

# VM Manager

Virtual Machine Management by Web

# Purpose

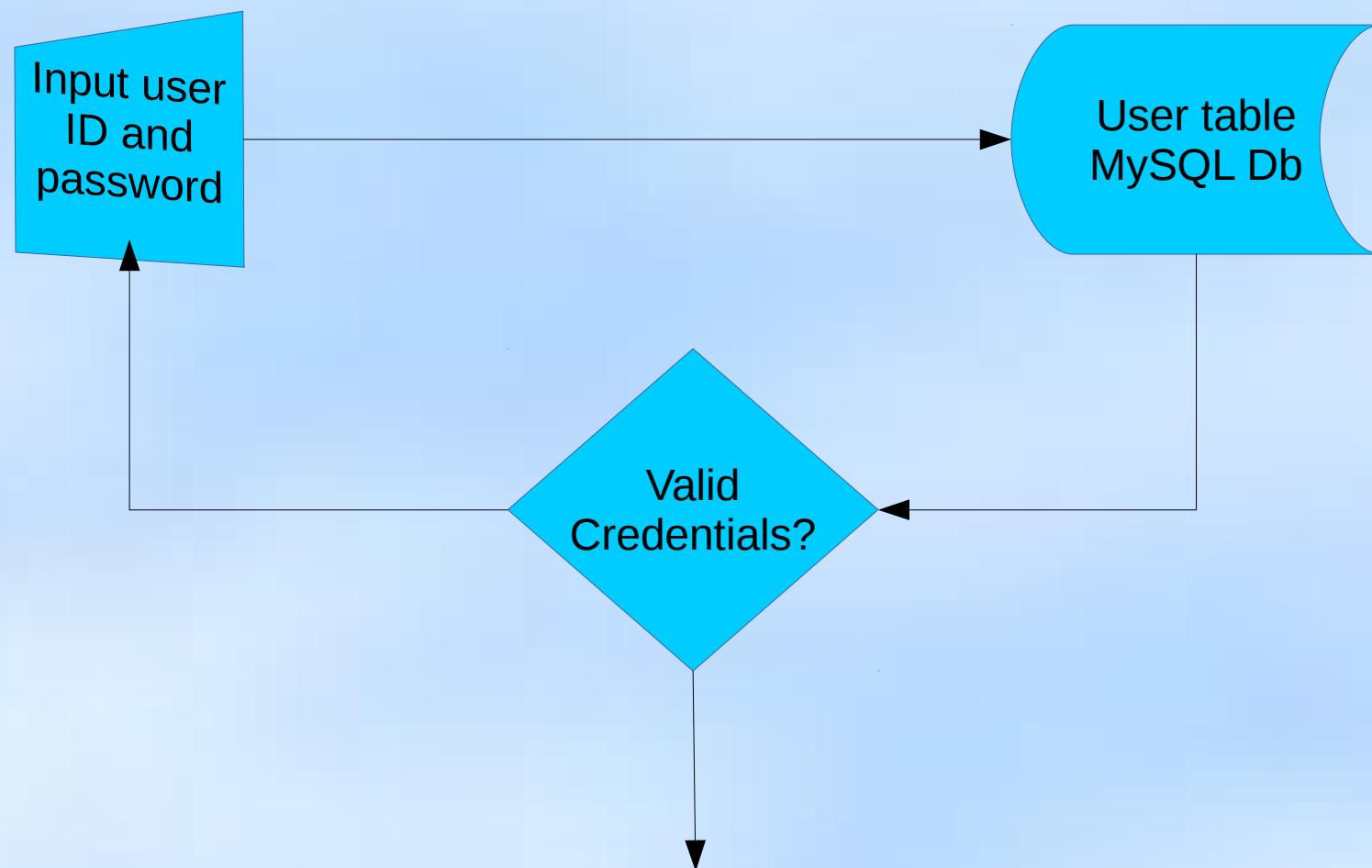
- Phase three of a custom training project conceived by Vigilant Cyber Systems
- Perform a few simple management tasks on remote virtual machines
- Introduce trainee to web development using:
  - Python
  - Flask
  - Paramiko
  - HTML
  - MySQL

# Functionality

- Login to the application
- Select which host to perform operations on
- Select which operation to perform:
  - Disk usage
  - Process table
  - Network interfaces
  - Network routes
  - Network interface configuration
  - Display password file
- View output from operation

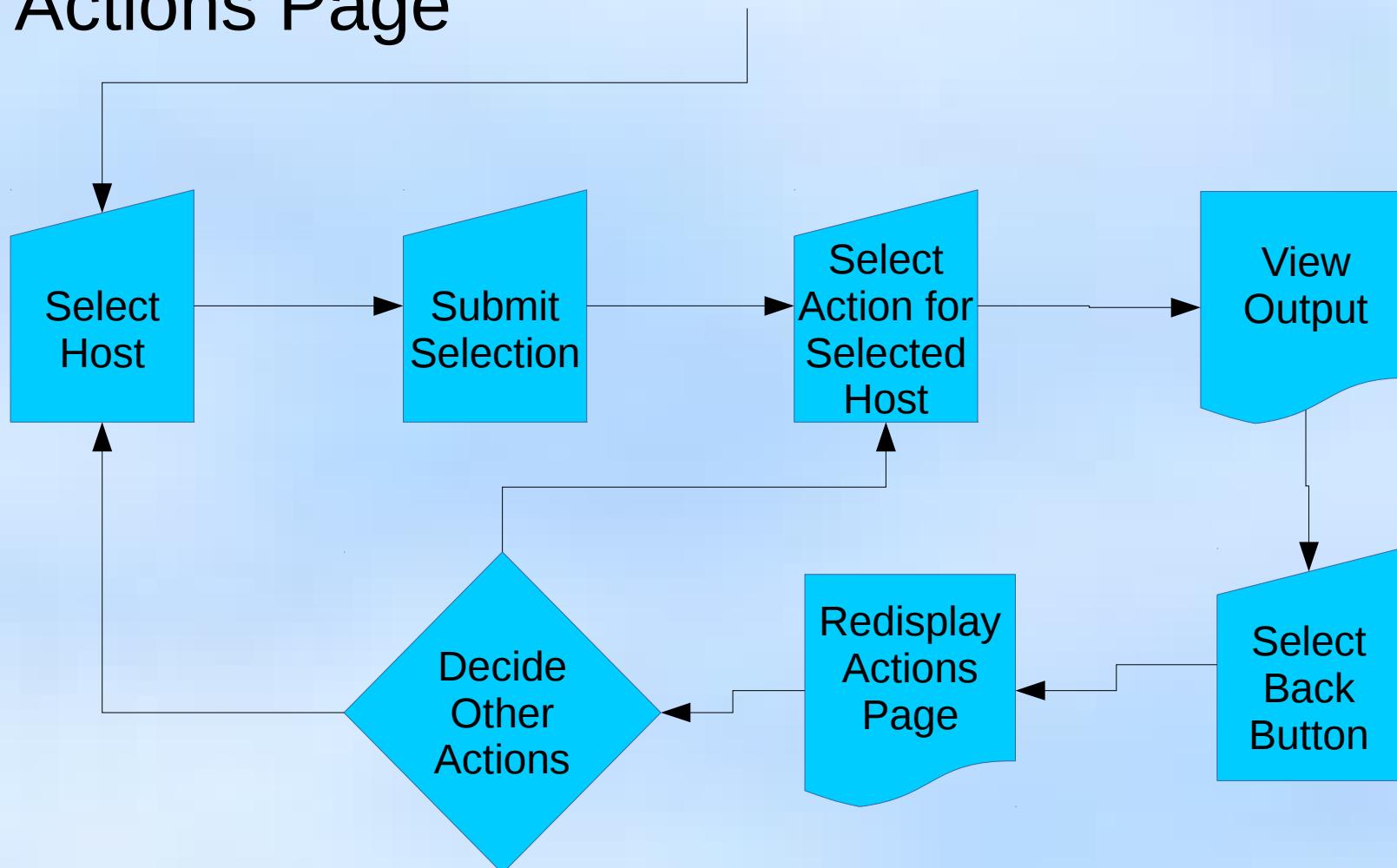
# Functionality

- Login page



# Functionality

- Actions Page



# Database Details

- VM Manager uses MySQL to store user and host connection information.
- There are three tables:
  - user
  - vm\_data
  - vm\_host
- host\_name in both vm\_data and vm\_host are unique indexes
- There is a foreign key defined on vm\_data.vm\_host\_name which references vm\_host.vm\_host\_name.

# user table - General Info

MySQL Workbench

Local instance 3306

File Edit View Query Database Server Tools Scripting Help

MANAGEMENT

- Server Status
- Client Connections
- Users and Privileges
- Status and System Variables
- Data Export
- Data Import/Restore

INSTANCE

- Startup / Shutdown
- Server Logs
- Options File

PERFORMANCE

- Dashboard
- Performance Reports
- Performance Schema Setup

SCHEMAS

- Filter objects
- blogger
- employee\_data
- my\_database
- sys
- vm\_manager

  - Tables
    - user
    - vm\_data
    - vm\_host
  - Views
  - Stored Procedures
  - Functions

Query 1 vm\_manager.user

Info Columns Indexes Triggers Foreign keys Partitions Grants

Local instance 3306

VM\_manager.user

**Table Details**

Engine:	InnoDB
Row format:	Dynamic
Column count:	3
Table rows:	1
AVG row length:	16384
Data length:	16.0 KiB
Index length:	32.0 KiB
Max data length:	0.0 bytes
Data free:	0.0 bytes
Table size (estimate):	48.0 KiB
Update time:	2020-04-02 15:32:37
Create time:	2020-04-02 16:52:16
Auto increment:	2
Table collation:	latin1_swedish_ci
Create options:	

Comment:

This table is the user table for VM Manager. The login ID and password are required to login to VM Manager. The login ID and password should match the login ID and password of the virtual machines that you intend to access.

Information on this page may be outdated. Click [Analyze Table](#) to update it.

Action Output

	Time	Action	Message	Duration / Fetch
1	16:51:46	ANALYZE TABLE `vm_manager`.`user`	OK	0.000 sec
2	16:52:16	ALTER TABLE vm_manager.user COMMENT = 'This table is the ...'	0 row(s) affected	0.067 sec

Object Info Session

Table: user

Columns:

recid	int(11) AI PK
login_id	varchar(20)
password	varchar(45)

Query Completed

# user table - Columns

MySQL Workbench

Local instance 3306

File Edit View Query Database Server Tools Scripting Help

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SCHEMAS

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- employee\_data
- my\_database
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- vm\_manager
  - Tables
    - user
    - vm\_data
    - vm\_host
  - Views
  - Stored Procedures
  - Functions

Query 1 vm\_manager.user

Columns

Column	Type	Default Value	Nullable	Character Set	Collation	Privileges	Extra	Comments
recid	int(11)		NO			select,insert,update,references	auto_increment	
login_id	varchar(20)		NO	latin1	latin1_swedish_ci	select,insert,update,references		
password	varchar(45)		YES	latin1	latin1_swedish_ci	select,insert,update,references		

Count: 3

Action Output

Time	Action	Message	Duration / Fetch
16:51:46	ANALYZE TABLE `vm_manager`.`user`	OK	0.000 sec
16:52:16	ALTER TABLE vm_manager.user COMMENT = 'This table is the ...'	0 row(s) affected	0.067 sec

Object Info Session

Table: user

Columns:

recid	int(11) AI PK
login_id	varchar(20)
password	varchar(45)

Query Completed

# user table - Indexes

MySQL Workbench

Local instance 3306

File Edit View Query Database Server Tools Scripting Help

MANAGEMENT

- Server Status
- Client Connections
- Users and Privileges
- Status and System Variable
- Data Export
- Data Import/Restore

INSTANCE

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- Options File

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SCHEMAS

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  - Tables
    - user
    - vm\_data
    - vm\_host
  - Views
  - Stored Procedures
  - Functions

Query 1 vm\_manager.user

Indexes in Table

Key	Type	Unique	Columns
PRIMARY	BTREE	YES	recid
recid_UNIQUE	BTREE	YES	recid
login_id_UNIQUE	BTREE	YES	login_id

Index Details

Key Name:  
Index Type:  
Allows NULL:  
Cardinality:  
Comment:  
User Comment:

Packed:  
Unique:

Columns in table

Column	Type	Nullable	Indexes
recid	int(11)	NO	PRIMARY, recid_UNIQUE
login_id	varchar(20)	NO	login_id_UNIQUE
password	varchar(45)	YES	

Create Index for Selected

Object Info Session

Table: user

Columns:

recid	int(11) AI PK
login_id	varchar(20)
password	varchar(45)

Action Output

	Time	Action	Message	Duration / Fetch
1	2018-07-16 16:51:46	ANALYZE TABLE `vm_manager`.`user`	OK	0.000 sec
2	7	16:51:46 ANALYZE TABLE `vm_manager`.`user`	OK	0.000 sec
3	8	16:52:16 ALTER TABLE vm_manager.user COMMENT = 'This table is the ...'	0 row(s) affected	0.067 sec

Query Completed

# vm\_data table – General Info

MySQL Workbench Local instance 3306 Apr 2 2020

File Edit View Query Database Server Tools Scripting Help

MANAGEMENT

- Server Status
- Client Connections
- Users and Privileges
- Status and System Variables
- Data Export
- Data Import/Restore

INSTANCE

- Startup / Shutdown
- Server Logs
- Options File

PERFORMANCE

- Dashboard
- Performance Reports
- Performance Schema Setup

SCHEMAS

- Filter objects
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- sys
- vm\_manager

  - Tables
    - user
    - vm\_data
  - Views
  - Stored Procedures
  - Functions

Query 1 vm\_manager.user vm\_manager.vm\_data

Info Columns Indexes Triggers Foreign keys Partitions Grants

Local instance 3306

vm\_manager.vm\_data

Table Details

Engine:	InnoDB
Row format:	Dynamic
Column count:	5
Table rows:	2
AVG row length:	8192
Data length:	16.0 KiB
Index length:	48.0 KiB
Max data length:	0.0 bytes
Data free:	0.0 bytes
Table size (estimate):	64.0 KiB
Update time:	2020-03-31 10:49:03
Create time:	2020-04-02 16:59:13
Auto increment:	4
Table collation:	latin1_swedish_ci
Create options:	

Comment:  
This table contains the connection information  
for databases you will connect to.

Information on this page may be outdated. Click [Analyze Table](#) to update it.

Action Output

	Time	Action	Message	Duration / Fetch
✓	2020-04-02 16:52:28	ANALYZE TABLE `vm_manager`.`user`	OK	0.000 sec
✓	9	16:52:28	ANALYZE TABLE `vm_manager`.`user`	0.000 sec
✓	10	16:59:13	ALTER TABLE vm_manager.vm_data COMMENT = 'This table c...' 0 row(s) affected	0.269 sec

Object Info Session

Table: vm\_data

Columns:

recid	int(11) AI PK
host_name	varchar(20)
ip_address	varchar(45)
os	varchar(45)
vm_host_name	varchar(45)

Query Completed

# vm\_data table - Columns

MySQL Workbench

Local instance 3306

File Edit View Query Database Server Tools Scripting Help

MANAGEMENT

- Server Status
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INSTANCE

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PERFORMANCE

- Dashboard
- Performance Reports
- Performance Schema Setup

SCHEMAS

- blogger
- employee\_data
- my\_database
- sys
- vm\_manager

Count: 5

Object Info Session

Action Output

Table: vm\_data

Columns:

recid	int(11) AI PK
host_name	varchar(20)
ip_address	varchar(45)
os	varchar(45)
vm_host_name	varchar(45)

Time Action Message Duration / Fetch

Time	Action	Message	Duration / Fetch
9 16:52:28	ANALYZE TABLE `vm_manager`.`user`	OK	0.000 sec
10 16:59:13	ALTER TABLE vm_manager.vm_data COMMENT = 'This table c ...'	0 row(s) affected	0.269 sec

Query Completed

The screenshot shows the MySQL Workbench interface with the 'vm\_manager' schema selected. In the left sidebar, the 'Tables' section is expanded, and the 'vm\_data' table is selected. The main pane displays the 'Columns' tab of the table editor, listing five columns: 'recid', 'host\_name', 'ip\_address', 'os', and 'vm\_host\_name'. Each column has its type, default value (NO), nullable status (NO), character set (latin1), collation (latin1\_swedish\_ci), privileges (select,insert,update,references), extra (auto\_increment), and comments (empty) specified. The 'recid' column is identified as the primary key (AI PK). At the bottom, the 'Action Output' pane shows two recent actions: an 'ANALYZE TABLE' command for the 'user' table and an 'ALTER TABLE' command for the 'vm\_data' table, both completed successfully.

# vm\_data table - Indexes

MySQL Workbench Local instance 3306 Apr 22

File Edit View Query Database Server Tools Scripting Help

MANAGEMENT

- Server Status
- Client Connections
- Users and Privileges
- Status and System Variables
- Data Export
- Data Import/Restore

INSTANCE

- Startup / Shutdown
- Server Logs
- Options File

PERFORMANCE

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- Performance Schema Setup

SCHEMAS

- Filter objects
- blogger
- employee\_data
- my\_database
- sys
- vm\_manager

  - Tables
    - user
    - vm\_data
  - Views
  - Stored Procedures
  - Functions

Query 1 vm\_manager.user vm\_manager.vm\_data

Indexes in Table

Key	Type	Unique	Columns
PRIMARY	BTREE	YES	recid
recid_UNIQUE	BTREE	YES	recid
host_name_UNIQUE	BTREE	YES	host_name
fk_vm_data_1_idx	BTREE	NO	vm_host_name

Index Details

Key Name: PRIMARY  
Index Type: BTREE  
Allows NULL: NO  
Cardinality: 1  
Comment:  
User Comment:

Packed: Unique:

Columns in table

Column	Type	Nullable	Indexes
recid	int(11)	NO	PRIMARY, recid_UNIQUE
host_name	varchar(20)	NO	host_name_UNIQUE
ip_address	varchar(45)	NO	
os	varchar(45)	NO	
vm_host_name	varchar(45)	NO	fk_vm_data_1_idx

Create Index for Selected Columns

Action Output

Time	Action	Message	Duration / Fetch
2015-04-22 16:52:28	ANALYZE TABLE `vm_manager`.`user`	OK	0.000 sec
2015-04-22 16:59:13	ALTER TABLE vm_manager.vm_data COMMENT = 'This table c...	0 row(s) affected	0.269 sec

Object Info Session

Table: vm\_data

Columns:

recid	int(11) AI PK
host_name	varchar(20)
ip_address	varchar(45)
os	varchar(45)
vm_host_name	varchar(45)

Query Completed

# vm\_data table – Foreign Keys

The screenshot shows the MySQL Workbench interface with the following details:

- Top Bar:** MySQL Workbench, Local instance 3306, April 2 2022.
- Left Sidebar (MANAGEMENT):** Server Status, Client Connections, Users and Privileges, Status and System Variable, Data Export, Data Import/Restore.
- Left Sidebar (INSTANCE):** Startup / Shutdown, Server Logs, Options File.
- Left Sidebar (PERFORMANCE):** Dashboard, Performance Reports, Performance Schema Setup.
- Left Sidebar (SCHEMAS):** Filter objects, blogger, employee\_data, my\_database, sys, vm\_manager (selected). Under vm\_manager: Tables (user, vm\_data, vm\_host), Views, Stored Procedures, Functions.
- Central Area:** Three tabs: Query 1 (selected), vm\_manager.user, vm\_manager.vm\_data. The Foreign keys tab is active, showing a table with one row:

Name	Schema	Table	Column	Referenced Schema	Referenced Table	Referenced Column
fk_vm_data_1	vm_manager	vm_data	vm_host_name	vm_manager	vm_host	vm_host_name
- Bottom Area:** Object Info tab selected, Action Output table showing history of actions on the vm\_data table.

Action	Time	Message	Duration / Fetch
ANALYZE TABLE `vm_manager`.`user`	9 16:52:28	OK	0.000 sec
ALTER TABLE vm_manager.vm_data COMMENT = 'This table c...'	10 16:59:13	0 row(s) affected	0.269 sec

# vm\_host table – General Info

MySQL Workbench

Local instance 3306

File Edit View Query Database Server Tools Scripting Help

MANAGEMENT

- Server Status
- Client Connections
- Users and Privileges
- Status and System Variables
- Data Export
- Data Import/Restore

INSTANCE

- Startup / Shutdown
- Server Logs
- Options File

PERFORMANCE

- Dashboard
- Performance Reports
- Performance Schema Setup

SCHEMAS

- Filter objects
- blogger
- employee\_data
- my\_database
- sys
- vm\_manager**
- Tables
- user
- vm\_data
- vm\_host**
- Views
- Stored Procedures
- Functions

Query 1 vm\_manager.user vm\_manager.vm\_data vm\_manager.vm\_host

Info Columns Indexes Triggers Foreign keys Partitions Grants

Local instance 3306  
vm\_manager.vm\_host

**Table Details**

Engine:	InnoDB
Row format:	Dynamic
Column count:	4
Table rows:	1
AVG row length:	16384
Data length:	16.0 KiB
Index length:	32.0 KiB
Max data length:	0.0 bytes
Data free:	0.0 bytes
Table size (estimate):	48.0 KiB
Update time:	2020-03-31 10:43:23
Create time:	2020-04-02 17:08:43
Auto increment:	2
Table collation:	latin1_swedish_ci
Create options:	

Comment: This table contains connection information to the VM host machine.

Information on this page may be outdated. Click [Analyze Table](#) to update it.

Object Info Session

Table: vm\_host

Columns:

recid	int(11) AI PK
vm_host_name	varchar(45)
ip_address	varchar(45)
os	varchar(45)

Action Output

Time	Action	Message	Duration / Fetch
11 16:59:20	ANALYZE TABLE `vm_manager`.`vm_data`	OK	0.000 sec
12 17:08:43	ALTER TABLE vm_manager.vm_host COMMENT = 'This table co...' 0 row(s) affected	0.230 sec	

Query Completed

# vm\_host table – Columns

MySQL Workbench Local instance 3306 Apr 2 2022

File Edit View Query Database Server Tools Scripting Help

MANAGEMENT

- Server Status
- Client Connections
- Users and Privileges
- Status and System Variables
- Data Export
- Data Import/Restore

INSTANCE

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- Server Logs
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SCHEMAS

- Filter objects
- blogger
- employee\_data
- my\_database
- sys
- vm\_manager

  - Tables
    - user
    - vm\_data
    - vm\_host
  - Views
  - Stored Procedures
  - Functions

Count: 4

Object Info Session

Action Output

Table: vm\_host

Columns:

recid	int(11) AI PK
vm_host_name	varchar(45)
ip_address	varchar(45)
os	varchar(45)

Time Action Message Duration / Fetch

10	2019-04-02 16:59:19	ALTER TABLE `vm_manager`.`vm_data` COMMENT = 'This table contains information about virtual machines.'	0 row(s) affected	0.230 sec
11	16:59:20	ANALYZE TABLE `vm_manager`.`vm_data`	OK	0.000 sec
12	17:08:43	ALTER TABLE vm_manager.vm_host COMMENT = 'This table contains information about host machines.'	0 row(s) affected	0.230 sec

Query Completed

# vm\_host table – Indexes

MySQL Workbench Local instance 3306 Apr 2 2022

File Edit View Query Database Server Tools Scripting Help

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  - Tables
    - user
    - vm\_data
    - vm\_host
  - Views
  - Stored Procedures
  - Functions

Indexes in Table

Key	Type	Unique	Columns
PRIMARY	BTREE	YES	recid
recid_UNIQUE	BTREE	YES	recid
vm_host_name_UNIQUE	BTREE	YES	vm_host_name

Index Details

Key Name: PRIMARY  
Index Type: BTREE  
Allows NULL: No  
Cardinality: 1  
Comment:  
User Comment:

Packed: Unique

Columns in table

Column	Type	Nullable	Indexes
recid	int(11)	NO	PRIMARY, recid_UNIQUE
vm_host_name	varchar(45)	NO	vm_host_name_UNIQUE
ip_address	varchar(45)	NO	
os	varchar(45)	NO	

Create Index for Selected Columns

Action Output

Object Info	Session	Action	Message	Duration / Fetch
Table: vm_host		ANALYZE TABLE `vm_manager`.`vm_data`	OK	0.000 sec
Columns:		ALTER TABLE vm_manager.vm_host COMMENT = 'This table co...	0 row(s) affected	0.230 sec

Query Completed

# Web Page Setup and Flow

- /: index.html - Home
  - Welcome page and login button
  - Methods: GET
- /login: login.html - Login page
  - Login fields and submit button
  - Methods: GET, POST
- /redirect: redirect.html
  - Redirects to the Actions Page
  - Methods: GET, POST
- /actions: actions.html
  - Contains the navigation bar (actions) and host selection drop down
  - Methods: GET, POST

# Web Page Setup and Flow

- /disk\_usage: disk\_usage.html
  - Displays output from the Disk Usage command
  - Methods: GET
- /processes: processes.html
  - Displays output from the Process Table command
  - Methods: GET
- /netstat\_i: netstat\_i.html
  - Displays output from the Network Interfaces command
  - Methods: GET
- /netstat\_r: netstat\_r.html
  - Displays output from the Network Routes command
  - Methods: GET

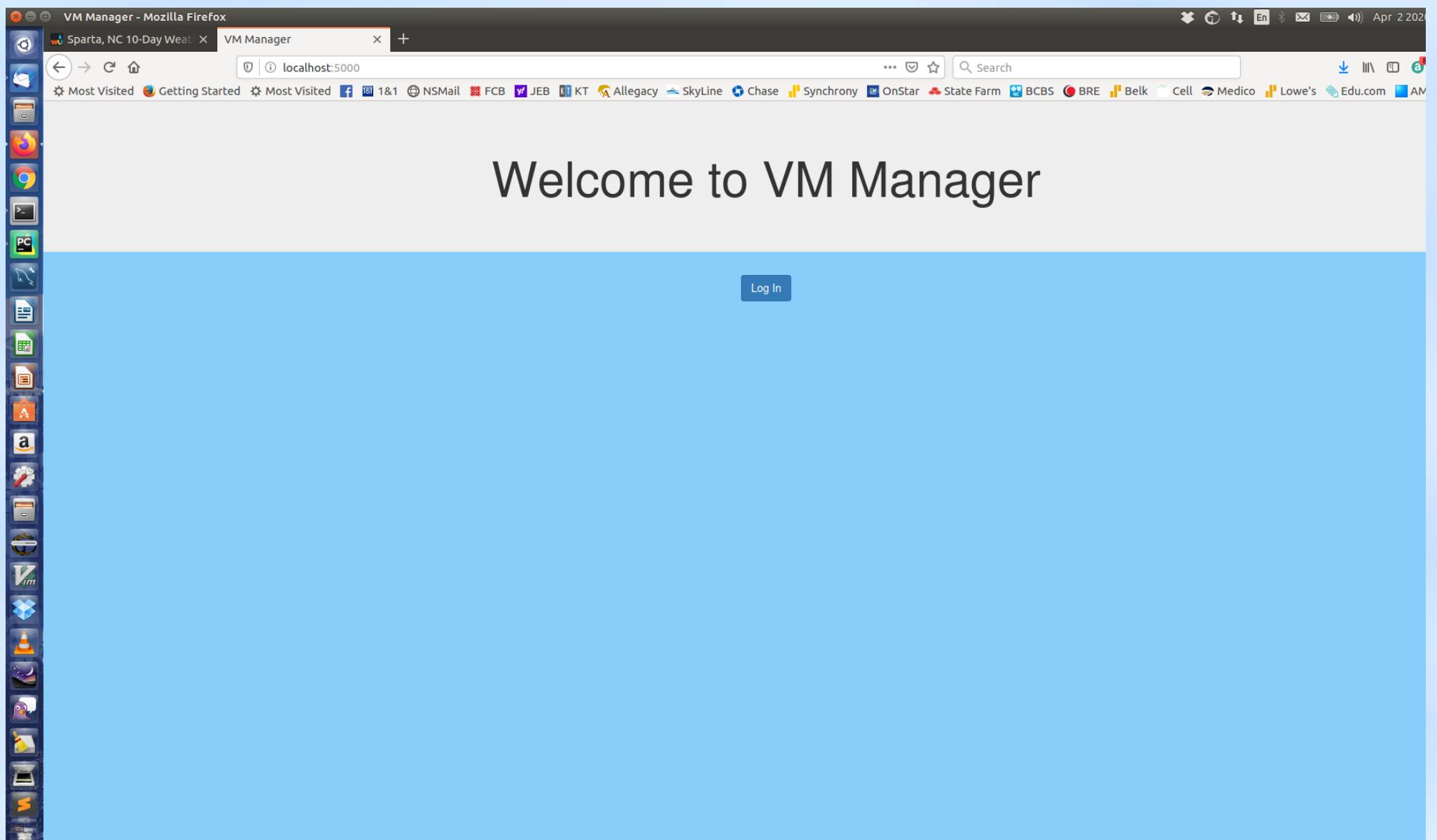
# Web Page Setup and Flow

- /ifconfig: ifconfig.html
  - Displays output from the Network Interface Configuration command
  - Methods: GET
- /passwd: passwd.html
  - Displays output from the Password File command
  - Methods: GET
- /about: about.html
  - Basic “Who done it?” page
- base.html
  - Contains CSS bootstrap and is extended by all other HTML files
- \_navbar.html
  - Defines the action menu for the Actions Page

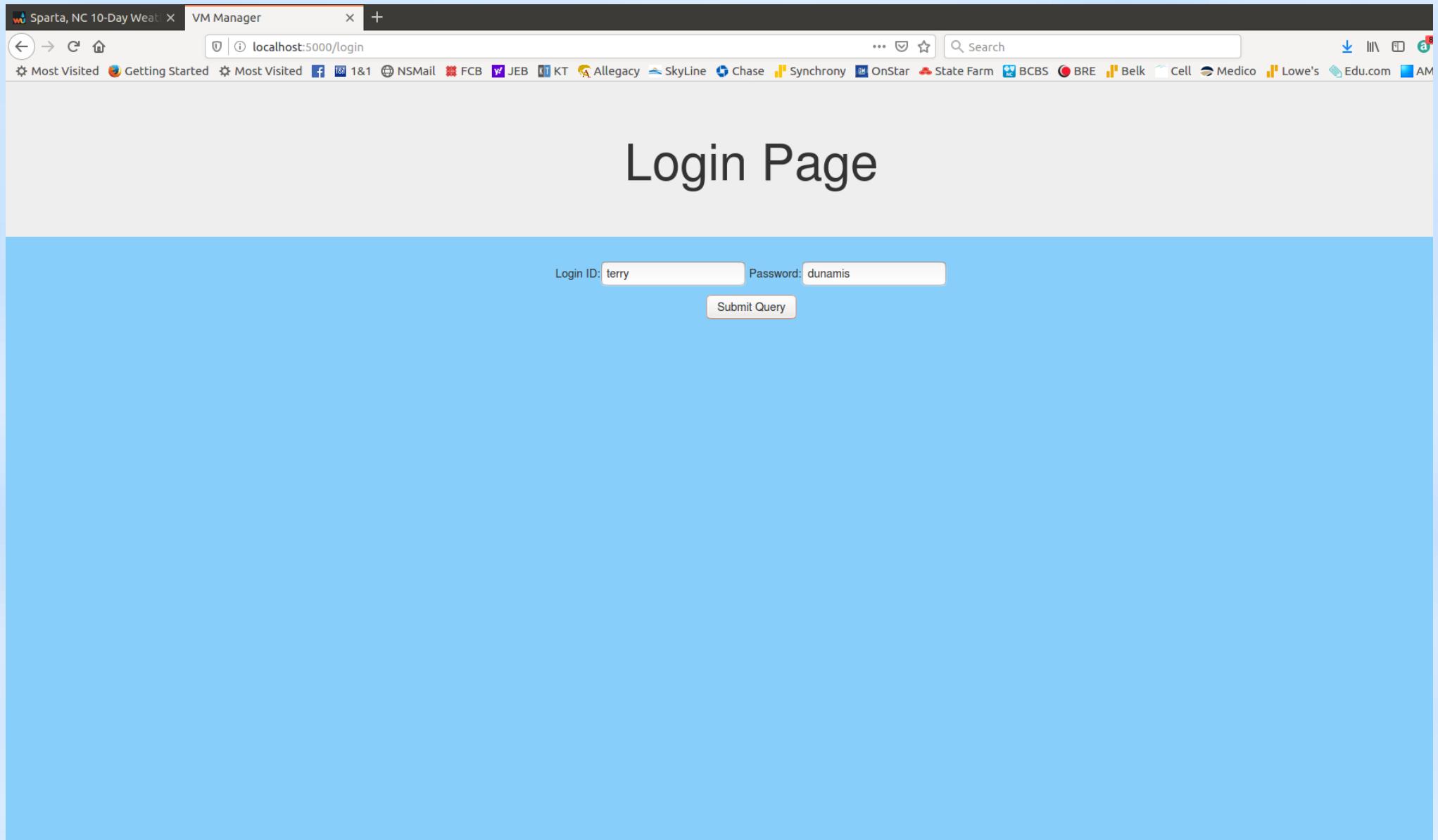
# Virtual Environment Setup

- This program was written using the IDE PyCharm.
- The virtual environment was completely configured by the IDE.
- I performed no actions or steps to set it up.
- All of the packages I installed go into this directory.

# Home Page



# Login Page



# Selecting Host from Drop Down

A screenshot of a Firefox browser window titled "VM Manager - Mozilla Firefox". The address bar shows "localhost:5000/login". The page content displays a form with a dropdown menu labeled "Luther" containing two options: "Luther" and "Calvin". The "Luther" option is highlighted with a red background. The "Submit Query" button is located to the right of the dropdown.

VM Manager - Mozilla Firefox

Sparta, NC 10-Day Weat X VM Manager +

localhost:5000/login

VM Manager Home Disk Usage Process Table Network Interfaces Network Routes Network Interface Configuration Password File About

Actions

Luther ▾

Luther  
Calvin

Submit Query

# Host is Selected

VM Manager - Mozilla Firefox

Sparta, NC 10-Day Weat X VM Manager +

localhost:5000/redirect

VM Manager Home Disk Usage Process Table Network Interfaces Network Routes Network Interface Configuration Password File About

Actions

Executing commands on Calvin...

Luther ▾ Submit Query

This screenshot captures a Linux desktop environment with a blue-themed interface. A central feature is a Firefox browser window titled "VM Manager" with the URL "localhost:5000/redirect". The browser's address bar also displays "Sparta, NC 10-Day Weat X". The main content area of the browser shows the word "Actions" in large letters, followed by the message "Executing commands on Calvin...". Below this message are two buttons: a dropdown menu labeled "Luther ▾" and a "Submit Query" button. To the left of the browser, a vertical dock contains icons for various applications, including Sparta, NSMail, FCB, JEB, Allegacy, SkyLine, Chase, Synchrony, OnStar, State Farm, BCBS, BRE, Belk, Cell, Medico, Lowe's, Edu.com, and AM. The desktop background is a light blue gradient.

# Disk Usage Output From Calvin

VM Manager - Mozilla Firefox

Sparta, NC 10-Day Weather | VM Manager | +

localhost:5000/disk\_usage

Search

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## Disk Usage

HOST: Calvin

Filesystem	Size	Used	Avail	Use%	Mounted on
udev	501M	0	501M	0%	/dev
tmpfs	105M	9.2M	95M	9%	/run
/dev/sdal	20G	5.5G	14G	29%	/
tmpfs	521M	148K	521M	1%	/dev/shm
tmpfs	5.3M	4.1k	5.3M	1%	/run/lock
tmpfs	521M	0	521M	0%	/sys/fs/cgroup
tmpfs	105M	46k	105M	1%	/run/user/1000

Back to Actions Page

A screenshot of a Linux desktop environment. The desktop has a light blue background. A vertical dock on the left contains icons for various applications like a terminal, file manager, and system tools. A horizontal dock at the bottom also has several icons. In the center, a Mozilla Firefox window is open, displaying a web page titled "Disk Usage". The page shows disk usage statistics for a host named "Calvin". The table includes rows for "/dev", "/run", the root partition, and several tmpfs entries. The desktop interface includes a top bar with system status icons and a date/time stamp.

# Disk Usage Output from Luther

VM Manager - Mozilla Firefox

Sparta, NC 10-Day Weather | VM Manager | +

localhost:5000/disk\_usage

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## Disk Usage

[Back to Actions Page](#)

```
HOST: Luther
Filesystem      Size  Used Avail Use% Mounted on
udev            501M    0   501M  0% /dev
tmpfs           105M   7.9M  97M  8% /run
/dev/sdal        20G  5.5G  14G  29% /
tmpfs            521M  144k  521M  1% /dev/shm
tmpfs             5.3M  4.1k  5.3M  1% /run/lock
tmpfs            521M    0   521M  0% /sys/fs/cgroup
tmpfs            105M   46k  105M  1% /run/user/1000
```

# Live Demo



# To Do

- The user interface is very plain and amateurish. Needs work.
- The drop down for picking a host probably should be placed in a different place or loaded in a different way.
- The password is not masked out when entering and it is stored as plain text in the database.
- This program would only work with Linux variants.

# To Do

- The list of actions should probably be loaded dynamically (from the database) dependent on the type of host selected.
- The list of actions are of some use but more need to be added such as, killing a process, shutting down or restarting a VM and others.
- The VM host should be added to the host drop down.
- Some of this functionality could be put into classes.