Node-Postgres

RDBMSs, Database Drivers, and Persistent Applications

Database Management System (DBMS)

- How to define records (Data Definition)
- CRUD (Create / Read / Update / Delete)
- Performant (B-Trees, etc.)
- Administration
- In short: handle the file system intelligently, without re-inventing the wheel for every project.

Progression of Databases

- **Navigational (< 1970s)**
  - More common during tape era; entries had references to next entries.
- **Relational (> 1970s)**
  - Based on relational (table-based) logic, see E.F. Codd.
- **NoSQL (> 2000s)**
  - "Not only SQL" — document storage, for example.

Some well-known rDBMSs


PostgreSQL

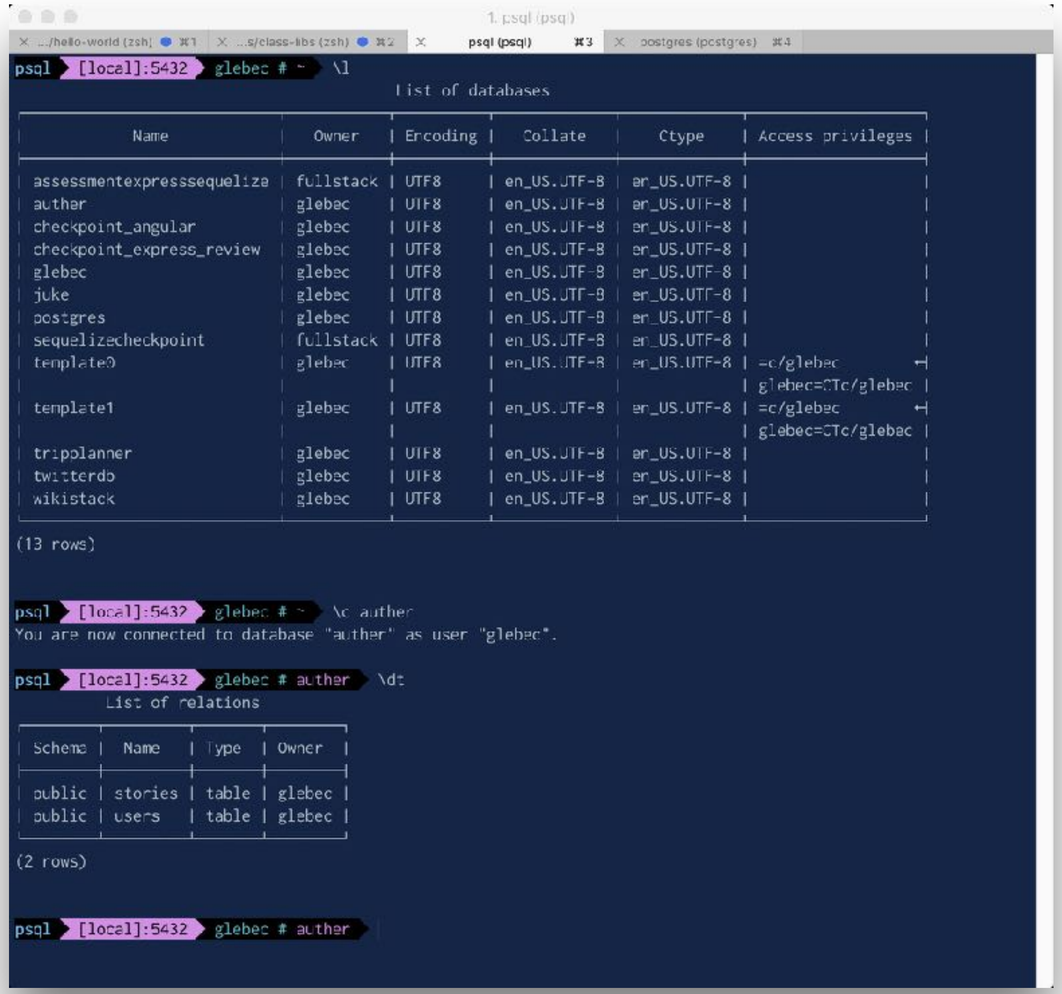
Why PostgreSQL?

- Advanced, powerful, and popular
- Rapid open source development
- Highly extensible (stored procedures)
- Deep SQL standards compliance
- NoSQL ("Not Only SQL"), objective support
- Excellent transactions / ACID reliability; focus on integrity
- Remote (SQLite is embedded)
- Multi-user management / administration

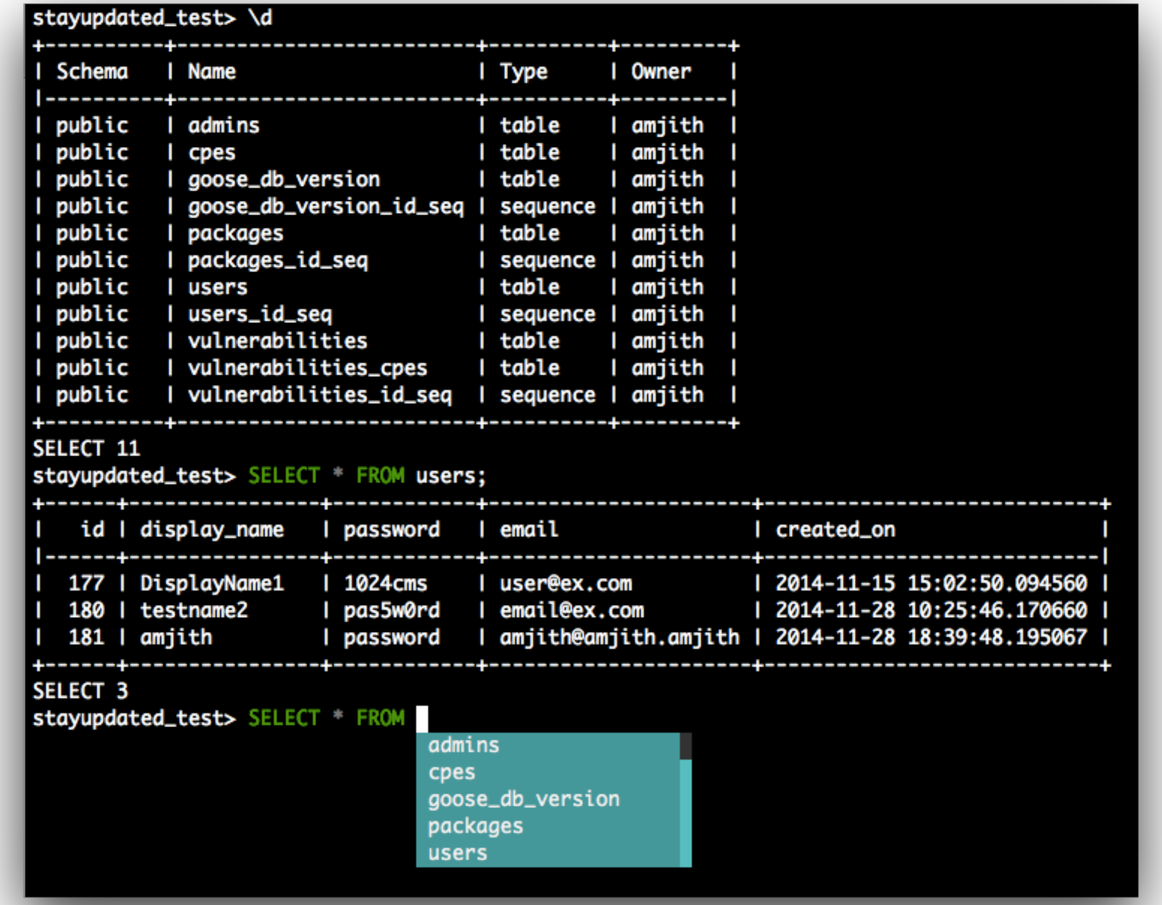
History of PostgreSQL

- 1970s at UC Berkley:
  INteractive **G**raphics **RE**trieval **S**ystem (INGRES)
- 1980s: POSTGRES ("Post-Ingres")
- 1995: POSTQUEL and Postgres95.
  - `monitor -> psql`
- 1996: Adopted by the open source community
  - Ongoing: stability, testing, documentation, new features
  - PostgreSQL

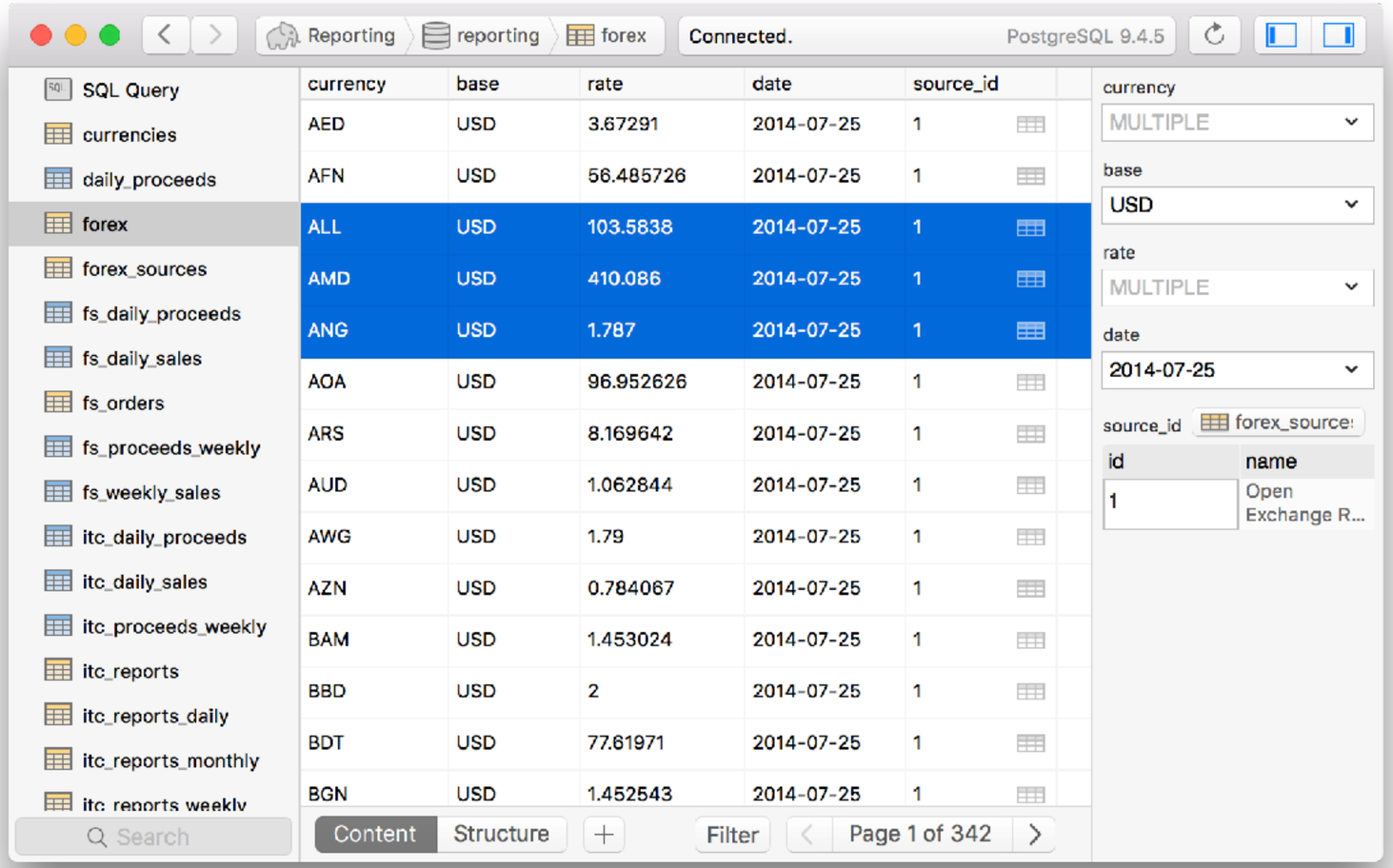
psql


1. psql (psql)
.../hello-world (zsh) ⌘1
...s/class-libs (zsh) ⌘2
psql (psql) ⌘3
postgres (postgres) ⌘4
psql [local]:5432 glebec # ~ \l
List of databases
Name | Owner | Encoding | Collate | Ctype | Access privileges
assessmentexpresssequelize | fullstack | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
auther | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
checkpoint_angular | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
checkpoint_express_review | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
glebec | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
juke | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
postgres | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
sequelizecheckpoint | fullstack | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
template0 | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 | =c/glebec
glebec=CTc/glebec
template1 | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 | =c/glebec
glebec=CTc/glebec
tripplanner | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
twitterdb | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
wikistack | glebec | UTF8 | en_US.UTF-8 | en_US.UTF-8 |
(13 rows)
psql [local]:5432 glebec # ~ \c auther
You are now connected to database "auther" as user "glebec".
psql [local]:5432 glebec # auther \dt
List of relations
Schema | Name | Type | Owner
public | stories | table | glebec
public | users | table | glebec
(2 rows)
psql [local]:5432 glebec # auther

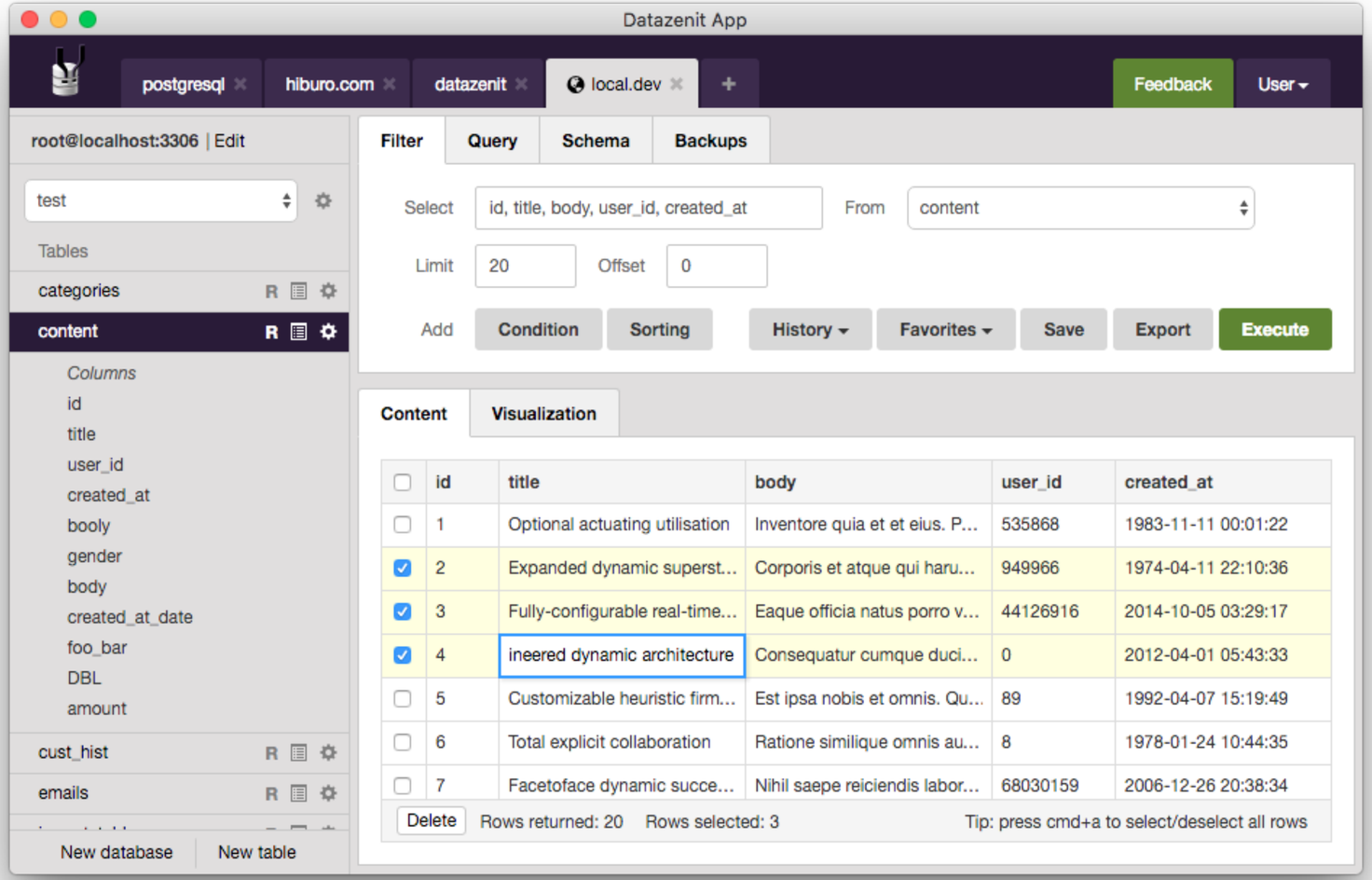
pgcli

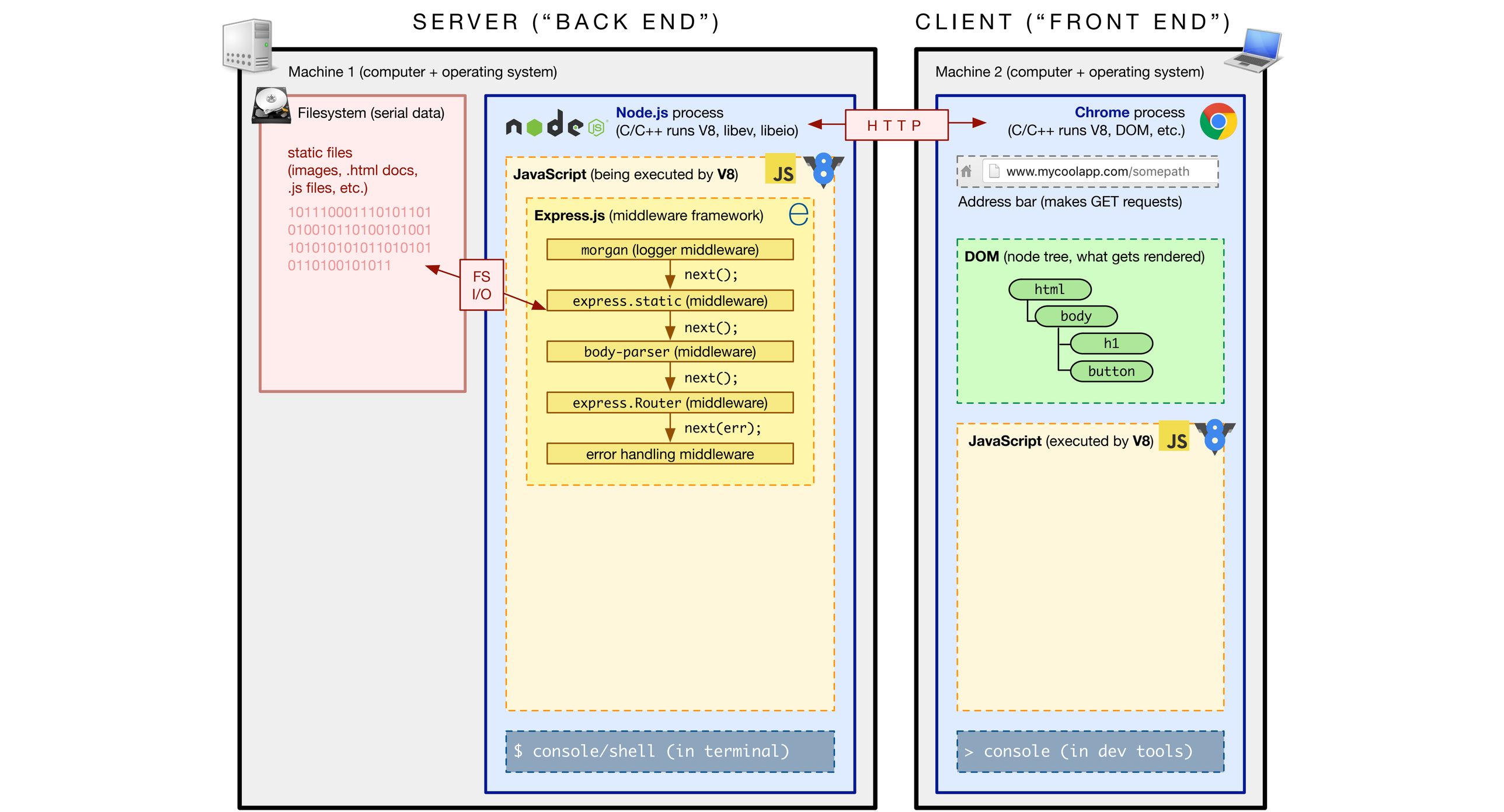

stayupdated_test> \d
Schema	Name	Type	Owner
public	admins	table	amjith
public	cpes	table	amjith
public	goose_db_version	table	amjith
public	goose_db_version_id_seq	sequence	amjith
public	packages	table	amjith
public	packages_id_seq	sequence	amjith
public	users	table	amjith
public	users_id_seq	sequence	amjith
public	vulnerabilities	table	amjith
public	vulnerabilities_cpes	table	amjith
public	vulnerabilities_id_seq	sequence	amjith
SELECT 11
stayupdated_test> SELECT * FROM users;
id	display_name	password	email	created_on
177	DisplayName1	1024cms	user@ex.com	2014-11-15 15:02:50.094560
180	testname2	pas5w0rd	email@ex.com	2014-11-28 10:25:46.170660
181	amjith	password	amjith@amjith.amjith	2014-11-28 18:39:48.195067
SELECT 3
stayupdated_test> SELECT * FROM
admins
cpes
goose_db_version
packages
users

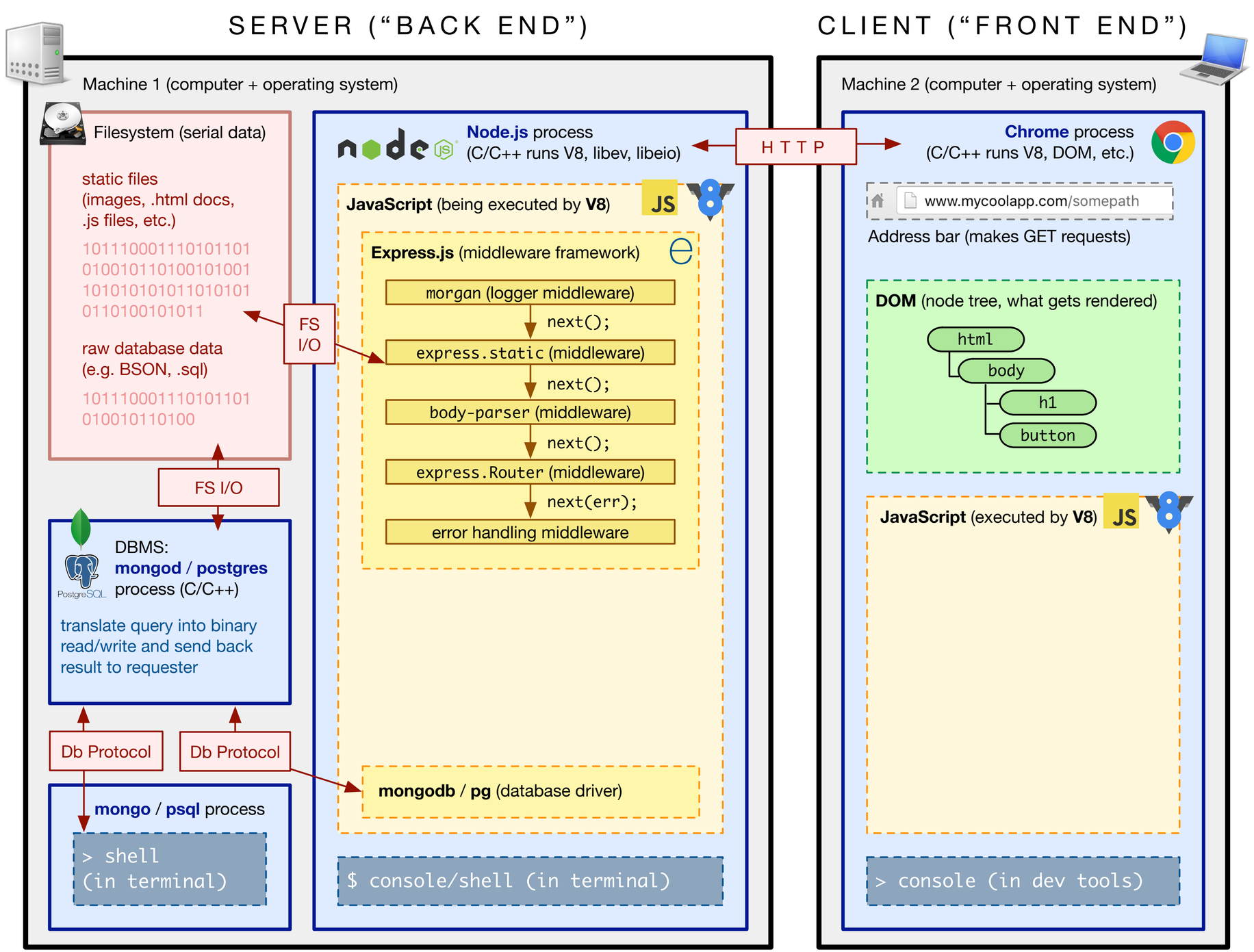
Postico


Reporting
reporting
forex
Connected.
PostgreSQL 9.4.5
SQL Query
currencies
daily_proceeds
forex
forex_sources
fs_daily_proceeds
fs_daily_sales
fs_orders
fs_proceeds_weekly
fs_weekly_sales
itc_daily_proceeds
itc_daily_sales
itc_proceeds_weekly
itc_reports
itc_reports_daily
itc_reports_monthly
itc_reports_weekly
Search
currency | base | rate | date | source_id
AED | USD | 3.67291 | 2014-07-25 | 1
AFN | USD | 56.485726 | 2014-07-25 | 1
ALL | USD | 103.5838 | 2014-07-25 | 1
AMD | USD | 410.086 | 2014-07-25 | 1
ANG | USD | 1.787 | 2014-07-25 | 1
AOA | USD | 96.952626 | 2014-07-25 | 1
ARS | USD | 8.169642 | 2014-07-25 | 1
AUD | USD | 1.062844 | 2014-07-25 | 1
AWG | USD | 1.79 | 2014-07-25 | 1
AZN | USD | 0.784067 | 2014-07-25 | 1
BAM | USD | 1.453024 | 2014-07-25 | 1
BBD | USD | 2 | 2014-07-25 | 1
BDT | USD | 77.61971 | 2014-07-25 | 1
BGN | USD | 1.452543 | 2014-07-25 | 1
Content
Structure
Filter
Page 1 of 342
currency
MULTIPLE
base
USD
rate
MULTIPLE
date
2014-07-25
source_id
forex_source
id
name
1
Open Exchange R...

Datazenit


Datazenit App
postgresql
hiburo.com
datazenit
local.dev
Feedback
User
root@localhost:3306 | Edit
test
Tables
categories
content
Columns
id
title
user_id
created_at
booly
gender
body
created_at_date
foo_bar
DBL
amount
cust_hist
emails
New database
New table
Filter
Query
Schema
Backups
Select
id, title, body, user_id, created_at
From
content
Limit
20
Offset
0
Add
Condition
Sorting
History
Favorites
Save
Export
Execute
Content
Visualization
id
title
body
user_id
created_at
1
Optional actuating utilisation
Inventore quia et et eius. P...
535868
1983-11-11 00:01:22
2
Expanded dynamic superst...
Corporis et atque qui haru...
949966
1974-04-11 22:10:36
3
Fully-configurable real-time...
Eaque officia natus porro v...
44126916
2014-10-05 03:29:17
4
ineered dynamic architecture
Consequatur cumque duci...
0
2012-04-01 05:43:33
5
Customizable heuristic firm...
Est ipsa nobis et omnis. Qu...
89
1992-04-07 15:19:49
6
Total explicit collaboration
Ratione similique omnis au...
8
1978-01-24 10:44:35
7
Facetoface dynamic succe...
Nihil saepe reiciendis labor...
68030159
2006-12-26 20:38:34
Delete
Rows returned: 20
Rows selected: 3
Tip: press cmd+a to select/deselect all rows


SERVER ("BACK END")
CLIENT ("FRONT END")
Machine 1 (computer + operating system)
Machine 2 (computer + operating system)
Filesystem (serial data)
static files
(images, .html docs,
.js files, etc.)
10111000111010110101001010011010010101010110101010110100101011
FS
I/O
Node.js process
(C/C++ runs V8, libev, libeio)
HTTP
Chrome process
(C/C++ runs V8, DOM, etc.)
JavaScript (being executed by V8)
JS
Express.js (middleware framework)
morgan (logger middleware)
next();
express.static (middleware)
next();
body-parser (middleware)
next();
express.Router (middleware)
next(err);
error handling middleware
www.mycoolapp.com/somepath
Address bar (makes GET requests)
DOM (node tree, what gets rendered)
html
body
h1
button
JavaScript (executed by V8)
JS
$ console/shell (in terminal)
> console (in dev tools)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raw database data
(e.g. BSON, .sql)
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010010110100
FS I/O
FS I/O
DBMS:
mongod / postgres
process (C/C++)
PostgreSQL
translate query into binary
read/write and send back
result to requester
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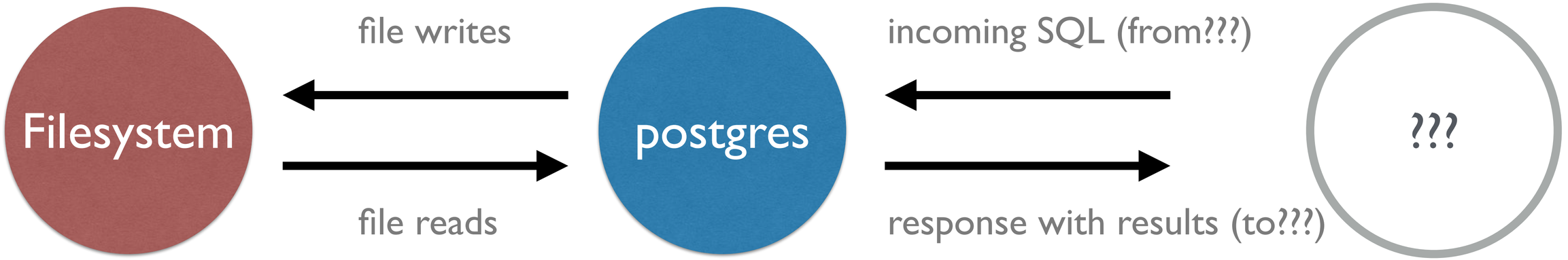
postgres process



- The rDBMS itself; a *daemon* (background process)
- Waits for incoming SQL
- Knows how to read/write to disk in a performant way
- Sends back results

Where does the "incoming SQL" come from?

Query Sources ("Clients")

- **psql CLI**
  - human input as text
- **GUI like Postico, Datazenit**
  - human actions turned into SQL queries
- **…and other applications**
  - "somehow" communicate with the postgres process

How to transmit SQL text to app?
How can postgres be "waiting for SQL"?
And how do the results get "sent back"?

Postgres is a TCP server!

- Listening on a TCP port (5432 by default) for *requests*
- Does disk access
- Sends back a TCP *response* to the *client* that made the requests

OK, Postgres is a TCP server.
Is it... HTTP?

Postgres uses the postgres:// protocol

	Transport Protocol	Message Protocol	Content Type
Node + Express	TCP/IP	http://	Anything: HTML, JSON, XML, TXT, etc.
Postgres	TCP/IP	postgres://	SQL

For HTTP clients, the TCP/IP was handled for you by the browser or Node. How can our JS app communicate with the postgres server?

“Let's implement the postgres protocol in JavaScript ourselves!”

– AMBITIOUS MCOVERKILL

https://www.postgresql.org/docs/current/static/protocol.html

“On second thought…
has anyone done this for us?”

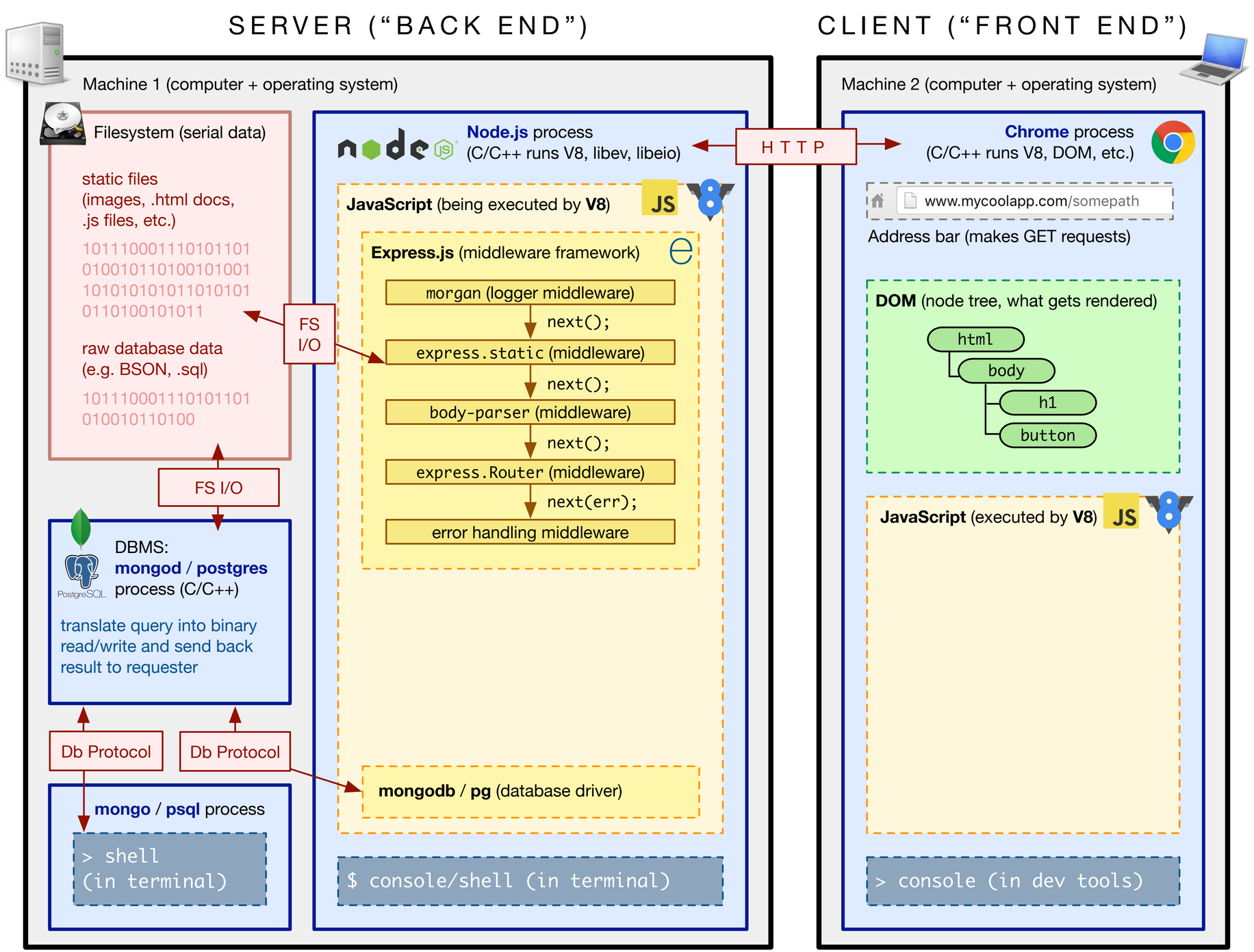
– SANEY MCREASONABLE

Node-postgres

- **npm library:** `npm install pg --save`
- *database driver*
- implements the postgres protocol in a Node module (JS!)
- Gives us a `client` object that we can pass SQL to
- Asynchronously talks via postgres protocol / TCP to postgres
- gives us a callback with `rows` array of resulting table

Example

```
client.query('SELECT * FROM users', function (err, data) {
  if (err) return console.error(err);
  data.rows.forEach(function (rowObject) {
    console.log(rowObject); // { name: 'Claire' }
  });
});
```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Final note: `returning`

- SQL comes in slightly different "dialects" depending on your RDBMS of choice (SQLite, MySQL, PostgreSQL etc.)
- PostgreSQL has a very convenient keyword `returning`
- Used during INSERT, UPDATE
- Returns the row(s) inserted/updated
- May come in handy during workshop, so check it out!