

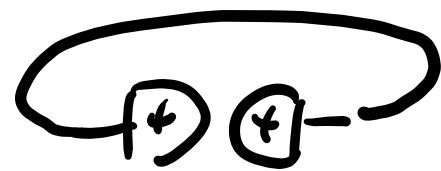
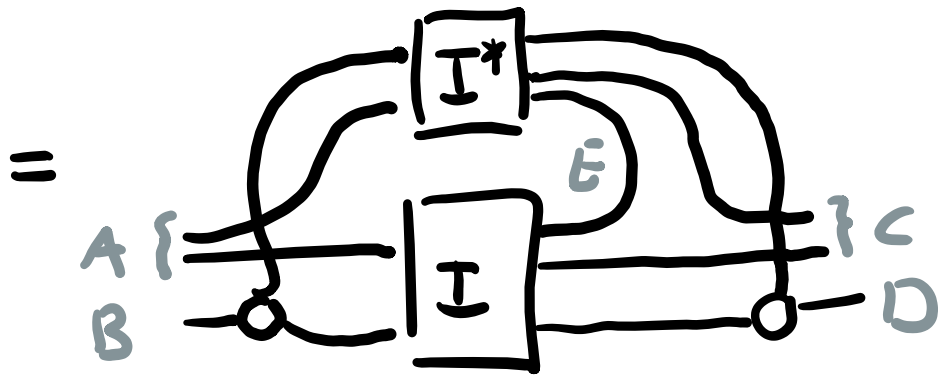
Quantum in Pictures Lecture Series

Lecturer: Stefano Gogioso

Fri 30 June 2023 –Morning Lecture

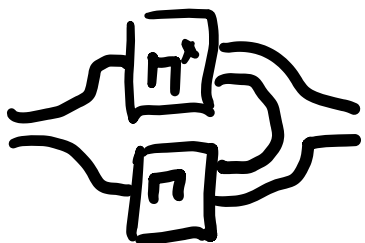


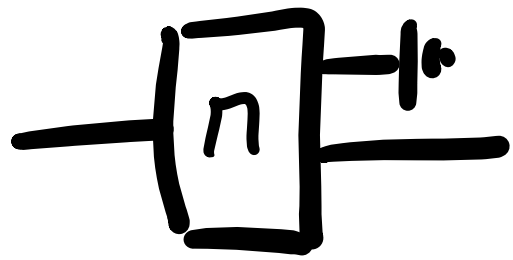
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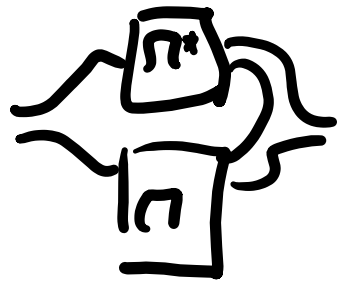
$$\text{Circuit with } \epsilon \text{ and } I \text{ at } A, B = \text{Circuit with } I^* \text{ and } \epsilon \text{ at } A, B = \langle \psi | - | \psi \rangle = \langle \psi | \psi \rangle = \text{Tr} [| \psi \rangle \langle \psi |]$$

$$\text{Circuit with } \epsilon \text{ and } I \text{ at } A, B = \text{Circuit with } I^* \text{ and } \epsilon \text{ at } A, B = \text{Tr}_A [| \psi \rangle \langle \psi |]$$



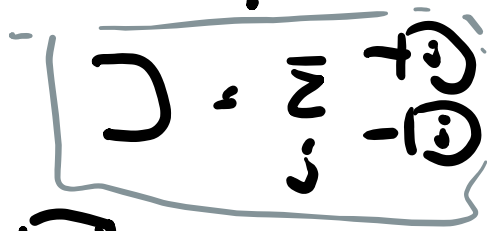
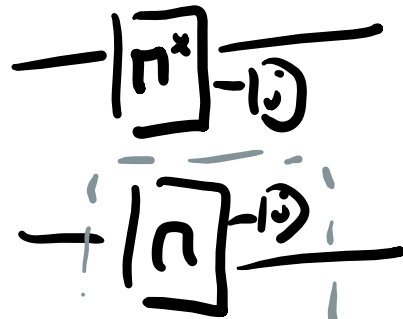


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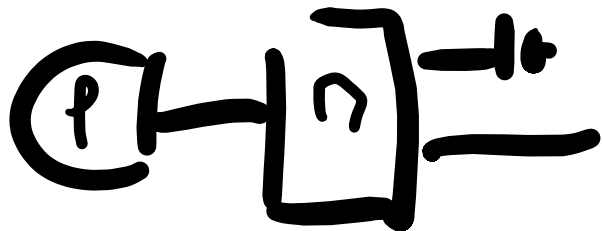
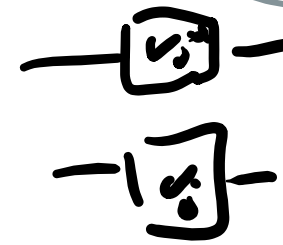
\sum_j



$-v_j$
Kaus cp

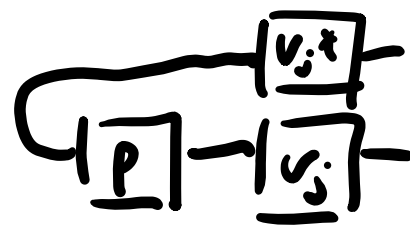
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\sum_j



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\sum_j



\sum_j

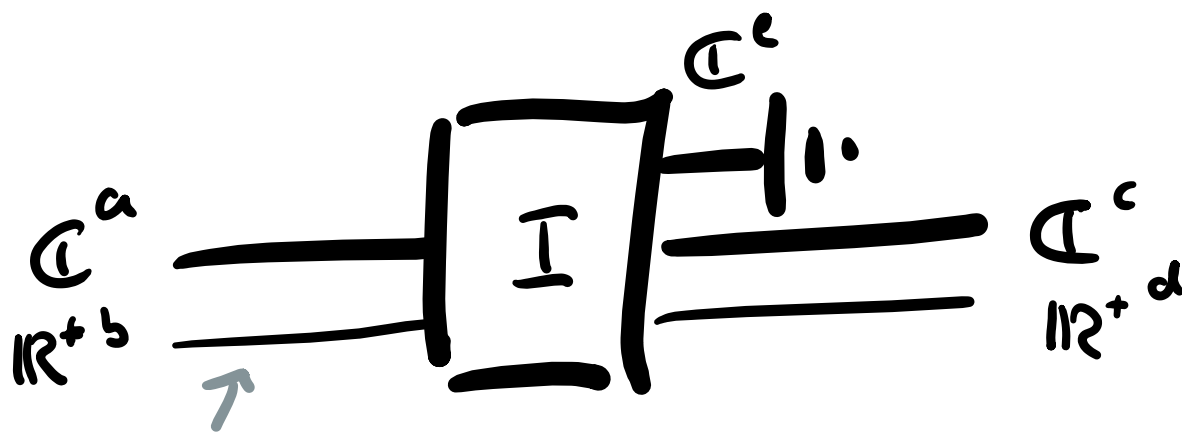


$P \mapsto \sum_j v_j P v_j^t$

$$\begin{aligned}
 |1\rangle &= \sum_j | \psi_j \rangle = \sum_j | \psi \rangle | j \rangle \\
 &\quad \uparrow \\
 &\quad (| \psi_j \rangle)_{j=0, \dots, d-1}
 \end{aligned}$$

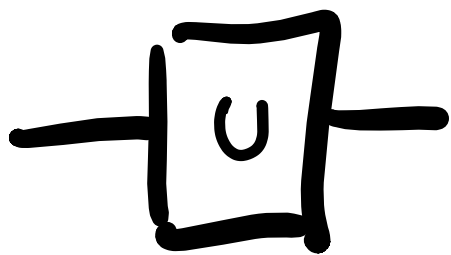
$$|1\rangle = \sum_j | j \rangle$$

Quantum Instrument

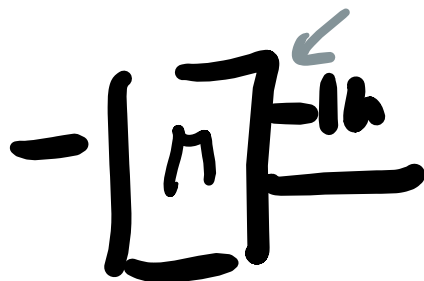


(Up to causality)

discard environment



Unitaries/Isos
(Pure Quantum Channels)

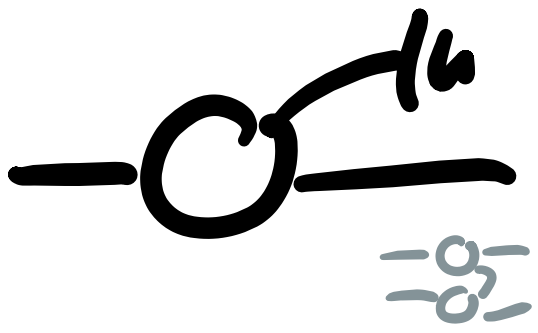


CPTP map
Quantum Channels

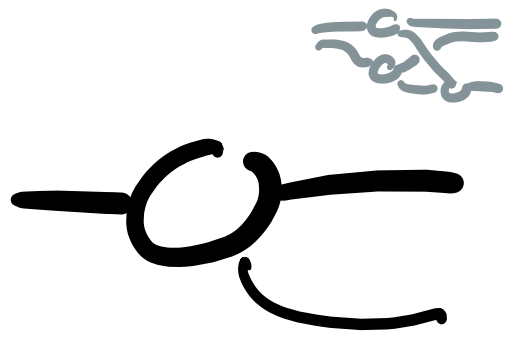


Tests

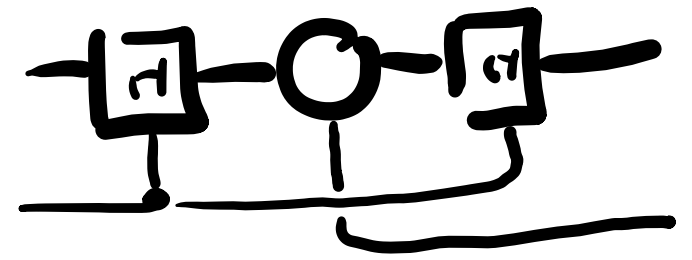
classical meas out



2 deshorner



non-démolition
2 mesure

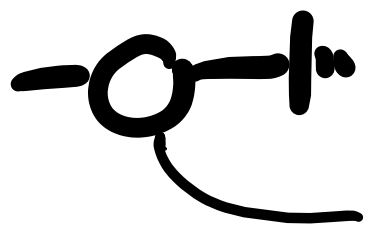


Controlled 2/x mes

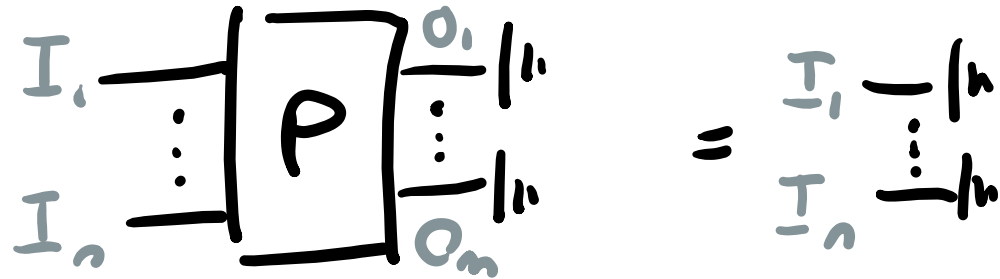


démolition
2 mesure

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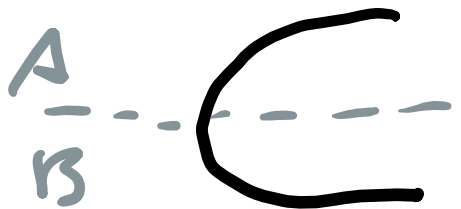
Causality in Process Theories



P is a causal process

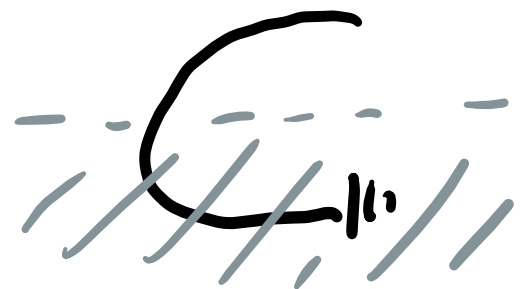
OPT "deterministic" (can be made to happen)

Q: P "sure-box"

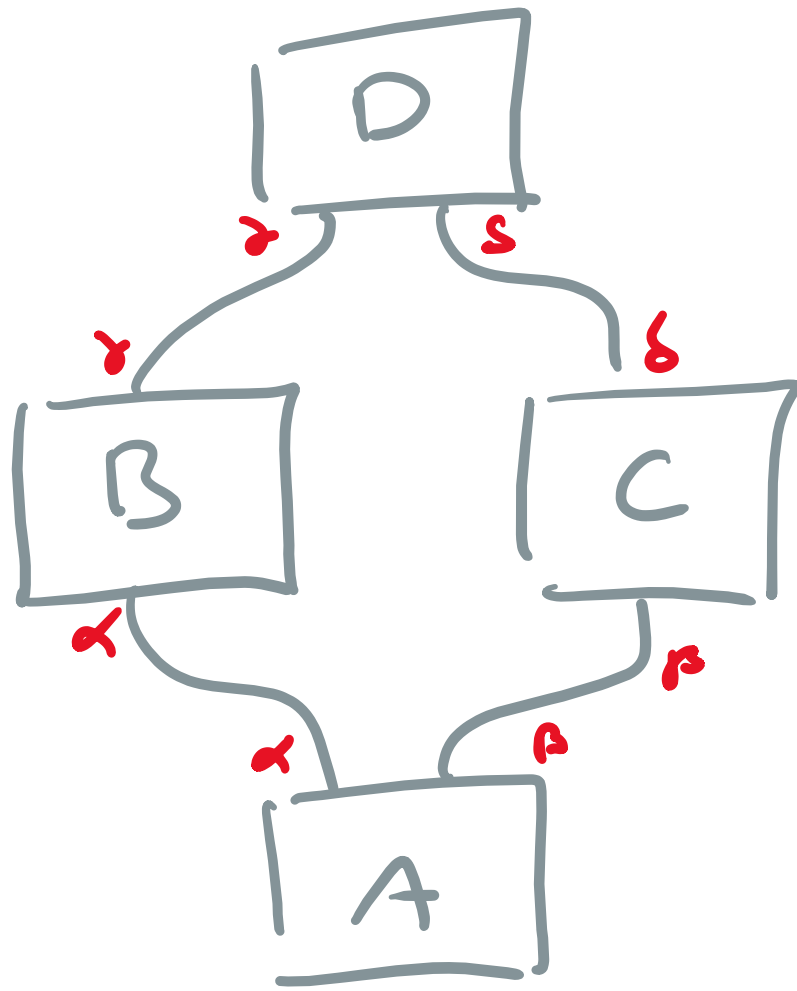
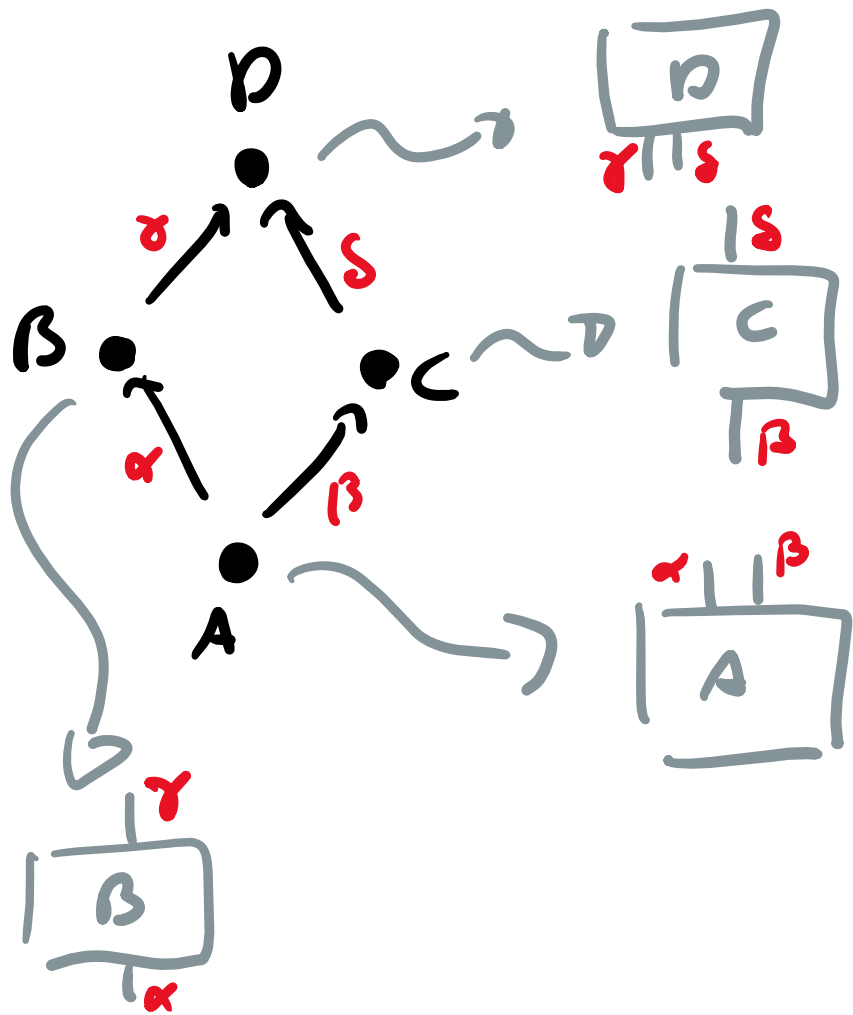
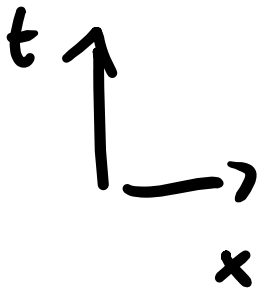


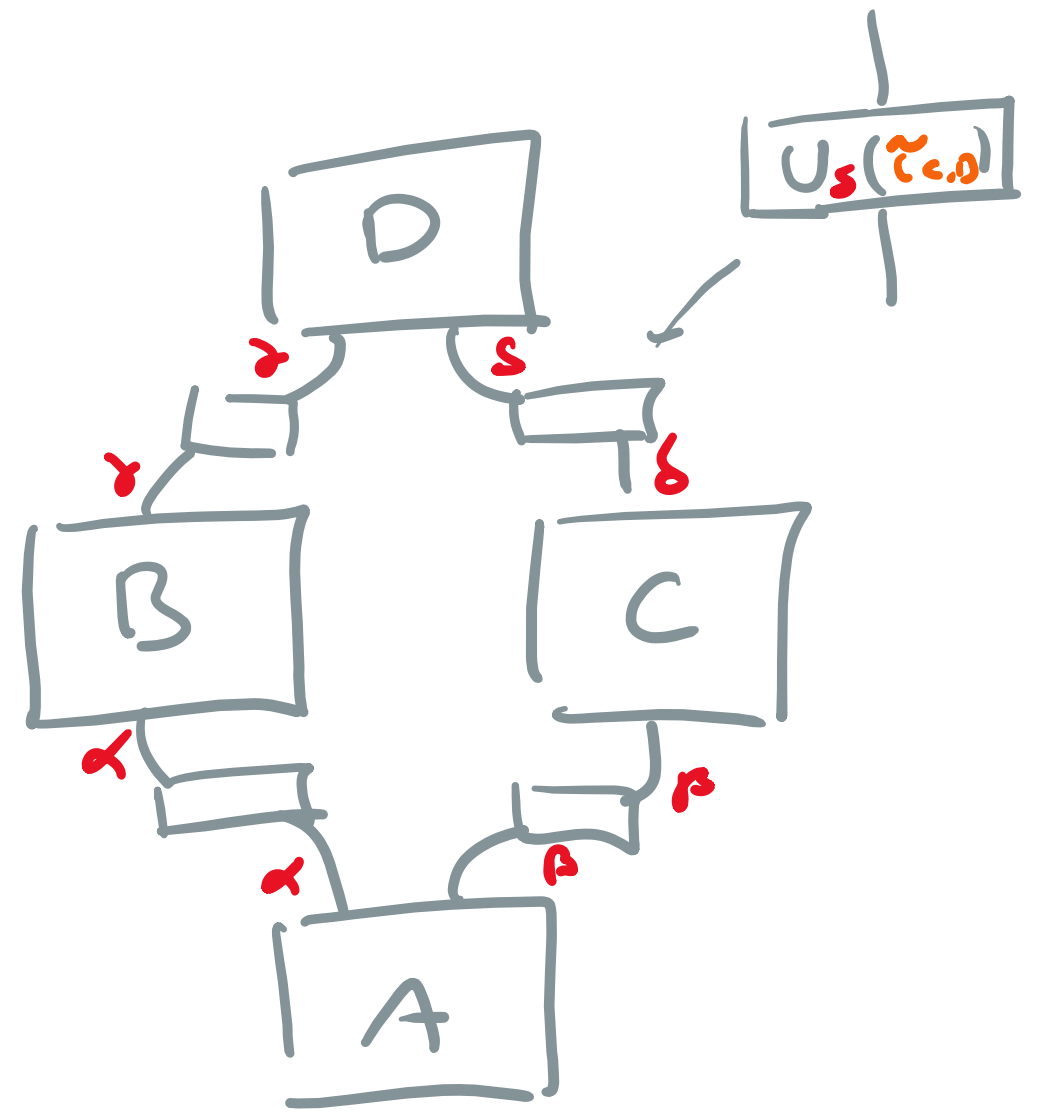
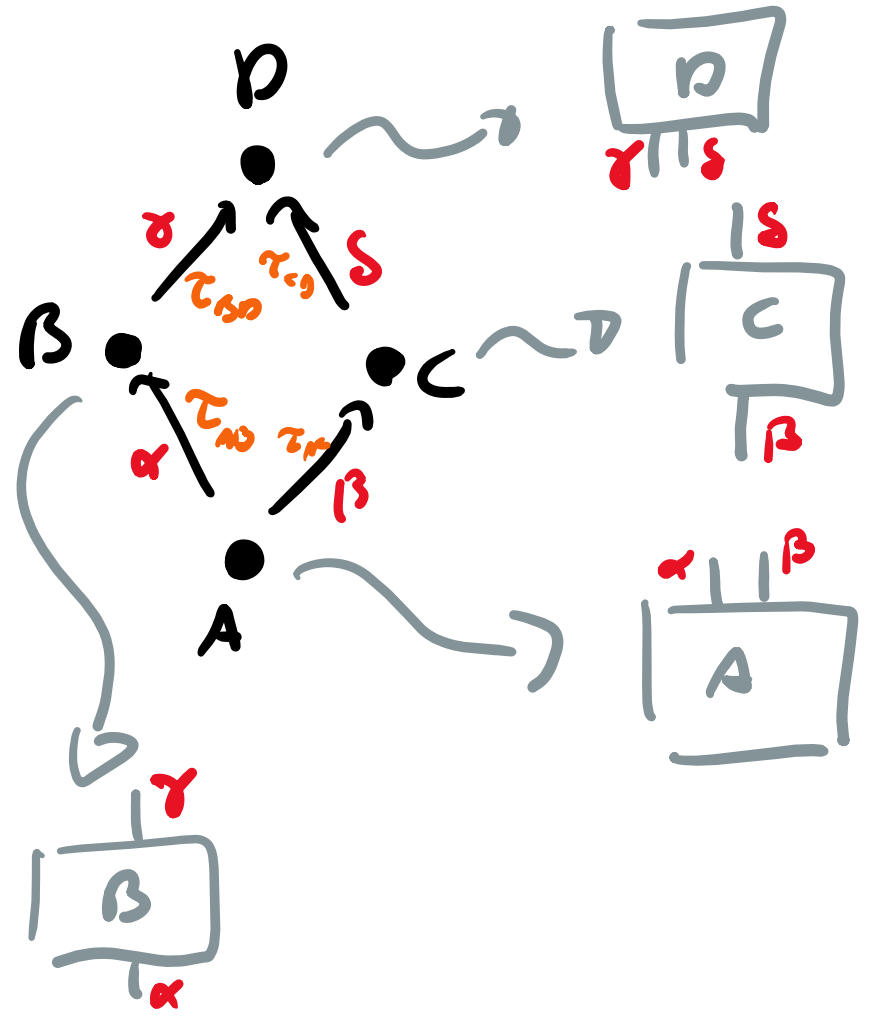
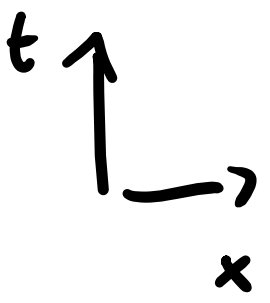
Marginal
Local state for A

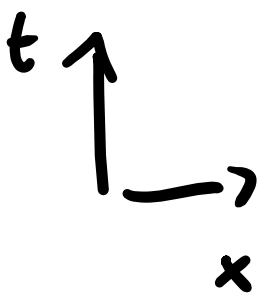
Local state for B



discarding = ignorance

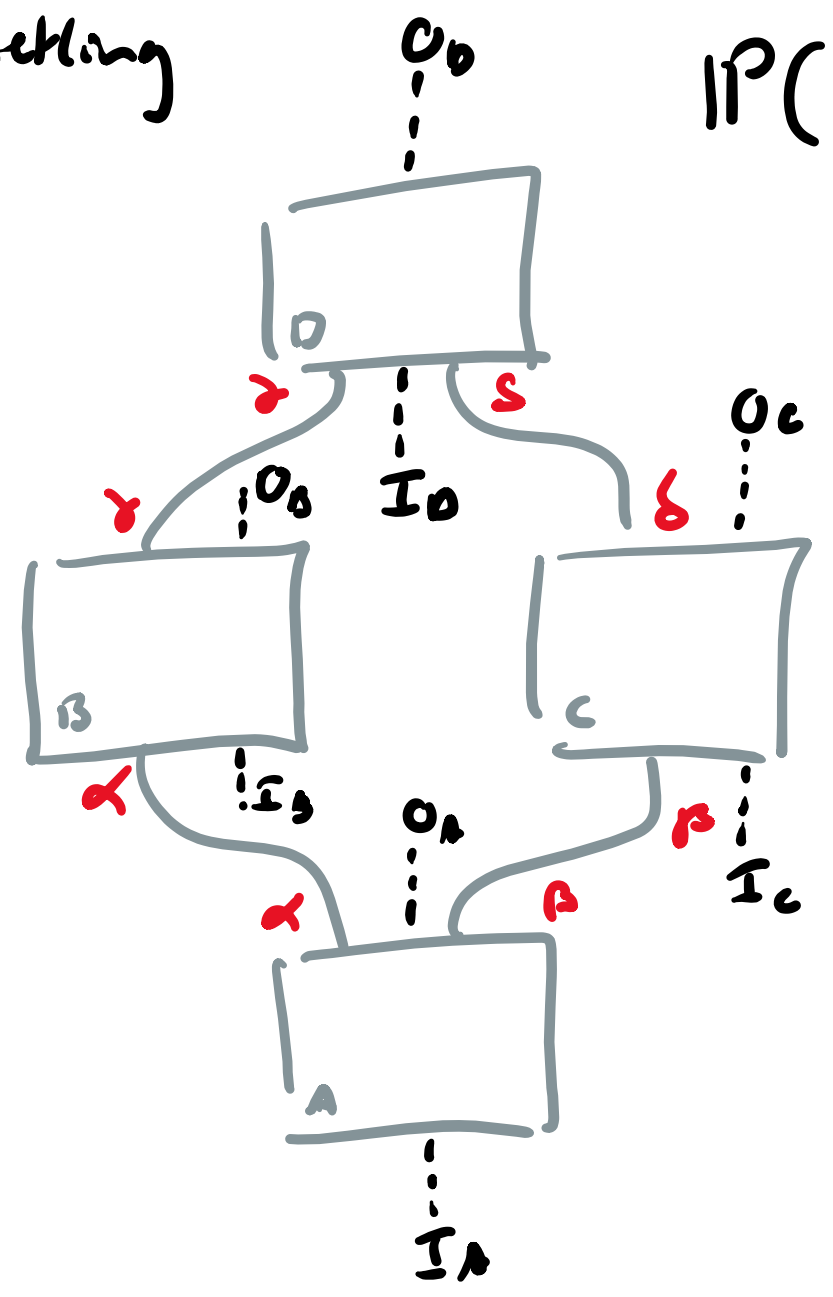
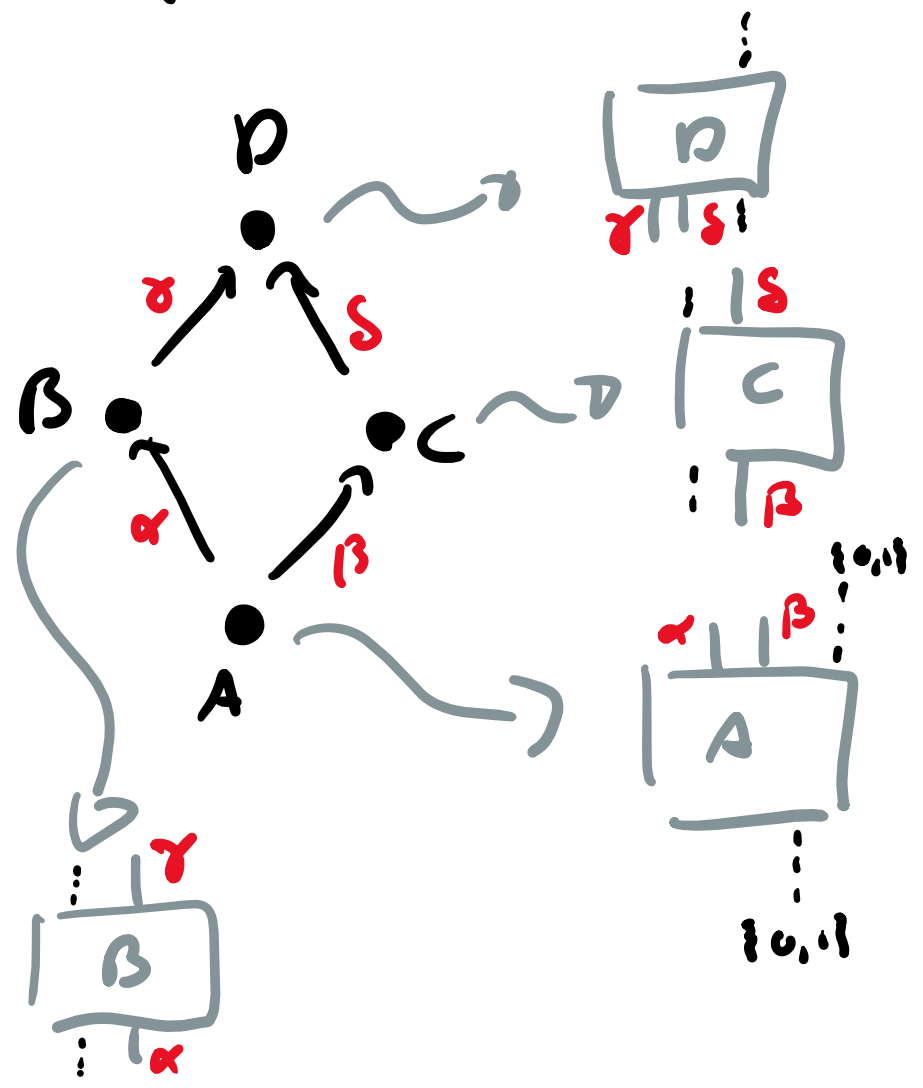


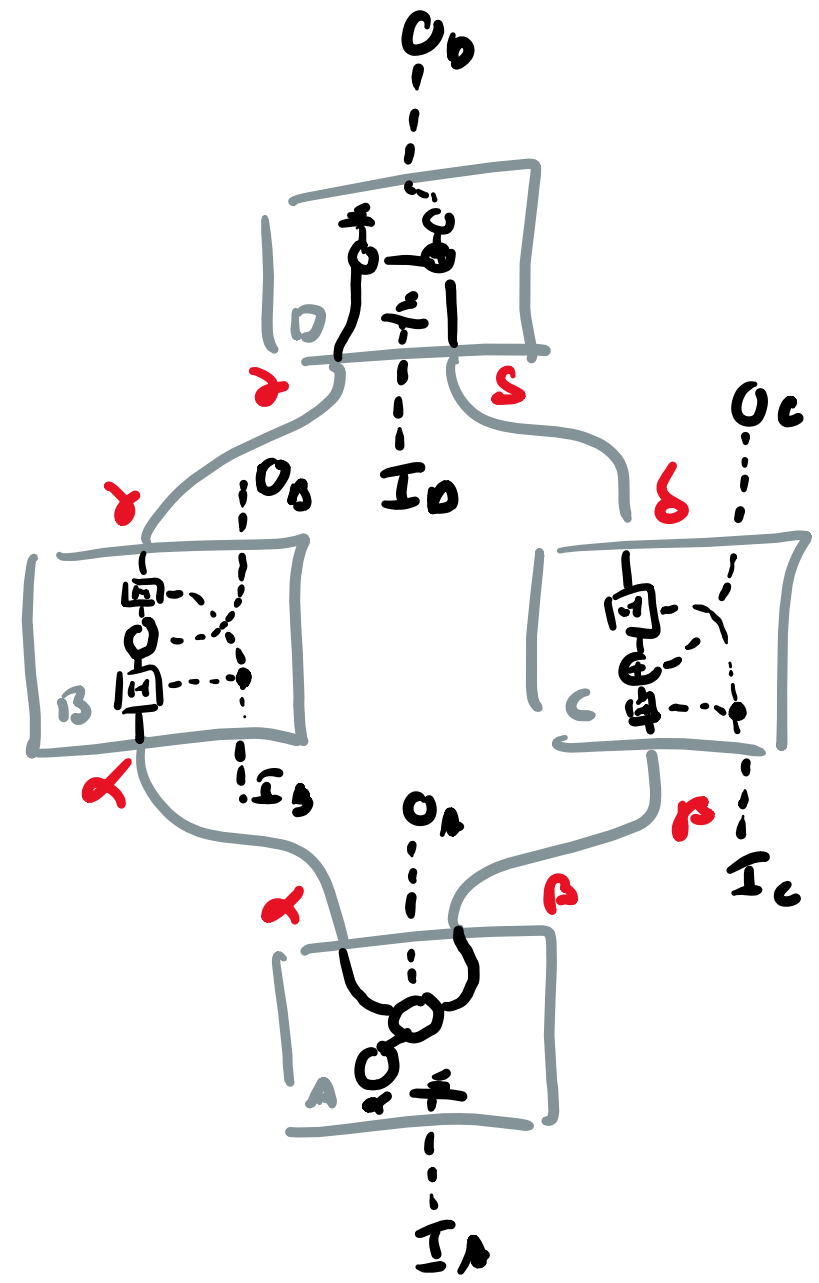
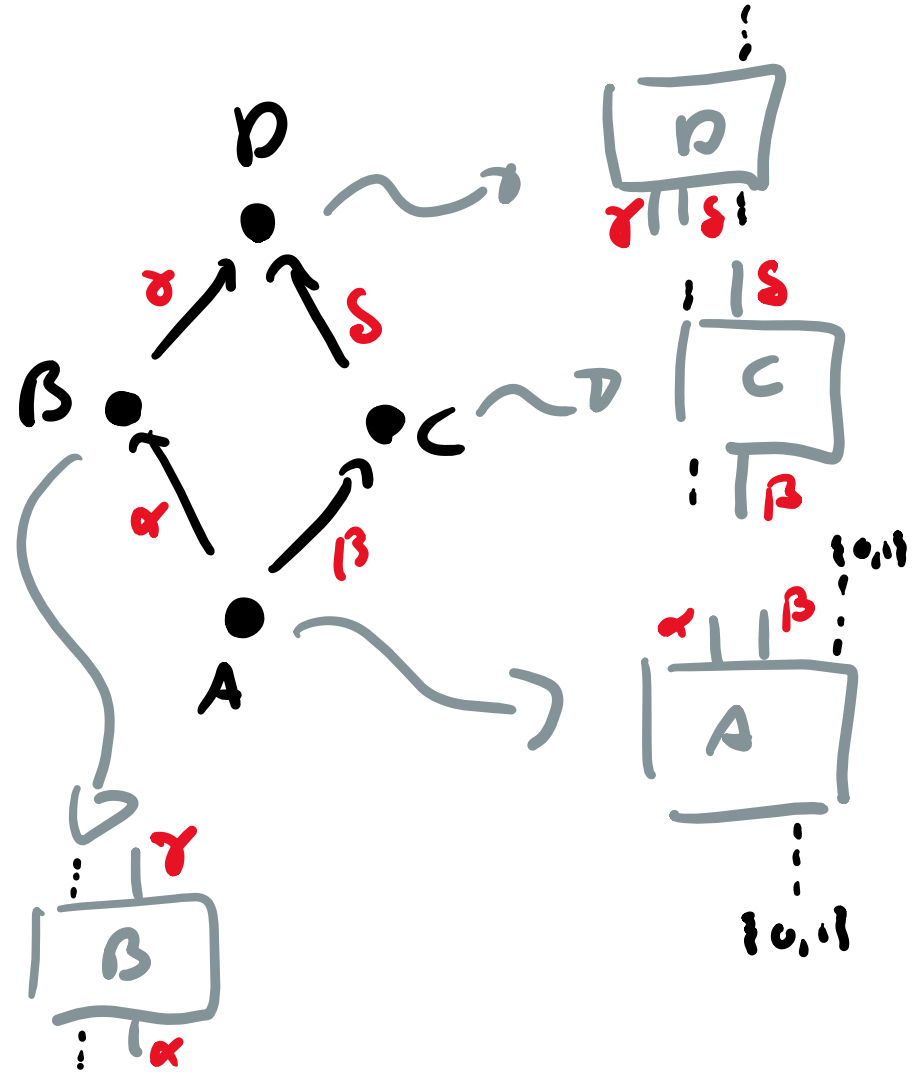
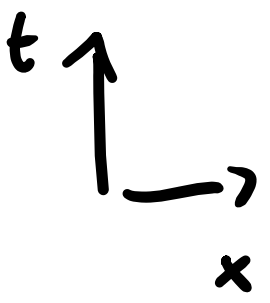




Device-independent setting

$$P(\underline{c} | \underline{I})$$

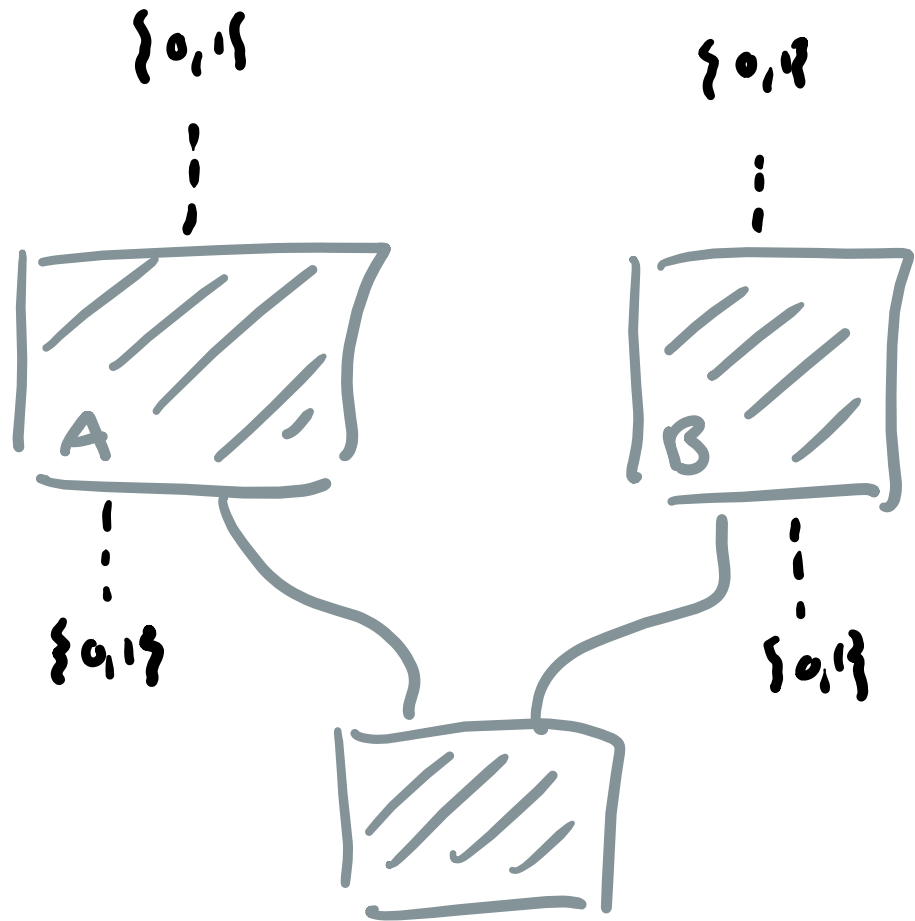




● A ● B

PR Box

(Box World)

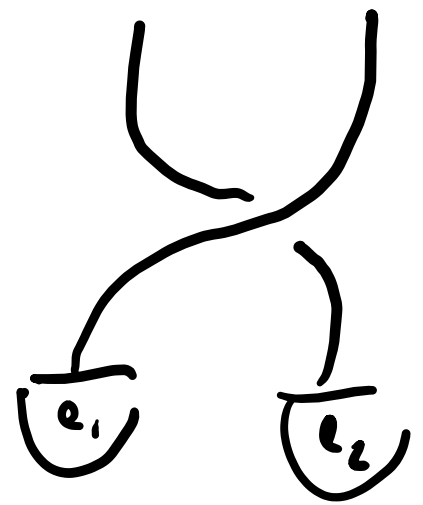


	00	01	10	11
00	$\frac{1}{2}$	00	$\frac{1}{2}$	
01	$\frac{1}{2}$	00	$\frac{1}{2}$	
10	$\frac{1}{2}$	00	$\frac{1}{2}$	
11	0	$\frac{1}{2}$	$\frac{1}{2}$	0

$$P(o_A o_B | i_A i_B) = \begin{cases} \frac{1}{2} & \text{if } o_A \oplus o_B = i_A \oplus i_B \\ 0 & \text{otherwise} \end{cases}$$

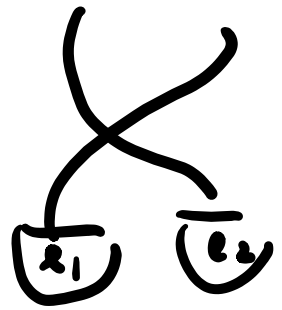
(Aside)

in space

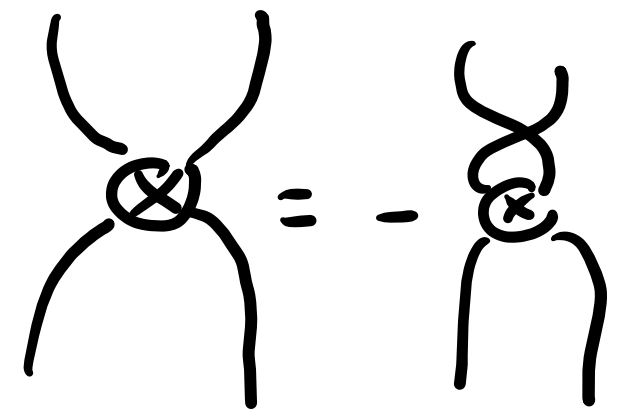
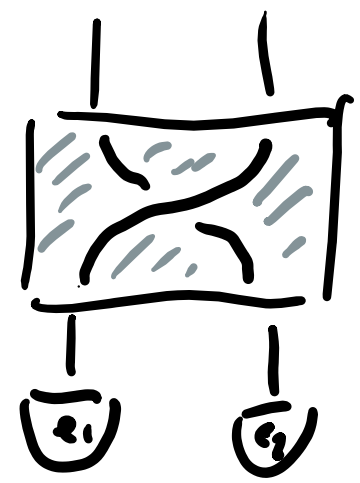


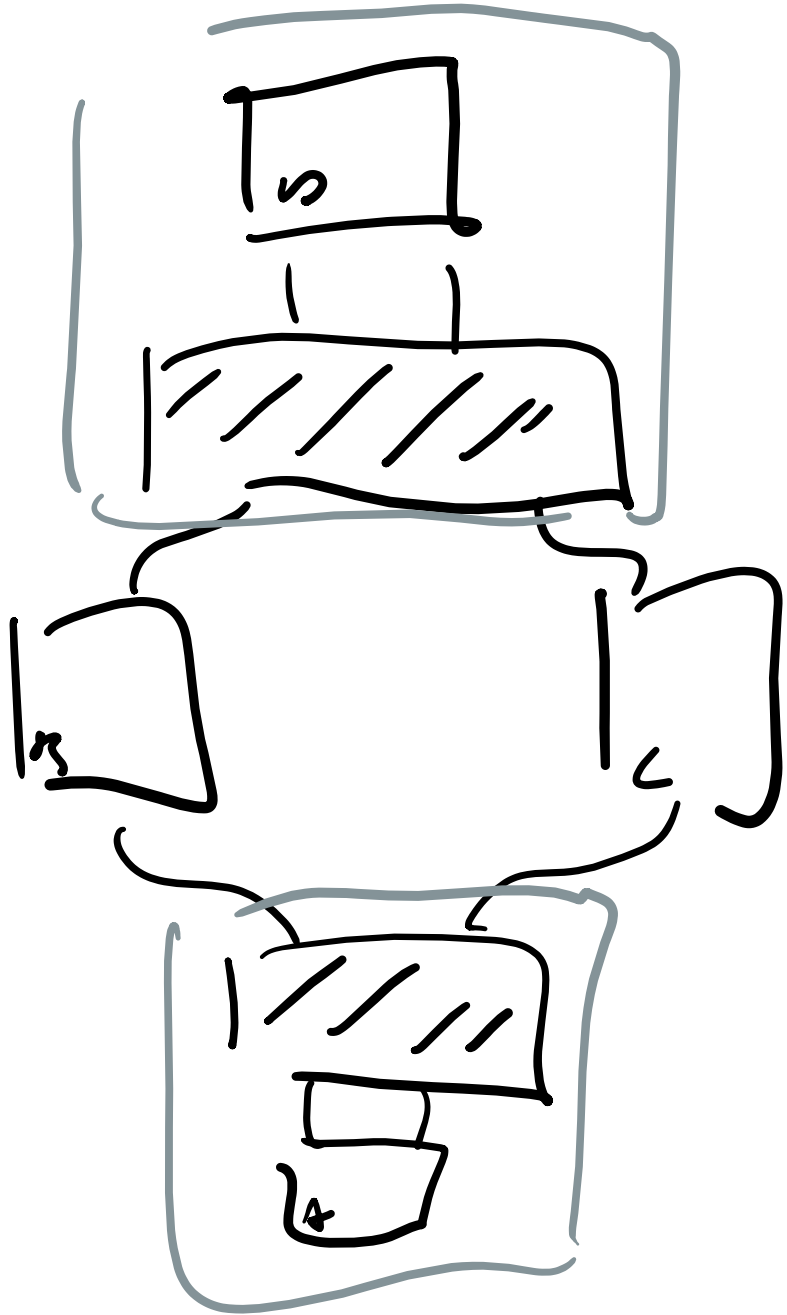
2+1

Super-selection Q Sys

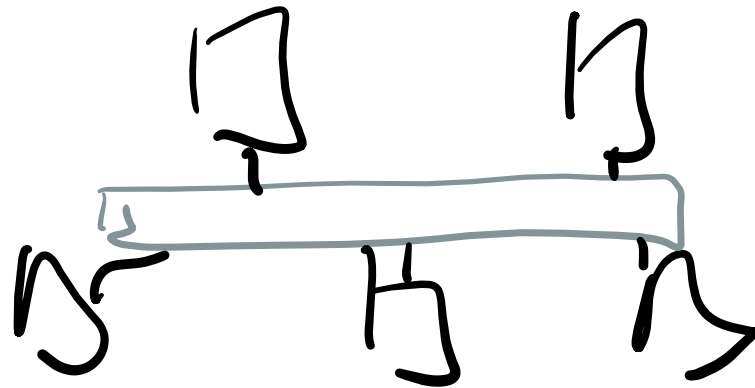


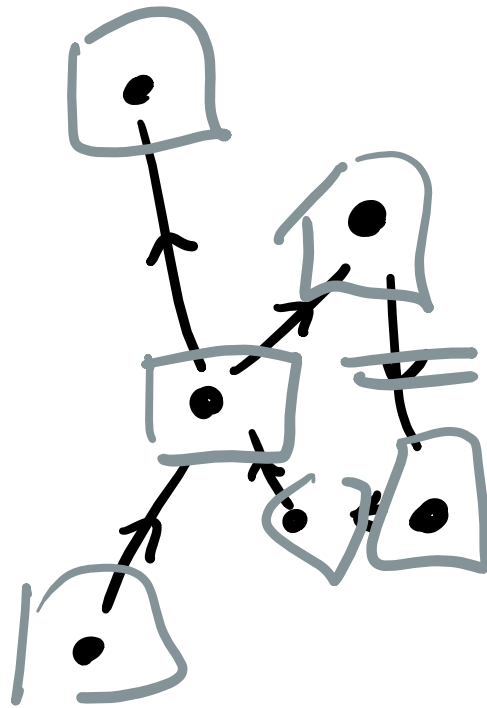
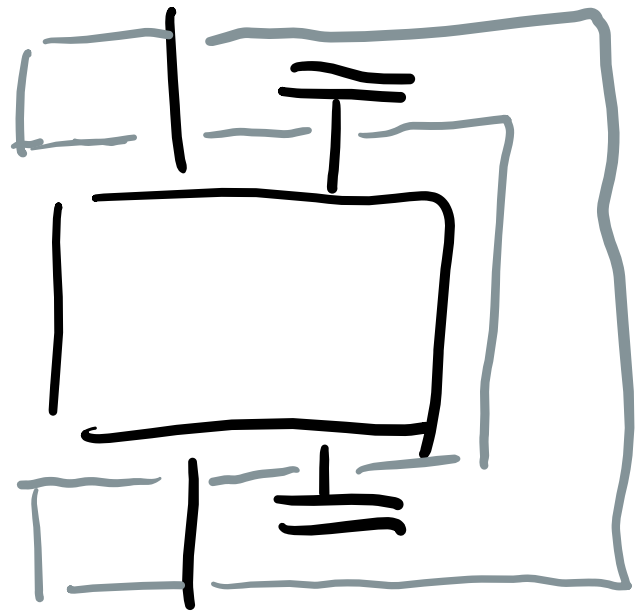
in formation



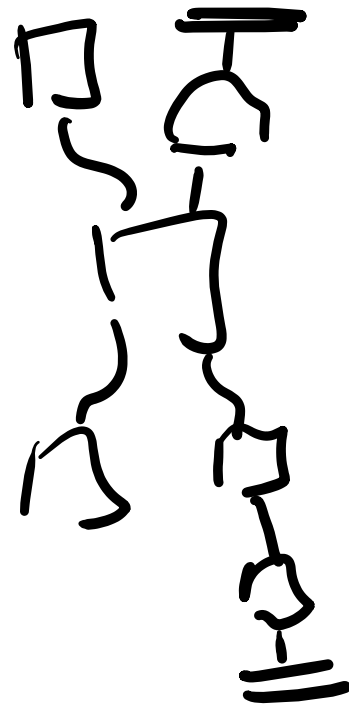


- (1) Diagrams over rule first causal and
- (2) " " over CTCs
- (3) Causality in diagrams
- (4) ?





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Uloyd / Deutsch models

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