Object Oriented Programming

College Of Computer Sciences and Mathematics

Dr. Firas Aswad

Dept. of Networks

Sept. 24, 2024

Testing and Debugging

- Even with careful programming, most programs will contain errors and must be thoroughly tested.
- Bug - a mistake in a program.
- Debugging - fixing mistakes in a program.
- Debugger – a software tool that helps with debugging.

Types of Errors

Generally, there are three types of errors:

1- Syntax

2- Run-time

3- Logic (Semantic)

Syntax

The syntax of a programming language is the set of grammatical rules for a language.

- A syntax error is a grammatical mistake in a program.

➢ misspelling a command, e.g., “pablic” instead of “public”.

➢ missing variable declaration.

➢ missing punctuation.

➢ using things inappropriately, e.g., assigning a string value to an int variable.

- Syntax errors:

➢ are caught by the compiler, hence the phrase “compile-time error”.

➢ relatively easy to fix.

➢ prevent the program from executing.

➢ frequently result in misleading error messages.

Run-time Errors

- An error detected when your program runs is a run-time error.
  - dividing a number by 0.
  - accessing memory that was de-allocated.
  - indexing out of bounds in an array.
  - reading input from a file that is not open.

- Run-time errors:

➢ terminate a program's normal execution.

➢ occasionally detected by the compiler.

➢ frequently result in misleading, incomplete, or non-intelligible messages.

➢ frequently difficult to find and fix.

Note: what is a run-time error in one language might be a logic error in another.

Logic (Semantic) Errors

- Just because a program compiles and runs without producing an error message does not mean the program is correct!

- Errors that cause programs to produce incorrect results are logic errors.

➢ `circle_Area = radius * radius; // pi * radius * radius`

➢ `sum = a - b; // should be sum = a + b;`

- Logic errors:

➢ not detected by the compiler.

➢ frequently produces no run-time error messages.

➢ causes the program to take incorrect action, or produce incorrect results during program execution.

➢ frequently difficult to find and fix.

Example
Run-time and Logic Errors

1- Mariner Bugs Out (1962)

- Cost: $18.5 million
- Disaster: The Mariner 1 rocket with a space probe headed for Venus diverted from its intended flight path shortly after launch. Mission Control destroyed the rocket 293 seconds after liftoff.
- Cause: A programmer incorrectly transcribed a handwritten formula into computer code, missing a single superscript bar. Without the smoothing function indicated by the bar, the software treated normal velocity variations as if they were serious, causing faulty corrections that sent the rocket off course.

2- CIA Gives the Soviets Gas (1982)

- Cost: Millions of dollars, significant damage to the Soviet economy.
- Disaster: Control software went haywire and produced intense pressure in the Trans-Siberian gas pipeline, resulting in the largest man-made, non-nuclear explosion in Earth's history.
- Cause: CIA operatives allegedly planted a bug in a Canadian computer system purchased by the Soviets to control their gas pipelines. The purchase was part of a strategic Soviet plan to steal or covertly obtain sensitive U.S. technology. When the CIA discovered the purchase, they sabotaged the software so that it would pass the Soviet inspection but fail in operation.

3- World War III... Almost (1983)

- Cost: Nearly all of humanity

- Disaster: The Soviet early warning system falsely indicated the United States had launched five ballistic missiles. Fortunately, the Soviet duty officer had a "funny feeling in my gut" and reasoned if the U.S. was really attacking they would launch more than five missiles, so he reported the apparent attack as a false alarm.

- Cause: A bug in the Soviet software failed to filter out false missile detections caused by sunlight reflecting off cloud-tops.

4- Medical Machine Kills (1985)

- Cost: Three people dead, three people critically injured
- Disaster: Canada's Therac-25 radiation therapy machine malfunctioned and delivered lethal radiation doses to patients.
- Cause: Because of a subtle bug called a “race condition,” a technician could accidentally configure Therac-25 so the electron beam would fire in a high power mode without the proper patient shielding.

Thank You!