ERD

Translation to tables

A Table Example

- t1 = (foo,bar,baz,x)
- t2 = (quz,bar,foo,y)

- t1[a1] = (baz)
- t2[a2] = ({y,z})

- t1[$\overline{a}$] = (baz,{x,y})
- t2[$\underline{\overline{k}}$] = (quz,bar)

	<u>k1</u>	**<u>k2</u>**	**a1**	**a2**
t1	foo	bar	baz	{x,y}
t2	quz	bar	foo	{y,z}

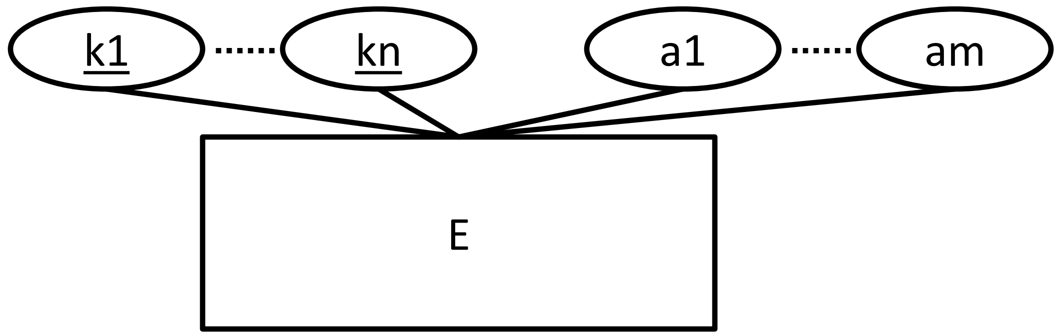
Vector of all **key** attributes

$\underline{\overline{k}}$ = (k1,k2)

$\overline{a}$ = (a1,a2)

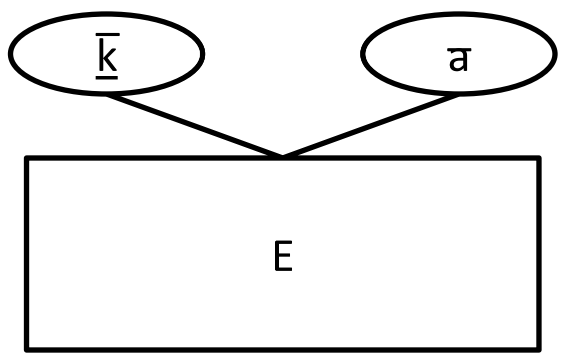
Vector of all **non-key** attributes

Entities

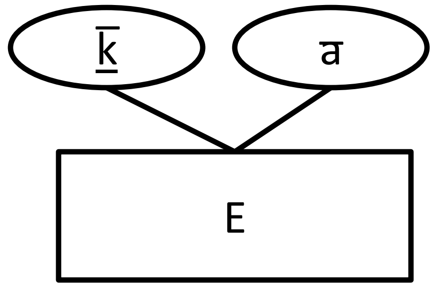


- A short representation:

$\underline{\bar{k}}$ = (k1,…,kn) $\bar{a}$ = (a1,…,am)



Entities

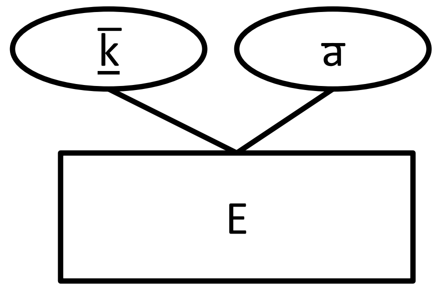


- Translation to a table:

	$\underline{\bar{k}}$			$\bar{a}$		
	<u>k1</u>	…	<u>kn</u>	a1	…	am
t:						

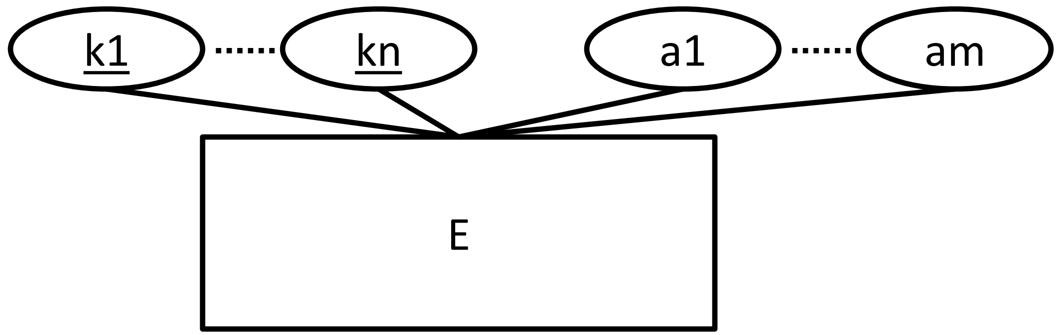
- Constraints:
  - $t_1[\underline{\bar{k}}] = t_2[\underline{\bar{k}}] \Rightarrow t_1[\bar{a}] = t_2[\bar{a}]$

Entities

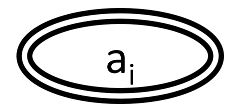


- $\underline{\bar{k}}$, $\bar{a}$ may be empty
- “No Key” – empty $\bar{a}$!
  - Every attribute is a part of the key (underlined)
- What is the meaning of empty $\underline{\bar{k}}$?

Entities

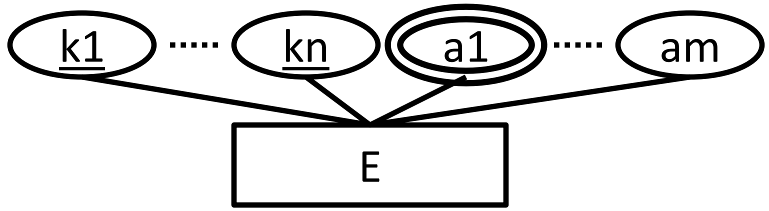


- Any a_i (or k_i) may be <u>multi-valued</u>



- In domain D, for a table row t:
  - for an attribute a_i: $t[a_i] \in D$
  - for a multi-valued attribute a_j: $t[a_j] \in P(D)$
    - a powerset.

Another representation of a multi-valued attribute



- A table without multi-valued attributes:

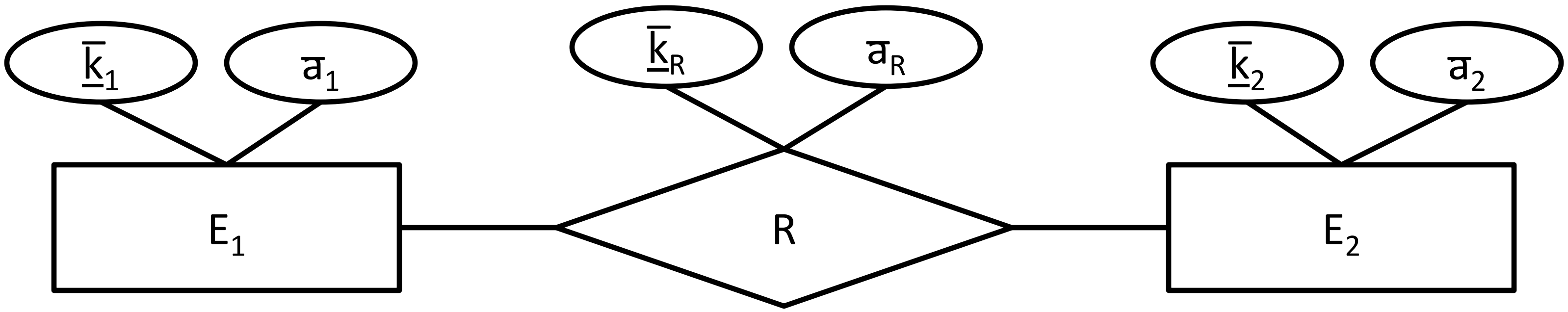
k̄			ā		
<u>k1</u>	…	<u>kn</u>	**a2**	…	am

- Tables - one for each multi-valued attribute:

k̄			**a1**
<u>k1</u>	…	<u>kn</u>	

- Multi-valued attributes cannot be a part of the key

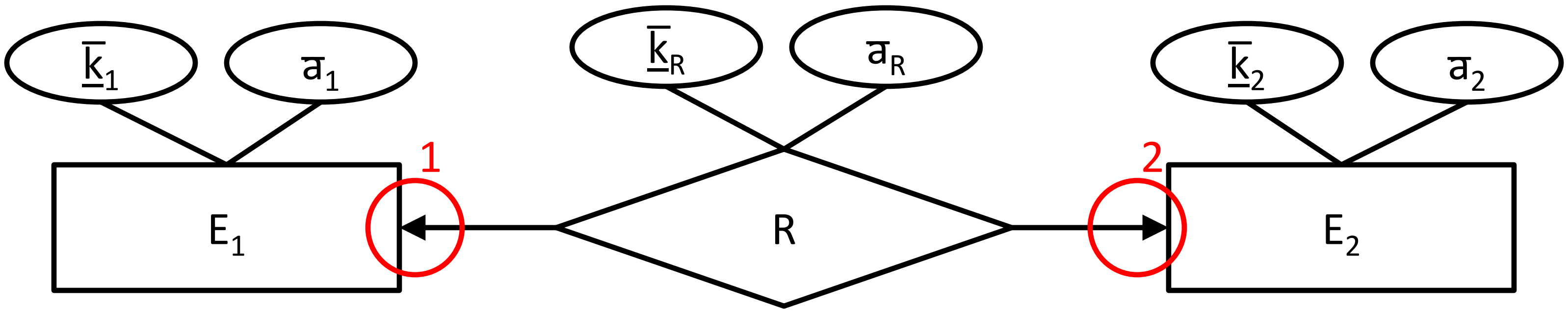
Relationships



- Each $\underline{\bar{k}}$, $\bar{a}$ may be empty
- Translation to a table:

	$\underline{\bar{k}}_1$	$\underline{\bar{k}}_R$	$\bar{a}_R$	$\underline{\bar{k}}_2$
t:				

Relationships



$K_1 := t_1[\bar{\underline{k}}_1]=t_2[\bar{\underline{k}}_1]$

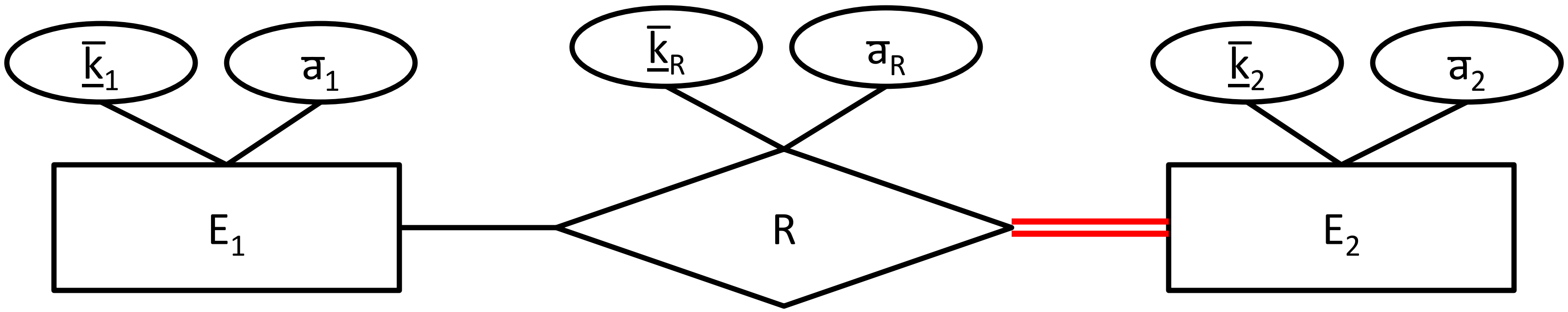
$K_2 := t_1[\bar{\underline{k}}_2]=t_2[\bar{\underline{k}}_2]$

$K_R := t_1[\bar{\underline{k}}_R]=t_2[\bar{\underline{k}}_R]$

$A_R := t_1[\bar{a}_R]=t_2[\bar{a}_R]$

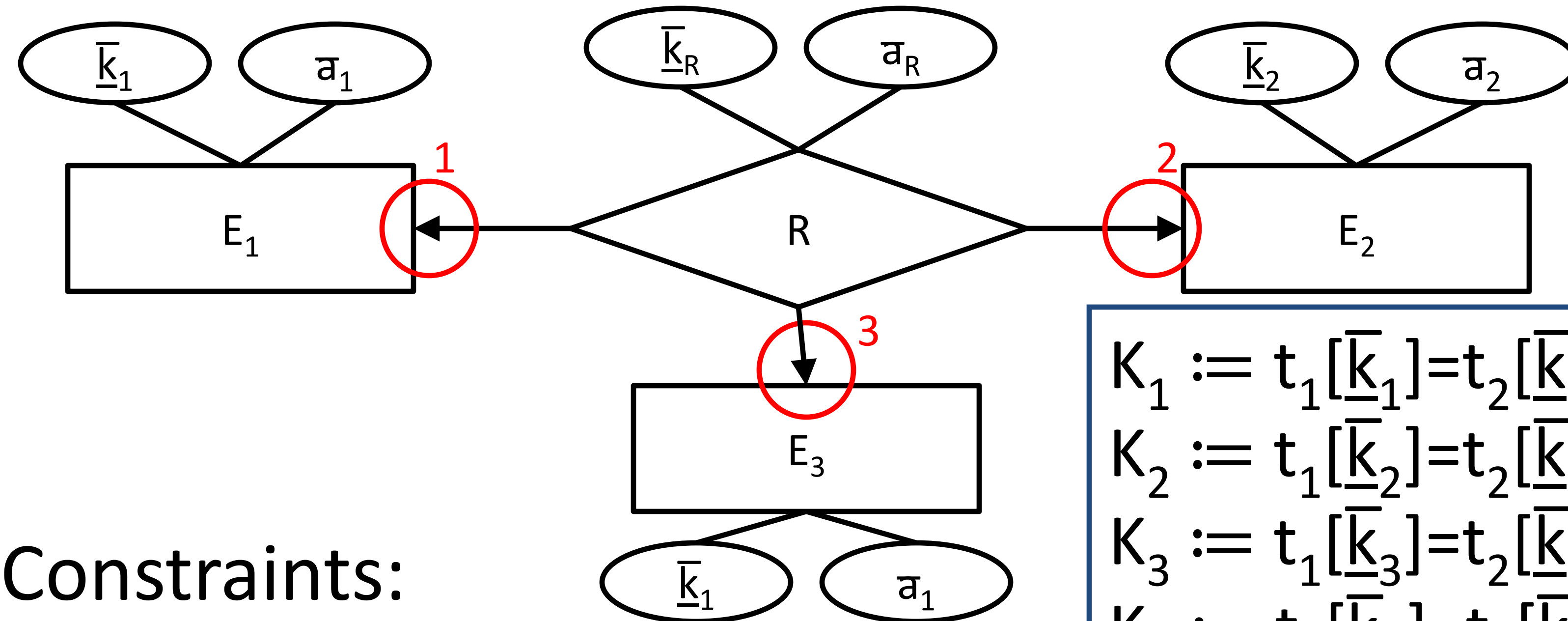
- Constraints:
  - $K_1 \land K_R \rightarrow K_2 \land A_R$ (1)
  - $K_2 \land K_R \rightarrow K_1 \land A_R$ (2)
  - $(K_1 \land K_R \rightarrow K_2 \land A_R) \land (K_2 \land K_R \rightarrow K_1 \land A_R)$ (1+2)

Relationships



- Constraints:
  - $\pi_{k2}(E_2) \subseteq \pi_{k2}(R)$
  - $\pi_{k2}(R) \subseteq \pi_{k2}(E_2)$ (**true** for **any** relationship!)

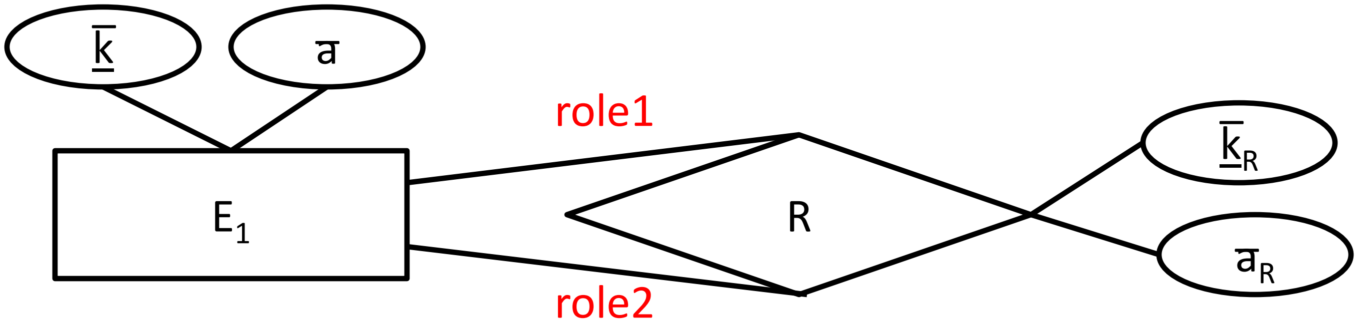
Ternary Relationships



$K_1 := t_1[\underline{\bar{k}}_1]=t_2[\underline{\bar{k}}_1]$
$K_2 := t_1[\underline{\bar{k}}_2]=t_2[\underline{\bar{k}}_2]$
$K_3 := t_1[\underline{\bar{k}}_3]=t_2[\underline{\bar{k}}_3]$
$K_R := t_1[\underline{\bar{k}}_R]=t_2[\underline{\bar{k}}_R]$
$A_R := t_1[\bar{a}_R]=t_2[\bar{a}_R]$

- Constraints:
  - $K_2 \wedge K_3 \wedge K_R \rightarrow K_1 \wedge A_R$ (1)
  - $K_1 \wedge K_3 \wedge K_R \rightarrow K_2 \wedge A_R$ (2)
  - $(K_2 \wedge K_3 \wedge K_R \rightarrow K_1 \wedge A_R) \wedge (K_1 \wedge K_3 \wedge K_R \rightarrow K_2 \wedge A_R)$ (1+2)
  - Each arrow is a layer and several arrows are a conjunction ($\wedge$) of layers

Roles

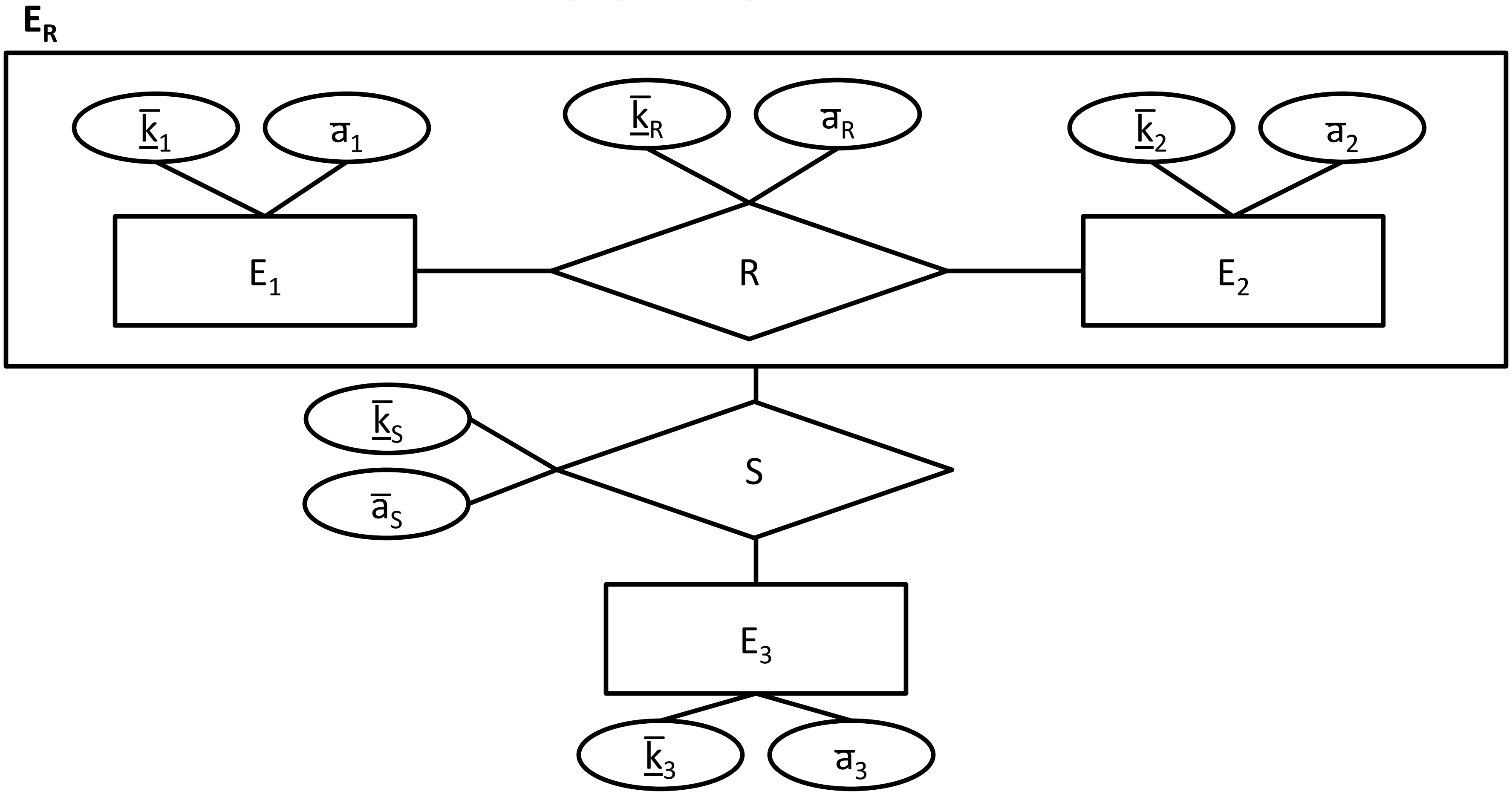


- Translation to a table:

	$\bar{k}$role1	$\bar{k}_R$	$\bar{a}_R$	$\bar{k}$role2
t:				

- Constraints are the same

Aggregations



- Turns the relationship into an entity with attributes of the relationship

Aggregations

E1:

$\underline{\bar{k}}_1$	$\bar{a}_1$

E2:

$\underline{\bar{k}}_1$	$\bar{a}_2$

E3:

$\underline{\bar{k}}_1$	$\bar{a}_3$

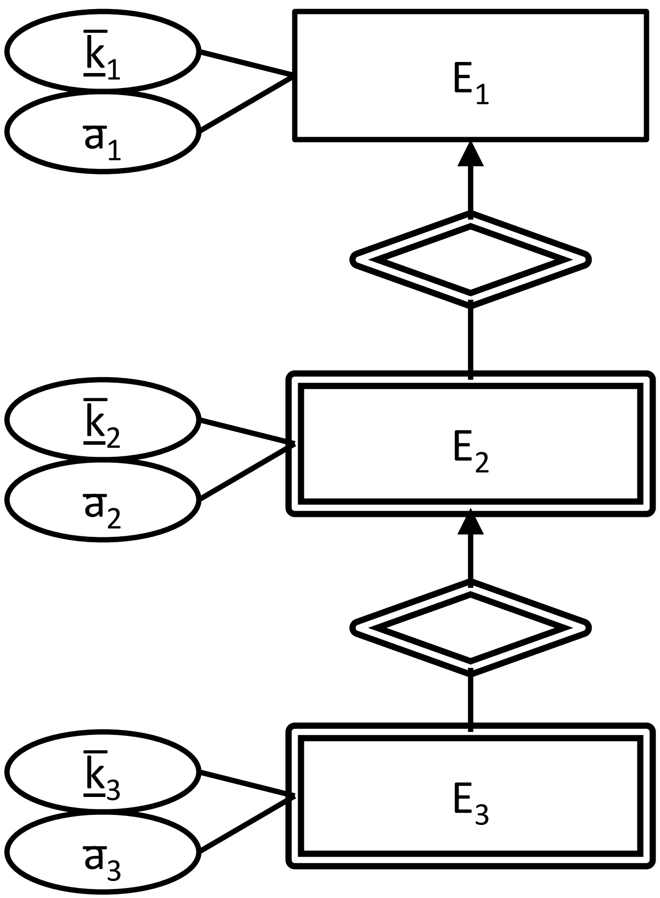
R:

$\underline{\bar{k}}_1$	$\underline{\bar{k}}_2$	$\underline{\bar{k}}_R$	$\bar{a}_R$

S:

$\underline{\bar{k}}_1$	$\underline{\bar{k}}_2$	$\underline{\bar{k}}_3$	$\underline{\bar{k}}_R$	$\underline{\bar{k}}_S$	$\bar{a}_S$

Weak Entities



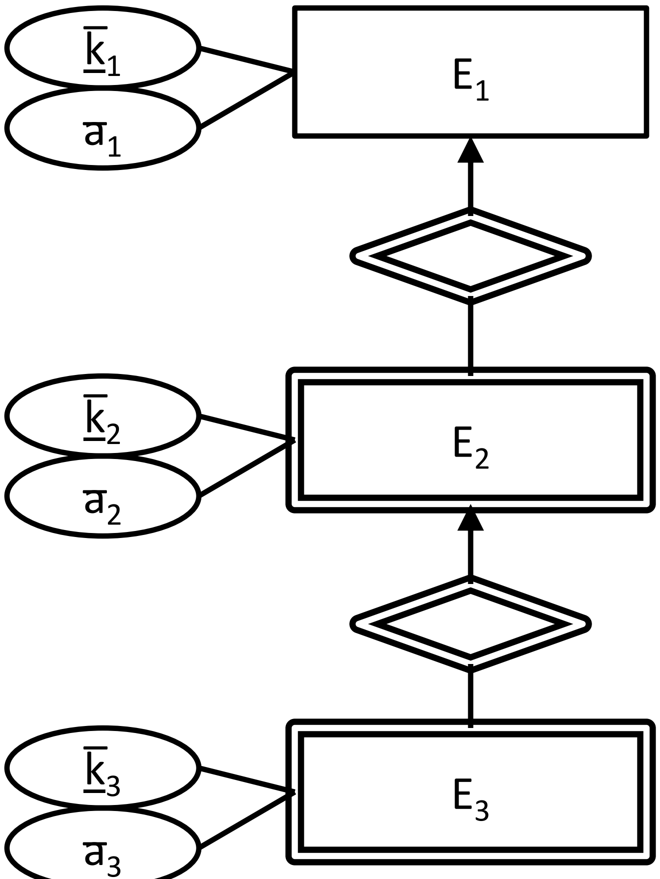
Translation to tables:

$\underline{k_1}$	a_1

$\underline{k_1}$	$\underline{k_2}$	a_2

$\underline{k_1}$	$\underline{k_2}$	$\underline{k_3}$	a_3

Weak Entities



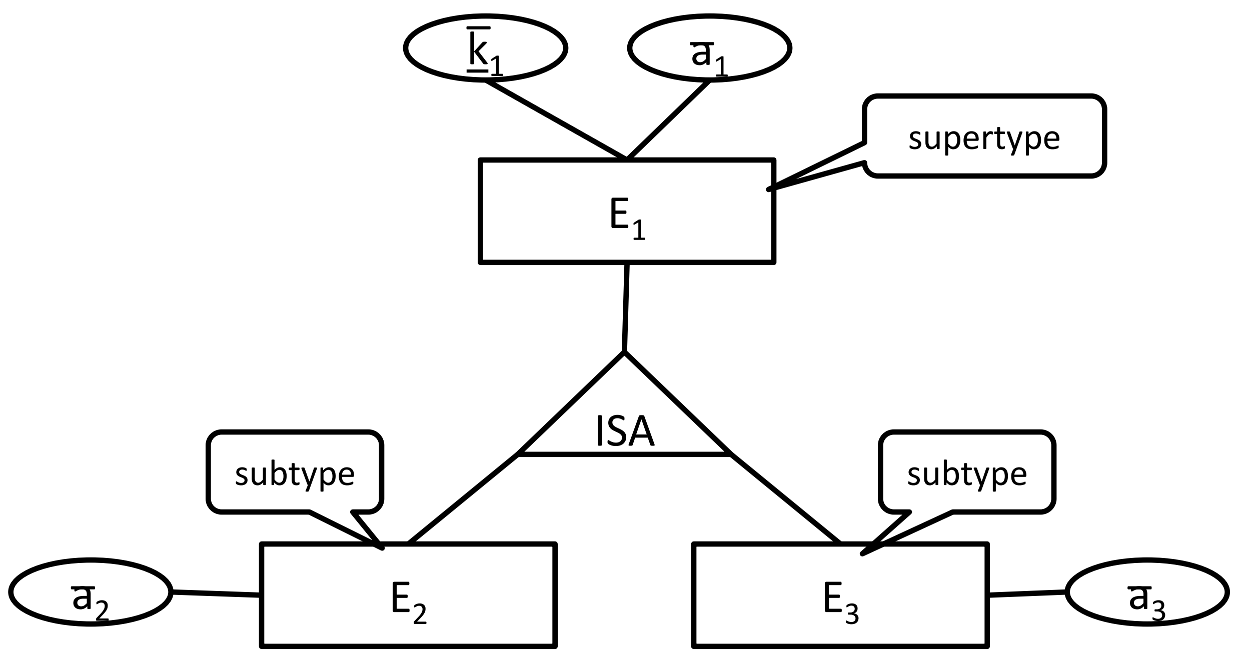
Constraints:

$\pi_{k1}(E_2) \subseteq \pi_{k1}(E_1)$

$\pi_{k1,k2}(E_3) \subseteq \pi_{k1,k2}(E_2)$

ISA

- ISA – a branching weak entity without key components in the subtype.



ISA – Translations and Constraints

E1:

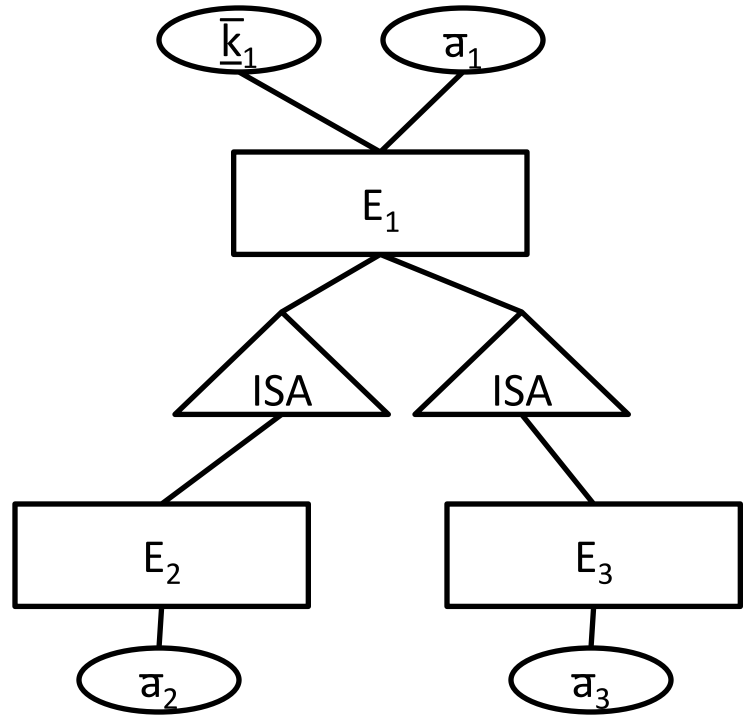
$\underline{\bar{k}}_1$	$\bar{a}_1$

E2:

$\underline{\bar{k}}_1$	$\bar{a}_2$

E3:

$\underline{\bar{k}}_1$	$\bar{a}_3$



Constraints:

$\pi_{k1}(E_3) \subseteq \pi_{k1}(E_1)$

$\pi_{k1}(E_2) \subseteq \pi_{k1}(E_1)$

Exclusive ISA

E_1:

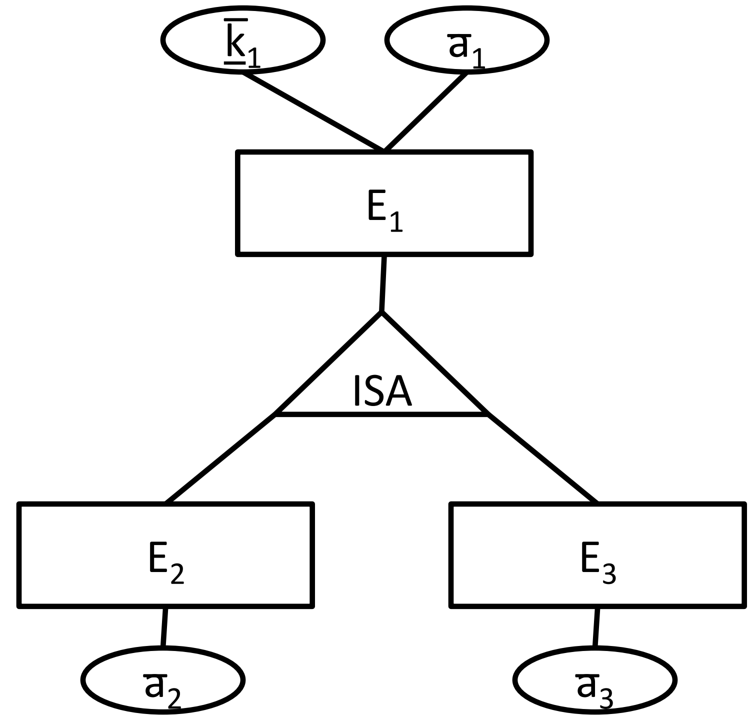
$\underline{k_1}$	a_1

E_2:

$\underline{k_1}$	a_2

E_3:

$\underline{k_1}$	a_3



Constraints:

$\pi_{k1}(E_3) \subseteq \pi_{k1}(E_1)$

$\pi_{k1}(E_2) \subseteq \pi_{k1}(E_1)$

$\boldsymbol{\pi_{k1}(E_2) \cap \pi_{k1}(E_3) = \emptyset}$

Covering All ISA

E1:

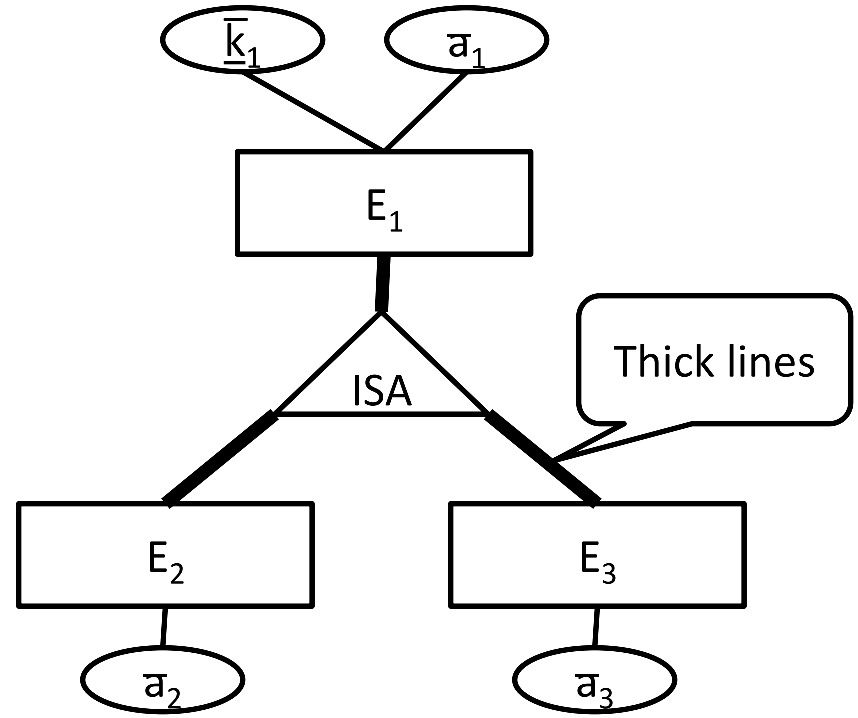
NO Table!

E2:

$\underline{k_1}$	a_1	a_2

E3:

$\underline{k_1}$	a_1	a_3



Constraints:

$$\pi_{k1}(E_2) \cap \pi_{k1}(E_3) = \emptyset$$