

GREENWORKS LANDSCAPING

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Website (please use OSU VPN and Firefox or Chrome): [GREENWORKS](#)

Executive Summary

GREENWORKS LANDSCAPING is a growing business that provides several landscaping services for customers (see Project Outline for more details). Our web application utilizes python, flask, HTML, CSS and jinja to display and add/update/remove data from a MySQL database.

The final version of the web application has a total of 5 entities: Customers, Employees, Services, Invoices, and Services_Invoices. In our initial proposal, there was a 6th entity, Equipment, however, after some feedback regarding potential normalization issues we decided to exclude Equipment from the project. The Equipment entity introduced a M:N relationship with another entity that was already part of a M:N relationship. This simplified our project implementation to better fit within the 11-week course.

As implementation progressed, we received additional feedback regarding normalization of the database, and adjusted attributes as suggested. The Services_Invoices entity (which is also an intersection table for a M:N relationship), was adjusted to reach second normal form. One attribute within the entity was dropped, another was added, and an existing attribute was renamed and assigned a different type.

Several attribute types were changed as implementation progressed. We found that using decimal attribute types was not effective for our use case and changed all decimal type attributes to integer instead. Phone numbers were changed from integer to varchar to capture that information more effectively.

During step 2 we realized that our database was missing a NULL-able foreign key field within a 1:M relationship as required in the project rubric. By step 3 we implemented this requirement in the Invoices entity, employee_id attribute. Within the web application, a user can UPDATE an invoice to add, change, or remove an employee_id from the selected invoice.

Step 5 allowed us to open our project to our peers. As users entered larger amounts of data than we experimented with, we found that the format of the web application needed updating. As each table grew (as data was added), the form at the bottom would get pushed further down the page, negatively affecting usability. To accommodate larger volumes of data, we moved data entry forms (which are static in height) to the top of each page, facilitating a better user experience.

The only feedback we received for Step 5 was to incorporate color and styling to the web application to improve usability. Our project's final version addresses this feedback. We added a variety of styles to update our web application: font size and design, navigation bar color and style, button color and style, table color and style, and form color and style.

Project and Database Outlines

GREENWORKS LANDSCAPING is a privately owned business that specializes in a variety of landscaping services within their community. With only one location (currently) in North America they have seen a huge spike in business, completing over \$200,000 worth of services for their customers last year!

The goal of this project is to help GREENWORKS LANDSCAPING track their employees, customers, services offered and most importantly their sales. GREENWORKS LANDSCAPING served over 350 customers within their community last year and are looking to expand their service area by 50 miles. They are also incorporating several new services for customers, for a total projected increase in sales of 20% by the end of this year.

The owners of this business would like to store information to break down their profits by month (or set of months), customer, and service. They hope to use this database to facilitate data-informed decision making as their business continues to grow.

1. **Customers:** Records details of customers requesting equipment and services.

Fields:

- **customer_id:** int, auto increment, not NULL, PK
- **first_name:** varchar(125), not NULL
- **last_name:** varchar(125), not NULL
- **address:** varchar(125), not NULL
- **city:** varchar (125), not NULL
- **state:** varchar(2), not NULL
- **zipcode:** varchar(10), not NULL
- **email:** varchar(125)
- **phone:** varchar(12), not NULL

Relationships:

- 1:M between **Customers** and **Invoices** with **customer_id** as a FK in **Invoices**

2. **Invoices:** Records money made for our business.

Fields:

- **invoice_id:** int, auto increment, not NULL, PK
- **customer_id:** int, not NULL, FK

- **employee_id**: int, FK
- **date_created**: date not NULL

Relationships:

- M:N relationship between **Invoices** and **Services**
 - Utilizes an intersection table called **Services_Invoices** with **invoice_id** as a FK
- M:1 relationship between **Invoices** and **Employees** with **employee_id** as a FK in **Invoices**

3. **Services**: Records information about each service that is offered.

Fields:

- **service_id**: int, auto increment, not NULL, PK
- **name**: varchar(125), not NULL, unique
- **cost_per_hour**: int, not NULL

Relationships:

- M:N relationship between **Services** and **Invoices**
 - Utilizes an intersection table called **Services_Invoices** with **service_id** as a FK
- M:N relationship between **Services** and **Equipments**
 - Utilizes an intersection table called **Equipments_Services** with **service_id** as a FK in **Equipments_Services**

4. **Employees**: Records employee information.

Fields:

- **employee_id**: int, auto increment, not NULL, PK
- **employee_fname**: varchar(125), not NULL
- **employee_lname**: varchar(125), not NULL
- **Phone_number**: varchar(12), not NULL

Relationships:

- 1:M relationship between **Employees** and **Invoices** with **employee_id** as FK in **Invoices**

5. **Services_Invoices**: Intersection table to simplify the M:N relationship between **Services** and **Invoices**. Stores information regarding every service line item for an invoice.

Fields:

- **Services_Invoices_id**: int, auto increment, not NULL, PK
- **service_id**: int, not NULL, FK
- **invoice_id**: int, not NULL, FK
- **qty**: int, not NULL
- **line_subtotal**: int, not NULL

Relationships:

- M:1 relationship between **Services_Invoices** and **Services** with **service_id** as FK in **Services_Invoices**
- M:1 relationship between **Services_Invoices** and **Invoices** with **invoice_id** as FK in **Services_Invoices**

Entity Relationship Diagram

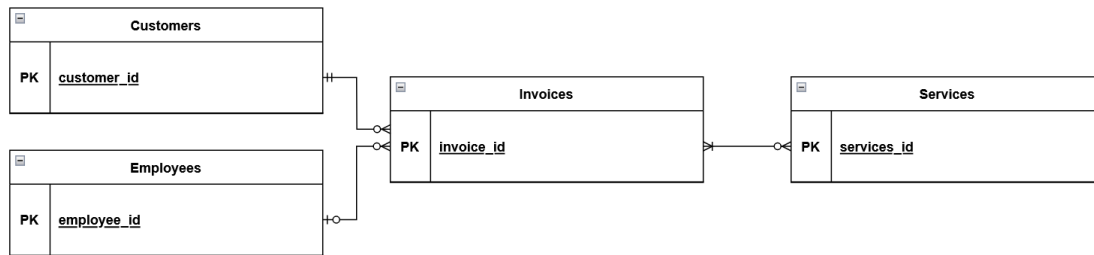


Figure 1. ER diagram outlines the high-level database overview.

Schema

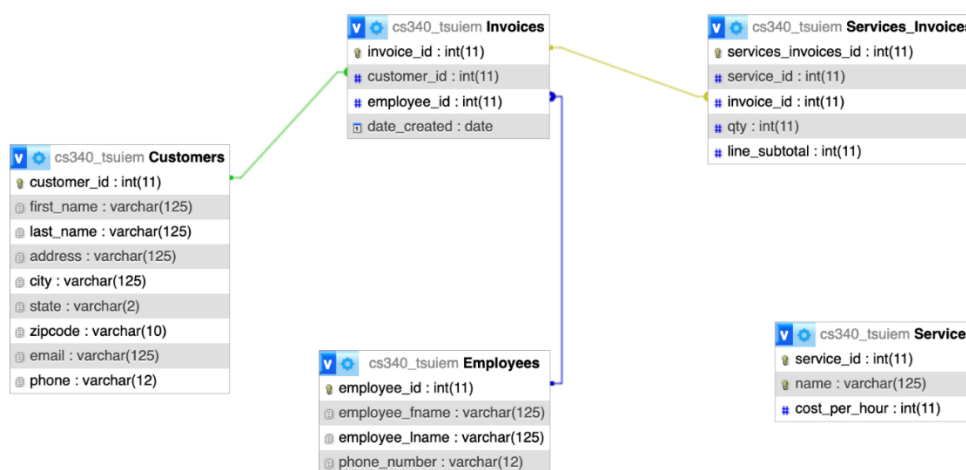


Figure 2. Schema provides an in-depth view of the relational database.

Example Data

The following data is inserted into the database when the “Reload Database” button on the Home page is selected.

Customers									
customer_id	first_name	last_name	address	city	state	zipcode	email	phone	
1	Brandon	Sanderson	12345 Twin Peaks Drive	Coos Bay	OR		93845 bsand@email.com	123-456-7890	
2	Patrick	Rothfuss	67890 Mayflower Street	Bandon	OR		98312 proth@email.com	123-456-7891	
3	Bill	Watterson	98311 Bonita Avenue	Coquille	OR		98622 NULL	123-456-7892	
4	Brent	Weeks	98744 Daisy Road	Coos Bay	OR		93845 bweek@email.com	123-456-7893	
5	April	Jackson	98411 Poppy Street	Bandon	OR		98312 NULL	123-456-7894	

Figure 3. Default Customers data.

Employees			
employee_id	employee_fname	employee_lname	phone_number
1	John	Gardener	123-456-7895
2	Frank	Weed	123-456-7896
3	Joe	Lawn	123-456-7897
4	Cindy	Mulch	123-456-7898
5	May	Flowers	123-456-7899

Figure 4. Default Employees data.

Invoices				
invoice_id	customer_id	employee_id	date_created	
1	3	2	1/31/2024	
2	2	2	1/30/2024	
3	5	3	1/31/2024	
4	1	5	1/20/2024	
5	3	4	1/20/2024	

Figure 5. Default Invoices data.

Services		
service_id	name	cost_per_hour
1	Mowing	\$ 60
2	Tree trimming	\$ 120
3	Mulching	\$ 100
4	Planting	\$ 90
5	Irrigation installation	\$ 130

Figure 6. Default Services data

Services_Invoices					
services_invoices_id	service_id	invoice_id	qty	line_subtotal	
1	2	3	7	\$ 840	
2	1	1	4	\$ 240	
3	2	1	6	\$ 720	
4	4	2	4	\$ 360	
5	5	4	8	\$ 1,040	

Figure 7. Default Services_Invoices (intersection table) data

UI Screenshots & Website Functionality

Home page

This page utilizes a SQL statement to populate a table with high level business facts. As the user scrolls down, they can choose to reload the database (set all tables back to default values) or read about project details.

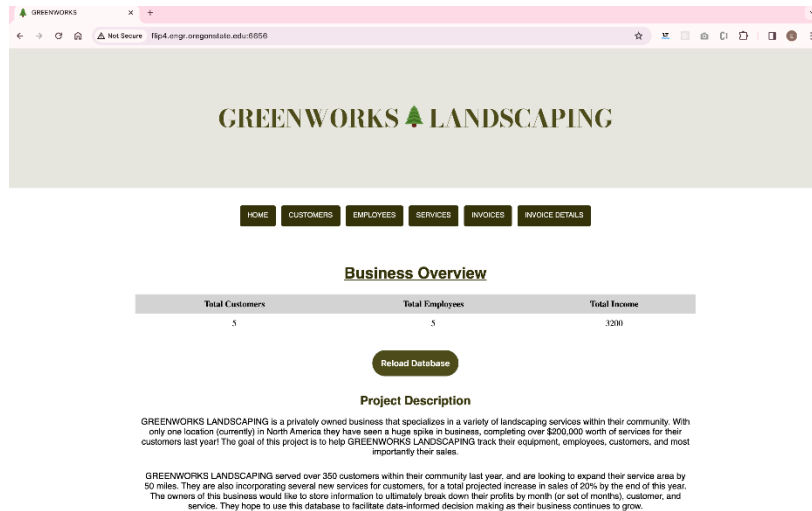


Figure 8. GREENWORKS LANDSCAPING Home page. On this page: traverse the web app using the nav bar, view high level business facts, reload the database, or scroll down to learn more about the project. The table is generated using a SQL SELECT statement.

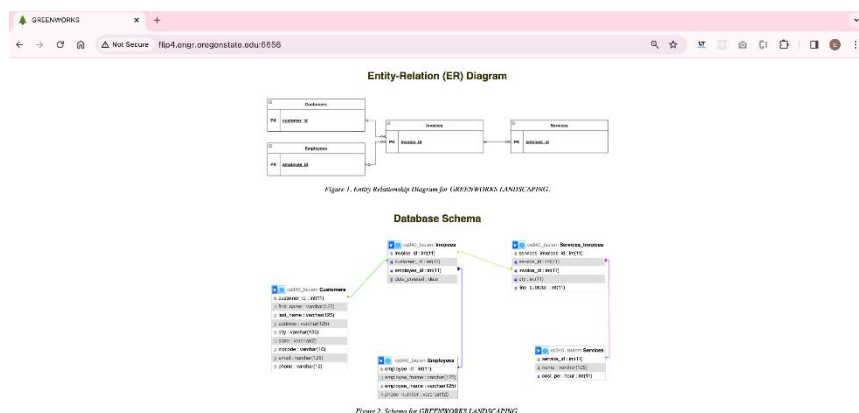


Figure 9. Scroll down on the Home page to view project details.

Customers

The Customers page supports full CRUD operations for the Customers entity. Select the appropriate tab and follow the form instructions to complete the desired operation.

READ/CREATE Customers Entity

GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Customer Information

Add Update Delete

Add Customer

* Fields are required.

* First Name * Last Name * Street Address * City * State * Zipcode * Email * Phone (303.303.3030)

Add

Customer ID	Name	Address	Email	Phone
1	Brandon Sanderson	12345 Twin Peaks Drive, Coos Bay, OR 97645	brand@email.com	123-456-7890
2	Patrick Rothfuss	67890 Mayflower Street, Bandon, OR 97612	patrick@email.com	123-456-7891
3	Bill Watson	98765 Bonita Avenue, Coquille, OR 97622	None	123-456-7892
4	Heert Weeks	98764 Daisy Road, Coos Bay, OR 97645	hweeks@email.com	123-456-7893
5	April Jackson	98411 Poppy Street, Bandon, OR 97612	None	123-456-7894

Figure 10. Customers page, Add Customer tab. Fill in the required fields and select “Add” to add a customer to the database.

READ/UPDATE Customers Entity

GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Customer Information

Add Update Delete

Update Customer

Select Customer

1 Brandon Sanderson
2 Patrick Rothfuss
3 Bill Watson
4 Heert Weeks
5 April Jackson

Update

Customer ID	Name	Address	Email	Phone
1	Brandon Sanderson	12345 Twin Peaks Drive, Coos Bay, OR 97645	brand@email.com	123-456-7890
2	Patrick Rothfuss	67890 Mayflower Street, Bandon, OR 97612	patrick@email.com	123-456-7891
3	Bill Watson	98765 Bonita Avenue, Coquille, OR 97622	None	123-456-7892
4	Heert Weeks	98764 Daisy Road, Coos Bay, OR 97645	hweeks@email.com	123-456-7893
5	April Jackson	98411 Poppy Street, Bandon, OR 97612	None	123-456-7894

Figure 11. Customers page, Update tab. Select the customer you wish to update from the drop box and select “Update” to be directed to the Edit Customer page.

UPDATE Customers Entity

GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Update Customer

* Fields are required.

Name: Brandon Address: 12345 Twin Peaks Drive City: Cres. Bay OR: 95945 Email: brad@email.com Phone: 123-456-7890

Update Cancel

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Figure 12. Edit Customers page. Make the desired changes to the selected customer and select “Update” to commit, or “Cancel” to discard. Reroutes back to the Customers page.

READ/DELETE Customers Entity

GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Customer Information

Add Update Delete

Delete Customer

Select Customer

1) Brandon Sanderson
2) Patrick Rothfuss
3) Bill Watson
4) Brent Weeks
5) April Jackson

Delete

Customer ID	Name	Address	Email	Phone
1	Brandon Sanderson	12345 Twin Peaks Drive, Cres. Bay, OR 95945	brad@email.com	123-456-7890
2	Patrick Rothfuss	67890 Mayflower Street, Bendon, OR 98312	proth@email.com	123-456-7891
3	Bill Watson	98311 Bonita Avenue, Coquille, OR 96621	None	123-456-7892
4	Brent Weeks	98744 Daisy Road, Cres. Bay, OR 93845	brweek@email.com	123-456-7893
5	April Jackson	98411 Poppy Street, Bendon, OR 98312	None	123-456-7894

Figure 13. Customers page, Delete Customer tab. Select the desired customer from the drop box and then select “Delete”. The user will be prompted to confirm deletion.

Employees

The Employees page supports full CRUD operations for the Employees entity. Select the appropriate tab and follow the form instructions to complete the desired operation.

READ/CREATE Employees Entity

The screenshot shows the 'Add Employee' form in the 'Employee Information' section. The form has three required fields: 'First Name', 'Last Name', and 'Phone'. Below the form is a table listing existing employees.

Employee ID	Name	Phone
1	John Gardner	123-456-7895
2	Frank Wood	123-456-7896
3	Joe Lawn	123-456-7897
4	Clady Mutch	123-456-7898
5	May Powers	123-456-7899

Figure 14. Employees page, Add Employee tab. Complete the form and select “Add” to add the employee information to the database.

READ/UPDATE Employees Entity

The screenshot shows the 'Update Employee' form in the 'Employee Information' section. A dropdown menu is open, showing a list of employees to select from. Below the form is a table listing existing employees.

Employee ID	Name	Phone
1	John Gardner	123-456-7895
5	Frank Wood	123-456-7896
2	Joe Lawn	123-456-7897
4	Clady Mutch	123-456-7898
3	May Powers	123-456-7899

Figure 15. Employees page, Update Employee tab. Select the desired employee from the drop box and select “Update” to be directed to the Edit Employee page.

UPDATE Employees Entity

The screenshot shows a web browser window with the URL `http4.engr.oregonstate.edu:6656/employees/`. The page header displays the logo "GREENWORKS LANDSCAPING" and a navigation bar with links: HOME, CUSTOMERS, EMPLOYEES, SERVICES, INVOICES, and INVOICE DETAILS. The main content area features a form titled "Update Employee" with the instruction "Fields are required." The form contains three input fields: "John" (likely a name), "Gardner" (likely a last name), and "123-456-7895" (likely a phone number). Below the input fields are two buttons: "Update" and "Cancel".

Figure 16. Edit Employee page. Make the desired changes to the selected employee and select “Update” to commit, or “Cancel” to discard. Reroutes to the Employees page.

READ/DELETE Employees Entity

The screenshot shows the same web browser window as Figure 16, but the "Delete Employee" tab is active. The form is titled "Delete Employee" and includes a "Select an Employee" dropdown menu. The dropdown menu is open, showing a list of employees with checkboxes next to their names. The first option, "1) John Gardner", is selected. Below the dropdown menu is a "Delete" button. The form also displays a table of employee information.

Employee ID	Name	Phone
1	John Gardner	123-456-7895
2	Frank Ward	123-456-7896
3	Joe Lann	123-456-7897
4	Cindy Mutch	123-456-7898
5	May Flowers	123-456-7899

Figure 17. Employee page, Delete Employee tab. Select the desired employee from the drop box and then select “Delete”. The user will be prompted to confirm deletion.

Services

The Services page supports full CRUD operations for the Services entity. Select the appropriate tab and follow the form instructions to complete the desired operation.

READ/CREATE Services Entity

GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Services

Add Update Delete

Add Service

* Fields are required.

* Service Name * Cost Per Hour (\$)

Add

Service ID	Name	Cost Per Hour
1	Mowing	\$60
2	Tree trimming	\$120
3	Mulching	\$100
4	Planting	\$90
5	Irrigation installation	\$130

Figure 18. Services page, Add Service tab. Complete the form and select “Add” to add the service information to the database.

READ/UPDATE Services Entity

GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Services

Add Update Delete

Update Service

Select a service

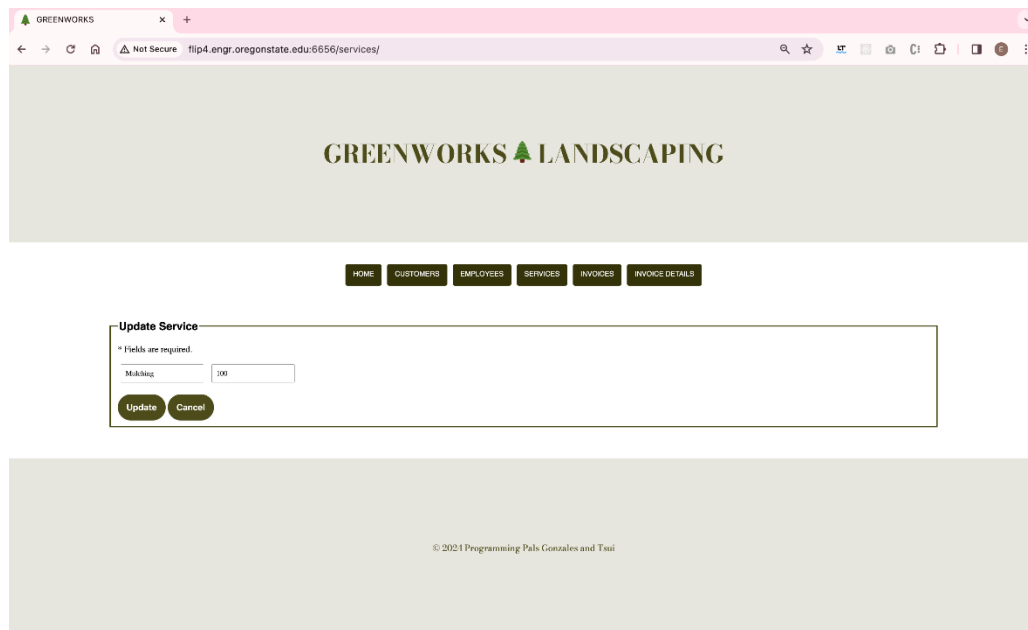
Update

Mowing
Tree trimming
Mulching
Planting
Irrigation installation

Service ID	Name	Cost Per Hour
1	Mowing	\$60
2	Tree trimming	\$120
3	Mulching	\$100
4	Planting	\$90
5	Irrigation installation	\$130

Figure 19. Services page, Update Service tab. Select the desired service from the drop box and select “Update” to be directed to the Edit Service page.

UPDATE Services Entity



GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Update Service

* Fields are required.

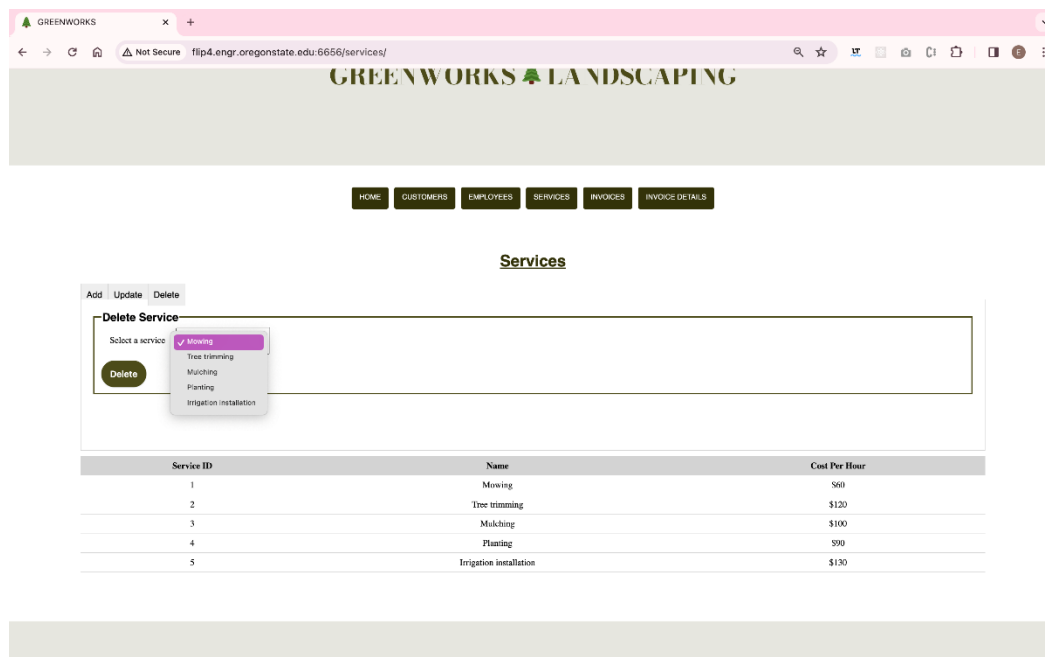
Mulching 00

Update Cancel

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Figure 20. Edit Service page. Make the desired changes to the selected service and select “Update” to commit, or “Cancel” to discard. Reroutes to the Services page.

DELETE Services Entity



GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Services

Add Update Delete

Delete Service

Select a service

Mowing (selected)

Tree trimming

Mulching

Planting

Irrigation installation

Delete

Service ID	Name	Cost Per Hour
1	Mowing	\$60
2	Tree trimming	\$120
3	Mulching	\$100
4	Planting	\$90
5	Irrigation installation	\$130

Figure 21. Service page, Delete Service tab. Select the desired service from the drop box and then select “Delete”. The user will be prompted to confirm deletion.

Invoices

The Invoices page supports full CRUD operations for the Invoices and Services Invoices entities. Select the appropriate tab and follow the form instructions to complete the desired operation. Changes made on the Invoices page are reflected on the Invoice Details page if applicable.

READ/CREATE Invoices Entity

GREENWORKS LANDSCAPING

Home | Dashboard | Invoices | Details | History | Account Settings

Invoice Information

Create Invoice

Customer: [Dropdown] Date: [Date Picker]

I now authorize you to complete for each service.

☐ Select Service
☐ Mowing
☐ Trimming
☐ Planting
☐ Fertilizing

ADD

Invoice ID	Date Created	Customer Name	Employee Name	Service	Total
1	2023-01-11	Bob Williams	Frank Wood	Tree trimming/Mowing	\$950
2	2023-01-10	Patricia Williams	Frank Wood	Planting	\$350
3	2023-01-11	John Williams	John Jones	Fertilizing	\$400
4	2023-01-10	Brandon Williams	Mike Jones	Pruning trees/shrubs	\$1000
5	2023-01-10	Bob Williams	Clay Smith	Mow	Mow

Figure 22. Invoices page, Create Invoice tab. Complete the form and select “Add” to add the invoice information to the database. Each service selected creates a line item in the Invoice Details page.

READ/UPDATE Invoices Entity

GREENWORKS LANDSCAPING

Home | Dashboard | Invoices | Details | History | Account Settings

Invoice Information

Update Invoice

Select Invoice: [Dropdown]

UPDATE

Invoice ID	Date Created	Customer Name	Employee Name	Service	Total
1	2023-01-11	Bob Williams	Frank Wood	Tree trimming/Mowing	\$950
2	2023-01-10	Patricia Williams	Frank Wood	Planting	\$350
3	2023-01-11	John Williams	John Jones	Fertilizing	\$400
4	2023-01-10	Brandon Williams	Mike Jones	Pruning trees/shrubs	\$1000
5	2023-01-10	Bob Williams	Clay Smith	Mow	Mow

Figure 23. Invoices page, Update Invoice tab. Select the desired invoice from the drop box and select “Update” to be directed to the Edit Invoice page.

UPDATE Invoices Entity

GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Update Invoice

Customer: Bill Watson Employee: Frank Wood Date: 8/29/2024

Enter number of hours completed for each service.

Missing	Tree trimming	Irrigation installation	Mulching	Planting
0	0	0	0	0

Update Cancel

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Figure 24. Edit Invoice page. Make the desired changes to the selected invoice and select “Update” to commit, or “Cancel” to discard. Reroutes to the Invoices page. **Employee attribute represents a NULLABLE foreign key relationship between Employees entity and Invoices entity. This is also a M:N update between Invoices and Services. Reflected on the Invoice Details page (Services_Invoices intersection table).**

DELETE Invoices Entity

GREENWORKS LANDSCAPING

HOME CUSTOMERS EMPLOYEES SERVICES INVOICES INVOICE DETAILS

Delete Invoice

Select Invoice

- 1. 2024-08-21: Frank Wood
- 2. 2024-08-21: Frank Wood
- 3. 2024-08-21: Frank Wood
- 4. 2024-08-21: Frank Wood
- 5. 2024-08-21: Frank Wood

Delete

Invoice ID	Date Created	Customer Name	Employee Name	Service	Total
1	2024-08-21	Bill Watson	Frank Wood	Tree trimming/Mulching	\$750
2	2024-08-21	Frank Wood	Frank Wood	Planting	\$150
3	2024-08-21	April Jackson	Frank Wood	Tree trimming	\$0.00
4	2024-08-21	Frank Wood	Frank Wood	Irrigation installation	\$1000
5	2024-08-21	Bill Watson	Frank Wood	Mulch	\$500

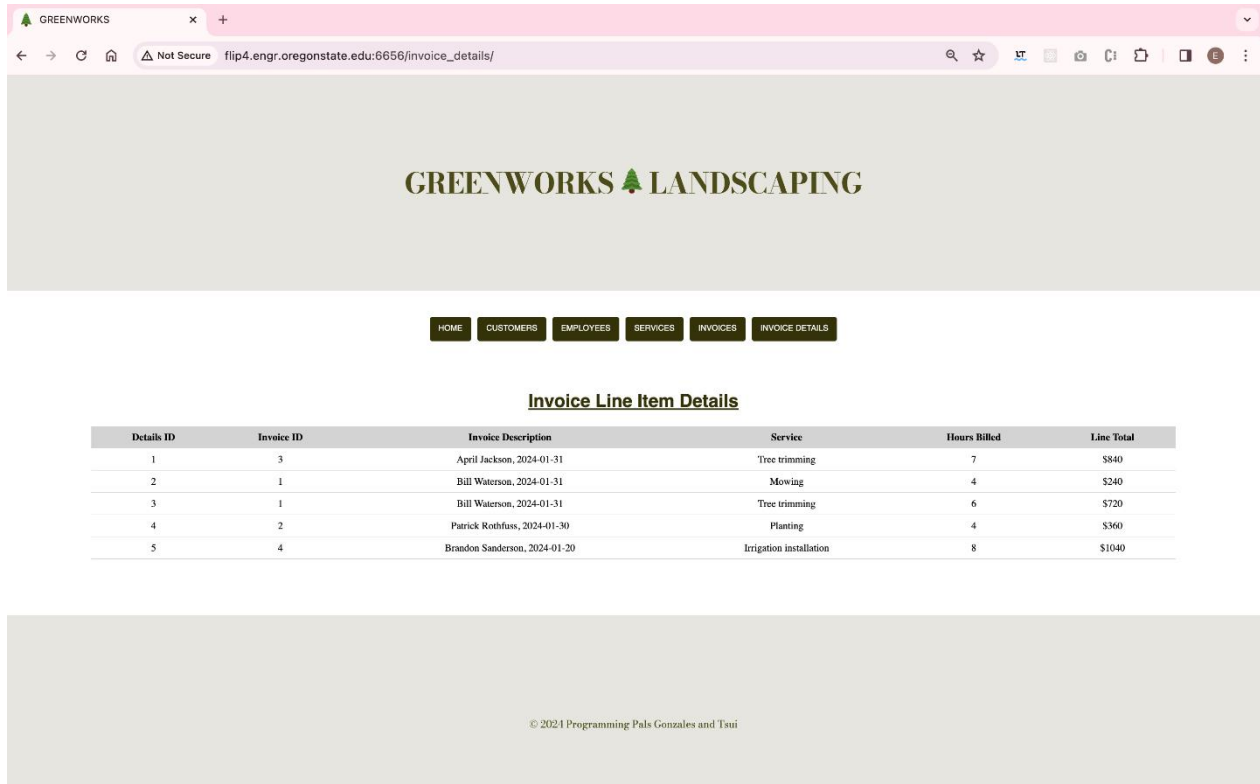
Figure 25. Invoice page, Delete Invoice tab. Select the desired invoice from the drop box and then select “Delete”. The user will be prompted to confirm deletion. **This action is a DELETE from a M:N relationship (Invoices entity M:N relationship with Services Entity). Reflected on the Invoice Details page (Services_Invoices intersection table).**

Invoice Details

This page displays the intersection table, Services_Invoices. Full CRUD operations are available to records in this table but can only be accessed via the Invoices page.

Additions/Updates/Deletions made to invoice line items from the Invoices page are reflected here.

READ Invoices Details Intersection Table



Details ID	Invoice ID	Invoice Description	Service	Hours Billed	Line Total
1	3	April Jackson, 2024-01-31	Tree trimming	7	\$840
2	1	Bill Waterson, 2024-01-31	Mowing	4	\$240
3	1	Bill Waterson, 2024-01-31	Tree trimming	6	\$720
4	2	Patrick Rothfuss, 2024-01-30	Planting	4	\$360
5	4	Brandon Sanderson, 2024-01-20	Irrigation installation	8	\$1040

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Figure 26. The Invoice Details page displays line items for each invoice.