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

History of PostgreSQL

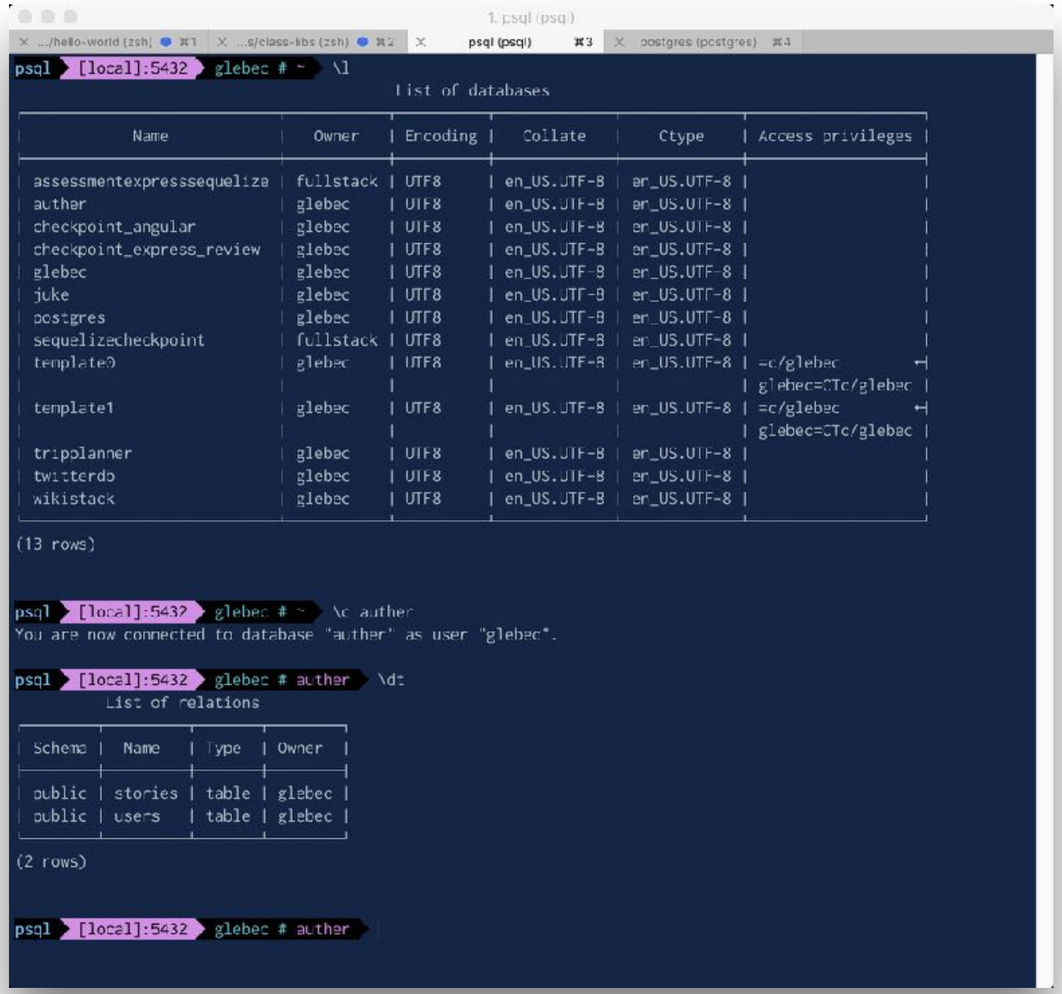
- **1970s at UC Berkley:**
  INteractive **G**raphics **RE**trieval **S**ystem (INGRES)
- **1980s: POSTGRES ("Post-Ingres")**
- **1995: POSTQUEL and Postgres95.**
  - `monitor -> psql`
- **1996: Adopted by the open source community**
  - Ongoing: stability, testing, documentation, new features
  - PostgreSQL

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

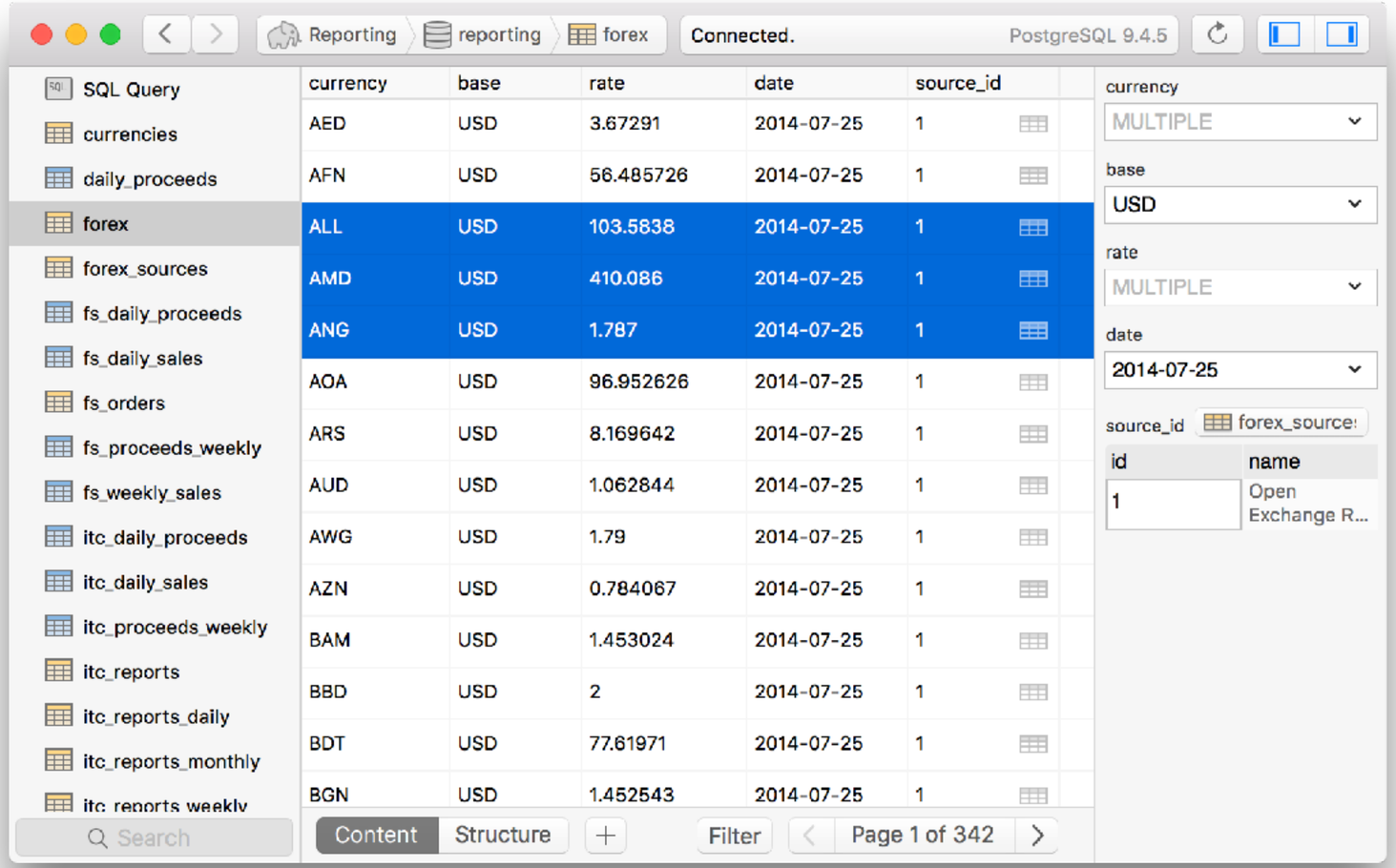
Tooling

- psql
- CLI



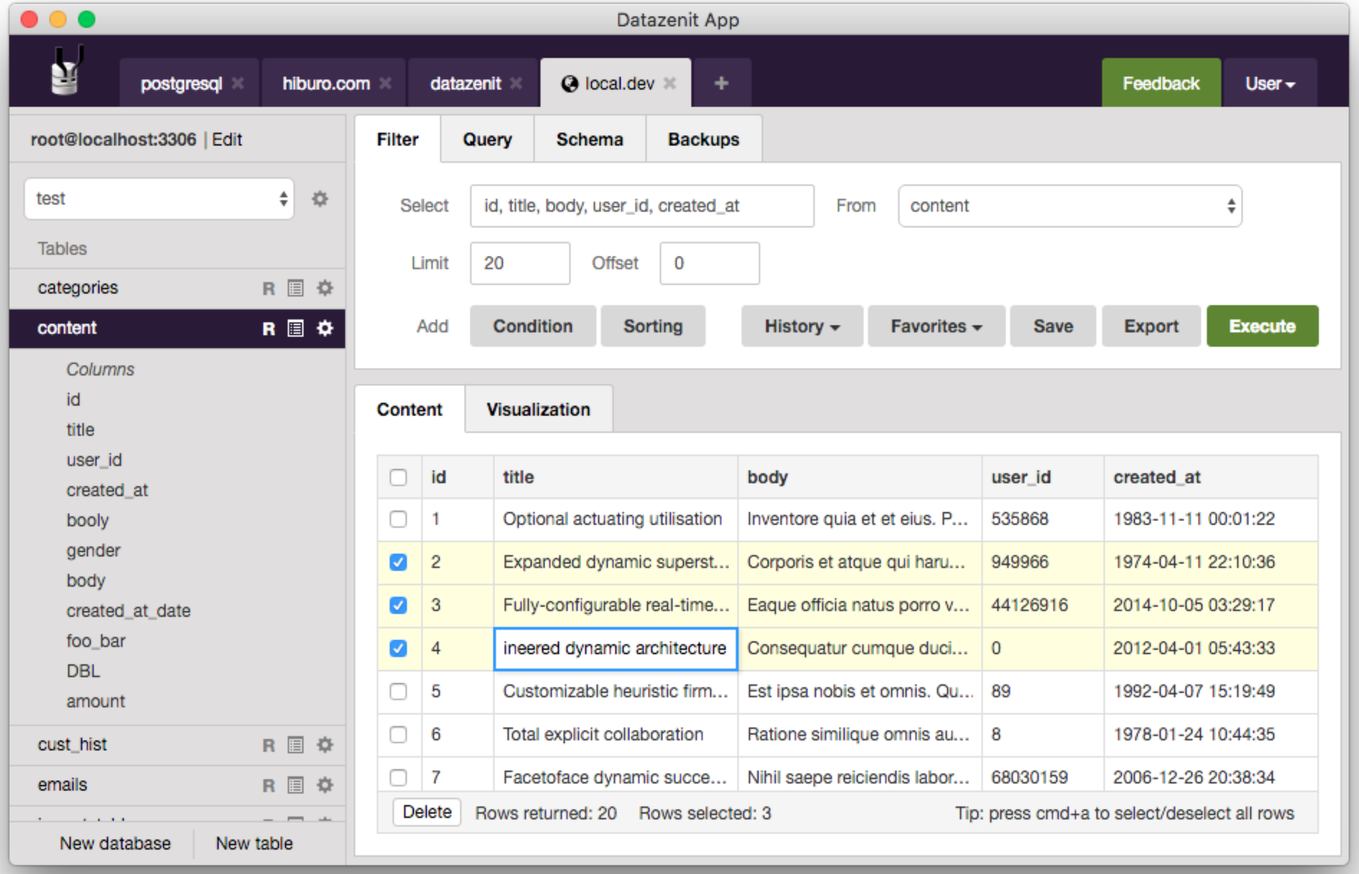
Tooling

- Postico
- Free

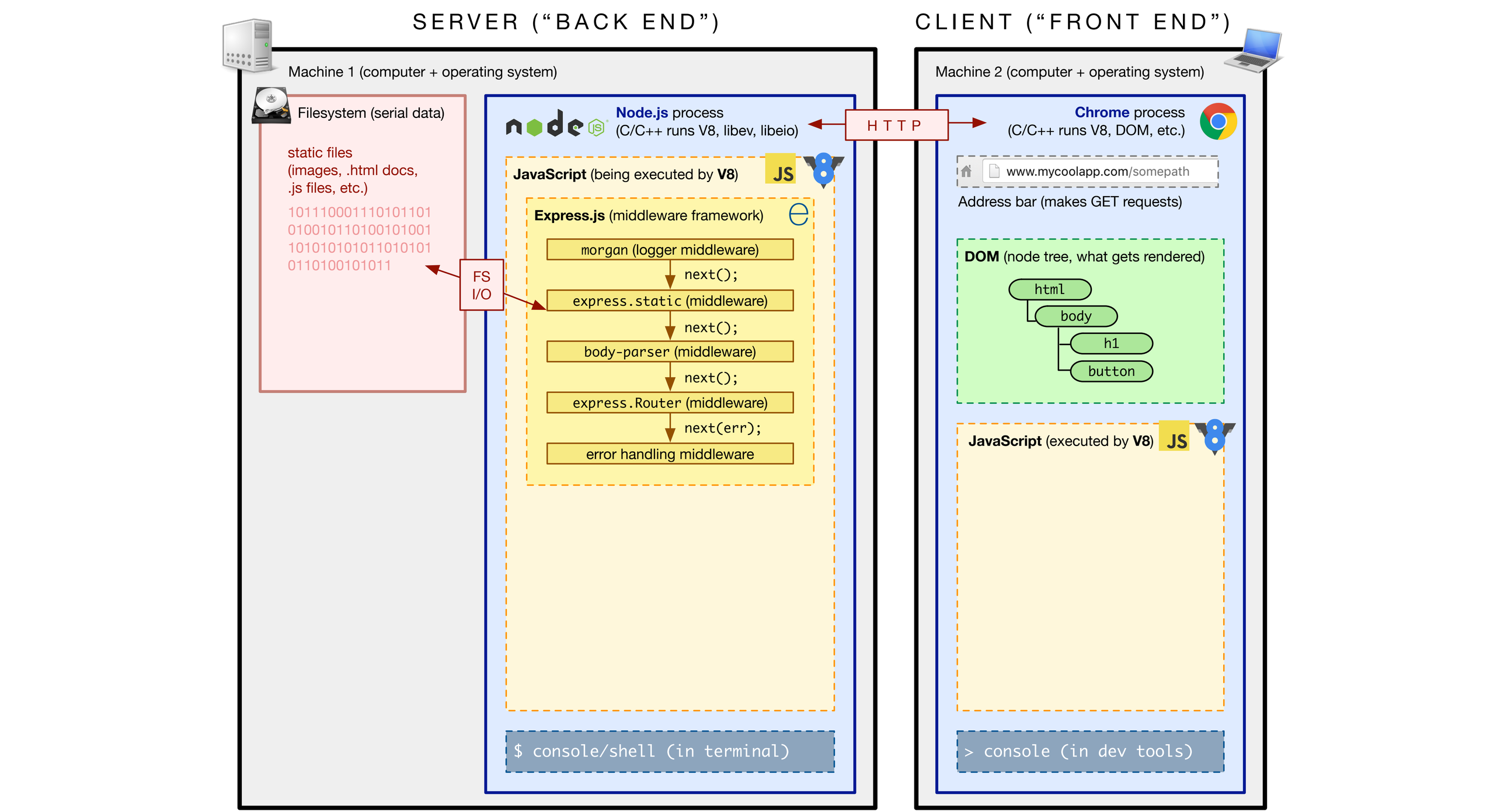


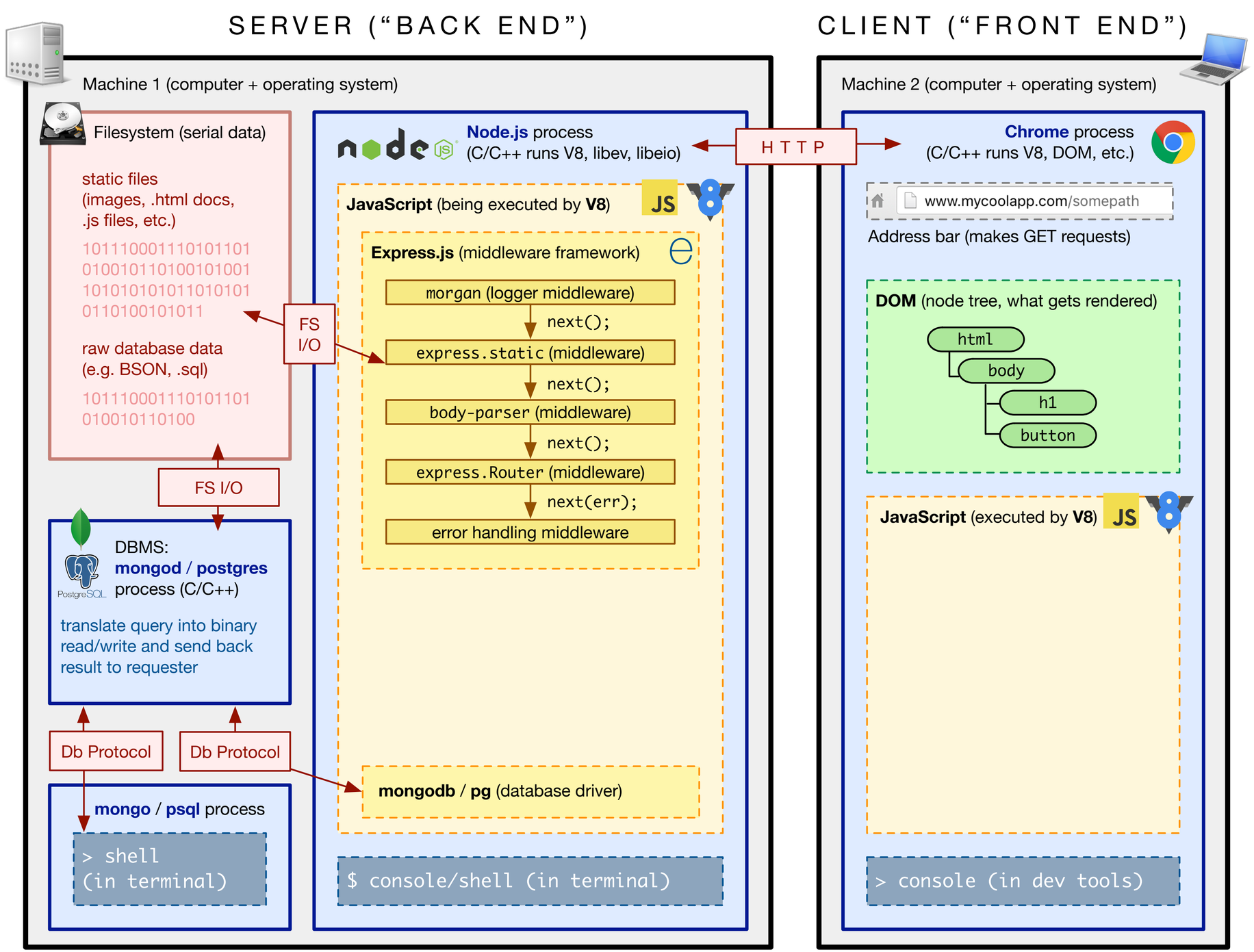
Tooling

- Datazenit
- $$$



Etc.


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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(e.g. BSON, .sql)
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DBMS:
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process (C/C++)
PostgreSQL
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read/write and send back
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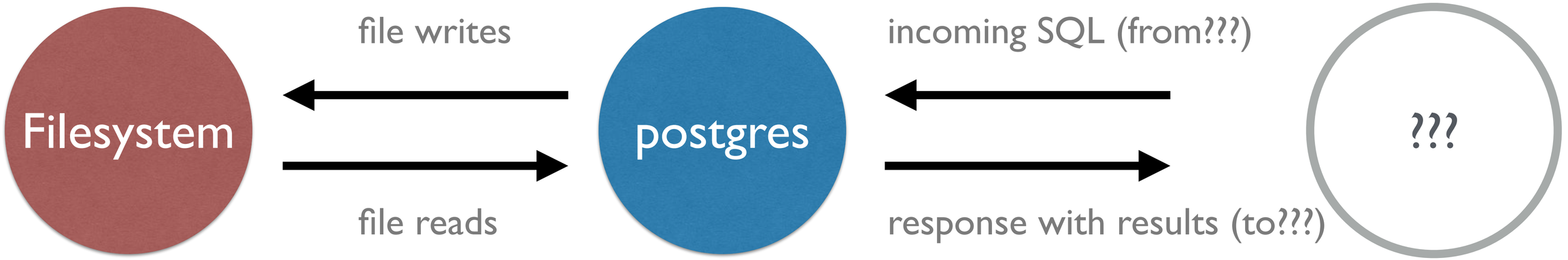
postgres process



- 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

- **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?”

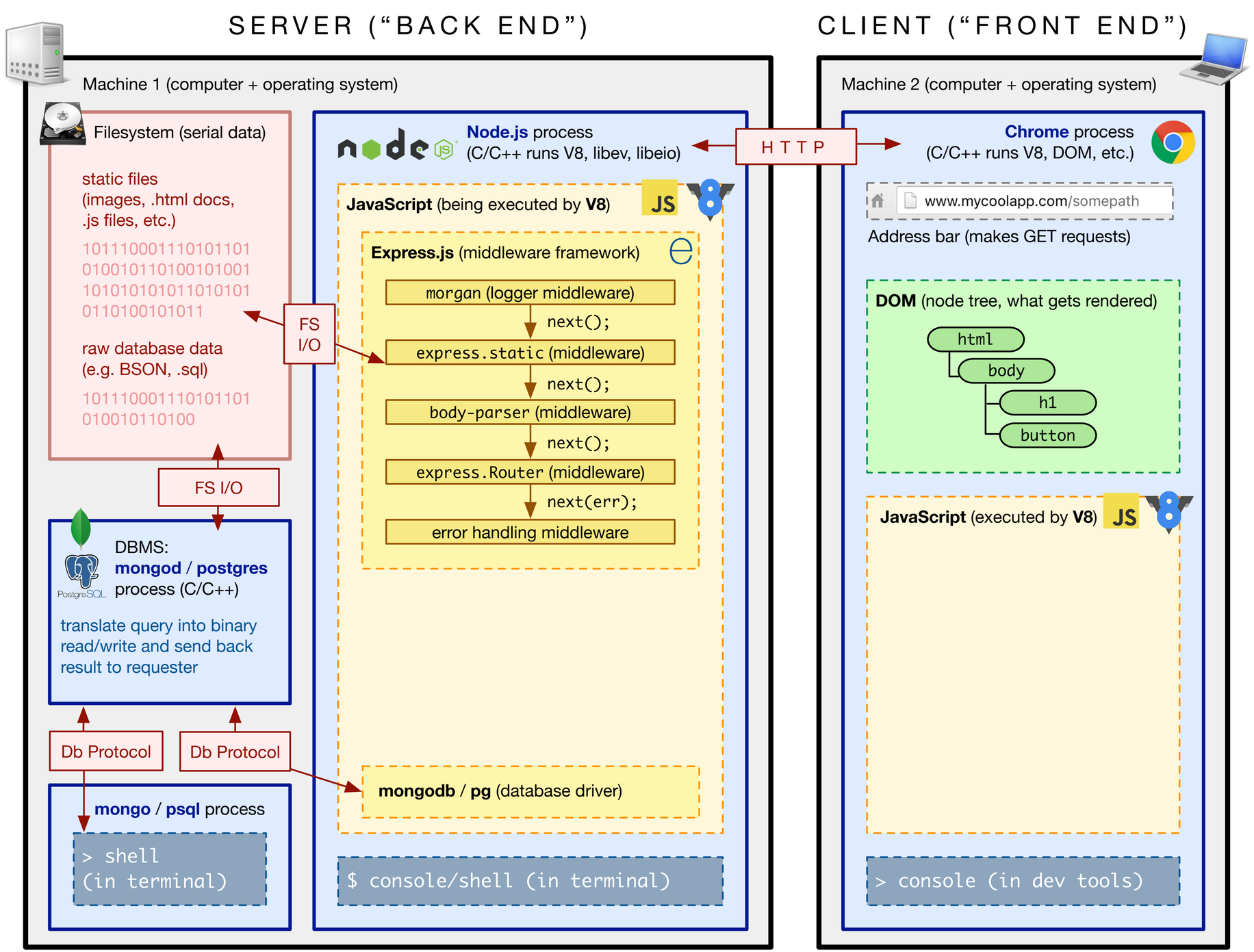
– SANEY MCREASONABLE

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!