Databases
Entity Relationship diagrams

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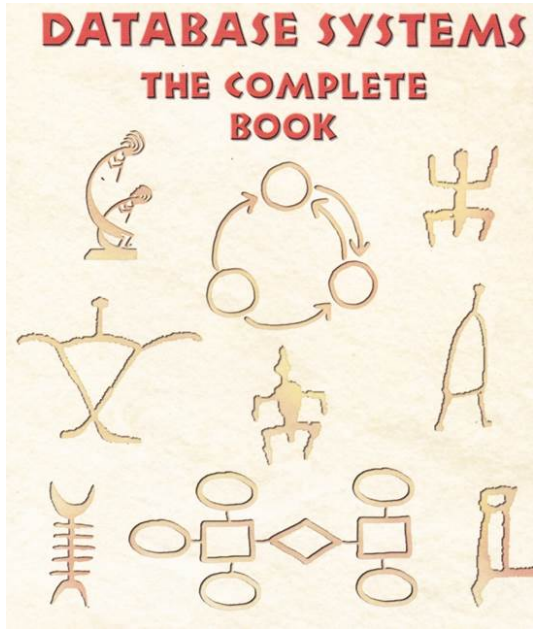
ER diagrams

- Database design starts with domain modeling
- Domain modeling is based on communication with domain specialists
- Domain specialists seldom have a background in formal techniques
- So domain modeling requires an intuitive communication tool
- *A picture is worth a thousand words*



ER diagrams

- An ERD can be used to derive a relational database scheme ...
- ... although we have not yet established what defines a *good* db scheme
- Normalization theory will provide us with quality notions for db schemes

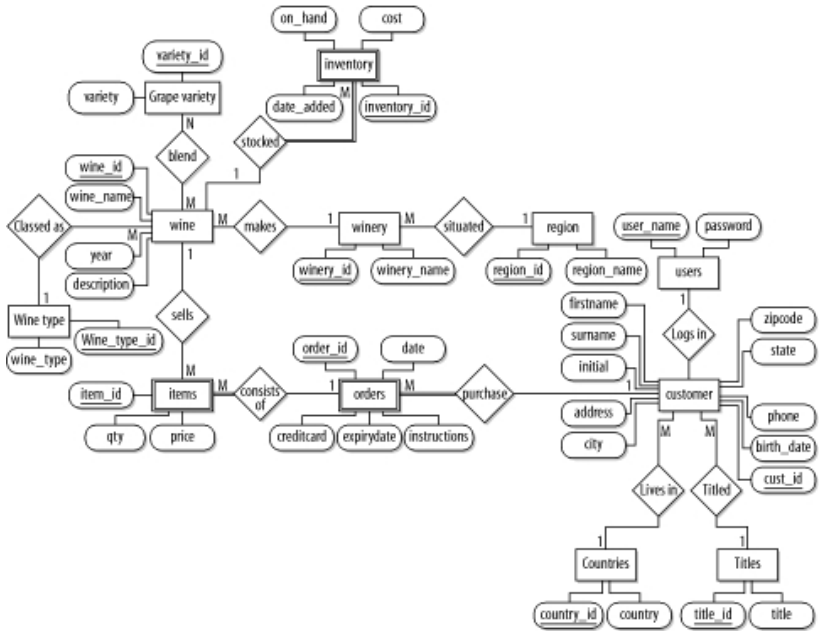
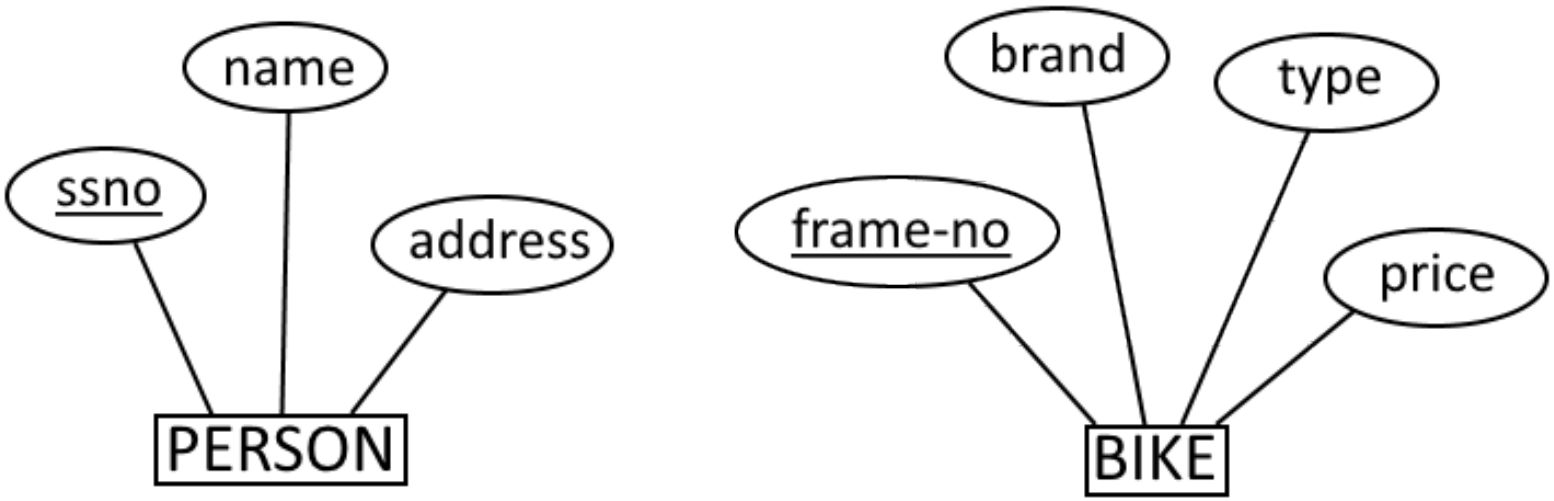


image from etutorials.org

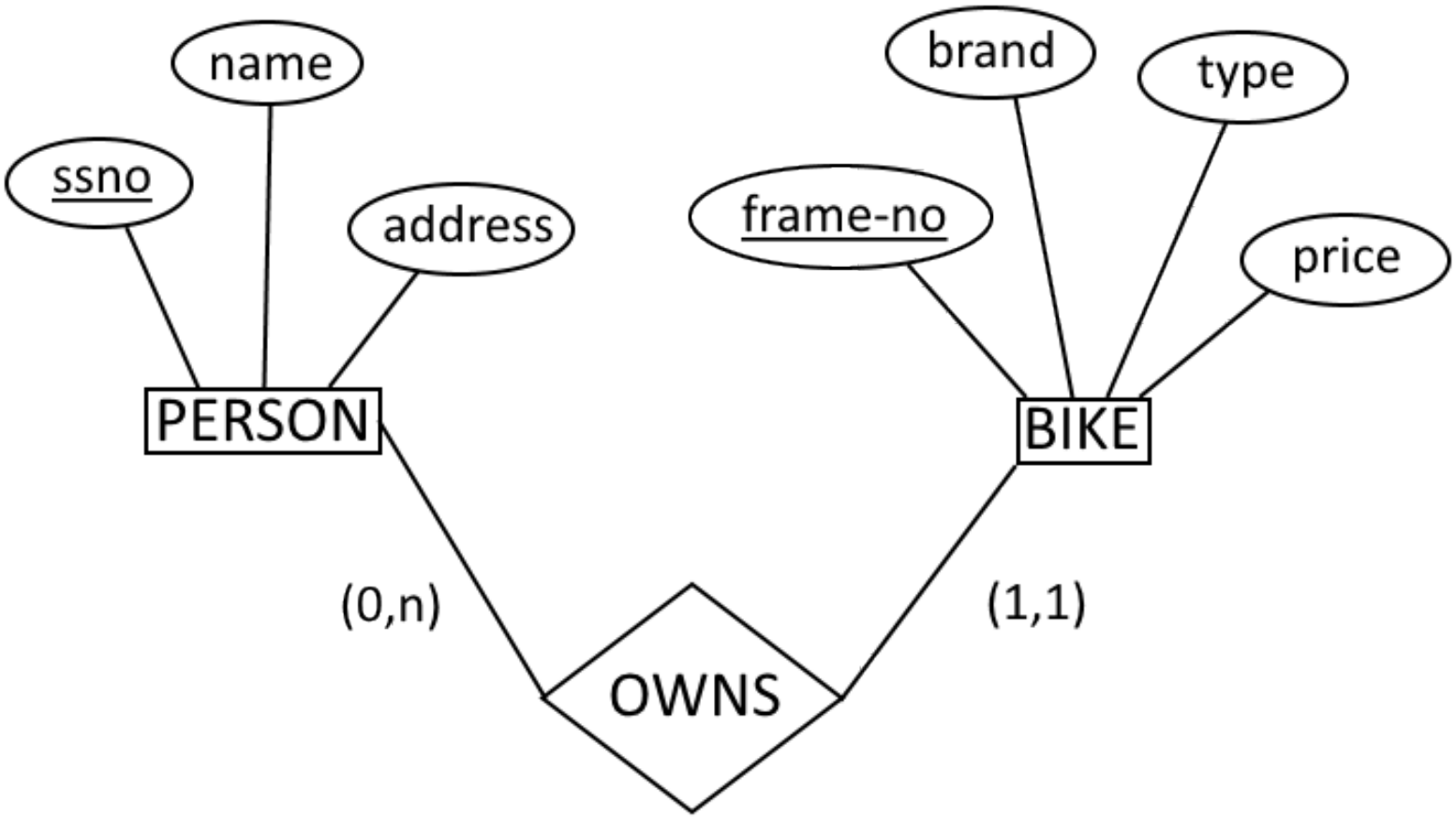
ER diagrams: a rather limited universe of interest

- Rectangle: entity set
- Ellipse: property (key underlined)



ER diagrams: a more cohesive universe of interest

- Diamond: relation (association) with cardinality constraints



ER diagrams: cardinality constraints

A relation between two entity sets can be:

- 1:1 (one-to-one)
- 1:n (one-to-many)
- m:n (many-to-many)

Participation of an entity in a relation can be:

- optional $(0, \ldots)$
- mandatory $(1, \ldots)$

The diversity in syntax is dazzling. Please stick to our conventions!

Weak entities

An entity set is *weak* if:

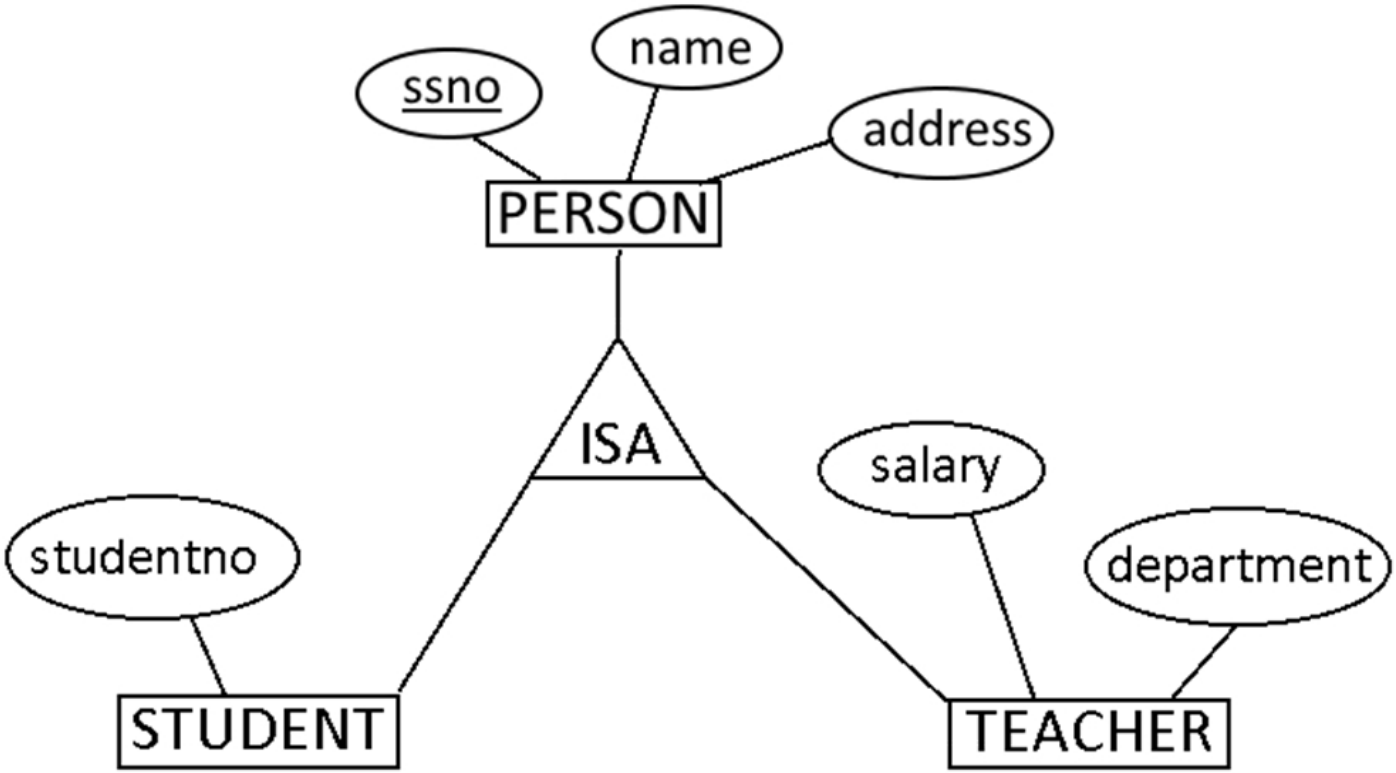
- its existence depends on another entity
- identification is done by extending the foreign key of that entity

Example: a bank withdrawal is identified by the combination of an account number and a serial number

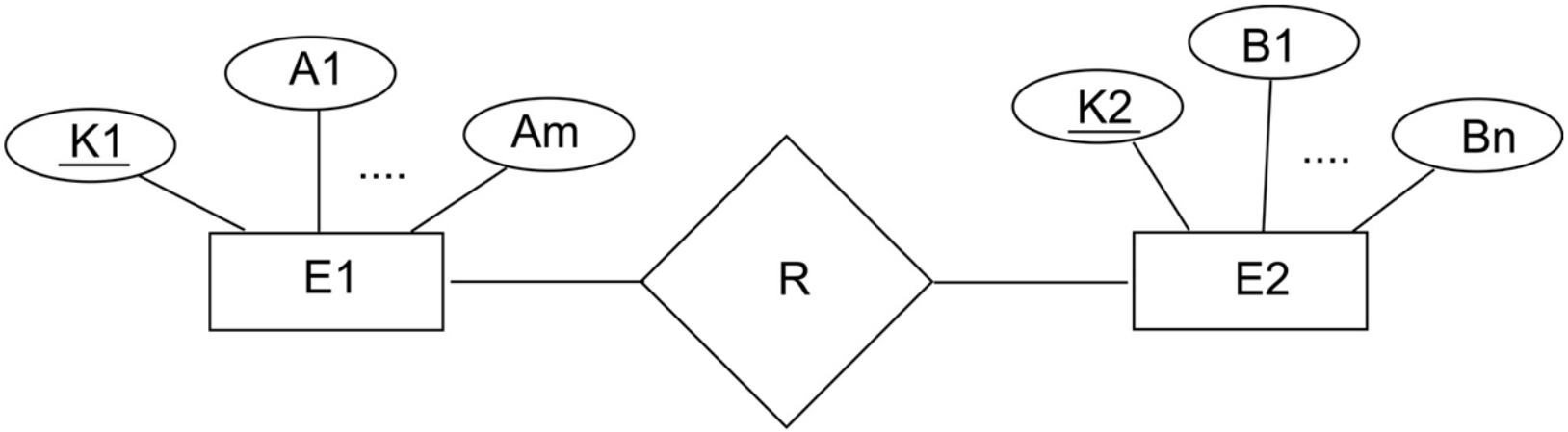
Apply weakness with care.

ISA hierarchy: specialization and inheritance

- Following OO-conventions, we adopt supertypes and subtypes
- Students inherit all the properties of Persons, including the key



From ER diagram to relational database scheme

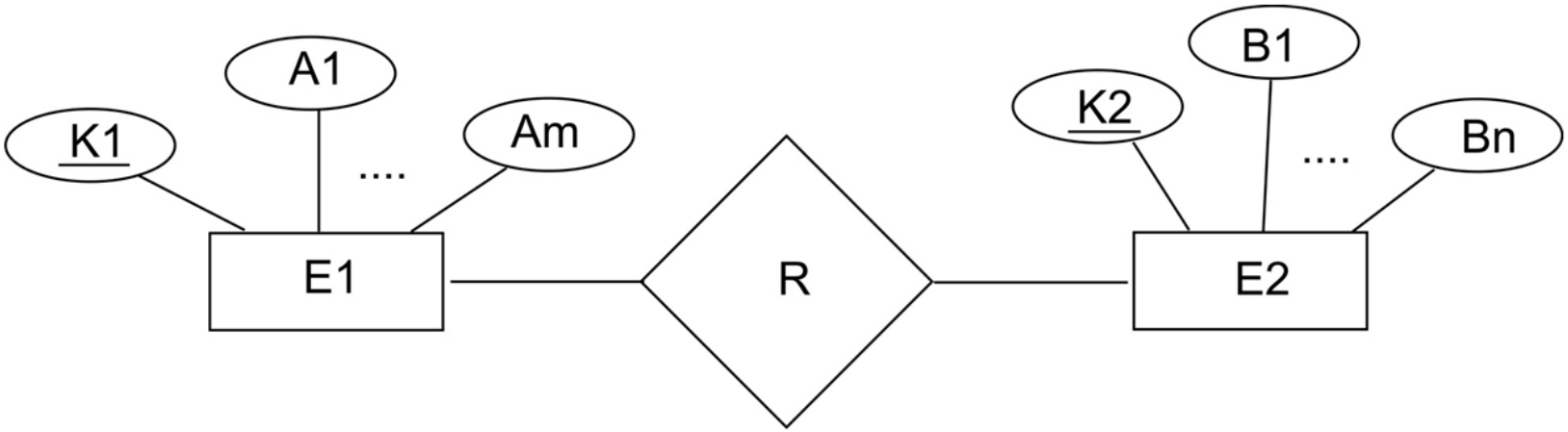


Option 1

E1 (K1, A1, ..., Am, K2)

E2 (K2, B1, ..., Bn)

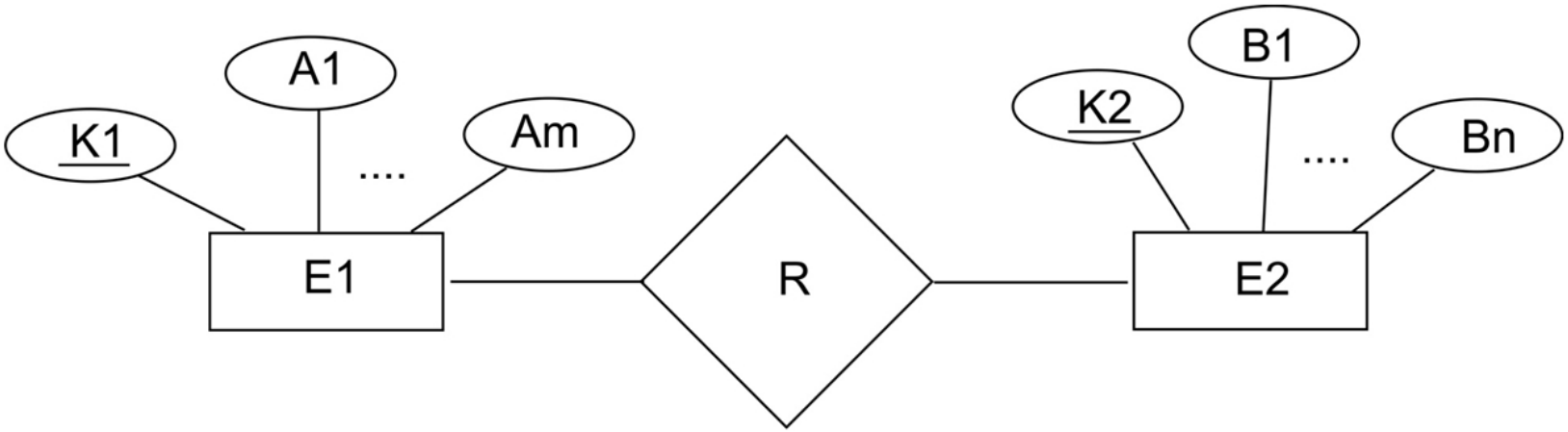
From ER diagram to relational database scheme



Option 1
E1 (K1, A1, ..., Am, K2)
E2 (K2, B1, ..., Bn)

Option 2
E1 (K1, A1, ..., Am)
E2 (K2, B1, ..., Bn, K1)

From ER diagram to relational database scheme

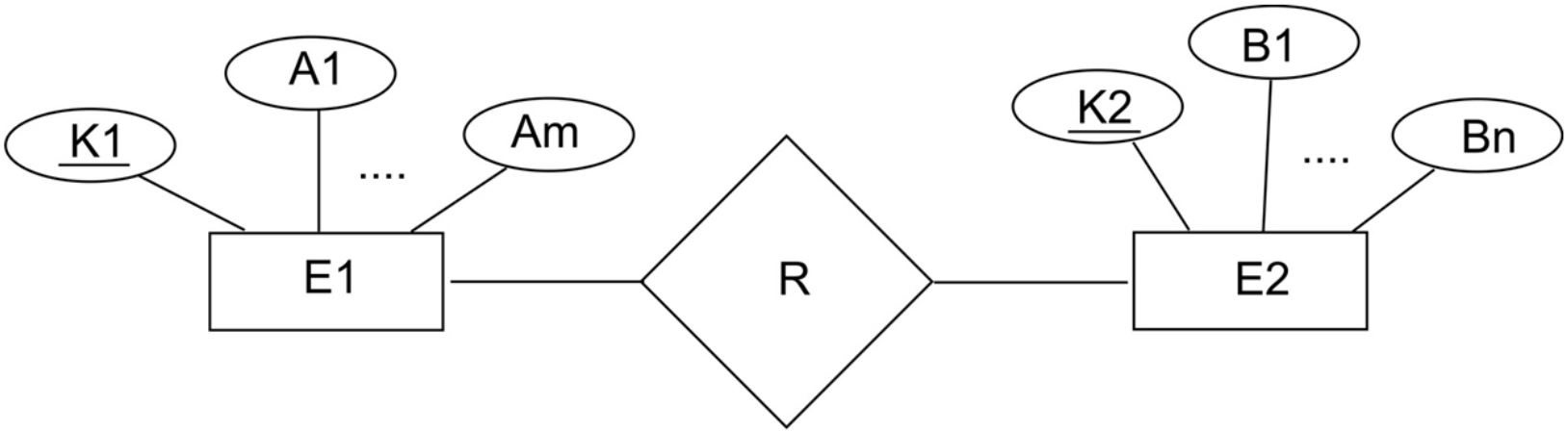


Option 3

E1 (K1, A1, ..., Am, K2)

E2 (K2, B1, ..., Bn, K1)

From ER diagram to relational database scheme



Option 4

E1 (K1, A1, ..., Am)

E2 (K2, B1, ..., Bn)

R (K1, K2)