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CS340-400

Final Project: Pathogenic Bacteria Database

Introduction

For the final project, I wanted to choose a topic that was of interest to me. I decided to create a database to store information about human-disease causing bacteria. This database will contain information about each bacterium's features and characteristics, pathogenesis, associated disease(s), as well as the drugs used as treatment. On the webpage application, a user is allowed to create, update (pathogen information) and delete elements in the database.

Database Outline

Below are the entities and their corresponding attributes in the database:

- Pathogen: name, species, gram staining, shape, oxygen requirements (aerobe, anaerobe, facultative, micro-aerophilic, micro-anaerobe, obligate aerobe, obligate anaerobe), and host.
- Pathogenesis: transmission mode, invasiveness (ability to invade tissues), toxigenesis (ability to produce toxins that cause harm to the host: endotoxins or exotoxins).
- Tissue: human tissue that is infected/affected by the bacterium. Organ name, tissue classification (epithelium, connective tissue, muscular tissue or nervous tissue).
- Disease: name and symptoms of the disease/infection caused by the pathogen.
- Treatment: drug(s) used to treat the associated disease/infection and the mode of action of the specific drug.

The relationships between the above entities is as follows:

- Pathogen and pathogenesis: each pathogen will have its own specific manner of causing and development into disease/infection.
- Pathogen and tissue: this is a many-to-many relationship. One pathogen can infect many tissues/organs in the human body, and many different pathogenic bacteria can infect one tissue type.
- Pathogen and disease: each pathogen can cause one or many different disease, but a specific disease is only associated with one pathogen.
- Disease and treatment: this is another many-to-many relationship. Each disease can have many different drug treatments, and each drug can be used to treat many different diseases.

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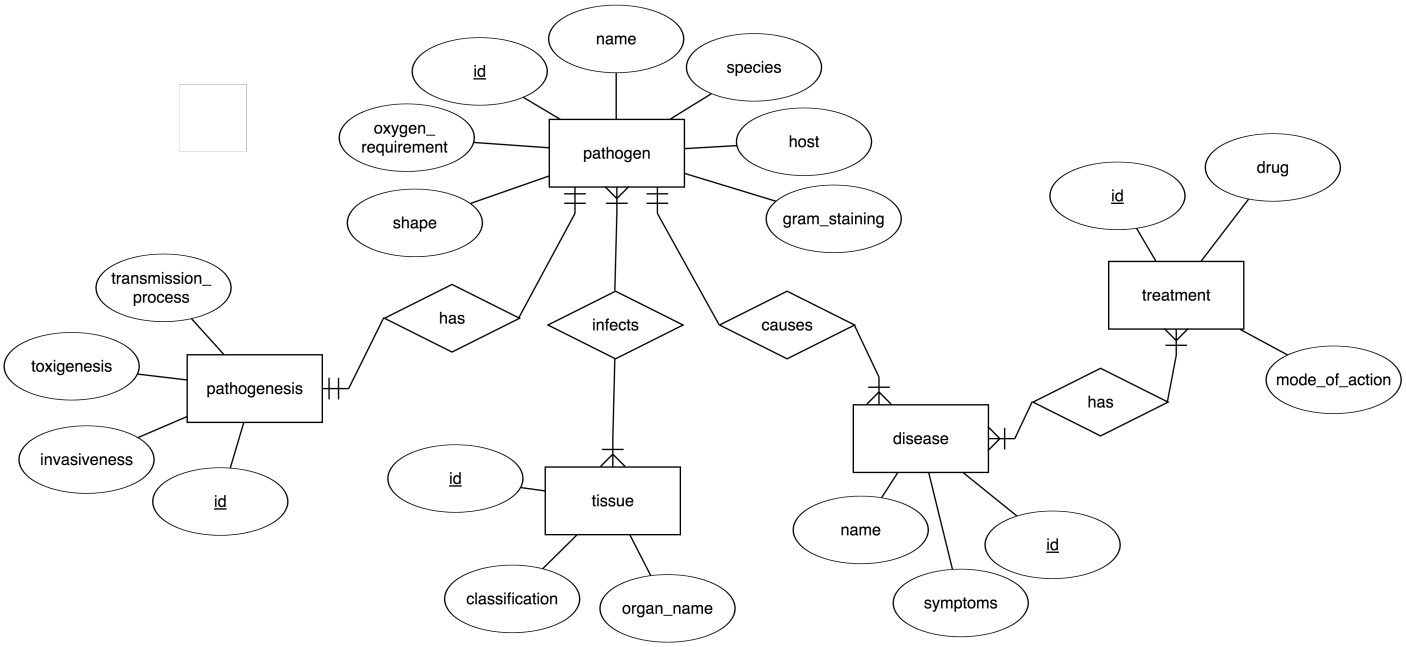
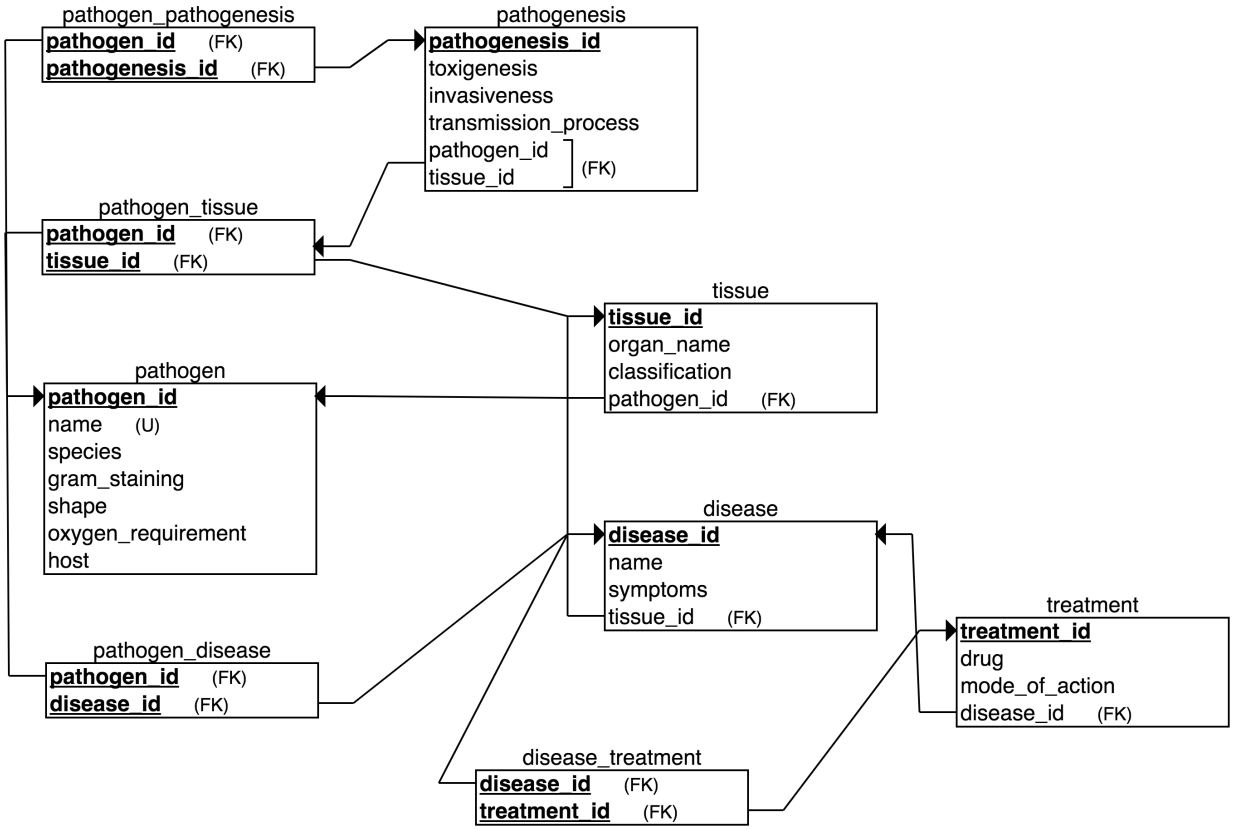
ER Diagram



Schema



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Data Definition Queries

```
SET FOREIGN_KEY_CHECKS = 0;
DROP TABLE IF EXISTS pathogen;
DROP TABLE IF EXISTS pathogenesis;
DROP TABLE IF EXISTS tissue;
DROP TABLE IF EXISTS disease;
DROP TABLE IF EXISTS treatment;
DROP TABLE IF EXISTS pathogen_pathogenesis;
DROP TABLE IF EXISTS pathogen_tissue;
DROP TABLE IF EXISTS pathogen_disease;
DROP TABLE IF EXISTS disease_treatment;
SET FOREIGN_KEY_CHECKS = 1;


CREATE TABLE pathogen(
        id int(11) NOT NULL AUTO_INCREMENT,
        name varchar(255) NOT NULL,
        species varchar(255) NOT NULL,
        gram_staining varchar(255),
        shape varchar(255),
        oxygen_requirement varchar(255),
        host varchar(255),
        PRIMARY KEY (id),
        UNIQUE (name)
) ENGINE=InnoDB;

CREATE TABLE pathogenesis(
        id int(11) NOT NULL AUTO_INCREMENT,
        transmission_mode text NOT NULL,
        invasiveness text NOT NULL,
        toxigenesis text NOT NULL,
        pathogenID int(11) NOT NULL,
        PRIMARY KEY (id),
        FOREIGN KEY (pathogenID) REFERENCES pathogen(id)
) ENGINE=InnoDB


CREATE TABLE tissue(
        id int(11) NOT NULL AUTO_INCREMENT,
        organ_name varchar(255) NOT NULL,
        classification varchar(255) NOT NULL,
        pathogenID int(11) NOT NULL,
        PRIMARY KEY (id)
) ENGINE=InnoDB
```

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```
CREATE TABLE disease(
	id int(11) NOT NULL AUTO_INCREMENT,
	name varchar(255) NOT NULL,
	symptoms text NOT NULL,
	tissueID int(11) NOT NULL,
	PRIMARY KEY (id),
	CONSTRAINT tissueID_on_tissue_disease FOREIGN KEY (tissueID) REFERENCES
tissue(id)
) ENGINE=InnoDB

CREATE TABLE treatment(
	id int(11) NOT NULL AUTO_INCREMENT,
	drug_name varchar(255) NOT NULL,
	uses text,
	mode_of_action text,
	diseaseID int(11) NOT NULL,
	CONSTRAINT diseaseID_on_disease_treatment FOREIGN KEY (diseaseID)
REFERENCES disease (id),
	PRIMARY KEY (id)
) ENGINE=InnoDB

CREATE TABLE pathogen_tissue(
	pathogenID int(11),
	tissueID int(11),
	PRIMARY KEY (pathogenID, tissueID),
	FOREIGN KEY (pathogenID) REFERENCES pathogen(id)
		ON DELETE CASCADE
		ON UPDATE CASCADE,
	FOREIGN KEY (tissueID) REFERENCES tissue(id)
		ON DELETE CASCADE
		ON UPDATE CASCADE
) ENGINE =InnoDB;

CREATE TABLE pathogen_disease(
	pathogenID int(11),
	diseaseID int(11),
	PRIMARY KEY (pathogenID, diseaseID),
	FOREIGN KEY (pathogenID) REFERENCES pathogen(id)
		ON DELETE CASCADE
		ON UPDATE CASCADE,
	FOREIGN KEY (diseaseID) REFERENCES disease(id)
		ON DELETE CASCADE
		ON UPDATE CASCADE
) ENGINE =InnoDB;
```

```
CREATE TABLE pathogen_disease(
        pathogenID int(11),
        diseaseID int(11),
        PRIMARY KEY (pathogenID, diseaseID),
        FOREIGN KEY (pathogenID) REFERENCES pathogen(id)
                ON DELETE CASCADE
                ON UPDATE CASCADE,
        FOREIGN KEY (diseaseID) REFERENCES disease(id)
                ON DELETE CASCADE
                ON UPDATE CASCADE
) ENGINE =InnoDB;


CREATE TABLE pathogen_pathogenesis(
        pathogenID int(11),
        pathogenesisID int(11),
        PRIMARY KEY (pathogenID, pathogenesisID),
        FOREIGN KEY (pathogenID) REFERENCES pathogen(id)
                ON DELETE CASCADE
                ON UPDATE CASCADE,
        FOREIGN KEY (pathogenesis) REFERENCES pathogenesis(id)
                ON DELETE CASCADE
                ON UPDATE CASCADE
) ENGINE =InnoDB;
```

Enter Data into Database Queries

```
insert into pathogen (name, species, gram_staining, shape, oxygen_requirement, host)
values
('Staphylococcus aureus', 'Staphylococcus', 'Gram-positive', 'Cocci; grape-like clusters',
'Aerobic/Fermentation', 'Humans')


insert into tissue (organ_name, classification) values
        ('Skin', 'Epithelium'),
   ('Lungs', 'Epithelium');


insert into disease (tissueID, name, symptoms) values
((SELECT tissue.id FROM tissue WHERE organ_name = 'Skin'), 'Skin infections', 'Redness,
swelling, paint at site of infection'),
```

((SELECT tissue.id FROM tissue WHERE organ_name = 'Lungs'), 'Pneumonia', 'Difficulty breathing, malaise, high fever, chills, cough with sputum that may be tinged with blood');

insert into treatment (diseaseID, drug_name, uses, mode_of_action) values
((SELECT id FROM disease WHERE name = 'Skin infections'), 'Mupirocin', 'Topical agent, primarily effective against Gram-positive bacteria', 'Selective binding to bacterial isoleucyl-tRAN synthase; halts the incorporation of isoleucine into bacterial proteins.'),
((SELECT id FROM disease WHERE name = 'Skin infections'), 'Retapamulin', 'Topical antibiotic used for the treatment of skin infections', 'Inhibit the initiation of protein synthesis by binding to a specific site on the 50S subunit of bacterial ribosome'),
((SELECT id FROM disease WHERE name = 'Pneumonia'), 'Flucloxacillin', 'Used to treat infections of: chest, ear, nose, throat, skin and soft tissue, heart, bone and joints, membranes of brain, guts, blood, kidney, bladder or urethra.', 'Inhibits the synthesis of bacterial cell walls'),
((SELECT id FROM disease WHERE name = 'Pneumonia'), 'Dicloxacillin', 'Used to treat infections caused by penicillinase-producing staphylococci which have demonstrated susceptibility to the drug', 'Inhibit the biosynthesis of the bacterial cell wall by binding to specific penicillin-binding proteins located inside the bacterial cell wall');

insert into disease_treatment (diseaseID, treatmentID) VALUES ('3', '6');
insert into disease_treatment (diseaseID, treatmentID) VALUES ('1', '1');
insert into disease_treatment (diseaseID, treatmentID) VALUES ('1', '2');
insert into disease_treatment (diseaseID, treatmentID) VALUES ('2', '4');
insert into disease_treatment (diseaseID, treatmentID) VALUES ('2', '3');

insert into pathogen_disease (pathogenID, diseaseID) VALUES ('1', '1');
insert into pathogen_disease (pathogenID, diseaseID) VALUES ('3', '3');
insert into pathogen_disease (pathogenID, diseaseID) VALUES ('4', '14');
insert into pathogen_disease (pathogenID, diseaseID) VALUES ('1', '2');

Data Manipulation Queries

Get Relationship Tables:

SELECT pathogen.name, disease.name
FROM disease, pathogen, pathogen_disease
WHERE pathogen_disease.pathogenID = pathogen.id
AND pathogen_disease.diseaseID = disease.id
ORDER by pathogen.name ASC

SELECT disease.name, treatment.drug_name
FROM disease, treatment, disease_treatment
WHERE disease_treatment.diseaseID = disease.id

AND disease_treatment.treatmentID = treatment.id
ORDER by disease.name ASC

Adding data to database:

INSERT INTO disease(name, symptoms, tissueID) VALUES ([],[],[]);

INSERT INTO disease_treatment(diseaseID, treatmentID) VALUES ([],[]);

INSERT INTO pathogen_disease(pathogenID, diseaseID) VALUES ([],[]);

NSERT INTO pathogen(name, species, gram_staining, shape, oxygen_requirement, host)
VALUES ([],[],[],[],[],[]);

INSERT INTO tissue (organ_name, classification) VALUES ([],[]);

INSERT INTO treatment(drug_name, uses, mode_of_action, diseaseID) VALUES (?,?,?,?);

Deleting data from database:

DELETE FROM disease WHERE id = ([]);

DELETE FROM pathogen WHERE id = ([]);

DELETE FROM tissue WHERE id = ([]);

DELETE FROM treatment WHERE id = ([]);

Updating pathogen information

UPDATE pathogen SET name = [], species = [], gram_staining = [], shape = [],
oxygen_requirement = [], host = [] WHERE id = [];