

CPSC 304 Project Cover Page

Milestone #: 2

Date: March 1st, 2024

Group Number: 106

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By typing our names and student numbers in the above table, we certify that the work in the attached assignment was performed solely by those whose names and student IDs are included above. (In the case of Project Milestone 0, the main purpose of this page is for you to let us know your e-mail address, and then let us assign you to a TA for your project supervisor.)

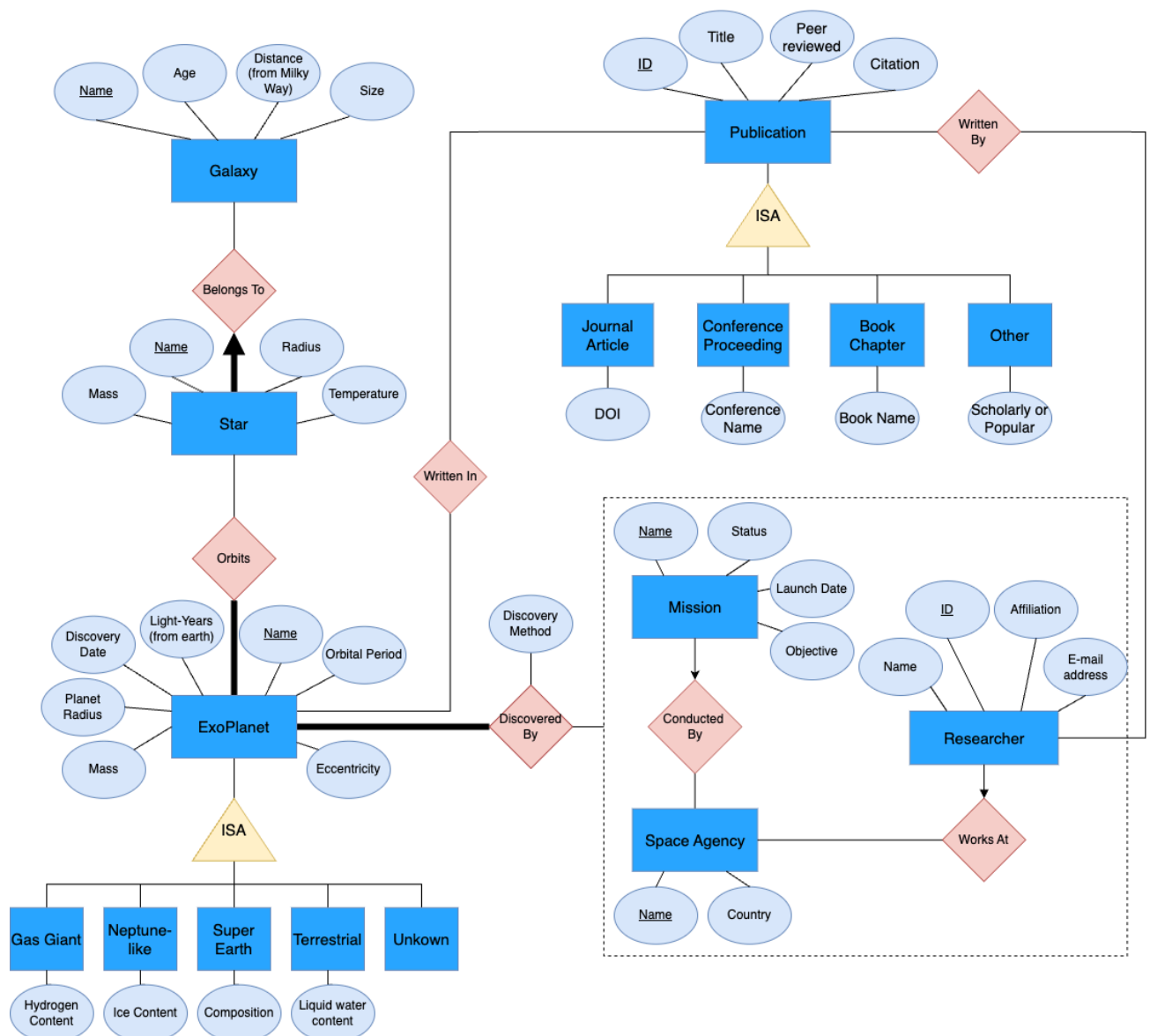
In addition, we indicate that we are fully aware of the rules and consequences of plagiarism, as set forth by the Department of Computer Science and the University of British Columbia

MILESTONE 2:

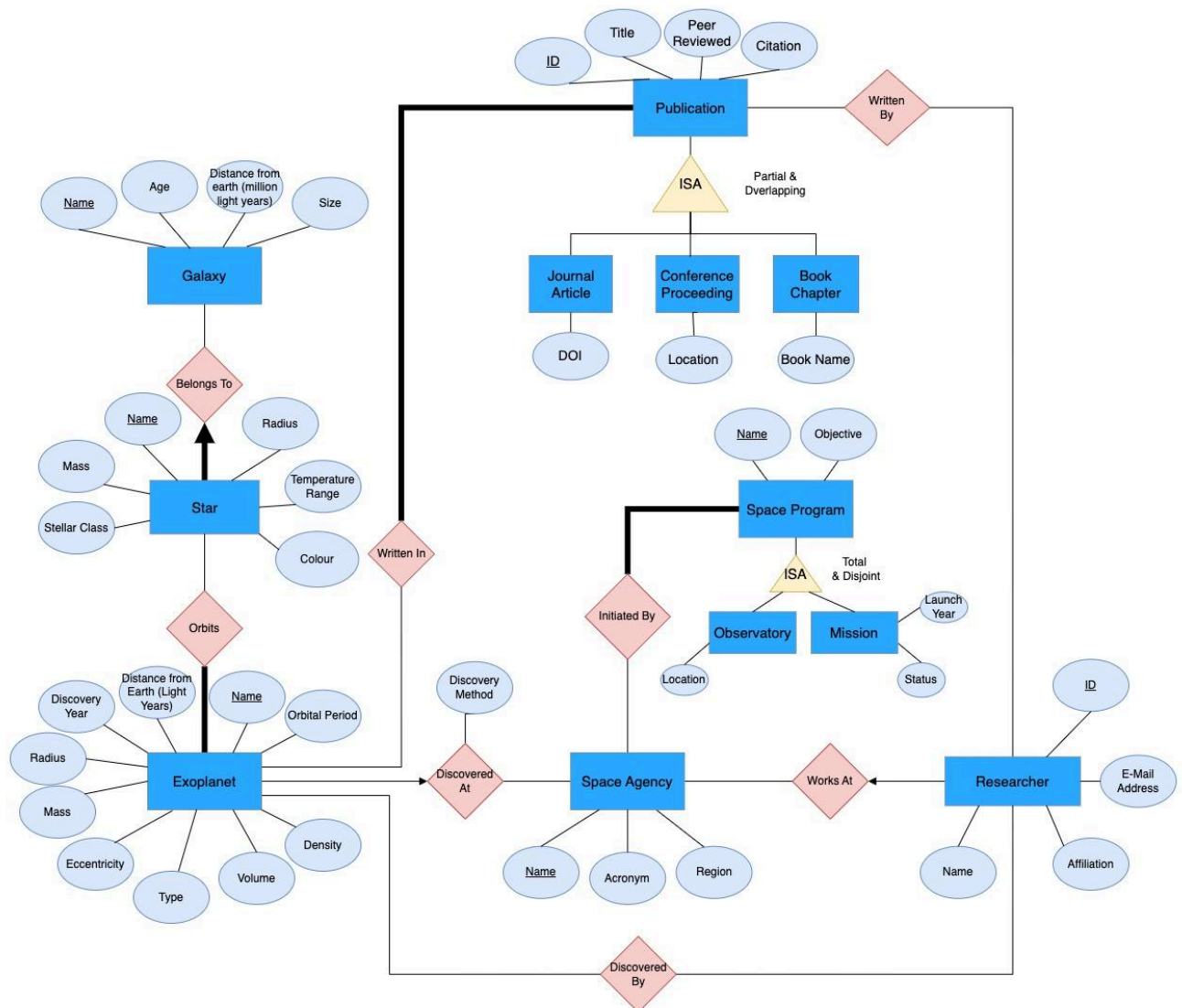
Project Summary

The goal of our project is to create a comprehensive user-friendly database that compiles information about various exoplanets. Our database will contain different entities such as stars, galaxies, researchers, space agencies, publications, and space missions; and will create a centralized platform for the purpose of storing and retrieving this data.

Old ER Diagram:



New ER Diagram



Changes to ER diagram:

- Removed ISA from exoplanet as it was difficult to find most of the unique features for planet types and the unique attributes were ending up as null values.
- Added an ISA called space program in place of Mission as there were 2 types Observatories and Missions (involving satellites) that had different features.
- Added ISA constraints as per the TA.
- Removed Aggregation and switched to a simple relation from exoplanet to space agency as the aggregation required every exoplanet to be discovered by a mission but this was not the case. Space Agencies without specific missions discovered exoplanets. Moreover independent researchers also discovered exoplanets.
- New Relation from exoplanet to Researcher since independent researchers also discovered exoplanets.

- Added 2 total participation constraints for WrittenIn and InitiateBy as the made sense. Every space program must be initiated by space agencies and every publication must be about some exoplanets otherwise we won't have them in the database.
- Added new attributes to accommodate new FDs.

Schema before Normalization

- Galaxy(Name: VarChar[100], Age: bigInt, Distance from earth (million light years): double, Size: bigInt)
PK: Name
CK: Name
FK: None
Constraints: None
- Star_BelongsTo(Name: VarChar[100], **GalaxyName**: VarChar[100] **NOT NULL**, Mass: double, Radius: double, Temperature Range: VarChar[100], Stellar Class: VarChar[100], Colour: VarChar[100])
PK: Name
CK: Name
FK: Galaxy.Name
Constraints: Galaxy.Name - Not Null
- Orbits(**ExoplanetName**: VarChar[100], **StarName**: VarChar[100])
PK: ExoplanetName & StarName
CK: ExoplanetName & StarName
FK: ExoplanetName & StarName
Constraints: Participation constraint not representable currently, assertion needed.
- Exoplanet_DiscoveredAt(Name: VarChar[100], Type: VarChar[100], Mass: double, Radius: double, Discovery Year: int, Distance from Earth (Light Years): double, Discovery Method: VarChar[100], Orbital Period: double, Eccentricity: double, Volume: double, Density: double, SpaceAgencyName: VarChar[100])
PK: Name
CK: Name
FK: SpaceAgencyName
Constraints: None
- Researcher_WorksAt(ID: VarChar[100], Name: VarChar[100], Affiliation: VarChar[100], E-Mail Address: VarChar[100] **UNIQUE**, **SpaceAgencyName**)
PK: ID
CK: ID
FK: SpaceAgencyName
Constraints: E-Mail Address - Unique
- DiscoveredBy(**ResearcherID**: VarChar[100], **ExoplanetName**: VarChar[100])

PK: ResearcherID & ExoplanetName
CK: ResearcherID & ExoplanetName
FK: ResearcherID & ExoplanetName
Constraints: None

- **SpaceAgency**(Name: VarChar[100], Acronym: char[100], Region: VarChar[100])
PK: Name
CK: Name
FK: None
- **InitiatedBy**(SpaceAgencyName: VarChar[100], SpaceProgramName: VarChar[100])
PK: SpaceAgencyName & SpaceProgramName
CK: SpaceAgencyName & SpaceProgramName
FK: SpaceAgencyName & SpaceProgramName
Constraint: Participation constraint not representable currently, assertion needed.
- **SpaceProgram**(Name: VarChar[100], Objective: VarChar[400])
PK: Name
CK: Name
FK: None
Constraint: None
- **SpaceProgram.Observatory**(Name: VarChar[100], Location: VarChar[100])
PK: Name
CK: Name
FK: Name
Constraint: None
- **SpaceProgram.Mission**(Name: VarChar[100], Launch Year: int, Status: VarChar[100])
PK: Name
CK: Name
FK: Name
Constraint: None
- **Publication**(ID: int, Title: char[100], Peer Reviewed: binary[1], Citation: VarChar(400))
PK: ID;
CK: ID;
FK: None
Constraints: Citation (Unique), Title (Not Null)
- **JournalArticle**(ID: int, DOI: VarChar[200])
PK: ID;

CK: ID;
FK: ID
Constraints: DOI(Unique)

- ConferenceProceeding(ID: int, Location: VarChar[100])
PK: ID;
CK: ID;
FK: ID
Constraints: Location(Not Null)
- BookChapter(ID: int, Book Name: VarChar[100])
PK: ID;
CK: ID;
FK: ID
Constraints: BookName(Not Null)
- WrittenIn(PublicationID: char[100], ExoplanetName: char[100])
PK: PublicationID & ExoplanetName
CK: PublicationID & ExoplanetName
FK: PublicationID & ExoplanetName
Constraints: Participation constraint not representable, assertion needed.
- WrittenBy(PublicationID: char[100], ResearcherID: char[100])
PK: PublicationID & ResearcherID
CK: PublicationID & ResearcherID
FK: PublicationID & ResearcherID
Constraints: None

Functional Dependencies:

1. Galaxy.Name → Galaxy.Age, Galaxy."Distance from earth (million light years)", Galaxy.Size
2. Star.Name → Star.StellarClass, Star.Mass, Star.Radius, Star.TemperatureRange, Star.Colour
3. Star.TemperatureRange → Star.StellarClass, Star.Colour
4. Star.Colour → Star.StellarClass, Star.TemperatureRange
5. Star.Class → Star.TemperatureRange, Star.Colour

6. Exoplanet.Name → Exoplanet.Volume, Exoplanet.Density, Exoplanet.Type, Exoplanet.Eccentricity, Exoplanet.Mass, Exoplanet.Radius, Exoplanet.DiscoveryYear, Exoplanet."Distance from Earth (Light Years)", Exoplanet.OrbitalPeriod, DiscoveryMethod
7. Exoplanet.Radius → Exoplanet.Volume
8. Exoplanet.Volume → Exoplanet.Radius
9. Exoplanet.Volume, Exoplanet.Mass → Exoplanet.Density
10. Exoplanet.Volume, Exoplanet.Density → Exoplanet.Mass
11. Exoplanet.Density, Exoplanet.Mass → Exoplanet.Volume
12. SpaceAgency.Name → SpaceAgency.Acronym, SpaceAgency.Region
13. SpaceProgram.Name → SpaceProgram.Objective
14. Observatory.Name → Observatory.Location
15. Mission.Name → Mission.LaunchYear, Mission.Status
16. Researcher.ID → Researcher.Name, Researcher.Affiliation, Researcher.E-MailAddress, SpaceAgency.Name
17. Publication.ID → Publication.Title, Publication.PeerReviewed, Publication.Citation
18. JournalArticle.ID → JournalArticle.DOI
19. ConferenceProceeding.ID → ConferenceProceeding.Location
20. BookChapter.ID → BookChapter.BookName

Note: All FDs mentioned in blue involve primary/candidate keys

NORMALISATION: This is only needed for Star and Exoplanet as the rest of the entity sets and relation sets only have candidate keys for the LHS of their functional dependencies and are already BCNF normalised.

Star_BelongsTo - 3NF Normalisation

Star.Name \rightarrow GalaxyName

Star.Name \rightarrow Star.Mass

Star.Name \rightarrow Star.Radius

Star.Name \rightarrow Star.TemperatureRange

Star.Name \rightarrow Star.StellarClass

Star.Name \rightarrow Star.Colour

Star.TemperatureRange \rightarrow Star.StellarClass, Star.Colour

Star.Colour \rightarrow Star.StellarClass, Star.TemperatureRange

Star.Class \rightarrow Star.TemperatureRange, Star.Colour

Step 1: Finding Minimal Cover

Step 1.1: Standardising the dependencies

Star.Name \rightarrow Star.Mass

Star.Name \rightarrow Star.Radius

Star.Name \rightarrow Star.TemperatureRange

Star.Name \rightarrow Star.StellarClass

Star.Name \rightarrow Star.Colour

Star.Temperature \rightarrow Star.StellarClass

Star.Temperature \rightarrow Star.Colour

Star.Colour \rightarrow Star.StellarClass

Star.Colour \rightarrow Star.TemperatureRange

Star.Class \rightarrow Star.Colour

Star.Class \rightarrow Star.Temperature

Step 1.2: Simplifying LHS (Already done)

Step 1.3: Removing Redundant relations

Fd1: Star.Name \rightarrow Star.Mass

Fd2: Star.Name \rightarrow Star.Radius

Fd3: Star.Name \rightarrow Star.StellarClass

Fd4: Star.StellarClass \rightarrow Star.Colour

Fd5: Star.StellarClass \rightarrow Star.TemperatureRange

Step 2: Decomposition (BCNF)

Star(Name, Mass, Radius, StellarClass, Color, TemperatureRange)

Star_A(Name, Mass, Radius, StellarClass, Color); Star_B(StellarClass, TemperatureRange) [fd5]

Star_A(Name, Mass, Radius, StellarClass); Star_B(StellarClass, TemperatureRange); Star_C(StellarClass, Color) [fd4]

Step 3: Unpreserved Dependencies:

Star.Temperature \rightarrow Star.Color

Star.Color \rightarrow Star.TemperatureRange

So we add another table:

Star_A(Name, Mass, Radius, StellarClass); Star_B(StellarClass, TemperatureRange); Star_C(StellarClass, Color), Star_D(TemperatureRange, Color)

However, we can since StellarClass is a super key for Color and Temperature, we can represent this in a simple way (and also maintain BCNF status) by conjoining the 3 new tables with stellar class as primary key:

Star_A(Name, Mass, Radius, StellarClass); Star_B(StellarClass, TemperatureRange, Color)

Renaming:

Star(Name, Mass, Radius, StellarClass); StellarClass(StellarClass, TemperatureRange, Color)

Exoplanet_DiscoveredAt - 3NF Normalization

Exoplanet.Name -> Exoplanet.Mass
Exoplanet.Name -> DiscoveryMethod
Exoplanet.Name -> SpaceAgency.Name
Exoplanet.Name -> Exoplanet.Radius
Exoplanet.Name -> Exoplanet.Volume
Exoplanet.Name -> Exoplanet.Density
Exoplanet.Name -> Exoplanet.Type
Exoplanet.Name -> Exoplanet.DiscoveryYear
Exoplanet.Name -> Exoplanet.Eccentricity
Exoplanet.Name -> Exoplanet.OrbitalPeriod
Exoplanet.Name -> Exoplanet.LightYearsFromEarth

Exoplanet.Radius → Exoplanet.Volume
Exoplanet.Volume → Exoplanet.Radius
Exoplanet.Volume, Exoplanet.Mass → Exoplanet.Density
Exoplanet.Volume, Exoplanet.Density → Exoplanet.Mass
Exoplanet.Density, Exoplanet.Mass → Exoplanet.Volume

Step 1: Finding Minimal Cover

Step 1.1: Standardising the dependencies (Already done)

Step 1.2: Simplifying LHS (Already done)

Step 1.3: Removing Redundant relations

Exoplanet.Name -> Exoplanet.Mass
Exoplanet.Name -> Exoplanet.Radius
Exoplanet.Name -> Exoplanet.Type
Exoplanet.Name -> Exoplanet.DiscoveryYear
Exoplanet.Name -> Exoplanet.Eccentricity
Exoplanet.Name -> Exoplanet.OrbitalPeriod
Exoplanet.Name -> Exoplanet.LightYearsFromEarth

Exoplanet.Radius → Exoplanet.Volume

Fd1: Exoplanet.Volume \rightarrow Exoplanet.Radius

Fd2: Exoplanet.Volume, Exoplanet.Mass \rightarrow Exoplanet.Density

Exoplanet.Volume, Exoplanet.Density \rightarrow Exoplanet.Mass

Exoplanet.Density, Exoplanet.Mass \rightarrow Exoplanet.Volume

Step 2: Decomposition (BCNF)

Exoplanet(Name, Mass, Radius, Volume, Density, Type, DiscoveryYear, Eccentricity, OrbitalPeriod, LightYearsFromEarth)

Exoplanet_A(Name, Mass, Volume, Density, Type, DiscoveryYear, Eccentricity, OrbitalPeriod, LightYearsFromEarth), Exoplanet_B(Radius, Volume)

Exoplanet_A(Name, Mass, Volume, Type, DiscoveryYear, Eccentricity, OrbitalPeriod, LightYearsFromEarth), Exoplanet_B(Radius, Volume), Exoplanet_C(Volume, Mass, Density)

Step 3: Unpreserved Dependencies:

Since Radius determines volume

Mass, Radius \rightarrow Density

Mass, Density \rightarrow Radius

Radius, Density \rightarrow Mass

Moreover, Radius determines Volume which is part of the candidate key (Volume, Mass) of table C.

Thus we can combine the tables B and C with Mass and Radius as the primary key and rename the second table to Exoplanet Dimensions.

Result:

**Exoplanet(Name, Mass, Radius, Volume, Type, DiscoveryYear, Eccentricity, OrbitalPeriod, LightYearsFromEarth),
ExoplanetDimensions(Radius, Volume, Mass, Density)**

Schema after Normalization

- Galaxy(Name: VarChar[100], Age: bigInt, Distance from milky way (Light Years): double, Size: bigInt)
PK: Name
CK: Name
FK: None
Constraints: None
- Star_BelongsTo(Name: VarChar[100], **Galaxy.Name**: VarChar[100] **NOT NULL**, Mass: double, Radius: double, Stellar Class: VarChar[100], Color: VarChar[100])
PK: Name
CK: Name
FK: Galaxy.Name
Constraints: Galaxy.Name - Not Null
- StellarClass(Stellar Class: VarChar[100], TemperatureRange: VarChar[100], Color: VarChar[100])
PK: StellarClass
CK: StellarClass, TemperatureRange, Color
FK: StellarClass, TemperatureRange, Color
Constraints: TemperatureRange - UNIQUE, NOT NULL; Color - UNIQUE, NOT NULL
- Orbits(**Exoplanet.Name**: VarChar[100], **Star.Name**: VarChar[100])
PK: Exoplanet.Name & Star.Name
CK: Exoplanet.Name & Star.Name
FK: Exoplanet.Name & Star.Name
Constraints: Participation constraint not representable currently, assertion needed.
- Exoplanet_DiscoveredAt(Exoplanet.Name: VarChar[100], Type: VarChar[100], Mass: double, Radius: double, Discovery year: int, Light-years from earth: double, Discovery Method: VarChar[100], Orbital period: double, Eccentricity: double, Volume: double, Density: double, SpaceAgency.Name: VarChar[100])
PK: Exoplanet.Name
CK: Exoplanet.Name
FK: SpaceAgency.Name
Constraints: None
- ExoplanetDimensions(Mass: double, Radius: double, Volume: double, Density: double)
PK: Mass, Radius
CK: (Mass, Radius), (Density, Radius), (Mass, Volume), (Density, Volume), (Mass, Volume)
FK: Mass, Radius, Volume, Density
Constraints: Volume - NOT NULL, Density - NOT NULL

- **Researcher_WorksAt**(ID: VarChar[100], Name: VarChar[100], Affiliation: VarChar[100], Email address: VarChar[100] **UNIQUE**, **SpaceAgencyName**)
PK: ID
CK: ID
FK: SpaceAgencyName
Constraints: Email address - Unique
- **DiscoveredBy**(**Researcher.ID**: VarChar[100], **Exoplanet.Name**: VarChar[100])
PK: Researcher.ID & Exoplanet.Name
CK: Researcher.ID & Exoplanet.Name
FK: Researcher.ID & Exoplanet.Name
Constraints: None
- **SpaceAgency**(SpaceAgency.Name: VarChar[100], Acronym: char[100], Region: VarChar[100])
PK: SpaceAgency.Name
CK: SpaceAgency.Name
FK: None
- **InitiatedBy**(**SpaceAgency.Name**: VarChar[100], **SpaceProgram.Name**: VarChar[100])
PK: SpaceAgency.Name & SpaceProgram.Name
CK: SpaceAgency.Name & SpaceProgram.Name
FK: SpaceAgency.Name & SpaceProgram.Name
Constraint: Participation constraint not representable currently, assertion needed.
- **SpaceProgram**(Name: VarChar[100], Objective: VarChar[400])
PK: Name
CK: Name
FK: None
Constraint: None
- **SpaceProgram.Observatory**(Name: VarChar[100], Location: VarChar[100])
PK: Name
CK: Name
FK: Name
Constraint: None
- **SpaceProgram.Mission**(Name: VarChar[100], Launch Year: int, Status: VarChar[100])
PK: Name
CK: Name
FK: Name

Constraint: None

- **Publication**(ID: int, Title: char(100), PeerReviewed: binary(1), Citation: VarChar(400))
PK: ID;
CK: ID;
FK: None
Constraints: Citation (Unique), Title (Not Null)
- **JournalArticle**(ID: int, DOI: VARCHAR(200))
PK: ID;
CK: ID;
FK: ID
Constraints: DOI(Unique)
- **ConferenceProceeding**(ID: int, Location: VARCHAR(100))
PK: ID;
CK: ID;
FK: ID
Constraints: Location(Not Null)
- **BookChapter**(ID: int, BookName: VARCHAR(100))
PK: ID;
CK: ID;
FK: ID
Constraints: BookName(Not Null)
- **WrittenIn**(Publication.ID: char[100], Exoplanet.Name: char[100])
PK: Publication.ID & Exoplanet.Name
CK: Publication.ID & Exoplanet.Name
FK: Publication.ID & Exoplanet.Name
Constraints: Participation constraint not representable, assertion needed.
- **WrittenBy**(Publication.ID: char[100], Researcher.ID: char[100])
PK: Publication.ID & Researcher.ID
CK: Publication.ID & Researcher.ID
FK: Publication.ID & Researcher.ID
Constraints: None

SQL DDL CREATE TABLE STATEMENTS

```
CREATE TABLE Galaxy(  
    Name VARCHAR[200] PRIMARY KEY,  
    Age BIGINT,  
    Size BIGINT,  
    "Distance from milky way (light years)" DOUBLE  
);
```

```
CREATE TABLE Star_BelongsTo (  
    Name VARCHAR PRIMARY KEY,  
    GalaxyName VARCHAR[200] NOT NULL,  
    Radius DOUBLE,  
    Mass DOUBLE,  
    StellarClassClass VARCHAR[200],  
    FOREIGN KEY (GalaxyName) REFERENCES Galaxy(Name)  
        ON DELETE CASCADE  
        ON UPDATE CASCADE,  
    FOREIGN KEY (StellarClassClass) REFERENCES StellarClass(Class)  
        ON DELETE CASCADE  
        ON UPDATE CASCADE  
);
```

```
CREATE TABLE Orbits (  
    ExoplanetName VARCHAR[200],  
    StarName VARCHAR[200],  
    PRIMARY KEY (ExoplanetName, StarName),  
    FOREIGN KEY (ExoplanetName) REFERENCES  
Exoplanet_DiscoveredAt(Name)  
        ON DELETE CASCADE  
        ON UPDATE CASCADE,  
    FOREIGN KEY (StarName) REFERENCES Star_BelongsTo(Name)  
        ON DELETE CASCADE  
        ON UPDATE CASCADE  
);
```

```
CREATE TABLE Exoplanet_DiscoveredAt (  
    Name VARCHAR[200] PRIMARY KEY,  
    Type VARCHAR[200],
```

```

    Mass DOUBLE,
    Radius DOUBLE,
    "Discovery Year" INT,
    "Light Years from Earth" DOUBLE,
    "Orbital Period" DOUBLE,
    Eccentricity DOUBLE,
    SpaceAgencyName VARCHAR[200],
    "Discovery Method" VARCHAR[200],
    FOREIGN KEY (SpaceAgencyName) REFERENCES SpaceAgency(Name)
        ON DELETE CASCADE
        ON UPDATE CASCADE
    FOREIGN KEY (Mass, Radius) REFERENCES
ExoplanetDimensions(Mass, Radius)
        ON DELETE CASCADE
        ON UPDATE CASCADE
);

```

```

CREATE TABLE Researcher_WorksAt (
    ID VARCHAR[200] PRIMARY KEY,
    Name VARCHAR[200],
    Affiliation VARCHAR[200],
    EmailAddress VARCHAR[200] UNIQUE,
    SpaceAgencyName VARCHAR[200],
    FOREIGN KEY (SpaceAgencyName) REFERENCES SpaceAgency(Name)
        ON DELETE CASCADE
        ON UPDATE CASCADE
);

```

```

CREATE TABLE DiscoveredBy (
    ResearcherID VARCHAR[200],
    ExoplanetName VARCHAR[200],
    PRIMARY KEY (ResearcherID, ExoplanetName),
    FOREIGN KEY (ResearcherID) REFERENCES Researcher_WorksAt(ID)
        ON DELETE CASCADE
        ON UPDATE CASCADE,
    FOREIGN KEY (ExoplanetName) REFERENCES
Exoplanet_DiscoveredAt(Name)
        ON DELETE CASCADE
        ON UPDATE CASCADE
);

```



```
CREATE TABLE SpaceAgency (  
    Name VARCHAR[200] PRIMARY KEY,  
    Acronym CHAR(100),  
    Region VARCHAR[200]  
);
```

```
CREATE TABLE SpaceProgram (  
    Name VARCHAR[200] PRIMARY KEY,  
    Objective VARCHAR[200]  
);
```

```
CREATE TABLE InitiatedBy (  
    SpaceAgencyName VARCHAR[200],  
    SpaceProgramName VARCHAR[200],  
    PRIMARY KEY (SpaceAgencyName, SpaceProgramName),  
    FOREIGN KEY (SpaceAgencyName) REFERENCES SpaceAgency(Name)  
        ON DELETE CASCADE  
        ON UPDATE CASCADE,  
    FOREIGN KEY (SpaceProgramName) REFERENCES  
SpaceProgram(Name)  
        ON DELETE CASCADE  
        ON UPDATE CASCADE  
);
```

```
CREATE TABLE Observatory (  
    SpaceProgramName VARCHAR[200] PRIMARY KEY,  
    Location VARCHAR[200],  
    FOREIGN KEY (SpaceProgramName) REFERENCES  
SpaceProgram(Name)  
        ON DELETE CASCADE  
        ON UPDATE CASCADE  
);
```

```
CREATE TABLE Mission (  
    SpaceProgramName VARCHAR[200] PRIMARY KEY,  
    LaunchYear INT,  
    Status VARCHAR[200],
```

```
    FOREIGN KEY (SpaceProgramName) REFERENCES  
SpaceProgram(Name)  
    ON DELETE CASCADE  
    ON UPDATE CASCADE  
);
```

```
CREATE TABLE Publication (  
    ID INT PRIMARY KEY,  
    Title VARCHAR[200] NOT NULL,  
    PeerReviewed BOOLEAN,  
    Citation VARCHAR[200] UNIQUE  
);
```

```
CREATE TABLE JournalArticle (  
    PublicationID INT PRIMARY KEY,  
    DOI VARCHAR[200],  
    FOREIGN KEY (PublicationID) REFERENCES Publication(ID)  
    ON DELETE CASCADE  
    ON UPDATE CASCADE  
);
```

```
CREATE TABLE ConferenceProceeding (  
    PublicationID INT PRIMARY KEY,  
    Location VARCHAR[200],  
    FOREIGN KEY (PublicationID) REFERENCES Publication(ID)  
    ON DELETE CASCADE  
    ON UPDATE CASCADE  
);
```

```
CREATE TABLE BookChapter (  
    PublicationID INT PRIMARY KEY,  
    BookName VARCHAR[200],  
    FOREIGN KEY (PublicationID) REFERENCES Publication(ID)  
    ON DELETE CASCADE  
    ON UPDATE CASCADE  
);
```

```
CREATE TABLE WrittenIn (  
    PublicationID INT,  
    ResearcherID VARCHAR[200],
```

```

PRIMARY KEY (PublicationID, ResearcherID),
FOREIGN KEY (PublicationID) REFERENCES Publication(ID)
    ON DELETE CASCADE
    ON UPDATE CASCADE,
FOREIGN KEY (ResearcherID) REFERENCES Researcher_WorksAt(ID)
    ON DELETE CASCADE
    ON UPDATE CASCADE
);

```

```

CREATE TABLE StellarClass (
    Class VARCHAR[200] PRIMARY KEY,
    TemperatureRange INT,
    Colour VARCHAR[200]
);

```

```

CREATE TABLE ExoplanetDimensions (
    Radius DOUBLE,
    Mass DOUBLE,
    Density DOUBLE,
    Volume DOUBLE,
    PRIMARY KEY (Radius, Mass));

```

SQL DDL INSERT STATEMENTS

```

INSERT INTO Galaxy(Name, Age, Size, "Distance from milky way (light
years)") VALUES
("Andromeda Galaxy (M31)", 10, 220000, 2.537),
("Triangulum Galaxy (M33)", 13, 60000, 2.73),
("Whirlpool Galaxy (M51)", 13, 60000, 23),
("Sombrero Galaxy (M104)", 11, 50000, 29.3),
("Pinwheel Galaxy (M101)", 13, 170000, 21),
("Large Magellanic Cloud (LMC)", 13.5, 14000, 0.163),
("Small Magellanic Cloud (SMC)", 13, 7000, 0.2),
("Messier 87 (M87)", 13.5, 98000, 53.5),
("Milky Way Galaxy", 13.51, 105700, 0)

```

```
INSERT INTO SpaceAgency(Name, Acronym, Region) VALUES
("National Aeronautics and Space Administration", "NASA", "USA"),
("European Space Agency", "ESA", "Europe"),
("Canadian Space Agency", "CSA", "Canada"),
("Indian Space Research Organisation", "ISRO", "India"),
("Japan Aerospace Exploration Agency", "JAXA", "Japan"),
("French Space Agency", "CNES", "France")
```

```
INSERT INTO Publication(ID, Title, PeerReviewed, Citation) VALUES
(1, "Discovery of Proxima Centauri b", 1, "Smith et al., 2020"),
(2, "Characterizing Kepler-452b", 1, "Johnson & Brown, 2018"),
(3, "Atmospheric Characterization of HD 209458 b Using Hubble Space Telescope", 1, "Garcia et al., 2019"),
(4, "TRAPPIST-1e: A Habitable Exoplanet in the TRAPPIST-1 System", 1, "Chen & Lee, 2021"),
(5, "WASP-1221b: A Neptune-like Exoplanet Orbiting a Sun-like Star", 1, "Wilson & Taylor, 2017"),
(6, "Exploring New Horizons in Exoplanet Research", 0, "Martinez et al., 2019"),
(7, "Advancements in Space Telescope Technology", 1, "Brown & Garcia, 2016"),
(8, "Recent Developments in Planetary Atmosphere Studies", 0, "Jones et al., 2020"),
(9, "Innovations in Space Exploration: Challenges and Opportunities", 1, "Gomez & Wilson, 2018"),
(10, "Frontiers in Exoplanet Detection Methods", 0, "Taylor & Martinez, 2015"),
(11, "The Search for Exoplanets: Past, Present, and Future", 0, "Johnson et al., 2017"),
(12, "Methods for Detecting Exoplanets Using Radial Velocity", 1, "Garcia & Smith, 2018"),
(13, "Exoplanet Atmospheres: Observations and Models", 1, "Brown et al., 2019"),
(14, "Characterization of Exoplanetary Systems", 0, "Wilson & Jones, 2020"),
(15, "Exoplanet Habitability: Conditions and Constraints", 1, "Martinez & Taylor, 2016")
```

```
INSERT INTO JournalArticle(PublicationID, DOI) VALUES
(1, "10.1038/nature19106"),
```

(2, "10.1126/science.aad8189"),
(3, "10.1088/0004-637X/680/2/1450"),
(4, "10.1126/science.aah6511"),
(5, "10.1093/mnras/stx1287")

INSERT INTO ConferenceProceeding(PublicationID, Location) VALUES

(6, "Houston, Texas"),
(7, "Cape Town, South Africa"),
(8, "Paris, France"),
(9, "Tokyo, Japan"),
(10, "Sydney, Australia")

INSERT INTO BookChapter(PublicationID, BookName) VALUES

(11, "Exoplanet Exploration: A Comprehensive Guide"),
(12, "Advances in Exoplanet Research: Techniques and Discoveries"),
(13, "Planetary Science: Recent Advances and Future Directions"),
(14, "The Encyclopedia of Exoplanets"),
(15, "The Handbook of Exoplanetology")

INSERT INTO StellarClass(Class, TemperatureRange, Colour) VALUES

("O", ">30000", "Blue"),
("B", "10000-30000", "Blue-White"),
("A", "7500-10000", "White"),
("F", "6000-7500", "White-Yellow"),
("G", "5200-6000", "Yellow"),
("K", "3400-4900", "Orange-Red"),
("M", "2100-3400", "Red")

INSERT INTO ExoplanetDimensions(Radius, Mass, Density, Volume)
VALUES

(1.17, 1.1, 0.05465441321, 20.12646254),
(1.6, 1.5, 0.02914214046, 51.47185404),
(1.35, 1.35, 0.04366390757, 30.9179841),
(0.62, 0.92, 0.307187044, 2.994917976),
(0.18, 0.001, 0.01364497112, 0.07328707342)

```

INSERT INTO SpaceProgram(Name, Objective) VALUES
("Kepler", "Discover Earth-like planets orbiting other stars."),
("TESS (Transiting Exoplanet Survey Satellite)", "Search for exoplanets in orbit around the brightest dwarfs in the sky."),
("CHEOPS (CHaracterising ExOPlanet Satellite)", "Characterize known exoplanets orbiting bright stars."),
("James Webb Space Telescope (JWST)", "Study exoplanet atmospheres, formation of stars and galaxies, and more."),
("Hubble Space Telescope", "Exoplanet atmosphere studies, among other astronomical observations."),
("Gaia", "Create a precise three-dimensional map of stars in the Milky Way, aiding in the indirect discovery of exoplanets."),
("PLATO (PLANetary Transits and Oscillations of stars)", "Detect and characterize a large number of exoplanetary systems, with a focus on discovering and characterizing Earth-sized planets and super-Earths."),
("COROT (Convection, Rotation and planetary Transits)", "The first mission dedicated to the search for exoplanets, it aimed to find Earth-sized planets."),
("ASTROSAT (not directly exoplanet-focused but significant for astrophysical studies)", "India's first dedicated multi-wavelength space observatory."),
("NEOSSat (Near-Earth Object Surveillance Satellite)", "Canada's satellite to track asteroids and near-Earth objects.")

```

```

INSERT INTO Star_BelongsTo(Name, GalaxyName, Radius, Mass, StellarClassClass) VALUES
("Proxima Centauri", "Milky Way Galaxy", 0.141, 0.123, "M"),
("Kepler-452", "Milky Way Galaxy", 1.11, 1.04, "G"),
("HD 209458", "Milky Way Galaxy", 1.203, 1.148, "G"),
("TRAPPIST-1", "Milky Way Galaxy", 0.1192, 0.0898, "F"),
("WASP-121", "Milky Way Galaxy", 1.458, 1.353, "M")

```

```

INSERT INTO Exoplanet_DiscoveredAt(Name, Type, Mass, Radius, "Discovery Year", "Light Years from Earth", "Orbital Period", Eccentricity, SpaceAgencyName, "Discovery Method") VALUES
("Proxima Centauri b", "Terrestrial", 1.1, 1.17, "2016-08-24", 4.24, 11.2, 0.35, "European Space Agency", "Radial Velocity"),
("Kepler-452b", "Terrestrial", 1.5, 1.6, "2015-07-23", 1402, 384.8, 0, "National Aeronautics and Space Administration", "Transit"),
("HD 209458 b", "Gas Giant", 1.35, 1.35, "1999-11-05", 153, 3.52, 0, "European Space Agency", "Transit"),

```

("TRAPPIST-1e", "Terrestrial", 0.92, 0.62, "2017-02-22", 39.6, 6.1, 0.08,
"National Aeronautics and Space Administration", "Transit"),
("WASP-1221b", "Neptune-like", 0.001, 0.18, "2015-06-02", 880, 1.27, 0,
"National Aeronautics and Space Administration", "Transit")

INSERT INTO Researcher_WorksAt(ID, Name, Affiliation, EmailAddress,
SpaceAgencyName) VALUES

("1", "Guillem Anglada-Escudé", "University of London", "anglada@eso.org",
"European Space Agency"),
("2", "Michael Mayor", "University of Geneva", "mayor@unige.ch", "European Space
Agency"),
("3", "David Charbonneau", "Harvard University", "charbonneau@harvard.edu",
"European Space Agency"),
("4", "Timothy M. Brown", "University of Colorado", "tbrown@lco.global",
"European Space Agency"),
("5", "Michael Gillon", "University of Liège", "m.gillon@uliege.be", "National
Aeronautics and Space Administration"),
("6", "Amaury H.M.J. Triaud", "University of Birmingham", "a.triaud@nasa.gov",
"National Aeronautics and Space Administration"),
("7", "Don Pollacco", "University of Warwick", "d.pollacco@warwick.ac.uk",
"European Space Agency"),
("8", "Coel Hellier", "Keele University", "c.hellier@keele.ac.uk", "European Space
Agency"),
("9", "Charles Bailyn", "Yale University", "charles@yale.edu", "European Space
Agency"),
("10", "Jon M. Jenkins", "NASA Ames Research Center", "jon@nasa.gov",
"National Aeronautics and Space Administration"),
("11", "Timothy M. Brown", "Las Cumbres Observatory", "timothy@lco.global",
"National Aeronautics and Space Administration"),
("12", "Michaël Gillon", "University of Liège", "michael@uliege.be", "National
Aeronautics and Space Administration"),
("13", "Laura Kreidberg", "University of California, Santa Cruz",
"laura@ucsc.edu", "National Aeronautics and Space Administration")

```
INSERT INTO DiscoveredBy(ResearcherID, ExoplanetName) VALUES
("1", "Proxima Centauri b"),
("2", "Proxima Centauri b"),
("3", "HD 209458 b"),
("4", "HD 209458 b"),
("5", "TRAPPIST-1e"),
("6", "TRAPPIST-1e"),
("7", "WASP-1221b"),
("8", "WASP-1221b")
```

```
INSERT INTO InitiatedBy(SpaceAgencyName, SpaceProgramName)
VALUES
("National Aeronautics and Space Administration", "Kepler"),
("National Aeronautics and Space Administration", "TESS (Transiting Exoplanet
Survey Satellite)"),
("European Space Agency", "CHEOPS (CHaracterising ExOPlanet Satellite)"),
("National Aeronautics and Space Administration", "James Webb Space
Telescope (JWST)"),
("National Aeronautics and Space Administration", "Hubble Space Telescope"),
("European Space Agency", "Gaia"),
("European Space Agency", "PLATO (PLANetary Transits and Oscillations of
stars)"),
("European Space Agency", "COROT (Convection, Rotation and planetary
Transits)"),
("Indian Space Research Organisation", "ASTROSAT (not directly
exoplanet-focused but significant for astrophysical studies)"),
("Canadian Space Agency", "NEOSSat (Near-Earth Object Surveillance
Satellite)")
```

```
INSERT INTO Observatory(SpaceProgramName, Location) VALUES
("Kepler", "USA"),
("TESS (Transiting Exoplanet Survey Satellite)", "USA"),
("CHEOPS (CHaracterising ExOPlanet Satellite)", "Switzerland"),
("PLATO (PLANetary Transits and Oscillations of stars)", "France"),
("COROT (Convection, Rotation and planetary Transits)", "France"),
("ASTROSAT (not directly exoplanet-focused but significant for astrophysical
studies)", "India")
```



```
INSERT INTO Mission(SpaceProgramName, LaunchYear, Status) VALUES
("Kepler", 2009, "Inactive"),
("TESS (Transiting Exoplanet Survey Satellite)", 2018, "Active"),
("CHEOPS (CHaracterising ExOPlanet Satellite)", 2019, "Active"),
("James Webb Space Telescope (JWST)", 2021, "Active"),
("Hubble Space Telescope", 1990, "Active"),
("Gaia", 2013, "Active"),
("PLATO (PLANetary Transits and Oscillations of stars)", 2026, "Upcoming"),
("COROT (Convection, Rotation and planetary Transits)", 2006, "Inactive"),
("ASTROSAT (not directly exoplanet-focused but significant for astrophysical studies)", 2015, "Active"),
("NEOSSat (Near-Earth Object Surveillance Satellite)", 2013, "Active")
```

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INSERT INTO WrittenIn(PublicationID, ResearcherID) VALUES
(1, "1"),
(2, "3"),
(3, "8"),
(4, "9"),
(5, "13")
```

```
INSERT INTO Orbits(ExoplanetName, StarName) VALUES
("Proxima Centauri b", "Proxima Centauri"),
("Kepler-452b", "Kepler-452"),
("HD 209458 b", "HD 209458"),
("TRAPPIST-1e", "TRAPPIST-1"),
("WASP-1221b", "WASP-121")
```