University of British Columbia, Vancouver
Department of Computer Science

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.)

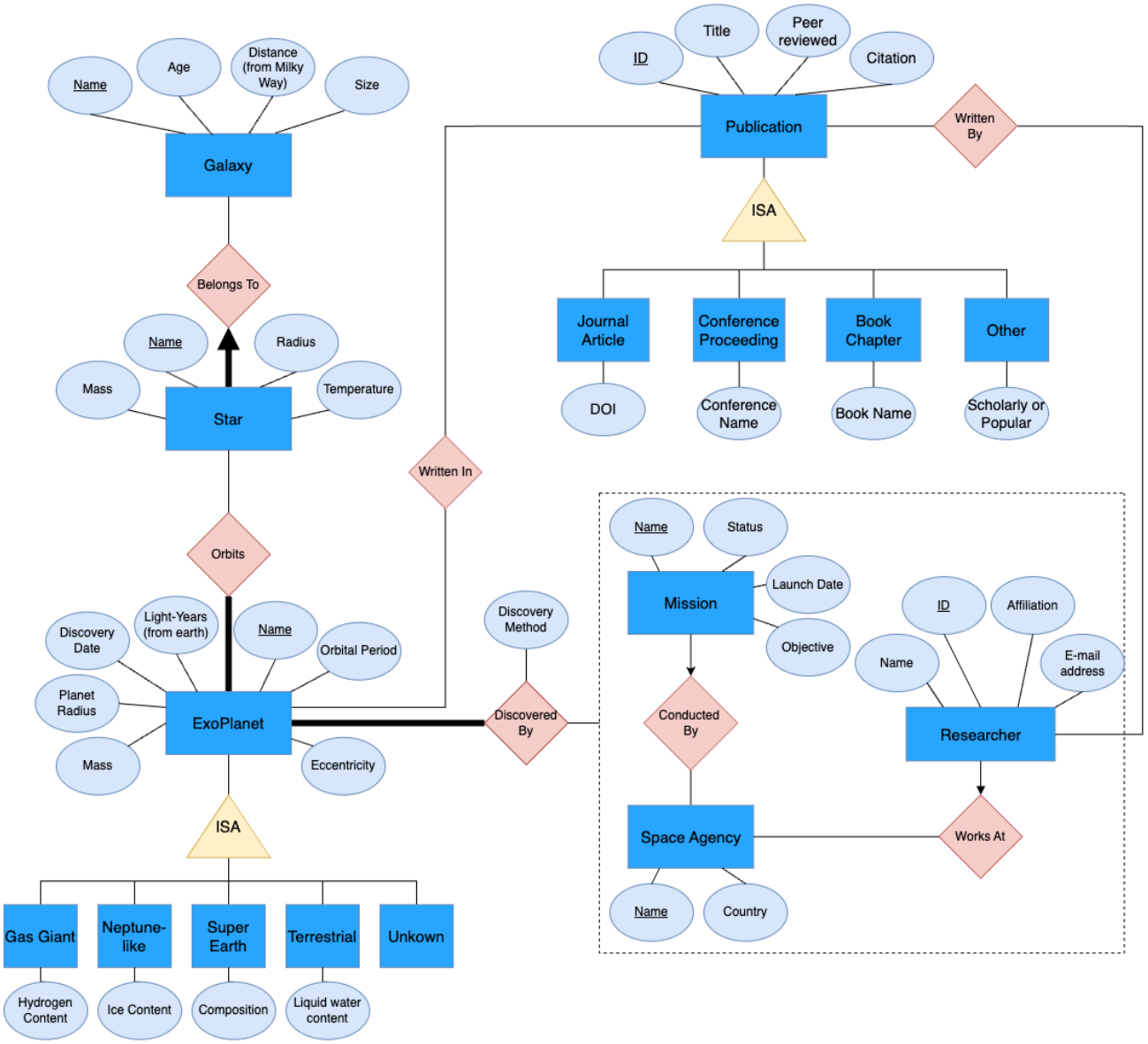
In addition, we indicate that we are fully aware of the rules and consequences of plagiarism, as set forth by the Department of Computer Science and the University of British Columbia

MILESTONE 2:

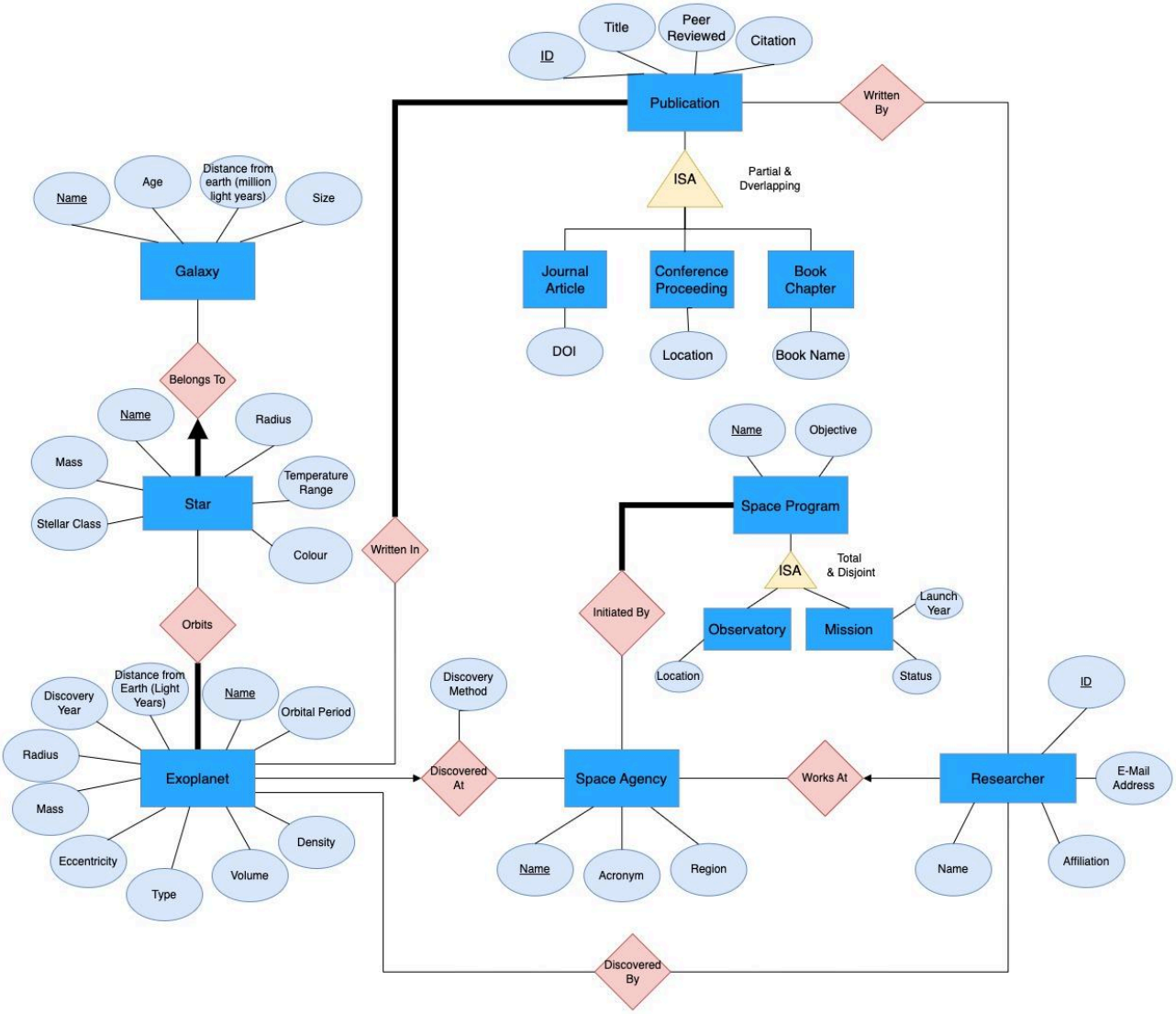
Project Summary

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 → GalaxyName
Star.Name → Star.Mass
Star.Name → Star.Radius
Star.Name → Star.TemperatureRange
Star.Name → Star.StellarClass
Star.Name → Star.Colour
Star.TemperatureRange → Star.StellarClass, Star.Colour
Star.Colour → Star.StellarClass, Star.TemperatureRange
Star.Class → Star.TemperatureRange, Star.Colour

Step 1: Finding Minimal Cover

Step 1.1: Standardising the dependencies
Star.Name -> Star.Mass
Star.Name -> Star.Radius
Star.Name -> Star.TemperatureRange
Star.Name -> Star.StellarClass
Star.Name -> Star.Colour

Star.Temperature → Star.StellarClass
Star.Temperature → Star.Colour
Star.Colour → Star.StellarClass
Star.Colour → Star.TemperatureRange
Star.Class → Star.Colour
Star.Class → Star.Temperature

Step 1.2: Simplifying LHS (Already done)

Step 1.3: Removing Redundant relations
Fd1: Star.Name -> Star.Mass
Fd2: Star.Name -> Star.Radius

Fd3: Star.Name -> Star.StellarClass
Fd4: Star.StellarClass → Star.Colour
Fd5: Star.StellarClass → 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 → Star.Color
Star.Color → 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 → Exoplanet.Radius
Fd2: Exoplanet.Volume, Exoplanet.Mass → Exoplanet.Density
Exoplanet.Volume, Exoplanet.Density → Exoplanet.Mass
Exoplanet.Density, Exoplanet.Mass → 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 -> Density
Mass, Density -> Radius
Radius, Density -> 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 PRIMARY KEY,
    Age BIGINT,
    Size BIGINT,
    “Distance from milky way (light years)” DOUBLE,
);

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

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

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(ID)
        ON DELETE CASCADE
        ON UPDATE CASCADE,
    FOREIGN KEY (ExoplanetName) REFERENCES Exoplanet(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(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),
    FOREIGN KEY (Radius) REFERENCES Exoplanet_DiscoveredAt(Radius)
        ON DELETE CASCADE
        ON UPDATE CASCADE,
    FOREIGN KEY (Mass) REFERENCES Exoplanet_DiscoveredAt(Mass)
        ON DELETE CASCADE
        ON UPDATE CASCADE
);
```

SQL DDL INSERT STATEMENTS

```
INSERT INTO Galaxy(Name, Age, Size, “Distance from milky way (light
years)”) VALUES
("Milk Way Galaxy", 13.51, 105700, 0"),
("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")


INSERT INTO Star_BelongsTo(Name, GalaxyName, Radius,
 Mass, StellarClass) 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 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")

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, "ESA", "Radial Velocity"),
("Kepler-452b", "Terrestrial", 1.5, 1.6, "2015-07-23", 1402, 384.8, 0, "NASA", "Transit"),
("HD 209458 b", "Gas Giant", 1.35, 1.35, "1999-11-05", 153, 3.52, 0, "ESA", "Transit"),
("TRAPPIST-1e", "Terrestrial", 0.92, 0.62, "2017-02-22", 39.6, 6.1, 0.08, "NASA", "Transit"),
("WASP-1221b", "Neptune-like", 0.001, 0.18, "2015-06-02", 880, 1.27, 0, "NASA", "Transit")

INSERT INTO Researcher_WorksAt(ID, Name, Affiliation, EmailAddress, SpaceAgencyName) VALUES
("1", "Guillem Anglada-Escudé", "University of London", "anglada@eso.org", "ESA"),
("2", "Michael Mayor", "University of Geneva", "mayor@unige.ch", "ESA"),
("3", "David Charbonneau", "Harvard University", "charbonneau@harvard.edu", "ESA"),
("4", "Timothy M.Brown", "University of Colorado", "tbrown@lco.global", "ESA"),
("5", "Michael Gillon", "University of Liége", "m.gillon@uliege.be", "NASA"),
("6", "Amaury H.M.J. Triaud", "University of Birmingham", "a.triaud@nasa.gov", "NASA"),
("7", "Don Pollacco", "University of Warwick", "d.pollacco@warwick.ac.uk", "ESA"),
("8", "Coel Hellier", "Keele University", "c.hellier@keele.ac.uk", "ESA"),

("9", "Charles Bailyn", "Yale University", "charles@yale.edu", "ESA"),
("10", "Jon M. Jenkins", "NASA Ames Research Center", "jon@nasa.gov", "NASA"),
("11", "Timothy M. Brown", "Las Cumbres Observatory", "timothy@lco.global", "NASA"),
("12", "Michaël Gillon", "University of Liège", "michael@uliege.be", "NASA"),
("13", "Laura Kreidberg", "University of California, Santa Cruz", "laura@ucsc.edu", "NASA")

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 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 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)"),
("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")

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")

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

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)
```