



Efficient application of AI algorithms for large-scale verification environments based on NoC architecture

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vtool smart
verification

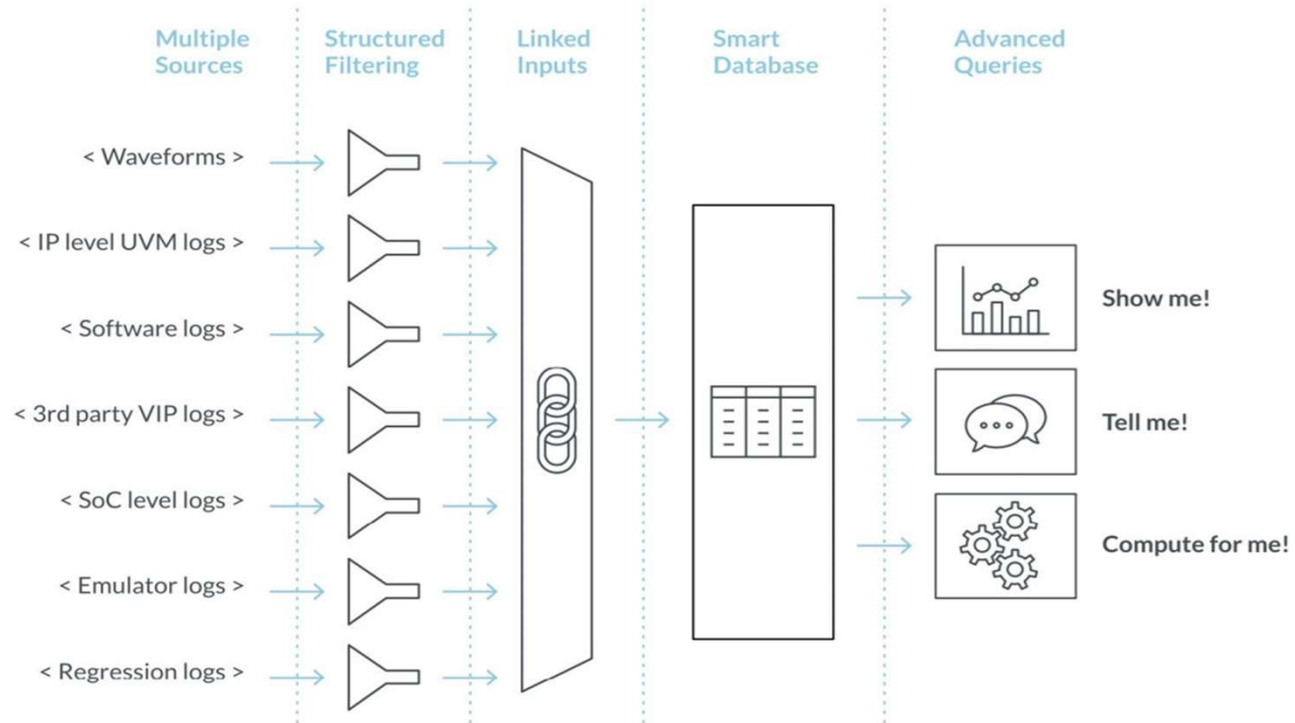
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Objectives

- Improve standard verification techniques
- Address key challenges in large-scale verification environments
- Understand verification outcome as one big-data dataset
- Explore areas where AI/ML are applicable for verification
- Introduce a novel approach: AI on unified big-data datasets from multiple sources

AI-driven verification flow



Typical NoC verification challenges

1. Unexpected transactions, for
 - Matching source and destination endpoints in failing transfers
 - Resolving common failures
 - Interleaving burst translations
2. Error response transactions, for reserved and/or broken address ranges
3. Distribution of transaction, for qualifying test and verification environment
4. Utilization of outstanding transactions, for improved performance
5. Detection of repetitive transaction patterns irregularity, for measuring throughput and detection of transfer timeouts

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Efficient test generation and distribution



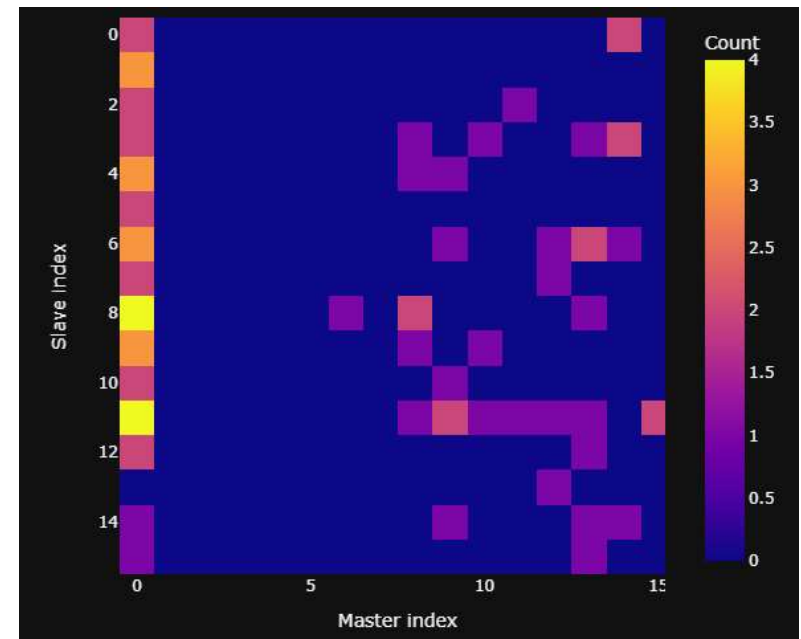
Transaction distribution

Issues

- Test quality
- Constraint issues
- Even distribution

Benefits

- Understand test scenarios before implementing functional coverage
- Cover test scenarios, faster
- Shorter regression time



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Faster verification and debugging



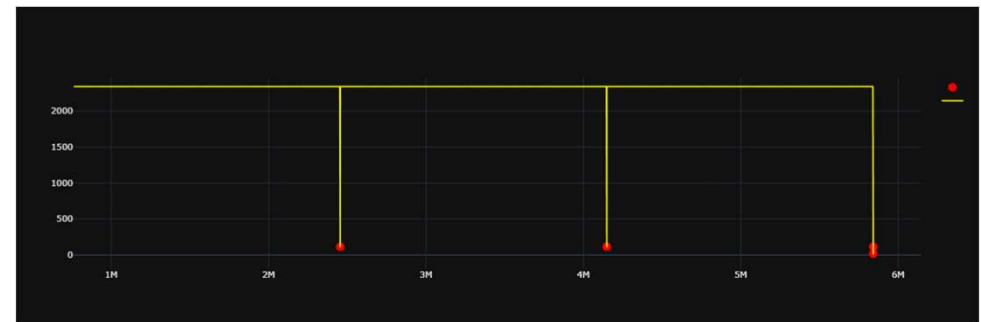
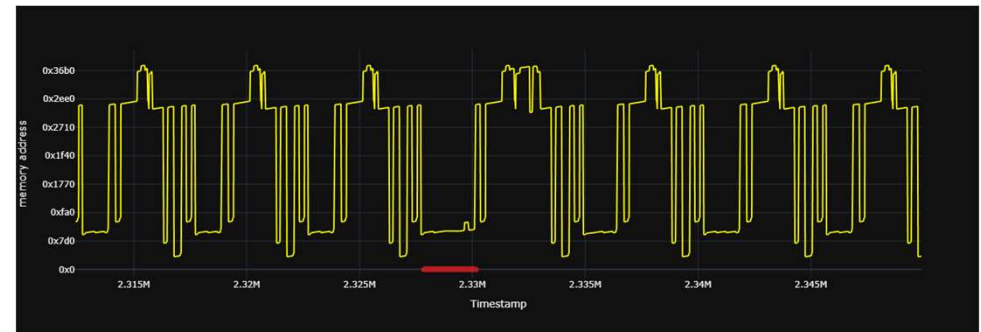
Detecting irregularity in repetitive transaction patterns

Issues

- HW/SW co-verification
- Multiple sources: Tarmac, UVM logs, waveforms, disassembly

Benefits

- Detecting unexpected branches in SW
- Unexpected interrupt
- Drops in efficiency
- Anomaly in transaction duration



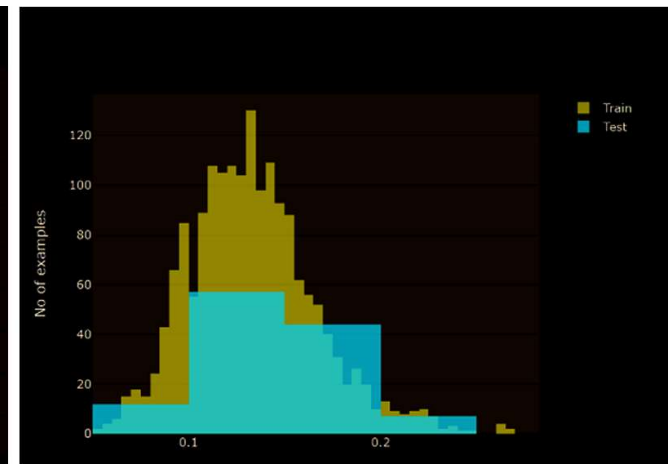
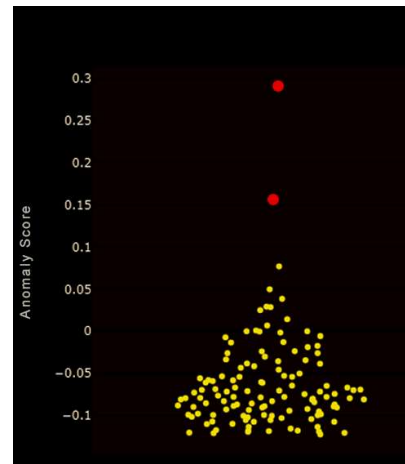
Neural network model training and deployment

Issues

- Incremental learning as project progresses
- Training on specific ENV, transactions, and interface
- Bugs not revealed by checkers

Benefits

- Verification-tailored models
- Auto-anomaly detection
- Checker validation



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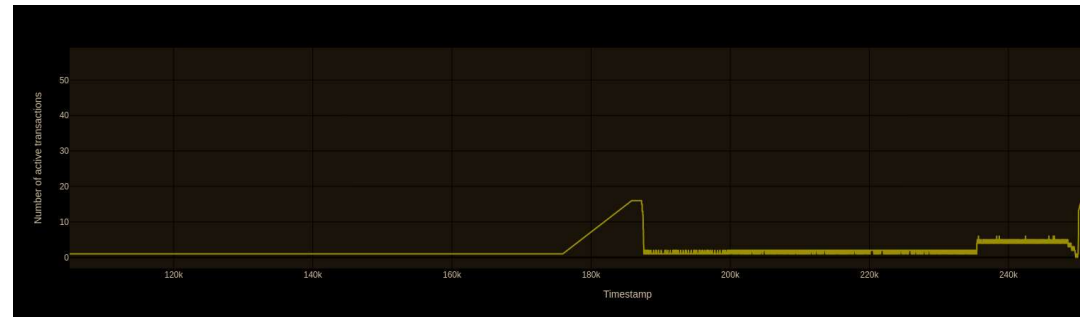
Performance, throughputs, and bottlenecks



Outstanding transactions utilization

Issues

- Interface utilizations
- Throughput and performance
- HW/SW profiling



Benefits

- Find bottlenecks
- Improve test scenarios
- Maximize outstanding transactions

Achievements of our AI-driven approach

Features

- Automated multi-dimensional anomaly detection
 - Timing: Consider duration of transactions and gaps between transactions
 - Values: Set of data fields
- Chat GPT: Ask questions on unified database
- Comparison of passing and failing tests
- Address distance

Benefits

- Bug detection
- Quality of test: Distribution
- Utilization (number of outstanding transactions)
- Performance (duration of transaction and gaps between transactions)
- Detect bottlenecks in the system

Conclusion

New mindset. Simulation as one big-data dataset

New top-down approach. Transform standard verification from bottom-up to macro-level process

AI-driven. Effective test generation and distribution

Speed and ease. Faster verification and debugging

Utilization. Optimize performance, thruputs, and bottlenecks

Beyond thinking. Amplify engineers' capacity for capturing SW irregularities and unused bandwidths across interconnected transmission

Limitless potential. Alleviate verification workloads with AI/ML

Thank you

