

Categories and Quantum Informatics: summary

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Categories

“Morphisms are more important than objects”

- ▶ **Set, Rel, FHilb**
- ▶ Universal properties: products

Monoidal categories

“Can compose morphisms in sequence and in parallel”

- ▶ Coherence theorem
- ▶ Graphical calculus: isotopy
- ▶ Braiding, symmetry

Scalars

“Monoidal categories replicate linear algebra features”

- ▶ Scalars commute
- ▶ Scalar multiplication
- ▶ Dagger categories
- ▶ Way of the dagger

Dual objects

“Dual objects model maximally entangled states”

- ▶ Definition: cup, cap, snake equation
- ▶ Names, conames
- ▶ Transpose morphisms
- ▶ Traces and dimension
- ▶ Teleportation, one-time pad encryption

Monoids and comonoids

“Comonoids model copying”

- ▶ Monoid: unit and multiplication
- ▶ Monoids embed into pair of pants
- ▶ No uniform cloning or deleting
- ▶ When tensor products are products

Frobenius structures

“Classical structures model classical data”

- ▶ Frobenius law: dagger and closure
- ▶ Spider theorem
- ▶ Phases
- ▶ In **FHilb**: matrix algebras and orthogonal bases
- ▶ in **Rel**: groupoids

Complementarity

“Complementary Frobenius structures are maximally incompatible”

- ▶ Mutually unbiased bases
- ▶ ZX calculus
- ▶ Oracles
- ▶ Deutsch-Jozsa algorithm

Exam

- ▶ Answer two out of three questions
- ▶ Lot like longer exercise sheet question / coursework
- ▶ If can't solve subquestion, assume answer and move on

Good luck!