Intruduction to GDB

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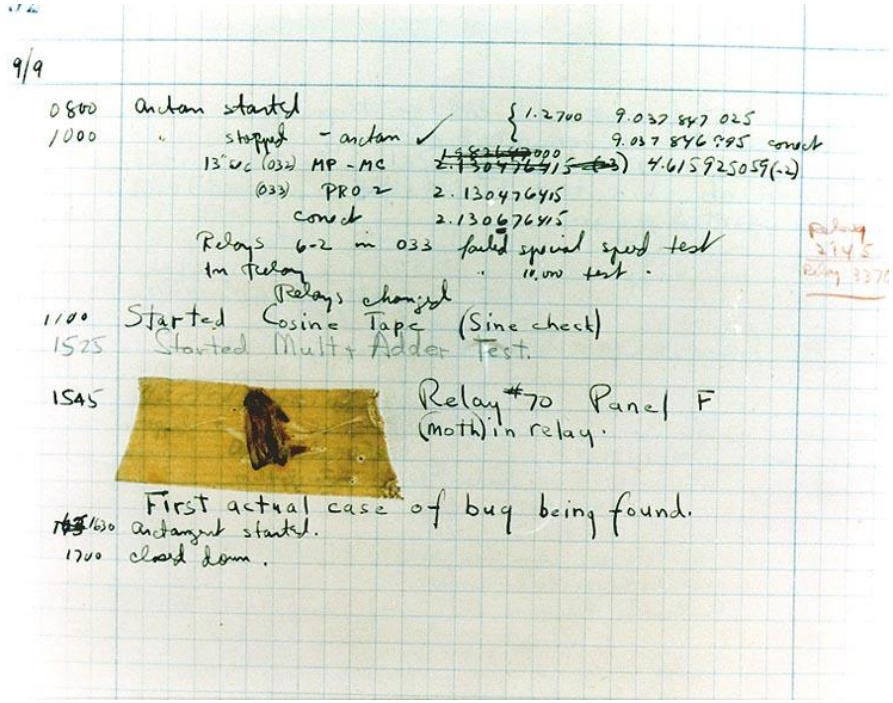
What is "Bug"?

- error, flaw, failure or fault in a computer program or system that causes it to produce an **incorrect or unexpected result**, or to behave in **unintended ways**. (from wikipedia)



What is "Debug"?

- To (1)find and (2)fix bug(s)

How to Debug?

1. How to find bug(s)?

- Review source codes
- Use printf
- Use debugger

2. How to fix bug(s)?

- Once you find bug(s), fixing them is easy

What is GDB?

- The GNU Project debugger

- https://www.gnu.org/software/gdb/

GDB Debugging Process

0. Compile a program for gdb
1. Start gdb
2. Set breakpoint(s)
3. Run program
4. Stop at the breakpoint
5. Execute every single line of source code
6. Find bug!
7. Quit gdb
8. Fix it!

GDB Manual

- **Compile a program for gdb**
  - `$ gcc -g SOURCE.c -o OBJECT`
- **Start gdb**
  - `$ gdb OBJECT`
    - OBJECT is the executable file
- **Quit gdb**
  - `(gdb) quit`

GDB Manual (Cont'd)

- **List parts of the source code**
  - (gdb) list
  - (gdb) list function_name
  - (gdb) list line_number

- **Examine the assembly code**
  - (gdb) disas
  - (gdb) disas function_name
  - (gdb) disas address

GDB Manual (Cont'd)

- **Set breakpoint**
  - `(gdb) break function_name`
  - `(gdb) break line_number`
- **Show breakpoint**
  - `(gdb) info break`
- **Delete breakpoint**
  - `(gdb) delete breakpoint_number`

GDB Manual (Cont'd)

- **Set watchpoint**
  - (gdb) watch variable_name
  - (gdb) watch $rax
- **Show watchpoint**
  - (gdb) info watch
  - (gdb) info break
- **Delete watchpoint**
  - (gdb) delete breakpoint_number

GDB Manual (Cont'd)

- **Run the program**
  - `(gdb) run`
  - `(gdb) run arglist < input > output`
- **Continue the program**
  - `(gdb) continue`
- **Run until current function returns**
  - `(gdb) finish`
- **Stop the program**
  - `(gdb) kill`

GDB Manual (Cont'd)

- **Step into current source line**
  - `(gdb) step`
  - `(gdb) step number_of_line`

- **Step over current source line**
  - `(gdb) next`
  - `(gdb) next number_of_line`

GDB Manual (Cont'd)

- **Step into current instruction**
  - `(gdb) stepi`
  - `(gdb) stepi number_of_line`

- **Step over current instruction**
  - `(gdb) nexti`
  - `(gdb) nexti number_of_line`

GDB Manual (Cont'd)

- **Display variable**
  - Display variable every time the program pauses
  - `(gdb) disp variable_name`
- **Show display list**
  - `(gdb) info disp`
- **Undisplay variable**
  - `(gdb) undisp display_number`

GDB Manual (Cont'd)

- **Print variable**
  - `(gdb) p variable_name`
  - `(gdb) p $rax`
  - `(gdb) p constant`
  - `(gdb) p /x variable_name`
    - Print variable in hexadecimal format
  - `(gdb) p /t variable_name`
    - Print variable in binary format
  - `(gdb) p *(long *) address`
    - Print long integer of long * type pointer

GDB Manual (Cont'd)

- **Examine data**
  - `(gdb) x address`
  - `(gdb) x $rax`
  - `(gdb) x function_name`
  - `(gdb) x/2g address`
    - Examine two (8-bytes) words starting at the address
  - `(gdb) x/20b address`
    - Examine first 20 bytes at the address

GDB Manual (Cont'd)

- **Useful information**
  - (gdb) `info frame`
    - Information about current stack frame
  - (gdb) `info registers`
    - Values of all the registers
  - (gdb) `info locals`
    - print all local variables
  - (gdb) `help`
    - Get information about gdb

Debugging Practice

- Let's try!