Creating a Web Portal for Approximate Query Processing

Master of Computing & Information Systems Capstone
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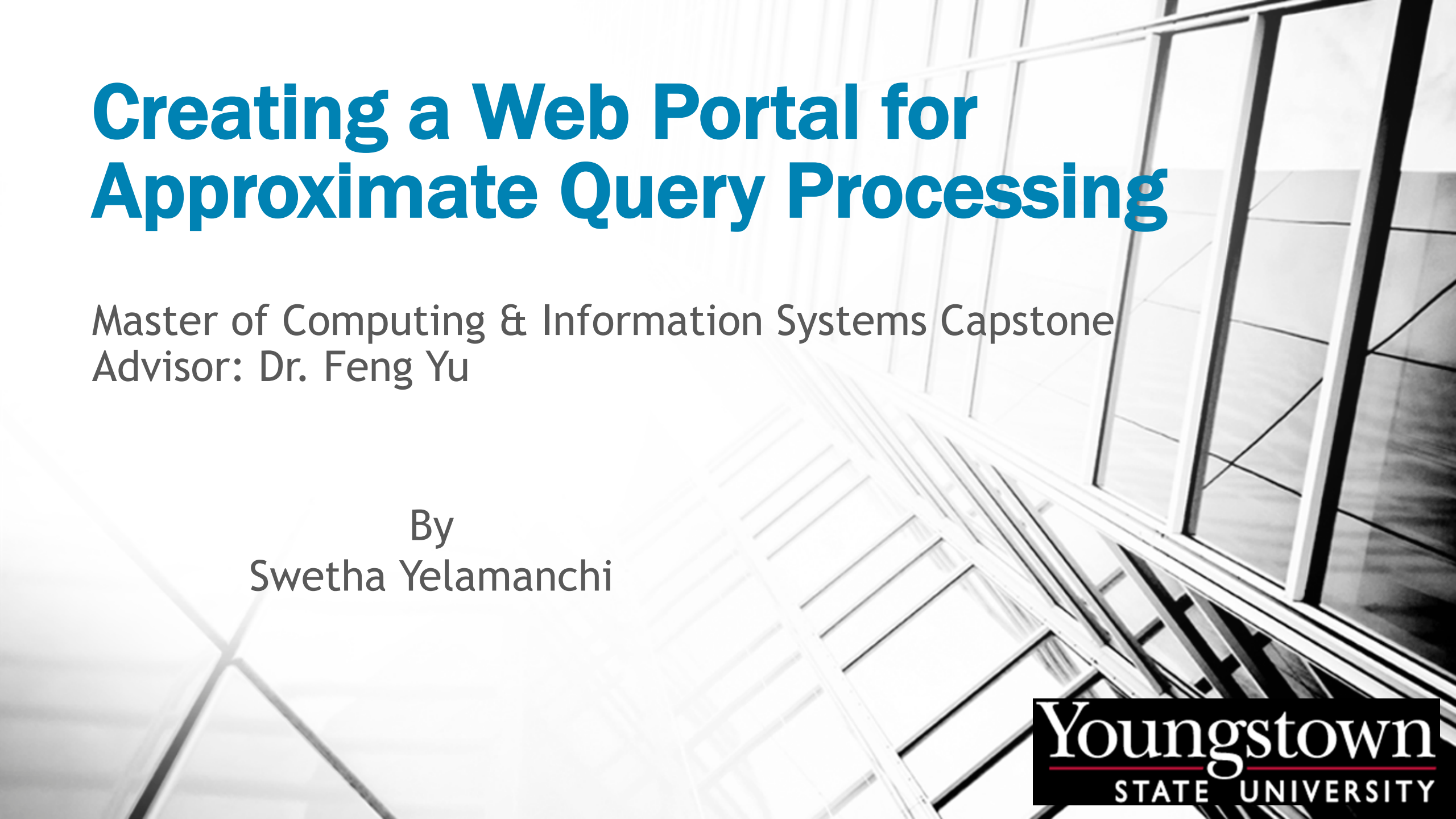


Agenda

1. Introduction
2. Literature review
3. Project Flow
4. Results and Analysis
5. Conclusion

Introduction

- A server-side web application was created using node.js express framework and embedded java script.
- The front-end web interface shows the text editor to submit a SQL query.
- Once submitted the application displays performance metrics and results of both Postgre and sample Postgre Databases.

Literature review

Node.js

- Node.js is a platform built on Chrome's JavaScript runtime for easily building fast and scalable network applications.
- Node.js uses an event-driven, non-blocking I/O model that makes it lightweight and efficient, perfect for data-intensive real-time applications that run across distributed devices.
- Node.js is an open source, cross-platform runtime environment for developing server-side and networking applications which are written in JavaScript.
- Node.js = Runtime Environment + JavaScript Library

Features of Node js

- **Asynchronous and Event Driven** - All APIs of Node.js library are asynchronous, that is, non-blocking
- **Very Fast** – Being built on Google Chrome's V8 JavaScript Engine, Node.js library is very fast in code execution

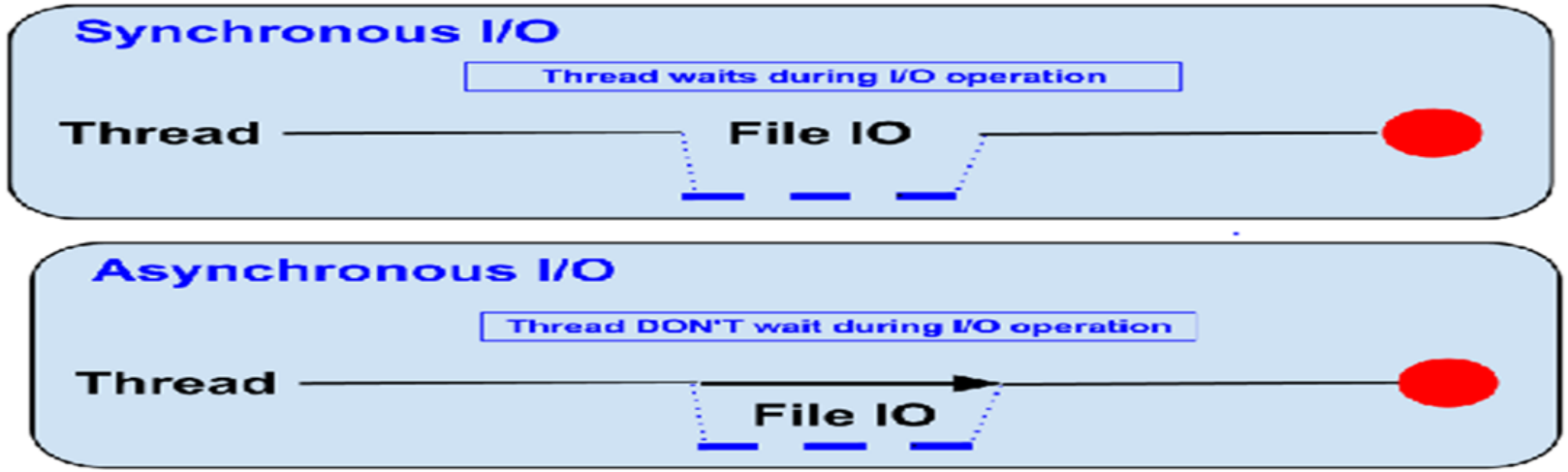


Fig 1: Asynchronous and Event Driven

Features contd…

- **No Buffering** – Node.js applications never buffer any data. These applications simply output the data in chunks
- **Single Threaded but Highly Scalable** – Node.js uses a single threaded model with event looping.

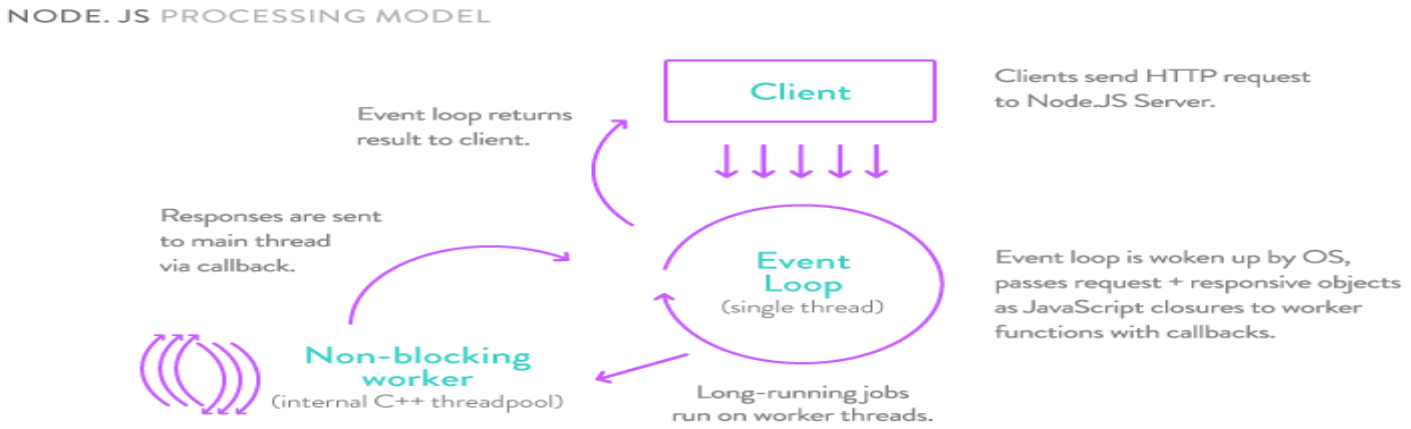


Fig 2: Single Threaded but Highly Scalable

Node.js - Express Framework

- Express is a minimal and flexible Node.js web application framework that provides a robust set of features to develop web and mobile applications. It facilitates the rapid development of Node based Web applications.
- Allows to set up middlewares to respond to HTTP Requests.

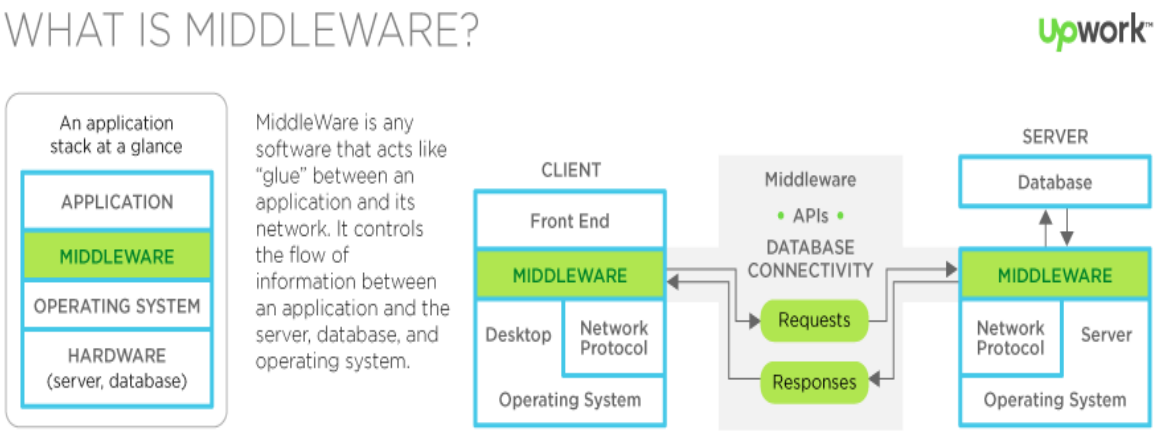


Fig 3: Middleware

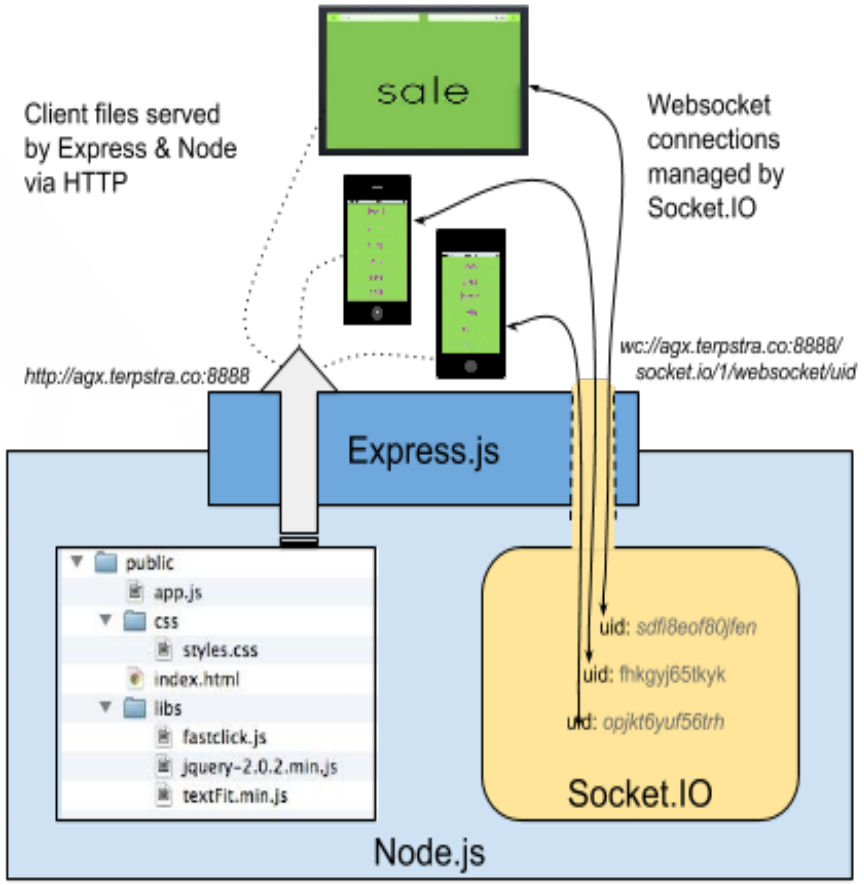


Fig 4: Node.js - Express Framework

NPM (Node Package Manager):

- NPM is a package manager for Node.js packages, or modules if you like.
- www.npmjs.com hosts thousands of free packages to download and use.
- The NPM program is installed on your computer when you install Node.js
- It installs the packages you want to use and provides a useful interface to work with them.

Fig 5: Node package Manager

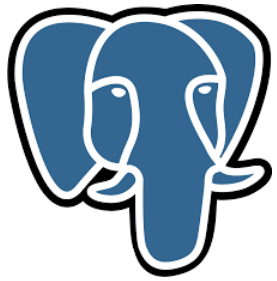
.EJS Files:

- EJS (Embedded JavaScript) is essentially HTML with JavaScript-based features embedded for templating.
- EJS is a JavaScript templating library commonly used for building html strings from JSON data.

Fig 6: .EJS Files

Bootstrap:

- Bootstrap is a free front-end framework for faster and easier web development
- Bootstrap includes HTML and CSS based design templates for typography, forms, buttons, tables, navigation, modals, image carousels and many other, as well as optional JavaScript plugins
- Bootstrap also gives you the ability to easily create responsive designs.
- Responsive web design is about creating web sites which automatically adjust themselves to look good on all devices, from small phones to large desktops.



PostgreSQL

- PostgreSQL is a powerful, open source object-oriented relational database system that uses and extends the SQL language combined with many features that safely store and scale the most complicated data workloads

Similar works

- HyPer – A Hybrid OLTP&OLAP High Performance DBMS
- HyPer is a main-memory-based relational DBMS for mixed workloads.
- It is a so-called all-in-one New-SQL database system that entirely deviates from classical disk-based DBMS architectures by introducing many innovative ideas including machine code generation for data-centric query processing and multi-version concurrency control, leading to exceptional performance.

A Hybrid OLTP&OLAP High Performance DBMS

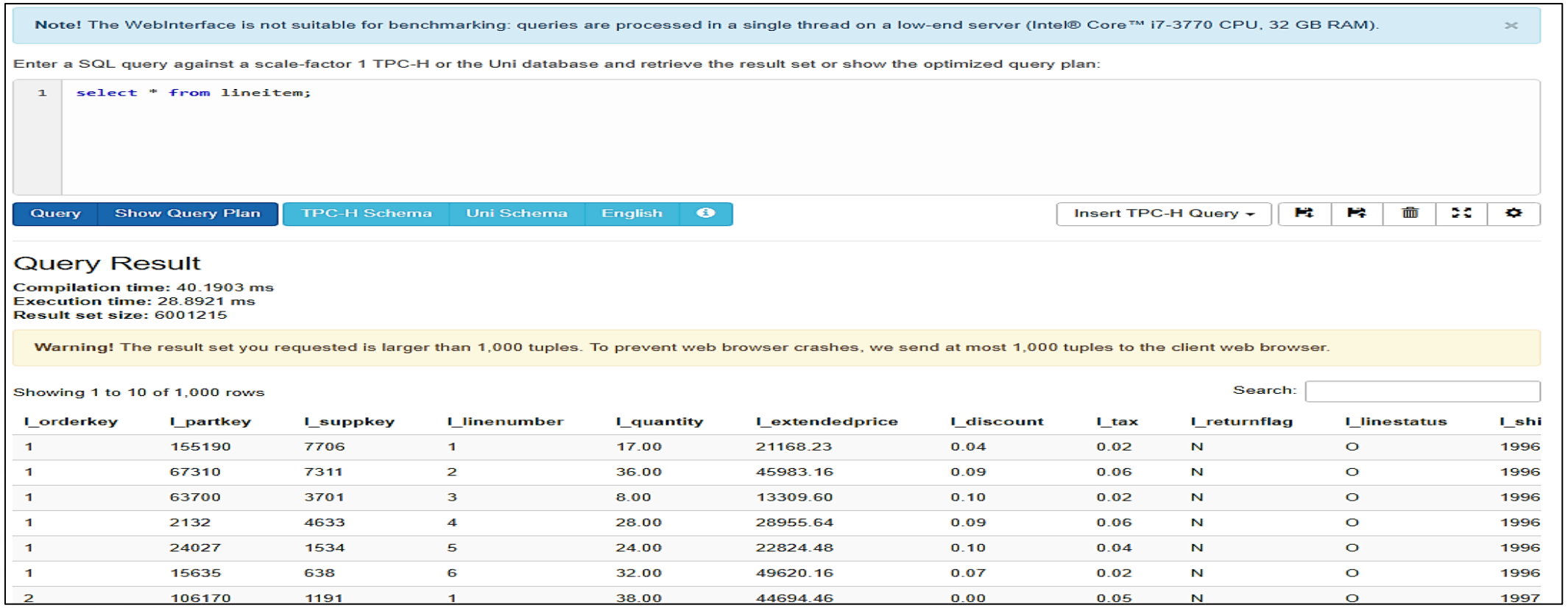


Fig 7 : Hyper web interface

Project idea

- The main idea of the project is to display the results of Correlated Sample Synopsis (CS2) produced sample dataset(s_tpch1g) by taking less planning and execution time compared to the original dataset(tpch1g).
- The front-end web interface shows the text editor to submit a SQL query.
- Once submitted the application displays performance metrics and results of both Postgre and sample Postgre Databases.
- The results are viewed directly on the web page.

Project Flow

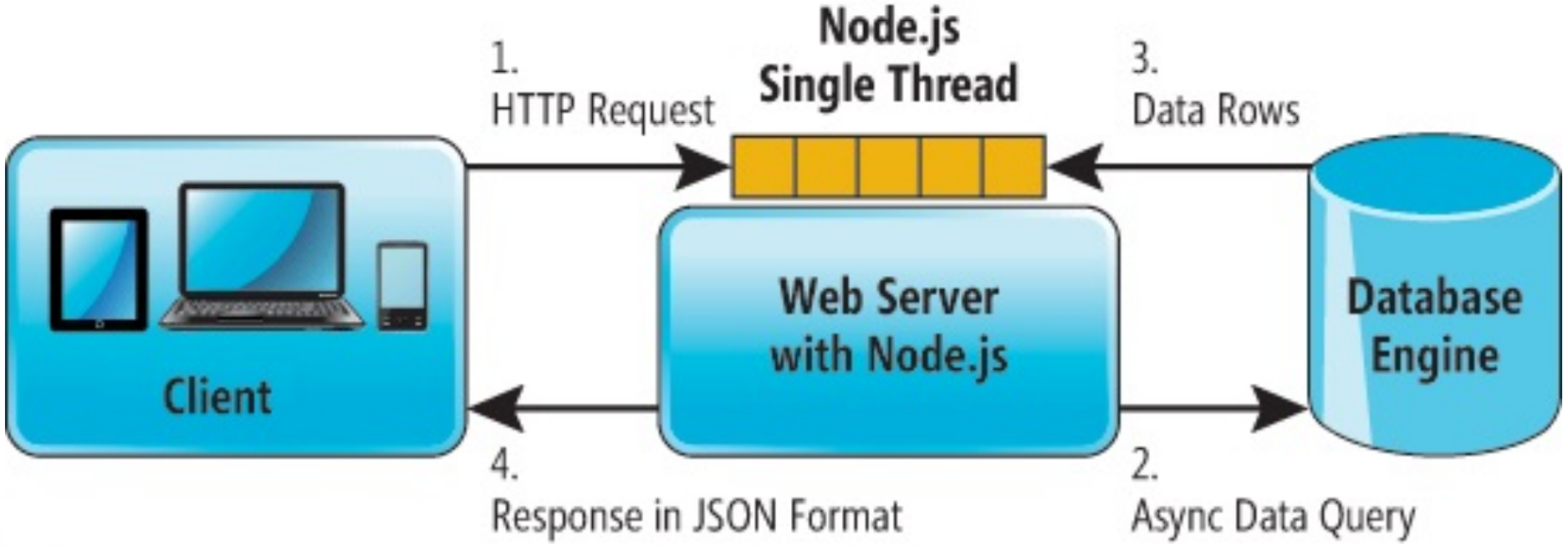


Fig 8 : General process flow

Project Flow Diagram

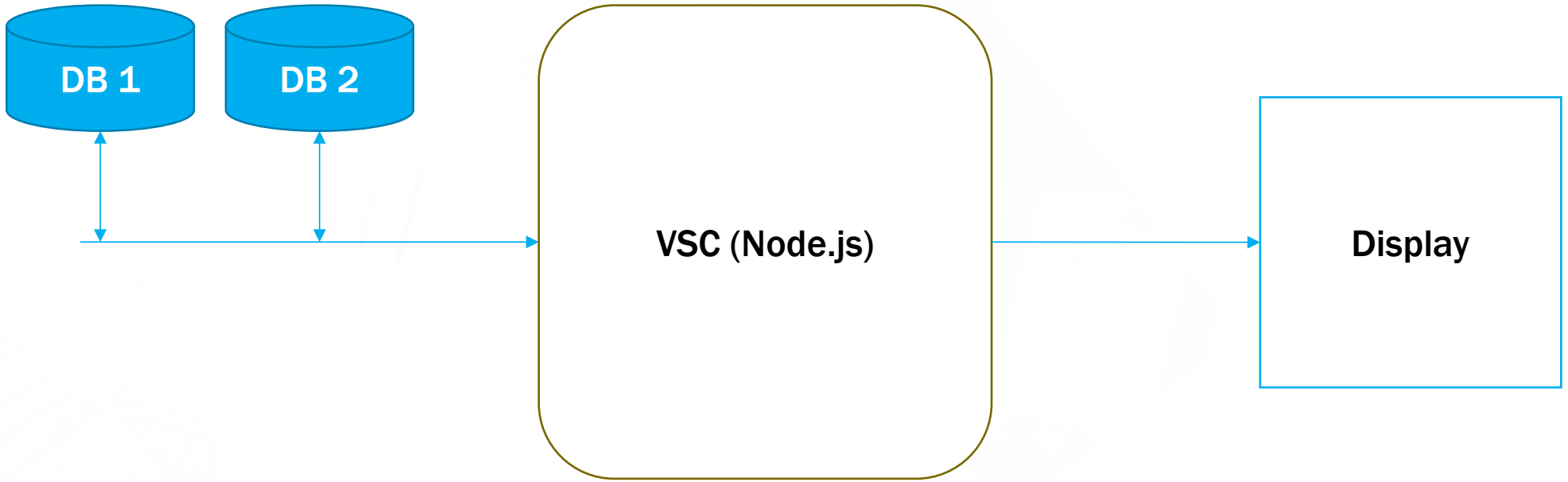


Fig 9 : Actual project flow

Selection of Data Sets

- Transaction Protocol Council Benchmark H (TPC-H)
- Correlated Sample Synopsis (CS2)

Transaction Protocol Council Benchmark H (TPC-H)

- The TPC Benchmark™H (TPC-H) is a decision support benchmark.
- It consists of a suite of business-oriented ad-hoc queries and concurrent data modifications.
- The queries and the data populating the database have been chosen to have broad industry-wide relevance.
- This benchmark illustrates decision support systems that examine large volumes of data, execute queries with a high degree of complexity, and give answers to critical business questions.

- 1 GB TPC-H dataset used (tpch1g)

```
postgres=# \d+
No relations found.
postgres=# \c tpch1g
You are now connected to database "tpch1g" as user "postgres".
tpch1g=# \d+
                    List of relations
 Schema |   Name   | Type  |  Owner   |    Size    | Description
--------+----------+-------+----------+------------+-------------
 public | customer | table | postgres | 28 MB      |
 public | lineitem | table | postgres | 903 MB     |
 public | nation   | table | postgres | 8192 bytes |
 public | orders   | table | postgres | 209 MB     |
 public | part     | table | postgres | 32 MB      |
 public | partsupp | table | postgres | 136 MB     |
 public | region   | table | postgres | 8192 bytes |
(7 rows)
```

Fig 10: Transaction Protocol Council Benchmark H (TPC-H)

Correlated Sample Synopsis (CS2)

- Correlated Sampling aims to gather a sample of joinable sample tuples from joinable relations in the database to form a synopsis.
- Consists of correlated sample tuples that retain join relationships with less storage.
- A statistical technique, called reverse sample, and design a powerful estimator, called reverse estimator, was used to fully utilize correlated sample tuples for query estimation.
- s_tpch1g dataset produced from the 1 GB TPC-H dataset using CS2

```
postgres=# \c s_tpch1g
You are now connected to database "s_tpch1g" as user "postgres".
s_tpch1g=# \d+
                                List of relations
 Schema |   Name   | Type  |  Owner   |    Size    | Description
--------+----------+-------+----------+------------+-------------
 public | customer | table | postgres | 8584 kB    |
 public | lineitem | table | postgres | 9336 kB    |
 public | nation   | table | postgres | 8192 bytes |
 public | orders   | table | postgres | 8504 kB    |
 public | part     | table | postgres | 8536 kB    |
 public | partsupp | table | postgres | 10176 kB   |
 public | region   | table | postgres | 8192 bytes |
 public | supplier | table | postgres | 1808 kB    |
(8 rows)
```

Fig 11: Correlated Sample Synopsis (CS2)

Node js coding in Visual studio code (VSC)

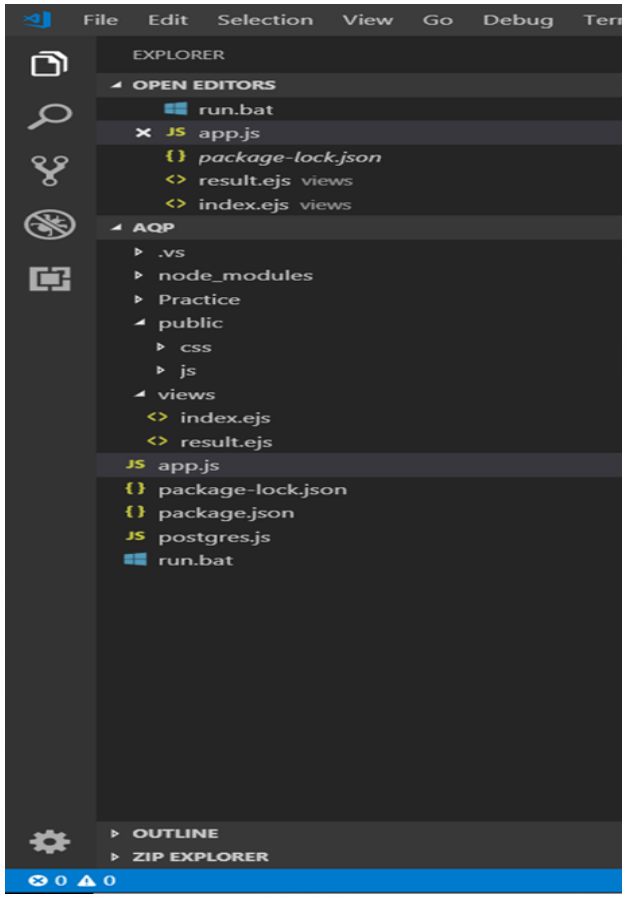


Fig 12: Modules

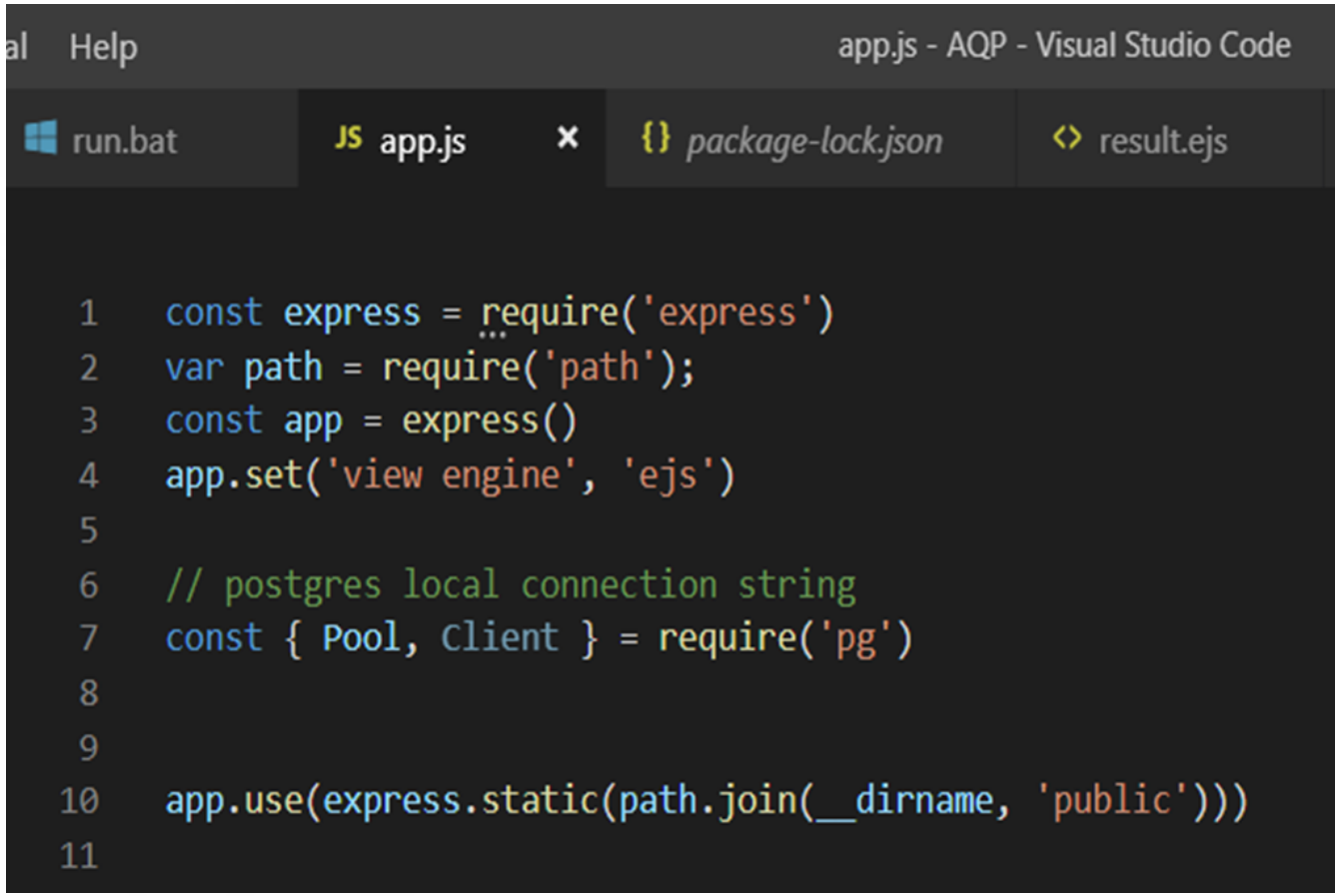


Fig 13: Required packages for app.js

Connection string to postgre databases in VSC

```
pool = new Pool({
    user: 'postgres',
    host: '10.70.0.141',
    database: 'tpch1g',
    password: [redacted]
    port: 5432,
})

GetPostgreStats(query);
GetPostgresResult(query);

samplePool = new Pool({
    user: 'postgres',
    host: '10.70.0.141',
    database: 's_tpch1g',
    password: [redacted]
    port: 5432,
})

GetSamplePostgreStats(query);
GetSamplePostgresResult(query);
```

Fig 14: Connection strings and functions

Display

```
function GetPostgresResult(query)
{
        pool.query(query, (err, res) => {
            if (!err) {
                rowsCount = res.rows.length;
                tableData= res.rows;
                pool.end()
                resultCount ++;
                console.log(resultCount)
            }
            else{
                queryerror = true;
                resultCount ++;
            }
        })

}
```

Fig 15: Function to get result

```
function GetPostgreStats(query)
{
        pool.query('EXPLAIN ANALYZE ' + query , (err, res) => {
            if (!err)
            {
                planningTime = '--';
                executionTime = '--';
                res.rows.forEach(element => {

                    if(element["QUERY PLAN"].includes('Aggregate'))
                        planningTime = element["QUERY PLAN"];

                    if(element["QUERY PLAN"].includes('Total runtime'))
                        executionTime = element["QUERY PLAN"];
                    });
                    resultCount ++;
                    console.log(resultCount)
                }
```

Fig 16: Function to get stats

Display

- Index .ejs: Displays initialize page of webserver without result
- Result.ejs: Displays web page with both performance metrics and results of postgre databases.

```
<html>
<head>
    <title></title>
    <script src="/js/modernizr-2.8.3.js"></script>
    <script src="/js/jquery-3.3.1.js"></script>
    <script src="/js/bootstrap.js"></script>
    <script src="/js/codemirror.js"></script>
    <script src="/js/placeholder.js"></script>
    <script src="https://cdn.datatables.net/1.10.19/js/jquery.dataTables.min.js"></script>
    <link href="/css/codemirror.css" rel="stylesheet" />
    <link href="/css/bootstrap.css" rel="stylesheet"/>
    <link href="/css/site.css" rel="stylesheet"/>
    <link href="https://cdn.datatables.net/1.10.19/css/jquery.dataTables.min.css" rel="stylesheet"/>
</head>
```

Fig 17: Bootstrap plugins

Results and Analysis

```
app.listen(3000, function () {
  console.log('Example app listening on port 3000!')
})
```

Fig 18: Http connection port

```
PS C:\Users\yelam\Desktop\AQP\AQP (5)\AQP> node .\app.js
Example app listening on port 3000!
express deprecated req.param(name): Use req.params, req.body, or req.query instead app.js:22:21
PS C:\Users\yelam\Desktop\AQP\AQP (5)\AQP> node .\app.js
Example app listening on port 3000!
express deprecated req.param(name): Use req.params, req.body, or req.query instead app.js:22:21
```

Fig 19: Node terminal output

Results and Analysis

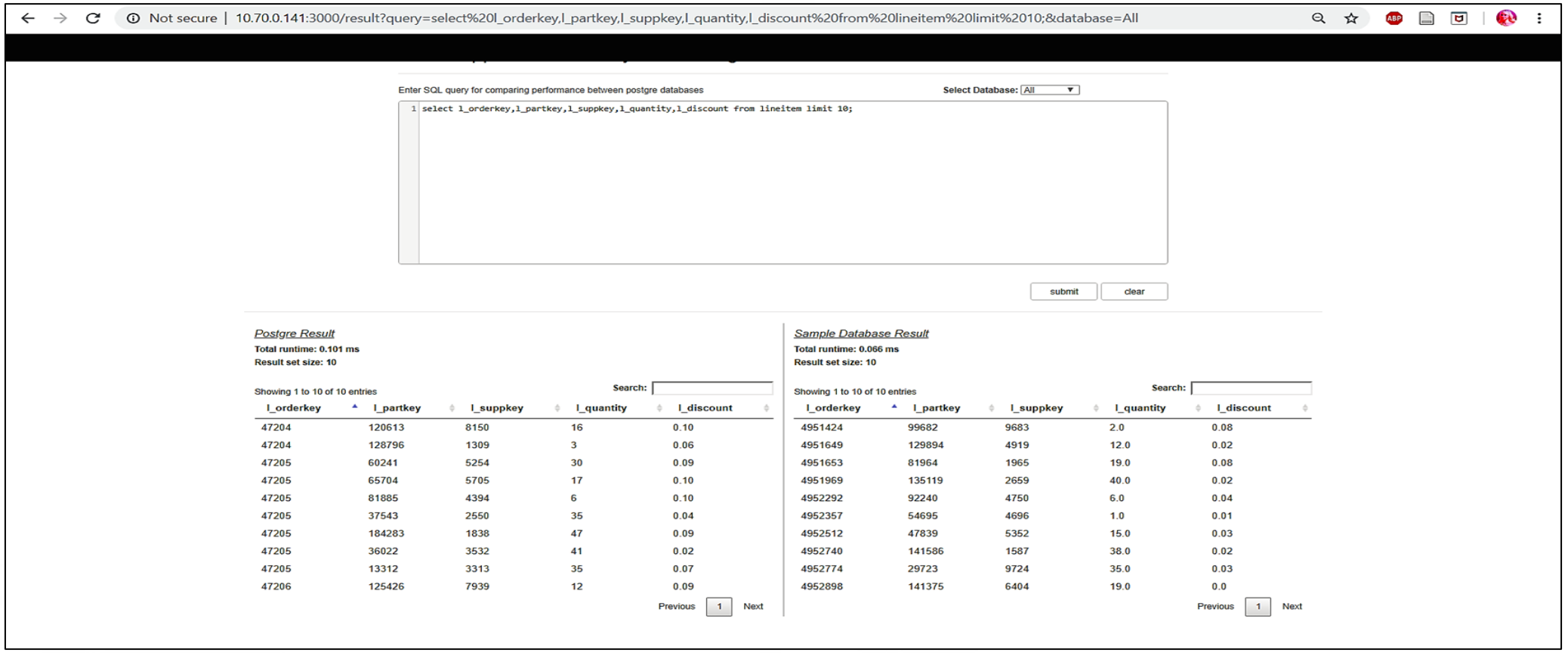


Fig 20: Web page display

Conclusion

- Multiple tools and plugins were used in coding for the web server page.
- TPC-H and CS2 Postgre SQL databases were used in connection string of the application.
- The application is deployed into postgre server
- The web server page obtained through the project display the front-end results of both sample dataset(s_tpch1g) and original tpch1g database.
- The sample dataset(s_tpch1g) takes less planning and execution time compared to the original dataset(tpch1g) by submitting the same SQL query in the text editor.

Acknowledgements

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