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**Autocuration: An Implementation of a  
Continuous Integration System Employed in the  
Development of AMD's Next-generation  
Microprocessor Core**

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# Agenda

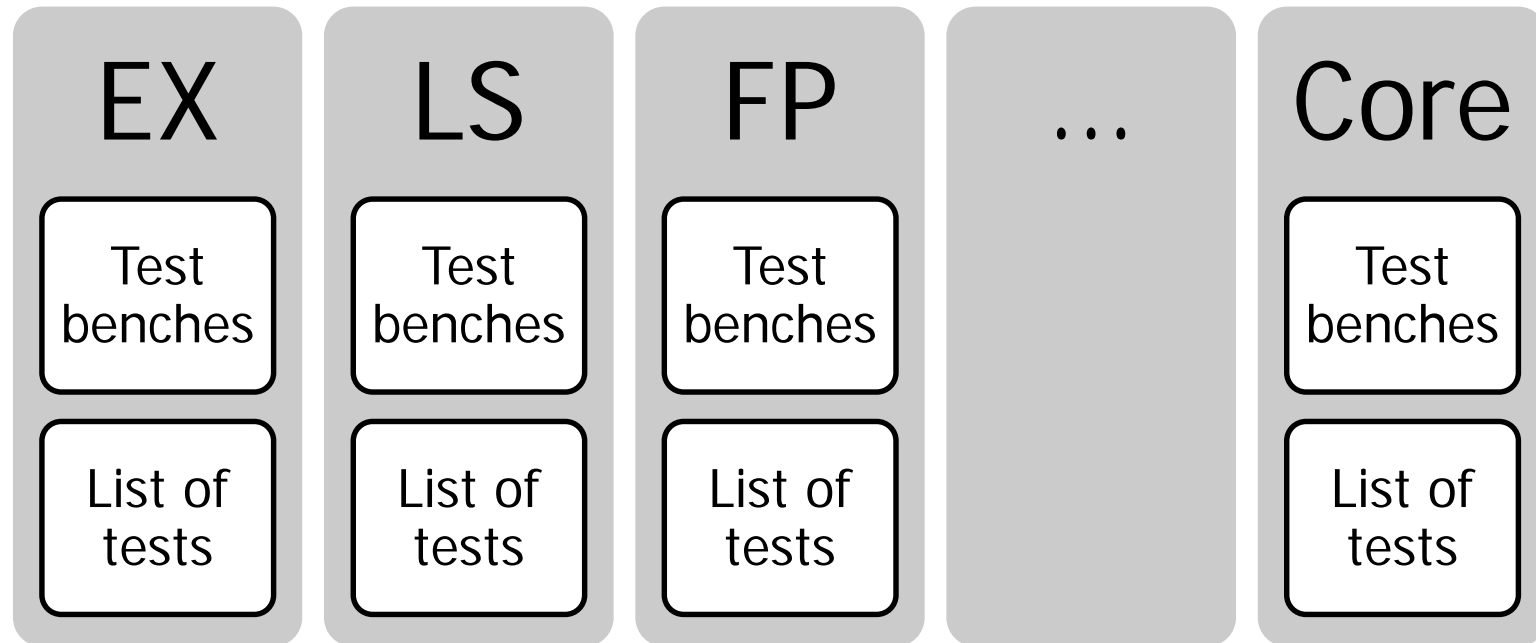
- Introduction
- Basic Workflow and Guidelines
- Details of the System
- Problems
- Ideas for Improvements
- Summary

# Introduction

- A version control system is used in all large microprocessor design projects.
- Complemented with a mechanism that validates each source-file commit.
- Part of a software development practice known as *continuous integration*.
- The Autocuration system is the set of tools comprising the automated continuous integration system used in the development of verification and Verilog HDL source codes for AMD's next-generation microprocessor core.

# Introduction

- Development team was organized into sub-teams based on the functional units of the core.

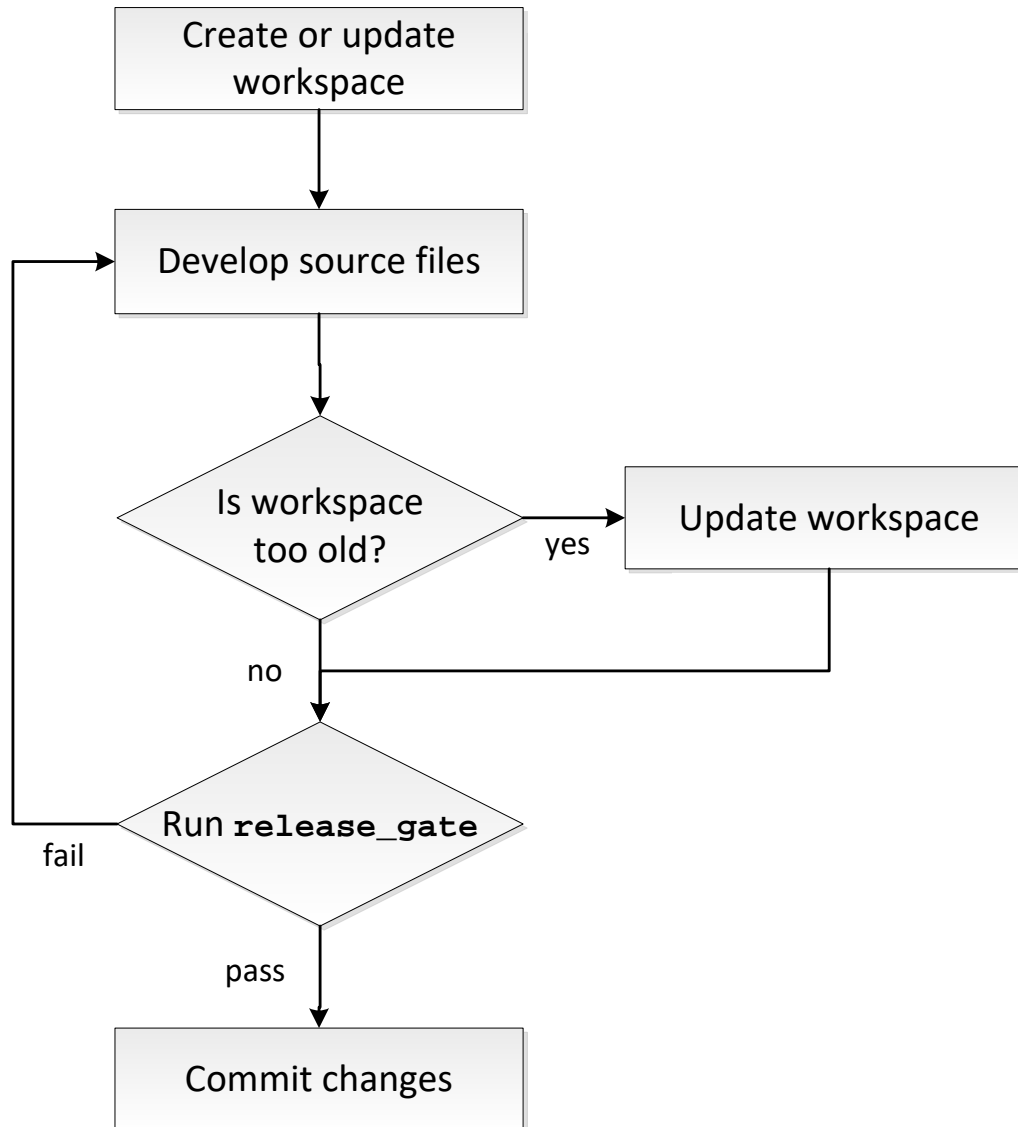


- Developed techniques to dynamically select the appropriate sub-set of regression test suites.

# Features of the system

- Efficient use of compute resources
- Continuous integration of all units of the core
- Individual “latest passing” tag for each unit
- Web site for viewing results of each commit
- Autocuration database is a good source for generating metrics

# Basic Workflow and Guidelines



# Basic Workflow and Guidelines

- Complicated merge conflicts warrant a rerun of **release\_gate**.
- Latest Known Good version passes all the regression test suites in **release\_gate**.
- The test suites in **release\_gate** should not take too long.
  - Meant to be an interactive process.
  - Also run by Autocuration on each commit.
- Key difference in the **release\_gate** run by Autocuration and the one run locally: former includes more changesets.

# Details of the System

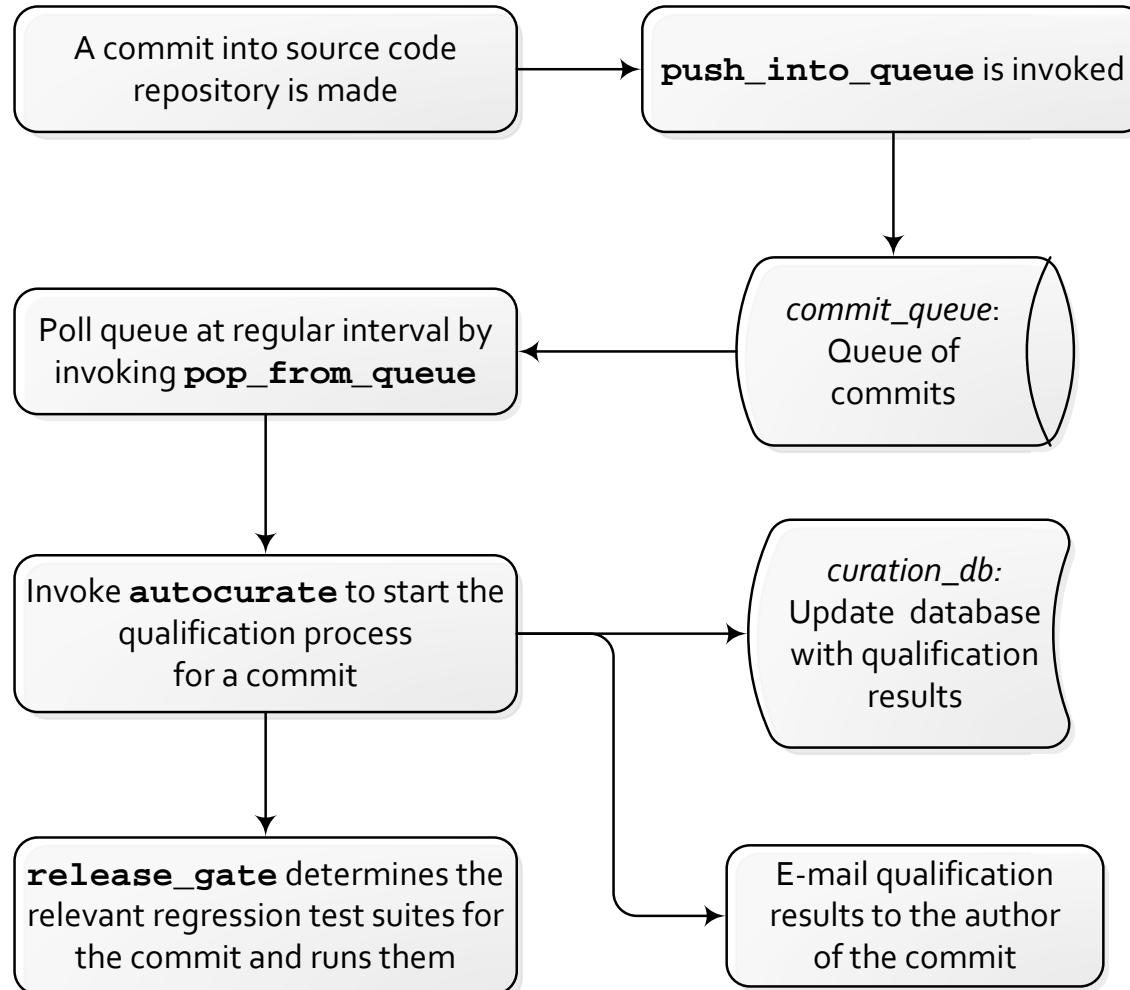
## Components of the Autocuration system

Perl scripts	Crontab entries
<ul style="list-style-type: none"> <li>• <code>push_into_queue</code></li> <li>• <code>pop_from_queue</code></li> <li>• <code>autocurate</code></li> <li>• <code>ac_cleanup</code></li> <li>• <code>release_gate</code></li> <li>• <code>auto_commit</code></li> </ul>	<ul style="list-style-type: none"> <li>• Run <code>pop_from_queue</code> every 5 minutes</li> <li>• Run <code>ac_cleanup</code> every 5 hours</li> <li>• Run <code>auto_commit</code> every 4 hours</li> </ul>
PHP scripts	MySQL database tables
<ul style="list-style-type: none"> <li>• <code>curation_index.php</code></li> <li>• <code>rm_from_queue.php</code></li> </ul>	<ul style="list-style-type: none"> <li>• <i><code>commit_queue</code></i></li> <li>• <i><code>curation_db</code></i></li> </ul>

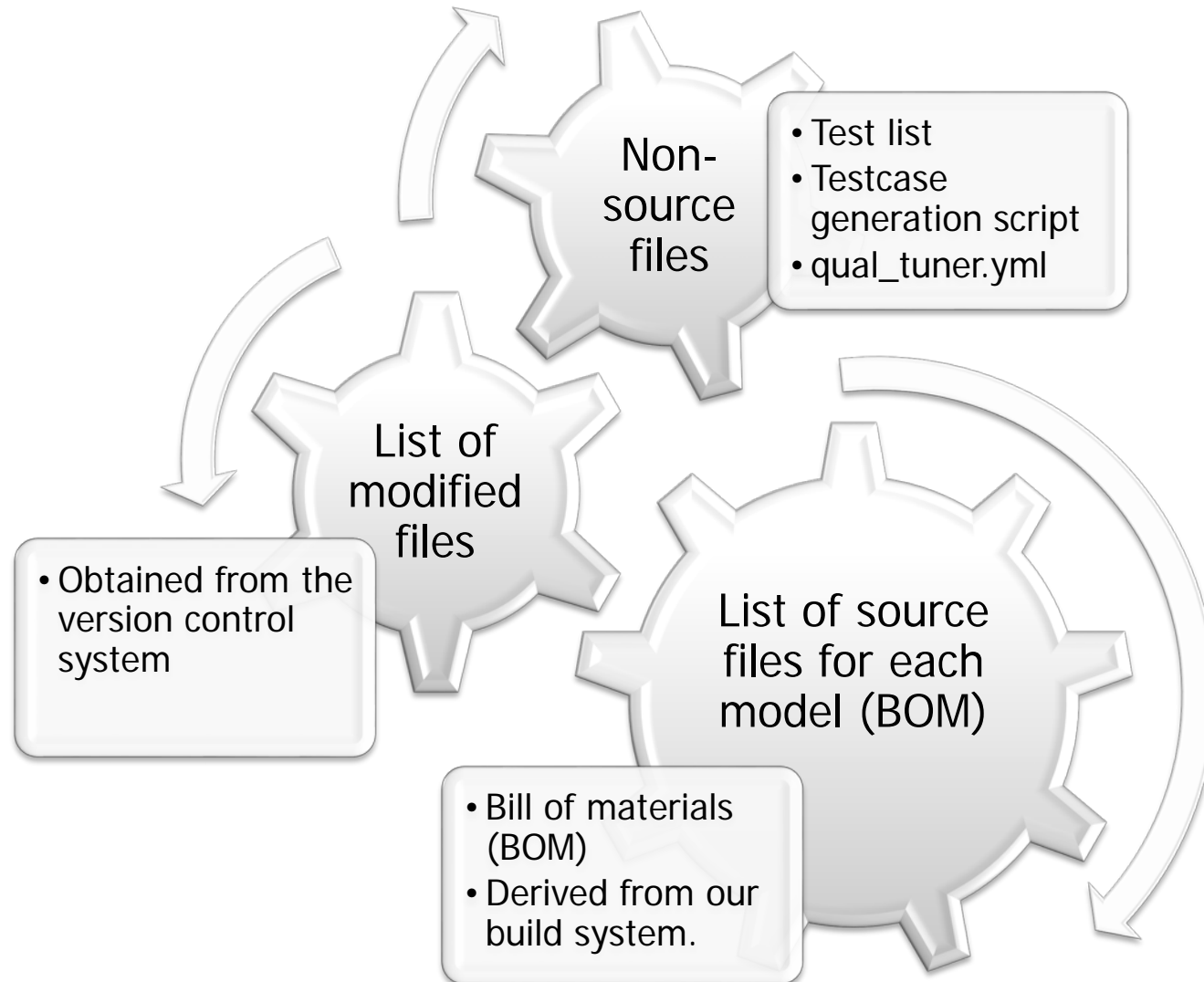


# Details of the System

## Autocuration Process Flow Diagram



# Dynamic Selection of Qualifications to Run



# Result States of a Qualification

- By inheriting the results of the previous commit, we can mark a commit as the Latest Known Good version even though only a sub-set of the unit suites were run.



Passed



Not run,  
but passed



Failed



Not run, but  
failed



Undetermined



In progress

# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	ST	Unit Suite Status						PG
				EX	LS	ID	FP	CU	CO	
10-20-11 17:59 UTC	@3330 [qual] [diff]	user_A	I	I	I	I	I	I	I	12/33
10-20-11 17:48 UTC	@3329 [qual] [diff]	user_B	I	I	I	I	I	I	I	18/25
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_C	P	NP	NP	P	NP	NP	P	DONE
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_D	F	NP	NP	NF	NP	P	P	DONE
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	NP	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	P	DONE
10-20-11 16:54 UTC	@3324 [qual] [diff]	user_C	U	NP	P	P	NP	U	P	DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]	user_F	U	NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

# Sample Autocuration Web Page

	Unit	Author	ST	Unit Suite Status						PG
				EX	LS	ID	FP	CU	CO	
	[qual] [diff]	user_A	I	I	I	I	I	I	I	12/33
10-20-11 17:48 UTC	@329 [qual] [diff]	user_B	I	I	I	I	I	I	I	18/25
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_C	P	NP	NP	P	NP	NP	P	DONE
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_D	F	NP	NP	NF	NP	P	P	DONE
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	NP	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	P	DONE
10-20-11 16:54 UTC	@3324 [qual] [diff]	user_C	U	NP	P	P	NP	U	P	DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]	user_F	U	NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

@3328 is the current Latest Known Good version.

# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	ST	Unit Suite Status						PG
				EX	LS	ID	FP	CU	CO	
10-20-11 17:59 UTC	@3330 [qual] [diff]	user_A	I	I	I	I	I	I	I	12/33
10-20-11 17:48 UTC	@3329 [qual] [diff]	user_B	I	I	I	I	I	I	I	18/25
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_C	P	NP	NP	P	NP	NP	P	DONE
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_D	F	NP	NP	NF	NP	P	P	DONE
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	NP	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	P	DONE
10-20-11 16:54 UTC				NP	P	P	NP	U	P	DONE
10-20-11 16:50 UTC				NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]		U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

user\_F's 3321 commit failed the FP unit suite and also timed out while waiting to inherit user\_H's results.

# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	ST	Unit Suite Status						PG
				EX	LS	ID	FP	CU	CO	
10-20-11 17:59 UTC	@3330 [qual] [diff]	user_A	I	I	I	I	I	I	I	12/33
10-20-11 17:48 UTC	@3329 [qual] [diff]	user_B	I	I	I	I	I	I	I	18/25
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_C	P	NP	NP	P	NP	NP	P	DONE
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_D	F	NP	NP	NF	NP	P	P	DONE
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	NP	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	P	DONE
10-20-11 16:54 UTC	@3324 [qual] [diff]									DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]									DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

Because user\_F's commit modified only files that mattered to the FP and CO suites, the rest are assigned a U state.

# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	ST	Unit Suite Status						PG
				EX	LS	ID	FP	CU	CO	
10-20-11 17:59 UTC	@3330 [qual] [diff]	user_A	I	I	I	I	I	I	I	12/33
10-20-11 17:48 UTC	@3329 [qual] [diff]	user_B	I	I	I	I	I	I	I	18/25
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_C	P	NP	NP	P	NP	NP	P	DONE
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_D	F	NP	NP	NF	NP	P	P	DONE
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	NP	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	user_F	P	NP	NP	P	P	P	P	DONE
10-20-11 16:54 UTC	@3324 [qual] [diff]	user_G	P	NP	NP	P	NP	U	P	DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]	user_H	P	NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

The EX and LS columns recovered from a U state in user\_G's 3322 commit because EX and LS files were modified.



# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	ST	Unit Suite Status						PG
				EX	LS	ID	FP	CU	CO	
10-20-11 17:59 UTC	@3330 [qual] [diff]	user_A	I	I	I	I	I	I	I	12/33
10-20-11 17:48 UTC	@3329 [qual] [diff]	user_B	I	I	I	I	I	I	I	18/25
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_C	P	NP	NP	P	NP	NP	P	DONE
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_D	P	NP	NP	P	NP	NP	P	DONE
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	P	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	P	DONE
10-20-11 16:54 UTC	@3324 [qual] [diff]	user_C	U	NP	P	P	NP	U	P	DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]	user_F	U	NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

The CU column only recovered from a U state on the cron-driven no-op 3325 commit.

# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	ST	Unit Suite Status						PG
				EX	LS	ID	FP	CU	CO	
10-20-11 17:59 UTC	@3330 [qual] [diff]	user_A	I	I	I	I	I	I	I	12/33
10-20-11 17:48 UTC	@3329 [qual] [diff]	user_B	I	I	I	I	I	I	I	18/25
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_E	I	P	P	P	NP	NP	P	DONE
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_E	I	P	P	P	NP	P	P	DONE
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	NP	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	P	DONE
10-20-11 16:54 UTC	@3324 [qual] [diff]	user_C	U	NP	P	P	NP	U	P	DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]	user_F	U	NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

user\_E's 3326 commit introduced a failure in the ID unit suite.

# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	ST	Unit Suite Status					PG	
								CU		CO
10-20-11 17:59 UTC	@3330 [qual] [diff]							I	I	12/33
10-20-11 17:48 UTC	@3329 [qual] [diff]	user_B						I	I	18/25
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_C	P	NP	NP	P	NP	NP	P	DONE
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_D	F	NP	NP	NF	NP	P	P	DONE
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	NP	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	P	DONE
10-20-11 16:54 UTC	@3324 [qual] [diff]	user_C	U	NP	P	P	NP	U	P	DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]	user_F	U	NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

user\_C's 3328 commit reverted user\_E's 3326 bad commit.

## Team of Curators

- The team of curators is made up of one representative from each unit.
- Ensure head of the trunk is always passing.
- Periodically monitor the health of the trunk.
- Fix or revert a bad commit.

# Problems

- Difficulty in identifying subsequent bad commit if an earlier bad commit was made.
- New releases can be blocked by a bad commit because the Latest Known Good version doesn't progress.

# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	Unit Suite Status					PG		
			LS	ID	FP	CU	CO			
10-20-11 17:59 UTC	@3330 [qual] [diff]	user_D	I	I	I	I	I	12/33		
10-20-11 17:48 UTC	@3329 [qual] [diff]	user_D	I	I	I	I	I	18/25		
10-20-11 17:23 UTC	@3328 [qual] [diff]	user_D	NP	NF	P	NP	NP	DONE		
10-20-11 17:12 UTC	@3327 [qual] [diff]	user_D	NP	NF	NP	P	P	DONE		
10-20-11 17:07 UTC	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	P	DONE	
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	DONE	
10-20-11 16:54 UTC	@3324 [qual] [diff]	user_C	U	NP	P	P	NP	U	P	DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]	user_F	U	NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

If user\_E's 3326 bad commit was not fixed or reverted, it would continue to propagate, preventing the Latest Known Good version from progressing.

# Sample Autocuration Web Page

Date mm-dd-yy HHMM	Commit	Author	ST	Unit Suite Status						PG
				EX	LS	ID	FP	CU	CO	
10-20-11 17:59 UTC	@3330 [qual] [diff]	user_A	I	I	I	I	I	I	I	12/33
	@3329 [qual] [diff]	user_B	I	I	I	I	I	I	I	18/25
	@3328 [qual] [diff]	user_J	F	NP	NP	NF	P	NP	NP	DONE
	@3327 [qual] [diff]	user_D	F	NP	NP	NF	NP	P	P	DONE
	@3326 [qual] [diff]	user_E	F	NP	NP	F	NP	NP	P	DONE
10-20-11 17:00 UTC	@3325 [qual] [diff]	Admin	P	P	P	P	P	P	P	DONE
10-20-11 16:54 UTC	@3324 [qual] [diff]	user_C	U	NP	P	P	NP	U	P	DONE
10-20-11 16:50 UTC	@3323 [qual] [diff]	user_F	U	NP	NP	U	P	U	P	DONE
10-20-11 16:48 UTC	@3322 [qual] [diff]	user_G	U	P	P	U	U	U	U	DONE
10-20-11 16:43 UTC	@3321 [qual] [diff]	user_F	U	U	U	U	F	U	P	DONE
10-20-11 16:36 UTC	@3320 [qual] [diff]	user_H	P	NP	NP	NP	NP	NP	P	DONE
10-20-11 16:25 UTC	@3319 [qual] [diff]	user_I	P	P	NP	NP	NP	NP	P	DONE

@3325 will then be the Latest Known Good version instead of @3328.

# Ideas for Improvement

- Further reduction of resource usage by combining several commits in a **release\_gate** run.
- Have a process that periodically walks through the result states for all completed commits to convert all the U states to either NP or NF states.
- Stage all commits in a branch. An automated branch-to-trunk merge process will be done for commits that pass **release\_gate**.



# Summary

- All logic design and verification engineers rely on the Autocuration system in their daily work.
- It makes efficient use of resources to provide fine-grained details about the quality of each commit.
- It provides individual Latest Known Good tag for each unit, which facilitates the nightly regression flow.
- The system has been proven to work for a large microprocessor design project with engineers spread across many geographical sites.

**Thank You!**