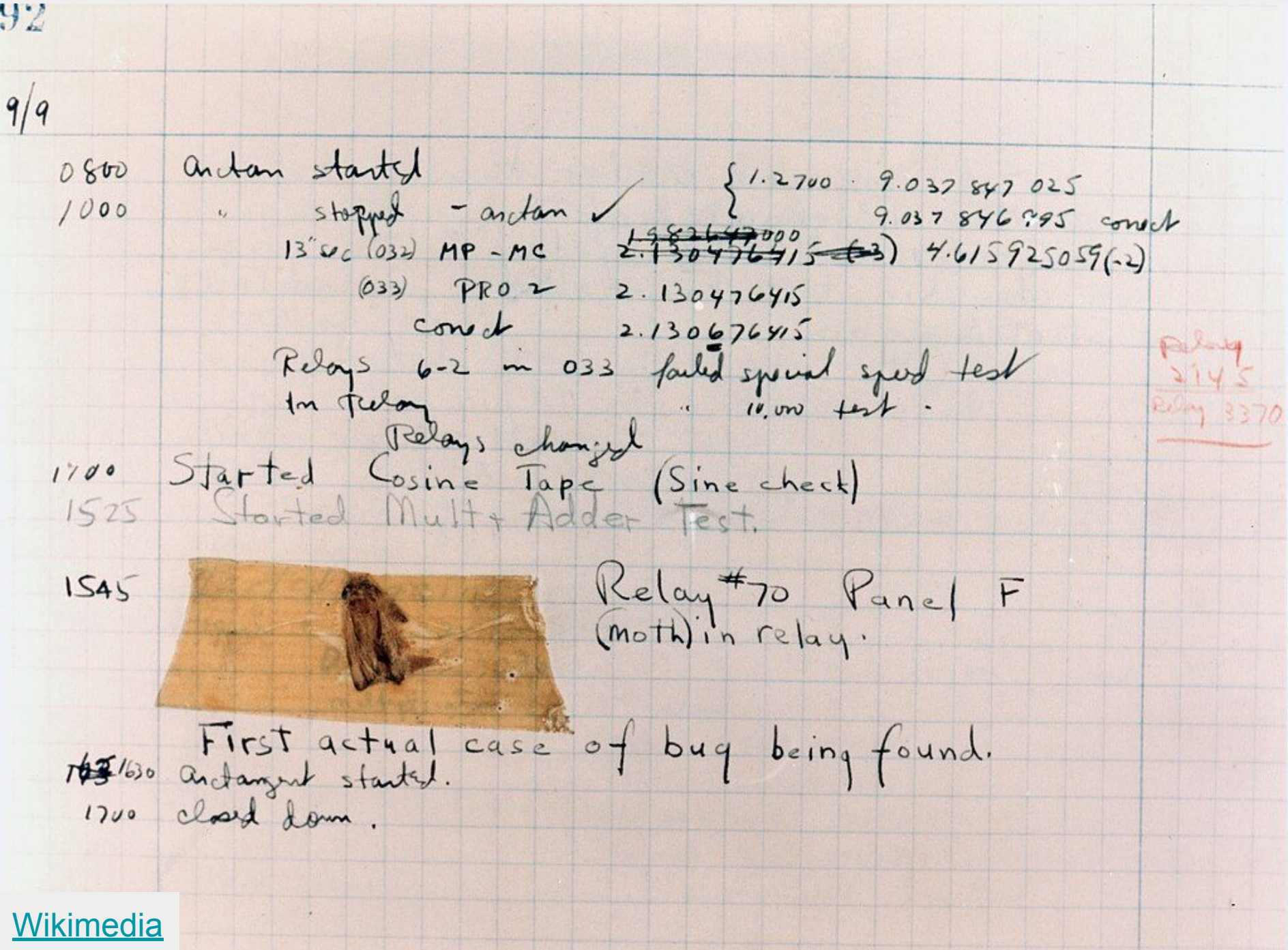
Debugging in C

Adapted from materials by Dr. Carrier



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- A program that lets you see what's going on inside a program *as it runs*

Why use a debugger?

- Helps fix segfaults and logic errors
- Provides more insights than print statements

Debugging in C under Linux

We'll be using gdb (GNU Project Debugger)

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1. Compile your code in debug mode
   ```
   gcc -g my_code.c
   ```
2. Launch gdb with your executable
   ```
   gdb ./a.out
   ```

Note for Mac users

You will likely not have `gdb`

You can use `lldb` instead.

Use will be very similar, but some commands will have different names.

Reference: https://lldb.llvm.org/use/map.html

Inside gdb

```
class/c/structs$ gdb ./a.out
GNU gdb (Ubuntu 12.1-0ubuntu1~22.04) 12.1
Copyright (C) 2022 Free Software Foundation, Inc.
License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
Type "show copying" and "show warranty" for details.
This GDB was configured as "x86_64-linux-gnu".
Type "show configuration" for configuration details.
For bug reporting instructions, please see:
<https://www.gnu.org/software/gdb/bugs/>.
Find the GDB manual and other documentation resources online at:
    <http://www.gnu.org/software/gdb/documentation/>.

For help, type "help".
Type "apropos word" to search for commands related to "word"...
Reading symbols from ./a.out...
(gdb)
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License GPLv3+: GNU GPL version 3 or later <http://gnu.org/licenses/gpl.html>
This is free software: you are free to change and redistribute it.
There is NO WARRANTY, to the extent permitted by law.
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- `kill` - stop program execution

Debugging a segfault

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2. `run`

```
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__GI___libc_realloc (oldmem=0x64, bytes=18446744073709519336) at ./malloc/malloc.c:3426
3426    ./malloc/malloc.c: No such file or directory.
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3. Examine the callstack with `backtrace` or `bt`

```
(gdb) bt
#0  __GI___libc_realloc (oldmem=0x64, bytes=18446744073709519336) at ./malloc/malloc.c:3426
#1  0x0000555555555230 in Append (vec_ptr=0x7fffffffdc10, x=7) at vector_broken.c:21
#2  0x0000555555555310 in main () at vector_broken.c:39
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4. Load a frame (`f`) using its number (e.g., `f 1`)

Debugging a segfault (page 2)

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6. Check the state of your variables

- Print a variable with `print` (or `p`) (e.g., `p size`)
- Print n items of an array with `*array@n`

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6. Check the state of your variables

- Print a variable with `print` (or `p`) (e.g., `p size`)
- Print n items of an array with `*array@n`

7. Try to deduce the problem! You can always examine other frames

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`enable/disable breakpoint_number`

`delete breakpoint_number` (`delete` for all)

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Recommendation: memcheck

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valgrind --tool=memcheck ./a.out
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This will check for memory leaks and other hard-to-spot memory issues!

```
==7995== Conditional jump or move depends on uninitialised value(s)
==7995==    at 0x1091F4: Append (vector_broken.c:16)
==7995==    by 0x109349: main (vector_broken.c:43)
```