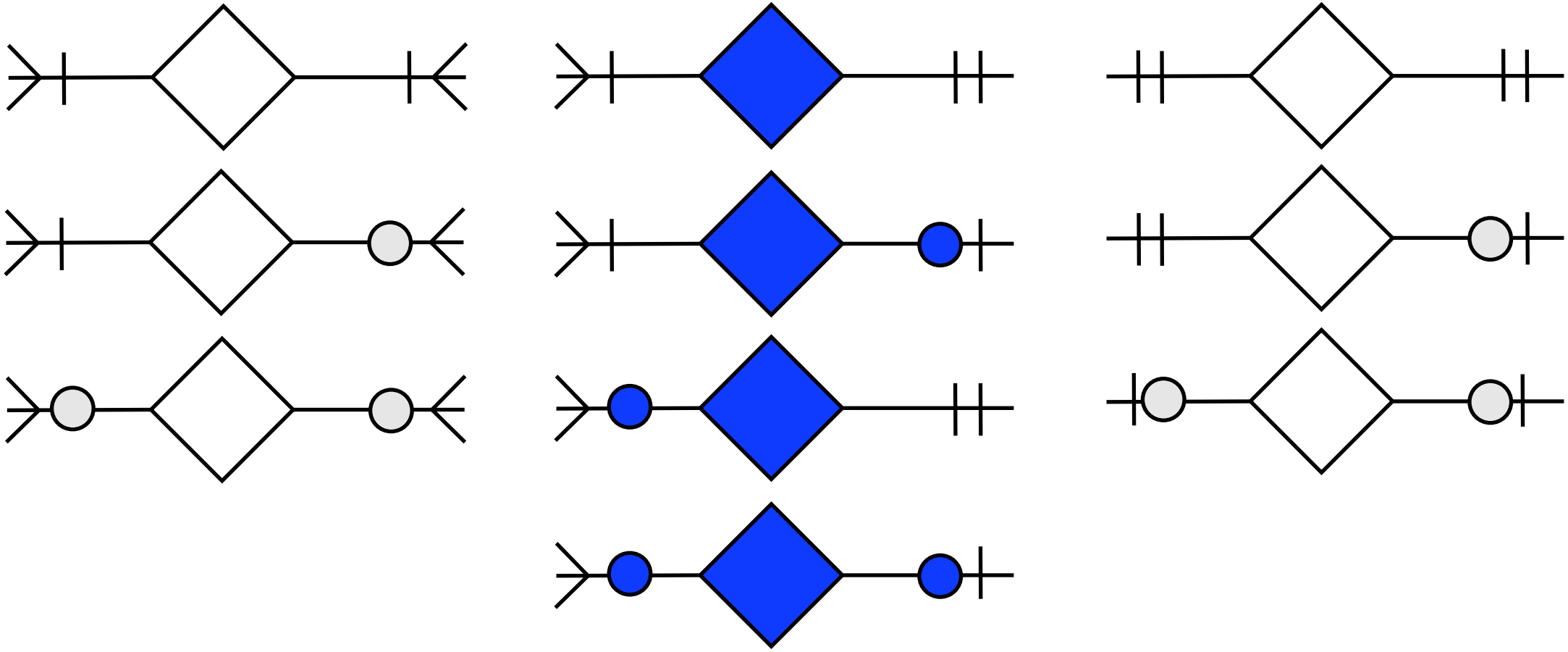
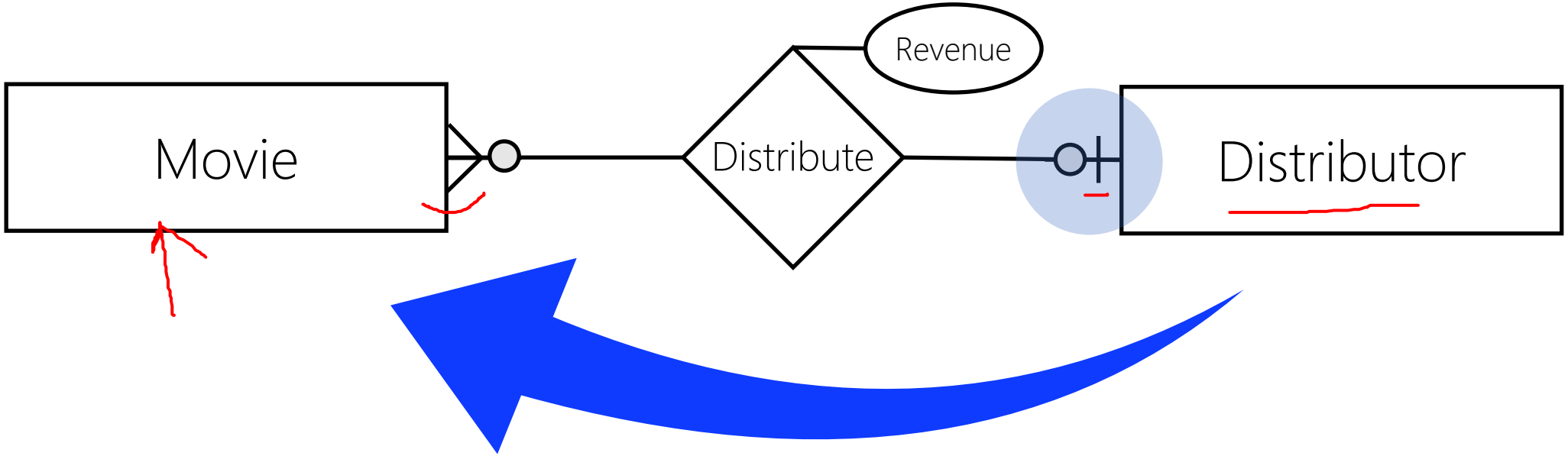
Logical Level | Relational Data Model

Relationship2Relation (R2R)

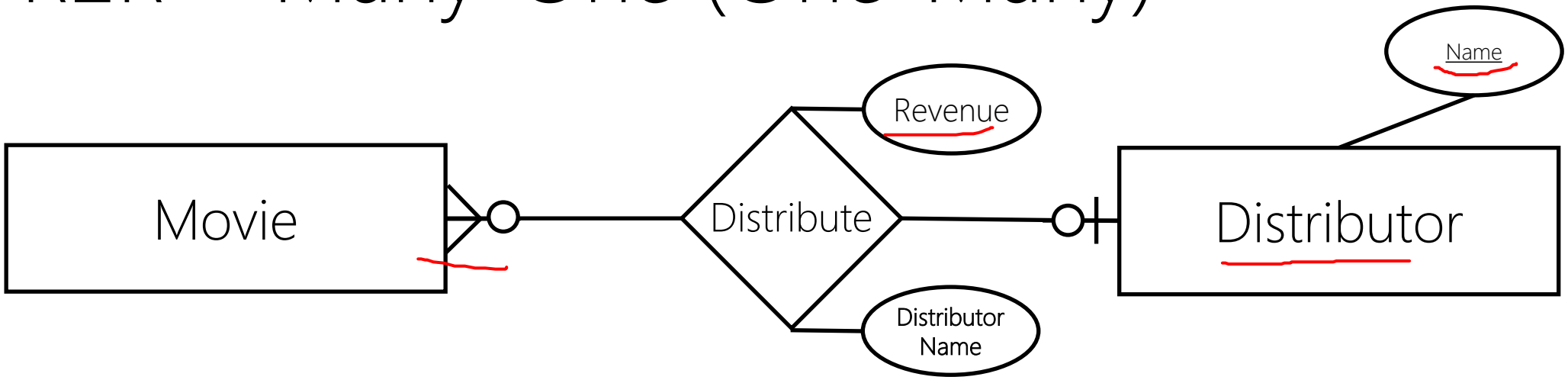


R2R × Many-One (One-Many)



Everything goes to entity set with cardinality one (i.e., many side)
Because it only needs to store one entity from other entity set

R2R × Many-One (One-Many)



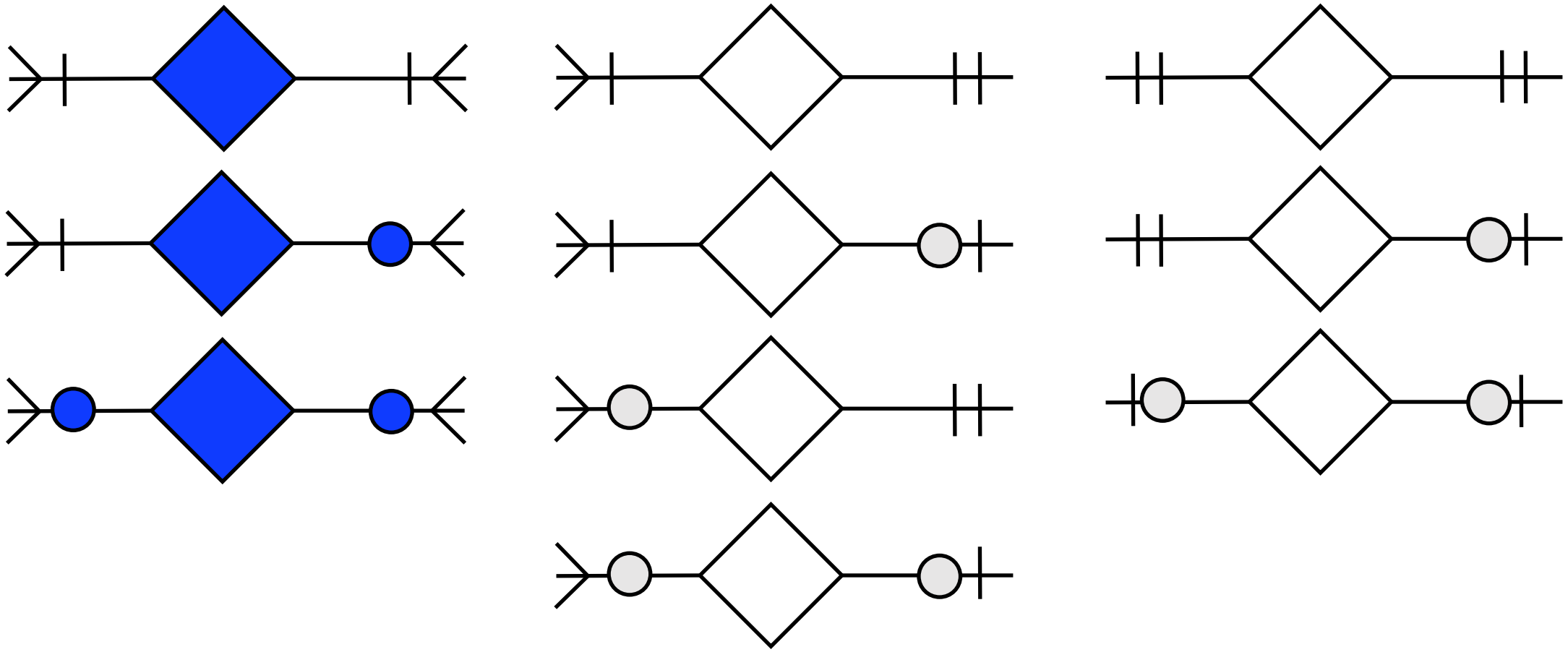
R_1: Distributor(Name, Address, POBox, Website, …)

R_2: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age, …

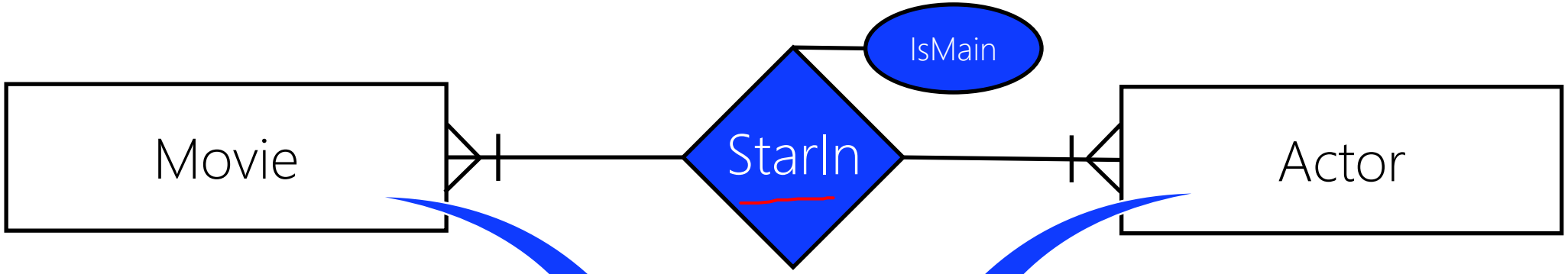
R_2: Movie Distributor.Name, Revenue)

Primary Key (PK) from other relation: Foreign Key (FK)

Relationship2Relation (R2R)

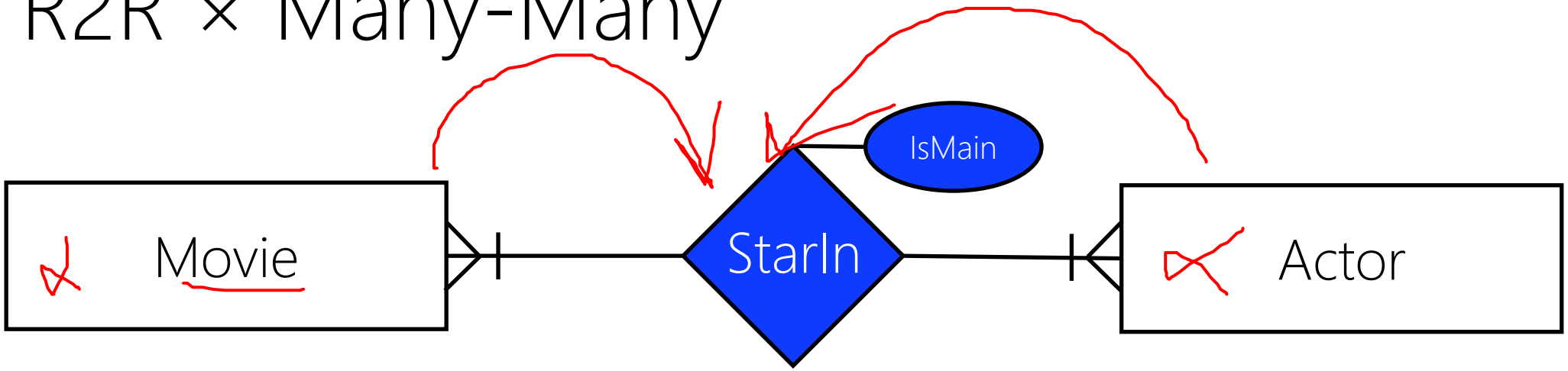


R2R × Many-Many



m_1	$m_1, a_1, 0$	a_1
m_2	$m_1, a_2, 1$	a_2
	$m_1, a_3, 0$	a_3
	$m_2, a_1, 1$	
	$m_2, a_3, 0$	

R2R × Many-Many



R_1: Movie(<u>Title</u>, <u>ReleaseYear</u>, <u>ReleaseMonth</u>, <u>ReleaseDay</u>, RunningTime, Age)

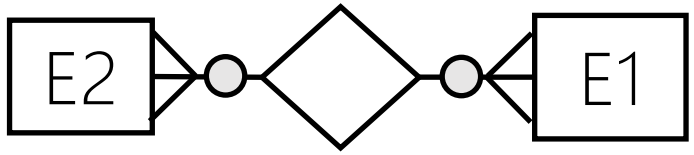
R_2: Actor(<u>FirstName</u>, <u>LastName</u>, <u>DateOfBirth</u>, PlaceOfBirth, Age)

R_3: StarIn(Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay, Actor.FirstName, Actor.LastName, Actor.DateOfBirth, IsMain)

FK_1

FK_2

R2R × Many-Many

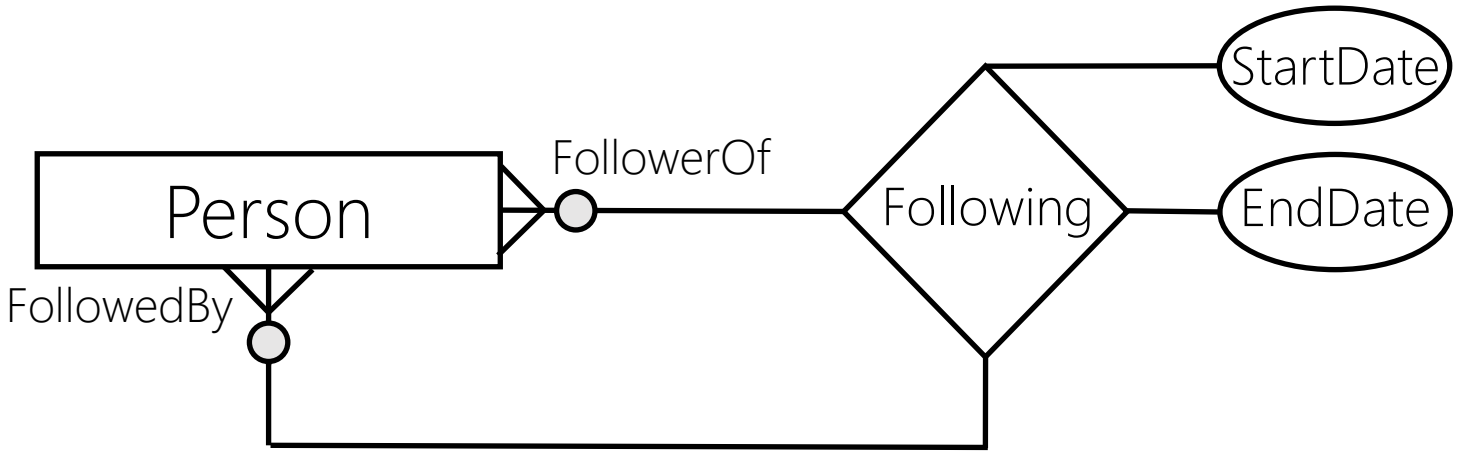


Input: Many-Many relationship btw. E2 and E1, i.e.,
Output: Relations R1 for E1, R2 for E2, and R3 for relationship.

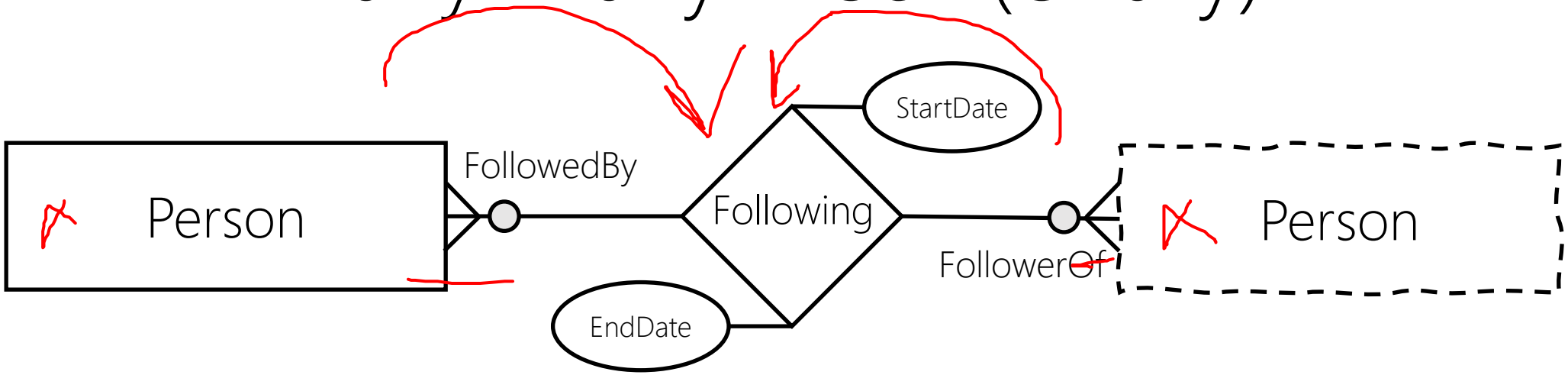
1) For E1, create relation R1 with the same attributes and keys as in E1
2) For E2, create relation R2 with the same attributes and keys as in E2
3) For many-many relationship set, create new relation R3
4) [Foreign Key Set FK_1] Add key set of E1 to R3
5) [Foreign Key Set FK_2] Add key set of E2 to R3
6) Add attributes of relationship set to R3
7) [Primary Key Set] Create key set for R3 from foreign key sets (step 4 & 5)
   $PK = FK_1 \cup FK_2$

Herein, we do not care about ordinality! We fix it later.

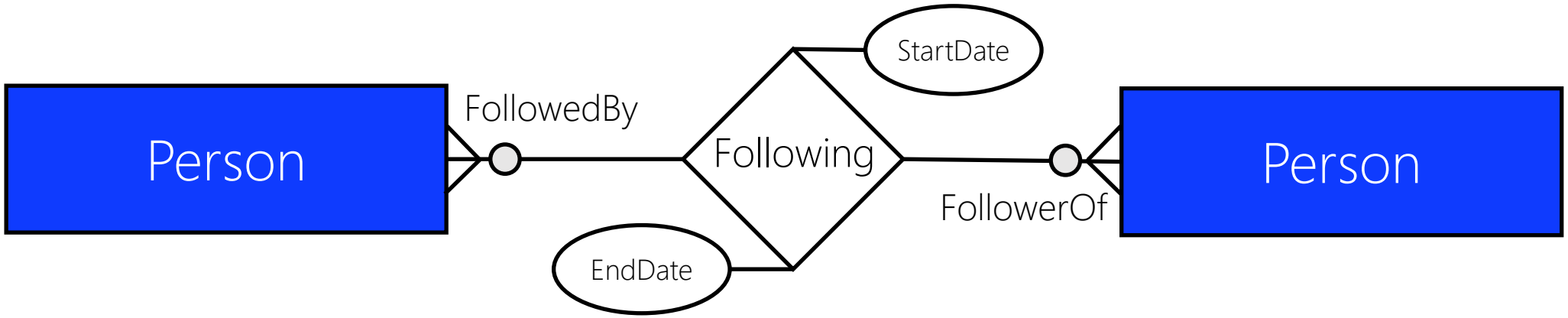
R2R × Many-Many × Self (Unary)



R2R × Many-Many × Self (Unary)

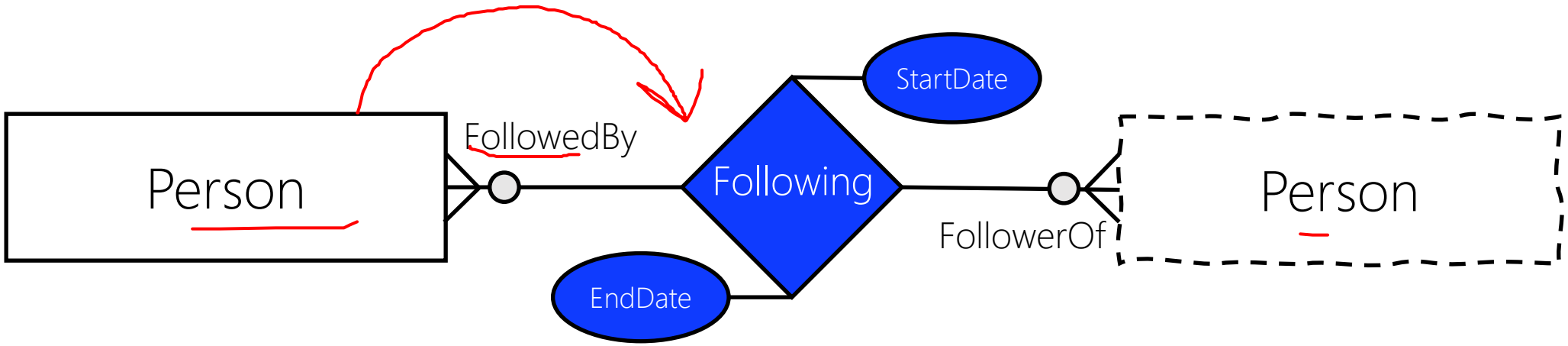


R2R × Many-Many × Self (Unary)



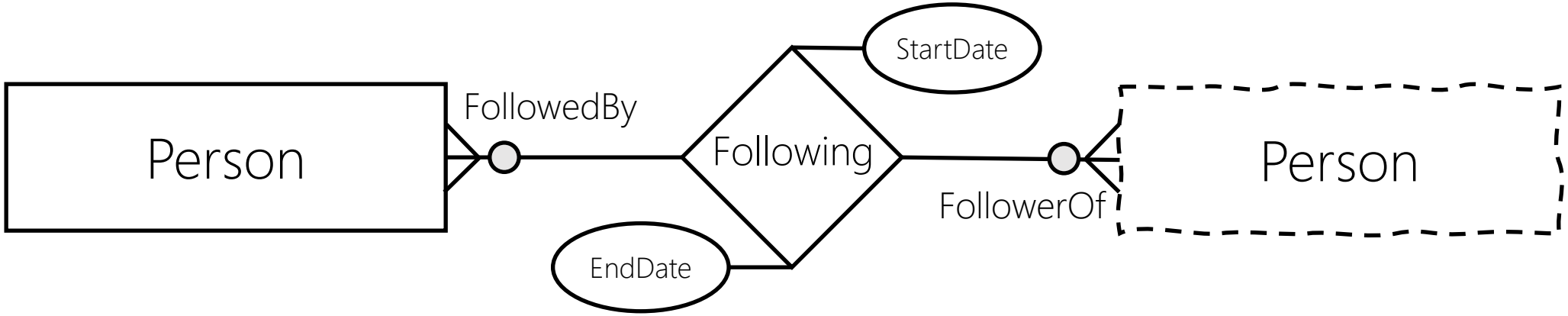
R_1: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
~~R_2: Person(~~FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)

R2R × Many-Many × Self (Unary)



R_1: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
R_2: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
R_3: Followership(FirstName, LastName, DateOfBirth, PlaceOfBirth, FK1
FirstName, LastName, DateOfBirth, PlaceOfBirth, FK2
StartDate, EndDate)

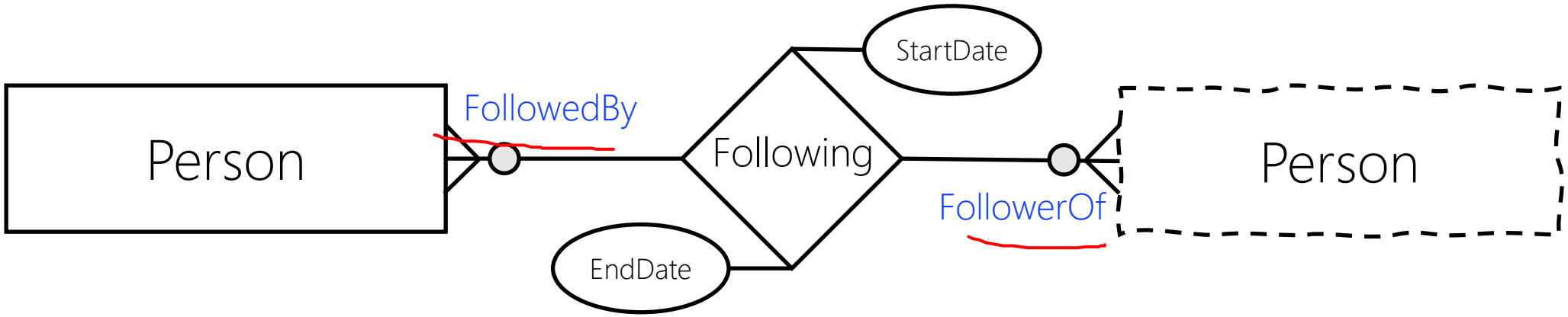
R2R × Many-Many × Self (Unary)



R_1: Person(<u>FirstName</u>, <u>LastName</u>, <u>DateOfBirth</u>, <u>PlaceOfBirth</u>, Age, ...)
R_2: Person(<u>FirstName</u>, <u>LastName</u>, <u>DateOfBirth</u>, <u>PlaceOfBirth</u>, Age, ...)
R_3: Followership(<u>FirstName</u>, <u>LastName</u>, <u>DateOfBirth</u>, <u>PlaceOfBirth</u>,
<u>FirstName</u>, <u>LastName</u>, <u>DateOfBirth</u>, <u>PlaceOfBirth</u>,
StartDate, EndDate)

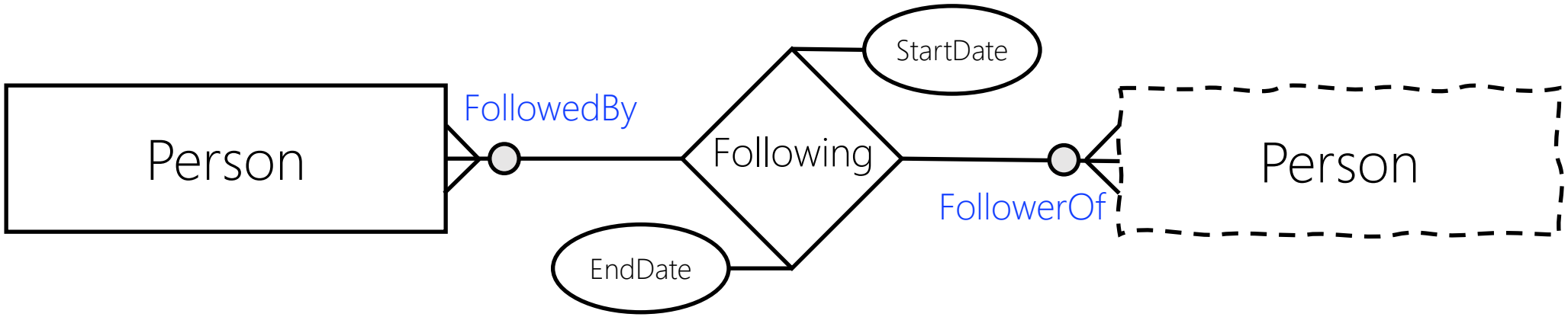
Naming conflict!

R2R × Many-Many × Self (Unary)



R_1: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
R_2: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
R_3: Followership(FollowerFirstName, FollowerLastName, FollowerDateOfBirth, FollowerPlaceOfBirth,
FollowedFirstName, FollowedLastName, FollowedDateOfBirth, FollowedPlaceOfBirth,
StartDate, EndDate)

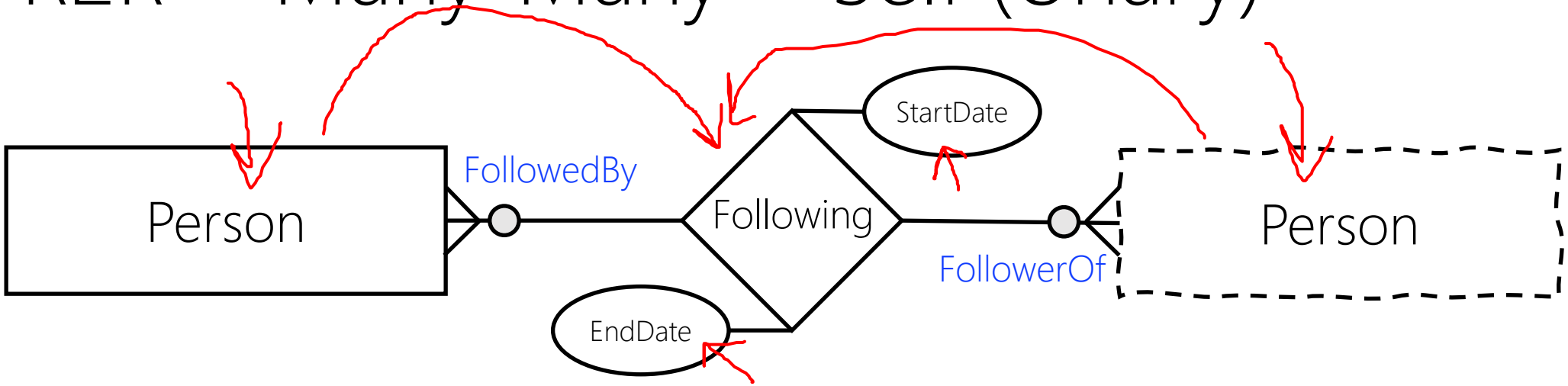
R2R × Many-Many × Self (Unary)



R_1: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
R_2: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
R_3: Followership(FollowerFirstName, FollowerLastName, FollowerDateOfBirth, FollowerPlaceOfBirth, FollowedFirstName, FollowedLastName, FollowedDateOfBirth, FollowedPlaceOfBirth, StartDate, EndDate)

PK??

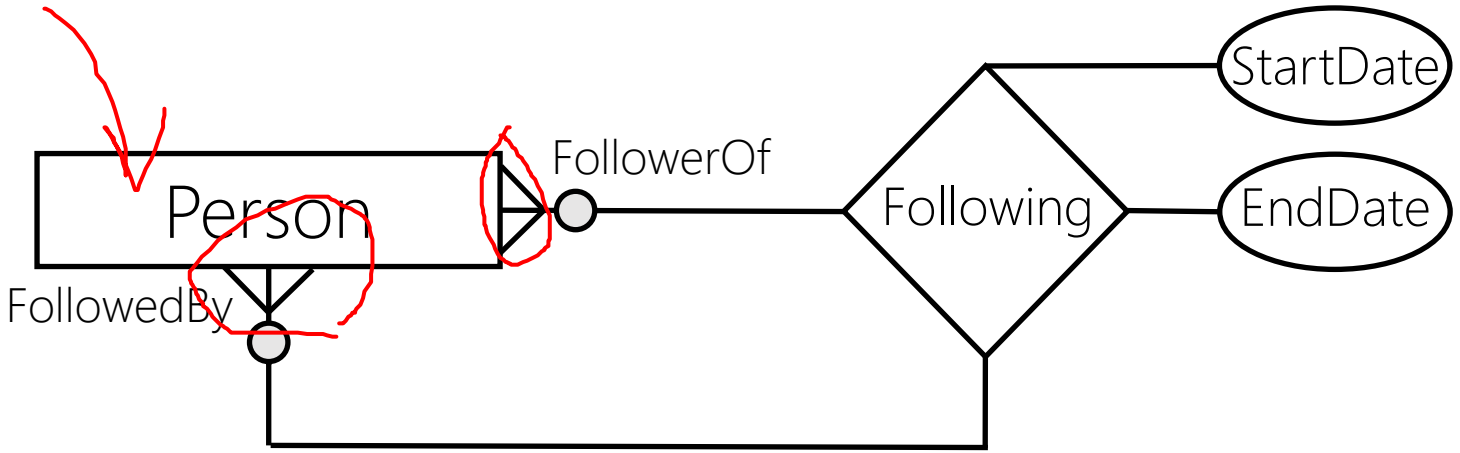
R2R × Many-Many × Self (Unary)



R_1: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
R_2: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)
R_3: Followership(FollowerFirstName, FollowerLastName, FollowerDateOfBirth, FollowerPlaceOfBirth, FollowedFirstName, FollowedLastName, FollowedDateOfBirth, FollowedPlaceOfBirth, StartDate, EndDate)

Should we include StartDate?

R2R × Many-Many × Self (Unary)



R_1: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)

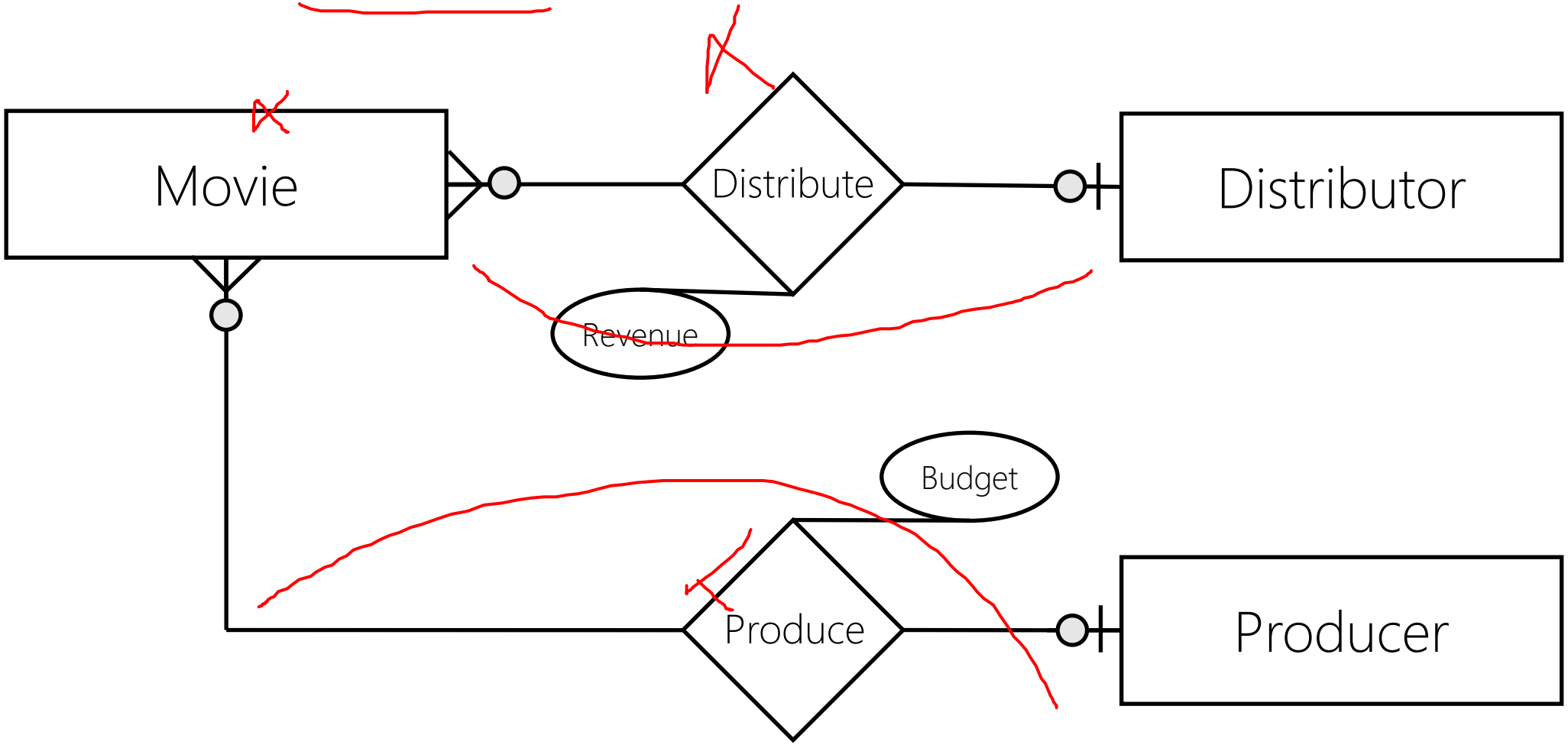
~~R_2: Person(FirstName, LastName, DateOfBirth, PlaceOfBirth, Age, ...)~~

R_2: Followership(FollowerName, FollowerName, FollowerDateOfBirth, FollowerPlaceOfBirth, FollowedFirstName, FollowedLastName, FollowedDateOfBirth, FollowedPlaceOfBirth, StartDate, EndDate)

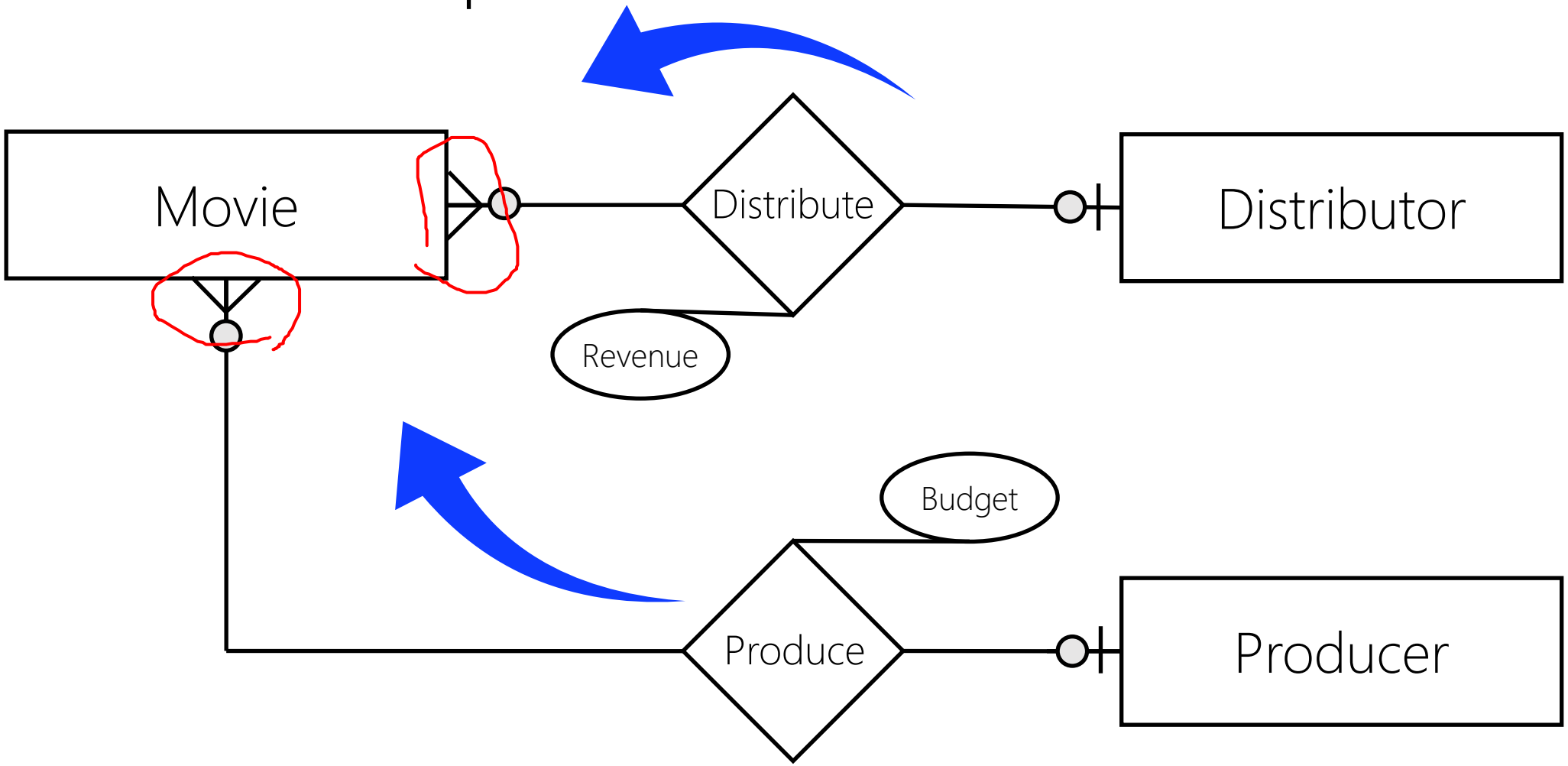
FK1={FollowerName, FollowerName, FollowerDateOfBirth, FollowerPlaceOfBirth}

FK2={FollowedFirstName, FollowedLastName, FollowedDateOfBirth, FollowedPlaceOfBirth}

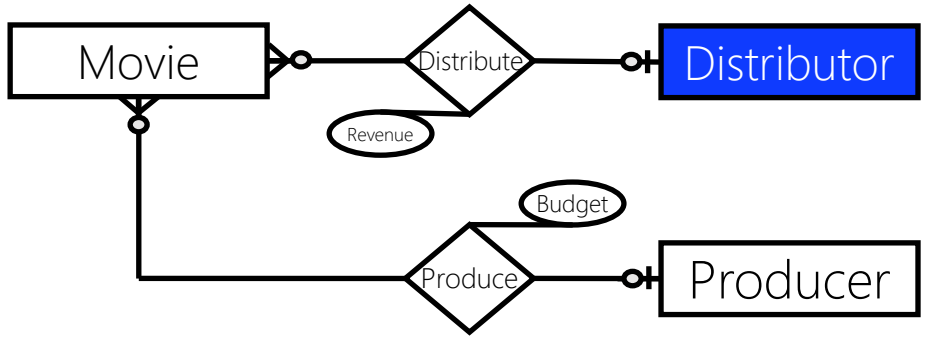
R2R × Multiple



R2R × Multiple

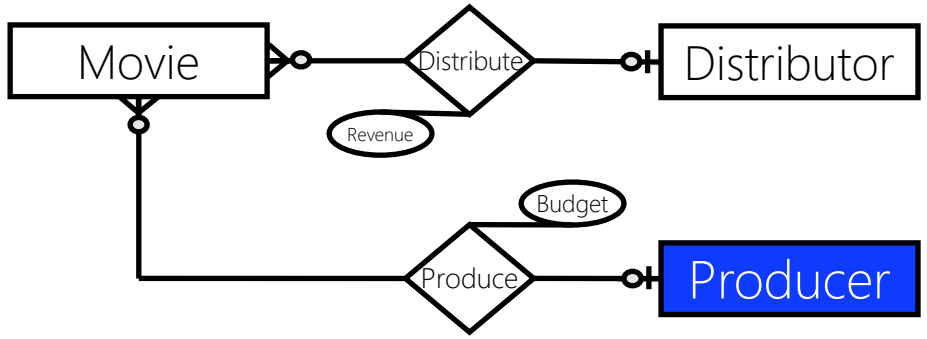


R2R × Multiple



R_1: Distributor(<u>Name</u>, Address, Phone, ...)

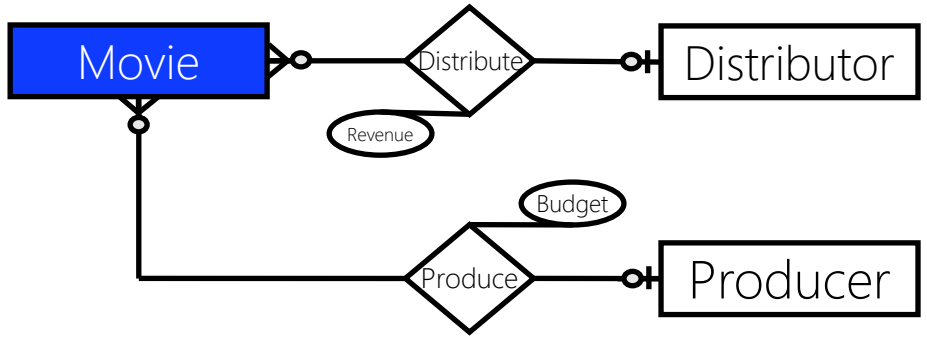
R2R × Multiple



R_1: Distributor(<u>Name</u>, Address, Phone, ...)

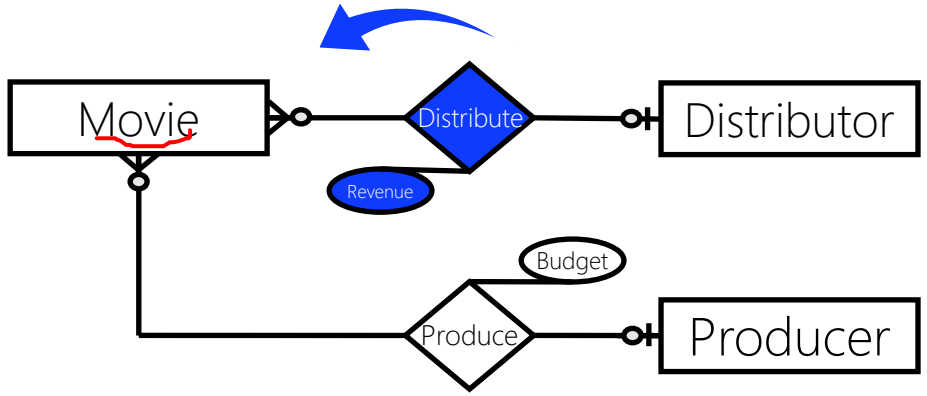
R_2: Producer(<u>Name</u>, Studio, Address, Phone, ...)

R2R × Multiple



R_1: Distributor(Name, Address, Phone, …)
R_2: Producer(Name, Studio, Address, Phone, …)
R_3: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime)

R2R × Multiple



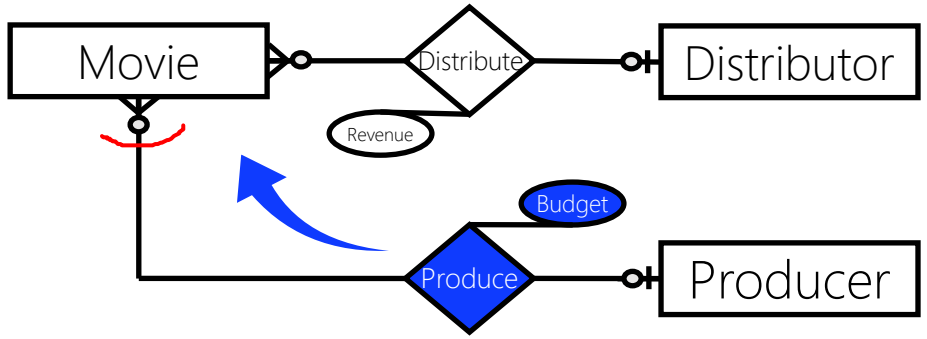
R_1: Distributor(Name, Address, Phone, …)

R_2: Producer(Name, Studio, Address, Phone, …)

R_3: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Distributor.Name, Revenue)

FK_1

R2R × Multiple



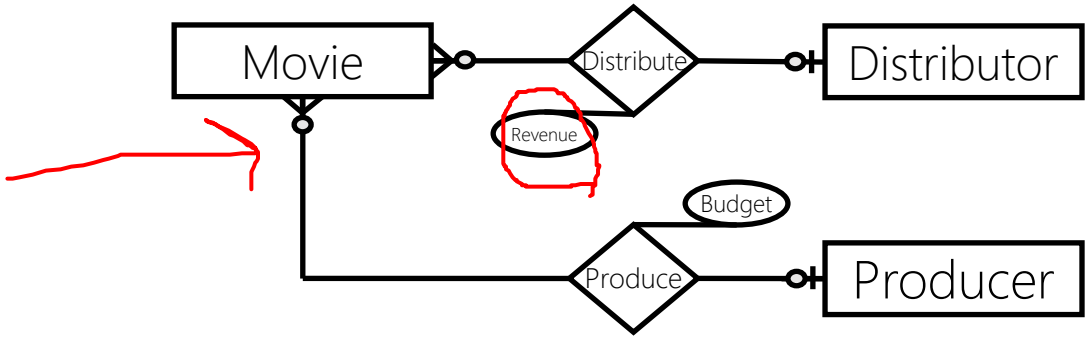
R_1: Distributor(Name, Address, Phone, …)

R_2: Producer(Name, Studio, Address, Phone, …)

R_3: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, DistributorName, Revenue Producer.Name, Budget)

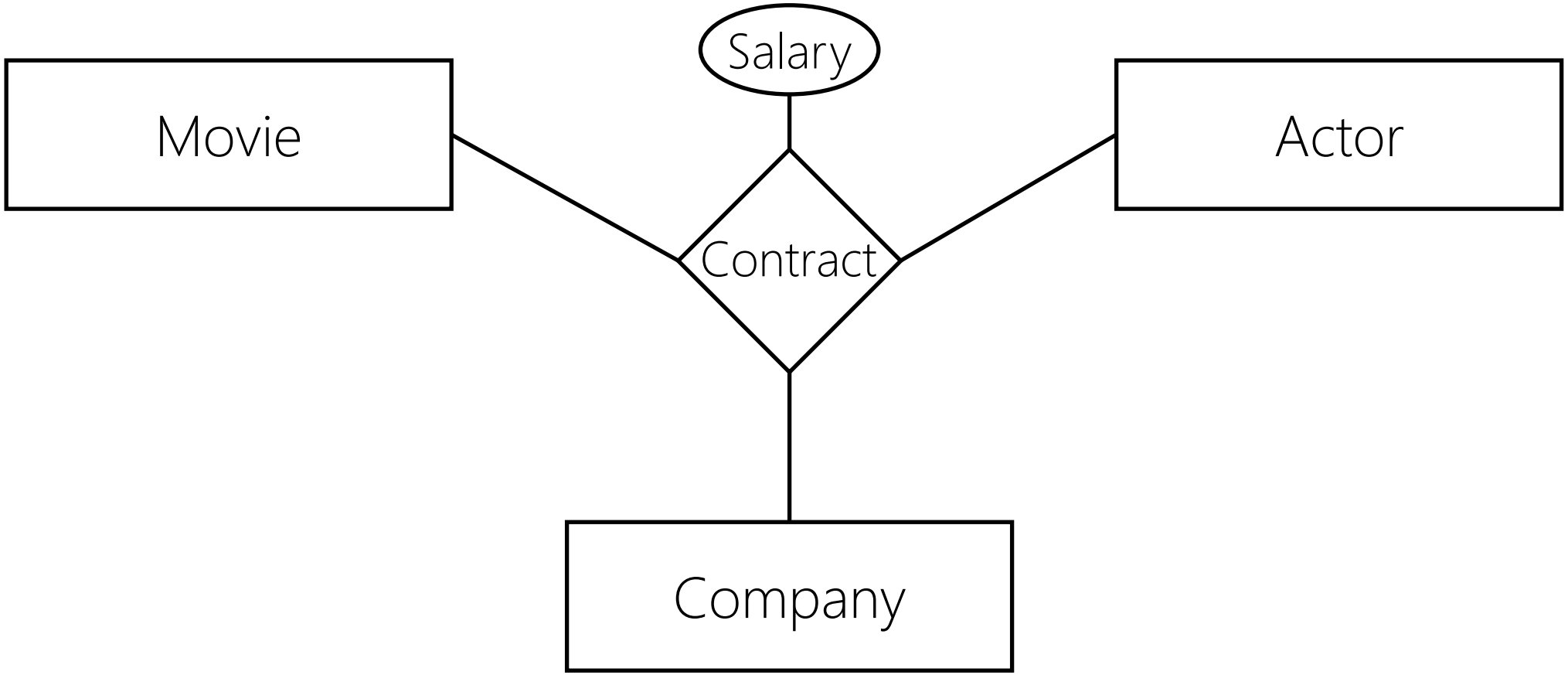
FK_2

R2R × Multiple

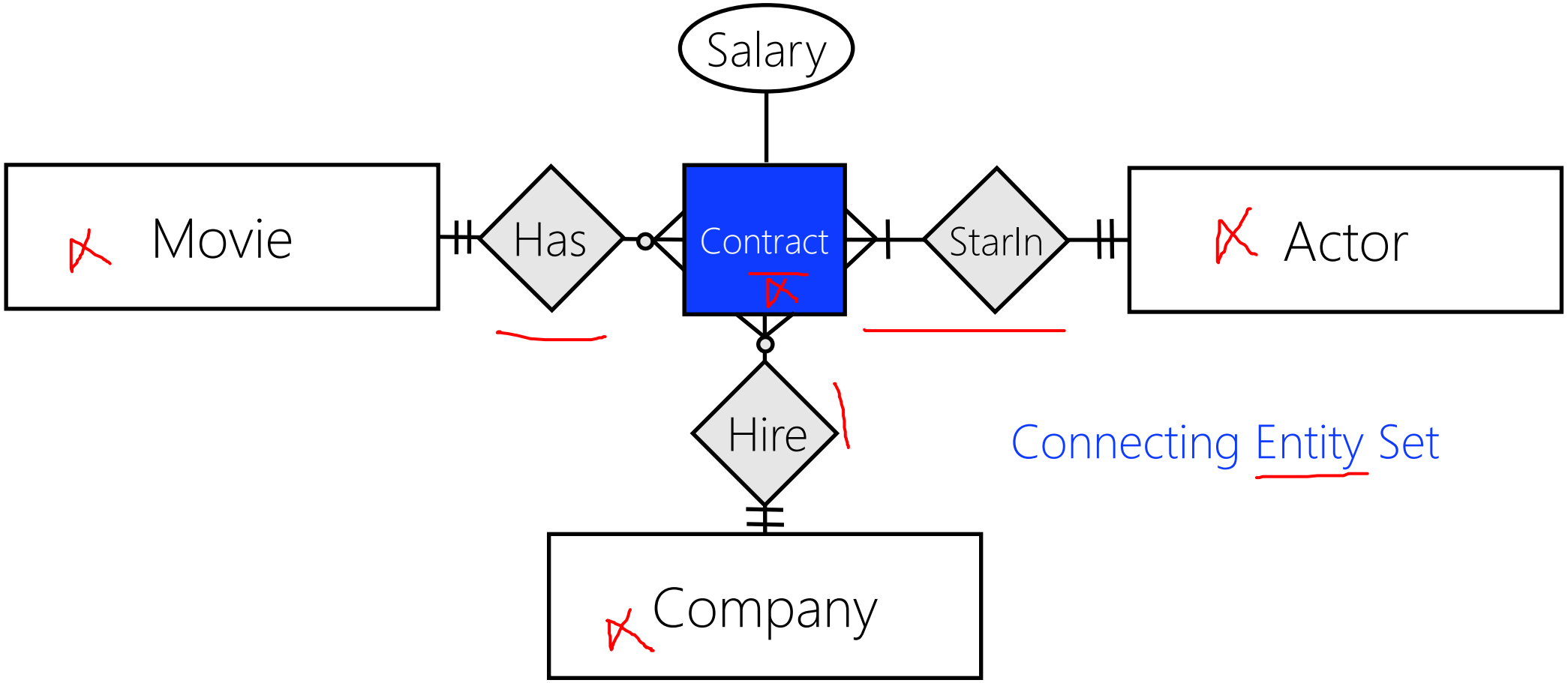


R_1: Distributor(<u>Name</u>, Address, Phone, …)
R_2: Producer(<u>Name</u>, Studio, Address, Phone, …)
R_3: Movie(<u>Title</u>, <u>ReleaseYear</u>, <u>ReleaseMonth</u>, <u>ReleaseDay</u>, RunningTime, Distributor.Name, Revenue, Producer.Name, Budget)
FK1={Distributor.Name} optional, FK2={Producer.Name} optional

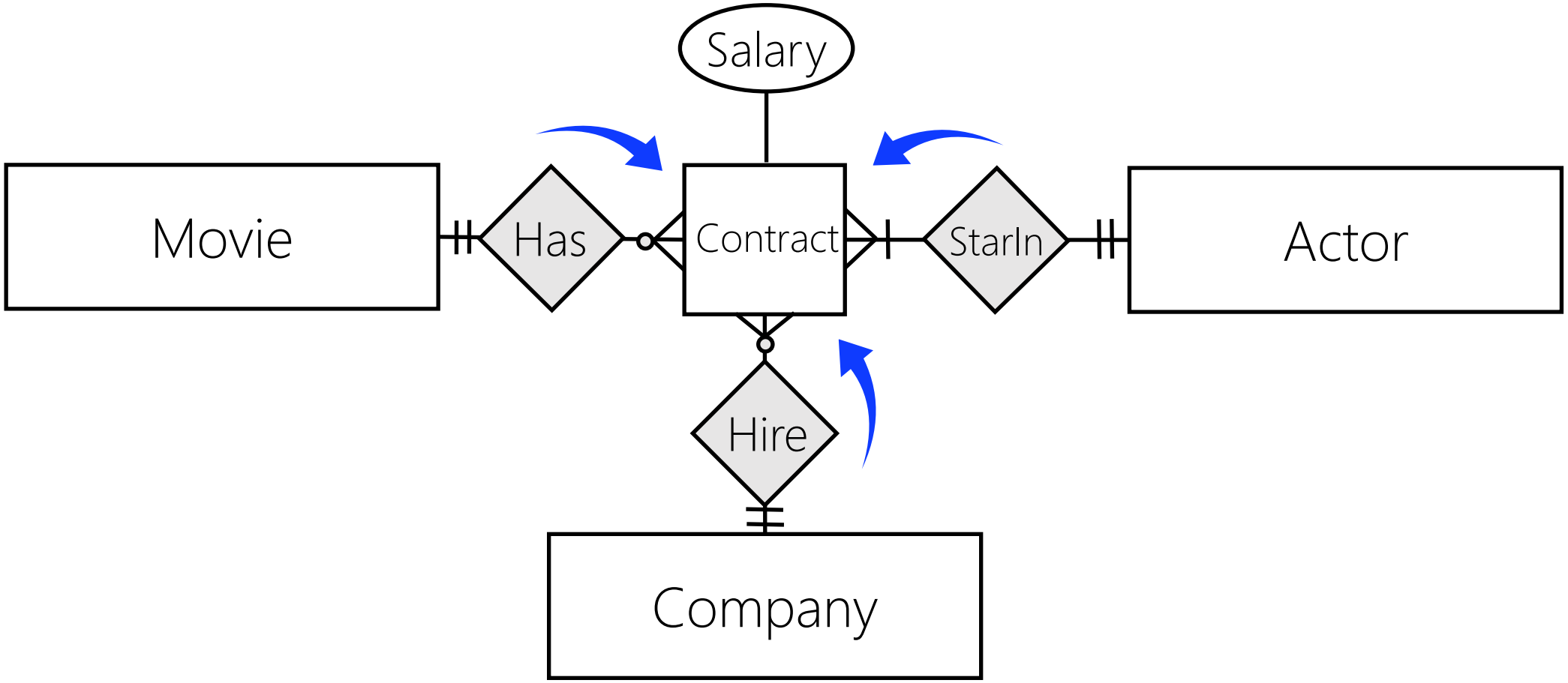
R2R × Ternary



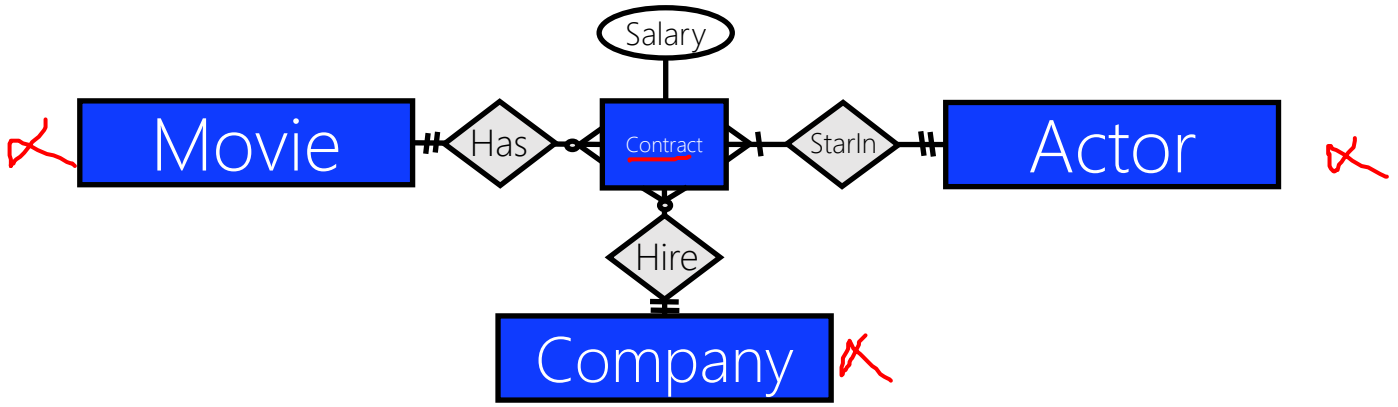
R2R × Ternary-2-Binary



R2R × Ternary-2-Binary

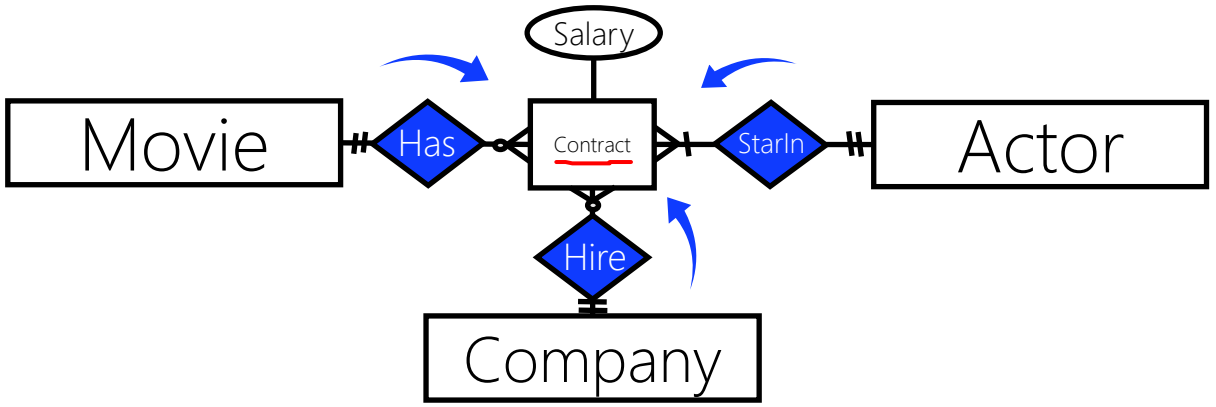


R2R × Ternary-2-Binary



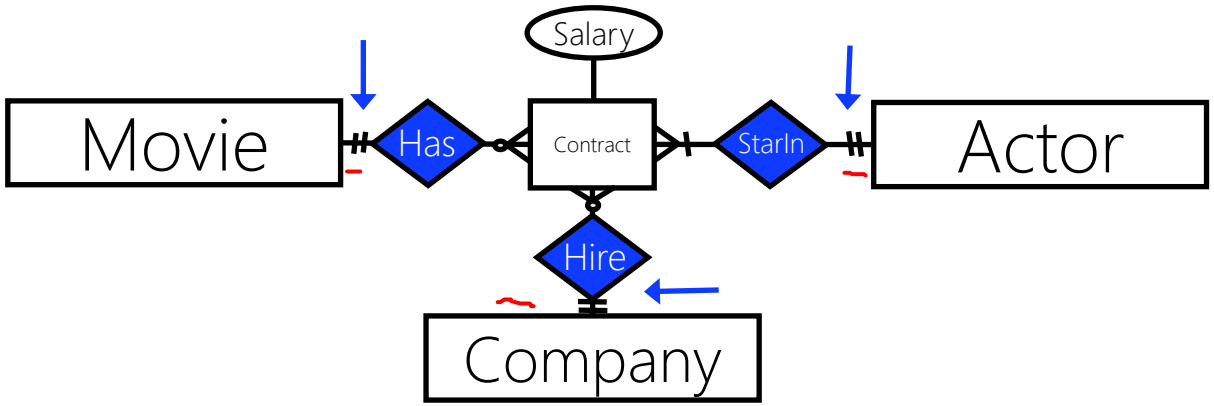
R_1: Company(Name, Address, Phone, ...)
R_2: Actor(FirstName, LastName, DateOfBirth, PlaceOfBirth, ...)
R_3: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime)
R_4: Contract(Salary)

R2R × Ternary-2-Binary



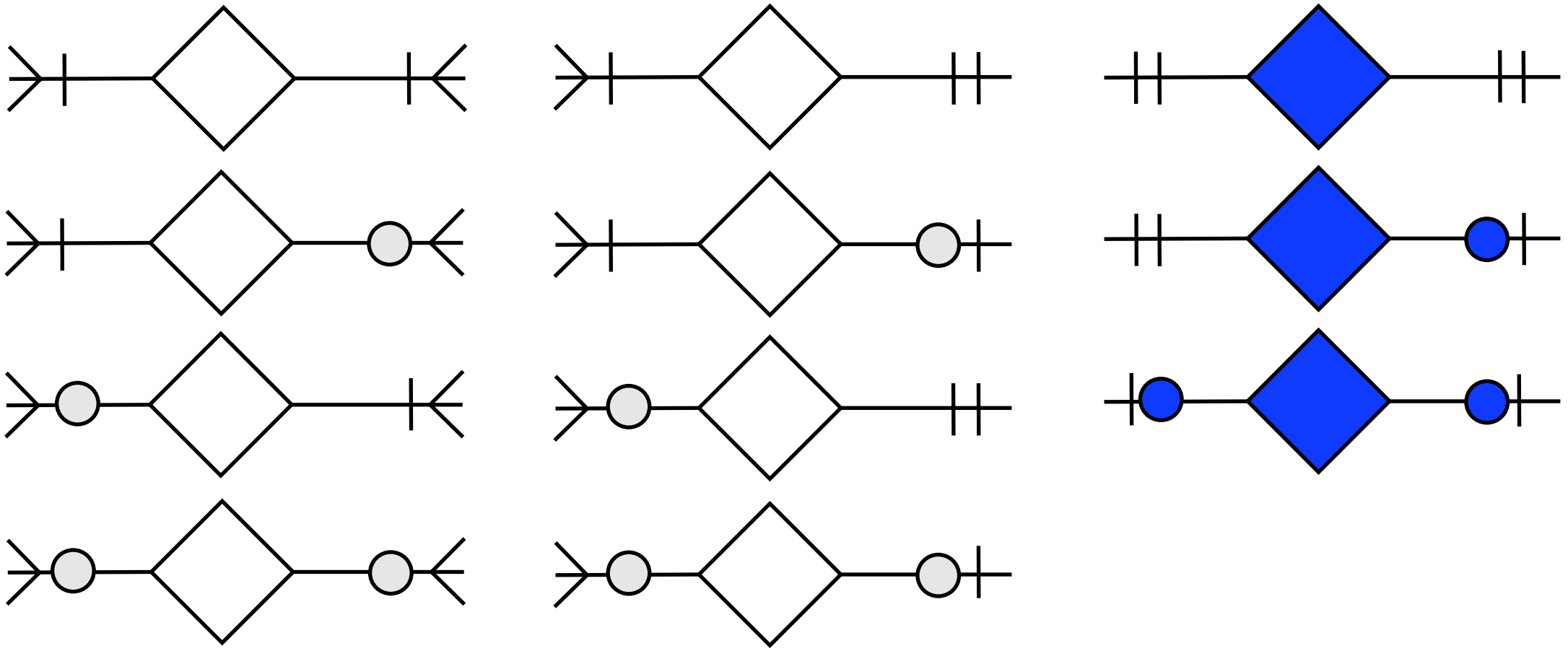
R_1: Company(Name, Address, Phone, ...)
R_2: Actor(FirstName, LastName, DateOfBirth, PlaceOfBirth, ...)
R_3: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime)
R_4: Contract(Salary,
Company.Name, FK_1
Actor.FirstName, Actor.LastName, Actor.DateOfBirth, FK_2
Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay) FK_3

R2R × Ternary-2-Binary

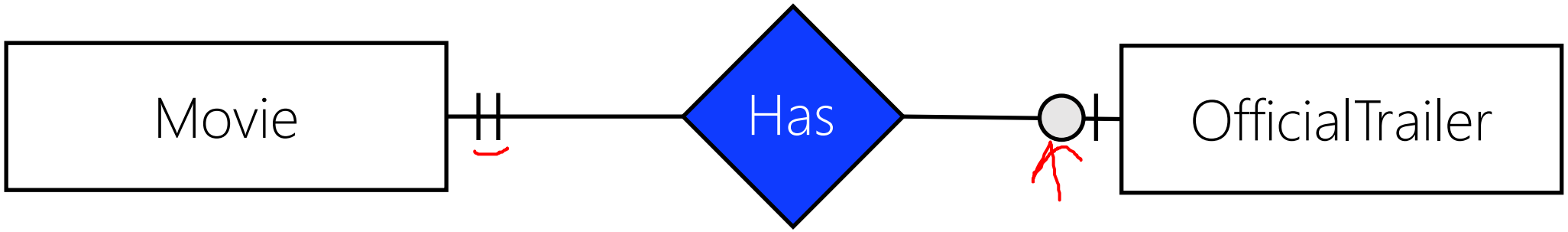


R_1: Company(Name, Address, Phone, ...)
R_2: Actor(FirstName, LastName, DateOfBirth, PlaceOfBirth, ...)
R_3: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime)
R_4: Contract(Salary,
Company.Name, FK_1 Mandatory
Actor.FirstName, Actor.LastName, Actor.DateOfBirth, FK_2 Mandatory
Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay) FK_3 Mandatory

Relationship2Relation (R2R)

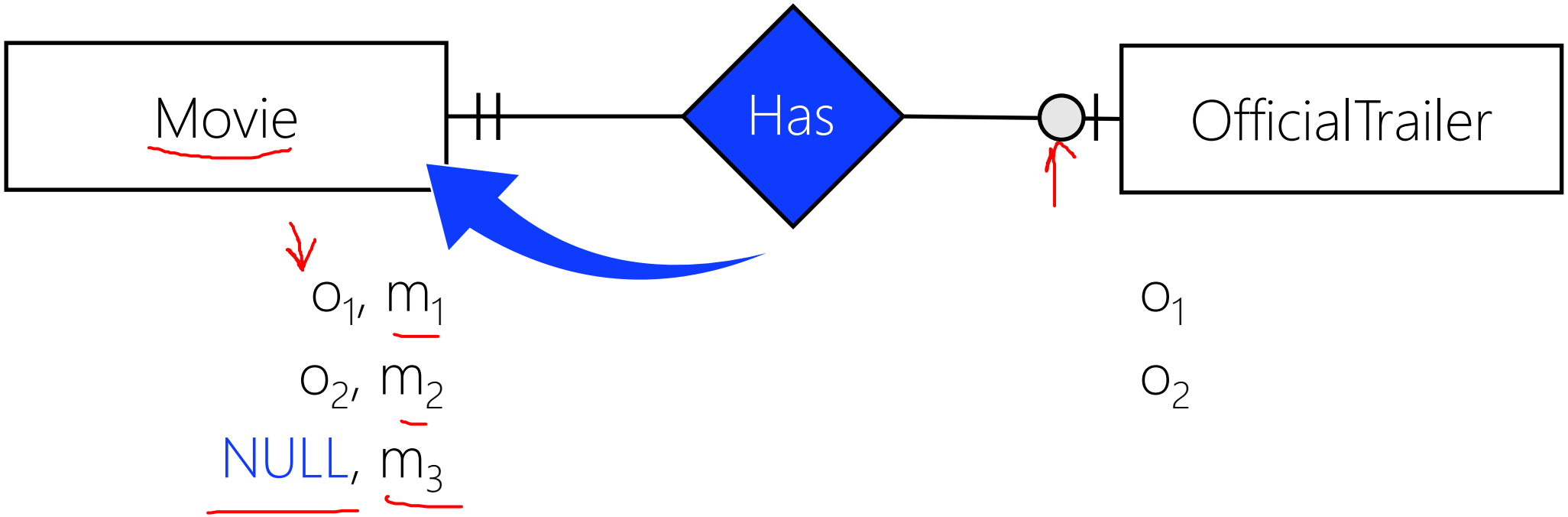


R2R × One-One

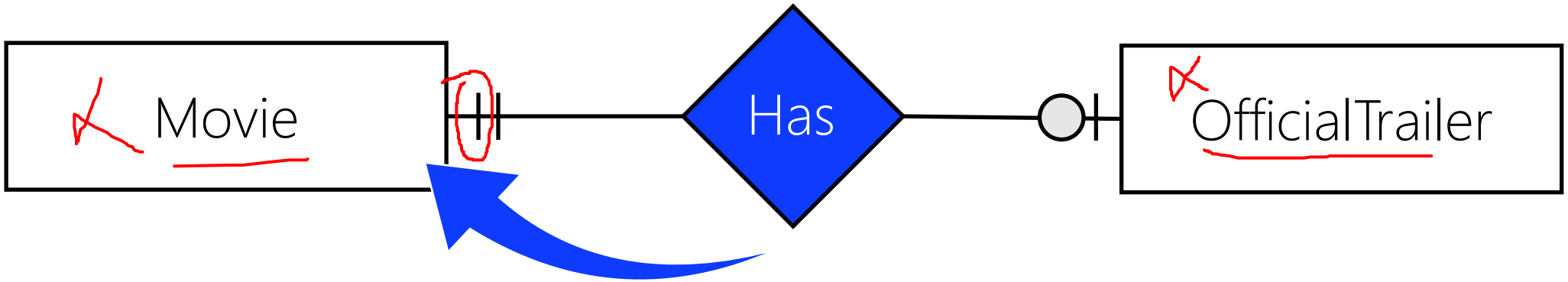


m_1	m_1, o_1	o_1
m_2	m_2, o_2	o_2
m_3	~~m_1, o_2~~	
	~~m_2, o_1~~	

R2R × One-One (Approach I)



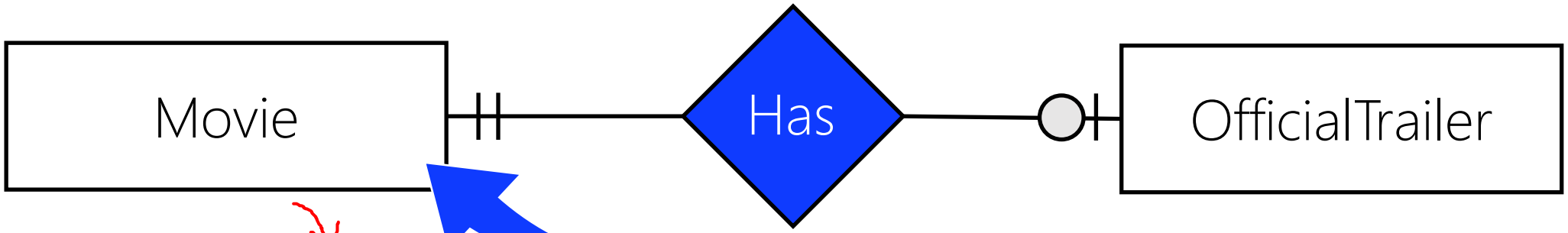
R2R × One-One (Approach I)



R_1: OfficialTrailer(Url, RunningTime)
R_2: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age, OfficialTrailer.Url)

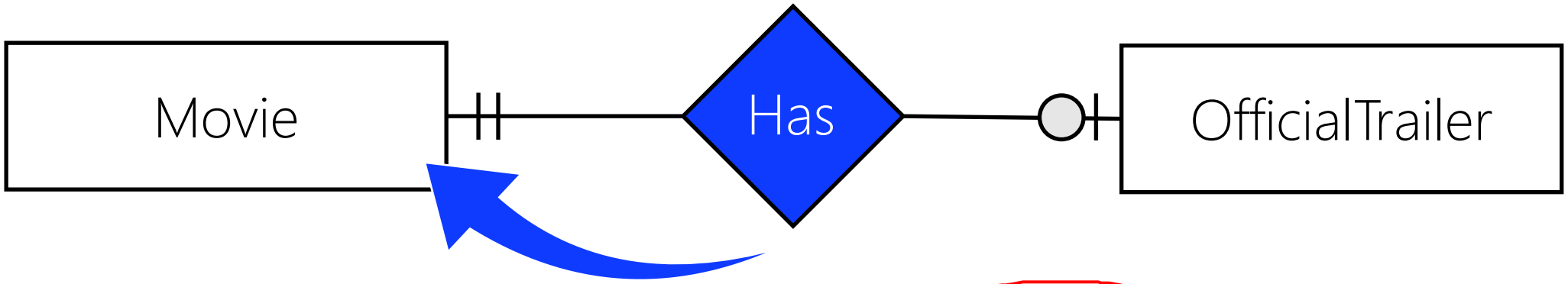
There is a problem! Where? Solution?

R2R × One-One (Approach I)



o_1,	m_1	o_1
o_2,	m_2	o_2
NULL,	m_3	
~~o_2~~,	~~m_1~~	Not possible because of key.
o_2,	m_4	Possible. Nothing prevents!

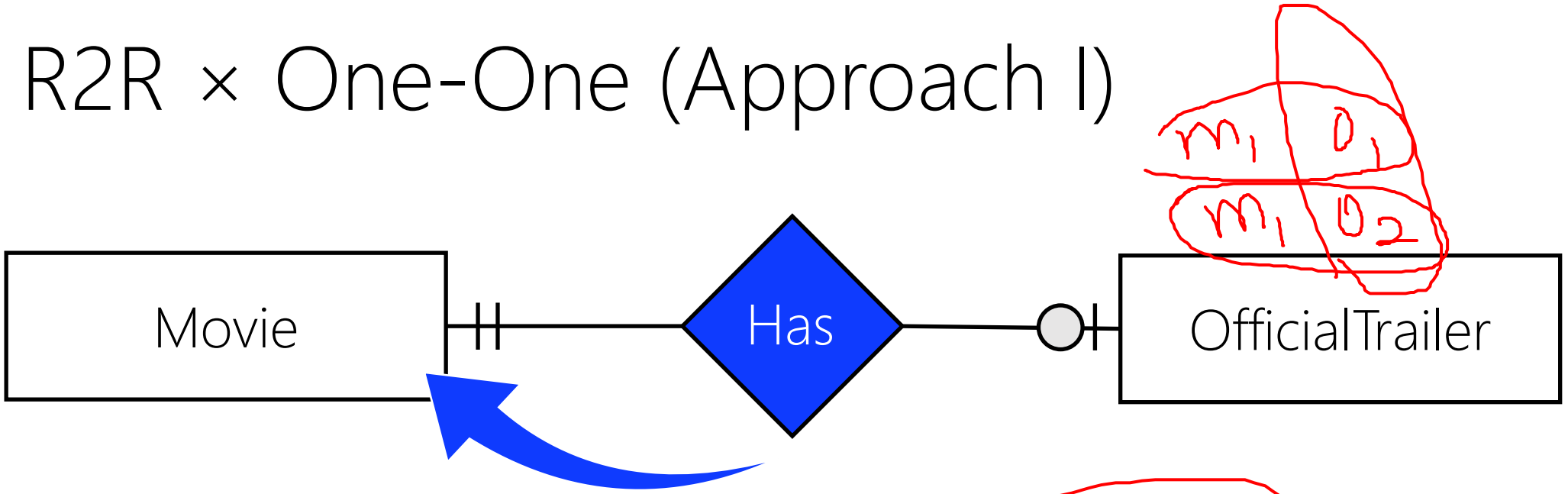
R2R × One-One (Approach I)



R_1: OfficialTrailer(<u>Url</u>, RunningTime)
R_2: Movie(<u>Title</u>, <u>ReleaseYear</u>, <u>ReleaseMonth</u>, <u>ReleaseDay</u>, RunningTime, Age, <u>OfficialTrailer.Url</u>)

The Movie relation allows an official trailer belongs to multiple movies!
We must make OfficialTrailer.Url unique. How? By being part of key set?

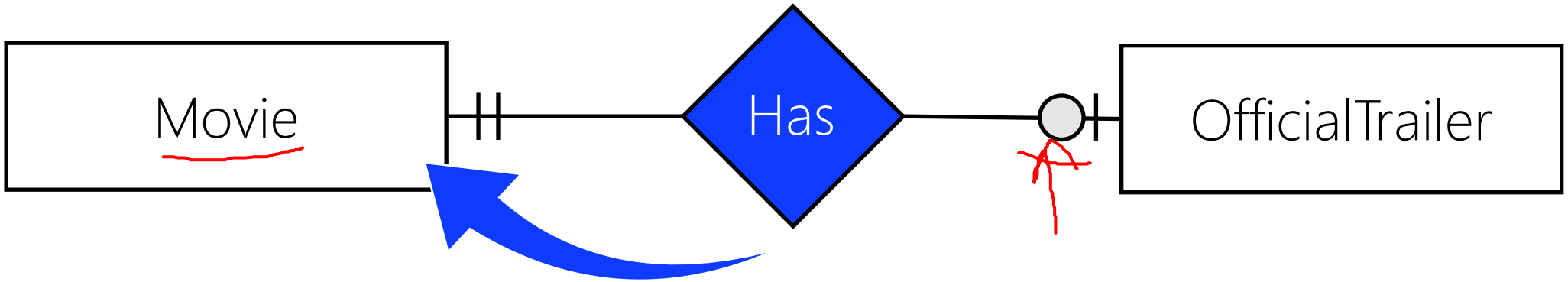
R2R × One-One (Approach I)



R_1: OfficialTrailer(Url, RunningTime)
R_2: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age, OfficialTrailer.Url)

The Movie relation allows an official trailer belongs to multiple movies!
We have to make OfficialTrailer.Url unique. How? By being part of key set? No! it does not solve the issue.
By being a new key set?

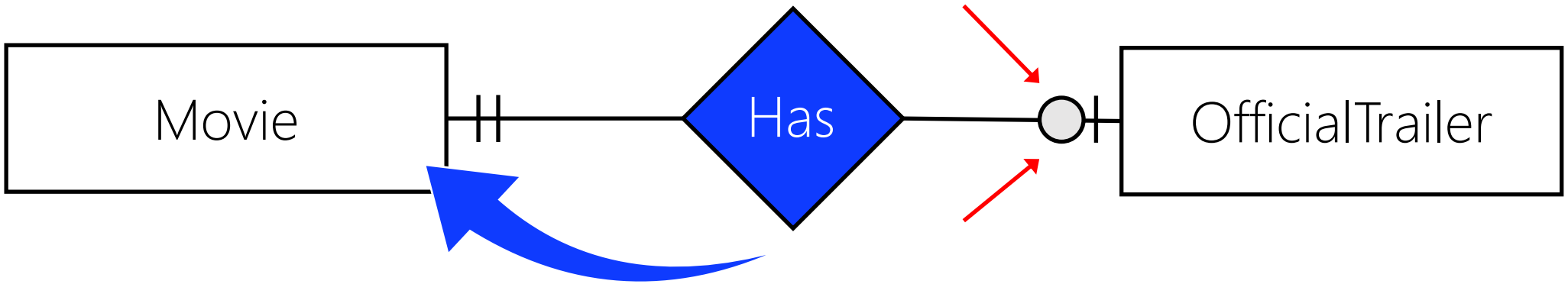
R2R × One-One (Approach I)



R_1: OfficialTrailer(Url, RunningTime)
R_2: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age, OfficialTrailer.Url)

New key set for R_2:
Secondary Key Set ={OfficialTrailer.Url}

R2R × One-One (Approach I)



R_1: OfficialTrailer(<u>Url</u>, RunningTime)
R_2: Movie(<u>Title</u>, <u>ReleaseYear</u>, <u>ReleaseMonth</u>, <u>ReleaseDay</u>, RunningTime, Age, OfficialTrailer.Url)

New key set for R_2:
SK={OfficialTrailer.Url} but if we choose this as key set, it should be mandatory!

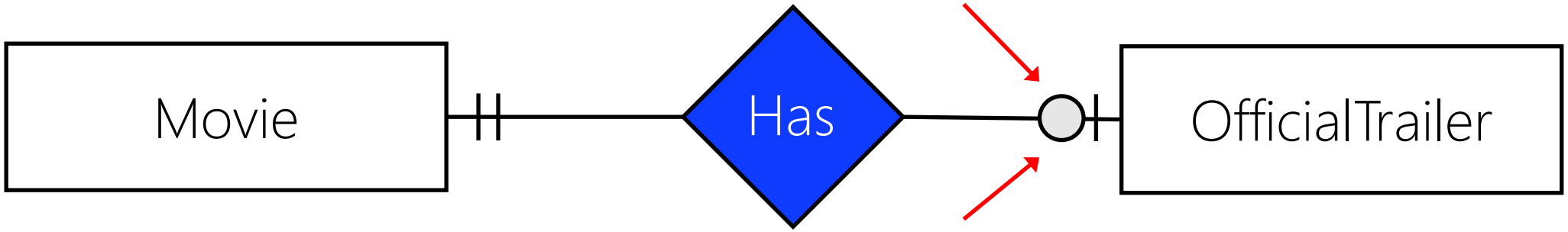
R2R × Candidate Key Set (CK)

Candidate Key is a possible key set whose attributes accept no value (NULL)

In contrast to primary key set which MUST have value for all its attributes, CK's attributes could be optional.

It is not called ~~Secondary~~ Key Set!
This way we have MULTIPLE key sets for a relation (table).
ER Diagram does not allow it.

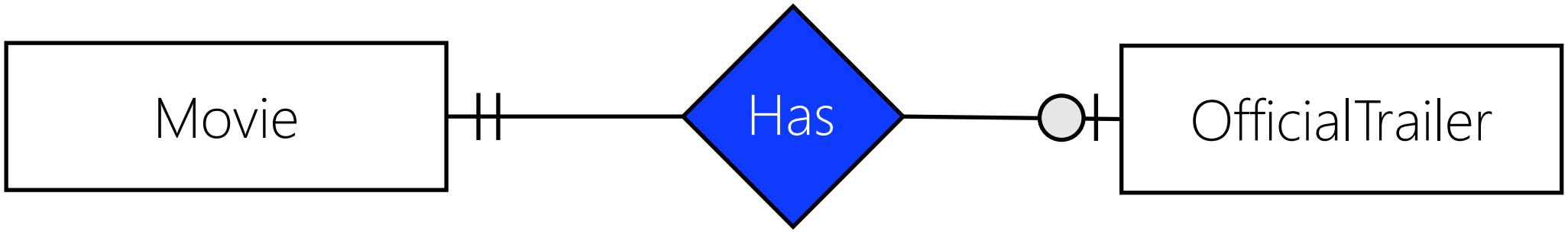
R2R × One-One (Approach I)



R_1: OfficialTrailer(Url, RunningTime)
R_2: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age, OfficialTrailer.Url)

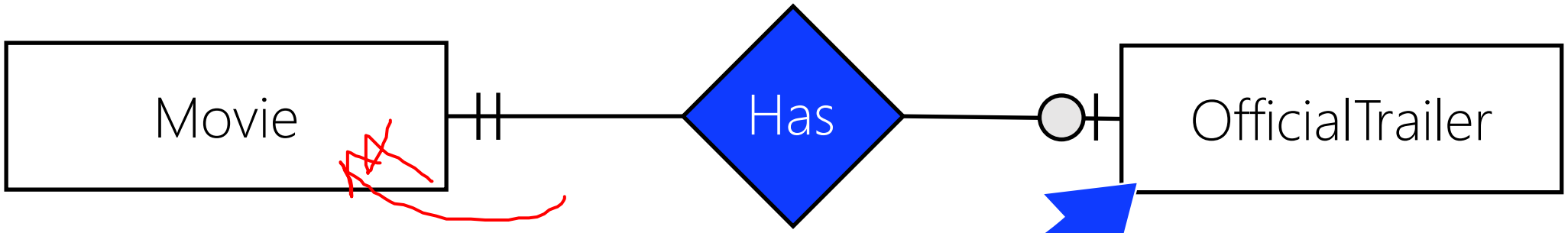
New key sets for R_2:
~~PK2=~~ CK=FK={OfficialTrailer.Url}

R2R × One-One



m_1	m_1, o_1	o_1
m_2	m_2, o_2	o_2
m_3		

R2R × One-One (Approach II)



m_1

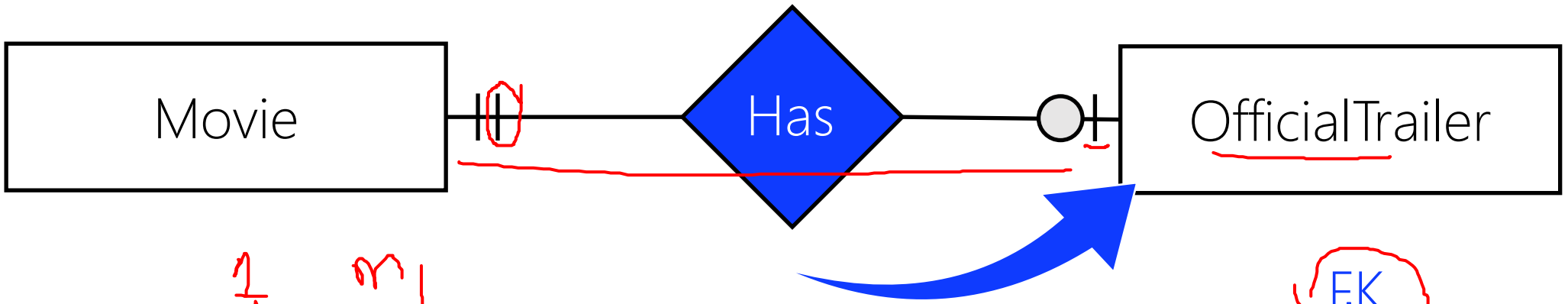
m_2

m_3

o_1, m_1

o_2, m_2

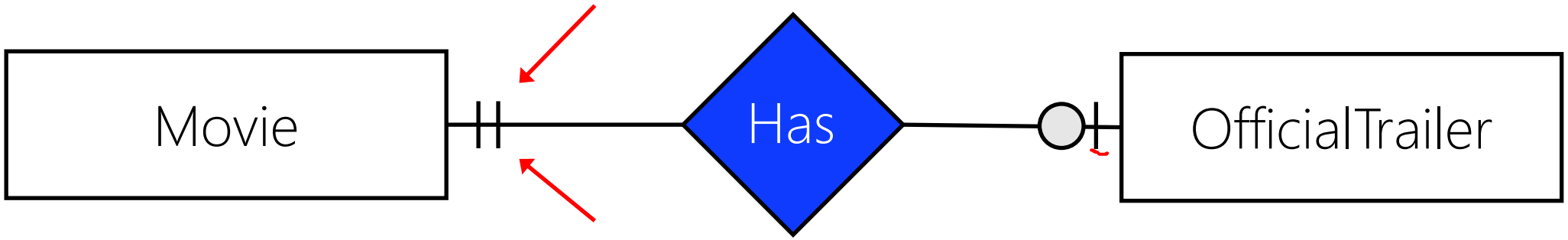
R2R × One-One (Approach II)



R_1: OfficialTrailer(Url, RunningTime, Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay)
R_2: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age)

New key set for R_1:
CK=FK={Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay}

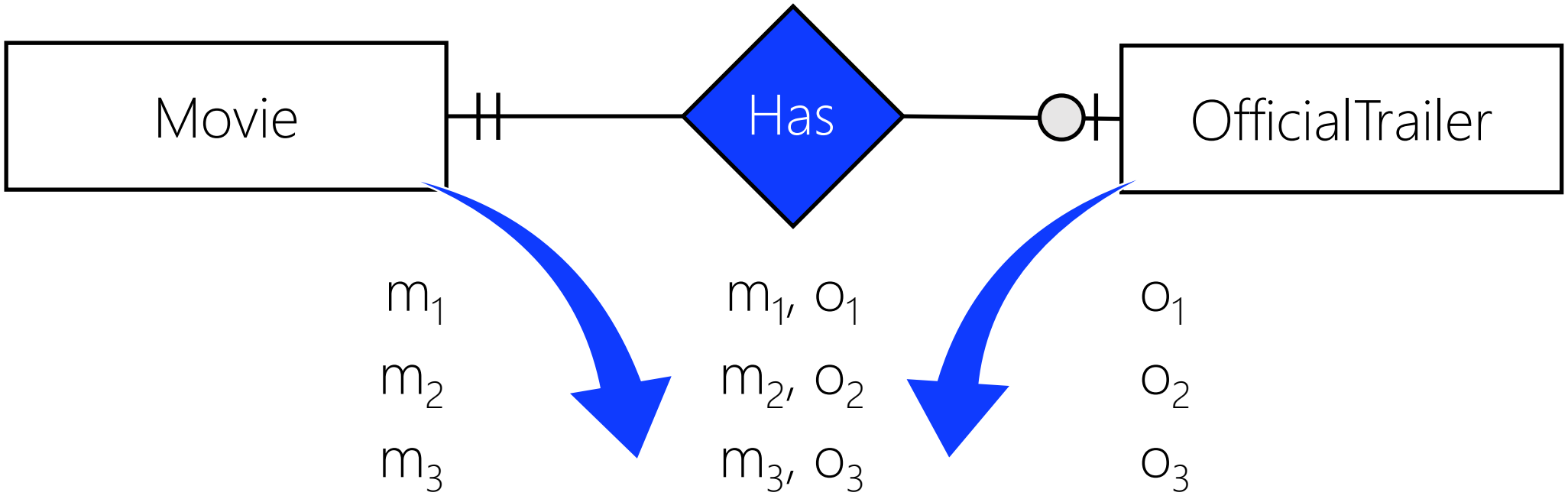
R2R × One-One (Approach II)



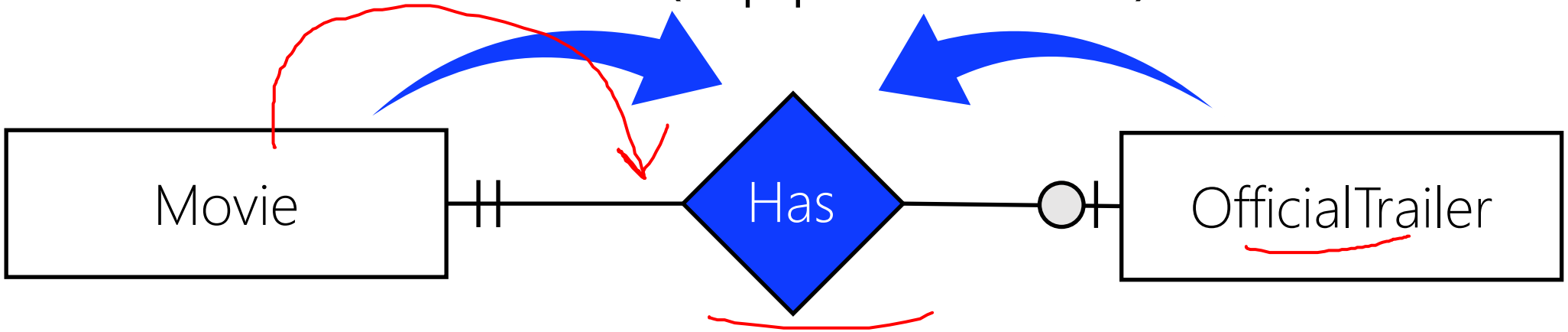
R_1: OfficialTrailer(Url, RunningTime, Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay)
R_2: Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age)

New key set for R_1:
CK=FK={Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay} Make CK Mandatory!

R2R × One-One (Approach III)



R2R × One-One (Approach III)

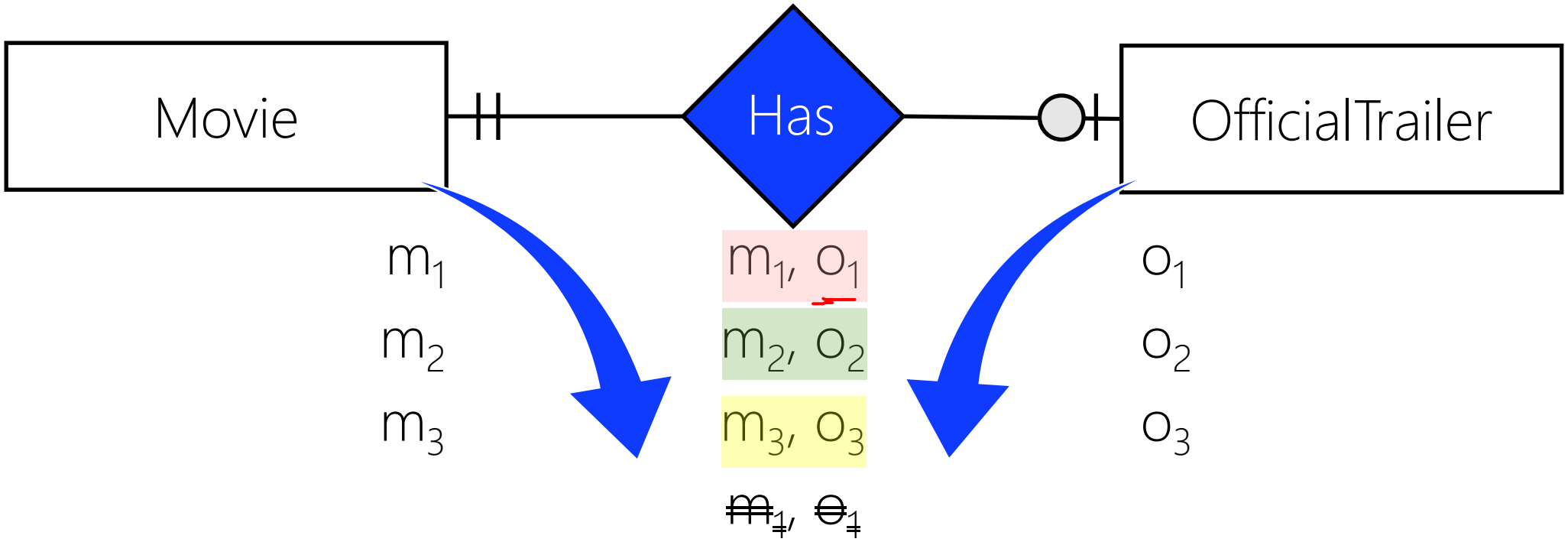


R_1: OfficialTrailer(<u>Url</u>, RunningTime)
R_2: Movie(<u>Title</u>, <u>ReleaseYear</u>, <u>ReleaseMonth</u>, <u>ReleaseDay</u>, RunningTime, Age)
R_3: MovieOfficialTrailer(Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay, OfficialTrailer.Url)

FK_1

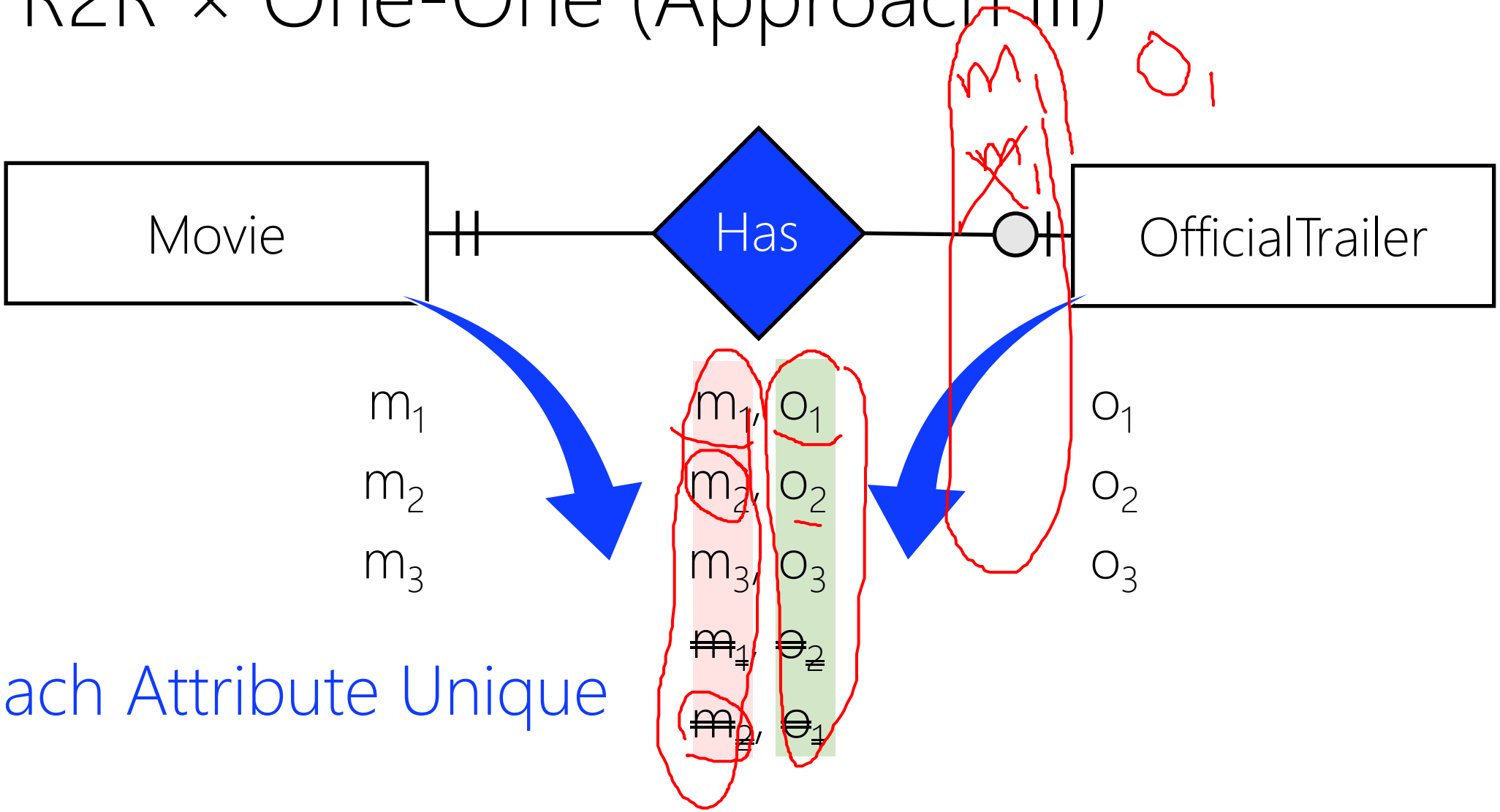
FK_2

R2R × One-One (Approach III)



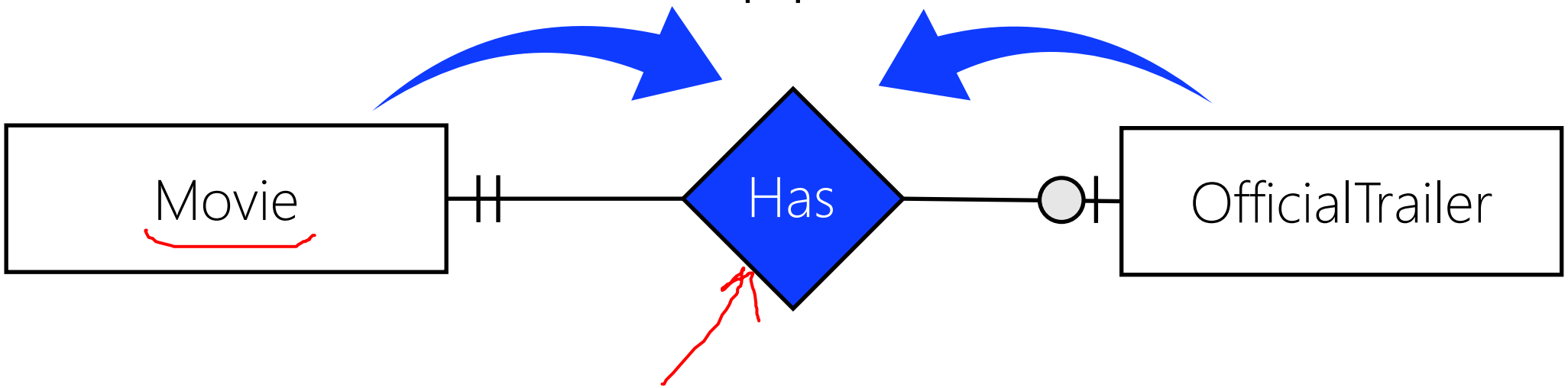
Together Unique

R2R × One-One (Approach III)



Each Attribute Unique

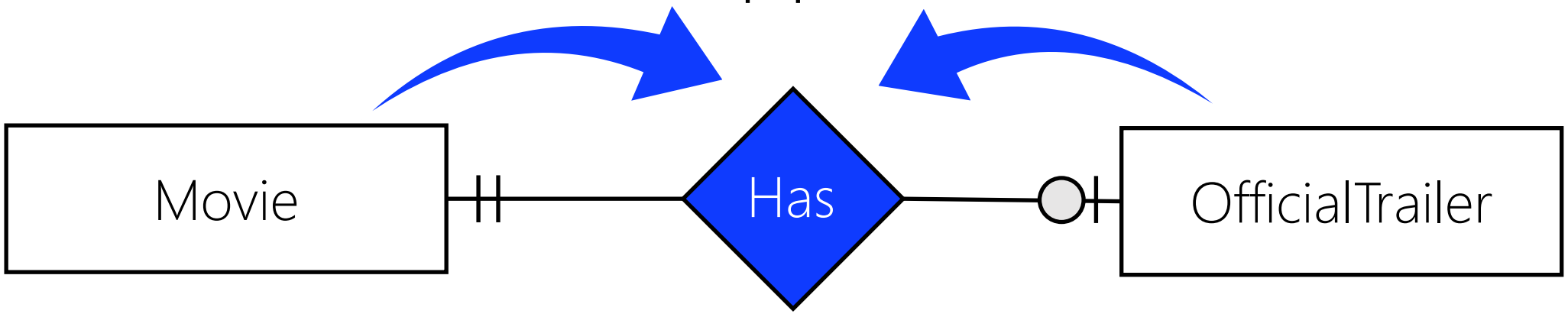
R2R × One-One (Approach III-a)



R_1: OfficialTrailer(Url, RunningTime)
R_2: Movie(Title, RunningTime, ReleaseYear, ReleaseMonth, ReleaseDay, Age)
R_3: MovieOfficialTrailer(Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay, OfficialTrailer.Url)

New key set for R_3:
CK={OfficialTrailer.Url} and mandatory (Why?)

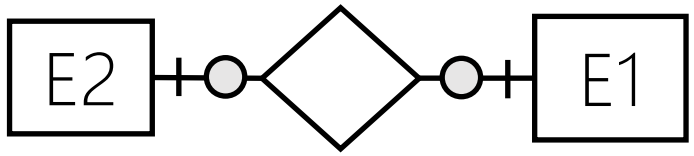
R2R × One-One (Approach III-b)



R_1: OfficialTrailer(Url, RunningTime)
R_2: Movie(Title, RunningTime, ReleaseYear, ReleaseMonth, ReleaseDay, Age)
R_3: MovieOfficialTrailer(Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay, OfficialTrailer.Url)

New key set for R_3:
CK={Movie.Title, Movie.ReleaseYear, Movie.ReleaseMonth, Movie.ReleaseDay} and mandatory (Why?)

R2R × One-One



Input: One-One relationship btw. E2 and E1, i.e.,
Output: Relations R1 for E1, R2 for E2, and/or R3 for relationship.

1) For E1, create relation R1 with the same attributes and keys as in E1
2) For E2, create relation R2 with the same attributes and keys as in E2
3) Do only one of the followings
   a) [Foreign & Candidate Key Set FK, CK]
   Add key set of E1 to R2 & make them candidate key of R2
   If E1's ordinality is mandatory, make CK mandatory
   b) [Foreign & Candidate Key Set FK, CK]
   Add key set of E2 to R1 & make them candidate key of R1
   If E2's ordinality is mandatory, make CK mandatory
   c) For one-one relationship set, create new relation R3
      I) [Foreign & Primary Key Set FK, PK] Add key set of E1 to R3 & make them primary key of R3
      II) [Foreign & Candidate Key Set FK, CK] Add key set of E2 to R3 & make them candidate key of R3 and mandatory

R2R × Surrogate Key

Sometimes Primary Ketset gets large,

e.g., Movie's PK={Title, ReleaseYear, ReleaseMonth, ReleaseDay}
e.g., Actor's PK={FirstName, LastName, DateOfBirth}

It replicates itself when becomes FK to other relations.

Not convenient!

R2R × Surrogate Key

One single attribute key (not a set)

System-generated, e.g., AUTONUMBER, i.e., 1,2,3,...,
Usually named Id | RowId

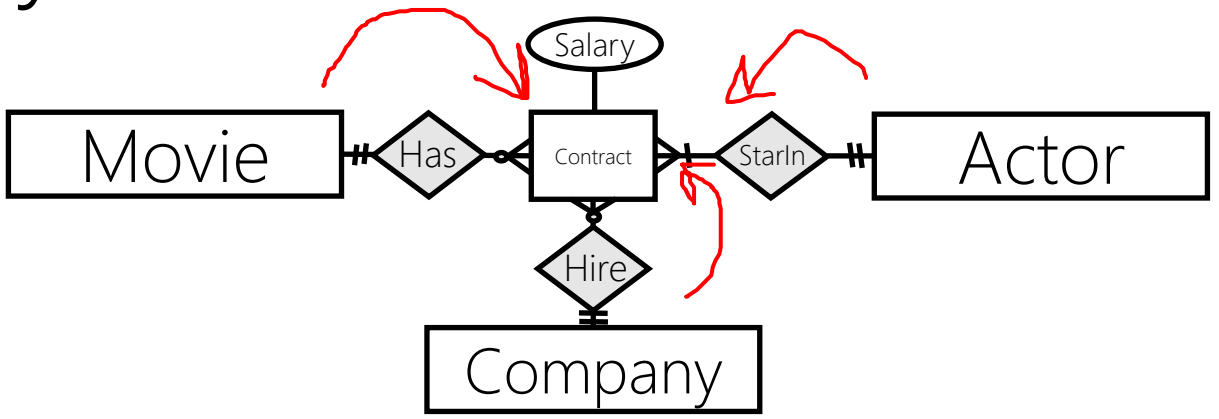
Surrogate Key vs. Natural Keyset (Business Keyset):
The values of generated surrogate key have NO meaning in real-world!
Surrogate key is just for data engineer convenience.
Old (natural) primary key set becomes mandatory candidate key.
Old (natural) primary key set becomes mandatory candidate key.

R2R × Surrogate Key

Movie(Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age, …)

Movie(Id, Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime, Age, …)
CK={Title, ReleaseYear, ReleaseMonth, ReleaseDay} and Mandatory

R2R × Ternary-2-Binary



R_1: Company(Id, Name, Address, Phone, ...)
CK={Name}

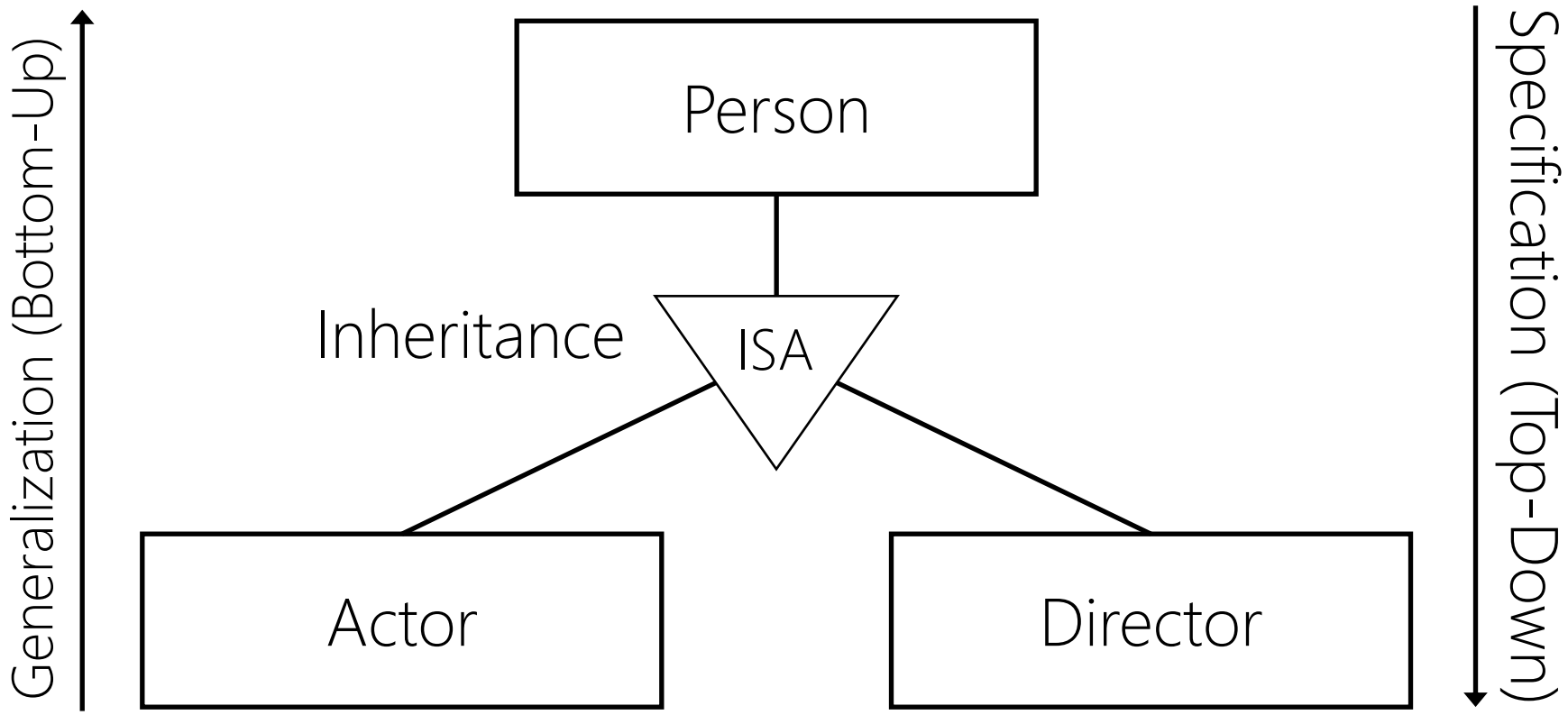
R_2: Actor(Id, FirstName, LastName, DateOfBirth, PlaceOfBirth, ...)
CK={FirstName, LastName, DateOfBirth}

R_3: Movie(Id, Title, ReleaseYear, ReleaseMonth, ReleaseDay, RunningTime)
CK={Title, ReleaseYear, ReleaseMonth, ReleaseDay}

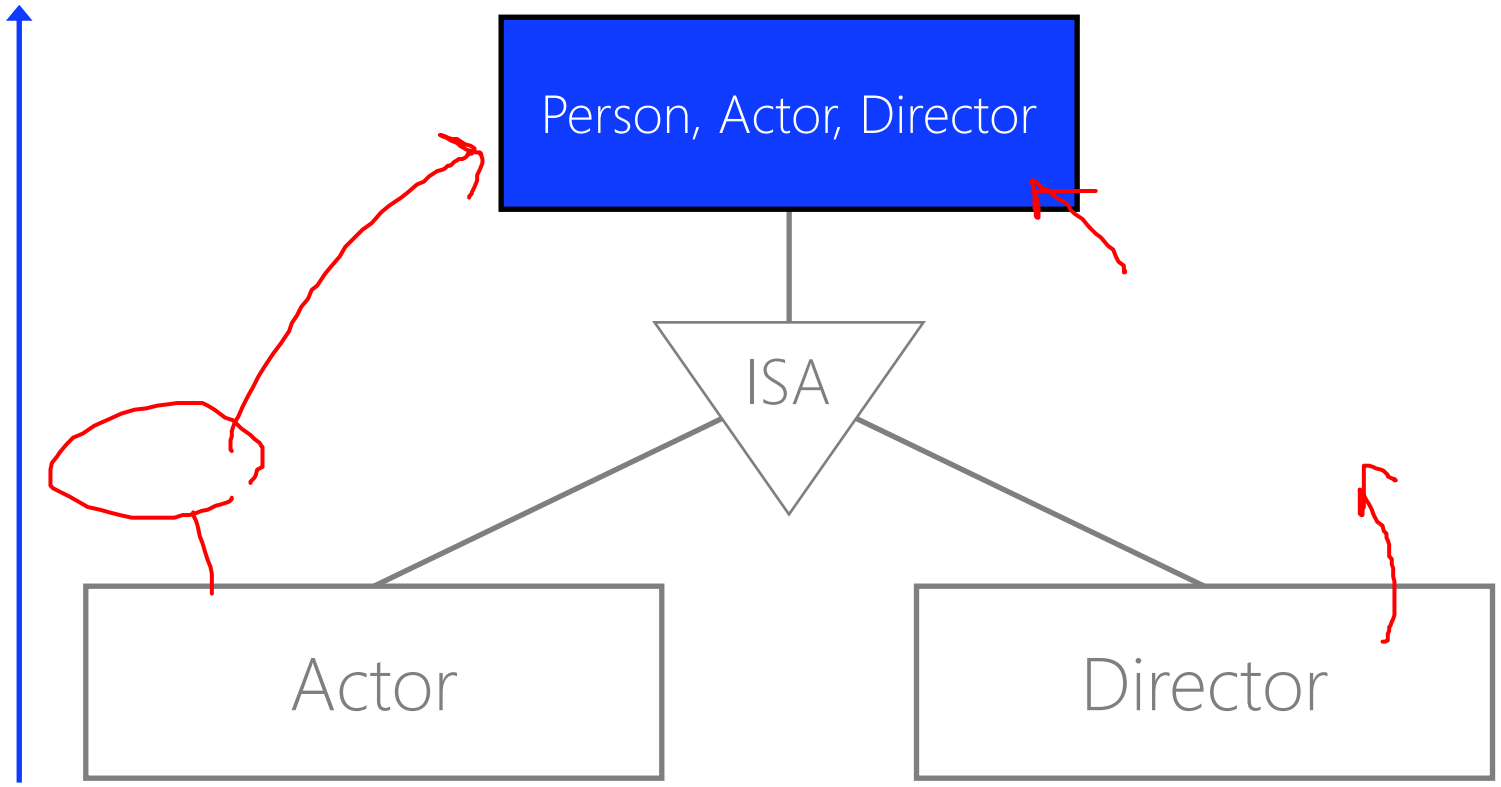
R_4: Contract(Id, Salary, Company.Id, Actor.Id, Movie.Id)
FK_1 FK_2 FK_3

ISA 2 Relation Mapping

R2R × ISA


Person
Inheritance
ISA
Actor
Director
Generalization (Bottom-Up)
Specification (Top-Down)

R2R × Single Relation (Approach I)



R2R × Single Relation (Approach I)

R_1: Person(Id, FirstName, LastName, DateOfBirth, PlaceOfBirth, …
PersonType,
ActorBestLine, ActorMovieCount,
DirectorBestMovie, DirectorMovieCount)

CK={FirstName, LastName, DateOfBirth}

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

Partial Specification

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

Partial and Overlapping Specification

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

These numbers are not movie titles! What are they?

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

These numbers are not movie titles! What are they?

Foreign Key values from Movie relation primary key.

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
~~7~~	~~Clint~~	~~Eastwood~~	~~May 31, 1930~~	~~USA~~	~~ActorDirector~~	~~A good ..~~	~~69~~	~~803~~	~~35~~

Is it possible to have Partial and Disjoint specification?

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

Is it possible to have Partial and Disjoint specification? Yes.

Partial: Make PersonType optional

Disjoint: If there is a value it MUST be only Director or Actor, not both.

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
~~6~~	~~Hossein~~	~~Fani~~	~~Sept. 11, 1983~~	~~Iran~~	~~NULL~~	~~NULL~~	~~NULL~~	~~NULL~~	~~NULL~~
~~7~~	~~Clint~~	~~Eastwood~~	~~May 31, 1930~~	~~USA~~	~~ActorDirector~~	~~A good ..~~	~~69~~	~~803~~	~~35~~

Is it possible to have Total and Disjoint specification?

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

Is it possible to have Total and Disjoint specification? Yes.

Total: Make PersonType mandatory

Disjoint: If there is a value it MUST be only Director or Actor, not both.

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

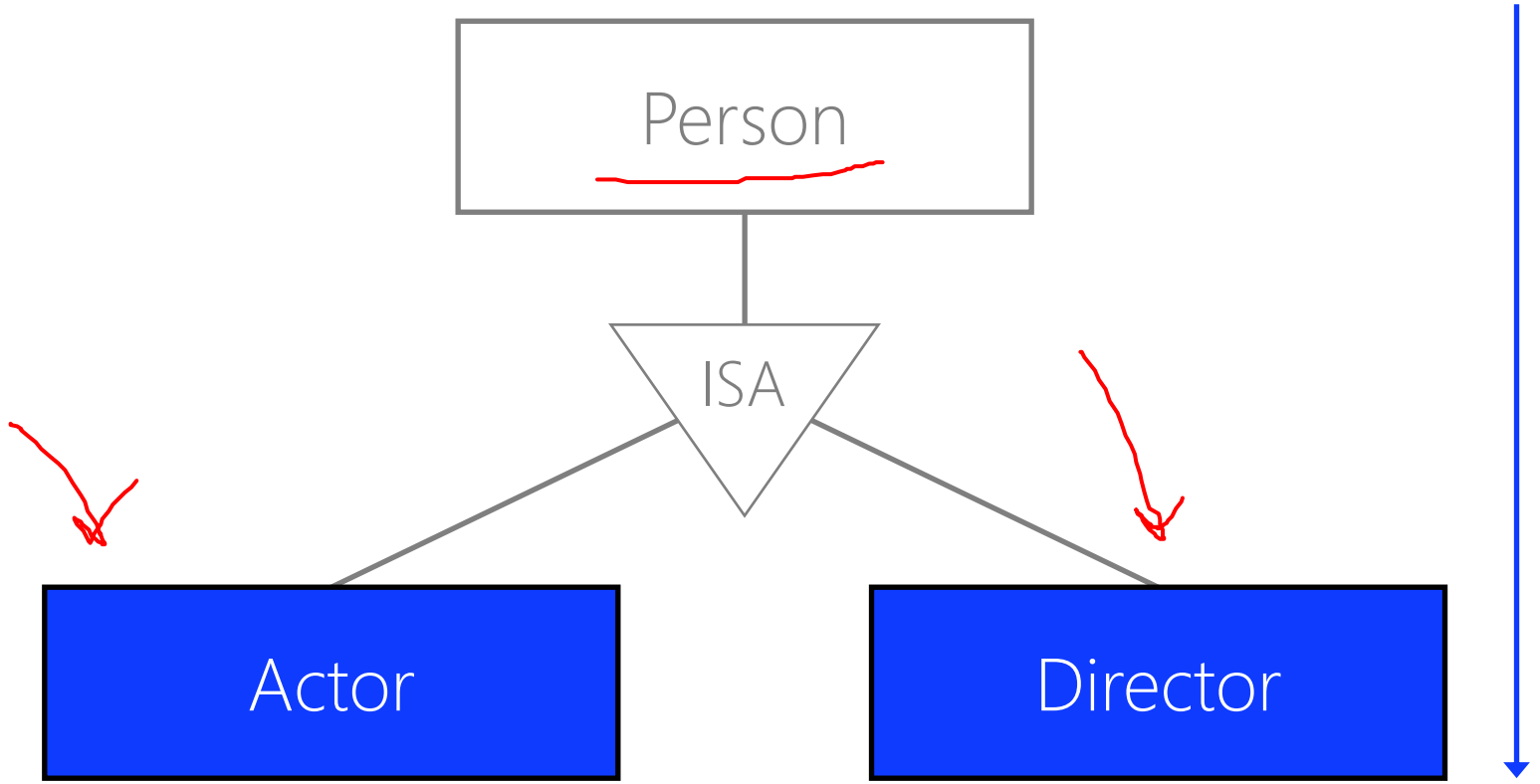
Is it possible to have Total and Overlapping specification? (At Home)

R2R × Single Relation (Approach I)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	PersonType	ActorBestLine	ActorMovieCount	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	Director	NULL	NULL	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	Director	NULL	NULL	203	47
3	John	Travolta	Feb. 18, 1954	USA	Actor	You ...	61	NULL	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	Actor	Say 'w...	125	NULL	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	Actor	I believe ..	51	NULL	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL	NULL	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	ActorDirector	A good ..	69	803	35

One big merged entity set to have all types of entities.
Person, Actor, and Director share same relationship sets.

R2R × Relation per Subclass (Approach II)



R2R × Relation per Subclass (Approach II)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	ActorBestLine	ActorMovieCount
1	John	Travolta	Feb. 18, 1954	USA	You ...	61
2	Samuel	Jackson	Dec. 21, 1948	USA	Say 'w...	125
3	Uma	Thurman	Apr. 29, 1970	USA	I believe ..	51
4	Clint	Eastwood	May 31, 1930	USA	A good ..	69

This is the similar to when we did not have ISA in E/R. Redundancy!

R2R × Relation per Subclass (Approach II)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	ActorBestLine	ActorMovieCount
1	John	Travolta	Feb. 18, 1954	USA	You ...	61
2	Samuel	Jackson	Dec. 21, 1948	USA	Say 'w...	125
3	Uma	Thurman	Apr. 29, 1970	USA	I believe ..	51
4	Clint	Eastwood	May 31, 1930	USA	A good ..	69

This is the similar to when we did not have ISA in E/R. Update Anomaly!

R2R × Relation per Subclass (Approach II)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	ActorBestLine	ActorMovieCount
1	John	Travolta	Feb. 18, 1954	USA	You ...	61
2	Samuel	Jackson	Dec. 21, 1948	USA	Say 'w...	125
3	Uma	Thurman	Apr. 29, 1970	USA	I believe ..	51
4	Clint	Eastwood	May 31, 1930	USA	A good ..	69

Partial and Disjoint?
Partial and Overlapping?
Total and Disjoint?
Total and Overlapping?

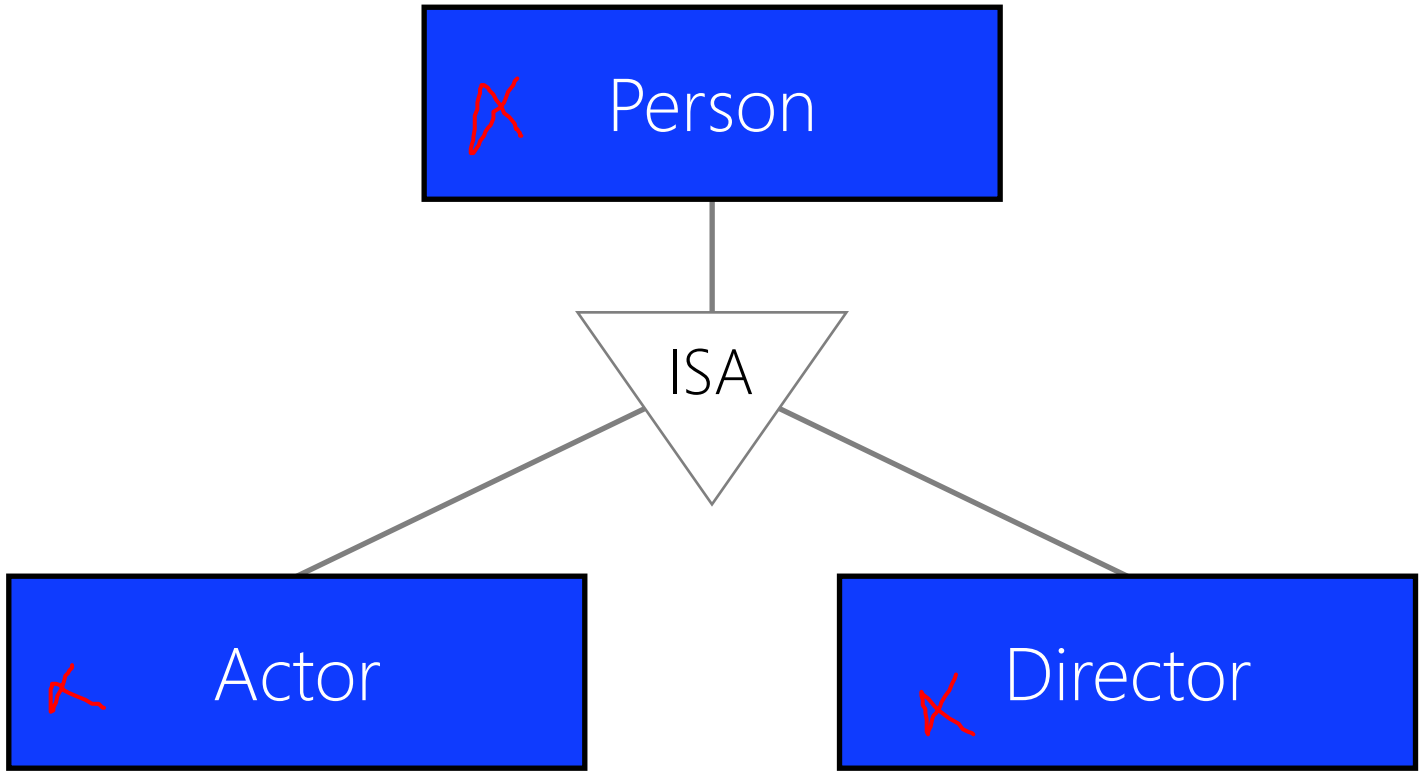
R2R × Relation per Subclass (Approach II)

Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	DirectorBestMovie	DirectorMovieCount
1	Stanley	Kubrick	Jul. 26, 1928	USA	102	13
2	Alfred	Hitchcock	Aug. 13, 1899	England	203	47
3	Clint	Eastwood	May 31, 1930	USA	803	35

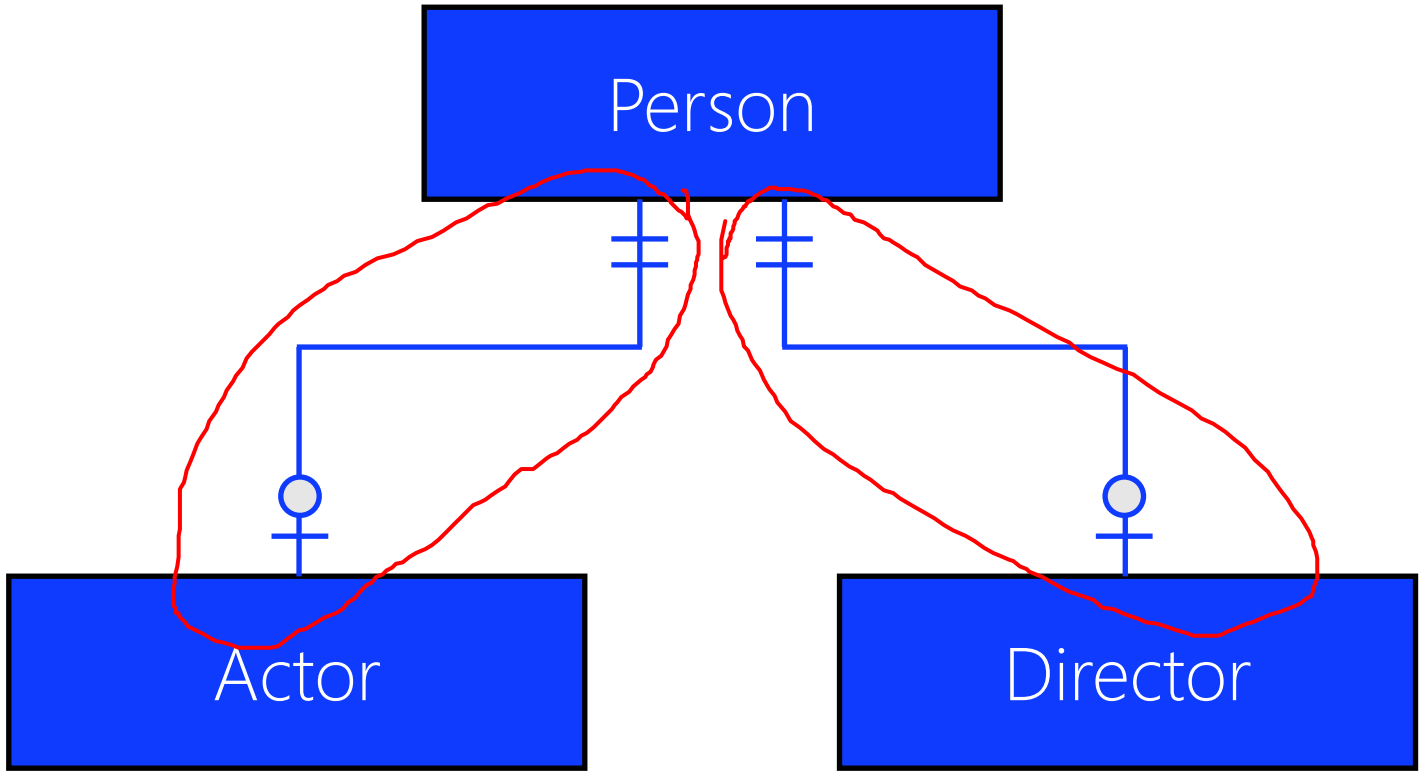
Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	ActorBestLine	ActorMovieCount
1	John	Travolta	Feb. 18, 1954	USA	You ...	61
2	Samuel	Jackson	Dec. 21, 1948	USA	Say 'w...	125
3	Uma	Thurman	Apr. 29, 1970	USA	I believe ..	51
4	Clint	Eastwood	May 31, 1930	USA	A good ..	69

Partial and Disjoint? N/A
Partial and Overlapping? N/A
Total and Disjoint? Yes.
Total and Overlapping? Yes. Replicate

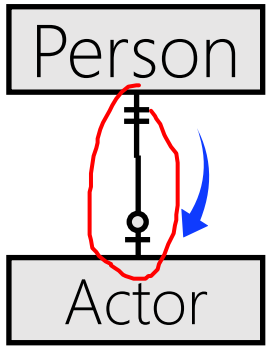
R2R × Relation per All (Approach III)



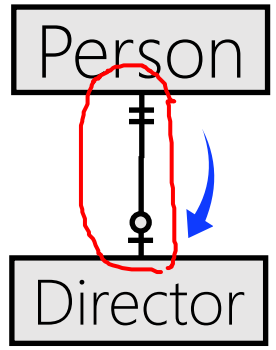
R2R × Relation per All (Approach III)



R2R × Relation per All (Approach III-a)



Id	FirstName	LastName	DateOfBirth	PlaceOfBirth
1	Stanley	Kubrick	Jul. 26, 1928	USA
2	Alfred	Hitchcock	Aug. 13, 1899	England
3	John	Travolta	Feb. 18, 1954	USA
4	Samuel	Jackson	Dec. 21, 1948	USA
5	Uma	Thurman	Apr. 29, 1970	USA
6	Hossein	Fani	Sept. 11, 1983	Iran
7	Clint	Eastwood	May 31, 1930	USA



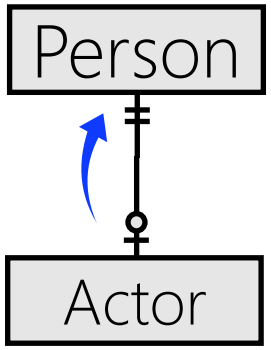
Id	ActorBestLine	ActorMovieCount	PersonId
1	You ...	61	3
2	Say 'w...	125	4
3	I believe ..	51	5
4	A good ..	69	7

FK1 = CK1 = Person.Id Mandatory

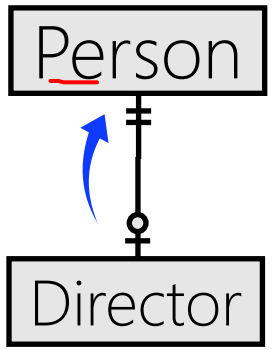
Id	DirectorBestMovie	DirectorMovieCount	PersonId
1	102	13	1
2	203	47	2
3	803	35	7

FK1 = CK1 = Person.Id Mandatory

R2R × Relation per All (Approach III-b)



Id	FirstName	LastName	DateOfBirth	PlaceOfBirth	ActorId	DirectorId
1	Stanley	Kubrick	Jul. 26, 1928	USA	NULL	1
2	Alfred	Hitchcock	Aug. 13, 1899	England	NULL	2
3	John	Travolta	Feb. 18, 1954	USA	1	NULL
4	Samuel	Jackson	Dec. 21, 1948	USA	2	NULL
5	Uma	Thurman	Apr. 29, 1970	USA	3	NULL
6	Hossein	Fani	Sept. 11, 1983	Iran	NULL	NULL
7	Clint	Eastwood	May 31, 1930	USA	4	3



Id	ActorBestLine	ActorMovieCount
1	You ...	61
2	Say 'w...	125
3	I believe ..	51
4	A good ..	69

FK1 = CK1 = Actor.Id Optional

FK2 = CK2 = Director.Id Optional

Id	DirectorBestMovie	DirectorMovieCount
1	102	13
2	203	47
3	803	35

R2R × Relation per All (Approach III)

Partial & Disjoint?
Partial & Overlapping?
Total & Disjoint?
Total & Overlapping?