

THE FUTURE OF THE POSTGRES EXTENSION ECOSYSTEM

**DAVID E. WHEELER
PGXN, TEMBO**



BEGINNINGS

LEGACY

Long history of extensibility

Two approaches

shared_preload_libraries

Pure SQL (including PLs)

A few intrepid adopters

PostGIS

BioPostgres

PL/R

PL/Proxy

pgTAP

POSTGRES 9.1

Dimitri Fontaine adds extensions

Key features:

Compile and install

CREATE/UPDATE/DROP EXTENSION

pg_dump and pg_restore

***“PostgreSQL today is not merely
a database, it’s an application
development platform.”***

ME, 2010



PGXN

FEATURES

Distribution

Source Code

Registration

Namespacing

Discovery

Search

Documentation

Tags

Installation

CLI

Compile & install

PGXS or Configure



PGXN

OUT OF SCOPE

Binary packaging

Binary distribution

Defer to apt/yum

Developer tooling

Build tooling

Defer to core (PGXS)



PGXN

HISTORY

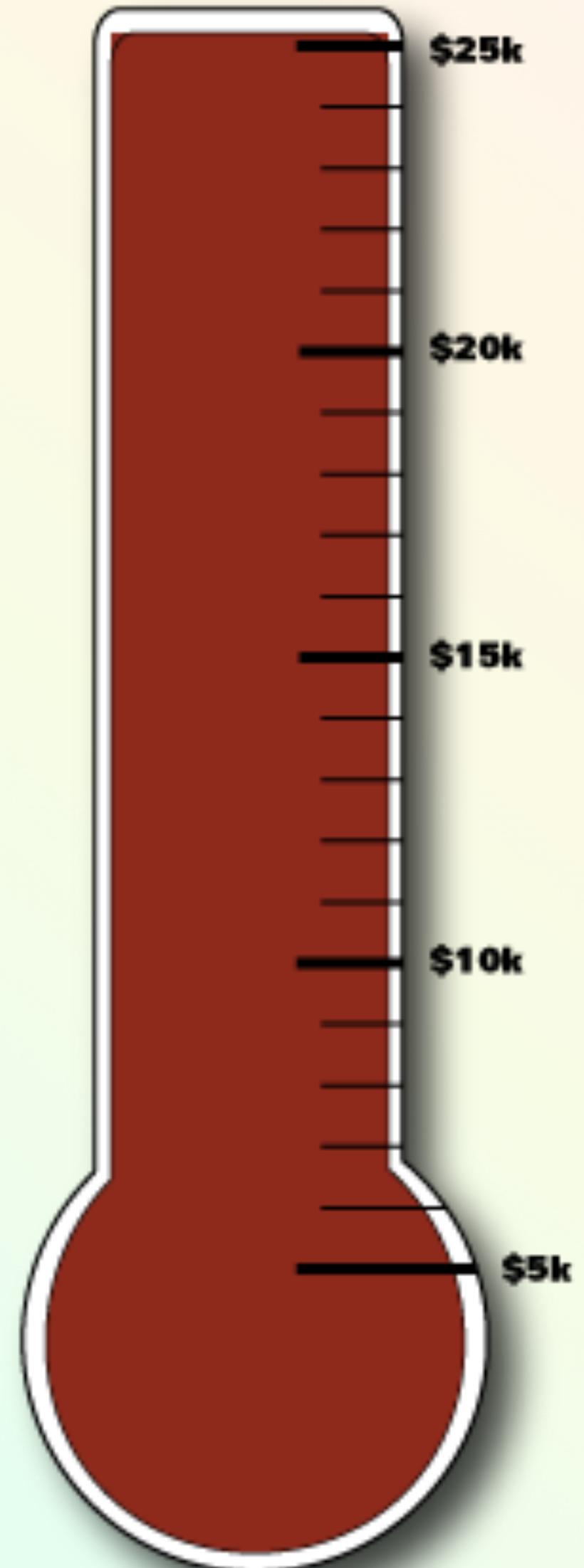
Started 2010

Funded December 2010

pgxn.org launched April 2011

Client by Daniele Varrazzo April 2011

Dev utils by Dickson S. Guedes June 2011



“In classic SDLC fashion, the PGXN POC shipped as an MVP and was neglected.”

ME, JUST NOW



TIME PASSED...

UPTAKE

PGXN: 396 Extensions/369 Distributions

joelonsql/PostgreSQL-EXTENSIONs.md: 1,186

CPAN: 217,860 Perl modules/45,137 distributions

PyPI: 543,205 Python projects

RubyGems: 180,839 Ruby Gems

crates.io: 146,401 Rust Crates



WHY?

LOST OPPORTUNITIES

POSTGRES EXTENSIONS:

Difficult to find and discover

Under-documented and difficult to understand

Maturity difficult to gauge

Hard to configure and install

No comprehensive binary packaging

Centralized source distribution insufficient

Insufficient developer tooling

The background features a series of overlapping, wavy shapes in shades of teal and dark blue, creating a sense of depth and motion.

FILLING THE GAPS

The Database Package Manager

For Postgres Trusted Language Extensions

[Getting started](#)[Documentation](#)

Download and install

Install extensions via a SQL command

```
select dbdev.install('olirice-index_advisor');
```

PUBLISHER HANDLE

EXTENSION NAME



A Postgres

Get Trunk

Cargo

cargo install pg-trunk

Copy

Trunk is an open-source package installer and registry for
PostgreSQL extensions.

Featured

7

Analytics

13

Auditing / Logging

7

All Extensions

Search 205 extensions

Search

> extensions, made easy

npm for PostgreSQL

[Brew](#)[Curl](#)

```
brew install pgxman/tap/pgxman 
```



EMPHASES

Ease of use

Platform neutrality

Stats

Curation

Architecture

x86-64 ⓘ

Operating system

Debian/Ubuntu ⓘ

Downloads

20 all time downloads

0 downloads in the last 30 days

1 download in the last 90 day

9 downloads in the last 180 days

```
> curl -sfL https://install.pgx.sh | sh
```

```
🎉 pgxman successfully installed
```

```
> pgxman install pgvector
```

The following Debian packages will be installed:
postgresql-14-pgxman-pgvector=0.5.1

```
> Do you want to continue? [Y/n] y
```

```
pgvector has been successfully installed
```

Featured

7

Analytics

13

Auditing / Logging

7

Change Data Capture

6

Connectors

27

Data / Transformations

49

Debugging

2

Index / Table Optimizations

14

Machine Learning

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Metrics

18

Orchestration

9

Procedural Languages

16

Query Optimizations

5

Search

11

Security

11

Tooling / Admin

14

MVPS

Trunk

Pull request integration

Postgres 14–16

Debian/Ubuntu-only

AMD64-only

210 Extensions

PGXMan

Form-based submission

Postgres 12–16

Debian/Ubuntu-only

AMD64 & ARM64

Apt-only

81 Extensions

dbdev

TLEs

CLI publishing

Postgres 11-16

No C/pgrx

pg_tle && pgsql-http

Count Unknown

STATE OF THE ECOSYSTEM

STATE OF AFFAIRS

Despite early promise...

No single source

Many incomplete attempts

Poor discovery

Difficult installation

Insufficient docs

Low adoption

But...

***“There sure has been a lot of
excitement around
extensions lately.”***

ME, AGAIN

OPPORTUNITIES (NEW)

PGXN V2

The New World Order

Started this year

Made possible by Tembo

Consider emerging patterns

Meditate on deficiencies

Engage deeply with the community

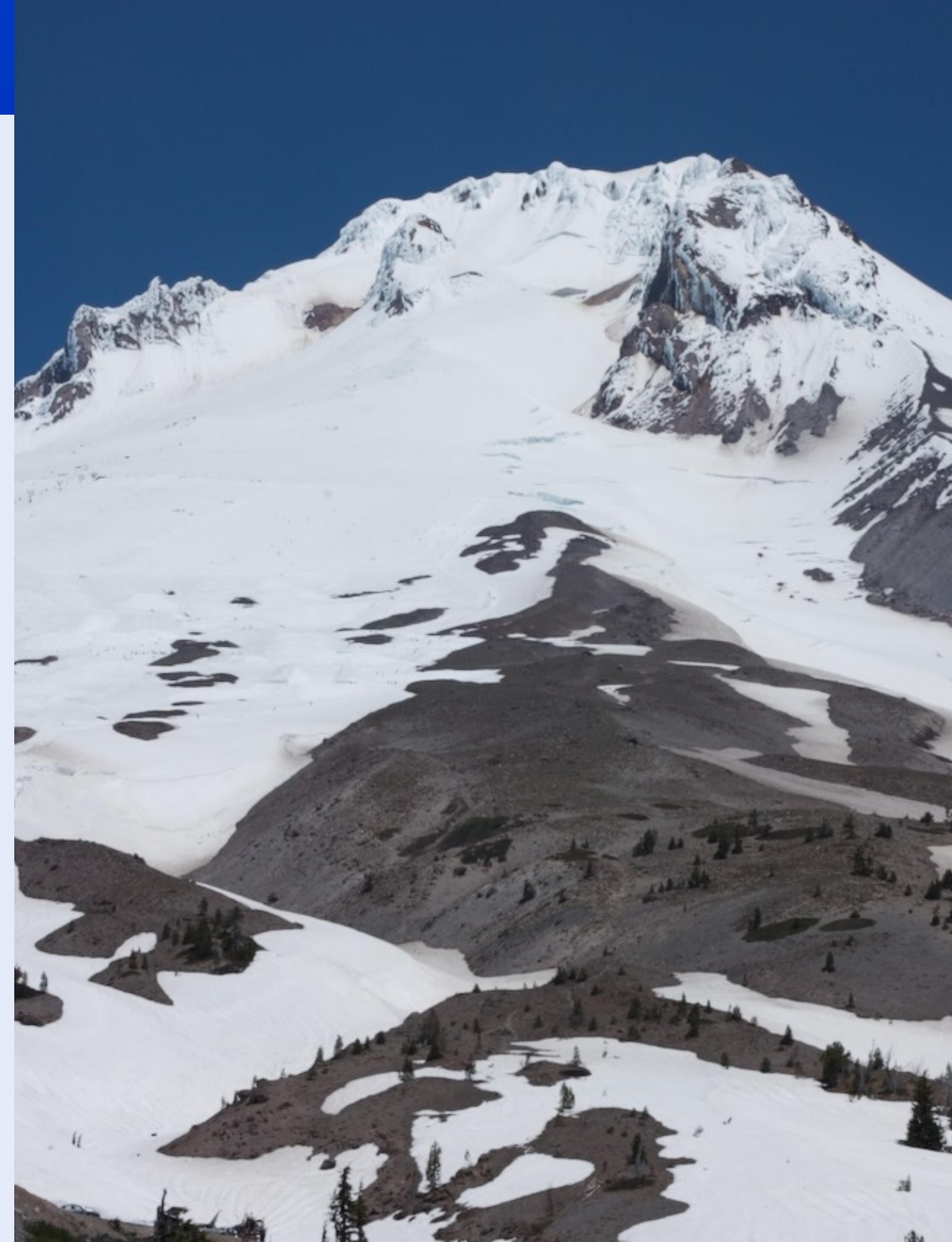
Design and implement new architecture

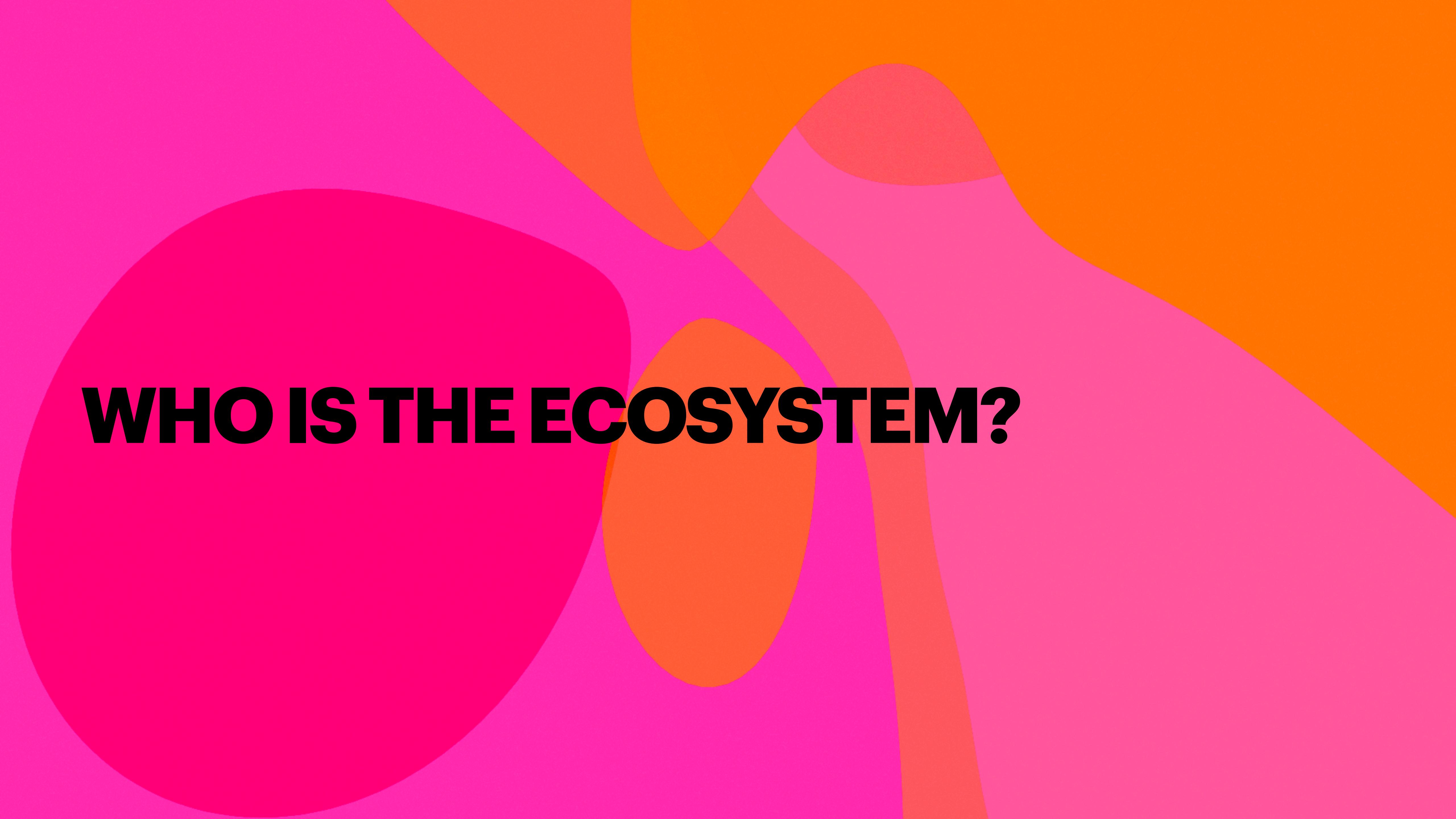
Serve the ecosystem for next decade



EXTENSION ECOSYSTEM SUMMIT

Collaborate to examine the ongoing work on PostgreSQL extension distribution, examine its challenges, identify questions, propose solutions, and agree on directions for execution.



The background features a dynamic composition of overlapping organic shapes in shades of pink, magenta, and orange. These shapes resemble petals or leaves, creating a sense of depth and movement. The colors transition from a bright magenta/pink on the left to a vibrant orange on the right.

WHO IS THE ECOSYSTEM?



EXTENSION AUTHORS



EXTENSION AUTHORS

Needs

Tools to create extensions

Learning materials

Standard patterns

Testing tools

Metadata management

Distribution & discovery

Packaging



EXTENSION AUTHORS

Delivery

Documentation

How-tos

Examples

Tutorials

References

Book?

CLI for tasks

Metadata

Testing

Scaffolding

Release

Documentation

CI/CD Automation

Canonical Registry

Discovery

Binary Packaging

Category Curation

Incentives

Quality Metrics

Documentation standards

Test coverage & matrices

Install Management

```
> pgxn installs ls
```

install	path
homebrew/14.12	/opt/homebrew/Cellar/postgresql@14/14.12
pgenv/16.3	/Users/david/.pgenv/pgsql-16.3
pgenv/17-devel	/Users/david/.pgenv/pgsql-17-devel
postgres.app/16.3	/Applications/Postgres.app/Contents/Versions/16/

```
> pgxn manage pgenv/16.3
```

```
Now managing extensions for pgenv/16.3
```

```
>
```

Develop CLI

```
› pgxn develop new --extension --language c --vcs github bike
```

Scaffolding C extension “bike”...

⚙️ Create bike.control

- META.json
- bike.control
- Makefile
- README.md

- src/bike.c
- sql/bike--0.0.1.sql
- doc/bike.md

- test/sql/base.sql
- test/expect/base.out

- .github/workflows/ci.yml
- .github/workflows/release.yml

✨ Init repository
git init bike

Develop CLI

```
› pgxn develop add-upgrade 0.0.2
```

Adding upgrade from 0.0.1 to 0.0.2...

- 🔥 Rename sql/bike--0.0.1.sql to sql/bike--0.0.2.sql
- ⚙️ Create sql/bike--0.0.1--0.0.2.sql
- 🆙 Update META.json
bike.control

Develop CLI

› pgxn develop require 14

Require PostgreSQL 14...

 Update META.json

› pgxn develop require semver 0.32.0

Requiring semver 0.32.0...

 Update META.json
semver.control

›

Develop CLI

```
> pgxn develop test --username postgres
```

```
Testing bike 0.0.2 in pgenv/16.3
```

```
make
```

```
  gcc -c -o src/pair.o src/pair.c  
  gcc src/pair.o -o src/pair.so
```

```
make install
```

```
  install -c -m 644 bike.control '/pgsql/share/extension/'  
  install -c -m 644 sql/bike--0.0.2.sql '/pgsql/share/bike/'  
  install -c -m 644 sql/bike--0.0.1--0.0.2.sql '/pgsql/share/bike/'  
  install -c -m 644 src/bike.so '/pgsql/lib/'
```

```
make installcheck PGUSER=postgres
```

```
ok 1          - base           15 ms  
1..1  
# All 1 tests passed.
```

Develop CLI

› `pgxn develop release`

Releasing bike 0.0.2 on PGXN...

- ✓ Validate META.json... Okay
- 📦 Bundle bike-0.0.2.zip with git archive...
- 🚀 Publish bike-0.0.2.zip on PGXN...

🎉 Done: <https://pgxn.org/theory/bike/0.0.2>

← CI

✓ Bump version in README to 0.32.1 #146

Summary

Jobs

✓ PostgreSQL 16

✓ PostgreSQL 15

✓ PostgreSQL 14

✓ PostgreSQL 13

✓ PostgreSQL 12

✓ PostgreSQL 11

✓ PostgreSQL 10

✓ PostgreSQL 9.6

✓ PostgreSQL 9.5

✓ PostgreSQL 9.4

✓ PostgreSQL 9.3

✓ PostgreSQL 9.2

Triggered via push 2 months ago

 theory pushed · 804f954 main

ci.yml

on: push

Matrix: build

✓ 12 jobs completed

Show all jobs

Annotations

12 warnings



Release on PGXN and GitHub

succeeded last month in 35s

> ✓ Set up job

> ✓ Initialize containers

> ✓ Check out the repo

> ✓ Bundle the Release

> ✓ Release on PGXN

> ✓ Generate Release Changes

> ✓ Create GitHub Release

> ✓ Upload Release Asset

> ✓ Post Check out the repo

> ✓ Stop containers

> ✓ Complete job



PACKAGERS



EXTENSION PACKAGERS

Needs

Release notification

Build automation

Predictable download URLs

Flexible sourcing

Extensive metadata

Feedback loops



EXTENSION PACKAGERS

Delivery

Release feeds & notification Webhooks

Package on every release

Build from source or repackage community binaries

Metadata to automate building from source

Report build and test failures

Submit download stats to root registry

```
Name:          bike
Version:       0.0.2
Source0:        https://pgxn.org/dist/theory/bike/bike-%{version}.zip
BuildRoot:      %{_tmppath}/%{name}-%{version}-%{release}-root-%(%{_id_u} -n)

%prep
%setup -q -n bike-%{version}

%build
pgxn package build

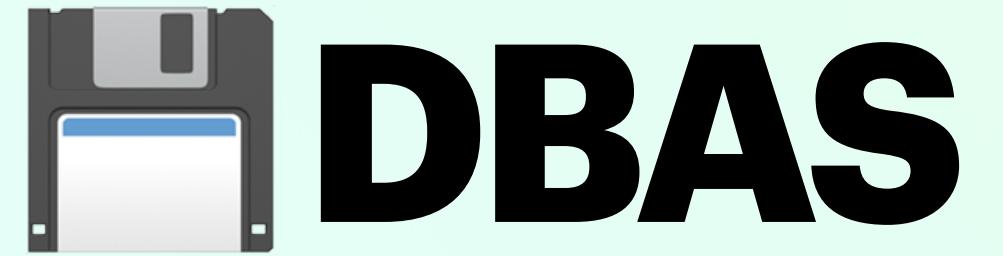
%install
pgxn package install --destdir $RPM_BUILD_ROOT
%{_fixperms} $RPM_BUILD_ROOT/*
%{_fixperms} $RPM_BUILD_ROOT/*/_data

%check
pgxn package installcheck --username postgres

%clean
rm -rf $RPM_BUILD_ROOT
```



ADMINISTRATORS



Needs

Reliable sourcing

Extension management

Inventory & audit reporting

Packaging choice & standardization

Trusted package sources

Internal packaging options

Mirroring & curation

Upgrade paths



Delivery

Extension Management

Fast binary installation

No compilation required

Use community binary packages

Or community OS packages

Or build own packages from binaries or source

Extension reporting

Registry access controls

Simplify upgrades (dupe extensions)?

Binary Registry Federation

Run own binary registry

Package your own extensions

Use the same tooling

Gate it by authentication or network

Subscribe to commercial registries with additional features

Binary Registry Mirroring

Mirror upstream registry

Fast local performance

Package Management

```
> pgxn package ls
```

Packages installed in pgdb/16.3:

package	installed	latest	description
core/citext	1.6.0	✓	data type for case-insensitive ch
core/jsonb_plperl	1.0.0	✓	transform between jsonb and plperl
core/unaccent	1.1.0	✓	text search dictionary that remov
theory/semver	0.32.0	0.32.1	Semantic version data type

```
>
```

Package Management

```
> pgxn upgrade -v theory/semver
```

```
Upgrading theory/semver 0.32.1 in pgdb-vum/16.3...
Found theory-semver-0.32.1+1.pg16+2.linux-arm64.zip
Unpacking theory-semver-0.32.1+1.pg16+1.linux-arm64.zip
Installing lib/semver.so in /usr/lib/postgresql/16/lib
Installing share/semver-0.32.1.sql in /usr/share/postgresql/16/extensions/
Installing share/semver.control in /usr/share/postgresql/16/extensions/
Installing doc/semver.md in /usr/share/doc/postgresql-doc-16
```

```
Done!
>
```

Also macOS,
***BSD, Windows,**

Package Management

```
> pgxn package ls
```

Packages installed in pgdb-yum/16.3:

package	installed	latest	description
core/citext	1.6.0	✓	data type for case-insensitive ch
core/jsonb_plperl	1.0.0	✓	transform between jsonb and plper
core/unaccent	1.1.0	✓	text search dictionary that remov
theory/semver	0.32.0	✓	Semantic version data type

```
>
```



theory > **semver**

[users](#) [tags](#) [recent](#)

semver



This Release: semver 0.32.1

Date: 2023-08-01

Status: Stable

Other Releases: 0.32.1 – 2023-08-01 ▾

Abstract: A semantic version data type

Description: A Postgres data type for the Semantic Version format with support for btree and hash indexing.

Released By: theory

License: PostgreSQL

Resources: [git](#) ♦ [repo](#) ♦ [bugs](#)

Special Files: [Changes](#) ♦ [LICENSE](#) ♦ [META.json](#) ♦ [Makefile](#) ♦ [semver.control](#)

Packagers: PGDB Yum ♦ PGDB Deb ♦ Trunk ♦ Homebrew ♦ Chocolatey ♦ PGXMan

Tags: semantic version ♦ semver ♦ version ♦ version number



USERS



USERS

Needs

Reliable index of extensions

Effective search

Curation & categorization

Quality signals

Version support info

Quick & easy installation

Informative documentation



USERS

Delivery

Canonical Registry

Discovery

Quality Signals

Category curation

Links & easy install instructions

Documentation

Getting started with extensions

How to use community tools

Beautiful extension documentation

Installation

One-line command

Fast binary installation

Many platforms

Many packages (Postgres installs)

OS packaging support

Usage

Documentation

Tested examples

Tutorials & references

Package Management

› pgxn search json

rating	package	version	date	
★★	hadi/json_fdw	1.0.0	2013-11-18	Foreign Data
★★★★★	theory/jsonschema	0.1.0	2024-04-30	JSON Schema
★★★	jma/yamltodb	0.10.0	2022-11-08	Database ch
★★	shanekilkelly/bedquilt	2.1.0	2016-09-12	A json docu
★★★	furstenheim/is_jsonb_valid	0.0.1	2017-08-17	JSONB valid
★★★	postgrespro/jsonb_schema	1.0.0	2020-08-24	Decouple js
★★	kungfury/jsoncdc	0.1.0	2017-11-23	Translates

›

Package Management

```
> pgxn install -v theory/jsonschema
```

```
Installing theory/jsonschema 0.1.0 into pgenv/16.3.  
Found theory-jsonschema-0.1.1+2.pg16+1.darwin-arm64.zip  
Unpacking theory-jsonschema-0.1.1+2.pg16+1.darwin-arm64.zip  
Installing lib/jsonschema.dylib in ~/.pgenv/pgsql-16.3/lib/  
Installing share/jsonschema-0.1.0sql in ~/.pgenv/pgsql-16.3/share/extension  
Installing share/jsonschema.control in ~/.pgenv/pgsql-16.3/share/extension  
Installing doc/jsonschema.md in ~/.pgenv/pgsql-16.3/share/doc/
```

```
Done!  
>
```

Package Management

```
> pgxn package ls
```

Packages installed in pgenv/16.3:

package	installed	latest	description
core/citext	1.6.0	✓	data type for case-insensitive ch
core/jsonb_plperl	1.0.0	✓	transform between jsonb and plperl
core/unaccent	1.1.0	✓	text search dictionary that remov
theory/jsonschema	0.1.0	✓	JSON Schema validation functions

```
>
```



INDUSTRY

Needs

Embrace and extend

Extension curation products

Extension rating products

Linked from root registry metadata

Offer extensions for customers

Use APIs to provide UX for DBaaS products

Immutability



INDUSTRY

Delivery

Specialized Registries

Additional metadata, stats, reports, signal

Binary Registry Federation

Curate extensions for customers by copying only approved extensions to own registry

Use APIs to provide UX for DBaaS products

Report back stats

Separate mutable extension directory



chm16



Extensions

[Manage](#) [Explore](#)

Search PGXN extensions

[Featured](#)

7

[Metrics](#)

16

[Query Optimizations](#)

4

[Change Data Capture](#)

2

[Orchestration](#)

6

[Index / Table Optim...](#)

13

[Procedural Languages](#)

14

[Machine Learning](#)

2

adminpack v2.1.0

adminpack serves as an auxilliary support to administrative management...

Tooling / Admin

amcheck v1.3.0

The amcheck module provides functions that allow you to verify the lo...

Index / Table Optimizations

auto_explain v15.3.0

The auto_explain module provides a means for logging execution plans ...

age v1.5.0

Leverage a graph database on top of the existing relational database.

Data / Transformations

argm v1.1.2

Argm postgresql extension: argmax/argmin and anyold aggregate functio...

Query Optimizations

autoinc

Functions for Autoincrementing

**Relies on
Community APIs**



THE VISION

PGXN V2 FEATURES

Canonical source registry

Search & discover all extensions

Streaming & federation

Quality metrics & reports

Binary packaging & distribution

Multi-platform & multi-version

Simple installation & package management

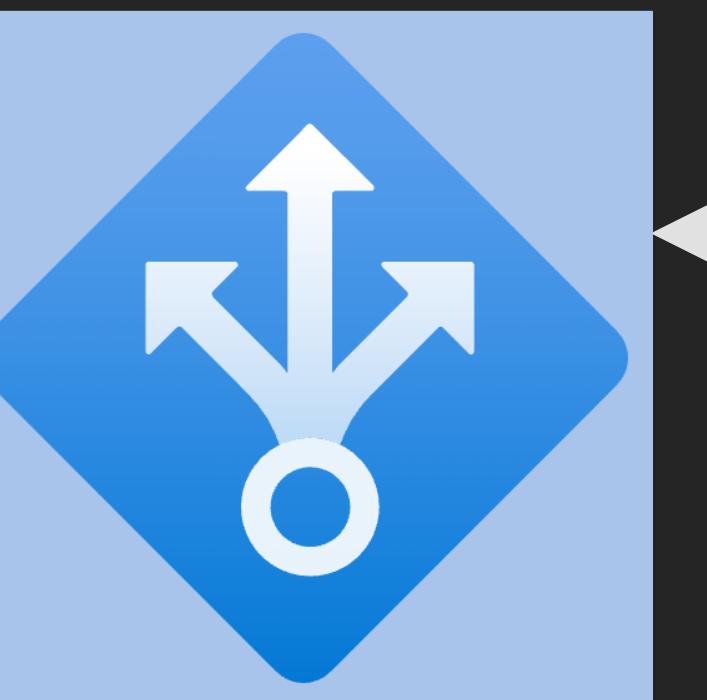
ARCHITECTURE SKETCH

- Search
- Curation
- Docs
- Download
- Badges
- Stats
- Links



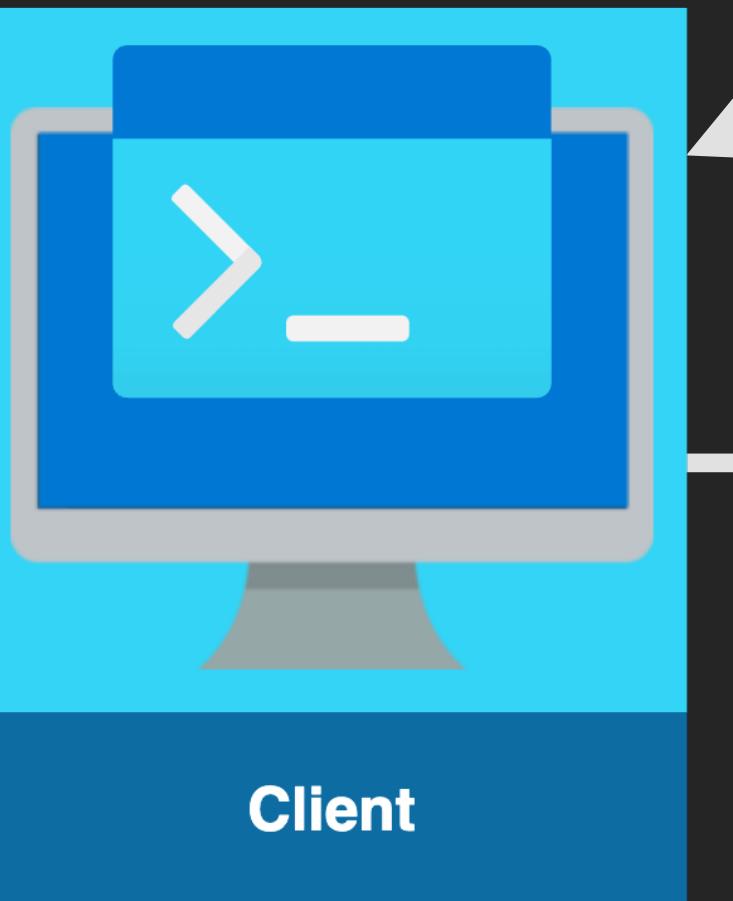
Web UX

- Register
- Release



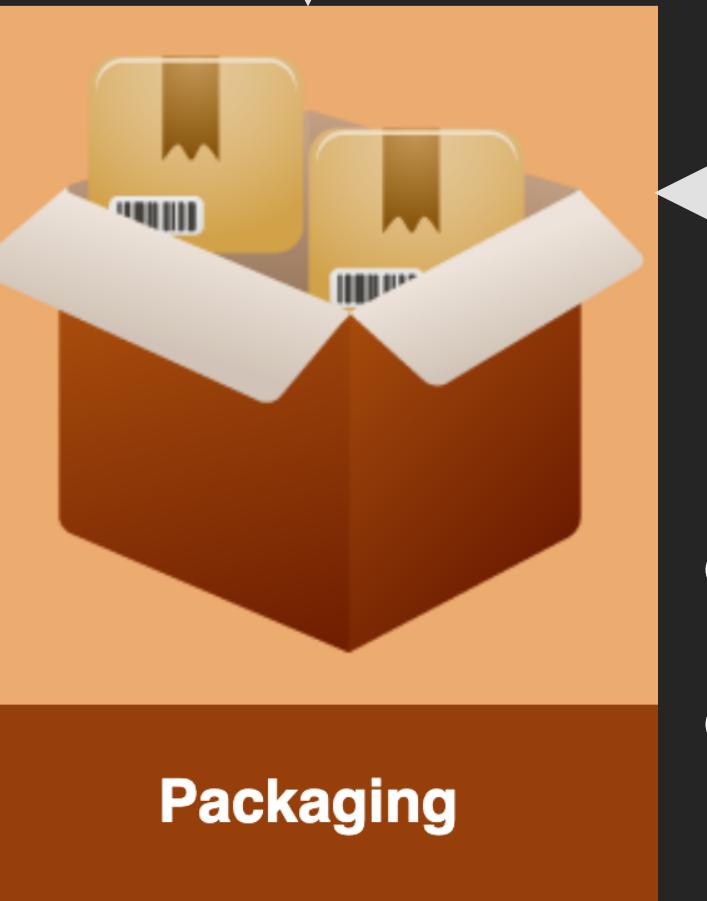
Root Registry

- Search
- Download
- Install



Client

- Compile
- Test



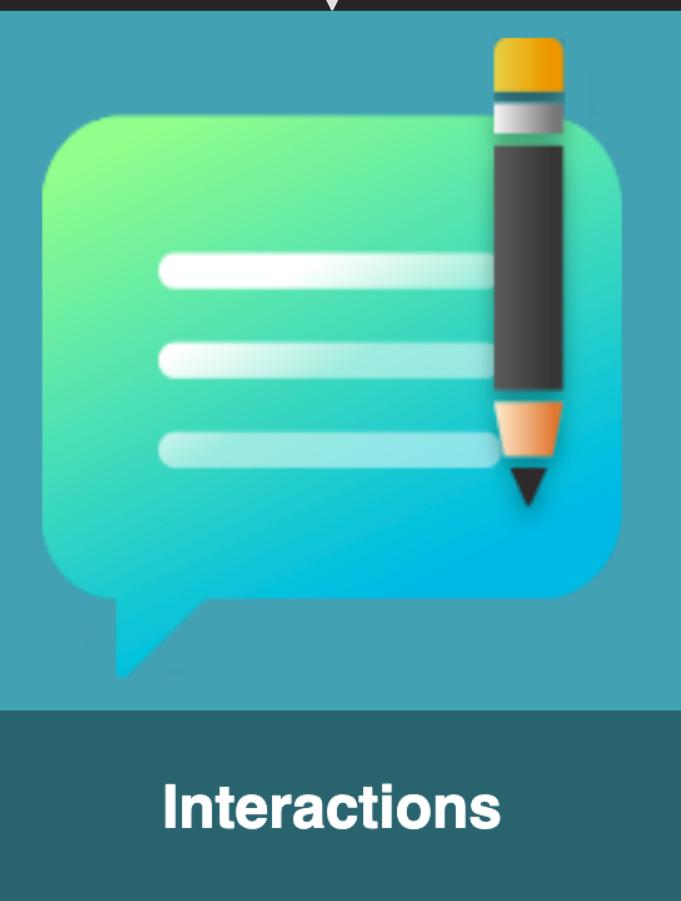
Packaging

- Package
- Release



Stats & Reports

- Announce
- Tests
- Stats
- Comments
- Reviews



Interactions

- Stream
- Notify
- Badges
- Reports

JOIN US

Background: https://wiki.postgresql.org/wiki/PGXN_v2

Architecture: https://wiki.postgresql.org/wiki/PGXN_v2/Architecture

Project: <https://github.com/orgs/pgxn/projects/1>

Tasks: <https://github.com/pgxn/planning/issues>

Writing: <https://justatheory.com/tags/pgxn/>

Slack: <https://pgtreats.info/slack-invite>

THANK YOU

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PGXN, TEMBO**