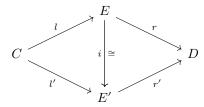
## Factorization systems

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A factorization system in a category  $\mathcal C$  consists of two classes of morphisms (L,R), such that both L and R contain isomorphisms and are closed under composition, and every morphism  $f:C\to D$  in  $\mathcal C$  admits a factorization into a morphism  $l\in L$  followed by a morphism  $r'\in R$ , which is unique up to unique isomorphism among such factorizations.



## Plan of work:

- show that factorization systems descend to slices
- construct a few elementary examples (in the **Set**, **Grp**, **CRing** etc.)
- show that the left class in a f.s. has the right cancellation property, and, dually, the right class has the left cancellation property
- define the orthogonality relation and show various closure properties of orthogonal complements (under (co)limits, (co)base change, etc.)
- either of the classes in a f.s. determines the other via orthogonal complements
- recognition principle for factorization systems: (L,R) is a factorization system iff every morphism  $f:C\to D$  in  $\mathcal C$  admits an (apriori non-unique) (L,R)-factorization, both classes are replete, and  $L\bot R$

If time permits it, we would also like to use the general theory of factorization systems to define (left-exact) modalities and study some of their properties. In particular, we would like to show that every (left-exact) modality determines a (left-exact) reflective subcategory and vice versa.