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

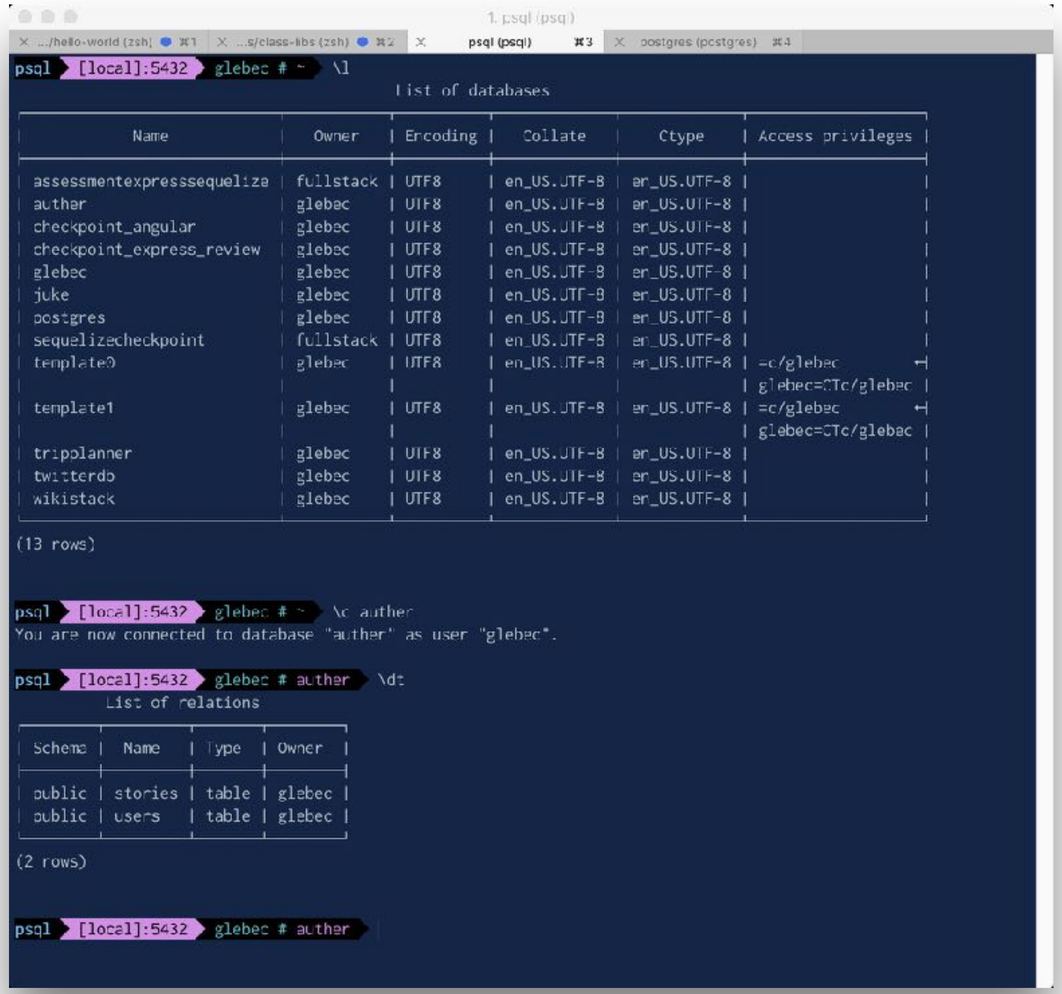
MySQL®

PostgreSQL

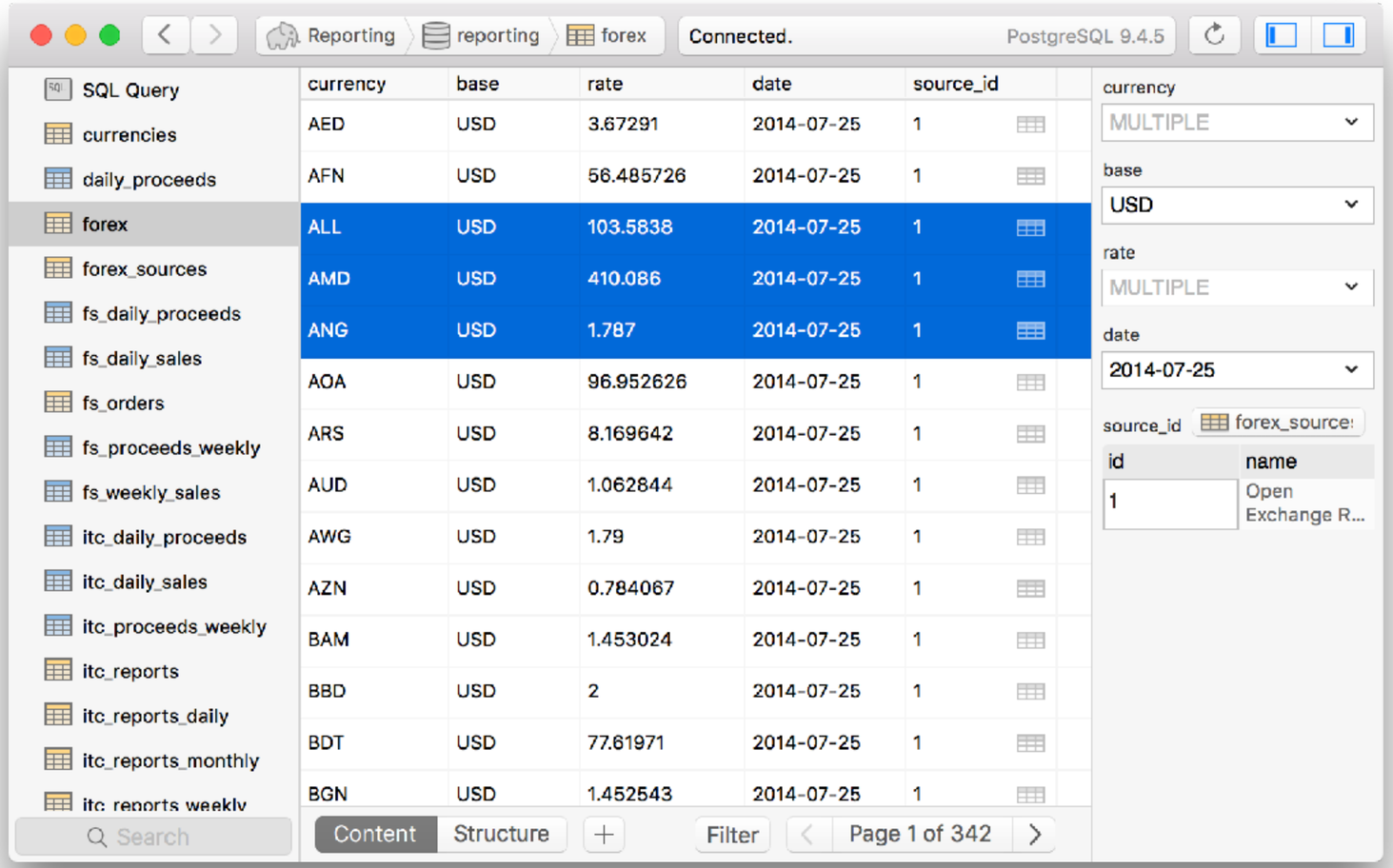
History of PostgreSQL

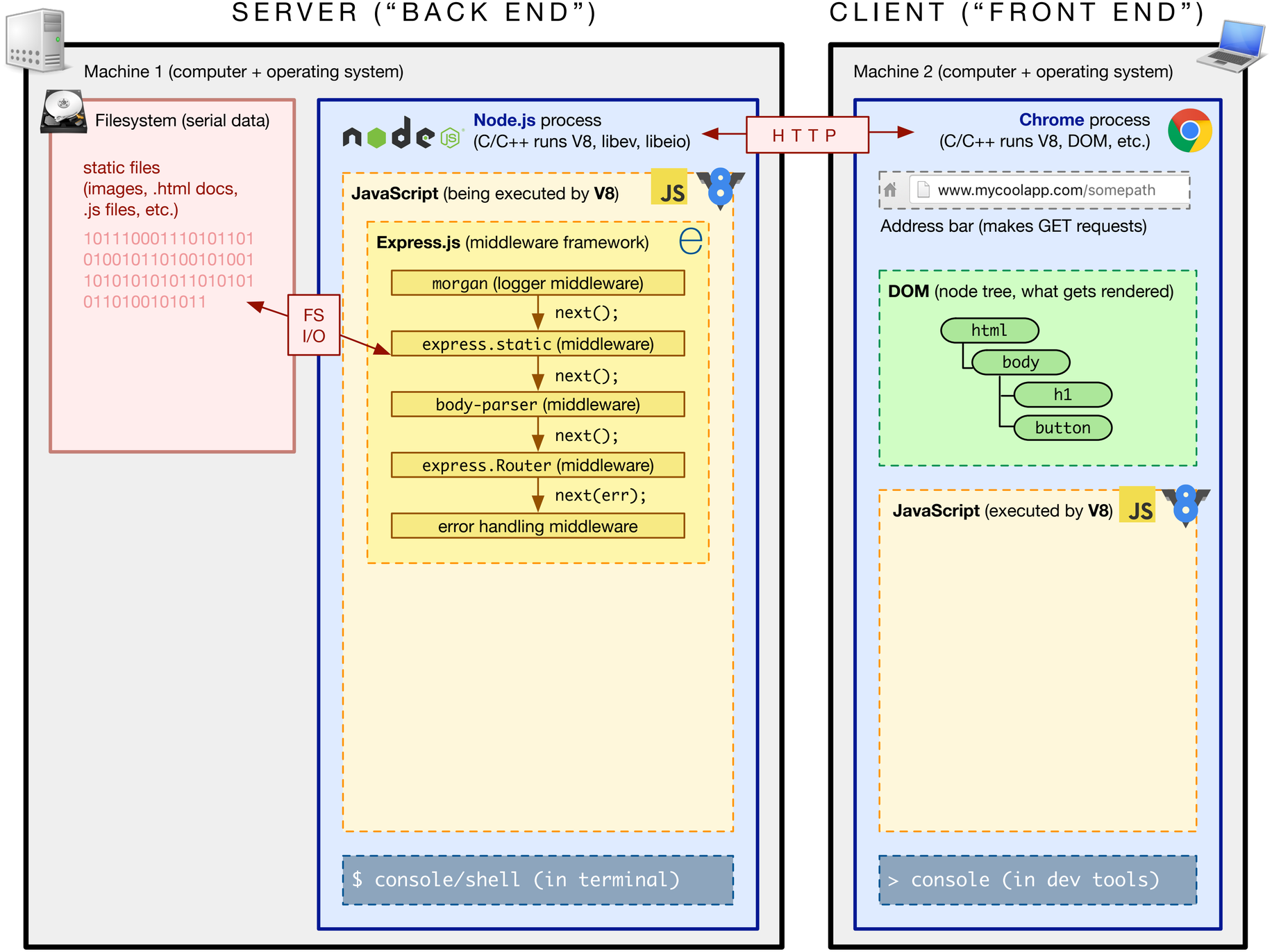
- 1970s at UC Berkley:
  INteractive **G**raphics **RE**trieval **S**ystem (INGRES)
- 1980s: POSTGRES ("Post-Ingres")
- 1995: POSTQUEL and Postgres95.
  - `monitor -> psql`
- 1996: Adopted by the open source community
  - Ongoing: stability, testing, documentation, new features
  - PostgreSQL

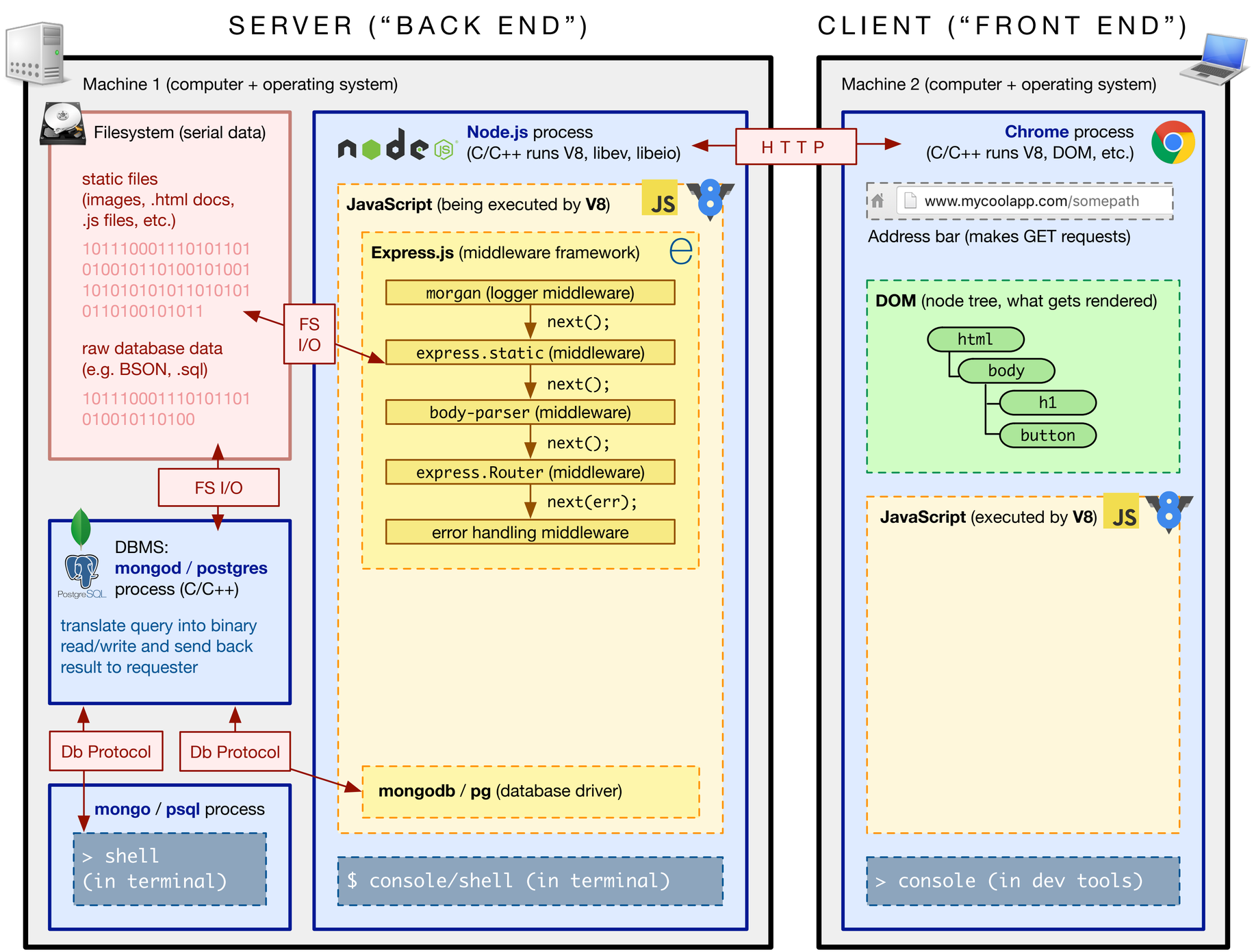
psql


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

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
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...


SERVER ("BACK END")
CLIENT ("FRONT END")
Machine 1 (computer + operating system)
Filesystem (serial data)
static files
(images, .html docs,
.js files, etc.)
101110001110101101
010010110100101001
101010101011010101
0110100101011
FS
I/O
Node.js process
(C/C++ runs V8, libev, libeio)
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
$ console/shell (in terminal)
HTTP
Machine 2 (computer + operating system)
Chrome process
(C/C++ runs V8, DOM, etc.)
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 (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
Db Protocol
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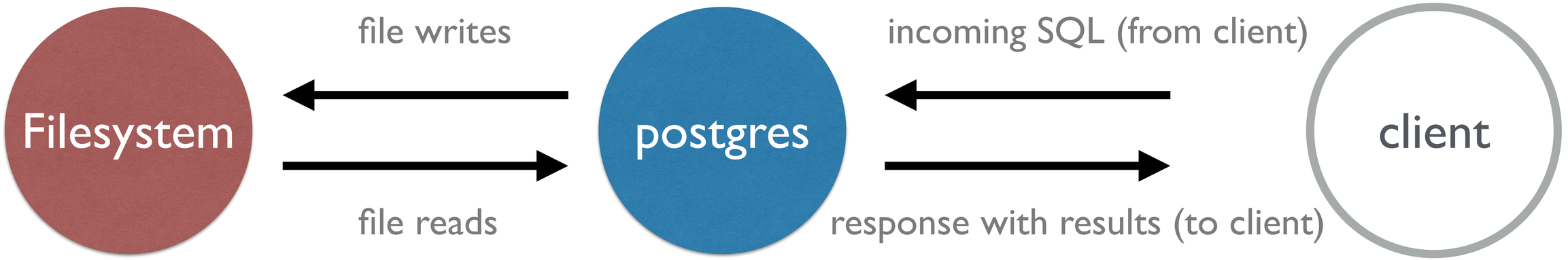
postgres process



- 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**
  - human actions turned into SQL queries
- **“drivers” like pg**
  - sends queries programmatically from a Node.js 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?”

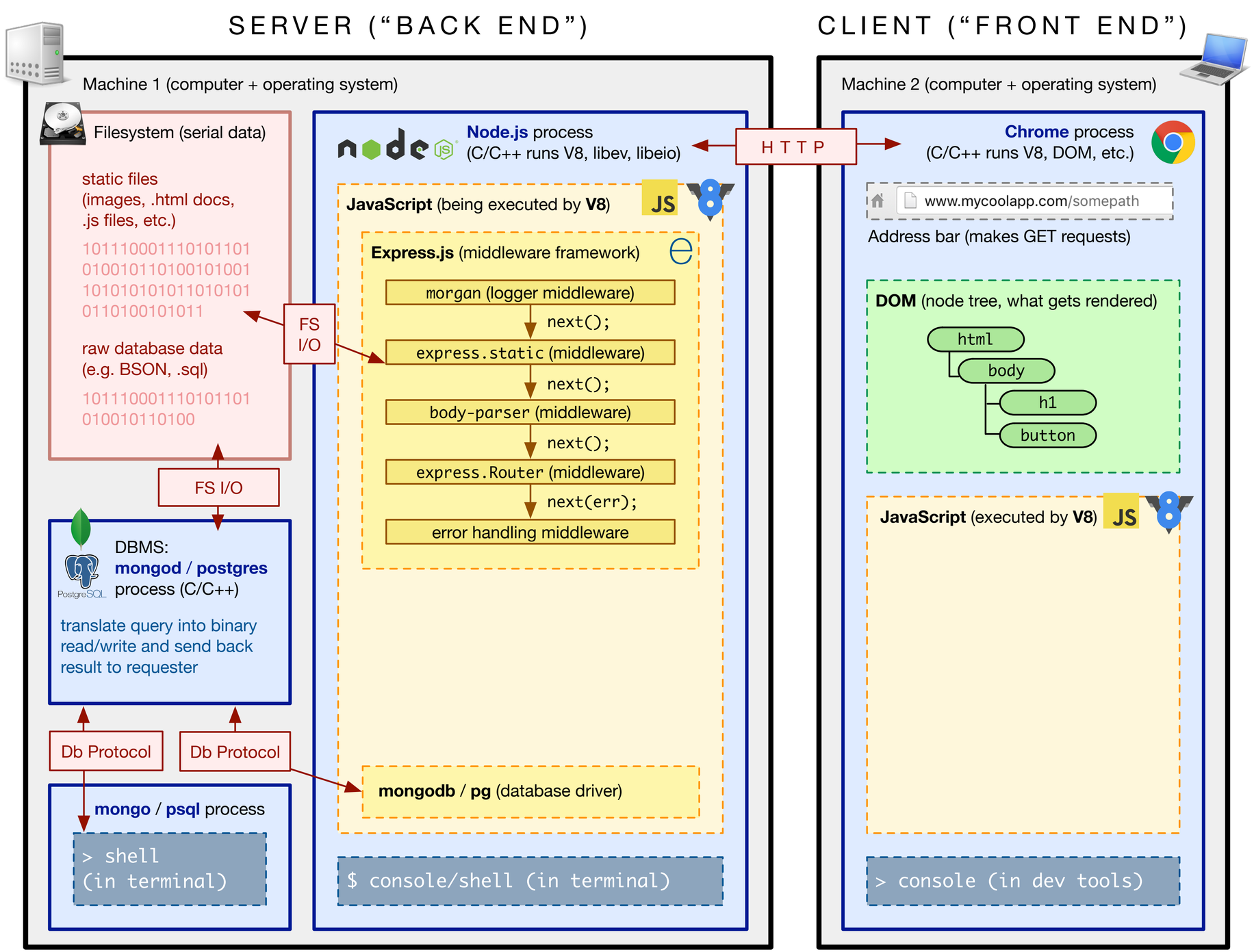
– SANEY MCREASONABLE

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!