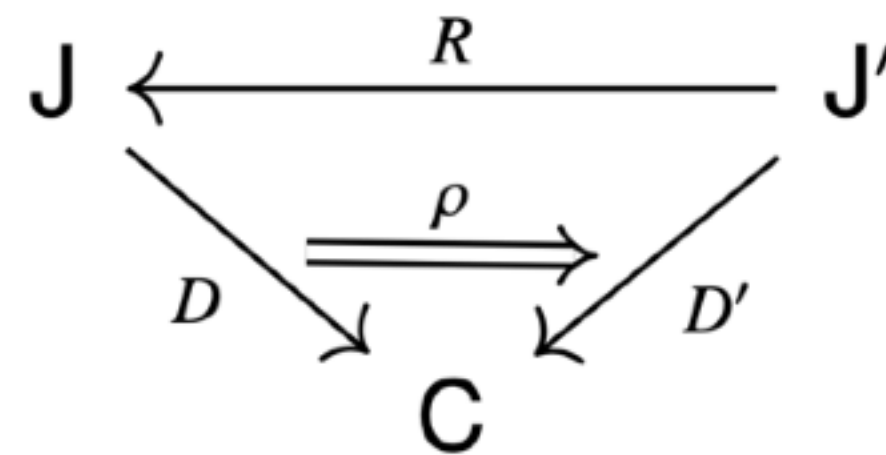


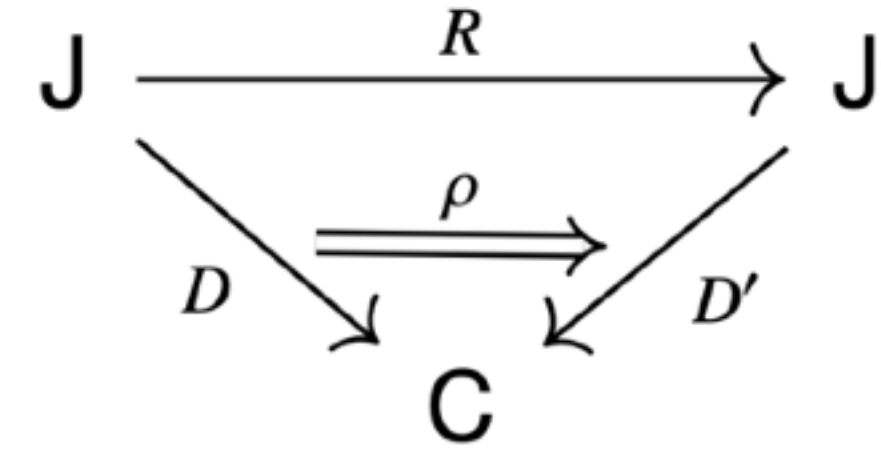
# Morphisms of diagrams

## Two constructions

- Given a category  $\mathcal{C}$ , the **backwards category of diagrams in  $\mathcal{C}$**  has objects  $(\mathcal{J}, D: \mathcal{J} \rightarrow \mathcal{C})$  and morphisms  $(R: \mathcal{J}' \rightarrow \mathcal{J}, \rho: D \circ R \Rightarrow D')$ ; the **forwards** category has morphisms  $(R: \mathcal{J} \rightarrow \mathcal{J}', \rho: D \Rightarrow D' \circ R)$



Forwards



Backwards

- If  $\rho$  is the identity, then we recover (the opposite of) the slice category  $\text{Cat}/\mathcal{C}$
- Morphisms in the *backwards* category send solutions to solutions
  - thus these tend to go in the direction of *increasing generality*, e.g. from static Maxwell–Faraday *with* potentials to static Maxwell–Faraday *without* potentials

# Purpose of morphisms

Why care?

- We can use morphisms for a few things, e.g.
  - steady states of diffusion processes
  - different presentations of the same physics (but this is subtle!)
  - boundary (and initial) value problems
    - this is the really nice one!