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Project Title: Model Managers
Project URL: http://classwork.engr.oregonstate.edu:3797/

## Project 4 Draft:

1. Feedback Received
    a. From TA: “Appears to mostly be generated from dump. Cleanly imports.” Received from Alex Lovato

2. Fixes based on the received feedback above:
    a. Updated the DDL to mirror the APIs used to generate forecasts and readings data.
    b. Did not make other changes because it was unclear what specifically to improve upon.

## Model-Managers Project Proposal

- **Overview:**

The Model-Managers company enables customers to determine which wind forecast models are most accurate for given locations over specified time intervals. There are a variety of wind forecast models (HRRR, ECMWF, GFS, MBLUE, etc. ) which often have different wind forecasts for a given location. Users of these forecast models usually cannot determine what model is the most accurate for their specific location. In other words, they would need to compare the model forecasts to actual data from weather/wind collection devices at specific locations to determine which model is typically more accurate for those locations.

The Model-Managers company solves this problem by storing hourly wind forecasts for a standardized forecast period of 7 days in a database, and then allowing users to interact with a web interface to compare the forecast data against the actual measured data at a location for different time intervals. The 3 criteria used to compare forecast predictions to measured wind are average wind speed, wind direction, and wind gust speed. The Model-Managers company uses the free OpenMeteo API (https://open-meteo.com) to obtain wind forecast data, and a Holfuy (https://api.holfuy.com/) device API to obtain the measured wind forecast data.

The minimal viable product of the Model-Managers company uses 2 weather forecast models (HRRR and ECMWF) and 1 Holfuy device, located at La Bajada Ridge, New Mexico. The Model-Managers interface is expected to be accessible by a minimum of 50 different users over 100 times per day. Model-Managers uses a GitHub repository at https://github.com/skipmcgee/wind-forecast to manage their codebase.

The entities that the Model-Manager’s Database uses are Models, Locations, Sensors, Forecasts, Dates, and Readings. There will be more instances of Dates, Readings and Forecasts than any other entity, as we are limiting the MVP to one Sensor and 2 Models. Since

there is one Sensor, that Sensor will be at 1 location for the MVP phase of the project. The Dates of the Readings and Forecasts will be taken hourly, so 24 times a day for approximately the next four months (each). This is anticipated to be around 2100 instances of each of the Dates, Forecasts and Readings entities.

- **Entities:**

☐ Models:
These are the individual weather models that the Model-Managers product supports. These weather models are the model that drives a specific forecast and include HRRR, ECMWF, etc models. This entity's purpose is to capture the weather model specifics.

a. modelID: int, auto_increment, unique, not NULL, PK
b. modelName: varchar(100), not NULL

Relationships: there is a one to many relationship between models and forecasts. For every model there are many forecasts. Forecasts are the intersection table(s) of the M:N or many to many relationship between Models and Locations.

☐ Locations:
The locations where customers desire to compare forecasts to measured values. This entity's purpose is to manage the location information such as latitude, longitude, and altitude.

a. locationID: int, auto_increment, unique, not NULL, PK
b. locationName: varchar(300), unique, not NULL
c. locationLatitude: float, not NULL
d. locationLongitude: float, not NULL
e. locationAltitude: int, not NULL

Relationships: A one to one relationship exists between locations and sensors. There is only one sensor at a specific location. A one to many relationship exists between locations and forecasts. There are typically greater than one forecast at a single location. Forecasts are the intersection table(s) of the M:N or many to many relationship between Locations and Models.

☐ Sensors:
The sensors that can measure the weather data at a specific location. These are specifically Holfuy sensors for the MVP but the attributes are intentionally generalized enough that these could be expanded to include other makes and models of sensor. The purpose of this entity is to manage the attributes of the specific sensors, This includes specific attributes of a sensor, such as its manufacturing number and the api key used to access it, as well as references to its location.

a. sensorID: int, auto_increment, unique, not NULL, PK
b. sensorName: varchar(300), not NULL
c. sensorLocationID: int, not NULL, FK, -> locationID
d. sensorAPIKey: varchar(300), not NULL
e. sensorNumber: int, not NULL

Relationships: there is a one to one relationship between sensors and locations.

- [ ] Forecasts:
  Intersection Table for hourly forecast information that is common across all weather models. The purpose of this entity is to hold the forecast prediction information for the weather at a specific date and time.
    a. forecastID: int, auto_increment, unique, not NULL,
    b. forecastMadeDateID: int, not NULL, FK -> dateID
    c. forecastForDateTime: DATETIME, not NULL
    d. forecastTemperature2m: float, not NULL
    e. forecastPrecipitation: float, not NULL
    f. forecastWeatherCode: varchar(100), not NULL
    g. forecastPressureMSL: int, not NULL
    h. forecastWindSpeed10m: float, not NULL
    i. forecastWindDirection10m: float, not NULL
    j. forecastCape: float, not NULL
    k. forecastLocationID: int, not NULL, FK -> locationID
    l. forecastModelID: int, FK -> modelID

  Relationships: Forecasts in an intersection table. There is a many to one relationship between forecasts and locations. There are many forecasts at a single location. There is a many to one relationship between forecasts and models. There are many forecasts for a single model. There is a many to one relationship for forecasts to dates. There are many forecasts at a date.

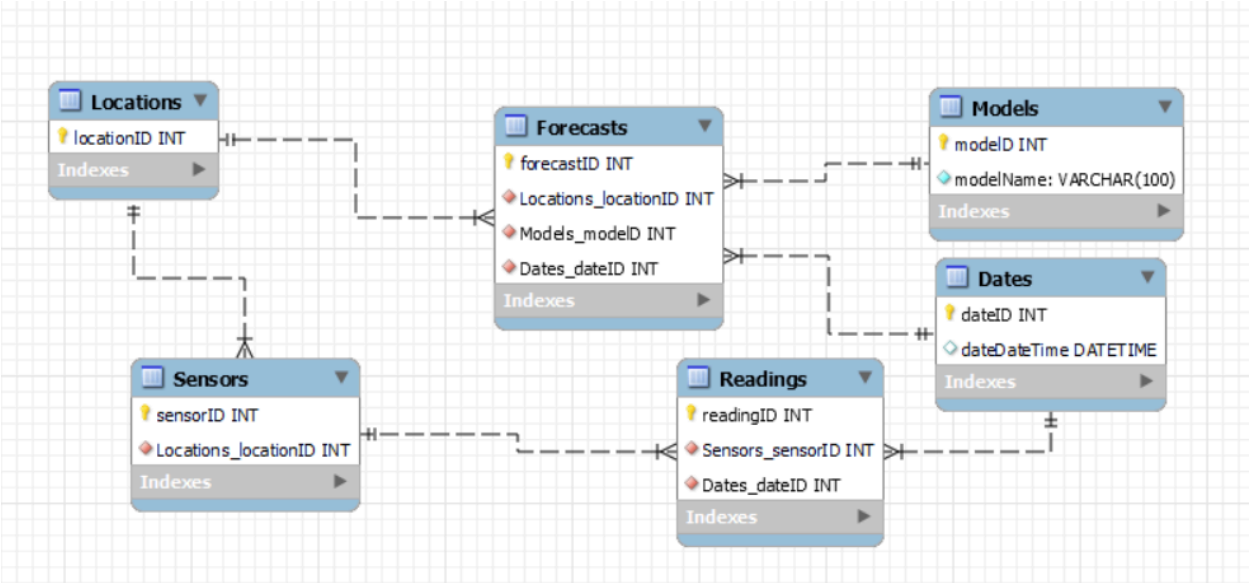
- [ ] Readings:
  The actual measured sensor readings at a specific location. The purpose of this entity is to hold the reading information that a sensor provides at a specific date and time.
    a. readingID: int, auto_increment, unique, not NULL, PK
    b. readingSensorID: int, not NULL, FK -> sensorID
    c. readingDateTime: int, not NULL, FK -> dateID
    d. readingWindSpeed: float, not NULL
    e. readingWindGust: float, not NULL
    f. readingWindMin: float, not NULL
    g. readingDirection: int, not NULL
    h. readingTemperature: float, not NULL

  Relationships: there is a many to one relationship between readings and sensors. There are many readings at a single sensor. There is a many to one relationship between readings and dates. There are many readings at a single date.

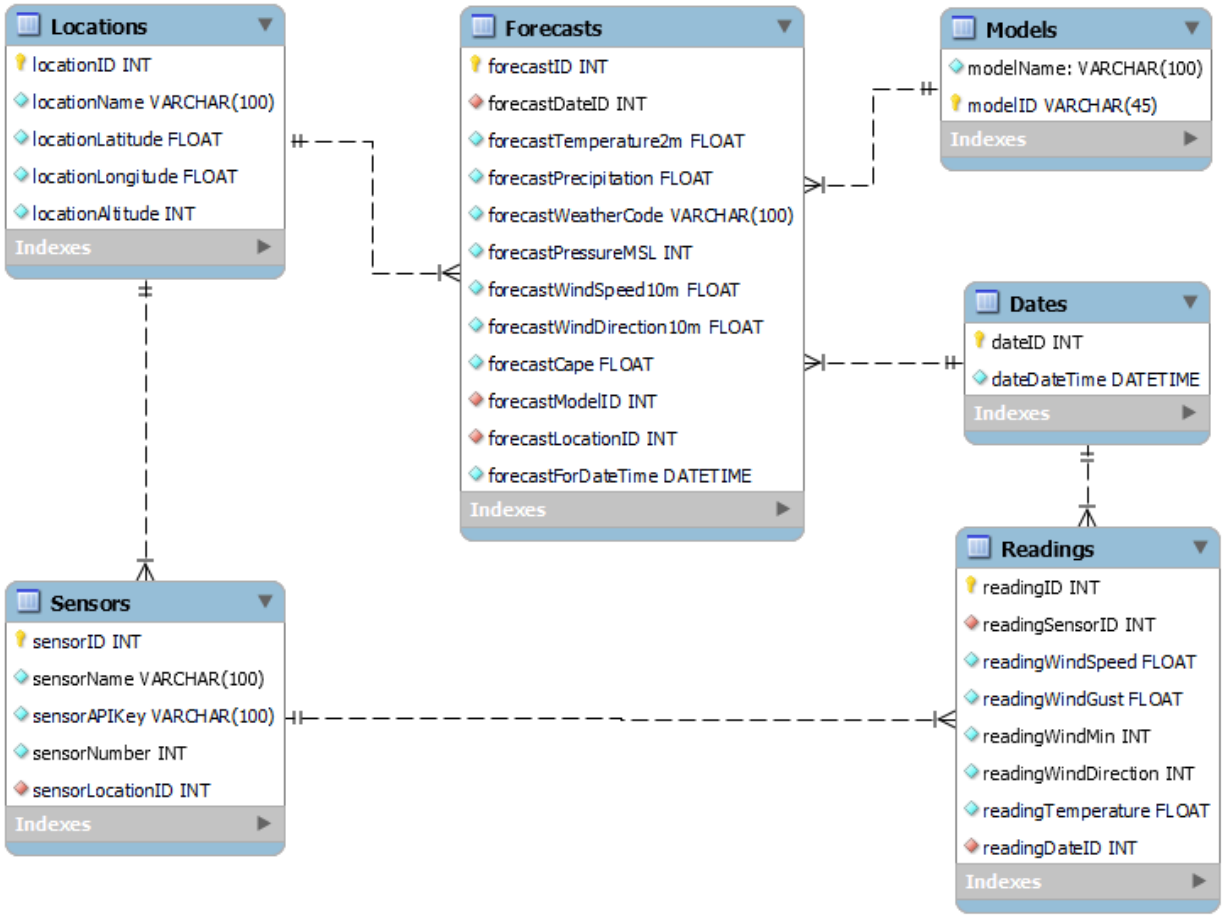
- [ ] Dates:
  The date and time. The purpose of this entity is to hold the date information and to faciliate access to a specific forecast and/or a specific reading at a date and time.
    a. dateID: int, auto_increment, unique, not NULL, PK
    b. dateDateTime: DateTime, not NULL,

Relationships: there is a many to one relationship between readings and dates. There are many readings at a single datetime. There is a many to one relationship between forecasts and dates. There and many forecasts for a single datetime.

- **<u>Updated Entity Relationship Diagram:</u>**




d) Schema:




e) Example Data:

```
Models Data:
('ECMWF'),
('HRRR'),
('GFS'),
('ICON'),
('MBLUE'),
('NAM');

Locations Data:
```

```
('La Bajada Ridge Launch', 35.56195,
-106.22596, 6135),
('Sandia Peak Launch', 35.196576, -106.434662,
10275),
('Sandia Crest Launch', 35.21342, -106.45026,
10600),
('Blue Springs Launch', 34.44002, -106.51913,
6200);

Sensors Data:
('La Bajada Holfuy', 1, 'mytestapikey1234',
1151),
('Sandia Peak Holfuy', 2, 'mytestapikey23456',
1152),
('Sandia Peak Tempest', 2,
'mytestapikey345670', 2),
('Sandia Crest Holfuy', 3,
'mytestapikey456789', 1153),
('Blue Springs Holfuy', 4, 'mytestapikey56789',
1154);

Dates Data:
('2024-04-01 08:00:00'),
('2024-04-01 09:00:00'),
('2024-04-01 10:00:00'),
```

```
('2024-04-01 11:00:00'),
('2024-04-01 12:00:00'),
('2024-04-01 13:00:00'),
('2024-04-01 14:00:00'),
('2024-04-01 15:00:00'),
('2024-04-01 16:00:00'),
('2024-04-01 17:00:00'),
('2024-04-01 18:00:00'),
('2024-04-01 19:00:00'),
('2024-04-01 20:00:00'),
('2024-04-01 21:00:00');

Readings Data:
(1, 1, 22.0, 28.0, 14.0, 250, 64),
(1, 1, 22.0, 28.0, 14.0, 250, 64),
(1, 2, 20.0, 22.0, 6.0, 231, 66),
(1, 3, 21.0, 24.0, 11.0, 242, 67),
(1, 4, 23.0, 25.0, 8.0, 250, 69),
(1, 5, 18.0, 21.0, 4.0, 256, 71),
(1, 6, 17.0, 22.0, 12.0, 264, 74),
(1, 7, 16.0, 20.0, 15.0, 270, 72),
(1, 8, 18.0, 21.0, 18.0, 265, 77),
(1, 9, 20.0, 24.0, 16.0, 254, 75),
(1, 10, 19.0, 22.0, 17.0, 246, 74);
```

```
Forecasts Data:
('2024-04-01 15:00:00', 1, 58, 0, '0.0', 3,
10.0, 14.7, 220.0, 3.5, 1, 1),
('2024-04-01 16:00:00', 2, 58, 0, '0.0', 3,
10.0, 14.7, 220.0, 4.1, 1, 1),
('2024-04-01 17:00:00', 3, 62, 0, '0.0', 4,
14.0, 24.0, 230.0, 4.2, 1, 1),
('2024-04-01 18:00:00', 4, 64, 0, '0.0', 4,
16.0, 25.2, 232.0, 3.6, 1, 1),
('2024-04-01 19:00:00', 5, 66, 0, '0.0', 4,
13.0, 25.0, 228.0, 3.4, 1, 1),
('2024-04-01 20:00:00', 6, 62, 0, '0.0', 4,
11.0, 24.0, 220.0, 3.3, 1, 1),
('2024-04-01 21:00:00', 7, 58, 0, '0.0', 3,
9.0, 20.0, 218.0, 3.1, 1, 1);
```