

Postgres

A History

Happy 20th Birthday

to the PostgreSQL Community!

Happy 30th Birthday

to the Postgres codebase!

Programme

- 1985: University Postgres (and Ingres)
- 1995: Dawn of the community
- 2000: Early attempts at community commercialization
- 2005: The database that launched a thousand forks
- 2016: Core development and the present day
 - How development gets done and how that relates to history
 - Themes in PostgreSQL development over time
- How to get involved and why you should

1976

Ingres Project



Ingres

Interactive **G**raphics **R**etrieval **S**ystem

Started by Michael Stonebraker with Eugene Wong.

Based on Codd's relational algebra papers.

Implemented a query language called "QUEL".

Predecessor to Sybase / Microsoft SQL Server (and others).

Research continued from 1973 - 1985.





Death of Leonardo da Vinci (Ingres)

1985

“The Design of Postgres”

THE DESIGN OF POSTGRES

Michael Stonebraker and Lawrence A. Rowe

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and Computer Sciences
University of California
Berkeley, CA 94720*

Abstract

This paper presents the preliminary design of a new database management system, called POSTGRES, that is the successor to the INGRES relational database system. The main design goals of the new system are to:

- 1) provide better support for complex objects,
- 2) provide user extendibility for data types, operators and access methods,
- 3) provide facilities for active databases (i.e., alerters and triggers) and inferencing including forward- and backward-chaining,
- 4) simplify the DBMS code for crash recovery,
- 5) produce a design that can take advantage of optical disks, workstations composed of multiple tightly-coupled processors, and custom designed VLSI chips, and
- 6) make as few changes as possible (preferably none) to the relational model.

The paper describes the query language, programming language interface, system architecture, query processing strategy, and storage system for the new system.

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Postgres Design Goals

Bring together three separate use-cases:

- Traditional business database
- Application persistence layer
- A rules engine
 - University Postgres' rules engine was based on query rewrite

Extensible data types, operators, access methods

Extensible access methods / indexes.

Berkeley POSTGRES Timeline

- 1987 - “demoware” working internally
- 1989 - POSTGRES 1.0 released to first external users
- 1990 - POSTGRES 2.0 rewrite features new rules engine
- 1991 - POSTGRES 3.0 multiple storage managers & new query executor...
and another rules engine rewrite
- 1992 - Stonebraker starts Illustra to commercialize POSTGRES
- 1994 - POSTGRES 4.2 released
- 1994 - POSTGRES project formally ends at Berkeley as Stonebraker retires
- 1996 - Illustra company sold to Informix for \$400m

“We would recruit the smartest [students] we could find, give them wonderful equipment, and they would basically die writing code for us.”



1994

seQUEL

“How hard could it be?”

Andrew Yu & Jolly Chen, grad students at Berkeley

Picture of
andrew and
jolly

worked on POSTGRES project (with really nice hardware?)

felt POSTGRES was held back by POSTQUEL query language

“We figured it would be about the size of a graduate class project.”

“Just a little bit of YACC and Bison, right?”

QUEL

range of E is EMPLOYEE

retrieve into W

(COMP = E.Salary / (E.Age - 18))

where E.Name = "Jones"

“We had this cool engine,
but instead of a steering wheel
we had all these knobs and levers.”

- Jolly Chen

SQL

```
select (e.salary / (e.age - 18))  
      as comp  
from employee as e  
where e.name = "Jones"
```

Postgres95

An unofficial POSTGRES port with SQL



Postgres95

Name inspired by a well-known operating system!

1995-1996

The increasingly inaccurately named Postgres95 years

Why use Postgres95?

- Looking for pretty much any kind of SQL database.
- Don't want to buy an expensive commercial product.
- It would compile on home systems.
- Willing to put up with software bugs... and fix them!
- Already has some very unique features like LISTEN/NOTIFY!

Difficulties with Postgres95

- Lightly maintained by the original authors
- Andrew and Jolly have other work to do, degrees to earn
- Users on mailing list find it difficult to get patches merged

Building databases requires focus...

> On Tue, 23 Apr 1996, Jolly Chen wrote:

>

> > I've posted a TODO list on the postgres95 web site

> > (<http://s2k-ftp.CS.Berkeley.EDU:8000/postgres95/www/todo.html>)

> > I've casually sorted the list by priority and I have some editorial

> > comments on some of them.

> >

> > If all the items on the TODO list were completed, postgres95 would be

> > much improved, and would really be a viable replacement for commercial

> > RDBMSs in some settings. Some of the items require quite a bit of work

> > and deep knowledge of postgres95 internals, though. **We would need a few**

> > **contributors with quite a lot of volunteer hours to make this happen**

> > **anytime soon. (A large number of contributors each with only a little**

> > **bit of time to contribute would not be equivalent)**

The First PostgreSQL Committer is Born!

Personally, I think that both Jolly and Andrew have done a fantastic job of bringing it to its currently level, but they, like most of the ppl on this list, have full time jobs that sap alot of their time...

...so, unless someone out there has already done this, and unless Jolly/Andrew tell me I can't (guys?)...I'm going to go ahead with what I wanted to do a few months ago...setup a development site similar to what is done with FreeBSD...

First stage will be to get a cvs archive of postgres 1.01 online tonight, with a sup server so that everyone has access to the source code.

If anyone has any patches they wish to submit based off of 1.01, please send them to postgres@ki.net and I'll commit those in as soon as cvs is up and running.

Unless there are any disaggrements with this (or someone else has done this that I missed in mail...sorry if I did...)...I'll send out further data on this as soon as its up and running...

PostgreSQL's Bug Tracker: "Bruce"

I think it would be great if Jolly and Andrew would continue to gather patches from postings to this list, and perhaps help suggest solutions to some of the more complex bugs left in the system (corrupt databases?).

If not, where are we going?

I am willing to bundle up a new release based on patches posted to this group since the release of 1.01.

I am also willing to start gathering a list of known bugs and coordinate efforts to develop patches to fix them.

After these steps, I am willing to post the todo list, and ask for volunteers to start work on them.

PostgreSQL '96

Top Row

- Thomas Lockhart [alumnus]
- Jolly Chen [PG95 author]
- Vadim Mikheev [alumnus]
- Jan Wieck [major contributor]
- Andrew Yu [PG95 author]
- Tom Lane [core team]

Bottom Row

- Bruce Momjian [core team]
- Marc Fournier [alumnus]

Early contributors include: Australia, Austria, Bulgaria, England, Germany, Italy, Japan, Russia...



1997

PostgreSQL Era Begins

From: "Vadim B. Mikheev" <vadim@sable.krasnoyarsk.su>
Date: Wed, 18 Sep 1996 15:04:22 +0800
Subject: Re: [PG95-DEV] postgres2.0

Marc G. Fournier wrote:

[...]

> **How about PostgresV6?**

And it's good name. But Ingres & Postgres are different in language (not only), and Postgres & Postgres'95 too, so why not to change prefix now again ?

> **Please...though...just not Postgres/SQL...it just doesn't slide off the tongue nicely :(**

Vote against too.

From: "Marc G. Fournier" <scrappy@ki.net>
Date: Tue, 22 Oct 1996 04:35:34 -0400 (EDT)
Subject: Re: [PG95-DEV] postgres.org
On Tue, 22 Oct 1996, Julian Assange wrote:

>

> Does anyone know what is happening with the delegation of the
> postgres domains? Indirect.com was going to hand them over,
> but as yet has not.

Last week, I sent an email off to the 'admin contact' asking for a status, but have heard nothing... Which is okay.

We had that major discussion on name changes, and **it seemed that the majority were in favor of PostgreSQL...so let's do it.**

```
commit 9b41da6ce48e3bed6730faa6347a5461175cff83
Author: Bruce Momjian <bruce@momjian.us>
Date:   Wed Dec 11 00:28:15 1996 +0000
```

```
    Rename postgres95 to PostgreSQL.
    Add comment for SELECT NULL
```

A perfect name?

From: Tom Lane <tgl@sss.pgh.pa.us>
Subject: The name of the game
Date: 2006-07-13 03:42:54

It might help to explain that the pronunciation is "post-gres" or "post-gres-cue-ell", not "post-gray-something".

I heard people making this same mistake in presentations at this past weekend's Postgres Anniversary Conference :-(
Arguably, the 1996 decision to call it PostgreSQL instead of reverting to plain Postgres was the single worst mistake this project ever made.

It seems far too late to change now, though.
regards, tom lane

Community PostgreSQL,
PostgreSQL Community.

“We wanted a place to merge and distribute all the patches people were writing already.”

-- Bruce Momjian

Community Postgres

- Global from the beginning: early committers were all in different countries.
- An emphasis on stewardship / service to community.
- No single business owner or commercial entity... ever!
- Mailing-list / public recorded discussion culture.

The mystery of the missing versions

- University Postgres 4.2
- Postgres95 1.01
- PostgreSQL 6.0

PostgreSQL 6.0 Release Highlights

- Crash bugs
- Database corruption fixes
- Support UNIQUE indexes
- BETWEEN, IN qualifiers
- GIST index type

PostgreSQL 6.X Highlights

- MVCC support!
- Simple SQL: NOT NULL, CASE, EXCEPT
- Japanese / multi-byte character support
- Russian language support

Don't worry!

We won't review all the release notes...

2000

Early commercialization of PostgreSQL

PostgreSQL Inc.

- The first PostgreSQL company, started June 1997
- Started by Marc Fournier, PostgreSQL community founder
- Hired Thomas Lockhart & Vadim Mikheev
- Never gets very large - quietly ends in 2005

Great Bridge Inc.

- Started May 2000
- \$45m raised after RedHat IPO
- “RedHat for Databases”
- Bruce Momjian, Tom Lane, and Jan Wieck join in October 2000
- Professional support for PostgreSQL 7.0 / 7.1
- “VP of Hacker Relations”, Ned Lilly
- "25 Coolest Global Companies" in 2000

Great Bridge Inc.

- ... company ended September 7th, 2001 (16 months lifespan)
- Developers dispersed
 - Tom Lane to RedHat to make RedHatDB
 - Bruce Momjian to SRA OSS Inc.
 - (and so on)

EnterpriseDB

- Similar plan to Great Bridge Inc.
- Better timing? Better execution?
- EnterpriseDB still here in 2016
- “EDB Postgres Advanced Server”
- Sells modified PostgreSQL & support
- Biggest funder of PostgreSQL contributions.
 - (Many core/major developers have worked at EDB for many years.)
 - (Other companies like 2ndQuadrant have made very significant contributions too.)

2005

The Forkable Database

Many “close” forks / ports exist

- “EDB Postgres Advanced Server”
- PowerGres from SRA OSS
- Fujitsu Enterprise PostgreSQL
- Mammoth from Command Prompt
- RedHat Database
- (... and many more)

Free as in BSD

- BSD license is extremely permissive
- Many closed forks of PostgreSQL exist
- BSD license helped transition from research to OSS project
- BSD license permits commercial companies to take PostgreSQL code private and modify it!
- Community has always welcomed forks

```
→ postgres git:(master) X cat COPYRIGHT
PostgreSQL Database Management System
(formerly known as Postgres, then as Postgres95)

Portions Copyright (c) 1996-2016, PostgreSQL Global Development Group

Portions Copyright (c) 1994, The Regents of the University of California

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“Distant” forks

Companies that started with PostgreSQL

Large-scale MPP Databases

- Netezza (forked 7.2)
- Greenplum (forked 7.4, catching up and newly OSS)
- Redshift / Paracel (forked 8.0, catching up but closed)
- Aster Data (forked 8.4)
- CitusData (forked 9.0, now an OSS extension)

Clustered Databases

- Translattice
- StormDB
- PostgresForest
- Postgres-XC
- Postgres-XL

Streaming Databases

- **TelegraphCQ**
 - Berkeley research project into streaming queries
- **Truviso**
 - Commercialized version of TelegraphCQ
 - Acquired by Cisco
- **PipelineDB**
 - Relatively new entrant

Interlude: How Postgres Gets Built

The past describes the future

The PostgreSQL Process

- Ideas are discussed in `pgsql-hackers`
- Candidate patches get posted and tracked in the `commitfest` app
- When reviewers have approved a patch (and the list supports it)
- A committer commits the patch to the project
- The next annual release includes the functionality
- Release team produces a release, packages, announces it, and so on.

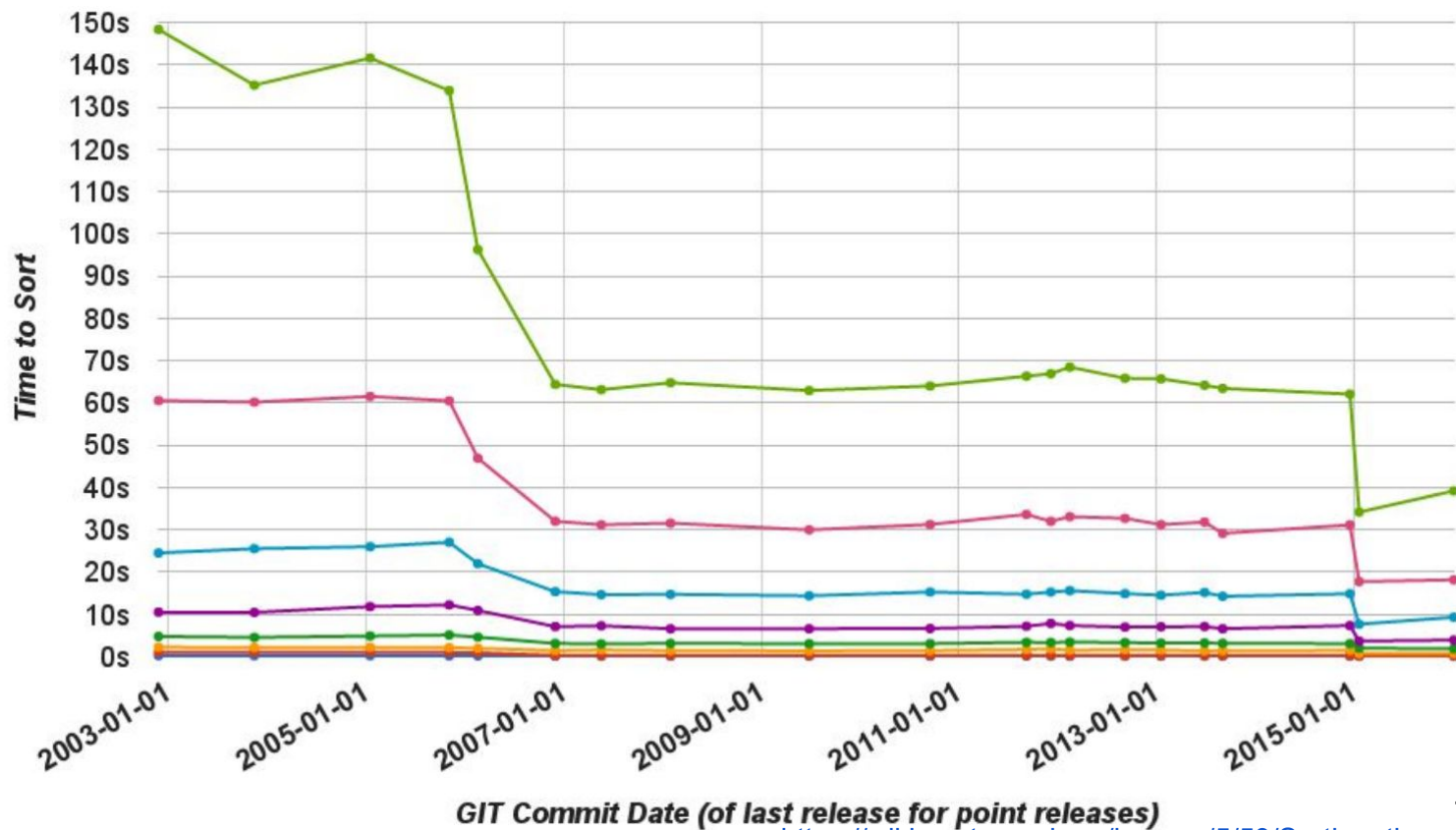
Themes in Postgres Development

The True Technical History of PostgreSQL

PostgreSQL Themes

- Release notes may sometimes look unexciting
 - “Feature X added capability Y”
 - 9.4: MATERIALIZED VIEW no longer requires read lock to refresh
- Themes span many releases
 - Replication, foreign data wrappers
- Sometimes themes may be quiet for years then return
- Each release implements capability to community code standards
- Early implementations may not be useful for end users

Theme: Sort Performance



-- Greg Stark

https://wiki.postgresql.org/images/5/59/Sorting_through_the_ages.pdf

Theme: Durability / Availability

- 7.1: WAL
 - Write-Ahead-Log provides crash resilience (Vadim Mikheev, Russia)
- 8.2: Warm Standby / WAL shipping
 - WAL is mirrored as each segment finishes
- 9.0: Hot Standby
 - Run queries on replica (Simon Riggs, UK)
- 9.0: Streaming Replication
 - WAL is sent in real-time (NTT OSS / Masao Fujii, Japan)
- 9.1: Synchronous Replication
 - COMMIT can wait until WAL is acknowledged
- 9.4: Logical replication
 - WAL can be sent as logical changes instead of binary updates

Theme: Remote Data Access

- 7.1: DBLink
 - Remote querying of databases via contrib module
- 8.4: SQL/MED “infrastructure”
 - No user-facing capabilities!
- 9.1: Foreign Data Wrappers added, `file_fdw` in contrib
 - Foreign data wrappers can now be written as extensions
 - (Mostly) trivial FDW in core as possibly-useful proof of concept
- 9.3: `postgres_fdw` (in core)
 - Official support for PostgreSQL foreign data
- 9.6: `postgres_fdw` improvements
 - postgres_fdw now supports remote joins, sorts, UPDATES, and DELETES

Theme: Indexing

- Pre-6.0: B-Tree, hash
- 6.0: GiST
- 8.3: GIN
- 9.1: K-NN
 - K-nearest-neighbors index
- 9.2: sp-GiST
 - Space-partitioned GiST
- 9.5: BRIN
 - Block Range INdex
- 10+?: VODKA, RUM? PostgresPro are still working on new indexes...

Other Themes

- Data Types
- SQL features
- VACUUM
- Semi-structured data (hstore, full text search, XML, json, jsonb)

Interlude:

Japanese Contributions

A brief history of Japanese contributions to
PostgreSQL

Major Japanese PostgreSQL Contributions (1 of 2)

- Multi-byte characters and Japanese language support
 - Many contributors, early contributions from Tatsuo Ishii / SRA OSS
- Windows support
 - Tatsuo Ishii, Yamada Tsutomu / SRA OSS, Hiroshi Saito
- Replication and clustered PostgreSQL (so many projects!)
 - Fujii Masao, Koichi Suzuki, Takahiro Itagaki, Sawada Masahiko, Kyotaro Horiguchi / NTT
 - Michael Paquier / VMWare
- pgsqldb ODBC maintainer
 - Hiroshi Inoue
- pgpool-II
 - Tatsuo Ishii, SRA OSS

Major Japanese PostgreSQL Contributions (2 of 2)

- SEPostgres
 - KaiGai Kohei / NEC
- pg_strom (GPU-supported query execution)
 - KaiGai Kohei / NEC
- Window Functions
 - Hitoshi Harada
- CTEs / WITH expressions
 - Hitoshi Harada
- PL/V8 (javascript PL engine)
 - Hitoshi Harada
- Thank you to companies Fujitsu, SRA OSS, NEC, NTT, and all other users, contributors to PostgreSQL and PGECons members.

Pan-Asian Influence is growing

- Chinese companies are getting involved: HUAWEI, AliBaba
- India has a long history of contribution

2016

Welcome to Today!

Vibrant Global Community

- Professional support and contributions around the world
- Committers employed by a wide variety of global companies big and small
 - 2nd Quadrant [UK]
 - Amazon Web Services [US]
 - Citus Data [Turkey]
 - CrunchyData [US]
 - EnterpriseDB [US]
 - SRA OSS [Japan]
 - NTT [Japan]
 - NEC [Japan]
 - Postgres Professional [Russia]

The POSTGRES
project is a success.

A truly distributed
team is a resilient
model.

The BSD license and
Berkeley permissive
culture are powerful.

To really understand
progress, look across
releases.

“Make it Happen”

Recommended Reading

- [PostgreSQL History \(manual\)](#)
- [The Design of POSTGRES](#)
- [Stonebraker's Turing Award Talk](#)
- [An Oral History of Michael Stonebraker](#)
- [A History of Slonik](#)
- [Sorting Through the Ages \(Greg Stark\)](#)
- [A Tour of PostgreSQL Forks \(Josh Berkus\)](#)
- [All of Bruce Momjian's Talks](#)
- [The Design of Research Labs](#)

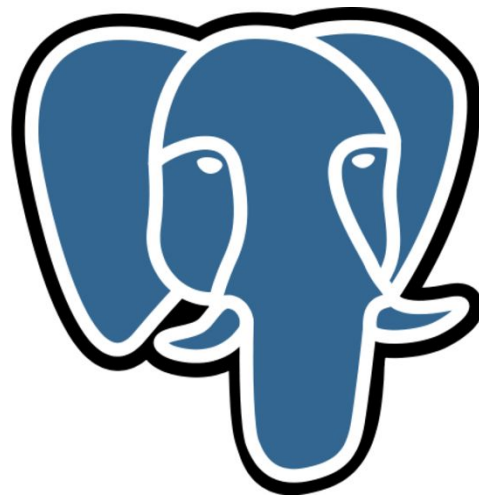
end

Thanks to Bruce Momjian, Oleg Bartunov, Jolly Chen, Marc Fournier, Greg Stark, Tatsuo Ishii, Magnus Hagander, and everyone else who contributed interviews, figures, and reviews.

Apologies to every project I wasn't able to discuss in such a short talk!

Bonus Logo History

- 2003 PostgreSQL Inc has a logo made
- Donates it to the community
- Slonik, the PostgreSQL Elephant is illustrated
- “Slonik” is Russian for “little Elephant”
- In Japan, a turtle is adopted
- Both are reliable, patient, strong... and slow.



Annex: Spare Slides

Future Work?

- VACUUM - wraparounds, freeze traffic
- JSON - operators, functions and indices
- Parallel query - splitting queries to run across multiple backends
- Scaling - beyond FDWs to... what, exactly? sharding?
- Connection pooling - pgpool in-core?
- Index types - RUM, VODKA, others?
- Data types - physical units, URLs, hierarchical documents?
- Storage engines - columnar data, append-only tables, LSM trees