HARVARD | BUSINESS | SCHOOL

Open-Source Computing and Research

Ian Gow

HBS Brown Bag

16 September 1995

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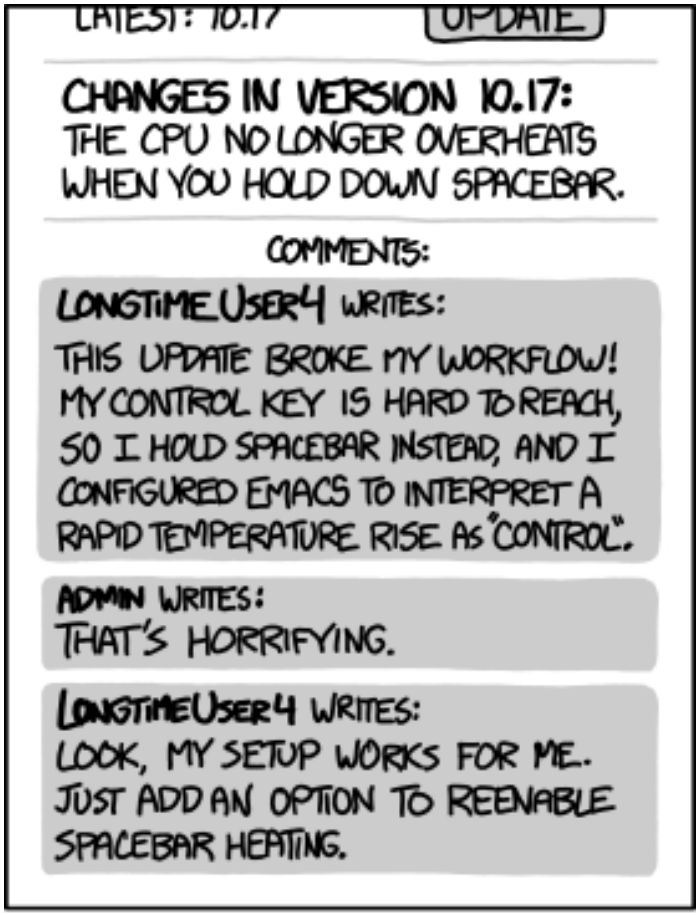
Goals of this talk

- Illustrate the power and convenience of having a relational database *as a repository of all of your data*
  - Quality data
  - Separate data from analysis
- Demonstrate the (open-source) relational database system that I happen to use (PostgreSQL)
- Illustrate how open-source computing tools can be used in research
- Argue for the value of version control for collaboration and reproducibility
- Provide some case studies to illustrate above

Caveats



EVERY CHANGE BREAKS SOMEONE'S WORKFLOW.

Research computing at HBS

- **Theory**
  - Data stored in MySQL servers
  - Code run on HBS Research Grid
  - Shared folders used to collaborate with co-authors at HBS and elsewhere
- **Practice**
  - Data stored on laptops and desktops
  - Code run on laptops and desktops
  - Sharing code and data?

Hardware requirements

Component	My setup	Minimum	TSS (DBA)
RAM	16 – 32 GB	8 – 16 GB	4 GB
HDD	512 GB – 3 TB	512 GB	256 – 300 GB
Processors	4 – 6 cores	2 – 4 cores	
Operating system	OS X (Mac)	Anything (Linux best)	OS X or Windows

Software

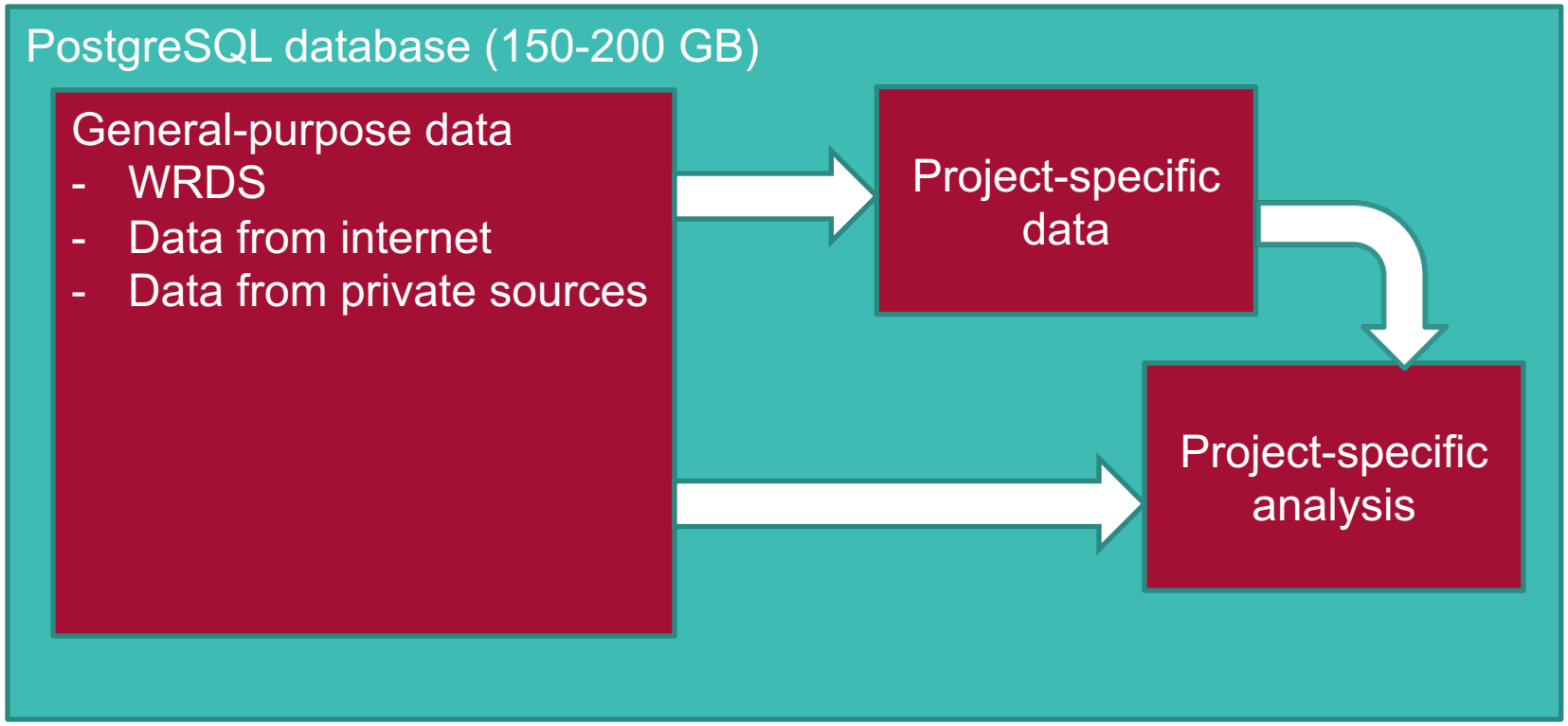
- The software I will describe is open-source, free, and available for all platforms:
  - PostgreSQL
  - R
  - RStudio
  - Python
  - Perl
  - Git
- In the last year or so, I have made the code I use to manage most of my publicly available, so you should be able to replicate what I will describe.

Lots of cool stuff I *won't* talk about

- "Big Data"
- Hadoop, Spark, etc.
- Cloud computing (AWS, etc.)
- Docker
- LaTeX, etc.
- Sharing bibliographies and papers (Mendeley, etc.)
- Many R, Python, etc., packages

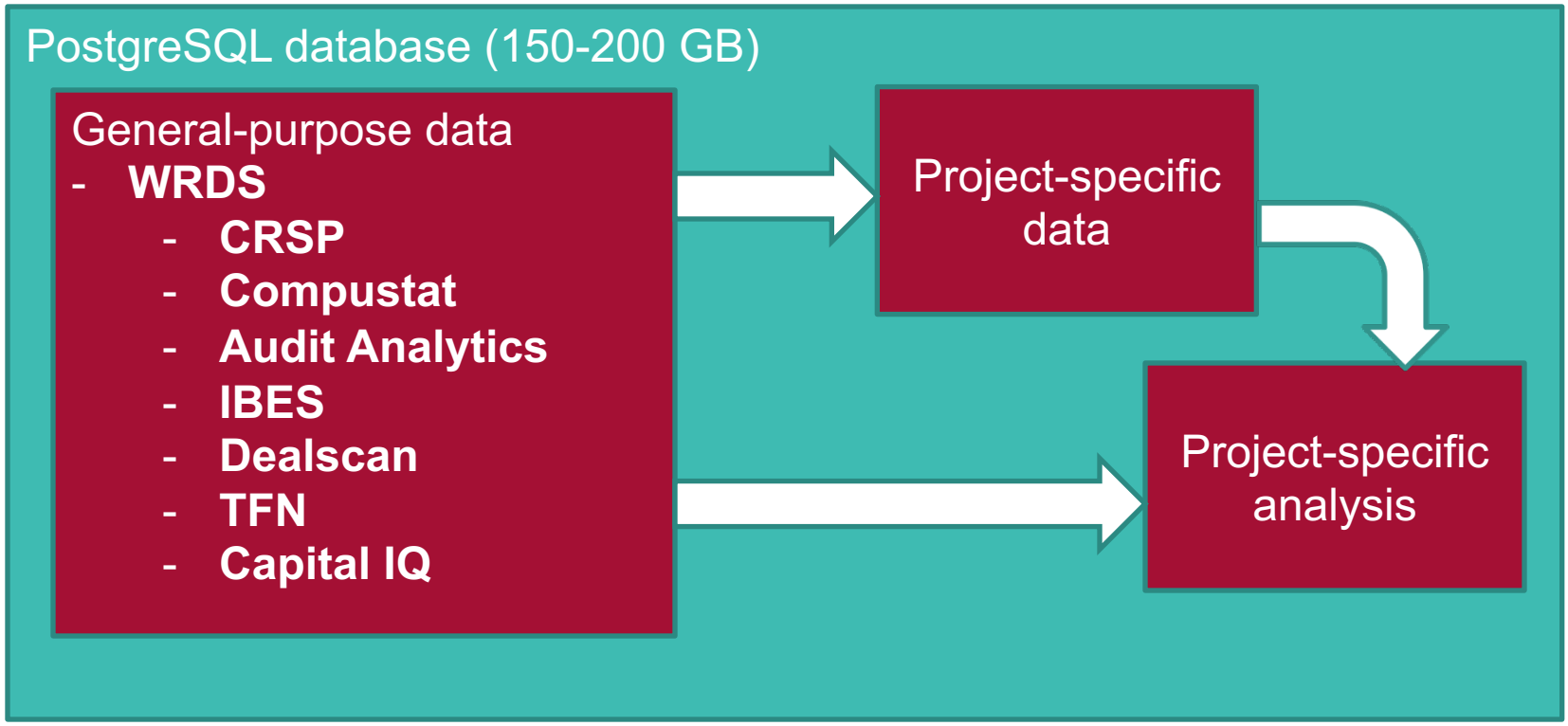
My background

Data



Some data is kept in system files (e.g., raw SEC filings).

Data



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Data: WRDS

- WRDS data is pulled into my database using pre-existing Perl scripts
  - Scripts determine if updates are available
  - Most data sets are easy, but some require special handling
  - Special handling reflected in custom scripts

WRDS: Compustat Point-in-Time Data

Data Set Name	COMPSNAP.WRDS_CSQ_PIT
Observations	8807954
Type	DATA
Variables	620
Indexes	2
Created	Wednesday, June 10, 2015 05:40:01 PM
Last Modified	Wednesday, June 10, 2015 05:40:01 PM
Label	Compustat Snapshot Quarterly/YTD - Point-In-Time
File Size	44,403,195,904 bytes

WRDS: Compustat Point-in-Time Data

```
2009-Mac-Pro:acct_data igow$ ./wrds_update.pl compsnap.wrds_csq_pit
Getting schema for compsnap.wrds_csq_pit

Beginning file import at 15:27:33

Importing data into compsnap.wrds_csq_pit.

COPY 8807954

Result of system command: 0

Completed file import at 17:10:07

Last modified: 06/10/2015 17:40:02
```

WRDS: Compustat Point-in-Time Data

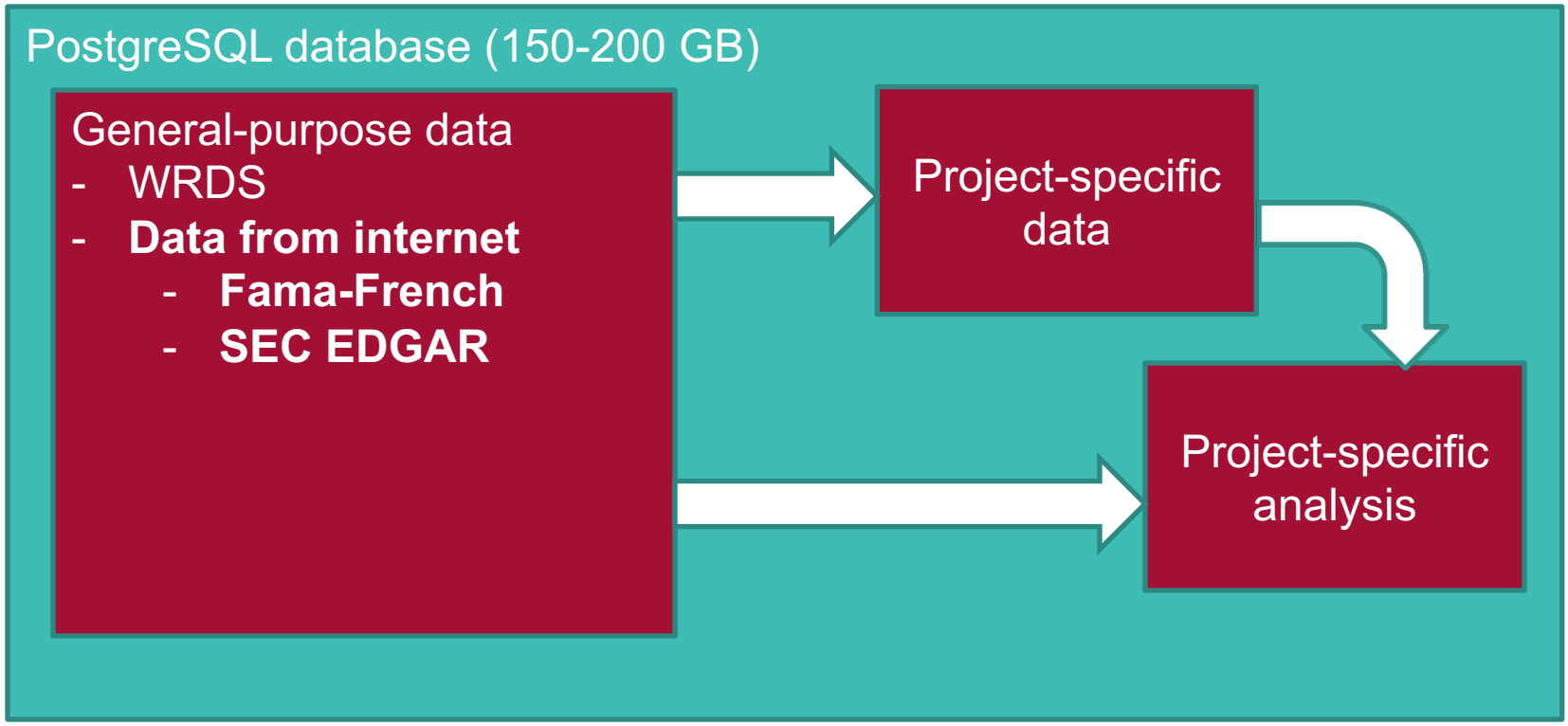
Alphabetic List of Indexes and Attributes

#	Index	# of Unique Values	Variables
1	dt	232765	PITDate1 PITDate2
2	gvkey	34685	

Sort Information

Sortedby	gvkey PITDate1 PITDate2 datadate indfmt datafmt consol popsrc
Sort Option	NODUPKEY

Data



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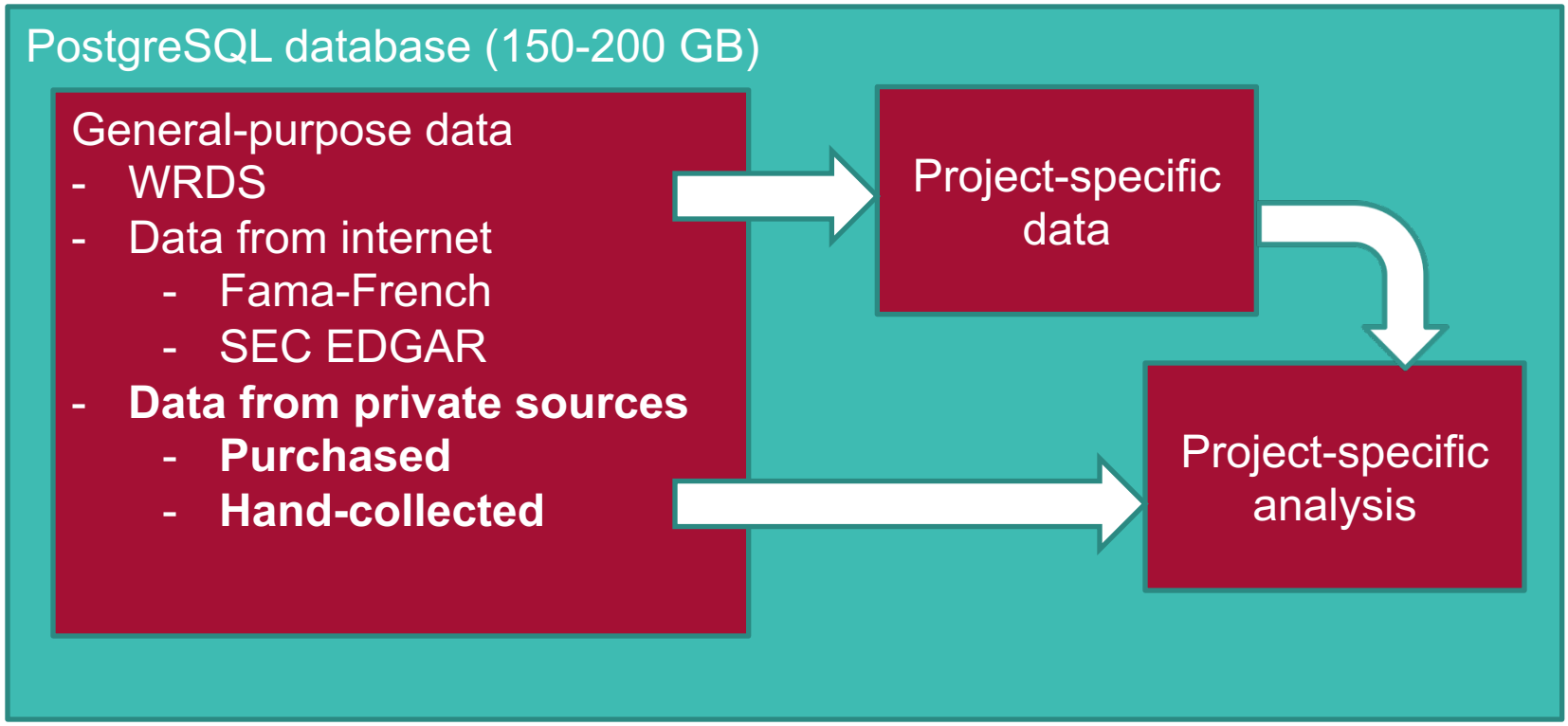
Data



Some data is kept in system files (e.g., raw SEC filings).

StreetEvents data

- Transcripts of more than 300,000 conference calls, etc.
- Data updates provided monthly
- Data provided as XML files
- Processed using Perl scripts into “clean” data stored in PostgreSQL
- Then easily subject to analysis

StreetEvents data: Fog

- Fog is a measure of linguistic complexity.
- Used by Feng Li in his dissertation (JAE 2008)
- So I emailed Feng for the code.

StreetEvents data: Fog

Hi Ian,

I used Perl for the calculations. Here is the core part, it's actually very simple. You need to save the file to a .txt file and download and install a Perl module called "`Lingua::EN::Fathom`".

```
use Lingua::EN::Fathom;
my $text = new Lingua::EN::Fathom;
$text->analyse_file("file.txt");

$percent_complex_words = $text->percent_complex_words;
$num_sentences     = $text->num_sentences;
$words_per_sentence = $text->words_per_sentence;

$fog   = $text->fog;
Print "$cik, $filedate, $file, $percent_complex_words, $num_sentences, ";
Print "$words_per_sentence, $fog, \n";
```

Let me know if you need more info about this.

Life is fine, busy with the recruiting stuff lately. Hope all is well with you.

Feng

Note: `sudo cpan -i Lingua::EN::Fathom` installs this module.

StreetEvents data: Fog

Fortunately, PostgreSQL allows you to define functions using other languages, including Perl, Python, R, C, SQL, JavaScript.

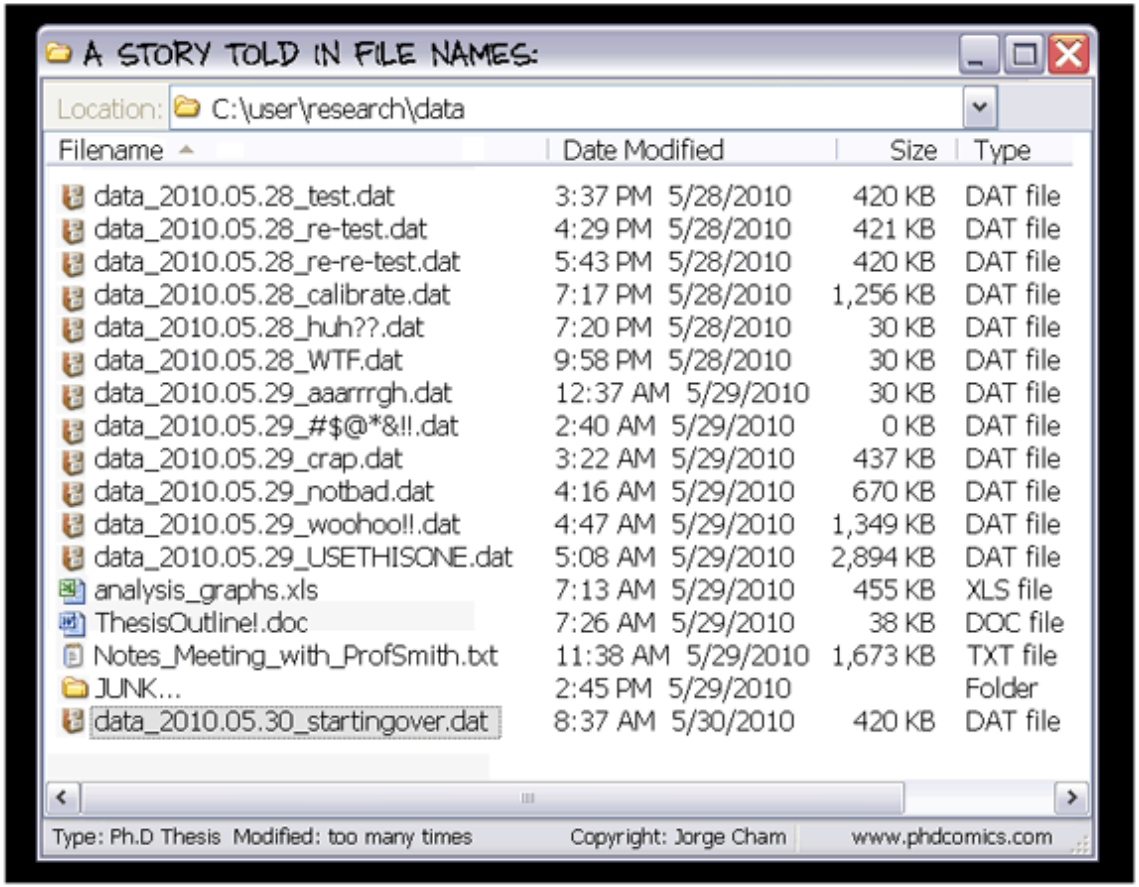
```
CREATE OR REPLACE FUNCTION fog_original(text)
  RETURNS double precision AS $BODY$
  # Load Perl modules that calculate fog, etc.
  use Lingua::EN::Fathom;
  my $text = new Lingua::EN::Fathom;
  if (defined($_[0])) {
    $text->analyse_block($_[0]);
    return($text->fog);
  }
$BODY$ LANGUAGE plperlu;
```

Some other examples

- Hand-collecting data
- Annotating director biographies

Version control?

More version control?



Version control, collaboration & reproducibility

- Dropbox
- Google Docs
- Google Drive
- Git (Bitbucket, GitHub)
- ShareLaTeX

Why PostgreSQL?

- Rich, modern SQL (cf. MySQL)
  - WINDOW functions
  - Common table expressions
  - USING, etc.
- Robust (cf. SQLite)
- Support for rich data types
  - Arrays (map to lists in Python)
  - JSON (easy to map to and from Python dictionaries, etc.)
- Procedural languages (cf. MySQL)
- Excellent documentation, licensing, etc.

Open-source is awesome

- PL/R example
- StackOverflow examples
- R packages for pretty much everything

Why not WRDS?

- WRDS is fine, but …
  - Need to use SAS predominantly
  - Some WRDS data is a mess (e.g., Audit Analytics)
  - What about all my *other* data? (StreetEvents, EDGAR, etc.)
  - Ultimately much more practicable to get WRDS data locally than trying to manage data on WRDS servers … see survey results

Why not HBS Research Grid?

- No PostgreSQL, just MySQL (see above)
- No RStudio Server
- Collaboration is difficult
- Even with MySQL, still (seem to) need to manage data
- HBS Research Grid seems walled off from the internet (none of my scripts work there, even though the servers run Linux).
- I seem not to be alone in *not* using it.

Challenges

- Collaboration is less of a pain
  - I don't want to be a DBA or systems administrator
  - Learning curve for co-authors
- Challenging to find resources to manage this
  - Research Computing and Baker Research Services are not in the business of providing comprehensive data services
  - I want to do *less* data-cleaning, not more
- Sharing setup is not easy
  - Value would come from scale
  - Need better documentation
  - Hardware limitations (no resources to leverage)