In-Flight Entertainment System

FINAL REPORT

By: Zhihao Cao
CSCI 54100
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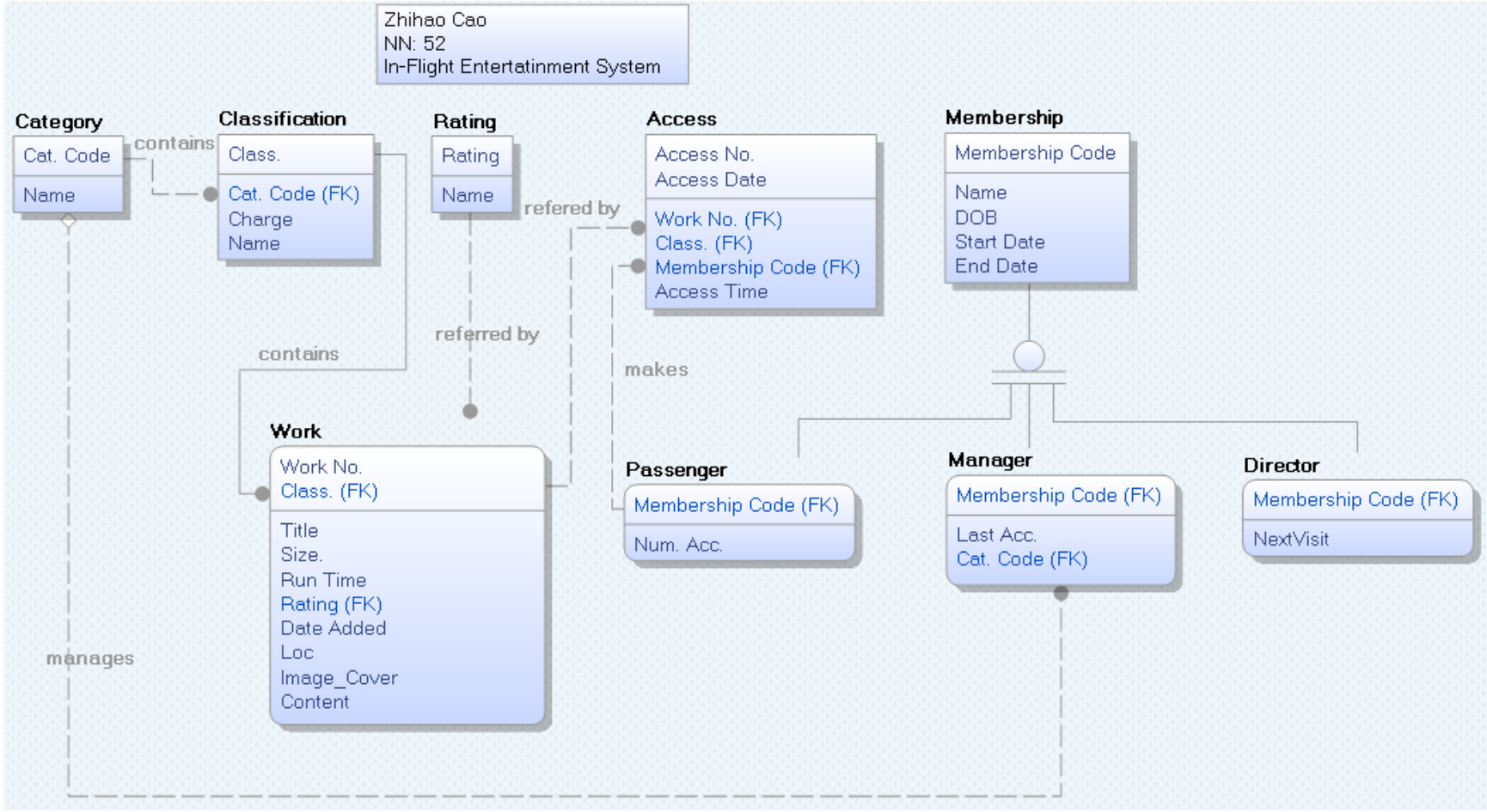
Problem Statement

In-Flight Entertainment System (IFES) offers enjoyable entertainment during the airline flight. There are many records are needed to be stored and operated in order to keep the system running.

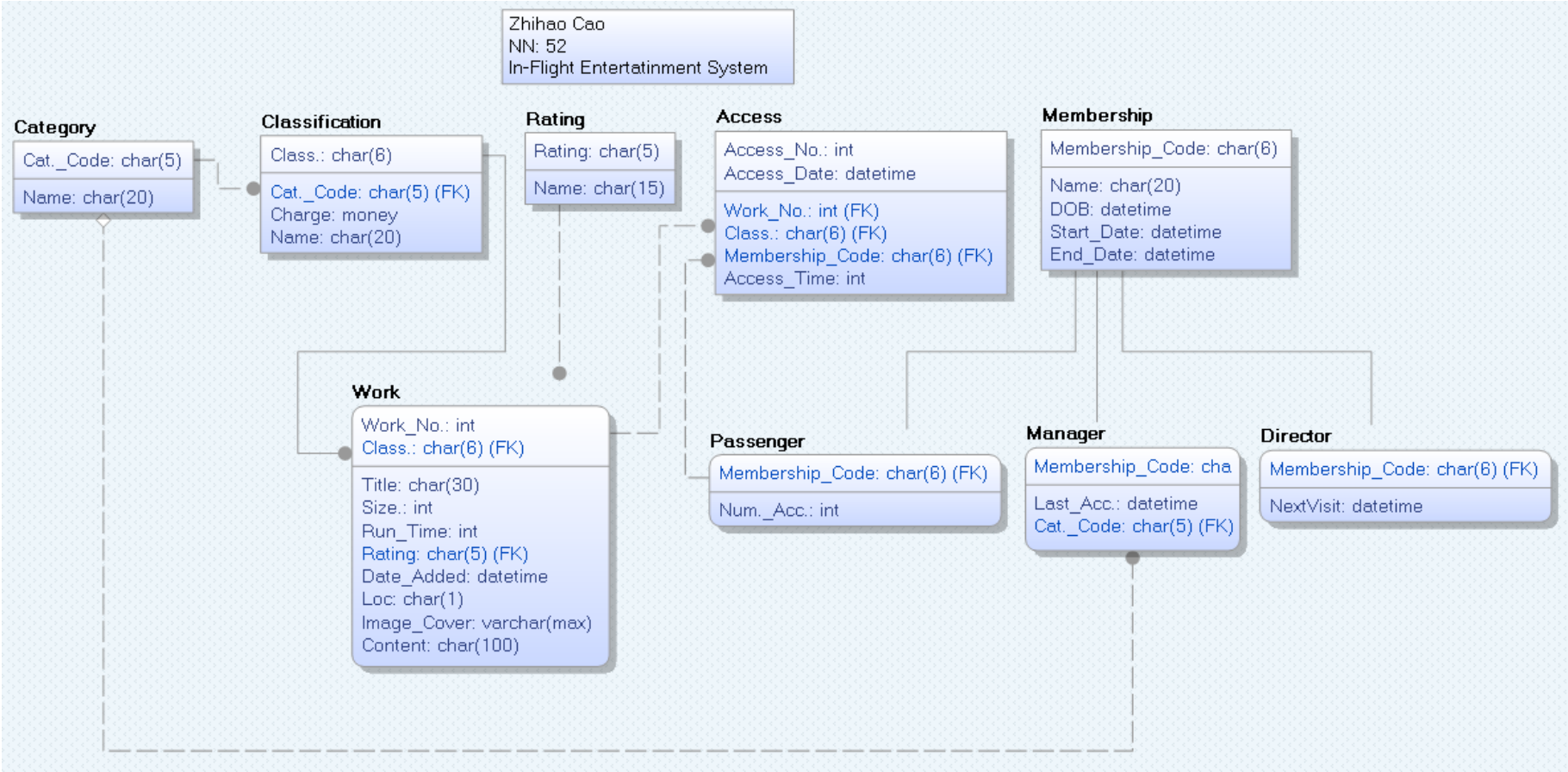
To make sure the availability and consistency of the records, 5NF database design technique is used. According to the data given from the Memos, different relations are designed to reduce the redundancies.

This report shows the design of the IFES database system, the current records in the system, and the results of typical queries applied for the system. In the appendix, the historical data will be given to show the changes during the designing period.

LDM & PDM Design



LDM


Zhihao Cao
NN: 52
In-Flight Entertainment System
Category
Cat._Code: char(5)
Name: char(20)
Classification
Class.: char(6)
Cat._Code: char(5) (FK)
Charge: money
Name: char(20)
Rating
Rating: char(5)
Name: char(15)
Access
Access_No.: int
Access_Date: datetime
Work_No.: int (FK)
Class.: char(6) (FK)
Membership_Code: char(6) (FK)
Access_Time: int
Membership
Membership_Code: char(6)
Name: char(20)
DOB: datetime
Start_Date: datetime
End_Date: datetime
Work
Work_No.: int
Class.: char(6) (FK)
Title: char(30)
Size.: int
Run_Time: int
Rating: char(5) (FK)
Date_Added: datetime
Loc: char(1)
Image_Cover: varchar(max)
Content: char(100)
Passenger
Membership_Code: char(6) (FK)
Num._Acc.: int
Manager
Membership_Code: cha
Last_Acc.: datetime
Cat._Code: char(5) (FK)
Director
Membership_Code: char(6) (FK)
NextVisit: datetime

PDM:

Show all data from all tables.

```
--1
SELECT * FROM Membership
```

Membership_Code	Name	Start_Date	End_Date	DOB
MC0000	Bob Bureaucarat	NULL	NULL	NULL
MC0101	Sam Supervisor	NULL	NULL	NULL
MC0102	Mary Manager	NULL	NULL	NULL
MC0103	Fred Foreman	NULL	NULL	NULL
MC0800	Ken White	1999-03-12 00:00:00.000	2011-03-30 00:00:00.000	1966-07-07 00:00:00.000
MC0900	James Mason	1999-05-22 00:00:00.000	NULL	1980-02-23 00:00:00.000
MC1009	Mike Smith	2011-01-23 00:00:00.000	NULL	1975-02-02 00:00:00.000
MC1011	Mary Smith	2011-03-11 00:00:00.000	NULL	1976-07-04 00:00:00.000
MC1014	John Doe	2008-12-11 00:00:00.000	NULL	1988-01-11 00:00:00.000
MC1022	Bill Doe	2011-03-11 00:00:00.000	NULL	2001-01-04 00:00:00.000
MC1023	Kelly Doe	2011-03-15 00:00:00.000	NULL	2006-06-06 00:00:00.000
MC1035	Ann Black	2011-03-12 00:00:00.000	2011-03-16 00:00:00.000	1972-06-17 00:00:00.000
MC1039	Jane Dough	2011-03-14 00:00:00.000	2011-03-14 00:00:00.000	1990-12-25 00:00:00.000
MC1040	Karen Kline	2011-03-14 00:00:00.000	NULL	1988-05-05 00:00:00.000
MC1045	Jack Jones	2001-01-22 00:00:00.000	NULL	1980-07-23 00:00:00.000
MC1065	Joe Grey	2011-01-13 00:00:00.000	NULL	1995-11-23 00:00:00.000

```
(16 row(s) affected)
--2
```

```
SELECT * FROM Passenger
Membership_Code Num_Acc
--------------- -----------
MC0800          1
MC0900          0
MC1009          3
MC1011          2
MC1014          6
MC1022          1
MC1023          1
MC1035          2
MC1039          1
MC1040          1
MC1045          2
MC1065          0

(12 row(s) affected)

--3
SELECT * FROM Manager
Membership_Code Last_Acc                Cat_Code
--------------- ----------------------- --------
MC0101          NULL                    MU
MC0102          NULL                    MO
MC0103          NULL                    SS
```

```
(3 row(s) affected)

--4
SELECT * FROM Director
Membership_Code NextVisit
--------------- ----------------------
MC0000          NULL

(1 row(s) affected)

--5
SELECT * FROM Access
Access_No   Access_Date             Membership_Code Work_No     Class  Access_Time
----------- ----------------------- --------------- ----------- ------ -----------
20          2015-03-10 00:00:00.000 NULL            2           Dram   42
21          2015-03-10 00:00:00.000 MC1014          1           Fan    152
30          2015-03-13 00:00:00.000 MC1009          7           ST     92
33          2015-03-11 00:00:00.000 MC1014          3           Fan    43
43          2015-03-15 00:00:00.000 MC1014          9           SiFi   60
44          2015-03-15 00:00:00.000 MC1035          13          Fan    85
45          2015-03-15 00:00:00.000 MC0800          1           Fan    152
54          2015-03-12 00:00:00.000 MC1009          10          SiFi   115
54          2015-03-15 00:00:00.000 MC1014          8           ST     25
57          2015-03-12 00:00:00.000 MC1011          6           SiFi   100
60          2015-03-15 00:00:00.000 MC1040          7           Fan    95
77          2015-03-03 00:00:00.000 NULL            5           ST     43
```

```
80          2015-03-13 00:00:00.000 MC1035          10          SiFi    45
82          2015-03-15 00:00:00.000 MC1039          14          SiFi    95
82          2015-03-16 00:00:00.000 MC1014          1           Dram    25
91          2015-03-15 00:00:00.000 MC1045          11          Fan     60
91          2015-03-16 00:00:00.000 MC1014          1           Folk    152
95          2015-03-16 00:00:00.000 MC1045          12          Fan     95
98          2015-03-13 00:00:00.000 MC1009          4           Folk    37
98          2015-03-16 00:00:00.000 MC1011          4           SiFi    75

(20 row(s) affected)

--6
SELECT * FROM Work
Work_No     Class  Title                          Size        Run_Time    Rating Date_Added              Loc  Image_Cover
Content
----------- ------ ------------------------------ ----------- ----------- ------ ----------------------- ----
1           Dram   Avengers                       2000        52          NR     2014-06-01 00:00:00.000 E    NULL
NULL
1           Fan    Harry Potter                   4000        152         PG     2014-01-01 00:00:00.000 D    NULL
NULL
1           Folk   James Taylor(album)            2000        152         NR     2014-06-01 00:00:00.000 E    NULL
NULL
2           Dram   West Wing                      590         53          NR     2013-02-01 00:00:00.000 D    NULL
NULL
3           Fan    Phantom of the Opera           3500        141         PG13   2015-05-01 00:00:00.000 D    NULL
NULL
```

4	Folk	Carpenters Gold	680	95	NR	2014-11-01 00:00:00.000 E	NULL
NULL							
4	SiFi	West World	2000	88	PG	2014-07-01 00:00:00.000 D	NULL
NULL							
5	ST	Annie	600	80	NR	2013-03-01 00:00:00.000 E	NULL
NULL							
6	SiFi	King Kong	2500	100	NR	2015-07-01 00:00:00.000 D	NULL
NULL							
7	Fan	Blazing Saddlers	3000	93	R	2015-04-01 00:00:00.000 D	NULL
NULL							
7	ST	J.C.Superstar	590	53	NR	2014-01-01 00:00:00.000 E	NULL
NULL							
8	ST	Phantom of the Opera	627	78	NR	2014-01-01 00:00:00.000 E	NULL
NULL							
9	SiFi	War of the Worlds	3800	97	R	2014-01-01 00:00:00.000 D	NULL
NULL							
10	SiFi	War of the Worlds	2800	117	PG13	2015-06-01 00:00:00.000 D	NULL
NULL							
11	Fan	Alice in Wonderland	2500	75	G	2014-07-01 00:00:00.000 D	NULL
NULL							
12	Fan	Alice in Wonderland	2900	83	MA	2014-07-01 00:00:00.000 D	NULL
NULL							
13	Fan	Alice in Wonderland	2700	109	PG	2015-03-01 00:00:00.000 D	NULL
NULL							
14	SiFi	Galaxy Quest	2500	102	PG	2014-01-01 00:00:00.000 D	NULL
NULL							

```
(18 row(s) affected)

--7
SELECT * FROM Rating
Rating Name
------ ---------------
G      General
MA     Age > 21
NR     Not Rated
PG     Age ? to 12
PG13   Age > 12
R      Age > 17

(6 row(s) affected)

--8
SELECT * FROM Classification
Class  Charge               Name               Cat_Code
------ -------------------- ------------------ --------
Dram   4.00                 Drama              SS
Fan    5.00                 Fantasy            MO
Folk   2.00                 Folk Tunes         MU
SiFi   5.00                 Science Fiction    MO
ST     3.00                 Show Tunes         MU
```

```
(5 row(s) affected)

--9
SELECT * FROM Category
Cat_Code Name
-------- --------------------
MO       Movie
MU       Music
SS       Short Subject

(3 row(s) affected)
```

Typical Queries and Results

1. What is the longest access time for a science fiction work?

```
use IFES52
go
SELECT MAX(A.Access_Time)
FROM Access A, Work W, Classification C
WHERE C.Class = 'SiFi'
AND C.Class = W.Class
AND W.Class = A.Class
AND W.Work_No = A.Work_No;
-----------
115

(1 row(s) affected)
```

2. For each access, list all of its access times (along with its work number) in chronological (date) order.

```
use IFES52
go
SELECT Work_No,Access_Time
FROM Access
ORDER BY Access_Date
Work_No     Access_Time
----------- -----------
5           43
```

```
2           42
1           152
3           43
10          115
6           100
10          45
7           92
4           37
8           25
9           60
13          85
1           152
14          95
7           95
11          60
1           152
12          95
1           25
4           75

(20 row(s) affected)
```

3. What is the full name for category SS?

```
use IFES52
go
SELECT Name
```

```
FROM Category
WHERE Cat_Code = 'SS'
Name
--------------------
Short Subject

(1 row(s) affected)
```

4. List the access times that are within 5 minutes of the run time for the work.

```
use IFES52
go
SELECT  A.Run_Time, A.Access_Time
FROM (
     SELECT W.Run_Time, A.Access_Time
     FROM Access A, Work W
     WHERE W.Work_No = A.Work_No
     AND   W.Class = A.Class) A
WHERE (A.Run_Time        - A.Access_Time >= 0
     AND A.Run_Time     - A.Access_Time <  5)
OR  (A.Access_Time     - A.Run_Time    >  0
     AND A.Access_Time - A.Run_Time    <  5)
Run_Time    Access_Time
----------- -----------
152         152
152         152
117         115
```

```
100         100
93          95
152         152

(6 row(s) affected)
```

5. List the access information for movies accessed in March 2015.

```
use IFES52
go
SELECT Access_No, Access_Date, W.Work_No, W.Run_Time, A.Access_Time
FROM Access A, Work W, Classification C, Category CT
WHERE CT.Name = 'Movie'
AND CT.Cat_Code = C.Cat_Code
AND C.Class = W.Class
AND W.Class = A.Class
AND W.Work_No = A.Work_No
AND (Access_Date >= '2015-3-1'
    AND Access_Date < '2015-4-1')
```

Access_No	Access_Date	Work_No	Run_Time	Access_Time
21	2015-03-10 00:00:00.000	1	152	152
33	2015-03-11 00:00:00.000	3	141	43
43	2015-03-15 00:00:00.000	9	97	60
44	2015-03-15 00:00:00.000	13	109	85
45	2015-03-15 00:00:00.000	1	152	152
54	2015-03-12 00:00:00.000	10	117	115

```
57          2015-03-12 00:00:00.000 6           100         100
60          2015-03-15 00:00:00.000 7           93          95
80          2015-03-13 00:00:00.000 10          117         45
82          2015-03-15 00:00:00.000 14          102         95
91          2015-03-15 00:00:00.000 11          75          60
95          2015-03-16 00:00:00.000 12          83          95
98          2015-03-16 00:00:00.000 4           88          75

(13 row(s) affected)
```

6. What categories contain works added to the system in January 2014?

```
use IFES52
go

SELECT DISTINCT CT.Name
FROM Category CT, Classification C, Work W
WHERE CT.Cat_Code = C.Cat_Code
AND C.Class = W.Class
AND W.Date_Added >= '2014-1-1'
AND W.Date_Added <  '2014-2-1'
Name
--------------------
Movie
Music

(2 row(s) affected)
```

7. Where are the Short Subjects stored on the system?

```
use IFES52
go
SELECT DISTINCT W.Loc
FROM Category CT, Classification C, Work W
WHERE CT.Name = 'Short Subject'
AND CT.Cat_Code = C.Cat_Code
AND C.Class = W.Class
Loc
----
D
E

(2 row(s) affected)
```

8. Who (Name and MC code) manages the Movie category?

```
use IFES52
go
SELECT  MS.Name,M.Membership_Code
FROM  Manager M, Membership MS
WHERE M.Cat_Code = 'MO'
AND M.Membership_Code = MS.Membership_Code
Name                 Membership_Code
-------------------- ---------------
```

```
Mary Manager          MC0102

(1 row(s) affected)
```

9. Who (Name and MC code) has access to data about the Music category?

```
use IFES52
go
SELECT DISTINCT MS.Name, MS.Membership_Code
FROM Membership MS, Passenger P, Access A, Work W, Classification C, Category CT
WHERE MS.Membership_Code = P.Membership_Code
AND P.Membership_Code = A.Membership_Code
AND A.Class = W.Class
AND A.Work_No = W.Work_No
AND W.Class = C.Class
AND C.Cat_Code = CT.Cat_Code
AND CT.Cat_Code = 'MU'
Name                 Membership_Code
-------------------- ---------------
Mike Smith           MC1009
John Doe             MC1014

(2 row(s) affected)
```

10. How many accesses are charged to each passenger (Name and MC code)?

```
use IFES52
go
```

```
SELECT MS.Name, MS.Membership_Code, P.Num_Acc
FROM  Passenger P, Membership MS
WHERE P.Membership_Code = MS.Membership_Code
```

Name	Membership_Code	Num_Acc
Ken White	MC0800	1
James Mason	MC0900	0
Mike Smith	MC1009	3
Mary Smith	MC1011	2
John Doe	MC1014	6
Bill Doe	MC1022	1
Kelly Doe	MC1023	1
Ann Black	MC1035	2
Jane Dough	MC1039	1
Karen Kline	MC1040	1
Jack Jones	MC1045	2
Joe Grey	MC1065	0

(12 row(s) affected)

11. List the accesses made by MC1014 in date order.

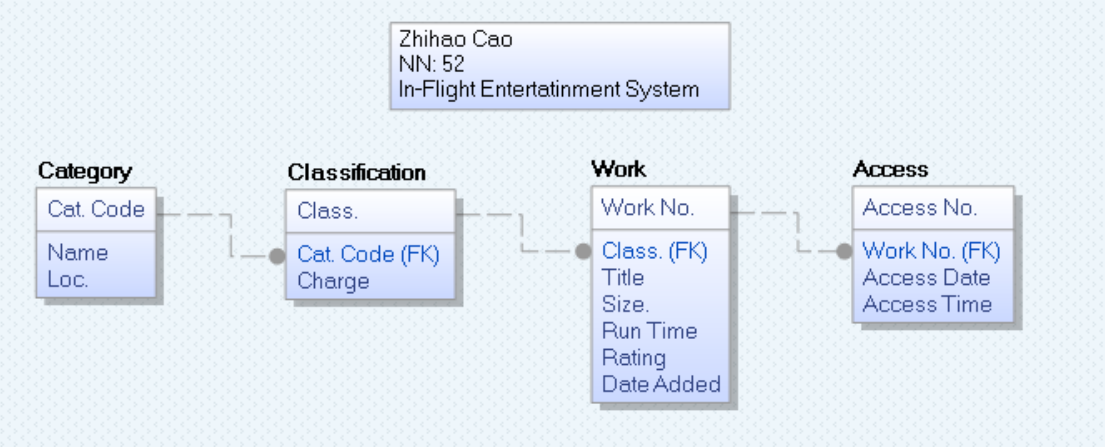
```
use IFES52
go
SELECT A.Access_No, A.Access_Date, A.Work_No, A.Class
FROM  Membership MS, Access A
WHERE A.Membership_Code = MS.Membership_Code
```

```
AND MS.Membership_Code = 'MC1014'
ORDER BY A.Access_Date
```

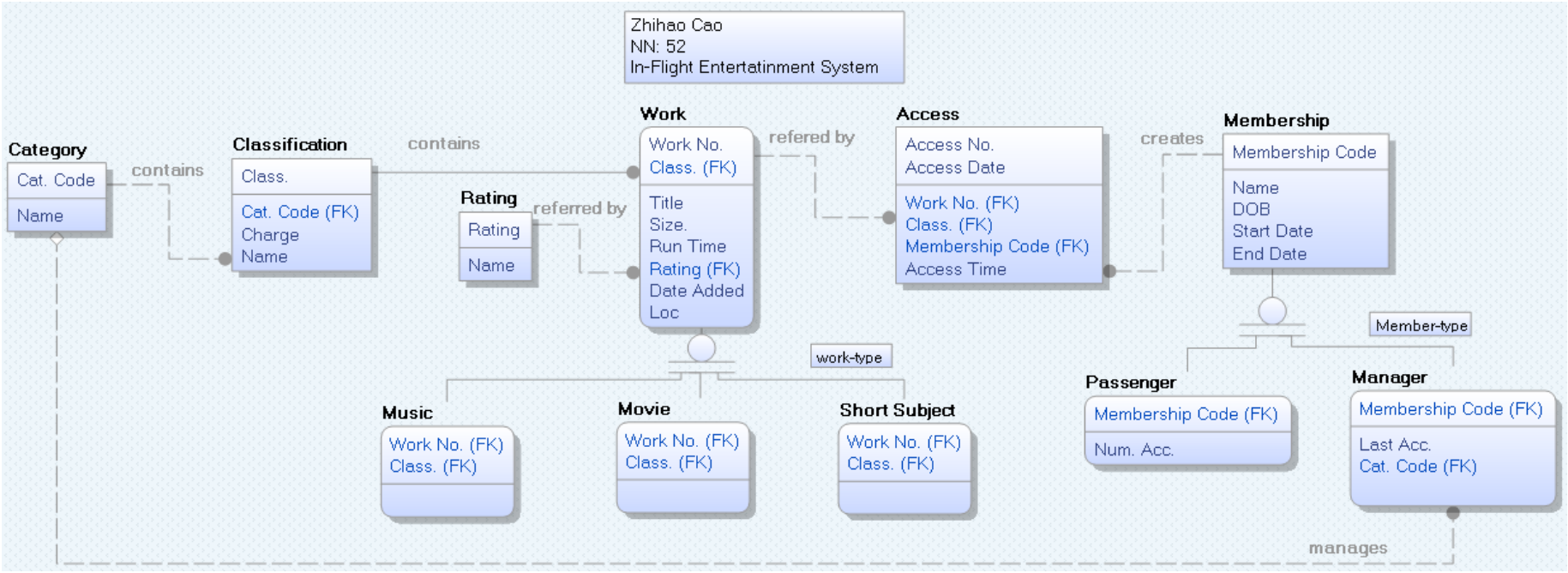
Access_No	Access_Date	Work_No	Class
21	2015-03-10 00:00:00.000	1	Fan
33	2015-03-11 00:00:00.000	3	Fan
43	2015-03-15 00:00:00.000	9	SiFi
54	2015-03-15 00:00:00.000	8	ST
82	2015-03-16 00:00:00.000	1	Dram
91	2015-03-16 00:00:00.000	1	Folk

(6 row(s) affected)

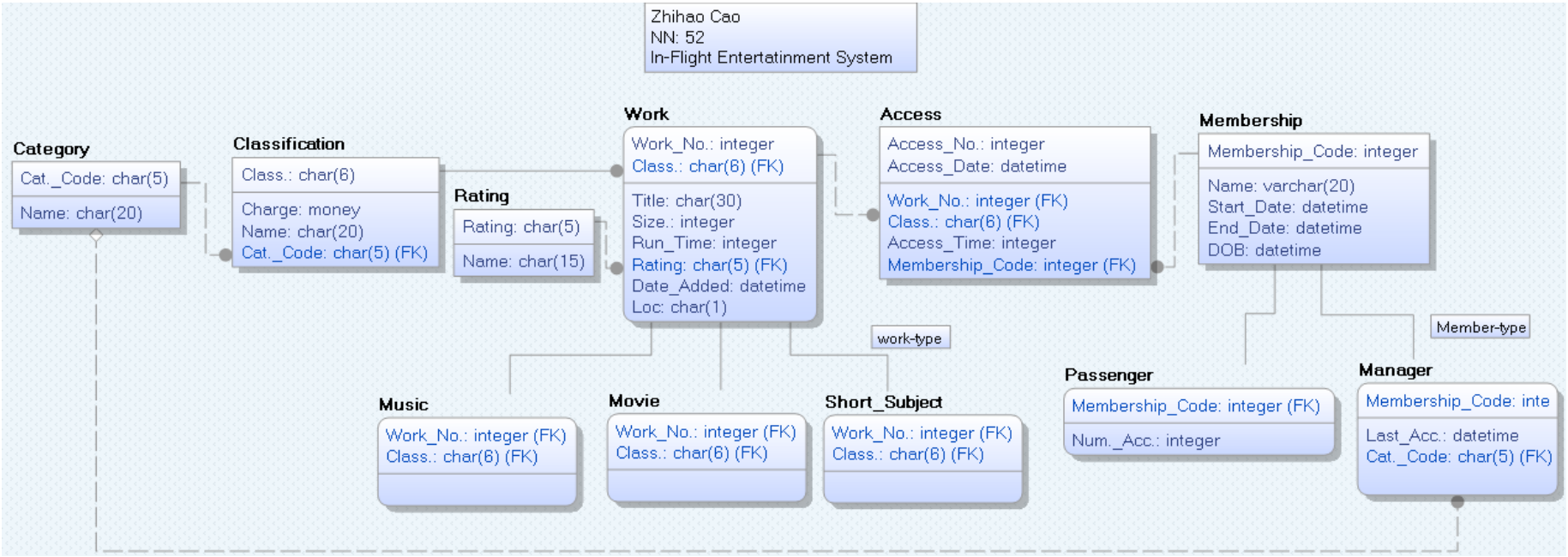
Appendix



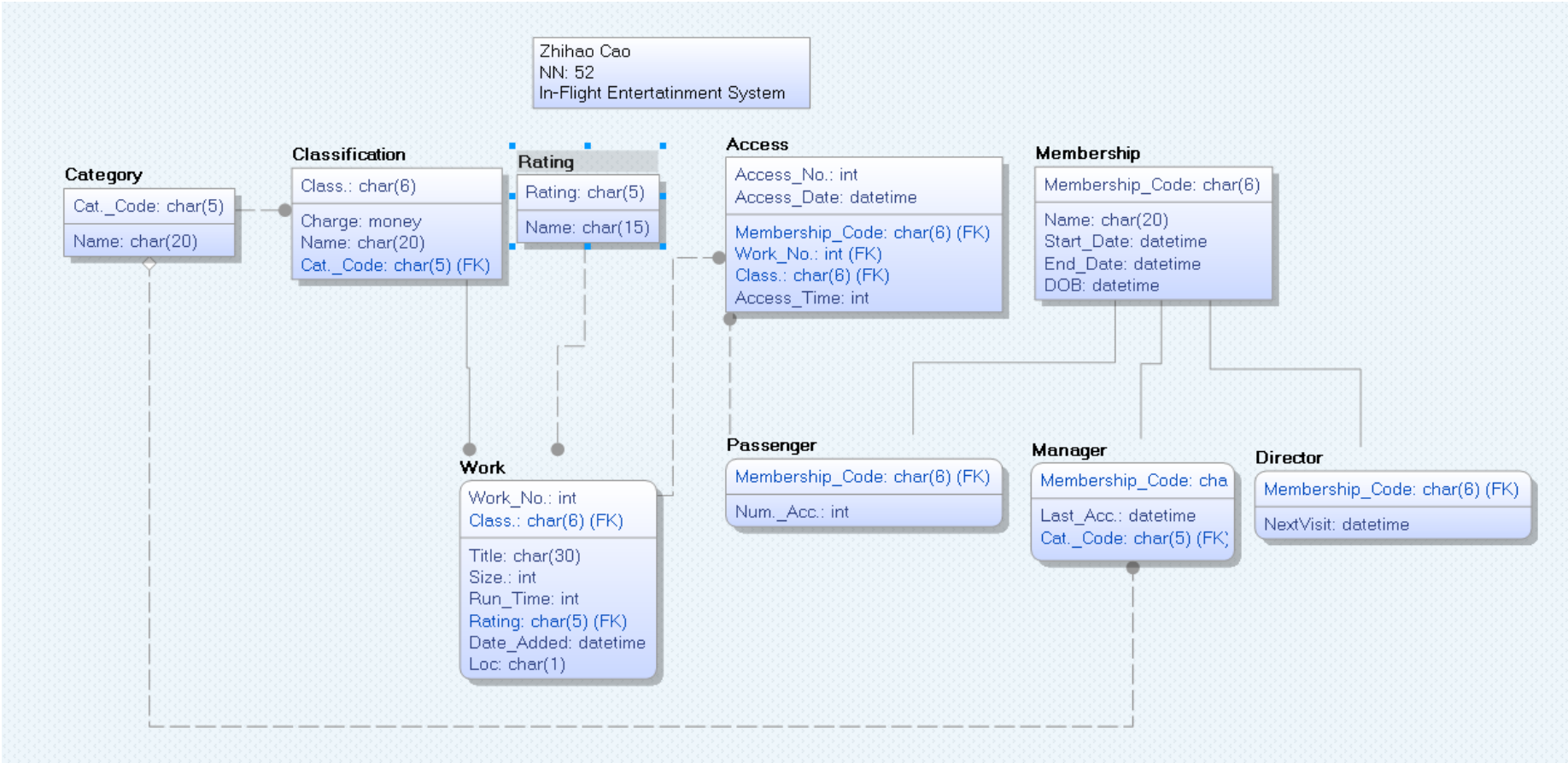
Version 1 LDM



Version 2 LDM



Version2 PDM



Version 3 PDM

(Latest version is shown in page 4 & 5)

	Class.	Cat. Code	Name	Date Added	Size	Loc	Run Time	Rating	Access No.	Access Date	Access Time	Charge	Work No.	Title
Class.	X	✓	✓	1&8	1&8	✓	1&8	3&4	1&8	1&8	1&8	✓	1&8	1&8
Cat. Code	3&5	X	✓	1&7	1&7	✓	1&7	3&4	1&7	1&7	1&7	1&7	1&7	1&7
Name	1&7	✓	X	1&7	1&7	✓	1&7	3&4	1&7	1&7	1&7	1&7	1&7	1&7
Date Added	3&8	3&8	3&8	X	3&8	3&8	3&8	3&8	3&8	3&8	3&8	3&8	3&8	3&8
Size	2&8	2&8	2&8	2&8	X	2&8	✓	✓	2&8	2&8	2&8	2&8	2&8	2&8
Loc	2&3	2&3	2&3	2&3	2&3	X	2&3	2&3	2&3	2&4	2&3	2&3	2&3	2&3
Run Time	2&8	2&8	2&8	2&8	✓	2&8	X	✓	2&8	2&8	2&8	2&8	2&8	2&8
Rating	1&2	1&2	1&2	1&2	1&2	1&2	1&2	X	1&2	1&2	1&2	1&2	1&2	1&2
Access No.	✓	✓	✓	✓	✓	✓	✓	✓	X	✓	✓	✓	✓	✓
Access Date	2&3	2&3	2&3	2&3	2&3	8&9	2&3	2&3	2&3	X	2&3	2&3	2&3	2&3
Access Time	1&4	1&4	1&4	1&4	1&4	1&4	1&4	1&4	1&4	1&4	X	1&4	1&4	1&4
Charge	3&5	✓	✓	3&4	3&4	✓	3&4	✓	3&4	3&4	3&4	X	3&4	3&4
Work No.	✓	✓	✓	✓	✓	✓	✓	✓	3&11	3&11	6&9	✓	X	✓
Title	✓	✓	✓	✓	✓	✓	✓	✓	3&11	3&11	6&9	✓	✓	X

Version 1 Functional Dependency

Text Representation of Version 1 FDs:

Class. → {Cat. Code, Name, Loc, Charge}
Cat. Code → {Name, Loc}
Name → {Cat. Code, Loc}
Size →{Run Time, Rating}
Run Time → {Size, Rating}
Access No. → {Class., Cat. Code, Name, Date Added, Size, Loc, Run Time, Rating, Access Date, Access Time, Charge, Work No., Title}
Charge → {Cat. Code, Name, Rating}
Work No. → {Class., Cat. Code, Name, Date Added, Size, Loc, Run Time, Rating, Charge, Title}
Title → {Class., Cat. Code, Name, Date, Added, Size, Loc, Run Time, Rating, Charge, Work No.}

	Class.	Cat. Code	Name	Date Added	Size	Loc	Run Time	Rating	Access No.	Access Date	Access Time	Charge	Work No.	Title
Class.	X	✓	✓	1&8	1&8	2&20	1&8	3&4	1&8	1&8	1&8	✓	1&8	1&8
Cat. Code	3&5	X	✓	1&7	1&7	2&20	1&7	3&4	1&7	1&7	1&7	1&7	1&7	1&7
Name	1&7	✓	X	1&7	1&7	2&20	1&7	3&4	1&7	1&7	1&7	1&7	1&7	1&7
Date Added	3&8	3&8	3&8	X	3&8	3&8	3&8	3&8	3&8	3&8	3&8	3&8	3&8	3&8
Size	2&8	2&8	2&8	2&8	X	2&8	5&12	5&12	2&8	2&8	2&8	2&8	2&8	2&8
Loc	2&3	2&3	2&3	2&3	2&3	X	2&3	2&3	2&3	2&4	2&3	2&3	2&3	2&3
Run Time	2&8	2&8	2&8	2&8	11&19	2&8	X	3&19	2&8	2&8	2&8	2&8	2&8	2&8
Rating	1&2	1&2	1&2	1&2	1&2	1&2	1&2	X	1&2	1&2	1&2	1&2	1&2	1&2
Access No.	7&18	7&18	7&18	7&18	7&18	7&18	7&18	7&18	X	7&18	7&18	7&18	16&19	7&18
Access Date	2&3	2&3	2&3	2&3	2&3	8&9	2&3	2&3	2&3	X	2&3	2&3	2&3	2&3
Access Time	1&4	1&4	1&4	1&4	1&4	1&4	1&4	1&4	1&4	1&4	X	1&4	1&4	1&4
Charge	3&5	✓	✓	3&4	3&4	3&4	3&4	3&4	3&4	3&4	3&4	X	3&4	3&4
Work No.	3&19	3&19	3&19	3&19	3&19	3&19	20&19	3&19	3&11	3&11	6&9	3&19	X	3&19
Title	4&14	4&14	4&14	10&16	10&16	4&14	9&13	10&16	3&11	3&11	6&9	4&14	10&16	X

Version 2 Functional Dependency (Red color represents changes from version 1 FDs)

Text Representation of Version 2 FDs:

Class. → {Cat. Code, Name, Charge}
Cat. Code → {Name }
Name → {Cat. Code}
Charge → {Cat. Code, Name }

Since many attributes are not determined by single determinant any more, composite keys are used to determine these attributes.

Text Representation of Version3 FDs:

Cat. Code → {Name(Category Name)}
Class. → {Cat. Code, Charge, Name(Classification Name)}
{Work No., Class.} → {Title, Size, Run Time, Rating, Date Added, Loc}
{Access No., Access Date} → {Work No., Class., Access Time}

Adding new data about user information and additional attributes, the latest version FDs:

Cat. Code → {Name(Category Name)}
Class. → {Cat. Code, Charge, Name(Classification Name)}
Rating → {Name(Rating Name)}
{Work No., Class.} → {Title, Size, Run Time, Rating, Date Added, Loc, Image_Cover, Content}
{Access No., Access Date} → {Work No., Class., Access Time, Membership Code}
Membership Code → {Name(Membership Name), DOB, Start Date, End Date, Num.Acc., Last Acc., Cat. Code, NextVisit}

(Add Image_Cover, Content to Work Table.)

Memo #7

1. New Data from Bob

There is no problem to insert this data into the database.
It doesn't violate any integrity constrains to insert into Category, Classification, Work, Access and Membership Tables.
In Work table, the composite key is "Work_No" and "Class". In Access table, the composite key is "Access_No" and "Access_Date".
It can be easily inspected that to insert in to these tables, the given data doesn't cause any problems.

2. Information from Sam and Mary

- A referential integrity problem will be triggered if try to remove this record from the database. The reason is that a record in Access table is referencing this record.
  To do so, the record in Access table which has the composite key ("95", "2015-3-16") has to be removed. Then, this record can be removed.

- The charge for Show Tunes is safe to be reduced to $2.50 in the database. The reason is that no other table has referential relationship with this field.

3. Data items from Bob that "look Different"

It will cause several problems to insert these data into the database.

- When inserting into Classification table, it will cause the "Charge" field to be inconsistent. The primary key is "Cat_Code", the integrity constrain will not allow the "Charge" field has two different value "2" and "3" for the same primary key. To solve the problem, update query is needed to change the value of "Charge" field. If this field is not desired to be changed, then the determinant of this field should be changed. The suggested way is to put the "Charge" field into Work table.
- When inserting into Work table, it will cause "Title", "Size", "Run_Time" and "Date_Added" fields to be inconsistent. The composite key ("1", "Folk") is already existed in the table. To solve this problem, a new composite key should be found. The suggested new composite key will be ("Work_No", "Class", "Size"). Then, the foreign key in Access table also needs to be updated.
- When inserting into Access table, it will also cause inconsistency problems for "Membership_Code" and "Access_Time" fields. The

composite key (“91”, “2015-3-16”) is already existed in the table. To solve this problem, a new composite key should be found. The suggested new composite key will be (“Access_No”, “Access_Date”, “Work_No”), but the “Work_No” field is one of the composite foreign key. Then, the new composite key has to be (“Access_No”, “Work_No”, “Class”, “Size”). (The “Access_Date” field is removed from the composite key, because the new composite key is power enough to determine all other fields in the table.)

4. Number of accesses field

This field is supposed to be calculated by a function that count the number of record can capture for each “Membership_Code” value by joining Membership table and Access table with the key “Membership_Code”.

If this field is removed, the system loses the count for the number of times of each member accesses. Other than that, no problem will cause.