Final Product

Final Schema Differences:

Change the Schema for moon:

Before: Moon (**id**, **planetId**, radius)

After: Moon (**id**, planetId, radius)

This was because planetId was not a necessary foreign key.

Schema:

GalaxyType (shape, TYPE)

BlackHoleMass (massType, mass)

StarTemperature (temperature, TYPE)

AsteroidComposition (composition, TYPE)

Galaxy (id, SIZE, **TYPE**)

BlackHole (id, radius, **mass**, **galaxyID**)

Asteroid (id, **composition**, **galaxyID**)

PlanetarySystem (id, TYPE, age, **galaxyID**)

Planet (id, declination, rightAscension, mass, radius, TYPE, **planetarySystemId**)

Satellite (id, **planetId**, mass)

Meteor (**id**, **planetEnteredID**)

Moon (**id**, planetId, radius)

Nebula (id, TYPE, magnitude, **galaxyID**)

Star (id, declination, rightAscension, mass, radius, **temperature**, luminosity, **planetarySystemID**)

Data Screenshots:

Galaxy:

Retrieved data from the table:

ID	SIZE	TYPE
Andromeda	220000	Spiral
Milky Way	87400	Spiral
Sombrero	60000	Peculiar
Triangulum	60000	Spiral
Whirlpool	50000	Spiral
ESO 243-49	50000	Spiral
Virgo A	60000	Elliptical

Galaxy Type:

Retrieved data from the table:

SHAPE	TYPE
Peculiar	Peculiar
Spiral	Spiral
Elliptical	Elliptical
Lenticular	Lenticular
Seyfert	Seyfert

Star:

Retrieved data from the table:

ID	DECLINATION	RIGHTASCENSION	MASS	RADIUS	TEMPERATURE	LUMINOSITY	PLANETARYSYSTEMID
Kepler 22	48	19	1	1	5596	1	Kepler 22
Lalande 21185	36	11	0	0	3547	0	Lalande 21185
Proxima Centauri	-63	14	0	0	2992	0	Proxima Centauri
Sun	10	14	1	1	5772	1	Solar System
TRAPPIST-1	-5	23	0	0	2566	0	TRAPPIST-1
Big-Chungus-ONE	-4	27	0	0	5772	0	C.K.Wrik-System
Big-Chungus-TWO	-6	30	1	0	2566	0	C.K.Wrik-System

Star Temperature:

Retrieved data from the table:

TEMPERATURE	TYPE
2566	M-Type
2992	M-Type
3547	M-Type
5596	G-Type
5772	G-Type

Planet:

Retrieved data from the table:

ID	DECLINATION	RIGHTASCENSION	MASS	RADIUS	TYPE	PLANETARYSYSTEMID
Earth	0	0	1	6378	Terrestrial	Solar System
Jupiter	268	18	318	69911	Gas Giant	Solar System
Kepler 22B	-48	19	2	6378	Terrestrial	Kepler 22
Saturn	41	3	95	58232	Gas Giant	Solar System
Uranus	257	17	15	25362	Ice Giant	Solar System
Planet-Ayush	258	20	16	25362	Gas Giant	C.K.Wrik-System
Planet-Max	259	30	17	25362	Ice Giant	C.K.Wrik-System

Satellite:

Retrieved data from the table:

ID	PLANETID	MASS
Europa	Jupiter	0
Ganymede	Jupiter	0
Miranda	Uranus	0
Moon	Earth	0
Titan	Saturn	0

Moon:

Retrieved data from the table:

ID	PLANETID	RADIUS
Moon	Earth	1737
Ganymede	Jupiter	2634
Miranda	Uranus	236
Titan	Saturn	2575
Europa	Jupiter	1561

Asteroid:

Retrieved data from the table:

ID	COMPOSITION	GALAXYID
Aarhus	Chondrite	Milky Way
Vermillion	Pallasite	Milky Way
Qidong	O Chondrite	Milky Way
Yamato 000593	Achondrite	Milky Way
Hoba	Iron	Milky Way
Asteroid1	Chondrite	Triangulum
Asteroid2	Pallasite	Triangulum
Asteroid3	O Chondrite	Triangulum
Asteroid4	Achondrite	Triangulum
Asteroid5	Iron	Triangulum
Asteroid6	Achondrite	Whirlpool
Asteroid7	Iron	Whirlpool

Meteor:

Retrieved data from the table:

ID	PLANETENTEREDID
Aarhus	Earth
Hoba	Earth
Qidong	Earth
Vermillion	Earth
Yamato 000593	Earth

Black Hole:

Retrieved data from the table:

ID	RADIUS	MASS	GALAXYID
Sagittarius A*	32	4154000	Milky Way
Cygnus X-1	21	21	Milky Way
HLX-1	0	90000	ESO 243-49
M87*	815932000000	2400000000000	Virgo A
SS 433	19	26	Milky Way

Black Hole Mass:

Retrieved data from the table:

MASSTYPE	MASS
Supermassive	4154000
Stellar	21
Intermediate	90000
Supermassive	2400000000000
Stellar	26

Nebula:

Retrieved data from the table:

ID	TYPE	MAGNITUDE	GALAXYID
Cat's Eye Nebula	Planetary	10	Milky Way
Dumbbell Nebula	Planetary	8	Milky Way
Helix Nebula	Bright Planetary	8	Milky Way
M2-09	Planetary	15	Milky Way
Ring Nebula	Planetary	9	Milky Way

Planetary System:

Retrieved data from the table:

ID	TYPE	AGE	GALAXYID
Kepler 22	Ordered	7	Milky Way
Lalande 21185	Ordered	8	Milky Way
Proxima Centauri	Ordered	5	Milky Way
Solar System	Ordered	5	Milky Way
TRAPPIST-1	Similar	8	Milky Way
C.K.Wrik-System	Similar	10	Whirlpool

List of SQL Queries:

Queries in file admin.php:

Insert Operation:

1. Line 348-`"INSERT INTO Galaxy VALUES ('$id', $size, '$galaxyType')";`
2. Line 360-`"INSERT INTO Moon VALUES ('$satelliteId', '$planetId', $radius)";`
3. Line 362-`"INSERT INTO Satellite VALUES ('$satelliteId', '$planetId', $mass)";`
4. Line 373-`"INSERT INTO Asteroid VALUES ('$asteroidId', '$composition', '$galaxyID')";`
5. Line 382-`"INSERT INTO PlanetarySystem VALUES ('$systemId', '$systemType', $age, '$galaxyID')";`
6. Line 394-`"INSERT INTO Planet VALUES ('$planetId', $declination, $rightAscension, $mass, $radius, '$planetType', '$planetarySystemId')";`
7. Line 401-`"INSERT INTO Meteor VALUES ('$meteorId', '$planetEnteredId')";`
8. Line 410-`"INSERT INTO Nebula VALUES ('$nebulaId', '$nebulaType', $nebulaMagnitude, '$galaxyID')";`
9. Line 423-`"INSERT INTO Star VALUES ('$starId', $declination, $rightAscension, $mass, $radius, $temperature, $luminosity, '$planetarySystemID')";`
10. Line 432-`"SELECT * FROM BlackHoleMass WHERE id = '$mass'";`
11. Line 443-`"INSERT INTO BlackHoleMass VALUES ('$massType', '$mass')";`
12. Line 447-`"INSERT INTO BlackHole VALUES ('$blackHoleId', $radius, $mass, '$galaxyID')";`

Delete Operation:

1. Line: 322 - `"DELETE FROM $type WHERE id = '$id'";`

Update Operation:

1. Line: 283 - `"UPDATE Galaxy SET \"SIZE\" = $newSize, \"TYPE\" = '$newType' WHERE id = '$id'";`
2. Line: 289 - `"UPDATE Satellite SET planetId = '$newPlanetId', mass = $newMass WHERE id = '$id'";`
3. Line: 292(this is to check, not update)- `"SELECT * FROM Moon WHERE id = '$id'";`
4. Line: 297-`"UPDATE Moon SET planetId = '$newPlanetId' WHERE id = '$id'";`

View Operation:

1. Line 474-`"SELECT * FROM $selectedType"`

Queries in file home.php:

Selection:

Line 217

```
$query = "SELECT $selectString FROM Galaxy WHERE \"SIZE\" $comparison
$galaxySize";
```

Line 223

```
$query = "SELECT $selectString FROM Galaxy WHERE \"TYPE\" = $galaxyType";
```

Line 229

```
$query = "SELECT $selectString FROM Galaxy WHERE \"SIZE\" $comparison
$galaxySize AND \"TYPE\" = $galaxyType";
```

Projection:

Line 217

```
$query = "SELECT $selectString FROM Galaxy WHERE \"SIZE\" $comparison
$galaxySize";
```

Line 219

```
$query = "SELECT $selectString FROM Galaxy";
```

Line 223

```
$query = "SELECT $selectString FROM Galaxy WHERE \"TYPE\" = $galaxyType";
```

Line 225

```
$query = "SELECT $selectString FROM Galaxy";
```

Line 229

```
$query = "SELECT $selectString FROM Galaxy WHERE \"SIZE\" $comparison
$galaxySize AND \"TYPE\" = $galaxyType";
```

Join: Lines 241-244

```
$query = "SELECT Planet.*, PlanetarySystem.galaxyID

            FROM Planet

            JOIN PlanetarySystem ON Planet.planetarySystemID =
PlanetarySystem.id

            WHERE PlanetarySystem.galaxyID = '$id'";
```

Aggregation with Group By: Line 253

```
$query = 'SELECT "TYPE", AVG(magnitude) AS "Average Magnitude" FROM Nebula
GROUP BY "TYPE"';
```

Aggregation with Having: Lines 264-268

```
$query = "SELECT BlackHoleMass.massType, avg(radius) as \"Average Radius\"

            FROM (BlackHole JOIN BlackHoleMass ON BlackHoleMass.mass =
BlackHole.mass)

            GROUP BY BlackHoleMass.massType

            HAVING avg(radius) $inequality $number

            ORDER BY avg(radius)";
```

Nested Aggregation with Group By: Lines 277-283

```
$query = 'SELECT GalaxyID, SUM(Count) AS "Number of Stars"

            FROM PlanetarySystem

            JOIN (SELECT planetarySystemID AS psid,
COUNT(planetarySystemID) AS Count

                FROM Star

                GROUP BY planetarySystemID)

            ON PlanetarySystem.id = psid

            GROUP BY GalaxyID';
```

Division: Lines 293- 297

```
$query = 'SELECT Galaxy.id FROM Galaxy

            JOIN Asteroid ON Galaxy.id = Asteroid.galaxyID

            JOIN AsteroidComposition ON Asteroid.composition =
AsteroidComposition.composition

            GROUP BY Galaxy.id

            HAVING COUNT(DISTINCT AsteroidComposition.composition) =
(SELECT COUNT(*) FROM AsteroidComposition)';
```

Functionality Screenshots:

For Data Before, see the screenshots above with all the data tables.

Selection

<table>
<tr><td>During:</td><td>Choose a type: Find Galaxies Submit

Filter by Size: Greater than 60000
Filter by Type:

Select Columns:

Type: Size: Submit</td></tr>
<tr><td>After:</td><td><table><tr><th>ID</th><th>SIZE</th><th>TYPE</th></tr><tr><td>Andromeda</td><td>220000</td><td>Spiral</td></tr><tr><td>Milky Way</td><td>87400</td><td>Spiral</td></tr></table></td></tr>
<tr><td colspan="2">Projection</td></tr>
<tr><td>During:</td><td>Choose a type: Find Galaxies Submit

Filter by Size: Greater than
Filter by Type:

Select Columns:

Type: Size: Submit</td></tr>
<tr><td>After:</td><td><table><tr><th>ID</th><th>TYPE</th></tr><tr><td>Andromeda</td><td>Spiral</td></tr><tr><td>Milky Way</td><td>Spiral</td></tr><tr><td>Sombrero</td><td>Peculiar</td></tr><tr><td>Triangulum</td><td>Spiral</td></tr><tr><td>Whirlpool</td><td>Spiral</td></tr><tr><td>ESO 243-49</td><td>Spiral</td></tr><tr><td>Virgo A</td><td>Elliptical</td></tr></table></td></tr>
<tr><td colspan="2">Join</td></tr>
<tr><td>During:</td><td>Choose a type: All Planets in Galaxy Submit

Enter a Galaxy ID to view all planets in that galaxy: Milky Way Submit</td></tr>
</table>

After:

Retrieved data from the table:

ID	DECLINATION	RIGHTASCENSION	MASS	RADIUS	TYPE	PLANETARYSYSTEMID	GALAXYID
Earth	0	0	1	6378	Terrestrial	Solar System	Milky Way
Jupiter	268	18	318	69911	Gas Giant	Solar System	Milky Way
Kepler 22B	-48	19	2	6378	Terrestrial	Kepler 22	Milky Way
Saturn	41	3	95	58232	Gas Giant	Solar System	Milky Way
Uranus	257	17	15	25362	Ice Giant	Solar System	Milky Way

Aggregation with Group By

During:

Choose a type: Average Magnitude of Nebula Types Submit

Click the button to view the average Magnitude of all types of Nebulae: Submit

After:

TYPE	Average Magnitude
Planetary	10.5
Bright Planetary	8

Aggregation with Having

During:

Get all black hole types comapred with the Radius:
Radius is: Greater than 1
Submit

After:

MASSTYPE	Average Radius
Stellar	20
Supermassive	407966000016

Nested Aggregation with Group By

During:

Choose a type: Average Stars per Galaxy Submit

Press to view the average number of stars per galaxy: Submit

<table>
<tr><td>After:</td><td>

GALAXYID	Number of Stars
Whirlpool	2
Milky Way	5

</td></tr>
<tr><td colspan="2">Division</td></tr>
<tr><td>During:</td><td>Choose a type: Galaxies with Every Asteroid Composition Submit

Press to view the galaxies that have every type of asteroid: Submit</td></tr>
<tr><td>After:</td><td>

ID
Milky Way
Triangulum

</td></tr>
</table>