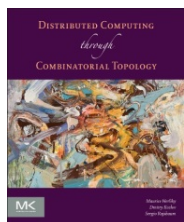


Read-Write Protocols for General Tasks

MITRO207, P4, 2019

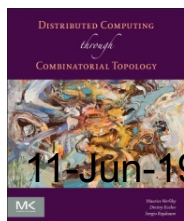


General Tasks

So far, focused on *colorless* tasks ...

only *sets* of input and output value matter

Not who is assigned which values



11-Jun-19

FetchAndIncrement

```
shared int v // shared counter
```

```
fetchAndIncrement() : int
```

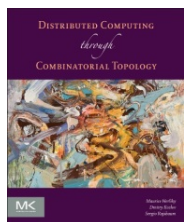
```
    atomic          // next 2 steps are atomic
```

```
    prior: int := v
```

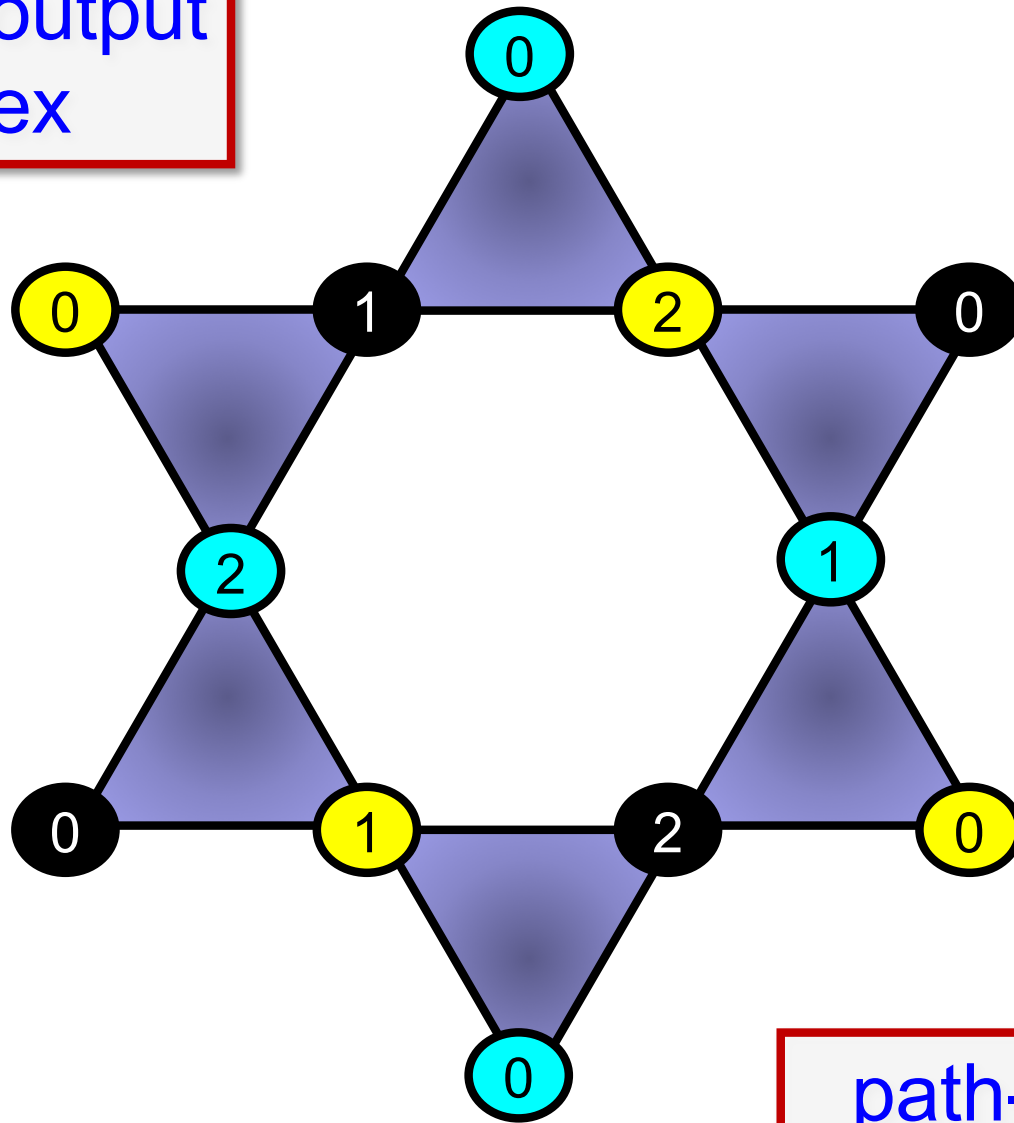
```
    v := v + 1
```

```
    return prior
```

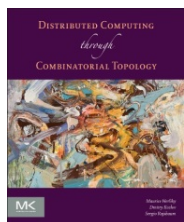
Not colorless because
outputs are *unique*



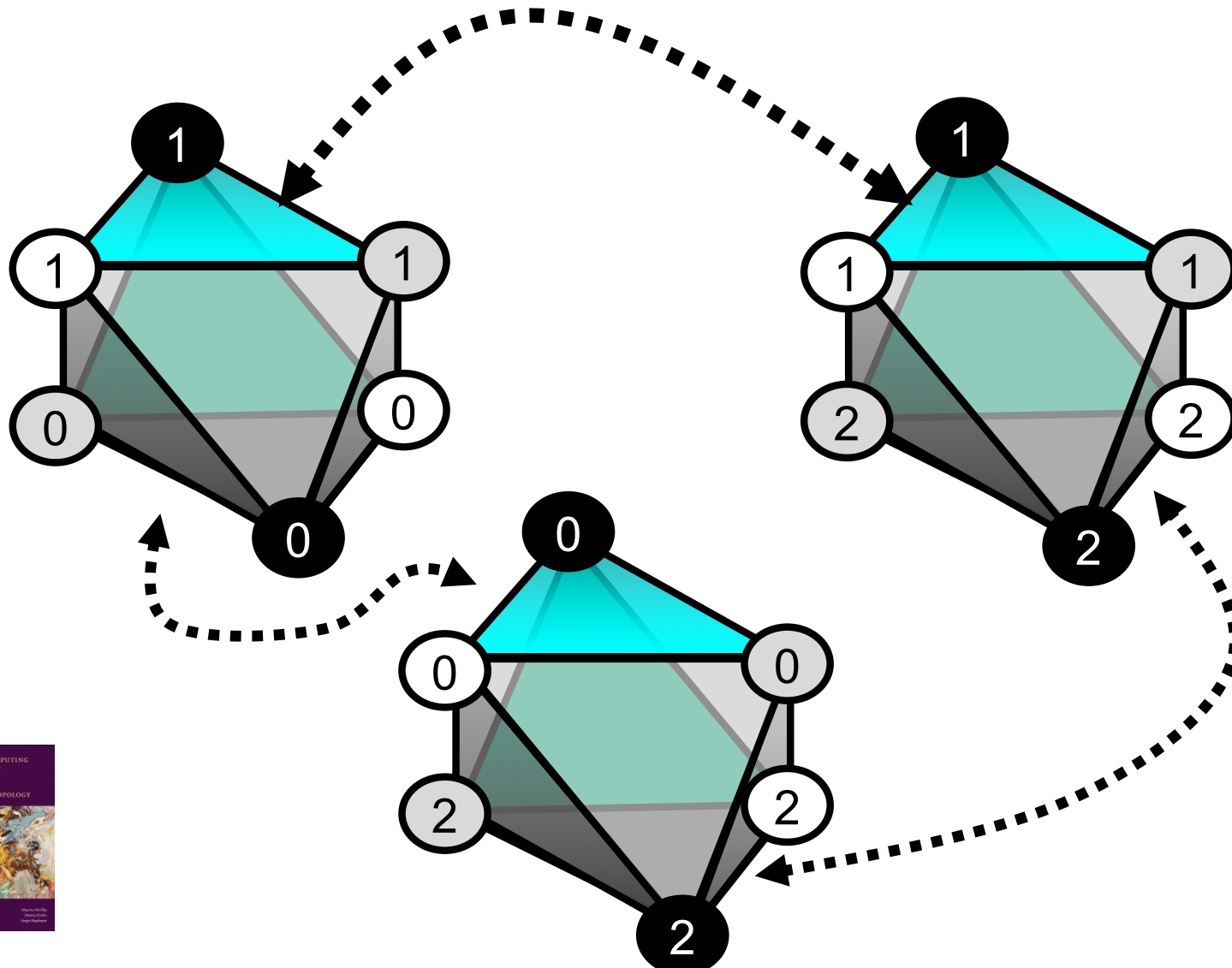
fetch&inc output
complex



path-connected
but has "holes"

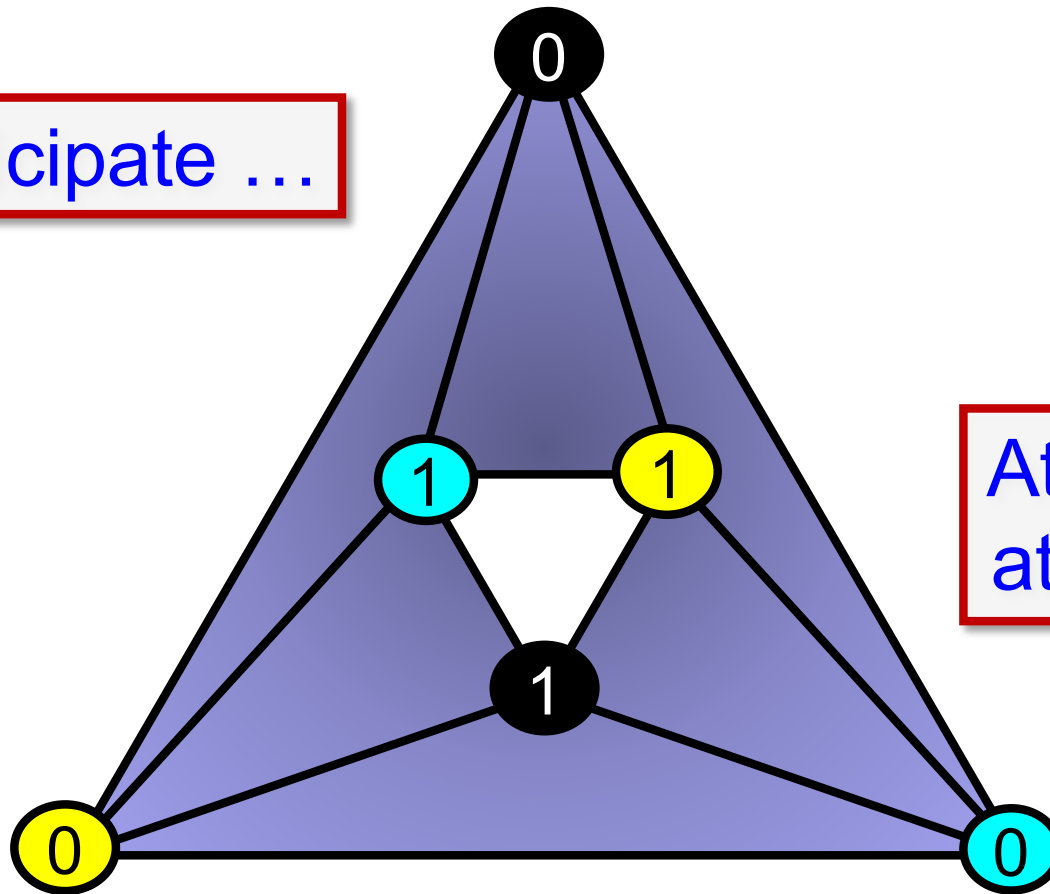


Output: (3,2)-Set Agreement

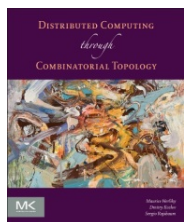


Weak Symmetry-Breaking

If all participate ...



At least one 0,
at least one 1.



Renaming

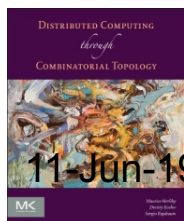
Input

Unique names from $\{0 \dots N\}$, $N \gg n$

Output

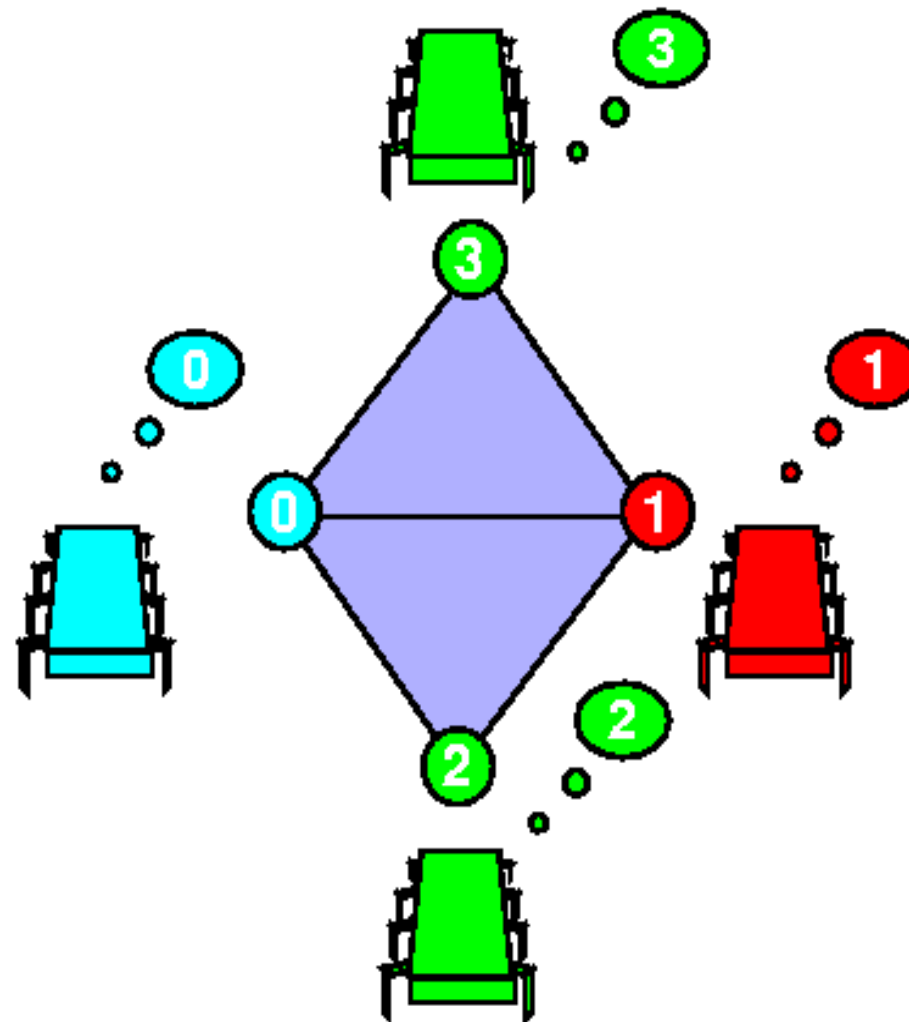
Unique names from $\{0 \dots M\}$, $N \gg M$

Output complex called *rook complex*

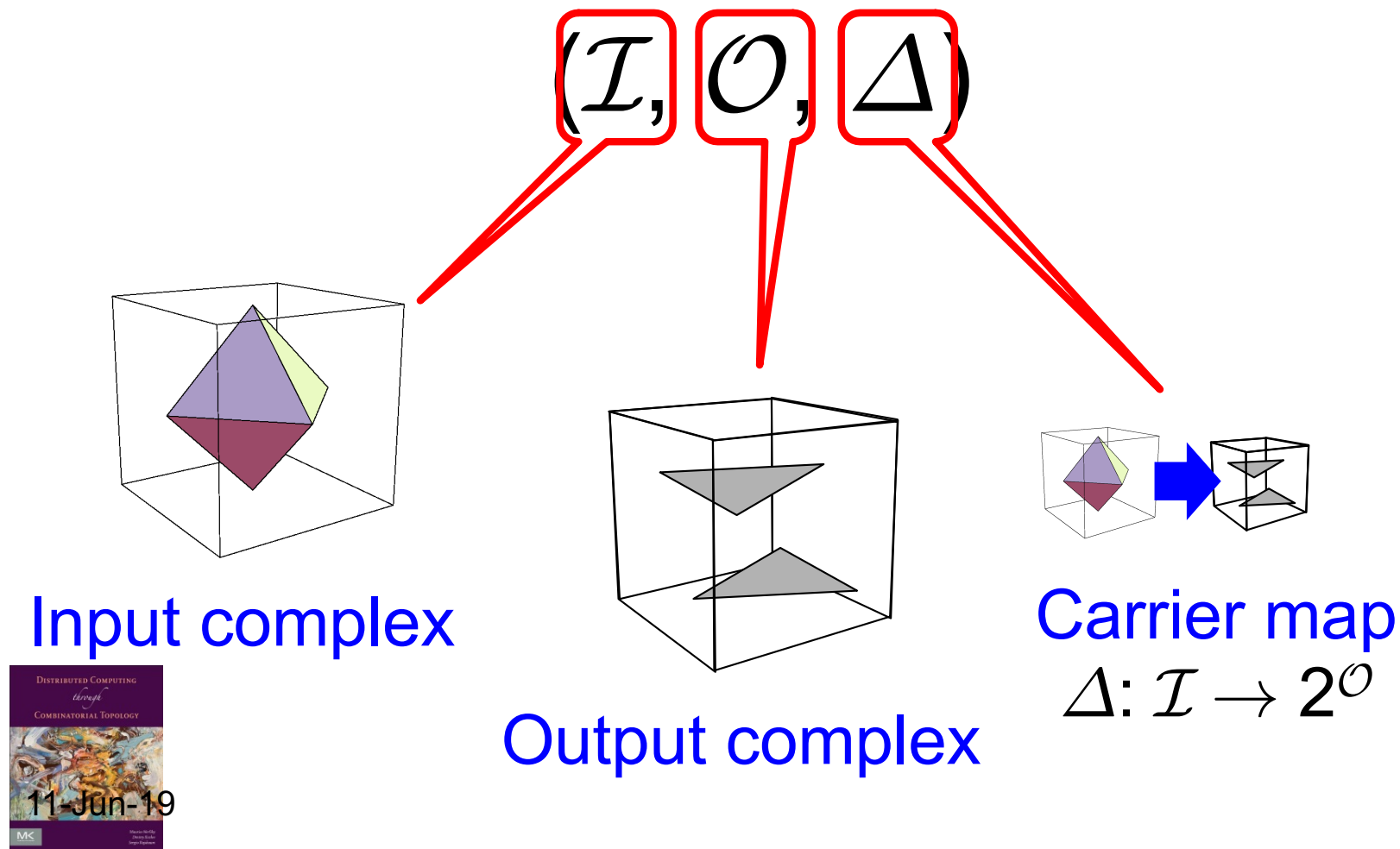


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Colored Complexes



Review: Task Specification

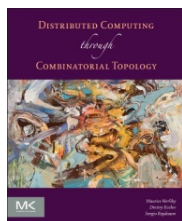


Immediate Snapshot Executions

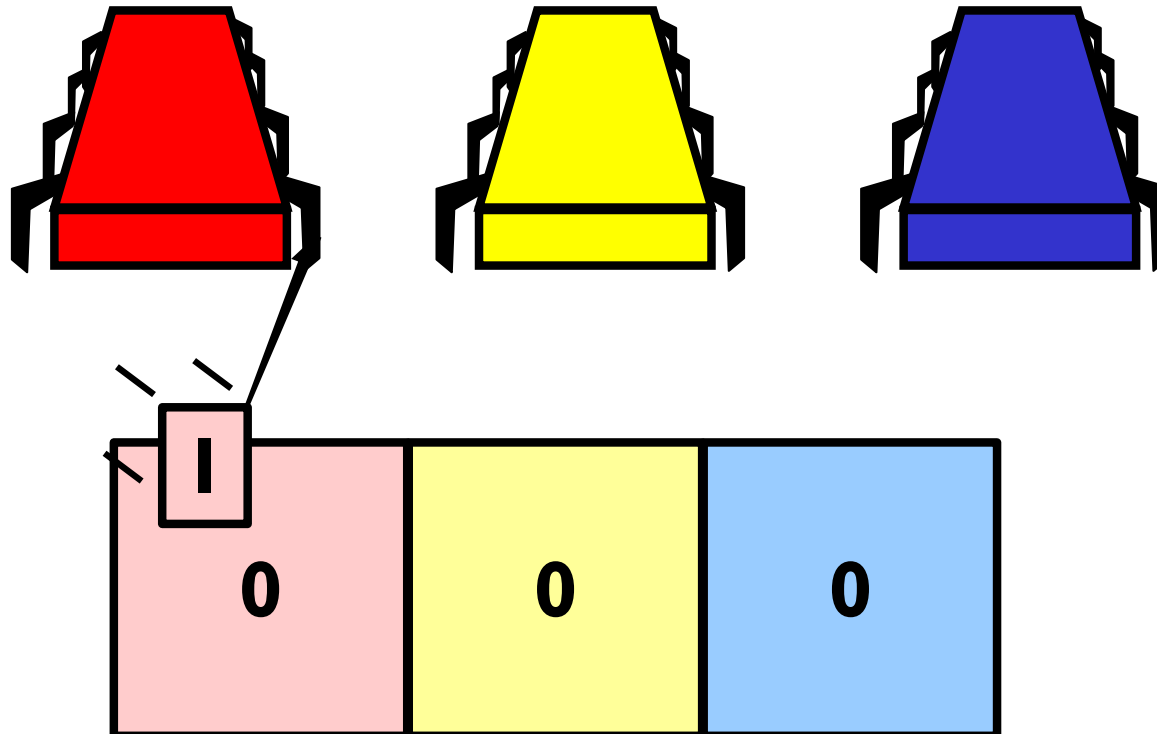
Restricted form of Read-Write memory

(Equivalent to regular R-W memory)

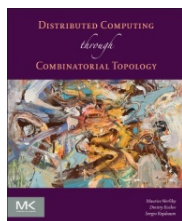
But we will not prove it yet.



Write



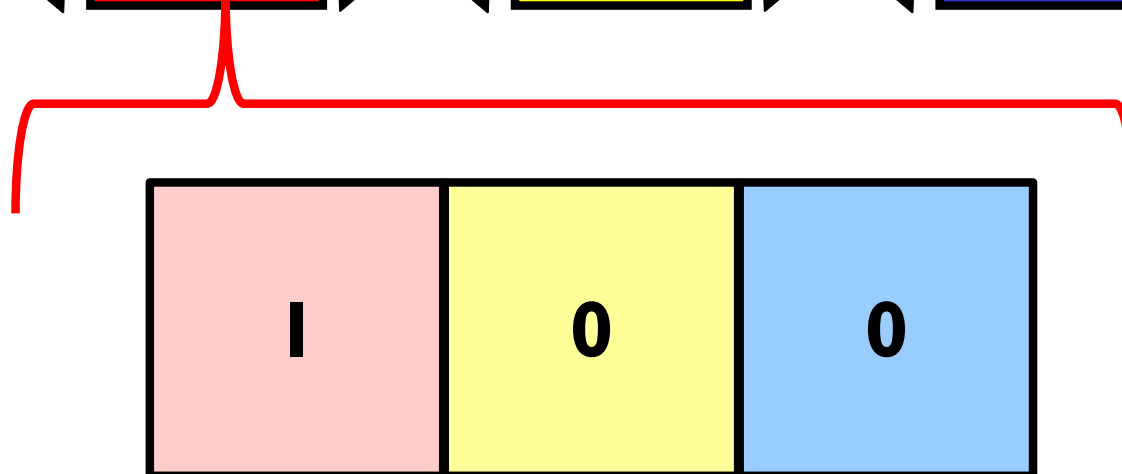
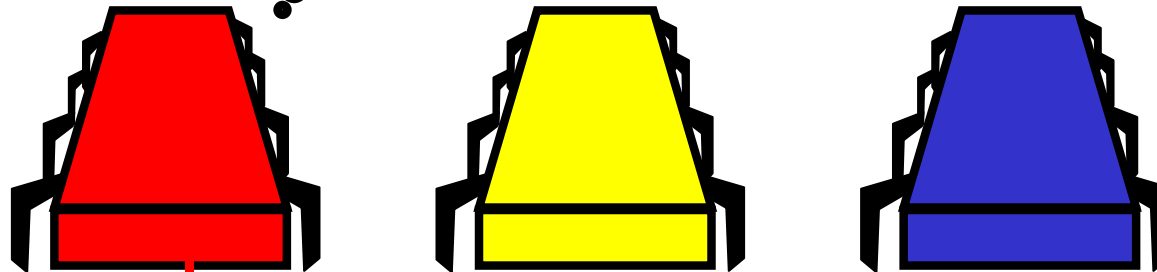
Single-writer, multi-reader variables



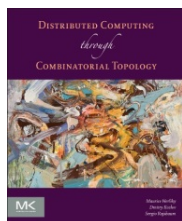
Distributed Computing through
Combinatorial Topology

Snapshot

100



Single-writer, multi-reader variables

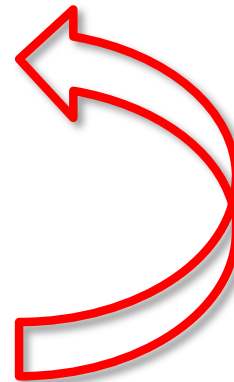


Immediate Snapshot Executions

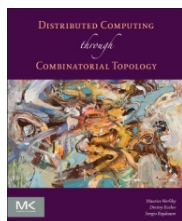
Pick a set of processes

write together

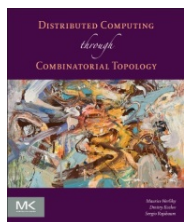
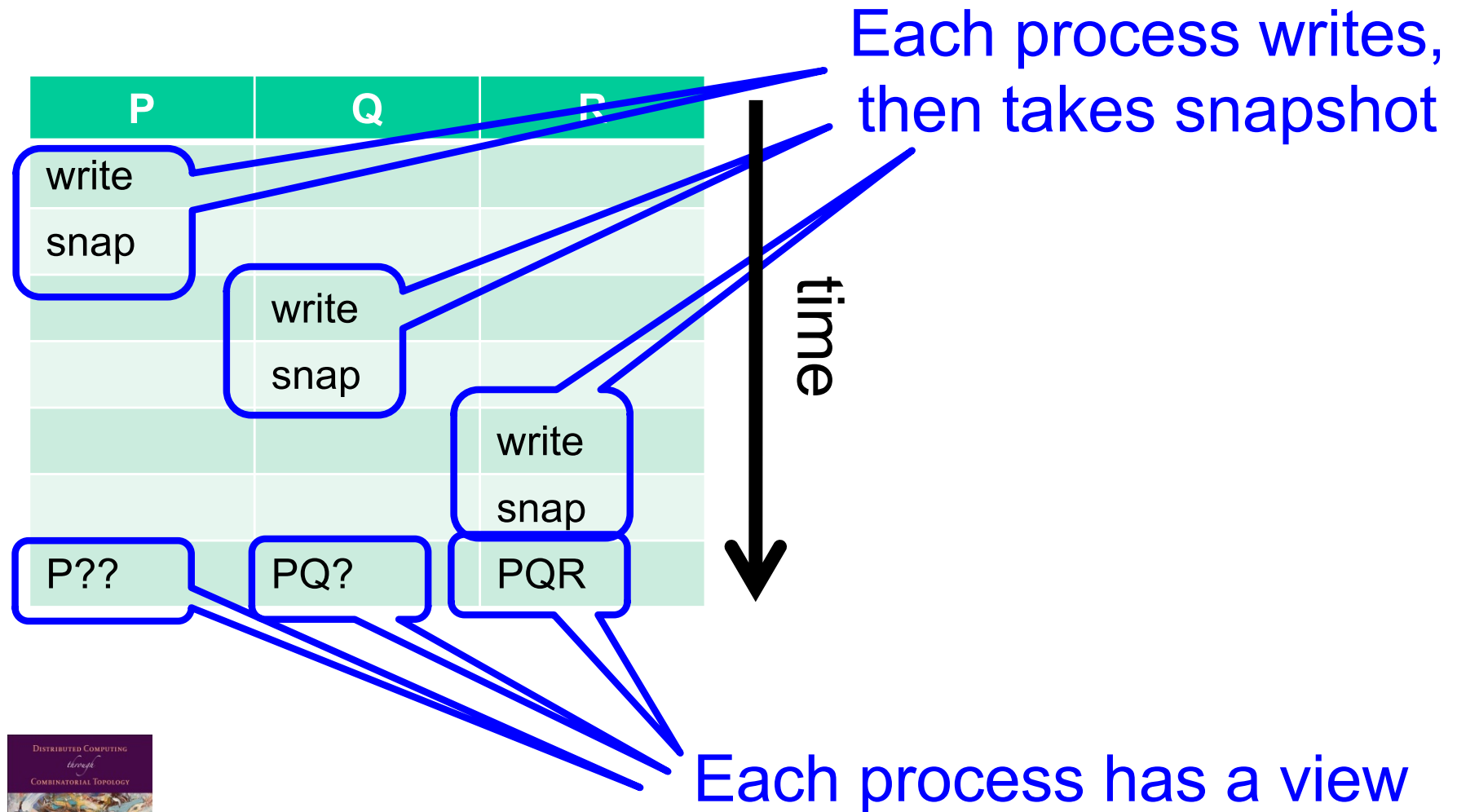
snapshot together



Repeat with another set



Example Executions



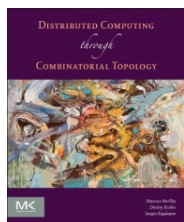
Example Executions

P	Q	R
write		
snap		
	write	
	snap	
		write
		snap
P??	PQ?	PQR



Moving last process
one round earlier,

Changes this view from PQ? to PQR

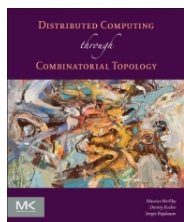


Example Executions

P	Q	R
write		
snap		
	write	write
	snap	snap
		write
		snap
P??	PQR	PQR



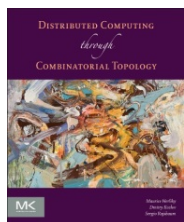
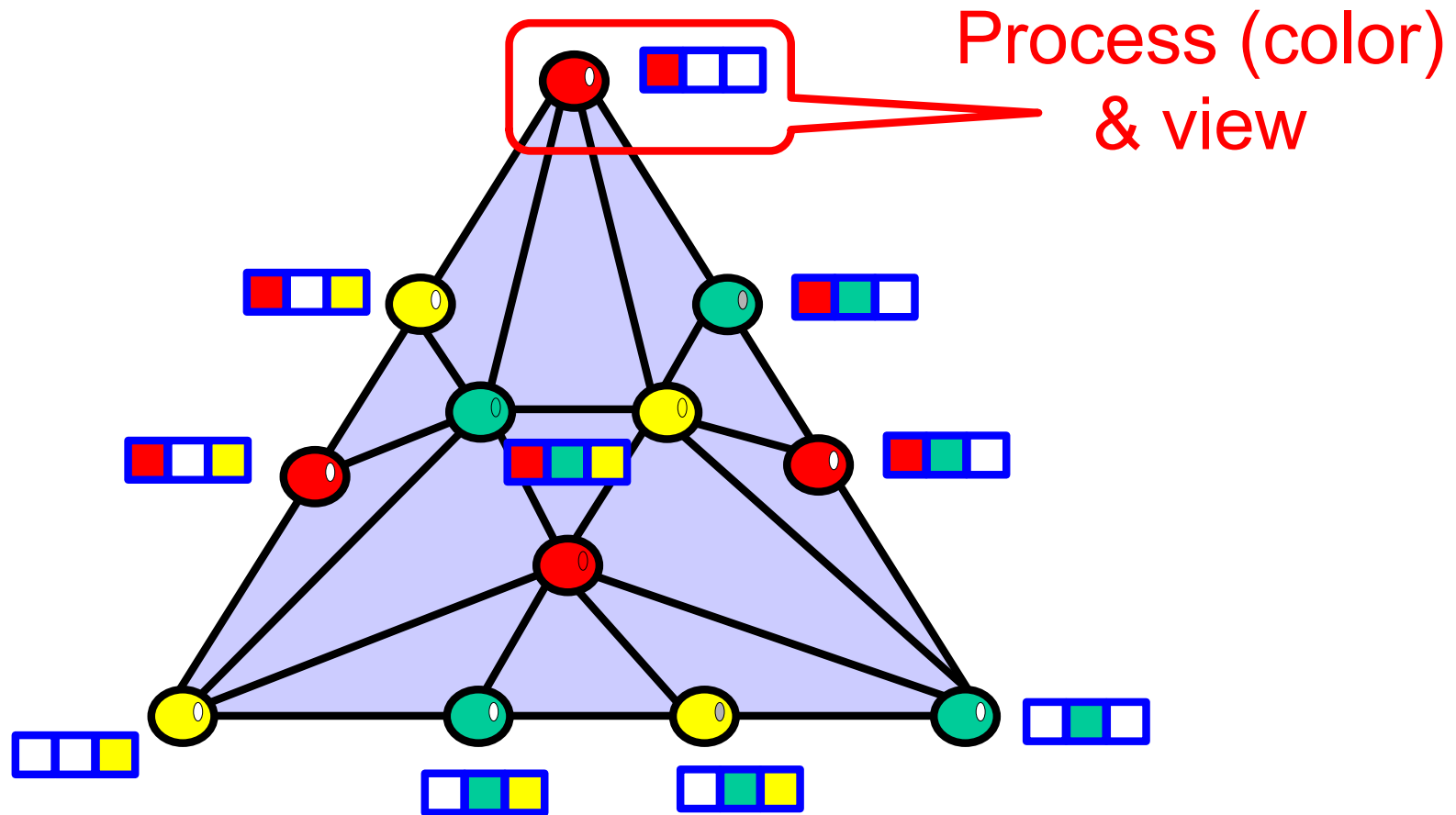
Moving last processes
one round earlier,



Changes this view from P?? to PQR

Distributed Computing Through
Combinatorial Topology

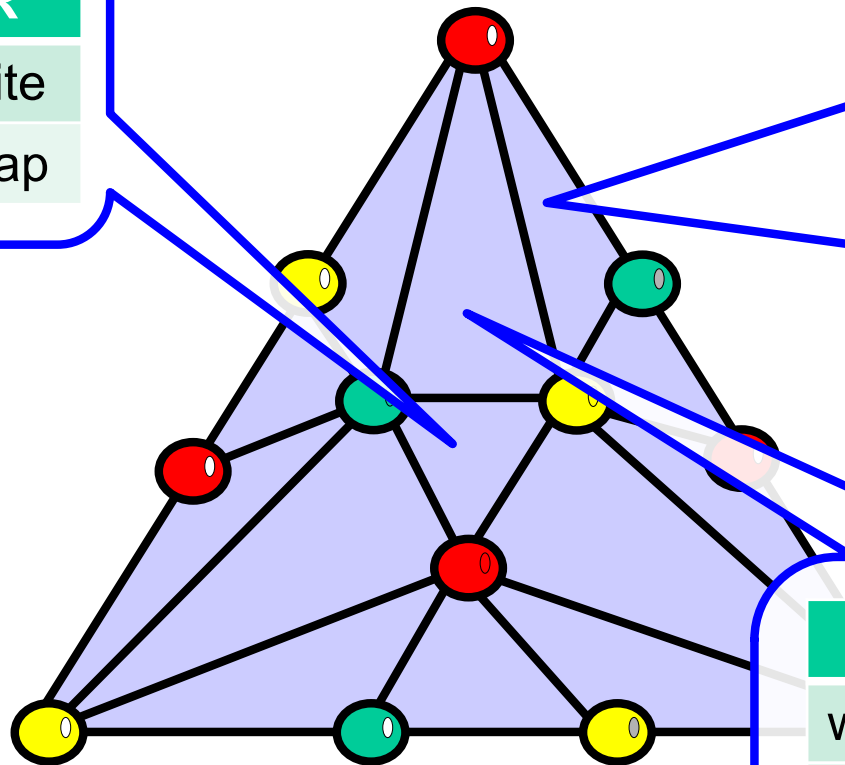
Protocol Complex



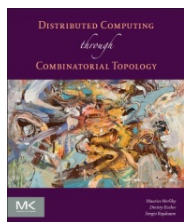
Protocol Completion

P	Q	R
write	write	write
snap	snap	snap

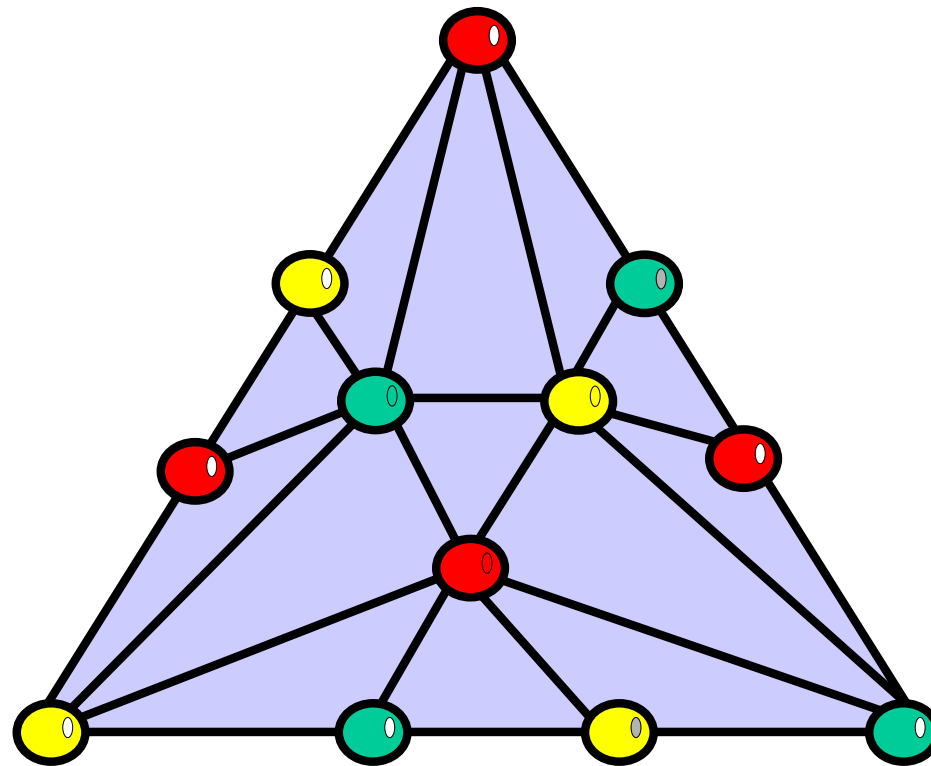
P	Q	R
write		
snap		
	write	
	snap	
		write
		snap



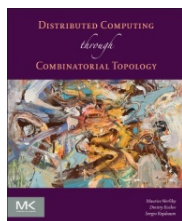
P	Q	R
write		
snap		
	write	write
	snap	snap



Standard Chromatic Subdivision



$\text{Ch}(\sigma)$



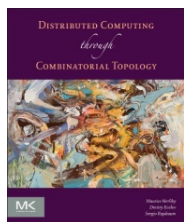
Combinatorial Definition (I)

Input simplex σ

Protocol complex $\mathcal{IS}(\sigma)$

Vertex (P_i, σ_i)

Process name view $\sigma_i \subseteq \sigma$



Combinatorial Definition (II)

Each process's write appears in its own view

$$P_i \in \text{names}(\sigma_i).$$

Snapshots are ordered

$$\sigma_i \subseteq \sigma_j \text{ or vice-versa}$$

Each snapshot ordered immediately after write

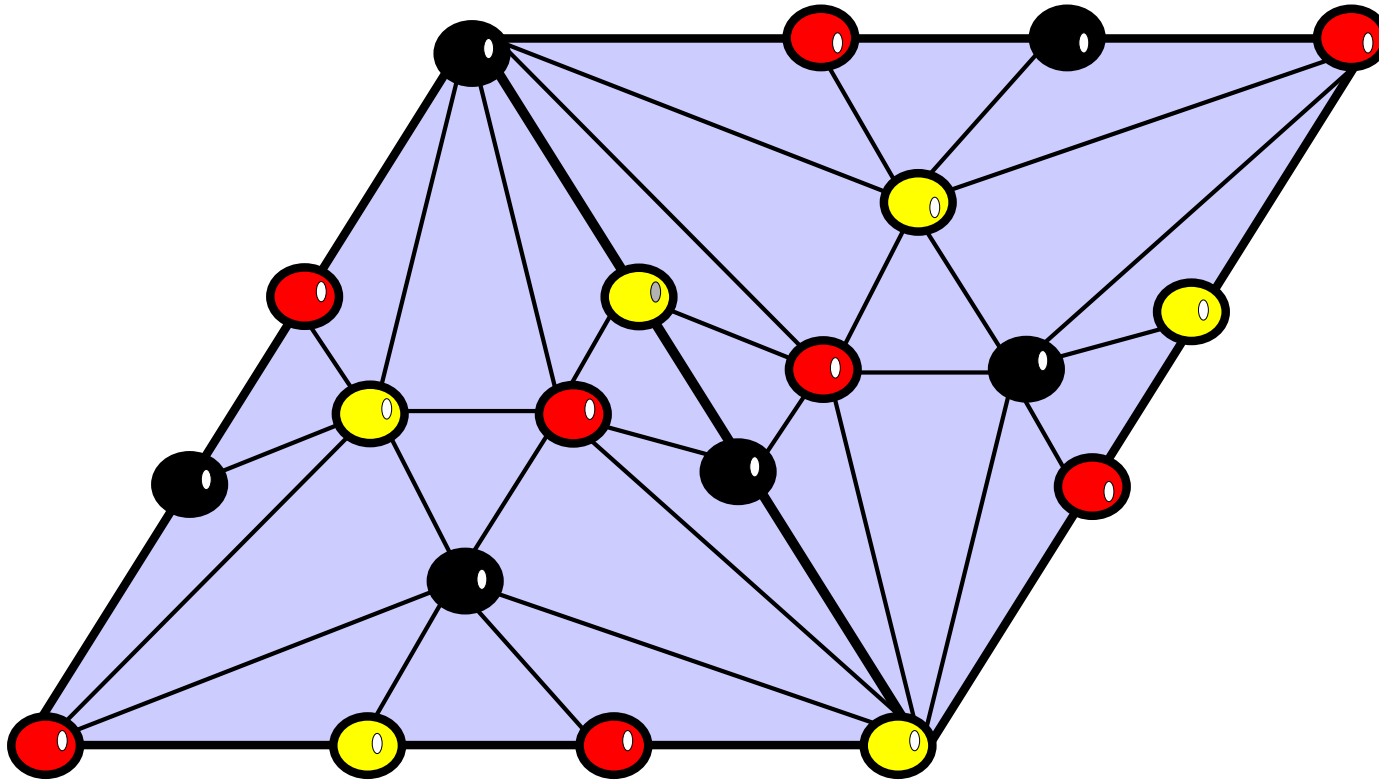
$$\text{if } P_i \in \text{names}(\sigma_j), \text{ then } \sigma_i \subseteq \sigma_j.$$

If P_j saw P_i write ...

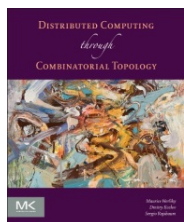
then P_j 's snapshot not later than P_i 's.



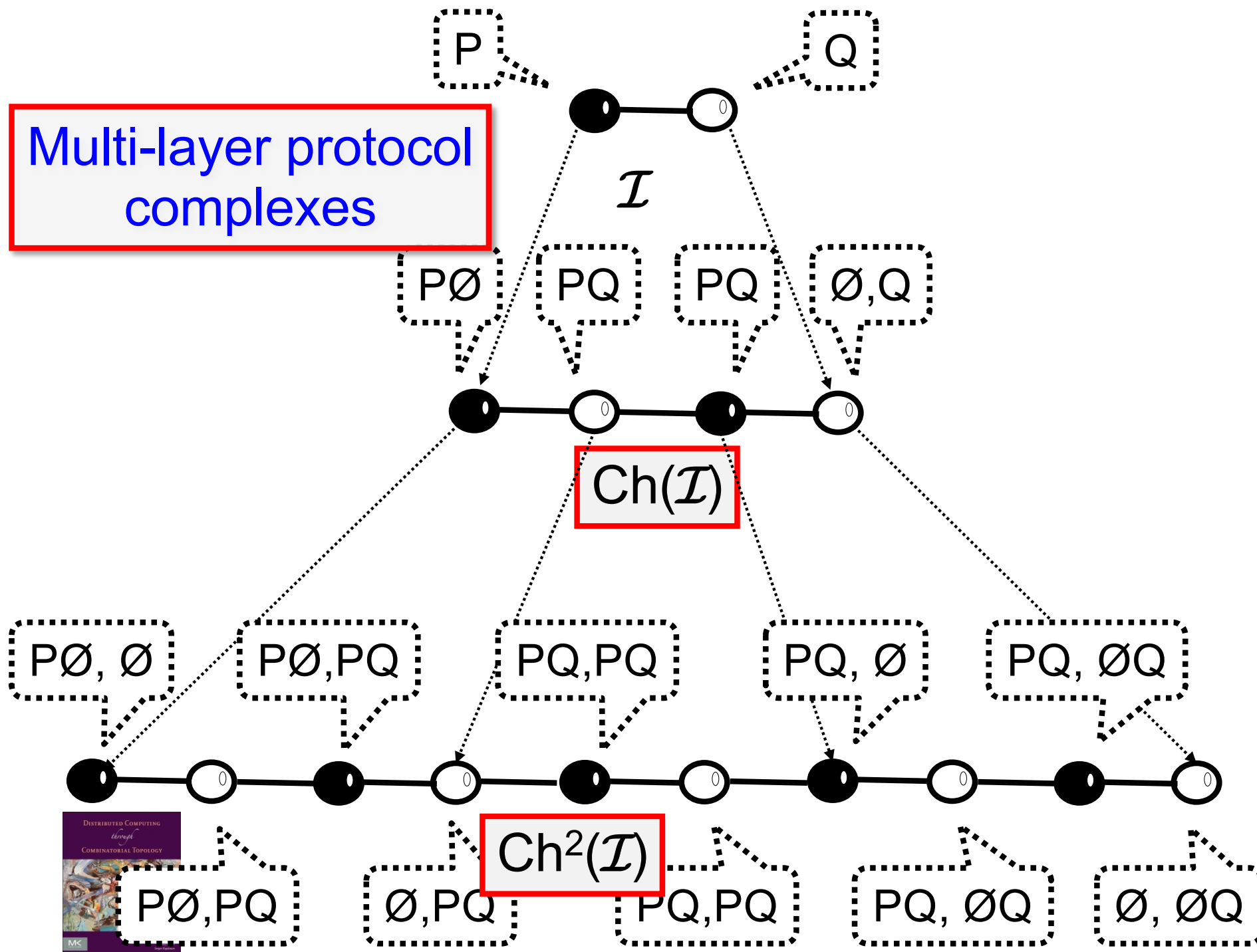
2 Input Simplexes, 1 Round



$$\text{Ch}(\sigma_0) \cup \text{Ch}(\sigma_0)$$



Multi-layer protocol complexes

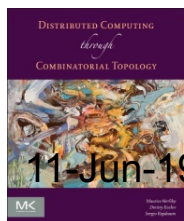


Summary

Tasks and protocols described as ...

colored complexes.

Protocols are layered immediate snapshot



11-Jun-19

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