QA Best Practices:
GUI Test Automation for EDA Software

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Agenda

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Introduction

- Digital transformation
- Massive Industrialization
- What’s common in every electronic system/device around you?
- Semiconductor chips (Integrated Circuits/ICs): The unseen tiny pieces of tech enabling this transformation.
Semiconductor Industry: The end use drivers

<table>
<thead>
<tr>
<th>End-Use Category</th>
<th>Computer</th>
<th>Communication</th>
<th>Consumer</th>
<th>Industrial</th>
<th>Automotive</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Growth</td>
<td>21.2</td>
<td>1.2</td>
<td>-3.0</td>
<td>8.2</td>
<td>-0.3</td>
<td>-11.8</td>
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<tr>
<td>Total Value ($B)</td>
<td>142.2</td>
<td>137.6</td>
<td>53.0</td>
<td>52.9</td>
<td>50.1</td>
<td>4.6</td>
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</tbody>
</table>
Semiconductor Industry: U.S. Market Share

2020 GLOBAL MARKET SHARE

- U.S.: 47%
- Korea: 20%
- Japan: 10%
- Europe: 10%
- Taiwan: 7%
- China: 5%
Semiconductor Industry: Strategic collaboration for Consumers

- Semiconductor Company ➔ Tape out
- Foundry ➔ Manufacture
- EDA Industry ➔ Facilitate the design and manufacturing processes by providing all the tools for various abstraction levels.
EDA Software: What are these?

- Electronic Design Automation tools (E-CAD)
- These are software tools for designing & manufacturing electronic systems, that facilitate,
  - Integrated Circuits (ICs)
  - Printed Circuit Boards (PCBs)
  - System level design
- Can be broadly categorized into tools for,
  - Technology computer-aided design, TCAD.
  - Design for Manufacturability, DFM
  - Silicon Lifecycle Management, SLM
  - Driving Intellectual Properties, IPs
EDA Software: Contribution/Impact

- Support technological scaling
- Fulfill the surge in need for complex ICs
- Complex ICs such as CPUs and GPUs demand increasingly sophisticated EDA tools to help them.
- Deal with production failures at customer sites, while maintaining their design integrity.
- Platform interoperability with other EDA tools for varying workflows, to deliver just the right amount of functionality
- Investment in optimizing the design with AI
- Availability of quick access
- Vendors provide various OA tools as well
- Semiconductor industry got a serious boost with the emergence of EDA.
EDA Software: Within IC Physical Design and Verification process

Changes in the Design Cost and Transistor count trends
The Calibre RealTime Tools and Interfaces

- The Calibre RealTime platform, developed by Siemens Digital Industries Software
- Apply rules for manufacturing of the circuit layout, to the layout design
- Provide instantaneous feedback on Design rule checking (DRC) violations during layout creation and editing
- [DRC is the process engineers use to determine if the physical layout of a chip design complies with the manufacturing requirements.]
- Reduce verification iterations and overall design time
- Enable design optimization during layout creation
- Perform DRC to determine the validity of design & physical implementation against the design rules
- RealTime was Electronic Design Magazine’s product of the year in 2011
- In 10 years, RealTime has never had to issue a patch due to a regression in functionality
GUIs Testing & Test Automation in EDA

The Calibre RealTime Digital Toolbar

External Design Implementation Tool
EDA Software: QA Challenges & Resolution

**Integrations**

**Challenges:**
- Multiple GUI tool, multiple binary environment with data transfer and GUI interaction challenges
- Differences in supported hardware platforms and software architectural differences in the collaborating tools

**Resolutions:**
- Establish tool communication through sockets
- Develop a testing framework that is flexible, portable, and able to set up communication with each tool and drive automation
EDA Software: QA Challenges & Resolution

Testing Strategies

Challenges:
- Complex tools with unlimited data entry possibilities used by very specialized engineers
- Different GUIs possible have different reserved character sets that could cause errors

Resolutions:
- QA engineers must be educated in the process and use cases of those using the tool. This requires investment in education
- Better understanding of different software packages used to create the GUI can help make educated guesses for testing strategy
QA TESTING TECHNIQUES - USING RESERVED CHARACTERS

QA Best Practices: GUI Test Automation for EDA Software #QAinEDA
QA TESTING STRATEGY - DEVELOPING QA EXPERTISE
QA TESTING TECHNIQUES – ELEMENT RELATIONSHIPS
EDA Software: QA Challenges & Resolution

Complex Customer Data

Challenges:
• Covering all types of test cases and tool customizations important to the customer
• Protecting the customer data
• Tracking performance results on real customer designs

Resolutions:
• Performing tests on parts of larger customer designs, so none of the important cases are missed, including custom code
• Signing an NDA, and storing design data with restricted access
• Performance, capacity, and stress testing
EDA Software: QA Challenges & Resolution

Builds and Releases

Challenges:

• Catching bugs as soon as possible in a complex environment
• Minimizing QA resources needed to test the entire integrated build due to changes
• Tracking the impact of underlying 3rd party changes

Resolutions:

• Hourly builds for tracking changes and daily builds that QA engineers run tests on
• Developers run regressions prior to check ins
• Smoke testing
• Effective engineering/QA communication
EDA Software: QA Challenges & Resolution

Software Versioning and Graphical Changes

Challenges:
• EDA tools are ever-evolving from one version to the next
• Operating the graphical forms on external tools and window sizes can change from release to release

Resolutions:
• Development and use of APIs for operating forms not dependent on X,Y coordinates
• Development of APIs that mimic tool operations without performing graphical operations
• Replay-ability of API commands
Additional QA Testing Techniques

Limitations and Boundary Value Analysis

- Design tools and foundry rules often impose limitations
- QA testing must be mindful of this

Exploratory Testing

- Especially important in EDA software testing where data is often shared by multiple tools
EDA Software Testing Best Practices: Summary

- Invest in developing QA expertise in the chip design domain and use that to guide testing of the individual tool and the whole design flow
- Invest in developing QA expertise in the software packages used and use that knowledge when testing data entry
- Develop a portable, flexible QA scripting framework designed for inter-process communication and hiding of graphical implementation specifics
- Hourly builds of the software, daily QA regression runs and analysis, updating of regressions
- Developers running the regressions prior to check in of software changes
- Including customer data and customization code in functional, performance, stress, and capacity tests
- Invest in developing APIs and replay-ability
- Perform boundary value analysis keeping in mind the whole flow and encourage exploratory testing by testers
Thank You.

Questions?
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