Concurrent Object Oriented Languages

Testing Concurrent Code

wiki.eecs.yorku.ca/course/6490A

“Sequential Testing”

If possible, first test your code in the same way you test sequential code.

Question

How would you test a concurrent implementation of a red-back tree?

Testing blocking operations

Problem

How do you test the blocking operations of a concurrent implementation of a red-black tree with read-write locks?

Testing

How can we test our concurrent code?

Tests fall into two categories:

- Safety: “nothing bad ever happens”
- Liveness: “something good eventually happens”

Caution

Test code can introduce timing or synchronization artifacts that can mask bugs.

Bugs that disappear when you add test code are sometimes called Heisenbugs. The term is a pun on the name of Werner Heisenberg, the physicist who first asserted the observer effect of quantum mechanics, which states that the act of observing a system inevitably alters its state.

source: German Federal Archives

Randomization

Tests should be random so that the compiler cannot precompute the results.

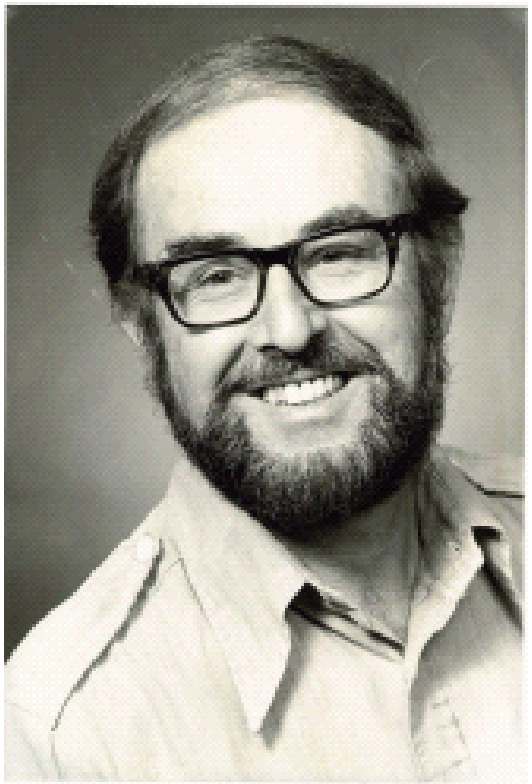
Random number generators can create couplings between classes and timing artifacts, because most random number generator classes are thread safe.

Randomization

```
static int xorShift(int random)
{
    random ^= (random << 6);
    random ^= (random >>> 21);
    random ^= (random << 7);
    return random;
}
```

George Marsaglia

- American mathematician and computer scientist.
- Professor at Washington State University and Florida State University.
- Known for developing some of the most commonly used methods for generating random numbers.



George Marsaglia

(1924–2011)

source: Journal of Modern Applied Statistical Methods

“Guarantee” Interleavings

- Ensure that all threads start at the “same time.” Use for example a CyclicBarrier.
- Ensure that each thread runs “long enough.”
- Ensure there are more threads than cores.