How to do E-R Analysis

Basic Concepts

They fall into four main types:-

* Real world abstractions/classes
* Real world occurrences/things
* Design abstractions/classes
* Design occurrences/things

Real World Abstractions and
Real World Occurrences

The difference between abstract and occurrence is the difference between classes of things and the things themselves.

Design Abstractions and
Design Occurrences

The abstractions are simply the “templates” : the record layouts and forms themselves.

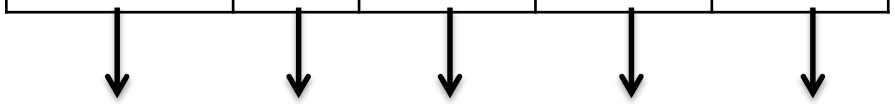
“Real World Abstractions” Van, Delivery, Driver, Shop

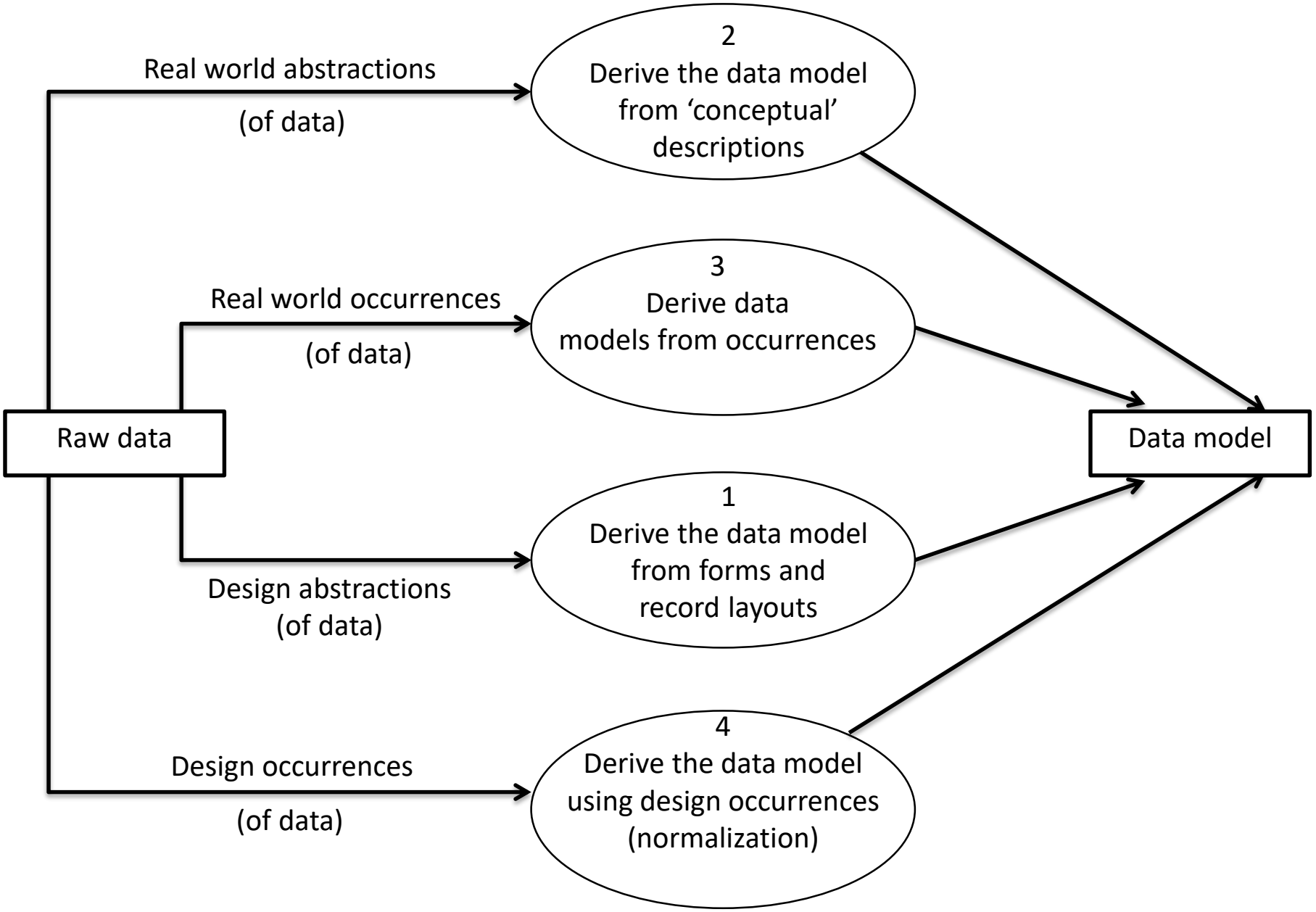
“Real World Occurrences” (Van) EGP 816J; (Van) AAP 18G; (Driver) Jim Jones; (Driver) Allan Smith; (Shop) The Bun Shop, Woking; (Shop) Sainsburys, St Albans

Design Abstractions” Van-record, Delivery Form A, Driver-record, Form 99B (Shop details)

Design Occurrences”

EGP 816J	99	38-7S4	22A	J Jones
AAP 18G	84	38-7S5	21A	J Jones





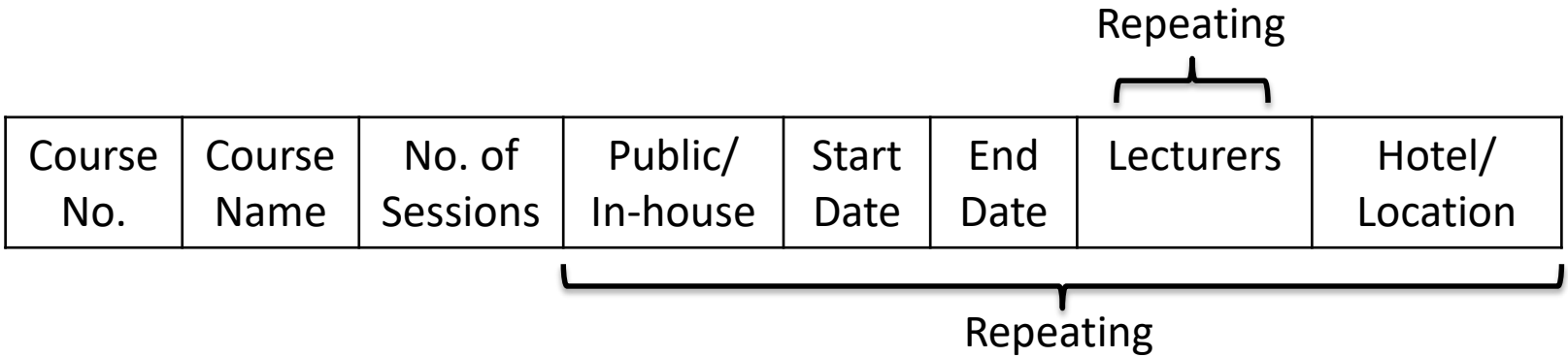
Summary of the four methods of data analysis

* Deriving the Data Model from Design Abstractions – such as forms and record layouts.
* Deriving the Data Model from Conceptual Descriptions (interview notes etc.)
* Deriving the Data Model from Conceptual Occurrences
* Deriving the Data Model from Design Occurrences – this is the well known method of “normalization”.

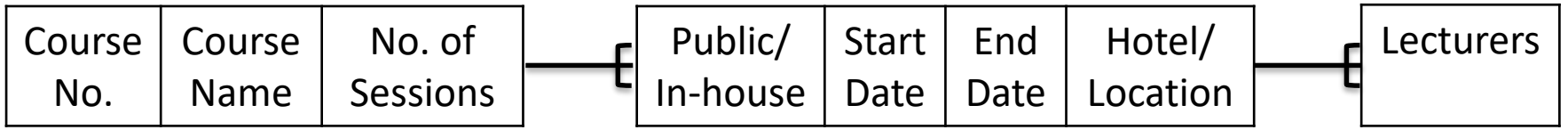
1. Deriving the Data Model from Design Abstractions (Forms and Record Layouts)

SCHEDULES OF COURSES FOR YEAR: ……				
COURSE NO: …… COURSE NAME: …… NO OF SESSIONS: ……				
Public/ In-house	Start Date	End Date	Lecturers	Hotel/Location

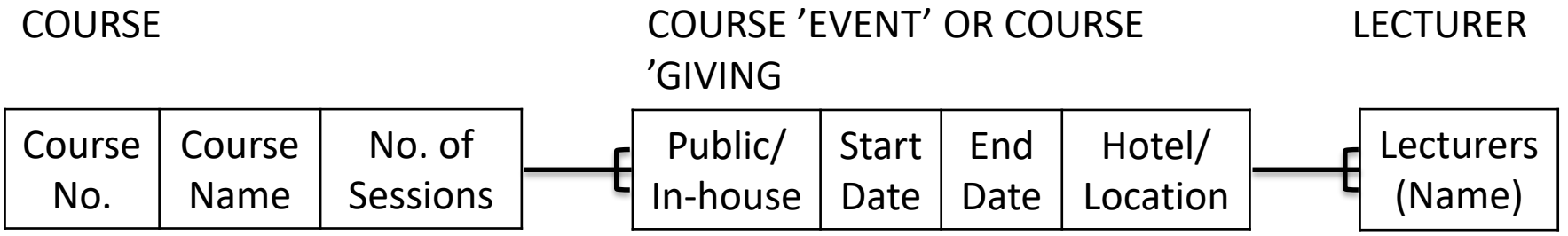
1. List out the Data Items on the form and indicate where one group of data items is repeated with respect to another. Where a single data item is in the plural (e.g. Hotels, Courses) assume this data item is also repeated.
2. Split the repeating from the non-repeating groups.
3. Pick out or choose a name for the thing which is being described by all the data items.
4. Check each data item. Is it describing the class of thing you have given the name to? Ask “of what”, “where” and “when”.
5. Draw the Data Model separately and list the potential Attributes. Do not duplicate Entities if they appear more than once. Merge the Relationships together.



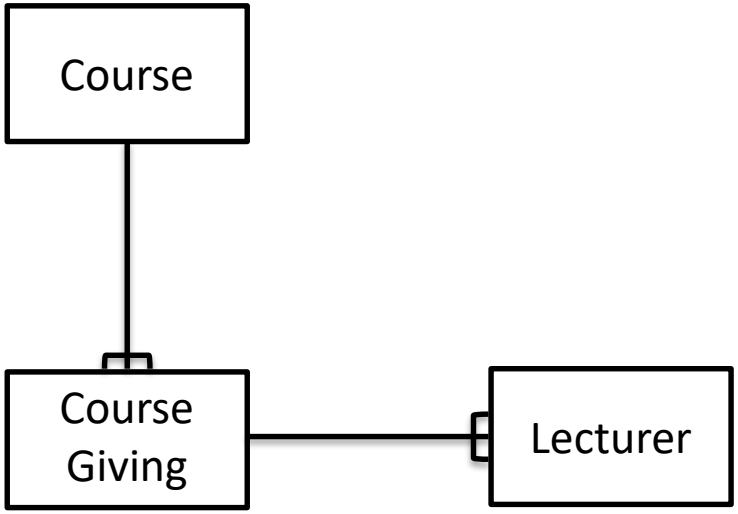
Example 1 – Step 1



Example 1 – Step 2



Example 1 – Step 3



Course
Course No.
Course Name
No. of Sessions in Course

Course Giving
Public/In-house Course Giving
Start Date of Course Giving
End Date of Course Giving
Hotel/Location of Course Giving

Lecturer
Name of Lecturer

Example 1 – Step 5

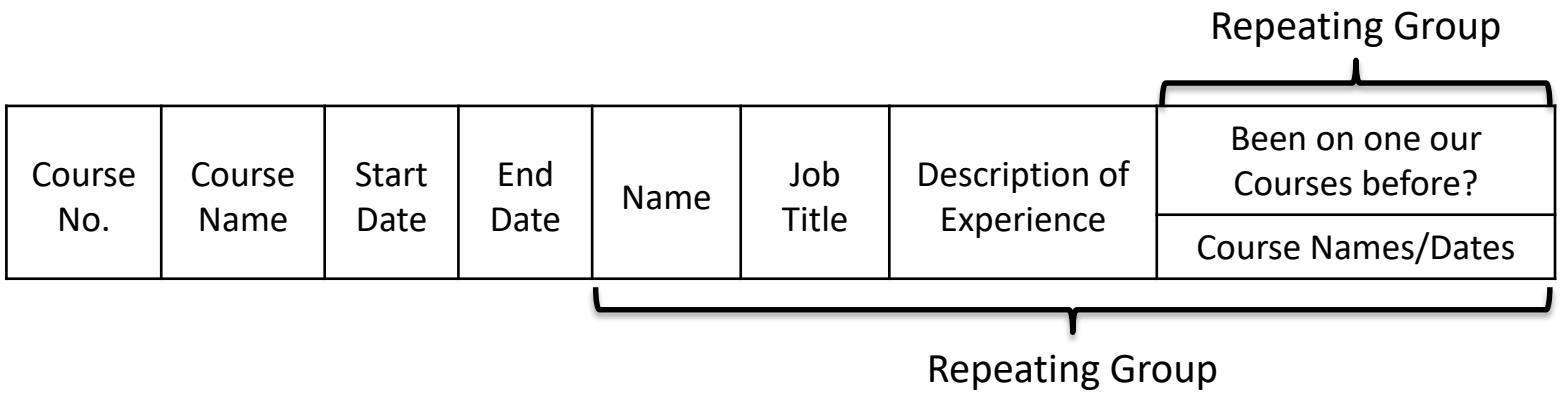
LECTURER'S STUDENT LIST

Course No: ……. Course Name: …….

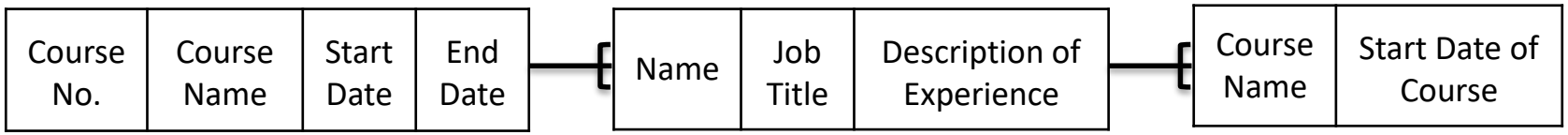
Start Date: ……. End Date: …….

STUDENTS				
Name	Job Title	Description of Experience	Been on one of our Courses before?	
			Course Names	Start Dates of Course

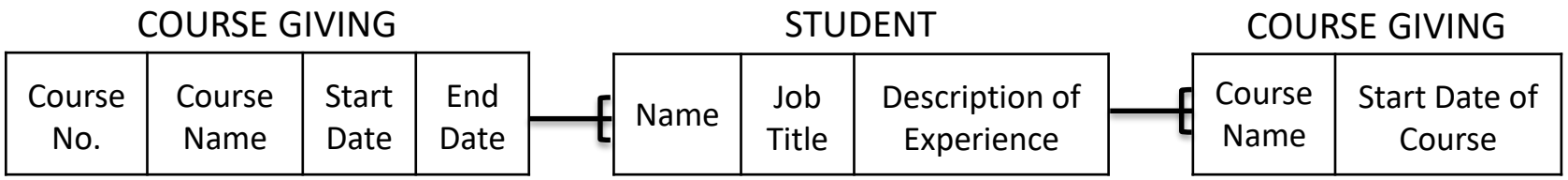
Example 2 – Form 2



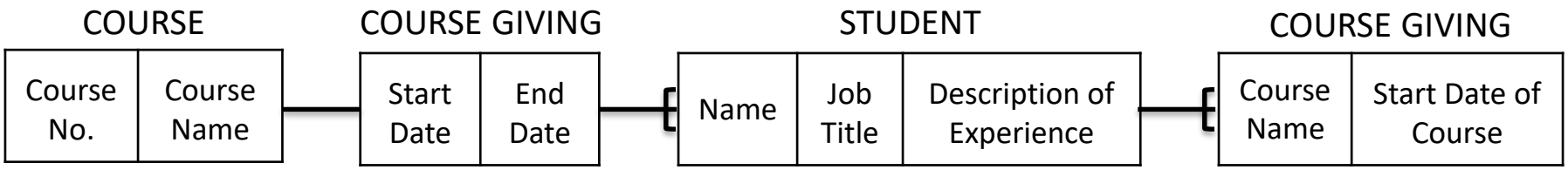
Example 2 – Step 1



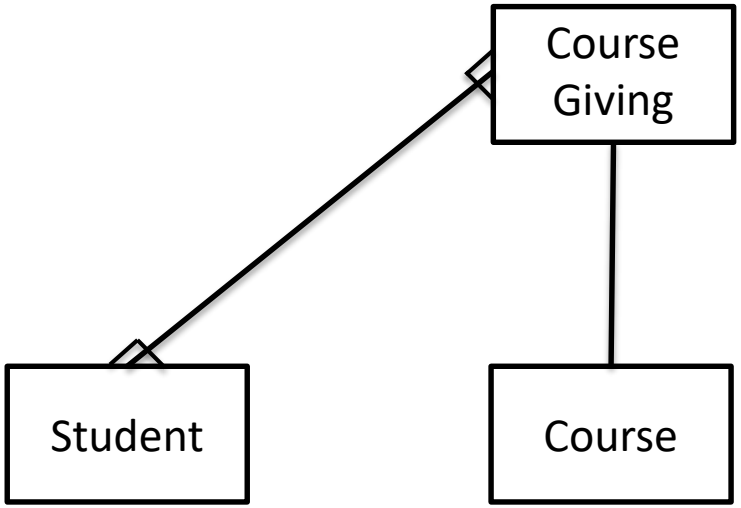
Example 2 – Step 2



Example 2 – Step 3



Example 2 – Step 3



Course Giving

Start Date
End Date

Student

Name
Job Title
Experience

Course

Course No.
Course Name

Example 2 – Step 5

Form – Hotel Booking Request

HOTEL BOOKING REQUEST

To: .....

Address: .....

.....

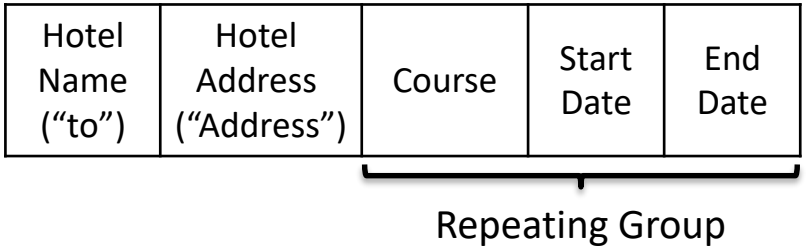
.....

.....

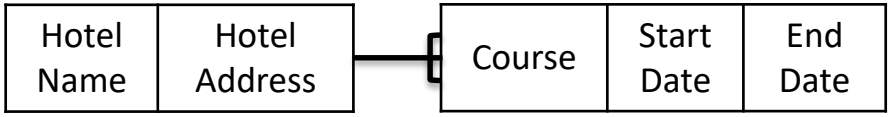
Please would you book us one of the rooms shown in your hotel for the courses and dates shown:-

Course	Start Date	End Date

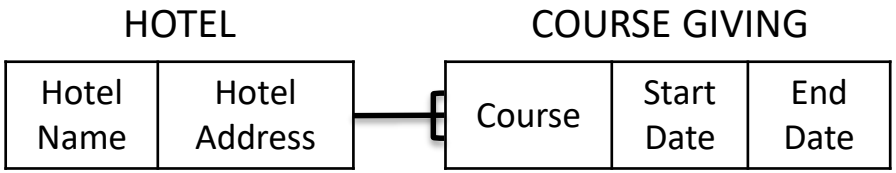
Example 3 – Form 3



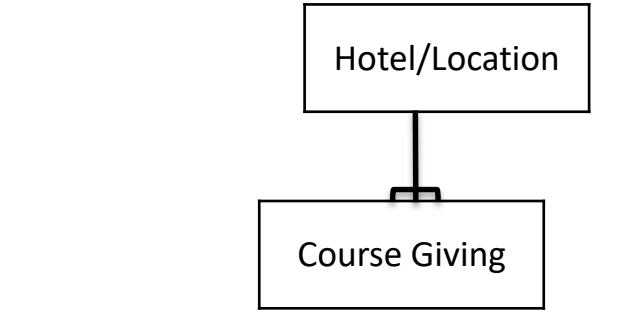
Example 3 – Step 1



Example 3 – Step 2



Example 3 – Step 3



Example 3 – Step 5

2. Deriving the Data Model from Conceptual Descriptions

- **STEP1: Reduce the Text to Factual Sentences**
- **STEP2: Remove any single occurrence**
- **STEP3: Draw a Data Model for each Sentence**
- **STEP4: Combine each Model using Names to combine**
- **STEP5: See if there is any implied sequence to the activities or in the text**

STEP 1

Reduce the Text to Factual Sentences

Remove filler words, unsubstantiated opinion and ‘link’ type words e.g. however and but.

Replace any ‘its’ , ‘hes’, ‘shes’ and ‘theys’ by the word it replaces.

Reduce any long sentences to simple ones of, roughly, the noun-verb-noun form.

Leave in any ‘mays’ , ‘somes’ or indications of numbers.

STEP 2

Remove any single occurrence

"Object, verb, class" or

"Class, verb, object".

but leave the class in place as a stand-along word,

e.g. John likes all Books

STEP 3

Draw a Data Model for each Sentence (Figures 3.26 and 3.27)

Pick out the nouns in the sentences and the verbs (if any exist).

Deduce from the text whether many or one is implied.

Create Entities from the nouns and draw boxes round them

Create Relationships from the verbs

STEP 4

Combine each Model using Names to combine

Combine each Model derived from the sentences using the Entity and Relationship names

Ensure the question marks are placed on the combined Model

Where question marks are resolved by other Models, remove them

STEP 5

See if there is any implied sequence to the activities or in the text

The verbs in the text often denote activity.

The user will very often imply a sequence to the activities by using such words as then, next and so on.

Exercise in deriving the Data Model from interview notes

Analyst: The area of your job which covers course administration. Could you tell me a bit about what happens?

User: Well, we have a number of courses which can be requested by a client or company.

Analyst: What form do these courses take?

User: Well the teachers we have, who by the way are all consultants, create new courses from scratch if a company requests a sort of course we haven't got.

Analyst: In other words, courses are created on demand.

User: Yes.

Analyst: How are the courses created?

User: Well, the sessions on the course are worked out in outline and allocated to the consultants to actually create them.

Analyst: Can a consultant be given many?

User: Oh yes, our consultants, generally speaking have created a fair number in their time.

Analyst: So there are some teachers who haven't created any sessions?

User: A few – not many though.

Analyst: Do you always have to create new sessions for a new course?

User: Now then, let me think, no we do re-use some.

Analyst: You mean you take them as they are and slot them in without alteration?

User: Yes we do.

Analyst: Do you alter any?

User: Yes, but we have to regard those as new sessions even though they may have started off the same. Very often as time goes on they diverge more and more and they end u[being very different. There's no value in recognizing that they were once the same.

Analyst: Tell me about your course brochure – I know you have one – what does that show?

User: Well it has a little bit of information on all our teachers and which courses they teach. It's funny how a face can sometimes sell a course!

Analyst: What else?

User: Well a description of the courses themselves of course.

Analyst: What sort of thing.

User: Well, the prices for them in different currencies and sometimes, if we think that people need to go on the courses in a set sequence, then we give that as well – you know the sort of thing – Information Analysis is our foundation course, then you can go on Systems Design and Design. Simple stuff really.

Analyst: That was most helpful. Thank you for your time. May I come back and just verify I've understood correctly?

User: Sure, bye bye.

Step 1

1. Company ‘X’ has a number of courses
2. Courses are requested by a client or company
3. Company ‘X’ has teachers
4. Teachers are all consultants
5. Teachers create courses
6. Company requests course (sort of course = course)
7. Sessions are on a course
8. [Sessions are worked out in outline]
9. Sessions are allocated to consultants
10. Consultants create sessions
11. Consultants can create many sessions
12. Some teachers have not created any sessions
13. {New sessions are not always created for a new course
    {Some sessions are re-used by a new course
    Implies: Sessions can be used for more than one course

14. {Some sessions may be altered for a new course
    {Altered sessions become new sessions
    Implies: that if a session is altered it becomes a new session.
    This has no effect on the Model, only the definition of a session.
15. Company X has a course brochure
16. Course brochure has teachers (details)
17. Course brochure has [teachers teach courses]
18. Course brochure has course (descriptions) – description is a loose term for some of its attributes
19. Course has course prices in currency
20. Course have sequence

Step 2

1. Course
2. Courses are requested by a client or company
3. Teachers
4. Teachers are all consultants
5. Teachers create courses
6. Company requests course
7. Sessions are on a course
8. [converted to Attribute-session worked out in outline – Y/N]
9. Sessions are allocated to consultants
10. Consultants create sessions
11. Consultants can create many sessions
12. Some teachers have not created any sessions
13. Sessions can be used for more than one course
14. -
15. -

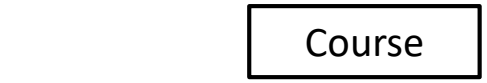
16. Teachers
17. Teachers teach courses
18. Course (descriptions)
19. Course has course prices in currency
20. Courses have sequence

Step 3

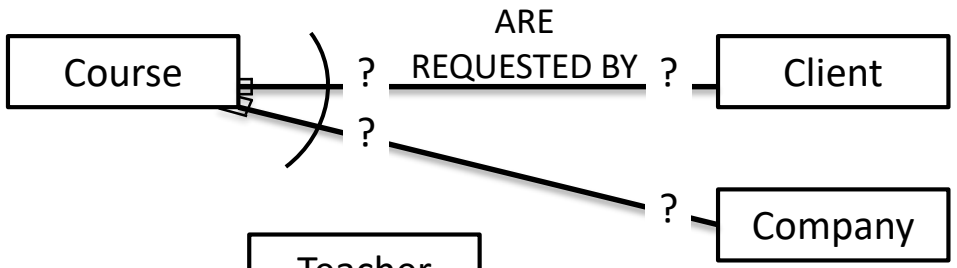
STEP3: Draw a Data Model for each Sentence (Please see following Figures)

STEP3: Draw a Data Model for each Sentence

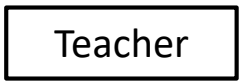
Course



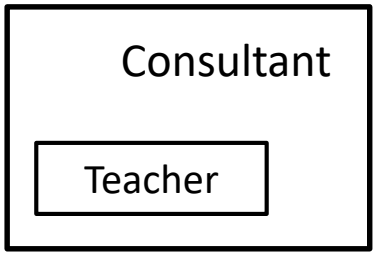
Courses ARE REQUESTED BY a Client or Company



Teacher



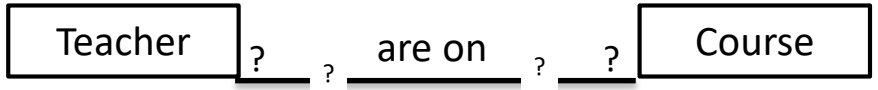
Teachers ARE ALL consultants



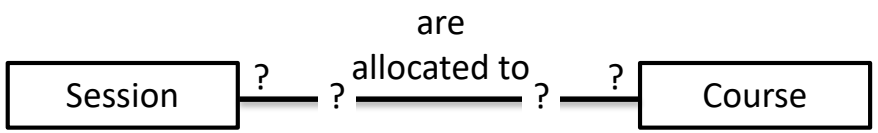
Teachers CREATE Courses

A Company REQUESTS a Course

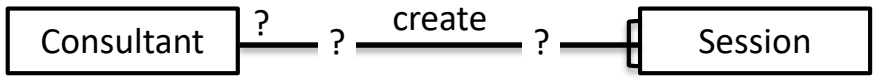
Sessions ARE ON a Course



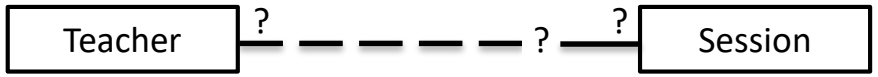
9. Sessions are allocated to Consultants



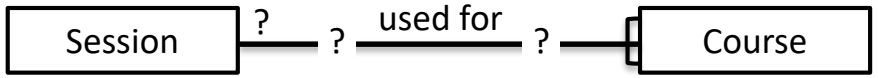
10. + 11. Consultants create sessions/Consultants can create many sessions



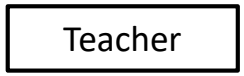
12. Some teachers have not created any sessions
N.B. If some teachers have not created sessions then by implication some consultants won't have either.



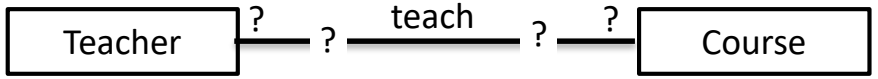
13. Sessions can be used for more than one course



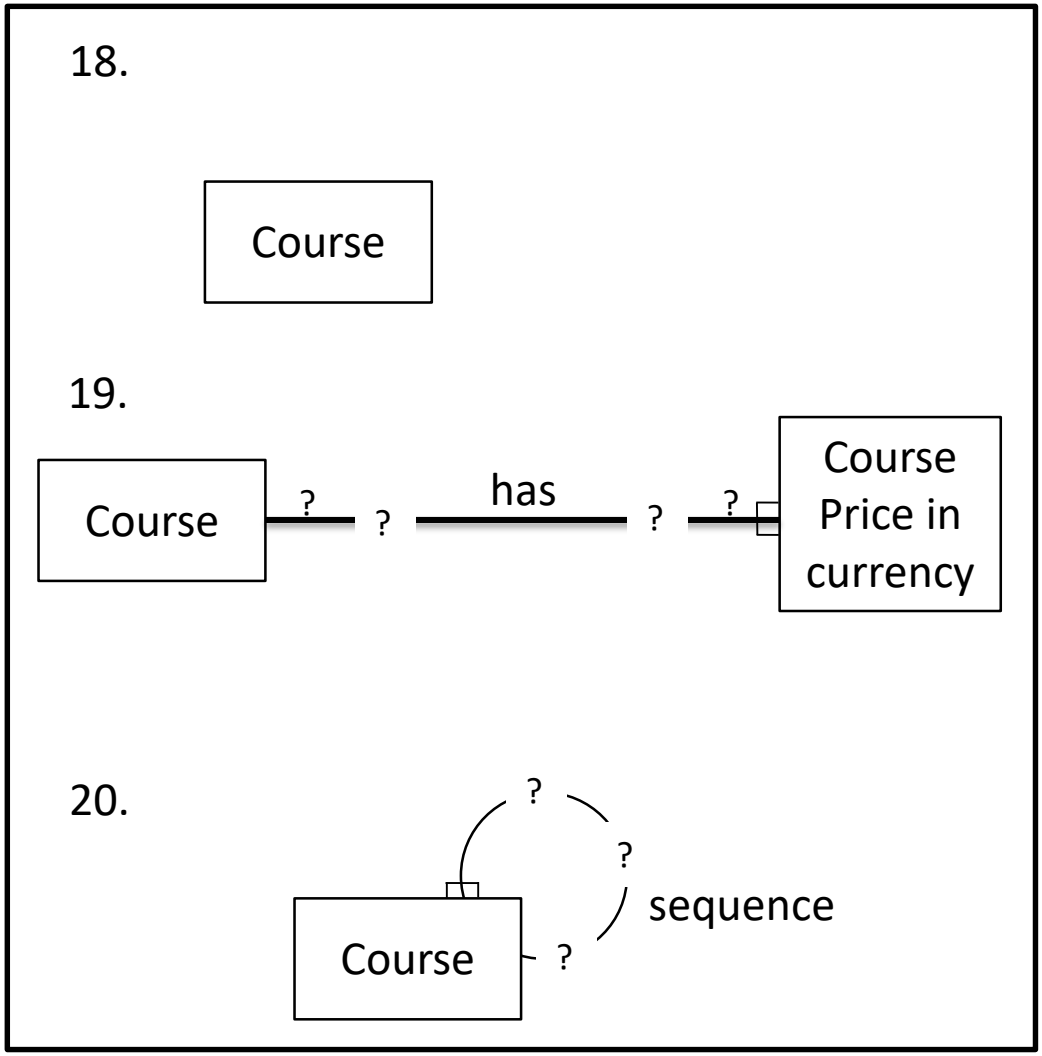
16. Teacher



17. Teachers teach courses

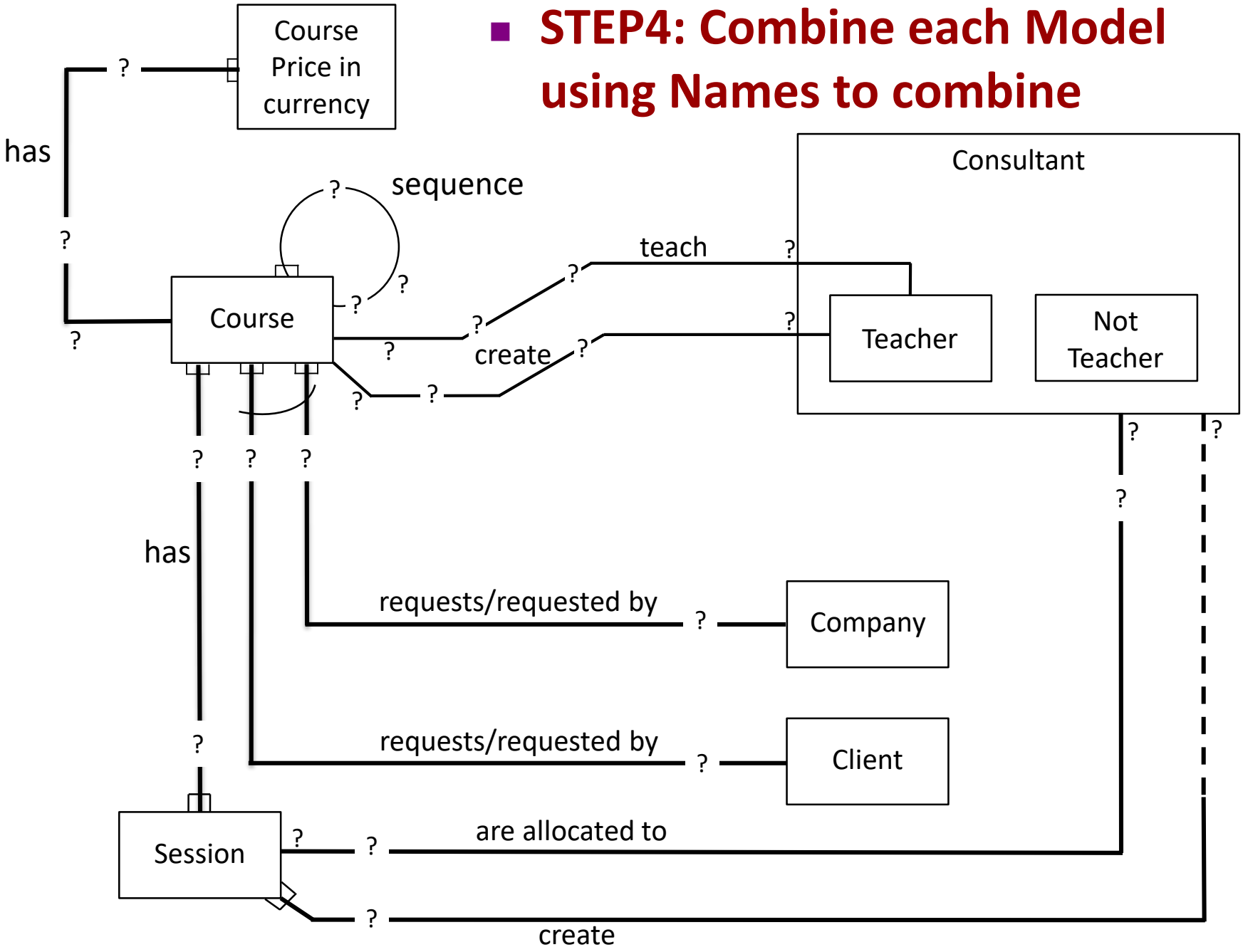


Figure


18.
Course
19.
Course
?
?
has
?
?
Course
Price in
currency
20.
?
?
sequence
Course
?

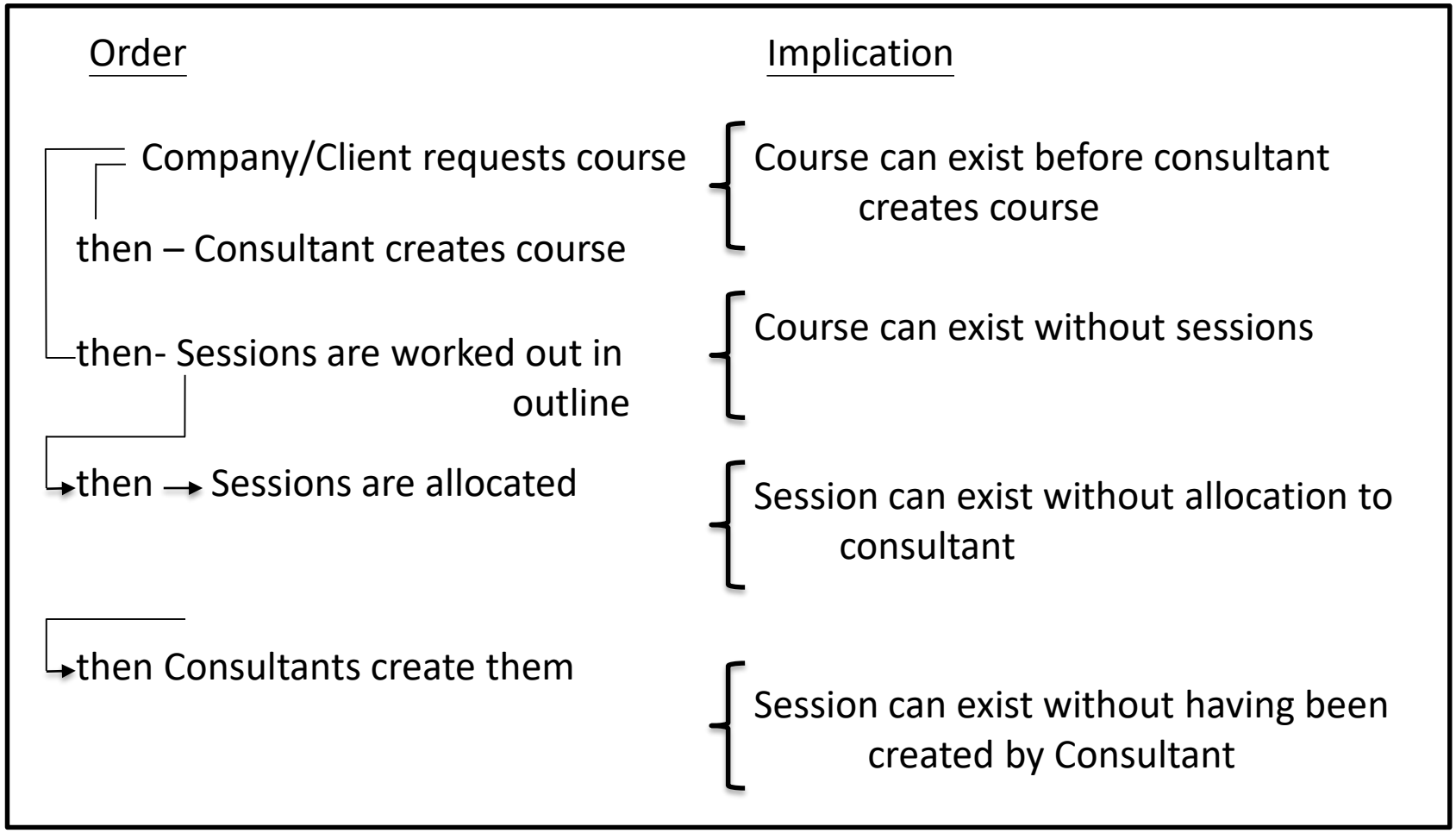
Figure

STEP4: Combine each Model using Names to combine

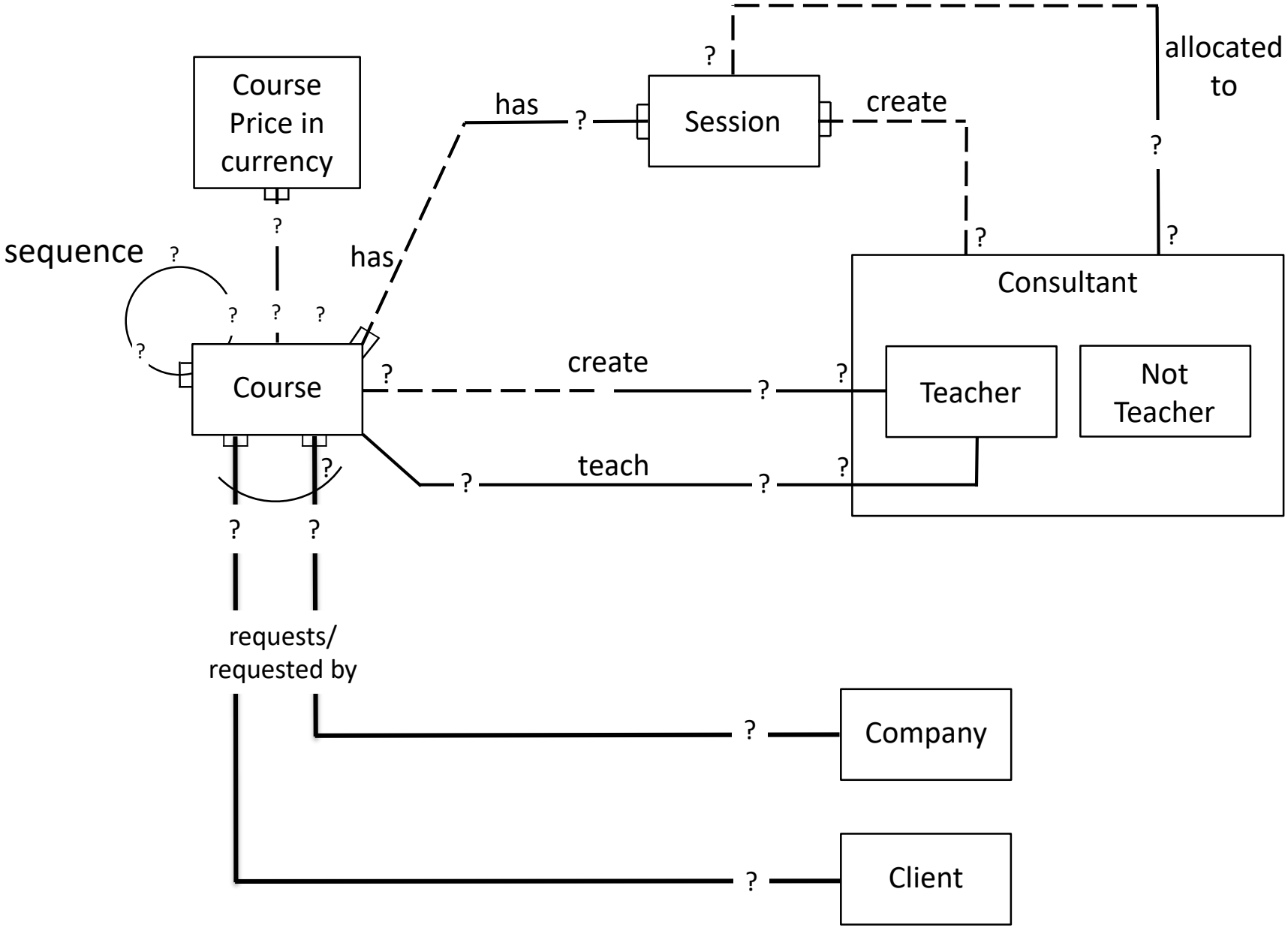


Figure

- **STEP5: See if there is any implied sequence to the activities or in the text**



Figure


Course
Price in
currency
Session
has
create
allocated
to
sequence
has
Consultant
Course
create
Teacher
Not
Teacher
teach
requests/
requested by
Company
Client

Figure

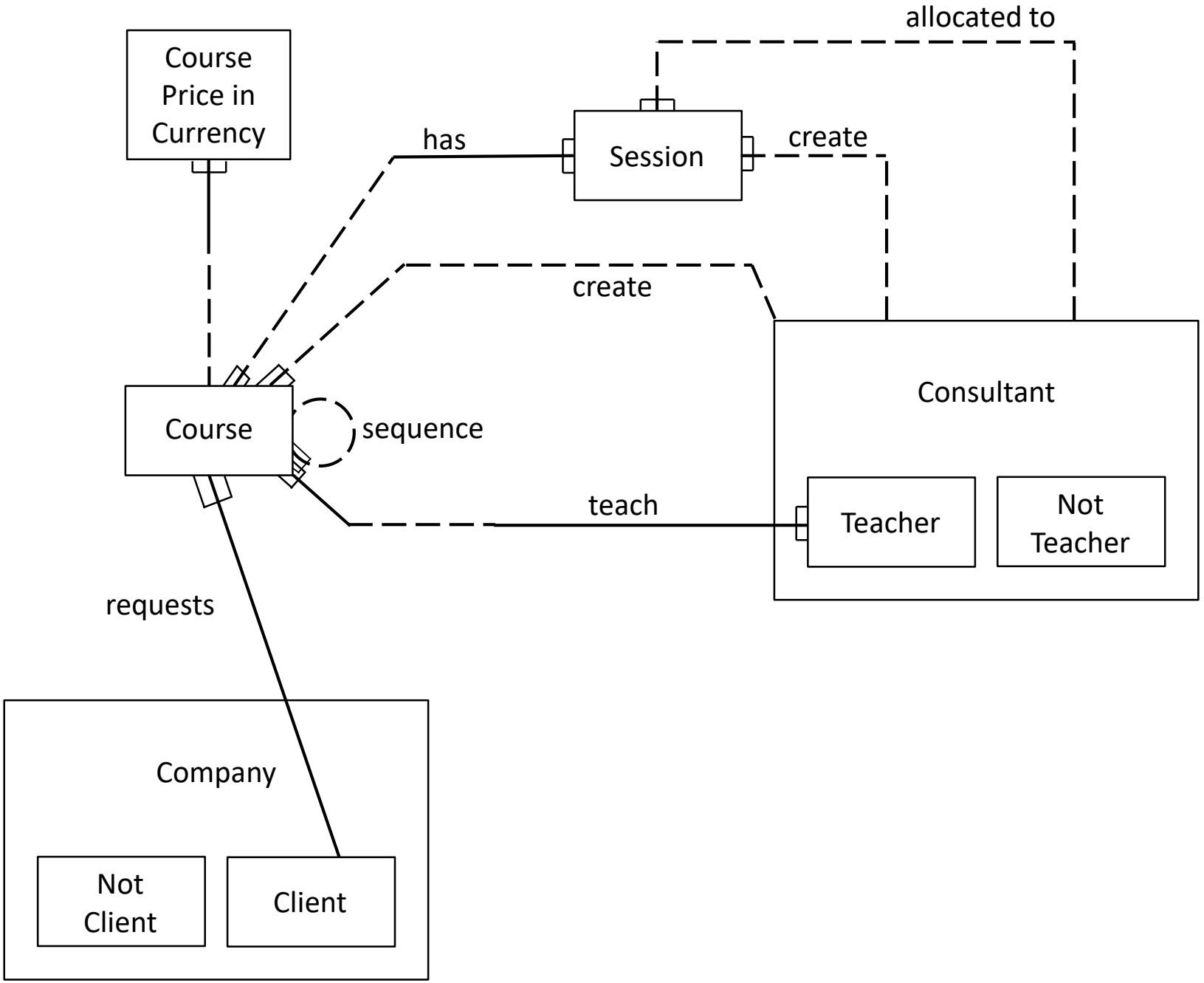


Figure Final Model after Questions

3. Deriving the Data Model Using Occurrences

- **Step1. Reduce the Text to Factual Sentences**

  Remove filler words, unsubstantiated opinion and 'link' type words, e.g. however, and, but.

  Replace any 'it's, 'he's, 'we's, 'she's, and things by the actual thing itself.

  Where a number of things are mentioned but not by name give each of them an arbitrary identifier.

- **Step2. Draw a “semantic network” using the sentences created.**

- **Step3. Classify the Occurrences**

  - Using the Entity occurrences first see what classes of thing are in the picture. Use the names to help you and pattern of similar relationship. You can also use the original sentences if this helps.

  - Combine the individual relationships to produce types.

- **Step 4. Create an Attribute classifying the Attribute values which identified each Entity occurrence.**

5. Step 5. Using semantic network to generate the facts to produce the Data Model.

CASE STUDY

Of the Feasibility Study Course, Prototyping Course and Information Analysis Course only two have actual courses planned or given. The Feasibility Study Course was given on 3.3.87; it was requested by Piggymon of Line House, Vienna. The Information Analysis Course will be given on 1.6.87 and 3.9.87 and was given on 8.8.86. The course to be given on 3.9.87 is to be held at The Hotel Splendid Vista, Brightside, Sheffield and was requested by Piggymon. The course held on 8.8.86 was requested by ABC Tubes and was held at their 5 Acacia Avenue, Geneva premises.

ABC Tubes' other premises at 9 High Street, Letchworth and 10 Green Street, Wapping have not been used by us.

The 1.6.87 course was also requested by ABC Tubes and held at their 5 Acacia Avenue premised. On this course were two of ABC Tubes Employees, Amby Dextrus and Jerry Atrick, along with To Kyo, Sydney Harbour-Bridge and Minnie Appolis, all from the Loob Company of Holland in Hash Street, Amsterdam. Minnie Appolis has also been on a course given on 3.3.87 (Feasibility Study).

Invoice 8897 has been sent for 8.8.86 to ABC Tubes and another invoice 8898 has been sent to the High and Dry Whisky Distillers Company of Glen Fiddick, the Glen, Scotland for the 50 employees they sent.

An invoice 8397 has been prepared for the 1.6.87 course which will go the ABC Tubes and another, 8399, which will go to the Loob Company of Holland.

- **Step1. Reduce the Text to Factual Sentences**

Remove filler words, unsubstantiated opinion and 'link' type words, e.g. however, and, but.

Replace any 'it's, 'he's, 'we's, 'she's, and things by the actual thing itself.

Where a number of things are mentioned but not by name give each of them an arbitrary identifier.

- **Reduce all long sentences to simple sentences of the form:**

noun-verb-noun e.g. John Smith visits Hospital-1

noun-verb-list of nouns e.g. Nurse Richards treats Patient-1, Patient-2, Patient-3.

list of nouns-verb-noun e.g. Doctor Harris, Doctor Jones, and Dr. Allen are treating Mrs. Smith.

Results after Step 1

Of the Feasibility study Course, Prototyping Course and Information Analysis Course only two have actual Courses planned or given } Introductory sentence amplified in next sentences
Prototyping Course (occurrence saved from sentence above)
Feasibility Study Course was given on 3.3.87
Feasibility Study Course of 3.3.87 was requested by Piggymon
Piggymon is at Line House, Vienna
Information Analysis Course will be given on [1.6.87, 3.9.87]
Information Analysis Course was given on 8.8.86
Information Analysis Course on 3.9.87 is to be held at Hotel Splendid Vista, Brightside, Sheffield
Information Analysis Course on 3.9.87 was requested by ABC Tubes
Information Analysis Course on 3.9.87 was held at 5 Acacia Avenue Geneva
5 Acacia Avenue Geneva are the premises of ABC Tubes
ABC Tubes has premises at [9 High Street, Letchworth], [10 Green Street, Wapping]
Information Analysis Course of 1.6.87 was requested by ABC Tubes
Information Analysis Course of 1.6.87 was held at 5 Acacia Avenue
Information Analysis Course of 1.6.87 had on it [Amby Dextrus, Jerry Atrick, To Kyo, Sydney Harbour-Bridge, Minnie Appolis]
[Amby Dextrus, Jerry Atrick] are employees of ABC Tubes
[To Kyo, Sidney Harbour-Bridge, Minnie Appolis] are employees of Loob Company
Loob Company has premises at Hash Street, Amsterdam, Holland
Minnie Appolis was on Feasibility Study Course of 3.3.87
Invoice 8897 was for Information Analysis Course 8.8.86
Invoice 8897 has been sent to ABC Tubes
Invoice 8898 has been sent to High and Dry Whisky Distillers Co.
High and Dry Whisky Distillers Co. have premises at Glen Fiddick, The Glen Scotland
Invoice 8898 was for Information Analysis Course 8.8.86
Information Analysis Course 8.8.86 had [Employee 1 to Employee 50]
[Employee 1 to Employee 50] are employees of High and Dry Whisky Distillers Co.
Invoice 8397 is for Information Analysis Course of 1.6.87
Invoice 8397 will go to ABC Tubes
Invoice 8399 will go to Loob Company (of Holland)
Invoice 8399 is for Information Analysis Course of 1.6.87

Step2 Draw a "semantic network" using the sentences created.

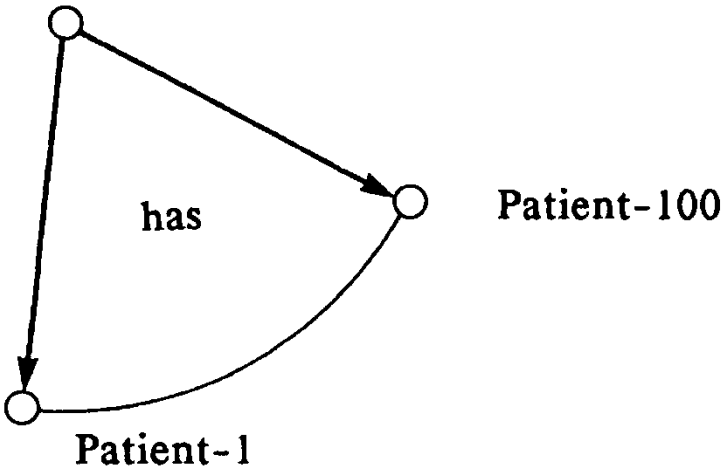
- Represent each thing by a node circle e.g. ○ John Smith
- Represent each verb by a line e.g. has
- Show the meaning of the sentence by using an arrow on the line

e.g. John Smith ○——likes——→○ Anne Smith

- Merge the individual sentences using the common names to produce a network of node points representing the things and the lines representing the verbs linking the things.

- Where many things are related an arc can be used,

e.g. Hospital-1



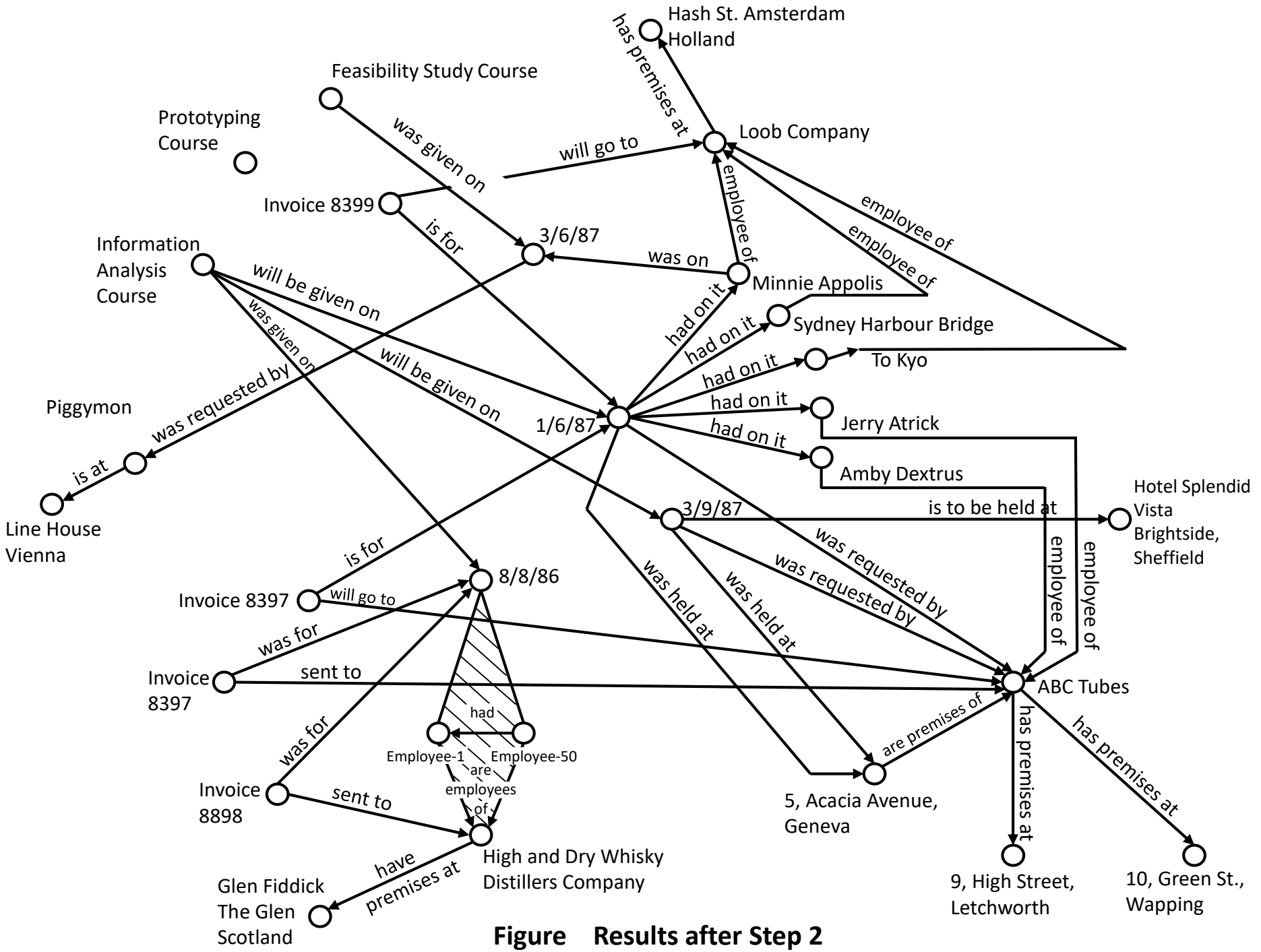
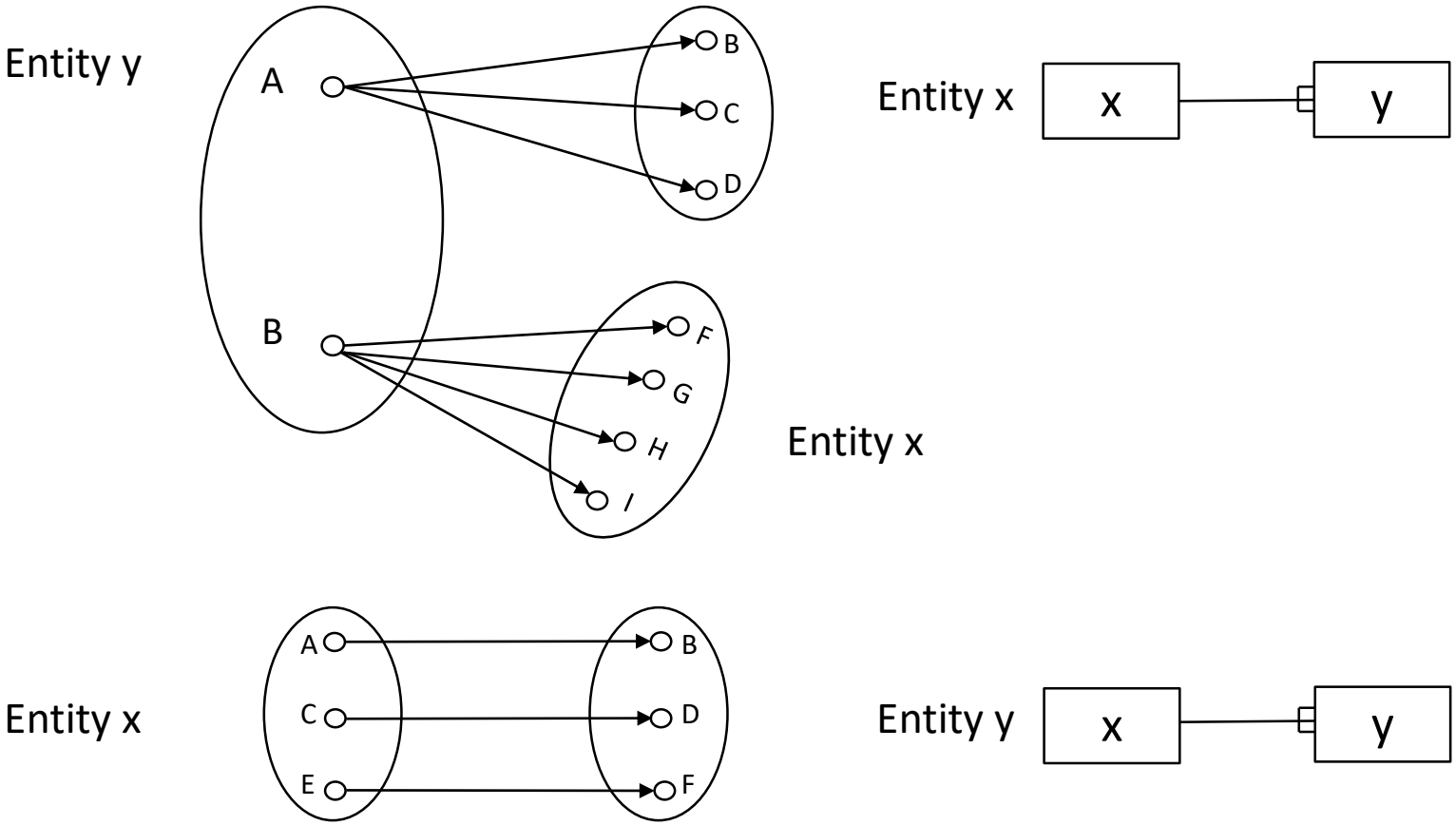


Figure Results after Step 2

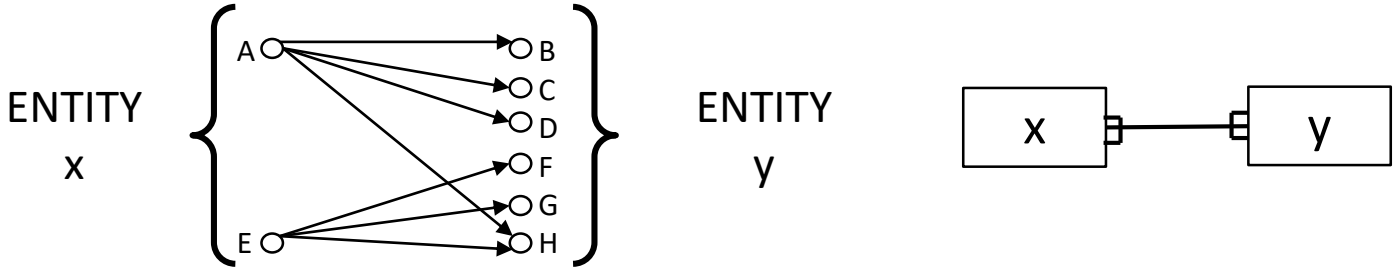
- **Step3. Classify the Occurrences**

- Using the Entity occurrences first see what classes of thing are in the picture. Use the names to help you and pattern of similar relationship. You can also use the original sentences if this helps.

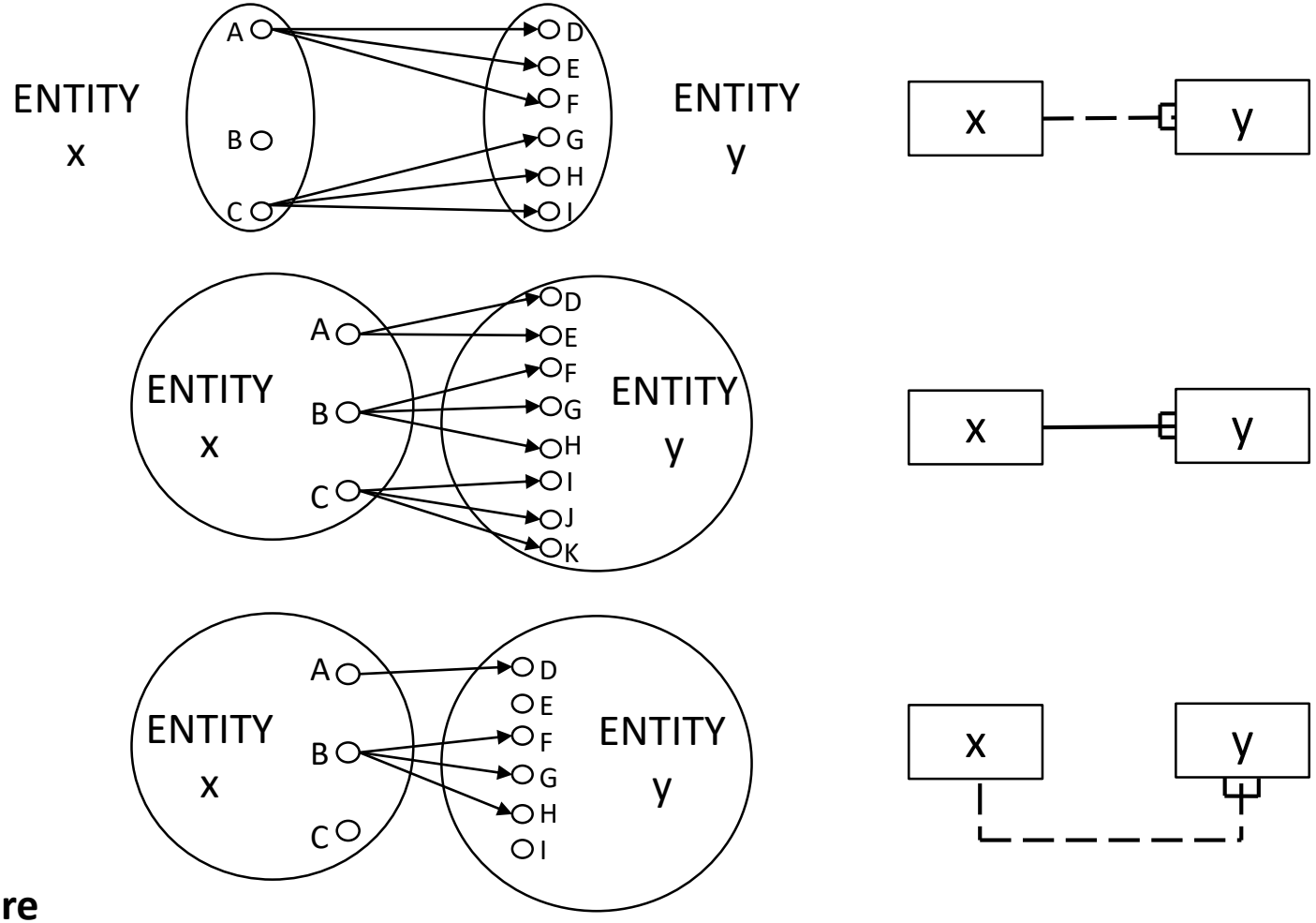
- Combine the individual relationships to produce types.


Entity y
A
B
B
C
D
F
G
H
I
Entity x
Entity x
x
y
Entity x
A
C
E
B
D
F
Entity y
x
y

Figure



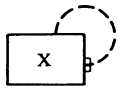
- Optionality is known from the occurrences as follows



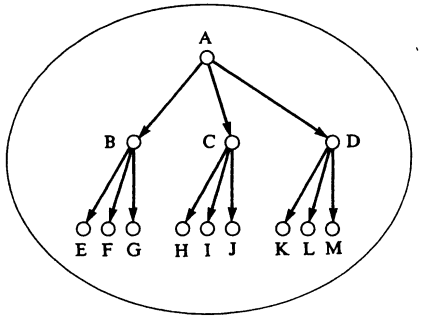
Figure

Occurrences

DATA MODEL

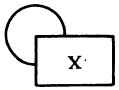


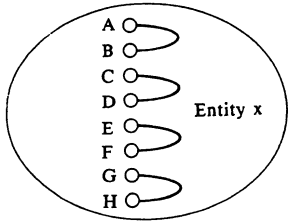
Entity x



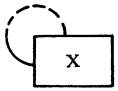
Only some occurrences 'have' other occurrences.

Only some occurrences 'are had by' another occurrence.

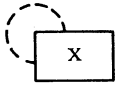


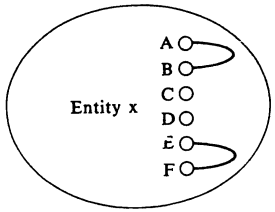


Each occurrence is both 'had' and 'had by' another occurrence.

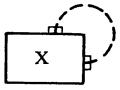


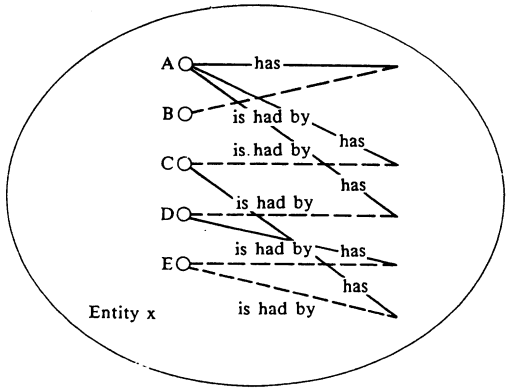
impossible





Only some occurrences have and are had by another occurrence.





Not every occurrence 'has' something.

Not every occurrence 'is had by' something.

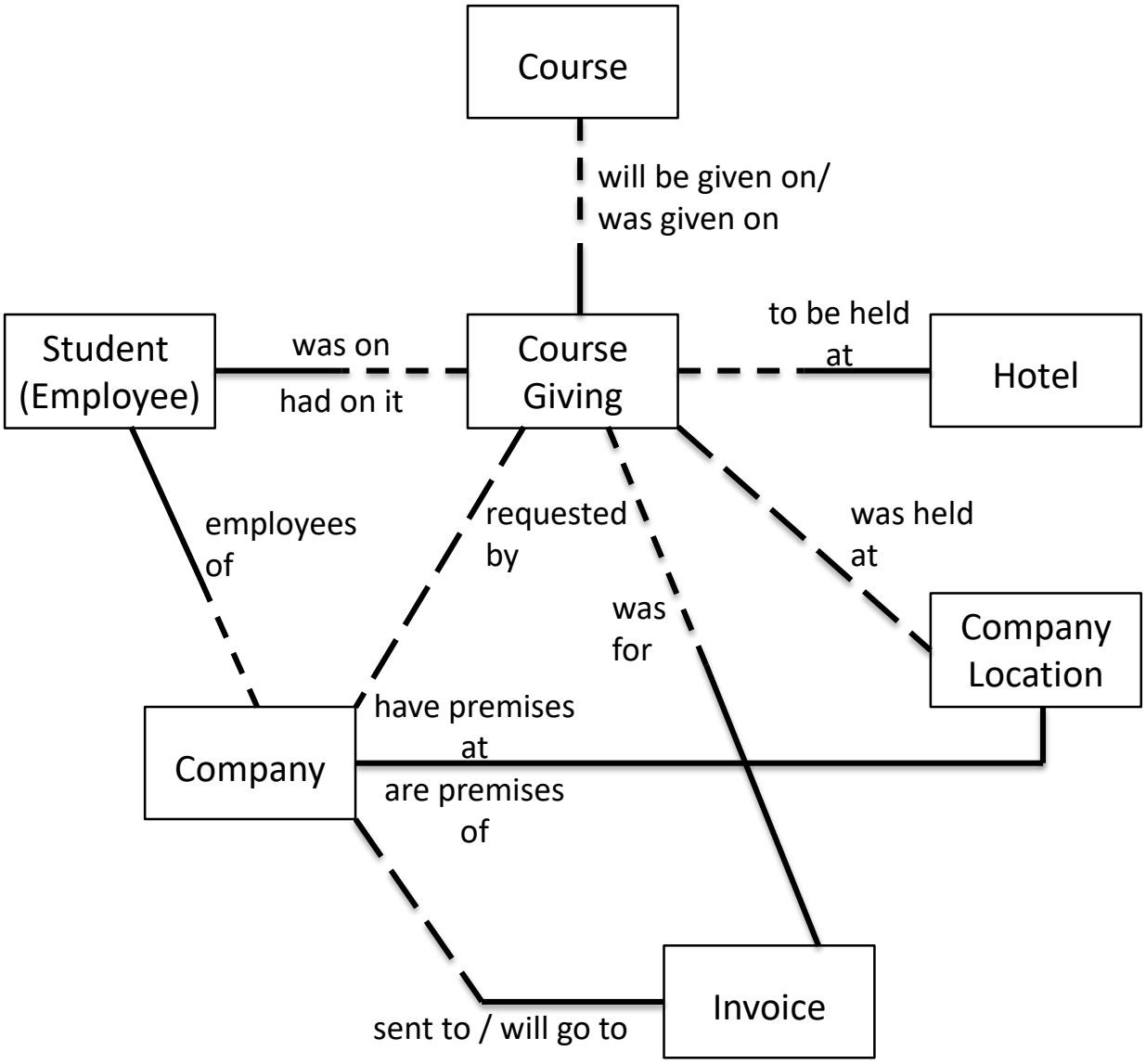
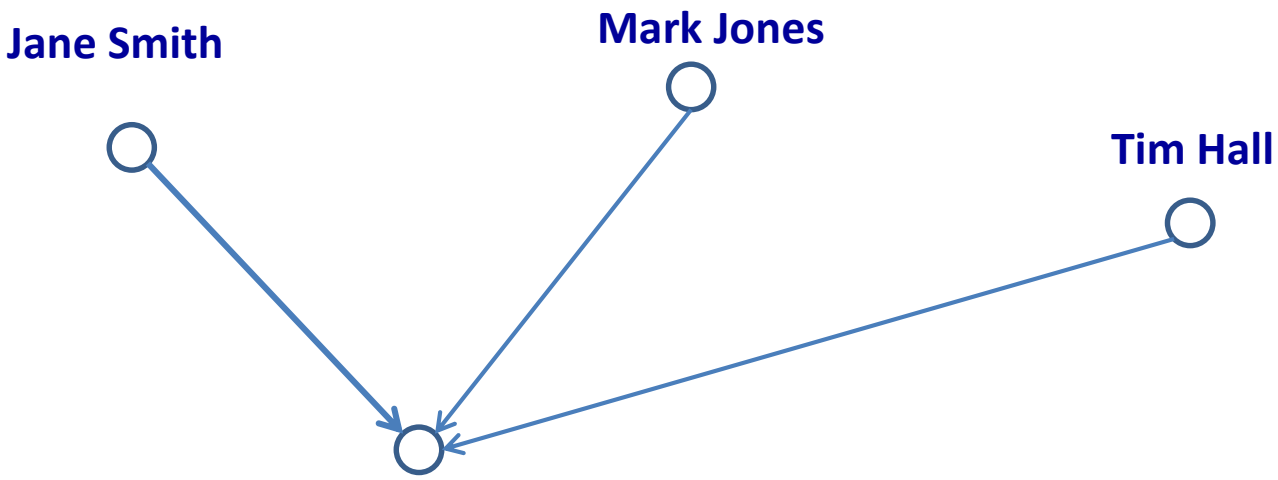


Figure The Data Model after Step 3

- **Step4 Create an Attribute classifying the Attribute values which identified each Entity occurrence.**



Entity = Person
Attribute = Full Name

Course

Name of Course

Company

Name of Company

Invoice

Invoice number

Student

Student (full) name

Hotel

Hotel name

Hotel address

Company location

Address

Course giving

Start date

4. Deriving the Data Model Using Design Occurrences

Basic Concepts: Normalization

The theory of data normalization is important to verify a relational data schema is well formed in order to avoid unnecessary data redundancies and potential inconsistencies due to data insertion, update, or deletion anomalies.

It is based on the analysis of functional dependencies among attributes.

Definition 1. Functional dependencies: An attribute A is functionally dependent on another attribute B (or B functionally determines A), if for every occurrence of B there exists one and only one possible occurrence of A. We write, B → A. Functional dependencies also apply to subsets of attributes of a relation schema R. Multi-valued dependencies are defined in the case where for every occurrence of an attribute B there is a set of dependent values for attribute A. These are special forms of integrity constraints on attributes.

Definition 2. 1st normal form (1NF): A relation schema R is in 1st normal form if every attribute of R is defined on an atomic domain (i.e. there is no aggregate attribute.)

Definition 3. 2nd normal form (2NF): A relation schema R is in 2nd normal form if it is in 1st normal form, and if every non-key attribute is functionally dependent on each attribute of the key of R and not on a subset of key attributes.

Definition 4. 3rd normal form (3NF): A relation schema R is in 3rd normal form if it is in 2nd normal form, and if every non-key attribute is not functionally dependent on another non-key attribute of R (i.e. there is no transitive dependencies).

Definition 5. Boyce-Codd normal form (BCNF): A relation schema R is in BCNF of whenever X → A holds in R, and A is not in X, then X is a superkey of R, i.e. X is or contains a key.

The Boyce-Codd normal form is the strongest form of the four types.

For instance, the following relational schema, with the following functional dependencies, not in normal form, even not in 1st normal form.

PARTS (P#, Price, (Buffer#, Location, Quantity)) Key: P#

P# → Price; Buffer# → Location; (P#, Buffer#) → Quantity

To normalize this data schema, the relation PARTS must be broken down into three simpler, non-decomposable, relational schemas as follows:

PARTS (P#, Price) Key: P# BUFFRES (Buffer#, Location) Key: Buffer#

STORAGE (P#, Buffer#, Quantity) Key: (P#, Buffer#)

STEP 1

The first step is to take the box or column headings and lay them out in simple table form with the headings across the top of the page and the values below the headings in rows. Repeating blocks of values should be listed against the set of values for which they repeat.

STEP 2

Find a column heading which will uniquely identify a full row of values. Ideally it should be just one heading. If we can't get uniqueness using one we must combine two or more until a unique identifier is found.

STEP 1

The first step is to take the box or column headings and lay them out in simple table form with the headings across the top of the page and the values below the headings in rows. Repeating blocks of values should be listed against the set of values for which they repeat.

STEP 2

Find a column heading which will uniquely identify a full row of values. Ideally it should be just one heading. If we can't get uniqueness using one we must combine two or more until a unique identifier is found.

NAME	NUMBER	DATE START	DATE END	NO. OF STUDENTS	COURSE NAME	COURSE NO.	ABBREV . NAME
Angela Angle Poise	112	5.4.86	9.4.86	15	Information Analysis	01	INFO ANAL
		6.6.86	10.6.86	10	Feasibility Study	02	FEASIBILILTY
		7.7.87	11.7.87	15	Database Design	04	DB BESIGN
James Robertson	133	3.3.86	5.3.86	20	Strategy Study	03	STRATEGY
		5.4.86	9.4.86	15	Information Analysis	01	INFO ANAL
		7.7.87	11.7.87	20	Feasibility Study	02	FEASIBILITY
		1.8.87	11.8.87	30	Application Systems Design	05	APPLIC DESIGN
Martin Henry	188	6.6.86	10.6.86	10	Feasibility Study	02	FEASBILITY
		3.3.87	7.3.87	8	Information Analysis	01	INFO ANAL
		7.7.87	11.7.87	15	Database Design	04	DB DESIGN
Pat Winters	354	-	-	-	-	-	-
John Smith	338	5.4.87	8.4.84	0	Information Analysis	01	INFO ANAL
Blank	000	6.4.87	11.4.87	0	Feasibility Study	02	FEASIBILITY

STEP 3

Now remove the repeating groups. This may have to be done in a series of steps if several layers of repeating group occur, or could be done in one step if only one occurs.

Create a separate table for the repeating group and duplicate the key value in the new table. Choose a key for the new table in the same way as you chose a key for the original table. You may have to invent a temporary one if one does not exist.

This step in Normalisation is called “Creating First Normal Form”.

Example 1

A	B	C	D	E	F
*	*	*	*	*	*
			*	*	*
			*	*	*

becomes

A	B	C
*	*	*

A and D are the key

A	D	E	F
*	*	*	*
*	*	*	*
*	*	*	*

Example 2

A	B	C	D	E	F
*	*	*	*	*	*
		*	*	*	*
			*	*	*
			*	*	*
			*	*	*

becomes on the first step

A	B
*	*

A and C together are the key

A	C	D	E	F
*	*	*	*	*
*	*	*	*	*
			*	*
			*	*
			*	*

and then on the next step

A	B
*	*

A	C
*	*
*	*

A,C and C together are the key

A	C	D	E	F
*	*	*	*	*
*	*	*	*	*
*	*	*	*	*
*	*	*	*	*
*	*	*	*	*

Figure 3.50 Examples 1 and 2 – Step 3

STEP 4

(In normalisation this is called “Conversion to Second Normal Form”).

Look at the keys which have been formed from a combination of column headings.

Taking each part of the key in turn, look through the non-key items and see if any items look like they depend on the part key rather than the whole key.

NAME	No.
Angela Anglepoise	112
James Robertson	133
Martin Henry	188
Pat Winters	354
John Smith	338
Blank	000

No.	DATE START	DATE END	NO. OF STUDENTS	COURSE NAME	COURSE NO.	ABBREV. NAME
112	5.4.86	9.4.86	15	Info Analysis	01	INFO ANAL
112	6.6.86	10.6.86	10	Feas. Study	02	FEASIBILITY
112	7.7.87	11.7.87	15	Database Design	04	DB DESIGN
133	3.3.86	5.3.86	20	Strat. Study	03	STRATEGY
133	5.4.86	9.4.86	15	Info Anal	01	INFO ANAL
133	7.7.87	11.7.87	30	Feas.Study	02	FEASIBILITY
133	1.8.87	11.8.87	20	Application Sys. Design	05	APPLIC DESIGN
188	6.6.86	10.6.86	10	Feas.Study	02	FEASIBILITY
188	3.3.87	7.3.87	8	Info Anal	01	INFO ANAL
188	7.7.87	11.7.87	15	Database Design	04	DB DESIGN
354	-	-	-	-	-	-
338	5.4.87	8.4.87	0	Info Analysis	01	INFO ANAL
000	6.4.87	11.4.87	0	Feas.Study	02	FEASIBILITY

Figure 3.51 First Normal Form

NAME	No.
Angela Anglepoise	112
James Robertson	133
Martin Henry	188
Pat Winters	354
John Smith	338
Blank	000

No.	DATE START	DATE END	NO. OF STUDENTS	COURSE NAME	COURSE NO.	ABBREV. NAME
112	5.4.86	9.4.86	15	Info Analysis	01	INFO ANAL
112	6.6.86	10.6.86	10	Feas. Study	02	FEASIBILITY
112	7.7.87	11.7.87	15	Database Design	04	DB DESIGN
133	3.3.86	5.3.86	20	Strat. Study	03	STRATEGY
133	5.4.86	9.4.86	15	Info Anal	01	INFO ANAL
133	7.7.87	11.7.87	30	Feas.Study	02	FEASIBILITY
133	1.8.87	11.8.87	20	Application Sys. Design	05	APPLIC DESIGN
188	6.6.86	10.6.86	10	Feas.Study	02	FEASIBILITY
188	3.3.87	7.3.87	8	Info Anal	01	INFO ANAL
188	7.7.87	11.7.87	15	Database Design	04	DB DESIGN
354	-	-	-	-	-	-
338	5.4.87	8.4.87	0	Info Analysis	01	INFO ANAL
000	6.4.87	11.4.87	0	Feas.Study	02	FEASIBILITY

Figure 3.52 First Normal Form

Name	No.
Angela Anglepoise	112
James Robertson	133
Martin Henry	188
Pat Winters	354
John Smith	338
Blank	000

No.	Date Start	No. of Students	Course Name	Course No.	Abbrev. Name
112	5.4.86	15	Info Analysis	01	INFO ANAL
112	6.6.86	10	Feas. Study	02	FEASIBILITY
112	7.7.87	15	Db.Design	04	DB DESIGN
133	3.3.86	20	Strategy Study	03	STRATEGY
133	5.4.86	15	Info.Analysis	01	INFO ANAL
133	7.7.87	30	Feas.Study	02	FEASIBILITY
133	1.8.87	20	Application Systems Design	05	APPLIC DESIGN
188	6.6.86	10	Feas.Study	02	FEASIBILITY
188	3.3.87	8	Info.Analysis	01	INFO ANAL
188	7.7.87	15	Db Design	04	DB DESIGN
354	-	-	-	-	-
338	5.4.87	0	Info Analysis	01	INFO ANAL
000	6.4.87	0	Feas.Study	02	FEASIBILITY

DATE START	DATE END
5.4.86	9.4.86
6.6.86	10.6.86
7.7.87	11.7.87
3.3.86	5.3.86
1.8.87	11.8.87
3.3.87	7.3.87
-	-
5.4.87	8.4.87
6.4.87	11.4.87

Figure 3.53 Second Normal Form

Second Normal Form

STEP 5

In normalisation this step is called “Conversion to Third Normal Form”. We now look at eatch table in turn.

Taking all non-key items in turn, we ask if any non-key item is dependent on another non-key item.

Second Normal Form

NAME	No.
Angela Anglepoise	112
James Robertson	133
Martin Henry	188
Pat Winters	354
John Smith	338
Blank	000

No.	DATE START	COURSE NO.	NO. OF STUDENTS
112	5.4.86	01	15
112	6.6.86	02	10
112	7.7.87	04	15
133	3.3.86	03	20
133	5.4.86	01	15
133	7.7.87	02	30
133	1.8.87	05	20
188	6.6.86	02	10
188	3.3.87	01	8
188	7.7.87	04	15
354	-	-	-
338	5.4.87	01	0
000	6.4.87	02	0

COURSE NO.	COURSE NAME	ABBREV. NAME	DATE START	DATE END
01	Info Analysis	INFO ANAL	5.4.86	9.4.86
02	Feas. Study	FEASIBILITY	6.6.86	10.6.86
03	Strategy Study	STRATEGY	7.7.87	11.7.87
			3.3.86	5.3.86
04	Database Design	DB DESIGN	1.8.87	11.8.87
			3.3.87	7.3.87
05	Application Systems Design	APPLIC DESIGN	-	-
			5.4.87	8.4.87
			6.4.87	11.4.87

Figure 3.56 Third Normal Form

STEP 6

Now we can convert the tables to a Data Model.

Remove the data values leaving only the column headings. Place the tables with the fewest key items at the top of the page and work progressively down the page as the number of key items increases (i.e. number of items which make up the key). For an example, see Figure 3.57.

Working from top to bottom connect the *Keys* by always placing the many end at the bottom end of the line. See Figure 3.58.

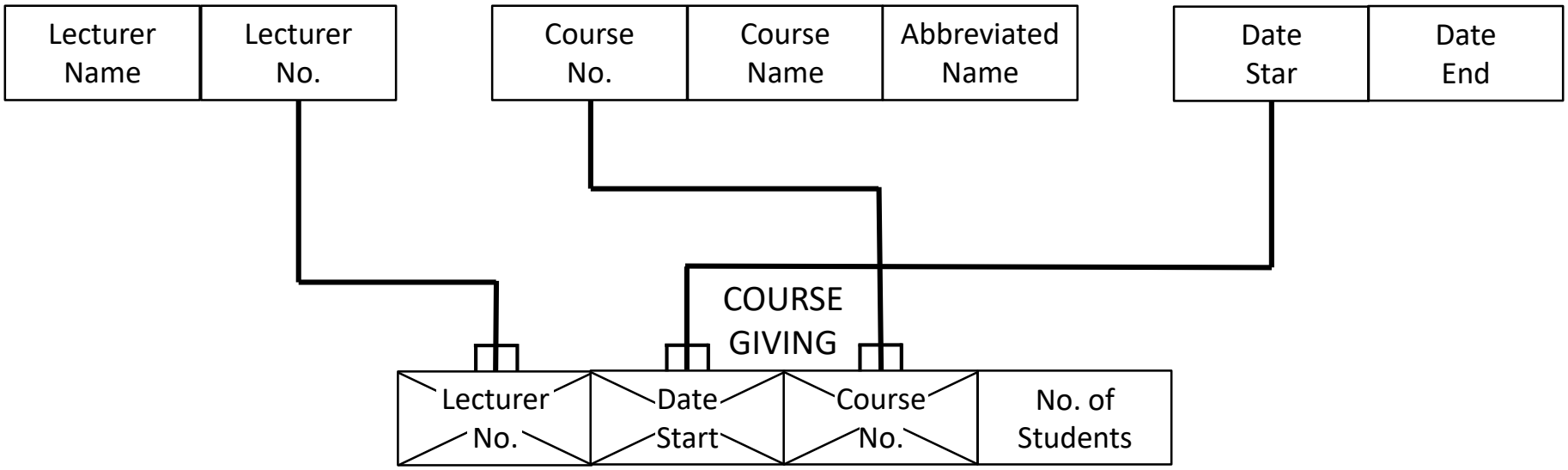
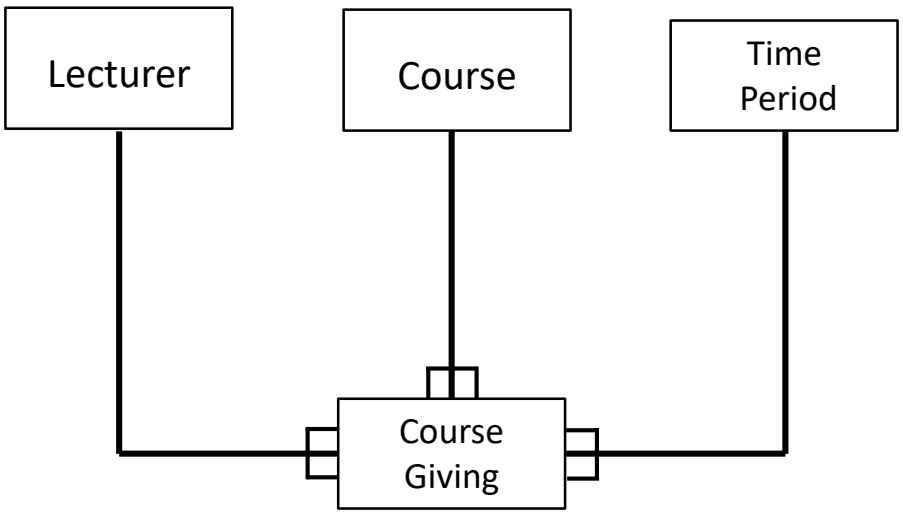


Figure 3.62 Lecture's schedule example - tables



Lecturer	Course	Time Period	Course Giving
Name No	Course No. Course Name Abbreviated Name	Start Date End Date	No. of Students

Figure 3.63 Lecturer's schedule example – Data Model with list of Attributes

STEP 7

Go back to the “Third Normal Form” table which had the data values in it.

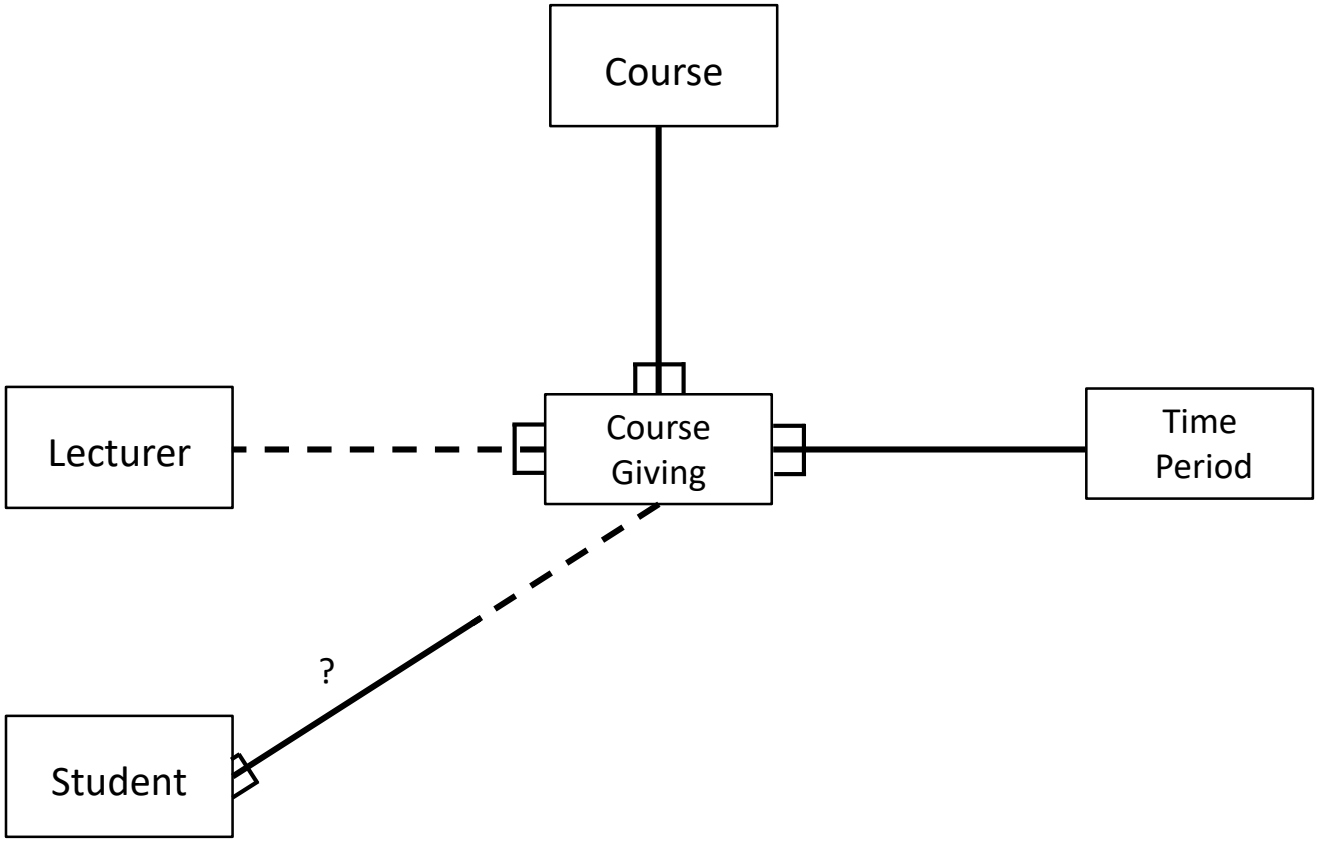


Figure 3.67 Lecturer’s schedule example – Resulting Model