

The GUCS: A Three-Hour Tour



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agenda

#what are GUCS?

#understanding GUCS

#simple basic configuration

#new GUCS

#grand tour

related stuff



#_hba.conf
#recovery.conf
#pg_hba.conf
#libpq.so.1
#postgresql.conf
#pg_ctl.conf
system functions

What are GUCS?

#“Grand Unified Configuration Settings”

- A large set of global and session database settings which live in:

`src/backend/utils/misc/guc.c`

#Your main way of configuring and tuning the database.

- in addition to compile options, system configuration and schema tuning!

#Pronounced “gucks”

269 Switches and Levers



“269 Settings?!?”



“Don't worry, Skipper!”



The 19 (or so) Settings

most users need to adjust

#listen_addresses	#temp_file_limit
#max_connections	#statement_timeout
#ssl (+3)	#idle_in_transaction_timeout
#shared_buffers	#archive_command
#work_mem	#archive_mode
#maintenance_work_mem	#hot_standby_feedback
#autovacuum_work_mem	#wal_level
#effective_cache_size	#wal_keep_segments
#random_page_cost	#logging settings (3-8)
#data_checksums	



Figuring things out.

Setting GUCS

6

7

8

Six GUCS Contexts

#session

#superuser

#reload

#restart

#backend

#internal

Six GUCS Contexts

#session, or “user”

- can be set on per-session basis at runtime
- can also be changed by altering the ROLE

#superuser

- can be set at runtime for the whole server, but only by the superuser

Six GUCS Contexts

#reload, or “sighup”

- requires a soft restart of the postmaster to change
- also called a “HUP”

#restart, or “postmaster”

- can only be changed with a hard restart

More on reloading

#Three methods for reloading

```
pg_ctl -D PGDATA reload
```

```
kill -HUP <postmaster.pid>
```

```
SELECT pg_reload_conf();
```

Six GUCS Contexts

#backend

- developer settings which have to be set before session start

#internal

- compile-time settings provided for reference. Unalterable.

7 Places to set GUCs

- 1.postgresql.conf file
- 2.config directory
- 3.SET
- 4.pg_settings
- 5.ALTER objects
- 6.command-line switches & PGOPTIONS
- 7.ALTER SYSTEM SET

postgresql.conf

`#$PGDATA/postgresql.conf`

- can be relocated or symlinked

#Primary way to change GUCS

- for performance
- for logging
- for defaults

postgresql.conf

#just a big list of settings

#defaults are “# commented” out

#if a setting appears multiple times, the last one takes effect

#can use “include” files

config directory

include_if_exists='dir'

#directories containing multiple config files

#loaded in alphanum order

#better for config managers/automation

SET & SHOW

#Access GUCS in a SQL session

– SET changes

- only applies to user and superuser contexts
- best way to change things for only one session
- can be embedded in stored procedures

```
SET enable_mergejoin = false;
```

– SHOW displays

- SHOW ALL lets you see all GUCS

```
SHOW shared_buffers;
```

SET & SHOW: set_config

#set_config(setting, value, is_local)

- alternative to SET
- better for scripts since it takes a string

```
SELECT set_config('work_mem', '1GB', TRUE);
```

#current_setting (setting)

- alternative to SHOW

```
SELECT current_setting('lc_collate');
```

pg_settings

#Tabular representation of GUCS

- a “system view”
- can be queried
- can be updated, which runs a SET on the relevant parameter

```
SELECT * FROM pg_settings  
WHERE name = 'work_mem';
```

```
UPDATE pg_settings SET setting = '12MB'  
WHERE name = 'work_mem';
```

ALTER objects

You can ALTER some objects to change their configuration settings

- ROLES (users)
- DATABASEs
- FUNCTIONs
- Changes configuration setting when that object is used (unless overridden by a SET)

```
ALTER ROLE "data entry" SET  
search_path = 'entry, public';
```

ALTER ROLE + DB

```
ALTER ROLE IN DATABASE accts SET  
search_path = '$user, webview,  
contrib, public';
```

#now can set ROLE-based settings just for a
specific database

#essential for search_path, useful for others

ALTER objects

Good way to discriminate between applications & users

- set search_path
 - sometimes for security
- primitive resource management
 - change work_mem, etc. for specific ROLES, applications or reports
- localization
 - if different users have different desired displays

```
ALTER DATABASE sao_paulo SET timezone =  
'America/SaoPaulo';
```

ALTER objects

```
CREATE FUNCTION check_password(uname TEXT, pass TEXT)
RETURNS BOOLEAN AS $$
DECLARE passed BOOLEAN;
BEGIN
    SELECT (pwd = $2) INTO passed
    FROM   pwds
    WHERE  username = $1;

    RETURN passed;
END;
$$ LANGUAGE plpgsql
SECURITY DEFINER
-- Set a secure search_path: trusted
-- schema(s), then 'pg_temp'.
SET search_path = admin, pg_temp;
```

command-line and pgoptions

#Set options when you start PostgreSQL

- as command-line switches
- using the PGOPTIONS shell variable

#Good for testing

- and for restarting with recovery options

#Also good with containers

```
postgres -c 'bgwriter_delay = 50ms'  
export PGOPTIONS = '-c zero_damaged_pages = ON'
```

ALTER SYSTEM SET

set postgresql.auto.conf settings via the command-line

postgresql.auto.conf lives in PGDATA

alternative to managing postgresql.conf via template

```
ALTER SYSTEM SET work_mem = '128MB';
```



“That's a lot of places for settings.”

New: pg_file_settings

```
gucs=# select sourcefile, sourceline, name from pg_file_settings;
```

sourcefile	sourceline	name
/var/lib/postgresql/data/postgresql.conf	59	listen_addresses
/var/lib/postgresql/data/postgresql.conf	64	max_connections
/var/lib/postgresql/data/postgresql.conf	113	shared_buffers
/var/lib/postgresql/data/postgresql.auto.conf	3	work_mem

Eight types of GUCS

#Boolean

#Time

#Integer

#Strings

#Float

#ENUMs

#Memory / Disk

#Lists

Eight types of GUCS

#Boolean

- take TRUE | FALSE or ON | OFF

`enable_seqscan = on`

#Integer

- take whole numbers only

`max_connections = 700`

Eight types of GUCS

#Float

- take decimal values

```
random_page_cost = 3.75
```

#Memory / Disk Size

- can take integers
- but can also take “computer units”: kB, MB, GB

```
work_mem = 512MB  
shared_buffers = 4096
```

Eight Types of GUCS

#Time

- take time values (units vary)
- units are often omitted

```
authentication_timeout = 30s
```

#Strings

- take unchecked strings
- often refers to file locations or program names

```
log_directory = 'pg_log'
```

Eight Types of GUCS

#ENUMs

- take a string value from a prescribed list

```
wal_level = hot_standby
```

#Lists

- take a list of values, either freeform or ENUM

```
search_path = 'main, archive, "$user"'
```

What's New, GUCS?



23 settings eliminated

trace_locks_oidmin

wal_sender_delay

max_fsm_pages

regex_flavor

krb_server_hostname

add_missing_from

krb_realm

unix_socket_directory

max_fsm_relations

explain_pretty_print

debug_deadlocks

wal_debug

sql_inheritance

ssl_renegotiation_limit

silent_mode

trace_lwlocks

trace_locks

trace_locks_table

custom_variable_classes

log_btree_build_statsj

checkpoint_segments

trace_userlocks

krb_srvname

69 settings added

# autovacuum_multixact_freeze_max_age	# max_parallel_workers	# ssl_crl_file
# autovacuum_work_mem	# max_parallel_workers_per_gather	# ssl_dh_params_file
# backend_flush_after	# max_pred_locks_per_page	# ssl_ecdh_curve
# bgwriter_flush_after	# max_pred_locks_per_relation	# ssl_key_file
# checkpoint_flush_after	# max_pred_locks_per_transaction	# ssl_prefer_server_ciphers
# cluster_name	# max_replication_slots	# synchronous_standby_names
# data_checksums	# max_sync_workers_per_subscription	# syslog_sequence_numbers
# default_transaction_deferrable	# max_wal_size	# syslog_split_messages
# dynamic_shared_memory_type	# max_worker_processes	# temp_file_limit
# enable_gathermerge	# min_parallel_index_scan_size	# track_commit_timestamp
# enable_indexonlyscan	# min_parallel_table_scan_size	# track_io_timing
# event_source	# min_wal_size	# transaction_deferrable
# exit_on_error	# old_snapshot_threshold	# unix_socket_directories
# force_parallel_mode	# operator_precedence_warning	# vacuum_multixact_freeze_min_age
# gin_pending_list_limit	# parallel_setup_cost	# vacuum_multixact_freeze_table_age
# hot_standby_feedback	# parallel_tuple_cost	# wal_compression
# huge_pages	# quote_all_identifiers	# wal_consistency_checking
# idle_in_transaction_session_timeout	# replacement_sort_tuples	# wal_log_hints
# ignore_checksum_failure	# restart_after_crash	# wal_receiver_status_interval
# lock_timeout	# row_security	# wal_receiver_timeout
# log_file_mode	# session_preload_libraries	# wal_retrieve_retry_interval
# log_replication_commands	# ssl_ca_file	# wal_sender_timeout
# max_logical_replication_workers	# ssl_cert_file	# wal_writer_flush_after

tuning disk flush

#backend_flush_after

#bgwriter_flush_after

#checkpoint_flush_after

#wal_writer_flush_after

identification

#cluster_name

#event_source

SSL config

#ssl_ca_file

#ssl_cert_file

#ssl_crl_file

#ssl_dh_params_file

#ssl_ecdh_curve

#ssl_key_file

#ssl_prefer_server_ciphers

Timeouts & Resource Limits

#old_snapshot_threshold

#lock_timeout

#idle_in_transaction_session_timeout

#autovacuum_work_mem

#max_pred_locks_per_page

#max_pred_locks_per_relation

#max_pred_locks_per_transaction

New replication stuff!

#max_logical_replication_workers

#max_replication_slots

#max_sync_workers_per_subscription

#wal_receiver_status_interval

#wal_receiver_timeout

#wal_retrieve_retry_interval

#wal_sender_timeout

#synchronous_standby_names

WAL compression

#wal_compression

#wal_log_hints

parallel query

#max_worker_processes

#max_parallel_workers

#max_parallel_workers_per_gather

#force_parallel_mode

#enable_gathermerge

#parallel_setup_cost

#parallel_tuple_cost

Getting Simpler: WAL size

#was:

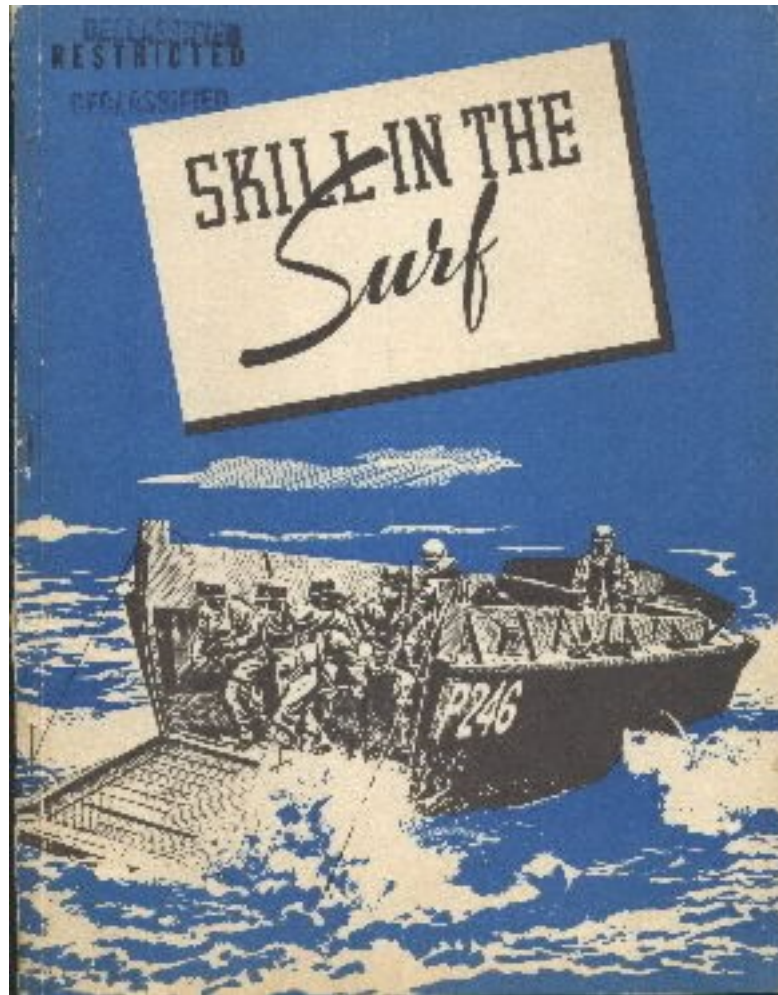
- checkpoint_segments
- wal_buffers
- checkpoint_timeout

#is:

- min_wal_size
- max_wal_size

... with good defaults!

GUCS Reference



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GUCS: the Grand Tour



Categories (mine)

#file locations

#statistics

#connection settings

#locks

#resource
management

#locale & formatting

#maintenance

#other settings &
defaults

#WAL & checkpoints

#compatibility

#replication

#custom GUCS

#query tuning

#developer options

#logging

#presets

custom variable classes

#for supporting various PostgreSQL Extensions

```
custom_variable_classes =  
'pg_stat_statements,auto_explain'  
  
pg_stat_statements.max = 10000  
pg_stat_statements.track = all  
  
auto_explain.log_min_duration = '200ms'  
auto_explain.log_nested_statements = on  
auto_explain.log_format = json
```

Contact

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