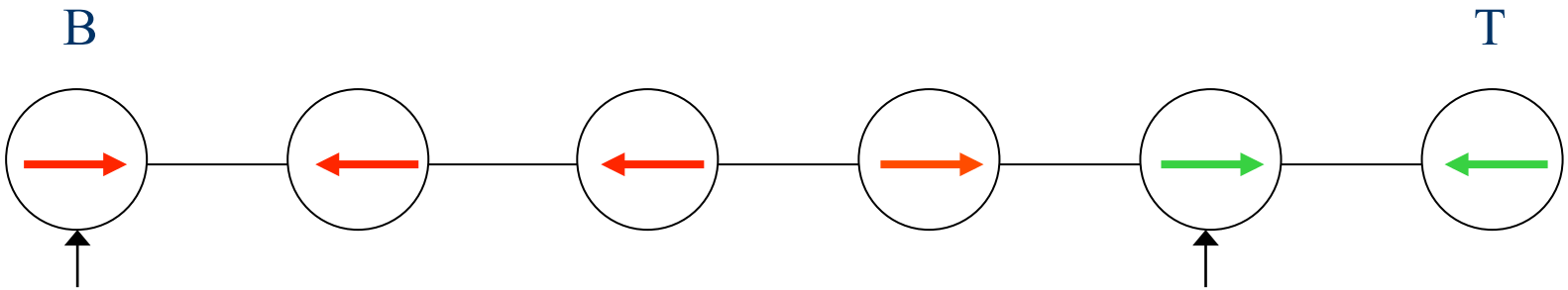


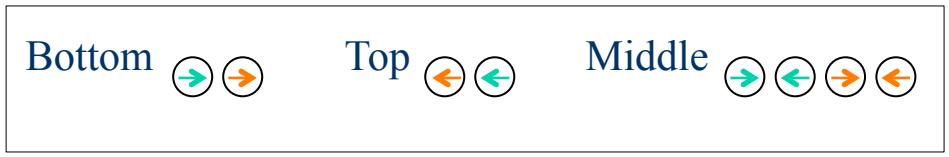


[Dijkstra 74]

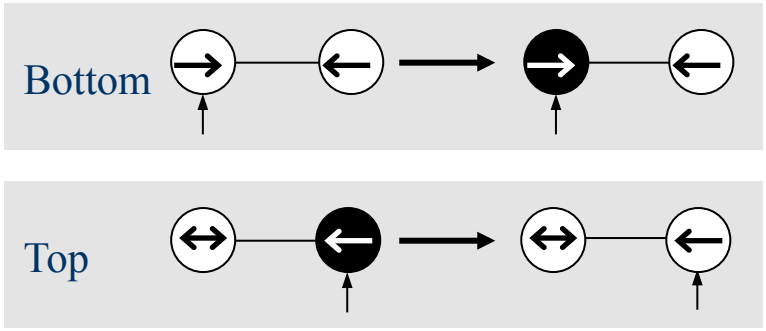


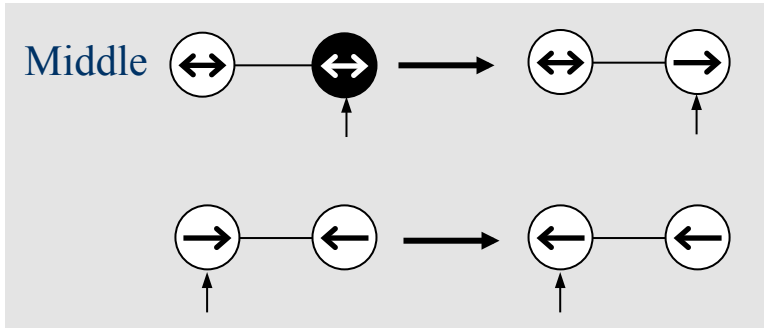


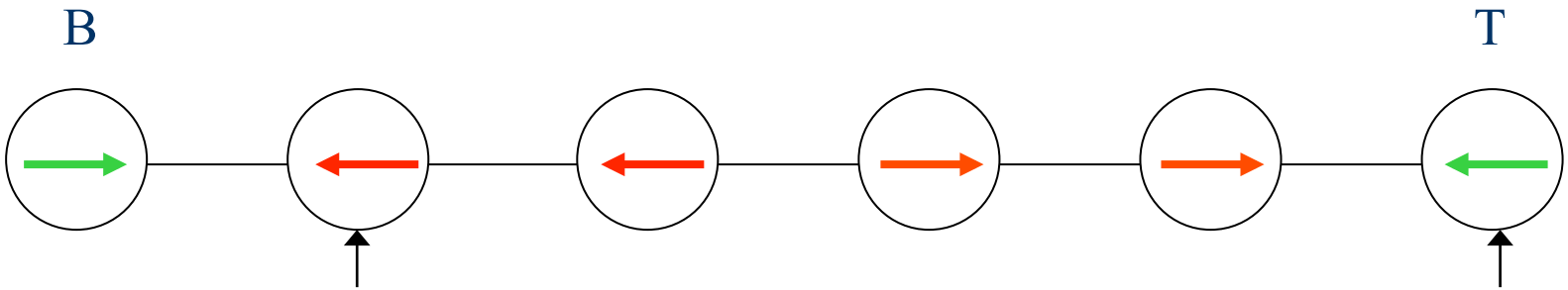


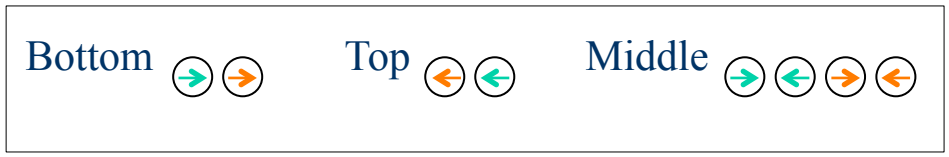


[Dijkstra 74]

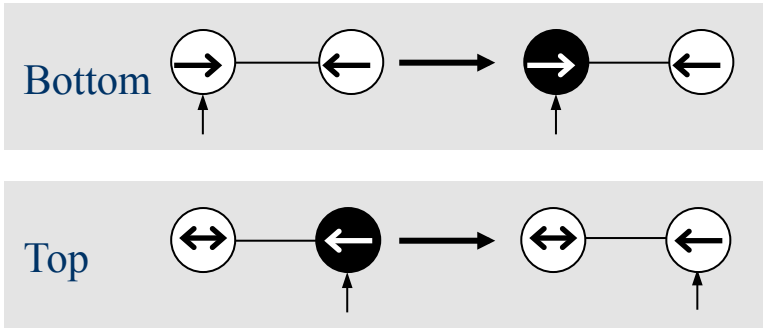


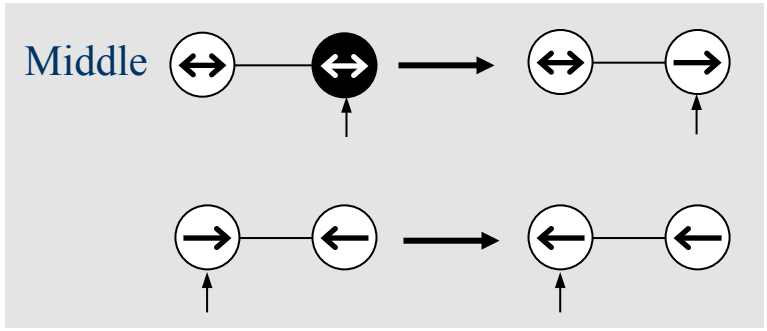


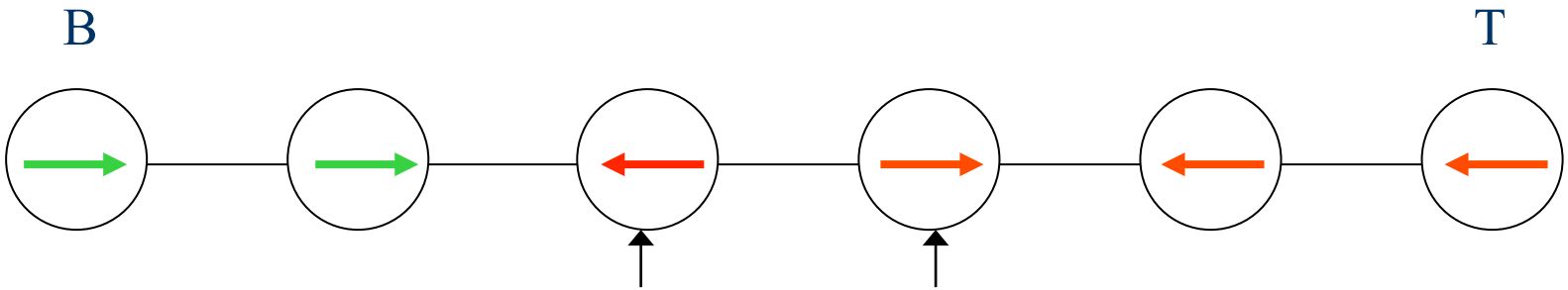


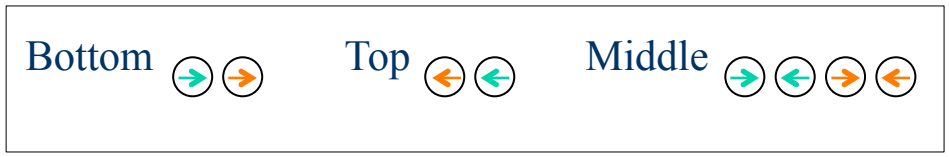


[Dijkstra 74]

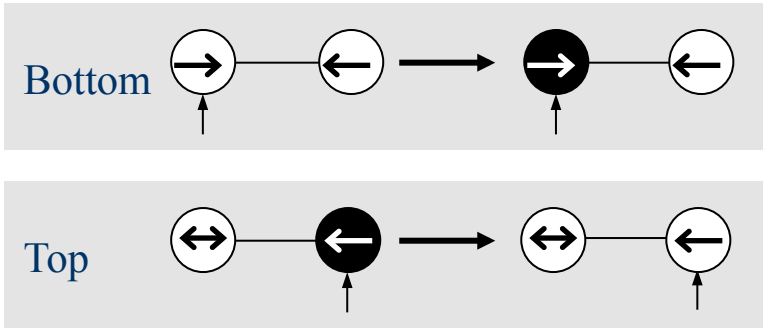


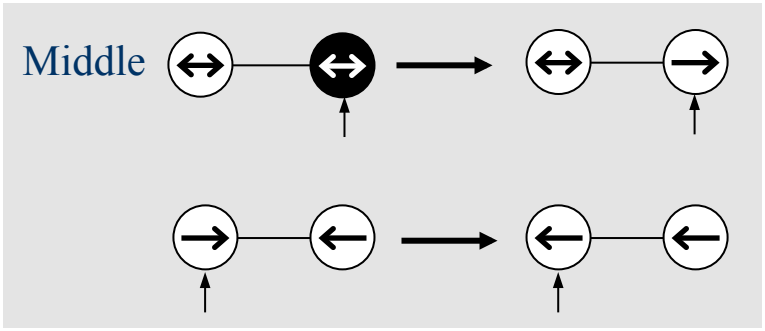


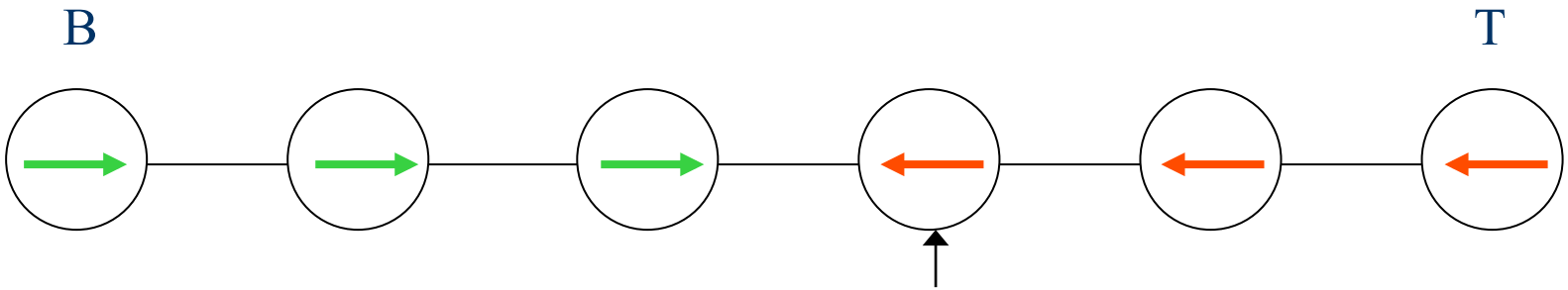




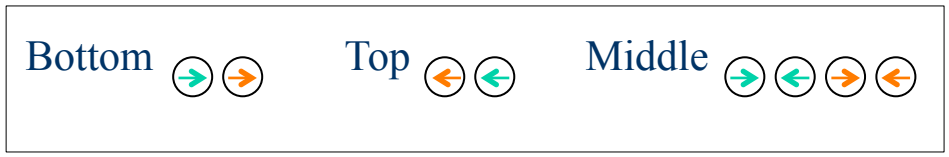
[Dijkstra 74]



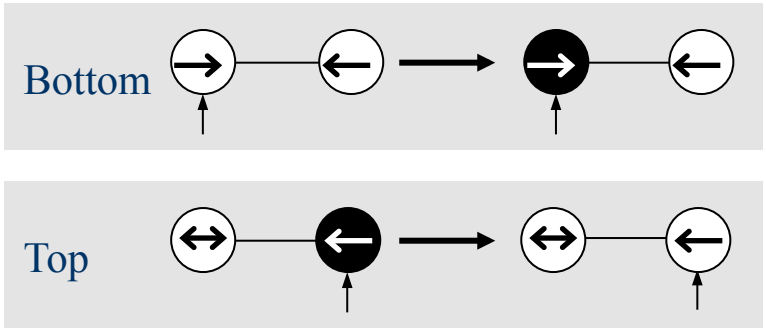


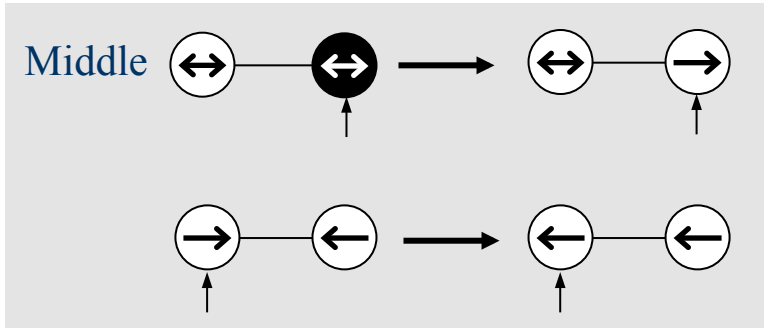


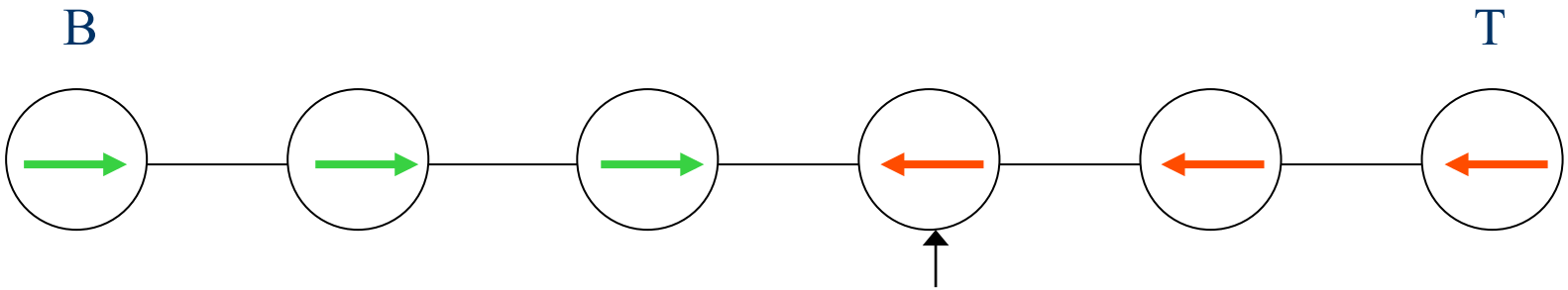
Stabilisé !



[Dijkstra 74]







Stabilisé !

Temps de stabilisation = O(n)