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Designing Negative Test Cases

Negative testing, also known as **error path testing**, evaluates how a system behaves under invalid, unexpected, or adverse conditions. The goal is to ensure the application handles errors gracefully, maintaining reliability and user satisfaction.

Why Negative Testing Is Important

1. **Enhances System Robustness**: Anticipates failure points and ensures the application responds appropriately to unexpected scenarios.
2. **Improves User Experience**: Applications that manage errors effectively reduce frustration and build user trust.
3. **Prevents Security Vulnerabilities**: Identifies potential security issues, such as injection attacks, before exploitation.

Steps to Design Effective Negative Test Cases

1. Understand Application Requirements

- Review the system's specifications to identify potential areas for invalid inputs or user actions.
- Collaborate with developers to identify edge cases and possible failure points.

2. Identify Error Scenarios

- Map out realistic negative scenarios, such as:
  - Entering invalid data types (e.g., text in numeric fields).
  - Exceeding maximum input limits (e.g., uploading a file larger than allowed).
  - Performing actions out of sequence (e.g., submitting a form without completing all steps).
  - Unauthorized access attempts (e.g., accessing admin features without authentication).

3. Define Expected Behavior

- Specify how the system should respond, such as:
  - Displaying user-friendly error messages.
  - Logging errors for analysis.
  - Preventing further actions while maintaining system stability.

4. Develop Comprehensive Test Cases

- Document each test case with:
    - **Test Case ID**: Unique identifier.
    - **Description**: Purpose and scenario being tested.
    - **Preconditions**: Setup required before executing the test.
    - **Steps**: Detailed execution instructions.
    - **Expected Results**: Clear outcomes for error handling.

5. Execute and Analyze Results

- Run tests across various environments to ensure consistency.
- Document findings, noting any discrepancies or areas for improvement.

Examples of Negative Test Cases

E-Commerce Application

1. **Invalid Input Types**: Entering text into the "Quantity" field, which only accepts integers.
    - **Expected Outcome**: Display error message: "Please enter a valid number."
2. **Exceeding Input Length**: Submitting a username longer than 50 characters.
    - **Expected Outcome**: Reject input with error: "Username exceeds the maximum length."
3. **Unauthorized Actions**: Attempting to apply a discount code without logging in.
    - **Expected Outcome**: Redirect user to the login page.

Banking Application

1. **Boundary Violations**: Entering a withdrawal amount of -1 for a minimum allowed value of 0.
    - **Expected Outcome**: Display error: "Invalid withdrawal amount."
2. **Session Timeout**: Performing a transfer after the session has expired.
    - **Expected Outcome**: Redirect to login with error: "Your session has expired."

Best Practices for Negative Testing

1. **Focus on Critical Functionalities**: Test areas that directly impact user satisfaction and security.
2. **Leverage Automation**: Use tools like Selenium or Appium to automate repetitive negative test cases.
3. **Document Thoroughly**: Maintain detailed records of test cases and results for easy reference and reuse.
4. **Include Edge Cases**: Test unusual or extreme inputs, such as empty strings, special characters, or very large numbers.
5. **Use Realistic Data**: Mimic real-world scenarios to ensure applicability.

Common Challenges and Solutions

Challenge	Solution
Handling False Positives	Ensure expected behavior is well-defined and aligns with business logic.

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Maintaining Test Coverage	Regularly review and update test cases to reflect application changes.
Managing Test Data	Use data-driven testing to centralize and reuse datasets efficiently.
Identifying Edge Cases	Collaborate with stakeholders to brainstorm uncommon but impactful scenarios.

Metrics to Evaluate Negative Testing

1. **Error Coverage**: Percentage of identified error scenarios tested.
2. **Test Execution Time**: Average time required to execute negative test cases.
3. **Defect Detection Rate**: Proportion of defects discovered during negative testing.
4. **False Positive Rate**: Frequency of valid inputs incorrectly flagged as errors.

Key Takeaways

Designing and executing robust negative test cases ensures:

- Systems can handle invalid inputs gracefully.
- Users experience fewer disruptions or frustrations.
- Applications are secure, reliable, and resilient under adverse conditions.

By focusing on realistic scenarios, automating repetitive tasks, and collaborating with stakeholders, teams can deliver software that meets the highest standards of quality and robustness.
