Name: Nair, Arvind **NN:** 24

Bears In Canada Project

Memo: #6 & #7

Final Report

DBDS **DataBase Design Specialists, Inc.**

"We are always 5NF"

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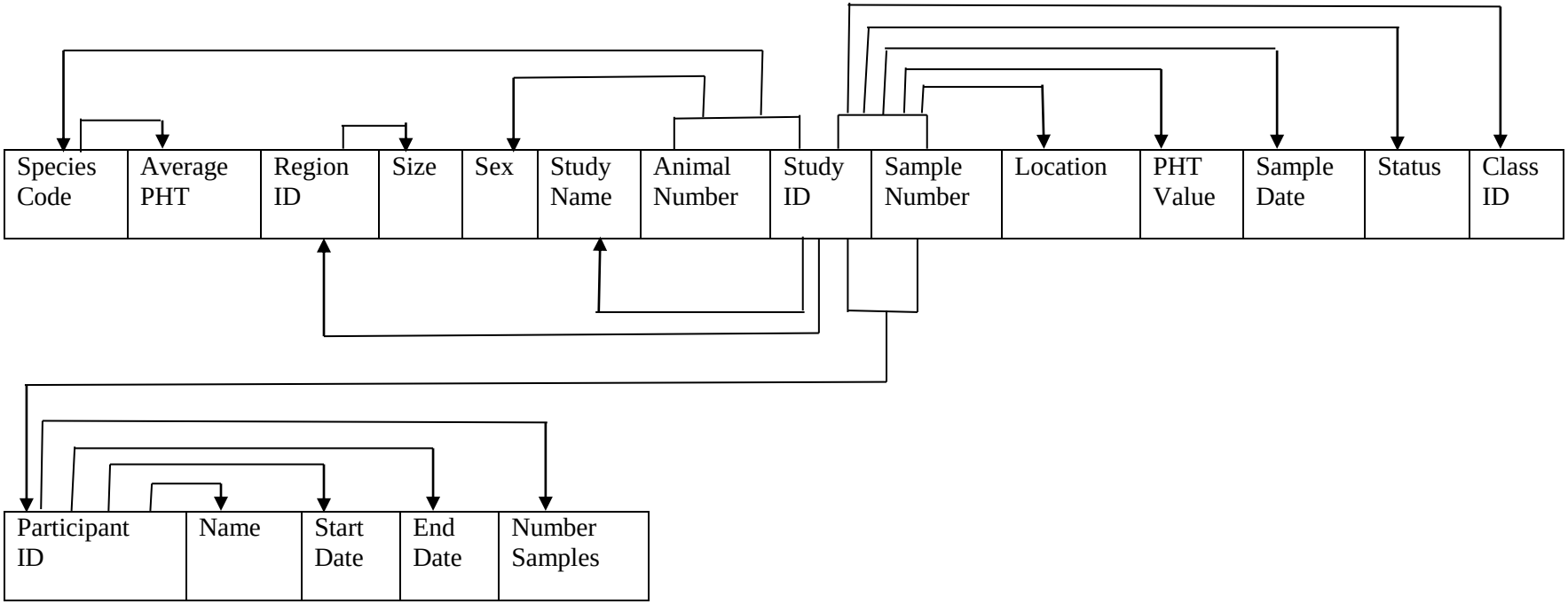
Bears In Canada Project Statement:

The motivation for this project is declining populations of bears. This project is about tracking the location and health of bears in or near a national park in Canada. Tracking is done by three different methods: telemetry tracking (after a bear has been captured and a tracking device has been attached), hair snags (found on bushes and trees in the area) and scats (animal feces) located by specially trained dogs. DNA data from hair and scat samples can be used to determine the sex of the bear and some health data. The scat samples provide individualized data on the physiological health of that animal.

There are many regions in which studies are being conducted. Three regions are to be part of the test data: North Region (NR), Central Region (CR) and South Region (SR).

The basis of the BIC project is the location and analysis of samples that are part of studies to determine the location and health of the animals that are the target population of the studies. Studies are carried out in various regions within a National Park in Canada. The basic unit of investigation within a particular study is a sample. That sample is associated with a particular animal using telemetry, hair snags and scats to determine the location and DNA analysis (if applicable) to gauge the health of the animal at the time of the sample.

Functional Dependencies:



List of Functional Dependencies:

1. SpeciesCode → AveragePHT

2. RegionID → Size

3. StudyID → StudyName
4. StudyID → RegionID

5. {StudyID, AnimalNumber} → Sex
6. {StudyID, AnimalNumber} → SpeciesCode

7. {StudyID, SampleNumber} → Location
8. {StudyID, SampleNumber} → PHTValue
9. {StudyID, SampleNumber} → SampleDate
10. {StudyID, SampleNumber} → Status
11. {StudyID, SampleNumber} → ClassID
12. {StudyID, SampleNumber} → ParticipantID

13. ParticipantID → Name
14. ParticipantID → StartDate
15. ParticipantID → EndDate
16. ParticipantID → NumberSamples

Logical Data Model (LDM) Final Design (Version 3):

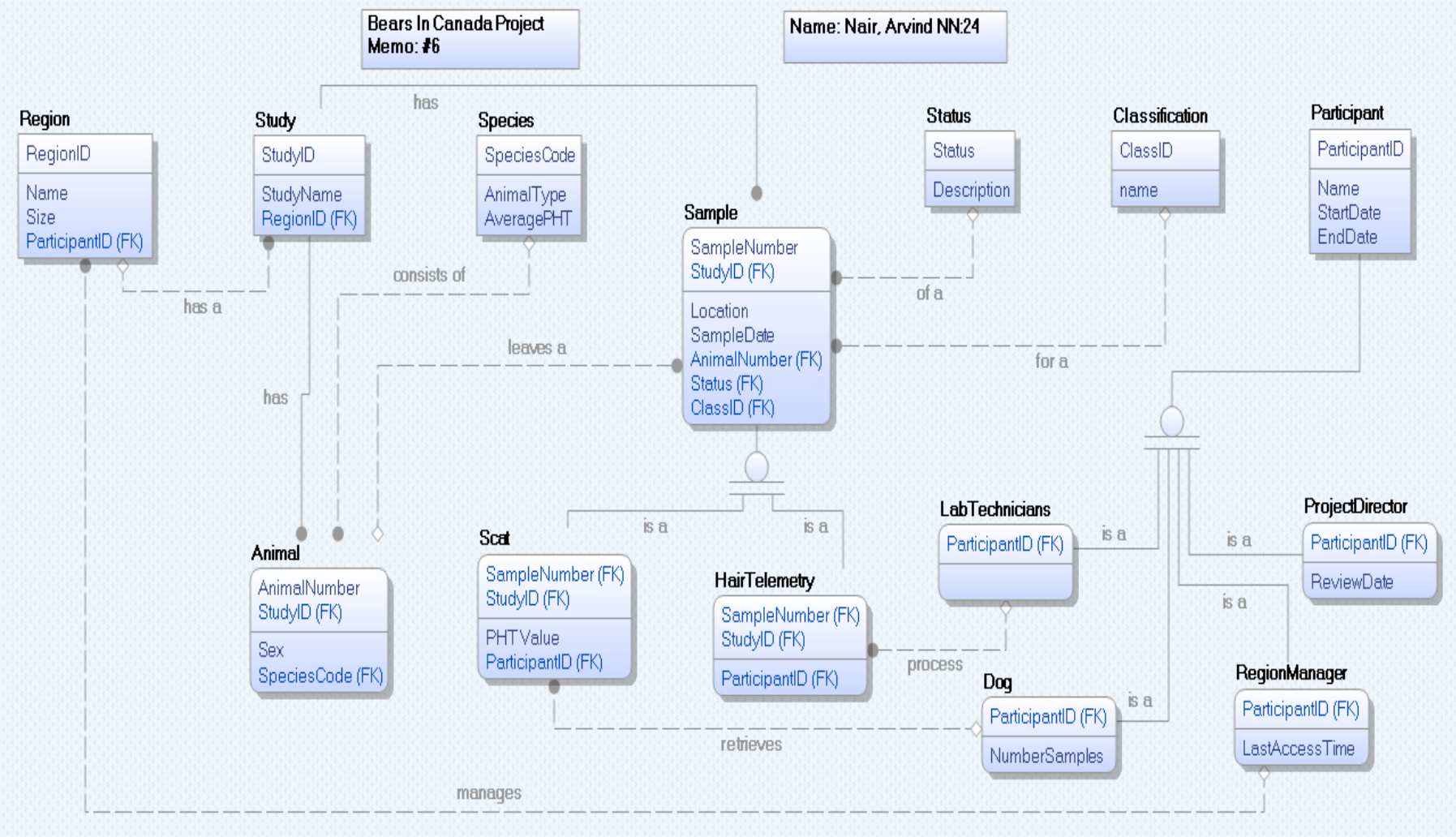


Figure 1: LDM Final Version (Version 3)

Physical Data Model (PDM) Final Design (Version 3):

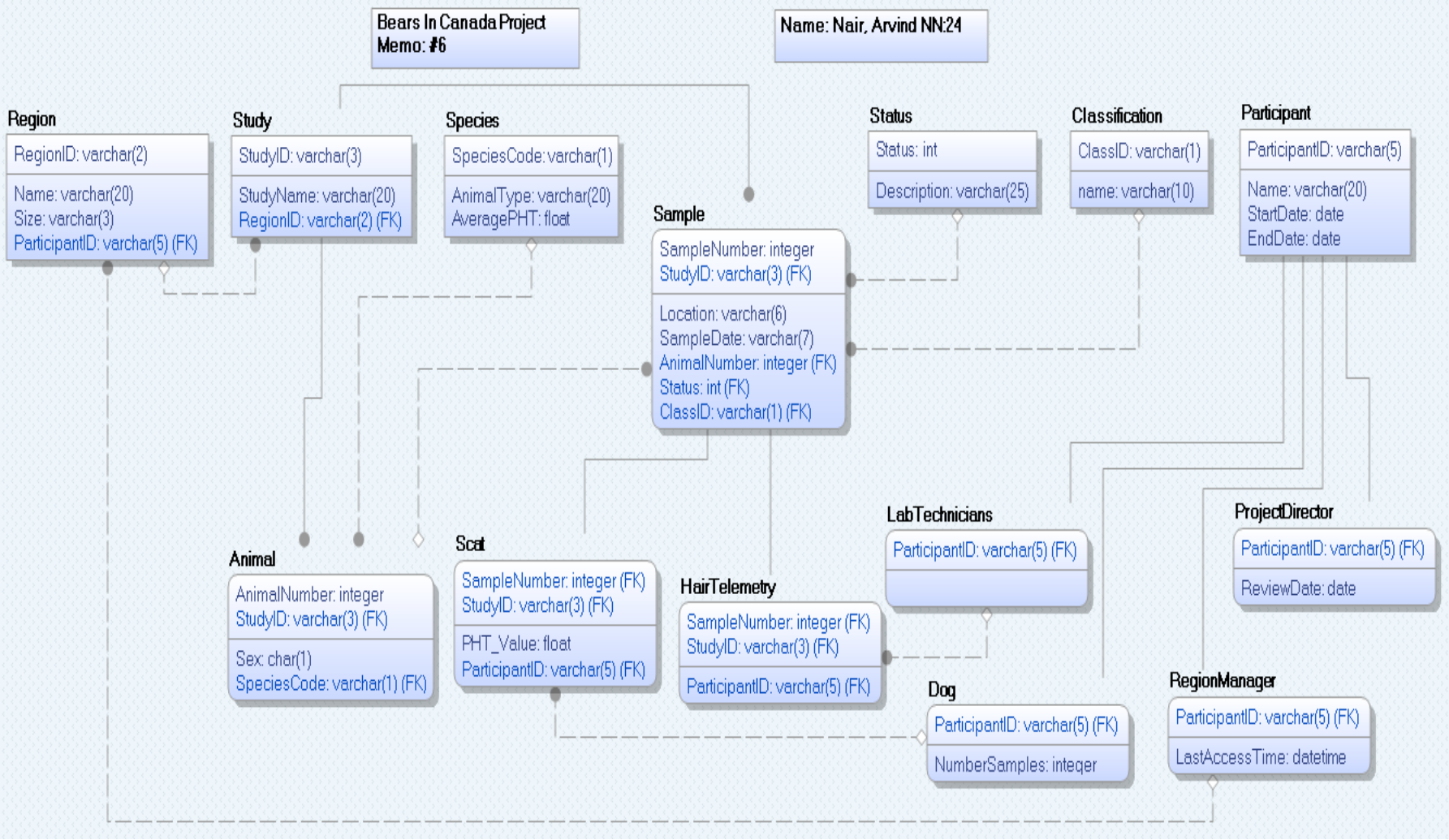


Figure 2: PDM Final Version (Version 3)

Queries:

Q1) What is the largest physiological health value observed for a black bear?

Query:

```
SELECT MAX (SC.PHT_VALUE) AS MAXIMUM_PHTVALUE_FOR_BLACK_BEAR
FROM SCAT SC, SAMPLE S, ANIMAL A
WHERE A.SPECIESCODE='B'
AND SC.STUDYID=S.STUDYID
AND SC.SAMPLENUMBER=S.SAMPLENUMBER
AND A.ANIMALNUMBER=S.ANIMALNUMBER
AND A.STUDYID=S.STUDYID;
```

Result:

```
MAXIMUM_PHTVALUE_FOR_BLACK_BEAR
-------------------------------
120

(1 row(s) affected)
```

Q2) For each animal, list all of its sample classifications in chronological (date) order.

Query:

```
SELECT S.STUDYID, S.ANIMALNUMBER, S.SAMPLEDATE, C.NAME AS SAMPLECLASSIFICATION
FROM SAMPLE S, CLASSIFICATION C
WHERE C.CLASSID=S.CLASSID
ORDER BY S.ANIMALNUMBER, S.SAMPLEDATE;
```

Result:

```
STUDYID ANIMALNUMBER SAMPLEDATE SAMPLECLASSIFICATION
------- ------------ ---------- --------------------
N14     42           2014/07    Scat
N14     42           2014/08    Scat
C15     50           2015/07    Scat
C14     59           2014/09    Telemetry
C14     59           2014/09    Telemetry
C15     59           2015/09    Scat
S14     63           2014/07    Scat
S14     66           2014/07    Hair Snag
N14     66           2014/07    Scat
C14     66           2014/11    Telemetry
S14     89           2014/11    Hair Snag
C15     112          2014/07    Scat
N14     113          2014/07    Scat
C14     113          2015/10    Hair Snag
C14     114          2014/10    Telemetry
C14     114          2014/10    Scat
N14     118          2014/06    Scat

(17 row(s) affected)
```

Q3) In what region is the Central 2014 study and what size grid pattern is used on that study?

Query:

```
SELECT R.NAME, R.SIZE
FROM REGION R, STUDY S
WHERE S.STUDYID='C14'
AND S.REGIONID=R.REGIONID;
```

Result:

```
NAME                 SIZE
-------------------- ----
Central Region       9X9

(1 row(s) affected)
```

Q4) List the animals that are within 5 units of their average physiological health value.

Query:

```
SELECT DISTINCT S.STUDYID, S.ANIMALNUMBER
FROM SAMPLE S, SCAT SC, SPECIES SP, ANIMAL A
WHERE SC.SAMPLENUMBER = S.SAMPLENUMBER
AND SC.STUDYID = S.STUDYID
AND SP.SPECIESCODE = A.SPECIESCODE
AND S.ANIMALNUMBER = A.ANIMALNUMBER
AND S.STUDYID = A.STUDYID
AND ABS (SC.PHT_VALUE-SP.AVERAGEPHT) <= 5
ORDER BY STUDYID, ANIMALNUMBER;
```

Result:

```
STUDYID ANIMALNUMBER
------- ------------
N14     42
S14     63

(2 row(s) affected)
```

Q5) List the sample information for the Central 2014 studies made in September 2014 and in November 2014.

Query:

```
SELECT S.SAMPLENUMBER, S.ANIMALNUMBER, S.LOCATION, S.SAMPLEDATE, C.NAME AS
SAMPLECLASSIFICATION, SU.DESCRIPTION, SP.ANIMALTYPE
FROM SAMPLE S, STATUS SU, CLASSIFICATION C, SPECIES SP, ANIMAL A
WHERE S.STUDYID='C14'
AND (S.SAMPLEDATE='2014/09' OR S.SAMPLEDATE='2014/11')
AND S.CLASSID=C.CLASSID
AND S.STATUS=SU.STATUS
AND S.STUDYID=A.STUDYID
AND S.ANIMALNUMBER=A.ANIMALNUMBER
AND A.SPECIESCODE=SP.SPECIESCODE;
```

Result:

```
SAMPLENUMBER ANIMALNUMBER LOCATION SAMPLEDATE SAMPLECLASSIFICATION DESCRIPTION        ANIMALTYPE
------------ ------------ -------- ---------- -------------------- ------------------ --------------------
44           59           32:1:9   2014/09    Telemetry            Sample used up     Black bear
47           59           41:2:3   2014/09    Telemetry            Sample used up     Black bear
82           66           31:5:8   2014/11    Telemetry            Sample used up     Grizzly bear

(3 row(s) affected)
```

Q6) What studies have animals for which samples were gathered in July 2014?

Query:

```
SELECT DISTINCT (ST.STUDYNAME)
FROM SAMPLE S, STUDY ST
WHERE S.SAMPLEDATE='2014/07'
AND S.STUDYID=ST.STUDYID;
```

Result:

```
STUDYNAME
--------------------
Central 2015
North 2014
South 2014

(3 row(s) affected)
```

Q7) What type of samples were collected in the South 2014 study?

Query:

```
SELECT DISTINCT (C.NAME)
FROM SAMPLE S, CLASSIFICATION C
WHERE S.STUDYID='S14'
AND S.CLASSID=C.CLASSID;
```

Result:

```
NAME
----------
Hair Snag
Scat

(2 row(s) affected)
```

Q8) Who (Name and ID) manages the Central Region?

Query:

```
SELECT P.NAME, R.PARTICIPANTID
FROM PARTICIPANT P, REGION R
WHERE R.REGIONID='CR'
AND R.PARTICIPANTID=P.PARTICIPANTID;
```

Result:

```
NAME                 PARTICIPANTID
-------------------- -------------
Mary Manager         P0102

(1 row(s) affected)
```

Q9) Who (Name and ID) has access data on South Region sample data?

Query:

```
SELECT P.NAME, R.PARTICIPANTID
FROM PARTICIPANT P, REGION R
WHERE R.REGIONID='SR'
AND R.PARTICIPANTID=P.PARTICIPANTID;
```

Result:

```
NAME                 PARTICIPANTID
-------------------- -------------
Fred Foreman         P0103

(1 row(s) affected)
```

Q10) How many times has each animal been sampled?

Query:

```
SELECT S.STUDYID, S.ANIMALNUMBER, COUNT (S.ANIMALNUMBER) AS NUM_OF_TIMES_ANIMAL_SAMPLED
FROM SAMPLE S
GROUP BY S.STUDYID, S.ANIMALNUMBER;
```

Result:

```
STUDYID ANIMALNUMBER NUM_OF_TIMES_ANIMAL_SAMPLED
------- ------------ --------------------------
N14     42           2
C15     50           1
C14     59           2
C15     59           1
S14     63           1
C14     66           1
N14     66           1
S14     66           1
S14     89           1
C15     112          1
C14     113          1
N14     113          1
C14     114          2
N14     118          1

(14 row(s) affected)
```

Q11) List the samples analyzed by P2045.

Query:

```
SELECT HT.STUDYID, HT.SAMPLENUMBER
FROM HAIRTELEMETRY HT
WHERE HT.PARTICIPANTID='P2045';
```

Result:

```
STUDYID SAMPLENUMBER
------- ------------
S14     22
C14     47
C14     82

(3 row(s) affected)
```

Q12) List the names of the dogs that have worked in each study.

Query:

```
SELECT DISTINCT ST.STUDYNAME, P.NAME
FROM SCAT SC, PARTICIPANT P, STUDY ST
WHERE SC.PARTICIPANTID=P.PARTICIPANTID
AND SC.STUDYID=ST.STUDYID
ORDER BY ST.STUDYNAME;
```

Result:

```
STUDYNAME            NAME
-------------------- --------------------
Central 2014         Max
Central 2015         Cindy
Central 2015         Max
North 2014           Max
North 2014           Rover
North 2014           Sampson
South 2014           Cindy

(7 row(s) affected)
```

Technical Responses to Changes from Memo #7:

1. New Data from Bob:

1. Row 1:
   We cannot add Row 1 data to the database as per the current design decided upon. The reason is Entity Integrity. This difficulty is faced due to the fact that SampleNumber attribute cannot be NULL as it is part of Composite Primary Key for Sample table. The Composite Primary Key for Sample table are StudyID and SampleNumber. We can add it once we get the SampleNumber.
2. Row 2:
   We cannot add Row 2 data to the database as per the current design decided upon. The reason is Entity Integrity. This difficulty is faced due to the fact that AnimalNumber attribute cannot be NULL as it is part of Composite Primary Key for Animal table. The Composite Primary Key for Animal table are StudyID and AnimalNumber. We can add it once we get the AnimalNumber.
3. Row 3:
   We cannot add Row 3 data to the database. The reason is Entity Integrity. This difficulty is faced due to the fact that this tuple already exists in the database (Tuple #8 of General Data Values in Memo: #4).

2. Information from Sam:

- For the first point, we just need to insert once into the Study table StudyID and StudyName as C16 and Central 2016 respectively. Only once it is required, as when we add samples we just add the StudyID and SampleNumber in Sample table and for adding animals we simply add the StudyID and AnimalNumber in Animal table. The reason is that all tables in the database are normalized to 5NF including Study table and normalization helps in performing only one insert (no insert anomalies-transitive dependencies are already taken care of as if database is in 5NF it will satisfy 3NF).
- For the second point, we just need to update once the AveragePHT value for Black Bear from 113 to 115 in the Species table. This change will be easily reflected across all Samples and Animals whenever queried as all tables in the database are normalized to 5NF including Species table and normalization helps in performing only one update (no update anomalies-transitive dependencies are already taken care of as if database is in 5NF it will satisfy 3NF).

The overall effort will be minimal as only once we do an insert/update (no redundancies, insert/update/delete anomalies) as per the current design.

3. Data items from Bob that "look different":

The main difficulty with adding the two rows is that the functional dependency of StudyID → RegionID breaks (as initially one region can have many studies but now even one study can have many regions). This will result in the first row getting inserted and second one not inserted as Entity Integrity comes into play due to the fact that StudyID is same for both and it is the primary key for Study table (tuple already present). To accommodate this change we need to create an M x N relationship between Region and Study table. With this, we can then track measurements on the same animal even if it has moved from one region to another. Also,

we need to add Region Manager as a non-identifying relationship in the M x N relationship table and the animal details (in that study) access ideally should fall to the Region Manager where the animal originally belongs. But, that can be decided as to whom the jurisdiction of the animal falls (original, new or both) if needed. Thus, the table and database design (metadata) can be updated in this way.

4. Number of samples field:

In the Dog table, the NumberSamples attribute represents the number of samples collected by a Dog participant. Since we have information about which dog collected which sample in the Scat table, we can count the number of samples collected by each dog by doing a count on the Scat table. Thus, we can still get this information via computation using the SQL in-built aggregate function viz. count().

Appendix:

A) Relational Data Model generated from ERWin:

```
CREATE TABLE [Participant]
(
	[ParticipantID]	varchar(5)  NOT NULL ,
	[Name]	varchar(20)  NULL ,
	[StartDate]	date  NULL ,
	[EndDate]	date  NULL ,
	 PRIMARY KEY  CLUSTERED ([ParticipantID] ASC)
)
go

CREATE TABLE [Dog]
(
	[ParticipantID]	varchar(5)  NOT NULL ,
	[NumberSamples]	integer  NULL ,
	 PRIMARY KEY  CLUSTERED ([ParticipantID] ASC),
	 FOREIGN KEY ([ParticipantID]) REFERENCES [Participant]([ParticipantID])
)
go

CREATE TABLE [RegionManager]
(
	[ParticipantID]	varchar(5)  NOT NULL ,
	[LastAccessTime]	datetime  NULL ,
	 PRIMARY KEY  CLUSTERED ([ParticipantID] ASC),
	 FOREIGN KEY ([ParticipantID]) REFERENCES [Participant]([ParticipantID])
)
go

CREATE TABLE [Region]
(
	[RegionID]	varchar(2)  NOT NULL ,
	[Name]	varchar(20)  NULL ,
	[Size]	varchar(3)  NULL ,
	[ParticipantID]	varchar(5)  NULL ,
	 PRIMARY KEY  CLUSTERED ([RegionID] ASC),
	 FOREIGN KEY ([ParticipantID]) REFERENCES [RegionManager]([ParticipantID])
)
go

CREATE TABLE [Study]
(
	[StudyID]	varchar(3)  NOT NULL ,
	[StudyName]	varchar(20)  NULL ,
	[RegionID]	varchar(2)  NULL ,
	 PRIMARY KEY  CLUSTERED ([StudyID] ASC),
```

```
        FOREIGN KEY ([RegionID]) REFERENCES [Region]([RegionID])
)
go

CREATE TABLE [Species]
(
        [SpeciesCode]       varchar(1)  NOT NULL ,
        [AnimalType]        varchar(20)  NULL ,
        [AveragePHT]        float  NULL ,
         PRIMARY KEY  CLUSTERED ([SpeciesCode] ASC)
)
go

CREATE TABLE [Animal]
(
        [AnimalNumber]      integer  NOT NULL ,
        [StudyID]           varchar(3)  NOT NULL ,
        [Sex]               char(1)  NULL ,
        [SpeciesCode]       varchar(1)  NULL ,
         PRIMARY KEY  CLUSTERED ([AnimalNumber] ASC,[StudyID] ASC),
         FOREIGN KEY ([StudyID]) REFERENCES [Study]([StudyID]),
 FOREIGN KEY ([SpeciesCode]) REFERENCES [Species]([SpeciesCode])
)
go

CREATE TABLE [Status]
(
        [Status]            int  NOT NULL ,
        [Description]       varchar(25)  NULL ,
         PRIMARY KEY  CLUSTERED ([Status] ASC)
)
go

CREATE TABLE [Classification]
(
        [ClassID]           varchar(1)  NOT NULL ,
        [name]              varchar(10)  NULL ,
         PRIMARY KEY  CLUSTERED ([ClassID] ASC)
)
go

CREATE TABLE [Sample]
(
        [SampleNumber]      integer  NOT NULL ,
        [StudyID]           varchar(3)  NOT NULL ,
        [Location]          varchar(6)  NULL ,
        [SampleDate]        varchar(7)  NULL ,
        [AnimalNumber]      integer  NULL ,
        [Status]            int  NULL ,
        [ClassID]           varchar(1)  NULL ,
```

```
	PRIMARY KEY  CLUSTERED ([SampleNumber] ASC,[StudyID] ASC),
	FOREIGN KEY ([AnimalNumber],[StudyID]) REFERENCES
[Animal]([AnimalNumber],[StudyID]),
 FOREIGN KEY ([Status]) REFERENCES [Status]([Status]),
 FOREIGN KEY ([StudyID]) REFERENCES [Study]([StudyID]),
 FOREIGN KEY ([ClassID]) REFERENCES [Classification]([ClassID])
)
go

CREATE TABLE [Scat]
(
	[SampleNumber]	integer  NOT NULL ,
	[StudyID]	varchar(3)  NOT NULL ,
	[PHT_Value]	float  NULL ,
	[ParticipantID]	varchar(5)  NULL ,
	 PRIMARY KEY  CLUSTERED ([SampleNumber] ASC,[StudyID] ASC),
	 FOREIGN KEY ([ParticipantID]) REFERENCES [Dog]([ParticipantID]),
 FOREIGN KEY ([SampleNumber],[StudyID]) REFERENCES [Sample]([SampleNumber],[StudyID])
)
go

CREATE TABLE [ProjectDirector]
(
	[ParticipantID]	varchar(5)  NOT NULL ,
	[ReviewDate]	date  NULL ,
	 PRIMARY KEY  CLUSTERED ([ParticipantID] ASC),
	 FOREIGN KEY ([ParticipantID]) REFERENCES [Participant]([ParticipantID])
)
go

CREATE TABLE [LabTechnicians]
(
	[ParticipantID]	varchar(5)  NOT NULL ,
	 PRIMARY KEY  CLUSTERED ([ParticipantID] ASC),
	 FOREIGN KEY ([ParticipantID]) REFERENCES [Participant]([ParticipantID])
)
go

CREATE TABLE [HairTelemetry]
(
	[SampleNumber]	integer  NOT NULL ,
	[StudyID]	varchar(3)  NOT NULL ,
	[ParticipantID]	varchar(5)  NULL ,
	 PRIMARY KEY  CLUSTERED ([SampleNumber] ASC,[StudyID] ASC),
	 FOREIGN KEY ([ParticipantID]) REFERENCES [LabTechnicians]([ParticipantID]),
 FOREIGN KEY ([SampleNumber],[StudyID]) REFERENCES [Sample]([SampleNumber],[StudyID])
)
go
```

B) DML Statements for loading data:

1. Inserts for Species:

```
INSERT INTO SPECIES VALUES ('B','Black bear','113');
INSERT INTO SPECIES VALUES ('G','Grizzly bear','142');
INSERT INTO SPECIES VALUES ('U','Undetermined',null);

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

2. Inserts for Status:

```
INSERT INTO STATUS VALUES ('1','Sample exists');
INSERT INTO STATUS VALUES ('0','Sample used up');

(1 row(s) affected)

(1 row(s) affected)
```

3. Inserts for Classification:

```
INSERT INTO CLASSIFICATION VALUES ('T','Telemetry');
INSERT INTO CLASSIFICATION VALUES ('H','Hair Snag');
INSERT INTO CLASSIFICATION VALUES ('S','Scat');

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

4. Inserts for Participant:

```
INSERT INTO PARTICIPANT VALUES ('P2001','Bill Brown','2014-02-14',null);
INSERT INTO PARTICIPANT VALUES ('P2004','Jane Smith','2014-02-14',null);
INSERT INTO PARTICIPANT VALUES ('P2036','Frank Martin','2012-08-15','2014-01-01');
INSERT INTO PARTICIPANT VALUES ('P2045','Anne Dough','2013-06-12',null);
INSERT INTO PARTICIPANT VALUES ('P2046','Mike Green','2012-10-28',null);
INSERT INTO PARTICIPANT VALUES ('D0004','Max','2014-06-01',null);
INSERT INTO PARTICIPANT VALUES ('D0008','Sampson','2014-02-05',null);
INSERT INTO PARTICIPANT VALUES ('D0013','Cindy','2013-12-10','2014-12-20');
INSERT INTO PARTICIPANT VALUES ('D0022','Rover','2014-05-20',null);
INSERT INTO PARTICIPANT VALUES ('P0000','Bob Bureaucrat',null,null);
INSERT INTO PARTICIPANT VALUES ('P0101','Sam Supervisor',null,null);
INSERT INTO PARTICIPANT VALUES ('P0102','Mary Manager',null,null);
INSERT INTO PARTICIPANT VALUES ('P0103','Fred Foreman',null,null);

(1 row(s) affected)
```

```
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(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

5. Inserts for Dog:

```
INSERT INTO DOG VALUES ('D0004','4');
INSERT INTO DOG VALUES ('D0008','2');
INSERT INTO DOG VALUES ('D0013','2');
INSERT INTO DOG VALUES ('D0022','2');

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

6. Inserts for ProjectDirector:

```
INSERT INTO PROJECTDIRECTOR VALUES ('P0000',null);

(1 row(s) affected)
```

7. Inserts for RegionManager:

```
INSERT INTO REGIONMANAGER VALUES ('P0101',null);
INSERT INTO REGIONMANAGER VALUES ('P0102',null);
INSERT INTO REGIONMANAGER VALUES ('P0103',null);

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

8. Inserts for Region:

```
INSERT INTO REGION VALUES ('NR','North Region','9x9','P0101');
INSERT INTO REGION VALUES ('CR','Central Region','9x9','P0102');
INSERT INTO REGION VALUES ('SR','South Region','5x5','P0103');

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

9. Inserts for Study:

```
INSERT INTO STUDY VALUES ('N14','North 2014','NR');
INSERT INTO STUDY VALUES ('S14','South 2014','SR');
INSERT INTO STUDY VALUES ('C14','Central 2014','CR');
INSERT INTO STUDY VALUES ('C15','Central 2015','CR');

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

10. Inserts for Animal:

```
INSERT INTO ANIMAL VALUES ('42','N14','M','B');
INSERT INTO ANIMAL VALUES ('89','S14','F','B');
INSERT INTO ANIMAL VALUES ('59','C14','M','B');
INSERT INTO ANIMAL VALUES ('113','C14','F','G');
INSERT INTO ANIMAL VALUES ('59','C15','F','B');
INSERT INTO ANIMAL VALUES ('50','C15','?','B');
INSERT INTO ANIMAL VALUES ('118','N14','F','B');
INSERT INTO ANIMAL VALUES ('112','C15','M','G');
INSERT INTO ANIMAL VALUES ('66','C14','F','G');
INSERT INTO ANIMAL VALUES ('66','N14','?','U');
INSERT INTO ANIMAL VALUES ('66','S14','M','B');
INSERT INTO ANIMAL VALUES ('113','N14','F','G');
INSERT INTO ANIMAL VALUES ('63','S14','M','B');
INSERT INTO ANIMAL VALUES ('114','C14','F','G');

(1 row(s) affected)

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(1 row(s) affected)
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(1 row(s) affected)

(1 row(s) affected)
```

11. Inserts for Sample:

```
INSERT INTO SAMPLE VALUES ('17','N14','05:8:3','2014/07','42','1','S');
INSERT INTO SAMPLE VALUES ('22','S14','93:2:4','2014/11','89','1','H');
INSERT INTO SAMPLE VALUES ('44','C14','32:1:9','2014/09','59','0','T');
INSERT INTO SAMPLE VALUES ('45','C14','40:1:1','2015/10','113','0','H');
INSERT INTO SAMPLE VALUES ('47','C14','41:2:3','2014/09','59','0','T');
INSERT INTO SAMPLE VALUES ('48','C15','34:4:4','2015/09','59','1','S');
INSERT INTO SAMPLE VALUES ('56','C15','40:1:1','2015/07','50','1','S');
INSERT INTO SAMPLE VALUES ('59','N14','07:1:2','2014/06','118','1','S');
INSERT INTO SAMPLE VALUES ('79','C15','32:5:5','2014/07','112','1','S');
INSERT INTO SAMPLE VALUES ('82','C14','31:5:8','2014/11','66','0','T');
INSERT INTO SAMPLE VALUES ('100','N14','01:1:9','2014/07','66','0','S');
INSERT INTO SAMPLE VALUES ('68','S14','80:3:2','2014/07','66','0','H');
INSERT INTO SAMPLE VALUES ('27','N14','15:2:6','2014/08','42','1','S');
INSERT INTO SAMPLE VALUES ('11','N14','19:4:7','2014/07','113','0','S');
INSERT INTO SAMPLE VALUES ('45','S14','90:3:4','2014/07','63','0','S');
INSERT INTO SAMPLE VALUES ('17','C14','38:4:1','2014/10','114','1','T');
INSERT INTO SAMPLE VALUES ('18','C14','38:4:1','2014/10','114','1','S');

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```

12. Inserts for Scat:

```
INSERT INTO SCAT VALUES ('17','N14','109','D0004');
INSERT INTO SCAT VALUES ('48','C15','100','D0013');
INSERT INTO SCAT VALUES ('56','C15','103.5','D0004');
INSERT INTO SCAT VALUES ('59','N14','120','D0022');
INSERT INTO SCAT VALUES ('79','C15','135','D0004');
INSERT INTO SCAT VALUES ('100','N14',NULL,'D0022');
INSERT INTO SCAT VALUES ('27','N14','115','D0008');
INSERT INTO SCAT VALUES ('11','N14','135','D0008');
INSERT INTO SCAT VALUES ('45','S14','117','D0013');
INSERT INTO SCAT VALUES ('18','C14','150','D0004');

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

13. Inserts for LabTechnician:

```
INSERT INTO LABTECHNICIANS VALUES ('P2001');
INSERT INTO LABTECHNICIANS VALUES ('P2004');
INSERT INTO LABTECHNICIANS VALUES ('P2036');
INSERT INTO LABTECHNICIANS VALUES ('P2045');
INSERT INTO LABTECHNICIANS VALUES ('P2046');
```

```
(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

14. Inserts for HairTelemetry:

```
INSERT INTO HAIRTELEMETRY VALUES('22','S14','P2045');
INSERT INTO HAIRTELEMETRY VALUES('44','C14','P2001');
INSERT INTO HAIRTELEMETRY VALUES('45','C14','P2046');
INSERT INTO HAIRTELEMETRY VALUES('47','C14','P2045');
INSERT INTO HAIRTELEMETRY VALUES('82','C14','P2045');
INSERT INTO HAIRTELEMETRY VALUES('68','S14','P2004');
INSERT INTO HAIRTELEMETRY VALUES('17','C14','P2004');
```

```
(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)
```

C) Tables after Loading Data:

1. Data in Species:

```
SELECT * FROM SPECIES;

SpeciesCode AnimalType           AveragePHT
----------- -------------------- ----------------------
B           Black bear           113
G           Grizzly bear         142
U           Undetermined         NULL

(3 row(s) affected)
```

2. Data in Status:

```
SELECT * FROM STATUS;

Status      Description
----------- -------------------------
0           Sample used up
1           Sample exists

(2 row(s) affected)
```

3. Data in Classification:

```
SELECT * FROM CLASSIFICATION;

ClassID name
------- ----------
H       Hair Snag
S       Scat
T       Telemetry

(3 row(s) affected)
```

4. Data in Participant:

```
SELECT * FROM PARTICIPANT;

ParticipantID Name                 StartDate  EndDate
------------- -------------------- ---------- ----------
D0004         Max                  2014-06-01 NULL
D0008         Sampson              2014-02-05 NULL
D0013         Cindy                2013-12-10 2014-12-20
D0022         Rover                2014-05-20 NULL
P0000         Bob Bureaucrat       NULL       NULL
P0101         Sam Supervisor       NULL       NULL
P0102         Mary Manager         NULL       NULL
P0103         Fred Foreman         NULL       NULL
P2001         Bill Brown           2014-02-14 NULL
P2004         Jane Smith           2014-02-14 NULL
P2036         Frank Martin         2012-08-15 2014-01-01
P2045         Anne Dough           2013-06-12 NULL
P2046         Mike Green           2012-10-28 NULL

(13 row(s) affected)
```

5. Data in Dog:

```
SELECT * FROM DOG;
```

```
ParticipantID NumberSamples
------------- -------------
D0004         4
D0008         2
D0013         2
D0022         2

(4 row(s) affected)
```

6. Data in ProjectDirector:

```
SELECT * FROM PROJECTDIRECTOR;
```

```
ParticipantID ReviewDate
------------- ----------
P0000         NULL

(1 row(s) affected)
```

7. Data in RegionManager:

```
SELECT * FROM REGIONMANAGER;
```

```
ParticipantID LastAccessTime
------------- -----------------------
P0101         NULL
P0102         NULL
P0103         NULL

(3 row(s) affected)
```

8. Data in Region:

```
SELECT * FROM REGION;
```

```
RegionID Name                 Size ParticipantID
-------- -------------------- ---- -------------
CR       Central Region       9x9  P0102
NR       North Region         9x9  P0101
SR       South Region         5x5  P0103

(3 row(s) affected)
```

9. Data in Study:

```
SELECT * FROM STUDY;
```

```
StudyID StudyName            RegionID
------- -------------------- --------
C14     Central 2014         CR
C15     Central 2015         CR
N14     North 2014           NR
S14     South 2014           SR

(4 row(s) affected)
```

10. Data in Animal:

```
SELECT * FROM ANIMAL;
```

```
AnimalNumber StudyID Sex  SpeciesCode
------------ ------- ---- -----------
42           N14     M    B
50           C15     ?    B
59           C14     M    B
59           C15     F    B
63           S14     M    B
66           C14     F    G
66           N14     ?    U
66           S14     M    B
89           S14     F    B
112          C15     M    G
113          C14     F    G
113          N14     F    G
114          C14     F    G
118          N14     F    B

(14 row(s) affected)
```

11. Data in Sample:

```
SELECT * FROM SAMPLE;
```

```
SampleNumber StudyID Location SampleDate AnimalNumber Status      ClassID
------------ ------- -------- ---------- ------------ ----------- -------
11           N14     19:4:7   2014/07    113          0           S
17           C14     38:4:1   2014/10    114          1           T
17           N14     05:8:3   2014/07    42           1           S
18           C14     38:4:1   2014/10    114          1           S
22           S14     93:2:4   2014/11    89           1           H
27           N14     15:2:6   2014/08    42           1           S
44           C14     32:1:9   2014/09    59           0           T
45           C14     40:1:1   2015/10    113          0           H
45           S14     90:3:4   2014/07    63           0           S
47           C14     41:2:3   2014/09    59           0           T
48           C15     34:4:4   2015/09    59           1           S
56           C15     40:1:1   2015/07    50           1           S
59           N14     07:1:2   2014/06    118          1           S
68           S14     80:3:2   2014/07    66           0           H
79           C15     32:5:5   2014/07    112          1           S
82           C14     31:5:8   2014/11    66           0           T
100          N14     01:1:9   2014/07    66           0           S

(17 row(s) affected)
```

12. Data in Scat:

```
SELECT * FROM SCAT;
```

```
SampleNumber StudyID PHT_Value              ParticipantID
------------ ------- ---------------------- -------------
11           N14     135                    D0008
17           N14     109                    D0004
18           C14     150                    D0004
27           N14     115                    D0008
45           S14     117                    D0013
48           C15     100                    D0013
56           C15     103.5                  D0004
59           N14     120                    D0022
79           C15     135                    D0004
100          N14     NULL                   D0022

(10 row(s) affected)
```

13. Data in LabTechnician:

```
SELECT * FROM LABTECHNICIANS;
```

```
ParticipantID
-------------
P2001
P2004
P2036
P2045
P2046

(5 row(s) affected)
```

14. Data in HairTelemetry:

```
SELECT * FROM HAIRTELEMETRY;
```

```
SampleNumber StudyID ParticipantID
------------ ------- -------------
17           C14     P2004
22           S14     P2045
44           C14     P2001
45           C14     P2046
47           C14     P2045
68           S14     P2004
82           C14     P2045

(7 row(s) affected)
```

Logical Data Model (LDM) Intermediate Design (Version 2):

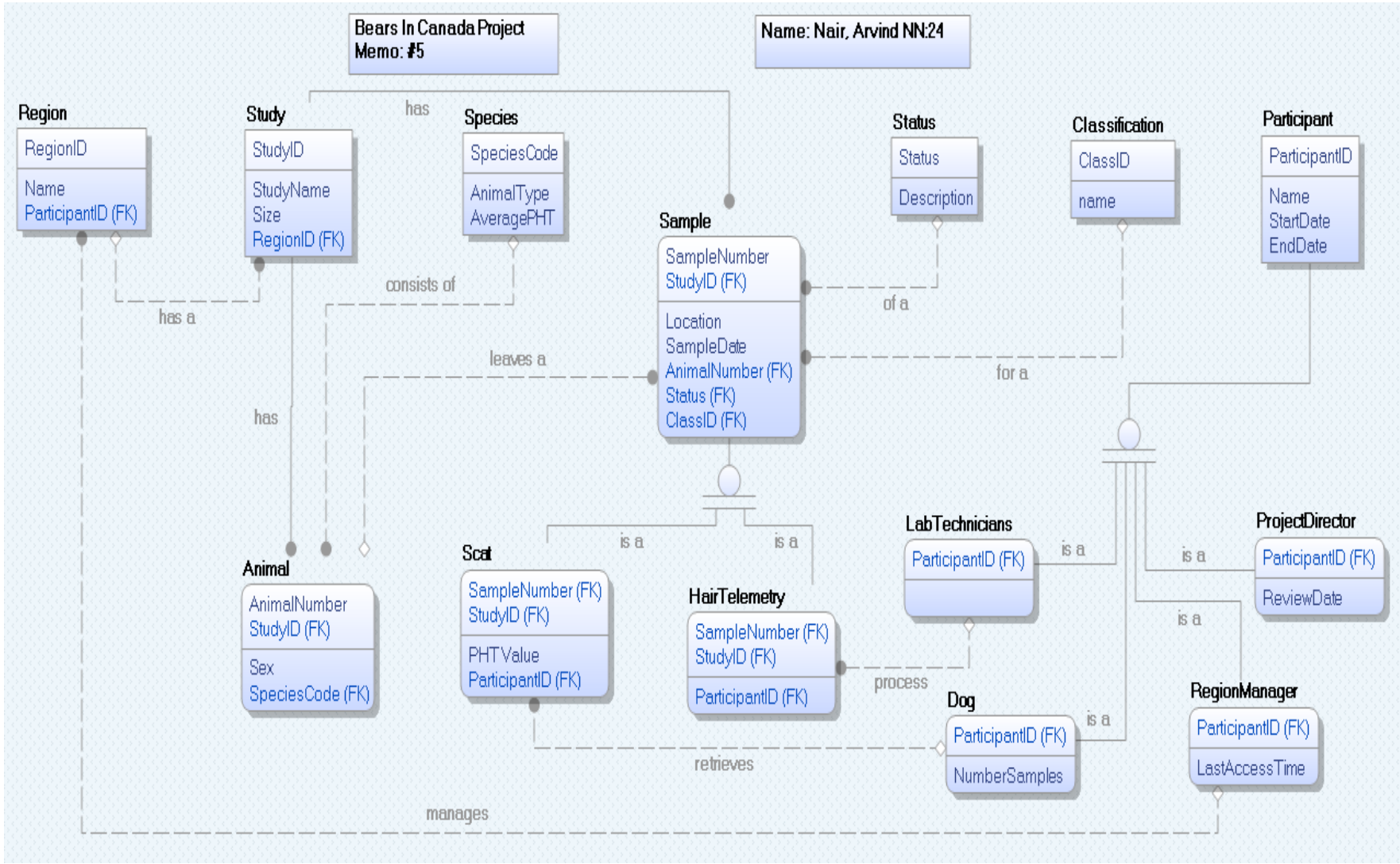

Figure 3: LDM Intermediate Design (Version 2)

Physical Data Model (PDM) Intermediate Design (Version 2):

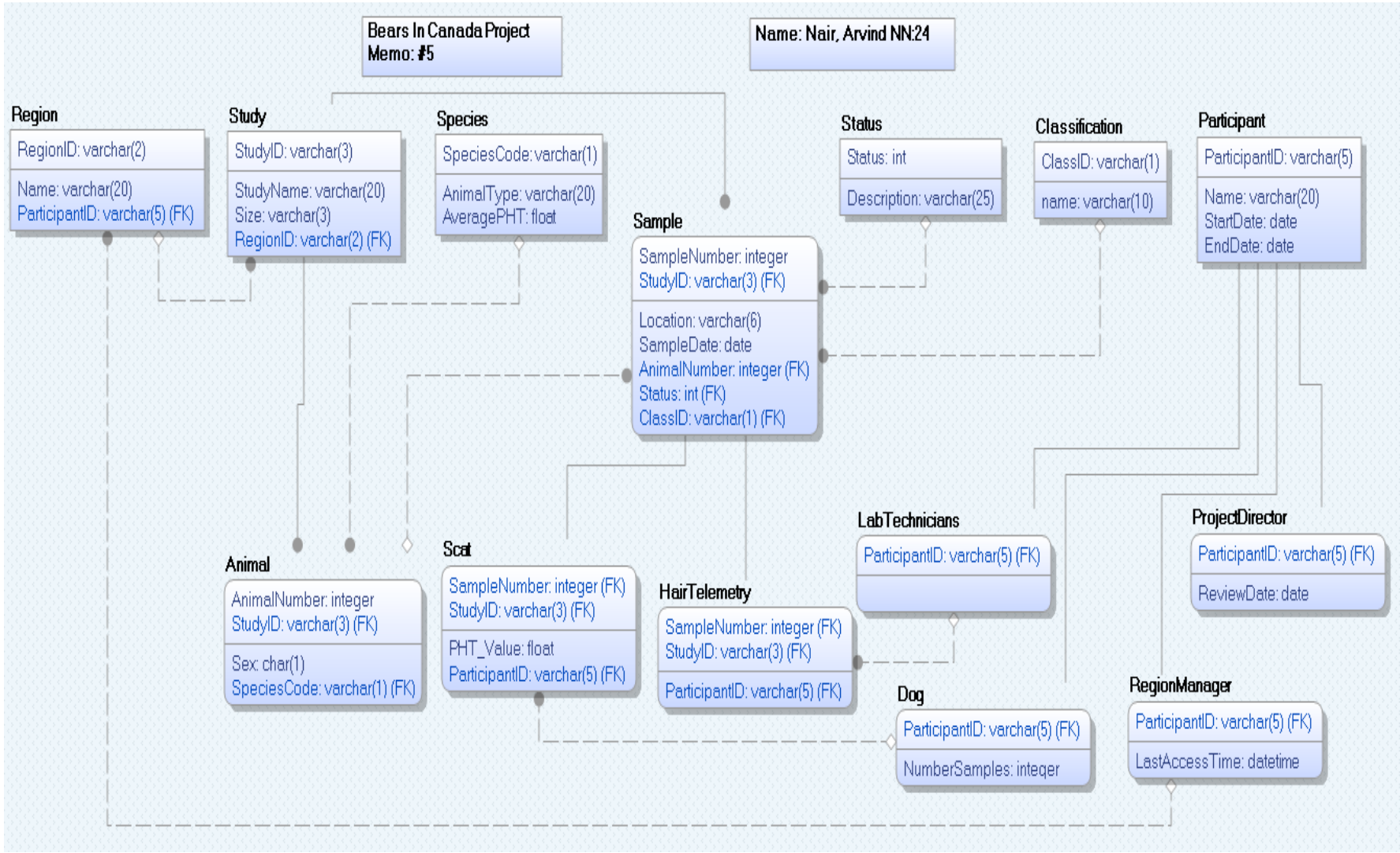

Figure 4: PDM Intermediate Design (Version 2)

Logical Data Model (LDM) Initial Design (Version 1):

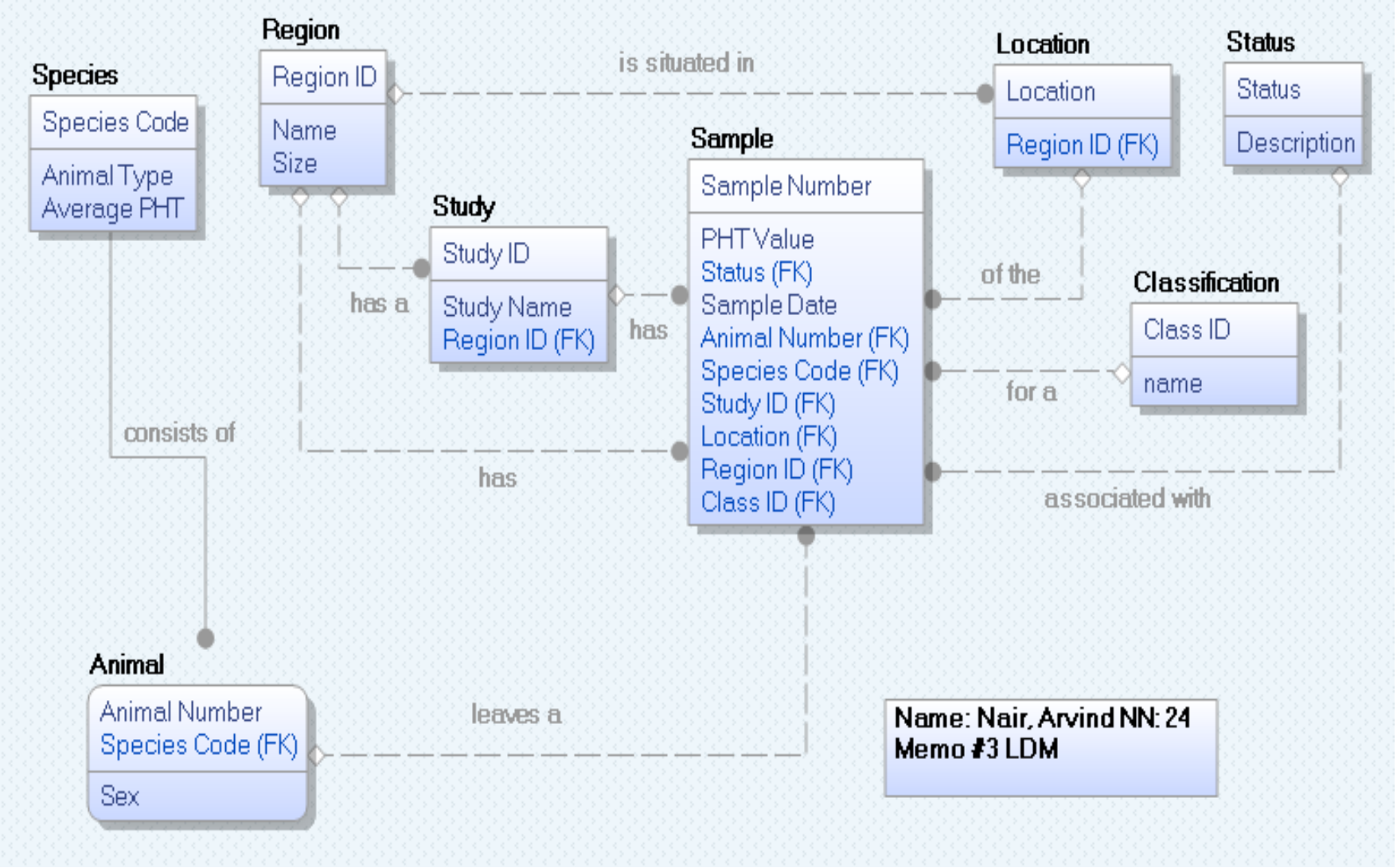

Figure 5: LDM Initial Design (Version 1)