Random Testing in a Trading System

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• What is Random Testing?
• Why we should use Random testing
• How Random testing works
• How Random testing is used to test Trading Systems at Cinnober
What Is Random Testing?

- Send randomly generated data to the system under test.
- The input data is generated from a predefined domain.
- The output from the System can be analyzed by a test oracle.
Why To Use Random Testing

- A powerful tool for finding low frequency bugs with high impact.
- Regular automatic tests do the same thing every time. Random tests can take a new route each time they are run.
- It is impossible to cover everything in a large complex system with other automated tests.
- Helps identify areas that need more testing.
- Easy to implement
- Cost Efficient
How it works

• Generate Random Data
• Test Oracle
• Analyze Results
Generating Input Data

- Random data from a uniform distribution or other distributions.
- Randomized objects, not only numbers
- Realistic or unrealistic
Random Test Oracles

- No Oracle
- Heuristic Oracle
- True Oracle
How we have used Random Testing

- Simulations using several different "Actors"
- No Oracle Strategy
- Simple Heuristic Oracle
- True Oracle Strategy using Constraint programming
The Trading System
Simulation

• **Actors**
  - Trading Actors
    - Enter different types of orders
      - Iceberg Orders
      - Stop-Loss orders
    - Update, Cancel orders
    - Send queries to system
  - Market Operations Actors
    - Add, Delete Users
    - Send Market Messages
Simulation

Actors

Orders

System

Event Flow

Oracle

Results
Using a No Oracle Strategy

• Finds bugs that cause the system to crash
• Finds bugs that cause the system to throw exceptions
• Can find other bugs as well.
Using a simple heuristic oracle

• Verify that output conforms to a few heuristics
Using a true oracle

• Developed a formal executable model of the real order matching mechanism
  – Easy to implement and therefore often correct.

• Example: ”if the limit price of a bid order $b$ is lower than that of an ask order $a$, then their traded quantity must be 0”

\[
lp_b \preceq lp_a \Rightarrow tq_{b,a} = 0
\]

• More costly, but allows to detect more failures
Conclusion

• Random testing finds low-frequency bugs that would not be found with other automated tests
• Random testing is easy to implement and cost efficient
Questions?