Data Structures for Network Languages
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Category Theory Workshop
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Backprop as Functor
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Figure 2. A request function allows an update function to be defined for the composite $J(q, I(p, -))$. 
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A data structure problem.

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(i) list all systems $f, g$ etc.

(ii) list the composition rule: for all systems arranged in all possible networks name the composite system.
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then check this data coheres.
This corresponds to taking the \textit{colimit} of \{white $\circ$\} $\xrightarrow{f}$ $\xrightarrow{g}$ \{black $\bullet$\}
To specify a **decorated cospan** hypergraph category:

(i) list all systems $f, g$ etc.
(ii) list how systems interact with functions.

then check this data forms a lax monoidal functor.

**Universal constructions** (colimits; a left Kan extension) take care of the rest.
For details, http://brendanfong.com/:

Decorated Cospans
Decorated Corelations
The Algebra of Open and Interconnected Systems
Seven Sketches in Compositionality
Chapters:

1. Generative effects: Posets and adjunctions
2. Resources: Monoidal posets and enrichment
3. Databases: Categories, functors, and universal constructions
4. Co-design: Profunctors and monoidal categories
5. Signal flow graphs: Props, presentations, and proofs
6. Circuits: Hypergraph categories and operads
7. Logic of behavior: Sheaves, toposes, and languages