The Chartered Institute for IT

BCSWomen Lovelace Colloquium

The national conference for undergraduate and MSc women in computing

Submission Form

- 250 word abstract
- Deadline Feb 6th
- Women and non-binary students
- Best poster awards (for each year and for MSc)

The 19th annual BCSWomen Lovelace Colloquium will be held on Wednesday 8th and Thursday 9th April 2026, in-person, hosted by University of Bath.

Example Abstracts

Introduction to Quantum Programming and Semantics

Lecture 7: Copying and deleting

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Overview

- Copying and deleting
- No-cloning and no-deleting
- Products
- Categories

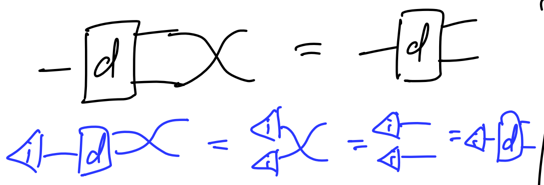
Copying and deleting

Copying machines

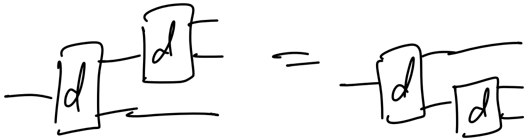
$A \xrightarrow{d} A \otimes A$

$A \xrightarrow{e} \mathbb{C}^0 = \mathbb{C}$

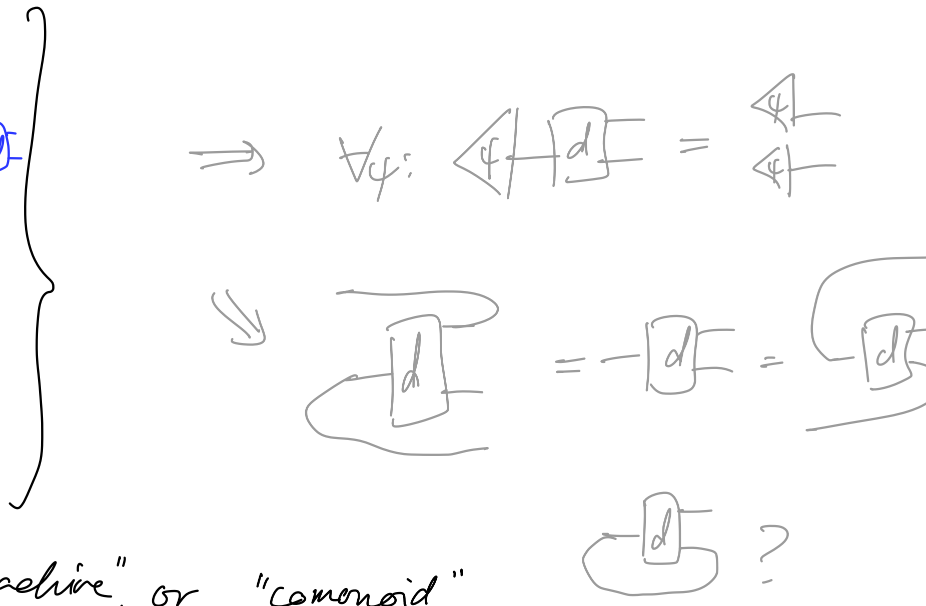
- commutative:



- associative:



- unital:



Such a process we'll call a "copying machine", or "comonoid",

e.g. $A = \mathbb{C}^n$

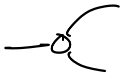
$d|i\rangle = |ii\rangle = |i\rangle \otimes |i\rangle$

$e|i\rangle = 1$

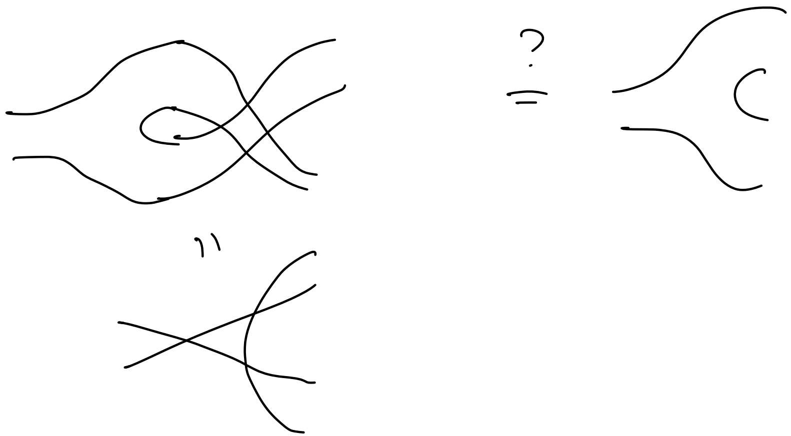
$d = \begin{pmatrix} 1 & 0 \\ 0 & 0 \\ 0 & 0 \\ 0 & 1 \end{pmatrix}$

$e = \begin{pmatrix} 1 & 1 \end{pmatrix}$

and we'll draw it as

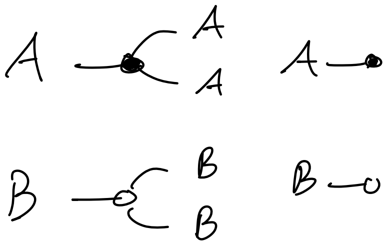
$d =$ 

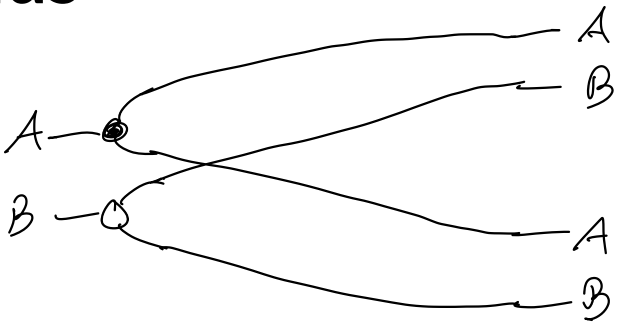
$e =$ 

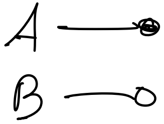


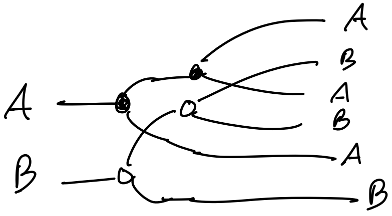
To distinguish different copying machines, we'll colour their pictures differently.

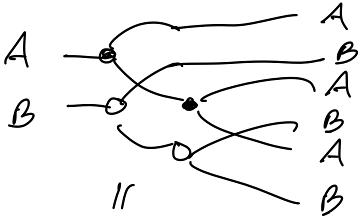
Combining comonoids

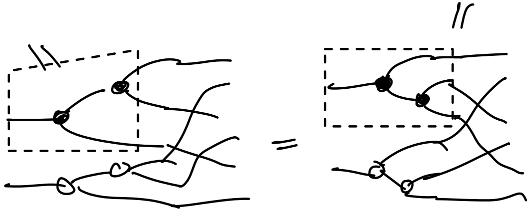




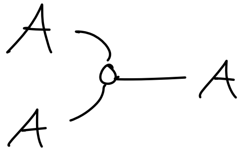


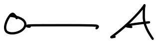






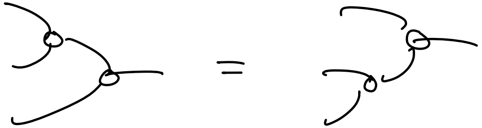
Monoids





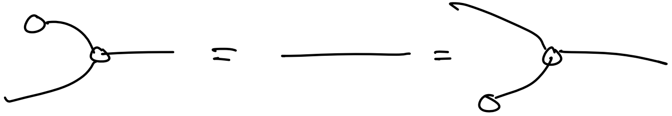
s.t.

associative:



$(m+n)+p = m+(n+p)$

unital:

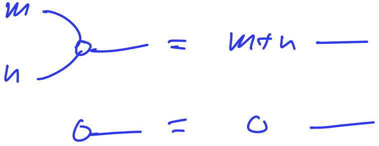


$0+m = m = m+0$

(commutative:

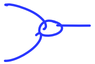
$n+m = m+n$)

e.g. $A = \mathbb{Z}$



or

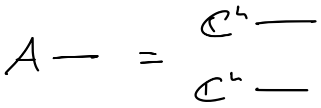
$A = M_n = \{$n-by-n complex matrices$\}$



$= \begin{pmatrix} 1 & & 0 \\ & \ddots & \\ 0 & & 1 \end{pmatrix}$

Pairs of pants

where

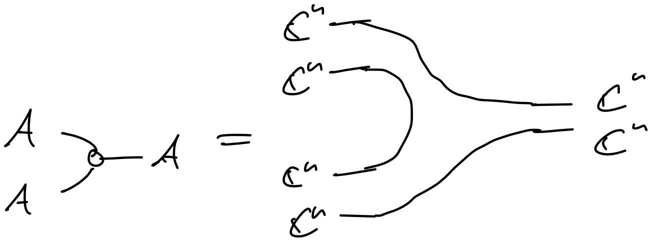


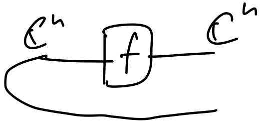
e.g. $A = \{n\text{-by-}n \text{ matrices}\}$

$\text{“} \cong \{f : \mathbb{C}^n \to \mathbb{C}^n \text{ linear}\} \text{”}$

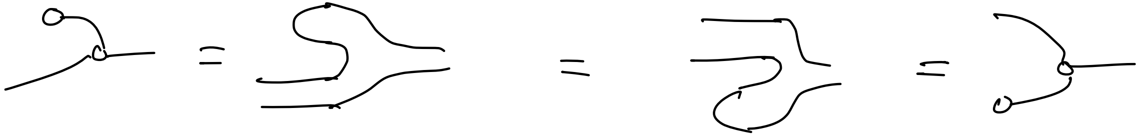
$\cong (\mathbb{C}^n)^* \otimes \mathbb{C}^n \ni x$

$x = \sum_{i,j} x_{ij} \langle j| \otimes |i\rangle$





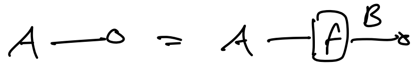
unital :

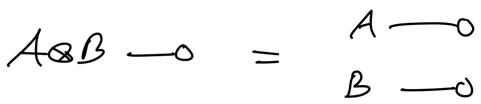


No-cloning and no-deleting

Uniform deleting

systematic deleting: for each type A, have 

s.t. for any process f: 

and: 

no-deleting theorem: if systematic deleting and caps and cups ("entanglement") are available, then there is a unique process A —[ ].

hence: unique scalar ∘…[s]…∘, so no quantities

Uniform copying

No-cloning theorem

Products

Universal property

Characterising products

Categories

Composition

Summary:

- Comonoids are copying machines
- No-cloning theorem holds syntactically
- Can recognise when semantics is classical via products
- Can interpret string diagrams generally in monoidal categories