Testing

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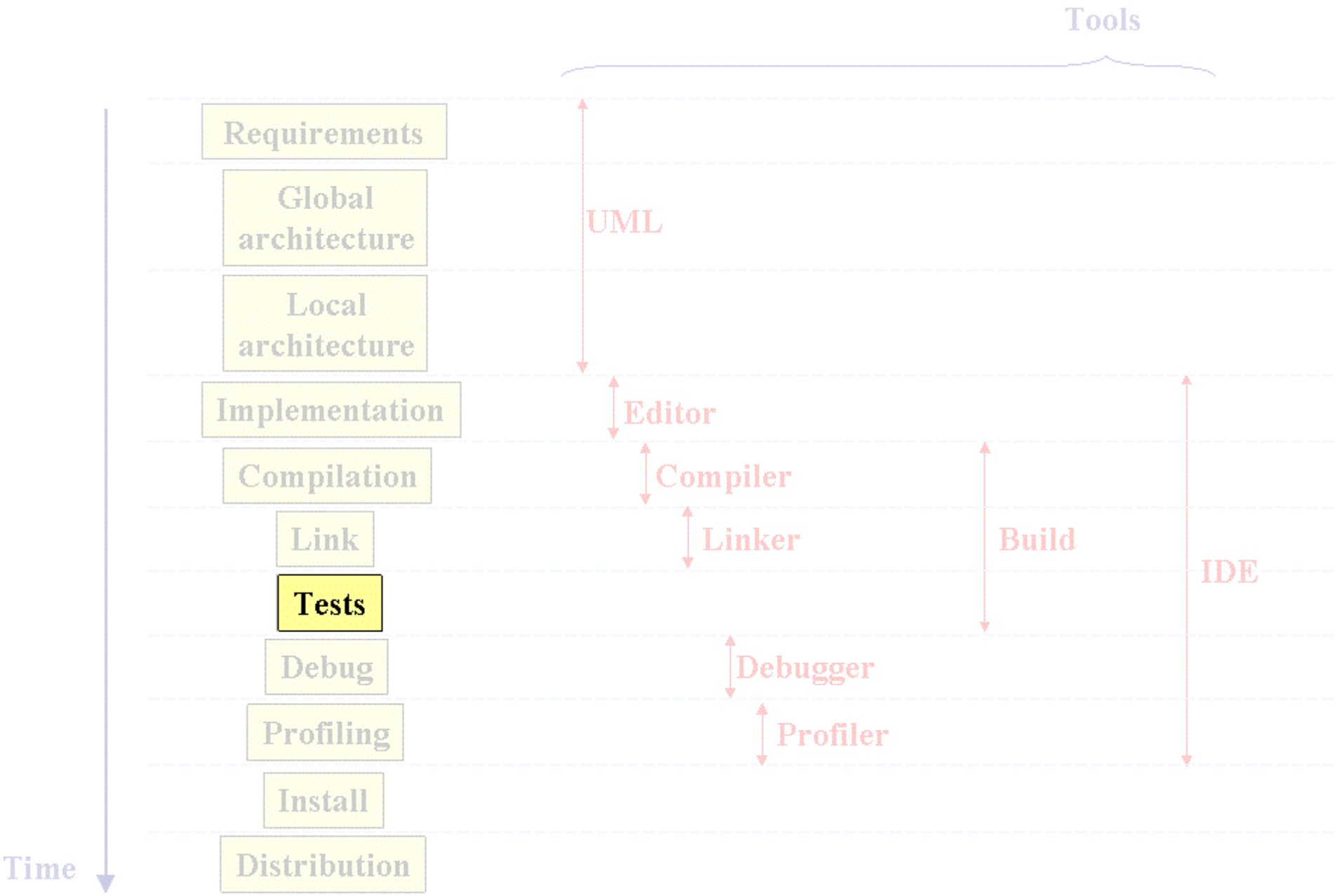
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Outline

- What is testing ?
- The need for testing
- Different approaches to testing
- What really matters

What is testing ?

- A component or function: takes input, generates output.
- Test:
  - For each input, verify generated output against expected output.
  - For sequences of input, verify generated output against expected output.

The need for testing

- Testing is good:
  - Users are not beta testers
  - Makes modifications easier
- Everyone knows that testing is a good thing but no one does it:
  - It is too hard
  - It is boring
- It is not hard
- It is boring but spending hours and days debugging your code is even more boring

Different types of testing

- Unit testing vs system testing:
  - Unit testing: test independent components separately.
  - System testing: test the system as a whole
- Regression testing:
  - Test existing functionality: detect regressions
  - New functionality = new test
  - New bug detected = new test to expose the bug

Different types of testing

- Black box vs white box testing:
  - Black box: use only the public API, do not assume anything about implementation.
  - White box: can use private API, can assume it knows the details of the implementation
- White box:
  - often easier to write
  - catches a lot of early bugs because you know where the implementation is weak

Test automation

- Goal: run the tests as often as possible.
  - Tests must be easy to run
  - Test reports must be easy to visualize

- Tools:
  - Use the tool used in your project.
  - Simple solution:
    - A single test function for each unit
    - A global function: invokes all test functions, print FAIL and PASS strings.
    - Invoke global test function often (ideally, each run of the program).
  - Fancy test automation and report generation tools: Junit and CppUnit.

Code coverage analysis

- Code coverage analysis tools can tell you which pieces of code are not exercised by the tests. Then, you know what kind of tests you need to write to cover a larger set of your software
- See: “gcov” and “lcov”:
  - Gcov: gcc manual
  - Lcov: http://ltp.sourceforge.net/coverage/lcov.php
    Sample output:
    http://www-sop.inria.fr/dream/personnel/Mathieu.Lacage/ns3-lcov/
- Java:
  - Coverlipse: http://coverlipse.sourceforge.net/
  - Cobertura: http://cobertura.sourceforge.net/
  - EclEmma: http://www.eclemma.org/
  - Emma: http://emma.sourceforge.net/
  - Tptp: http://www.eclipse.org/tptp/

Fuzzy testing

- Floating point arithmetics:
  use interval specifications to describe the input and/or expected output

- Pdiff: perceptual diff library for images.
  http://pdiff.sourceforge.net/

Conclusion

- Prefer white-box testing to black-box testing
- Test boundary conditions first (the common case is tested by the rest of the code)
- Test the easy stuff first:
  - Input combinations can be easily generated
  - Number of input combinations is small
- Use system or unit testing depending on which is the easiest to get started with
- Start with simple test automation, use more fancy tools later if you need them.