Debugging HPC Applications with mdb

Tom Meltzer

Schmidt Sciences
Institute of Computing for Climate Science

Introduction

Schmidt Sciences

Institute of Computing for Climate Science

$> whoami

- Principal RSE @ ICCS
- PhD in Theoretical Phys
- C&EA WHPC Co-Chair
- HPC enthusiast
- Professional Debugger

Schmidt Sciences

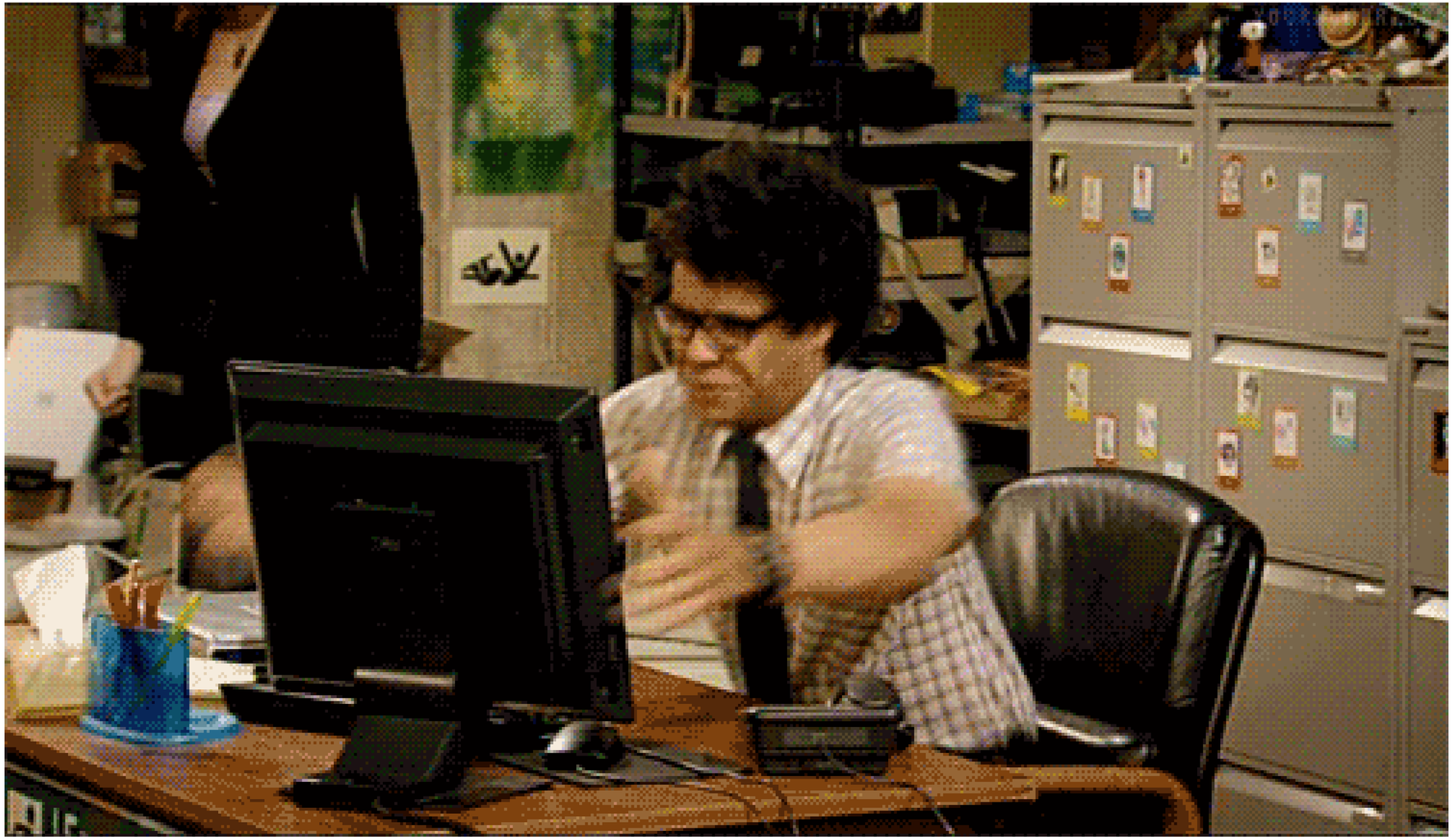
Institute of Computing for Climate Science

Debugging 101

What are my options?

1. Write bug-free code…
2. Use `printf()`
3. Ignore it 🤦 (Ostrich Method)
4. Use a debugger (e.g., `gdb`, `lldb`, …)

Write bug-free code



source: giphy.com/gifs/M11UVCRrc0LUk

Use `printf()`

Use `printf()`

- Valid if code cannot run without optimization

Use `printf()`

- Valid if code cannot run without optimization
- Requires recompiling code

Use `printf()`

- Valid if code cannot run without optimization
- Requires recompiling code
- Could introduce new bugs

Use `printf()`

- Valid if code cannot run without optimization
- Requires recompiling code
- Could introduce new bugs
- Want to see a new variable?

Use `printf()`

- Valid if code cannot run without optimization
- Requires recompiling code
- Could introduce new bugs
- Want to see a new variable?
- Recompile again 🥲

Use `printf()`

- Valid if code cannot run without optimization
- Requires recompiling code
- Could introduce new bugs
- Want to see a new variable?
- Recompile again 🥲
- Cannot interactively alter runtime

Ignore it (Ostrich Method)

- Valid if cost outweighs solution

Use a debugger

Use a debugger

- Interact at runtime – *change the flow of execution*

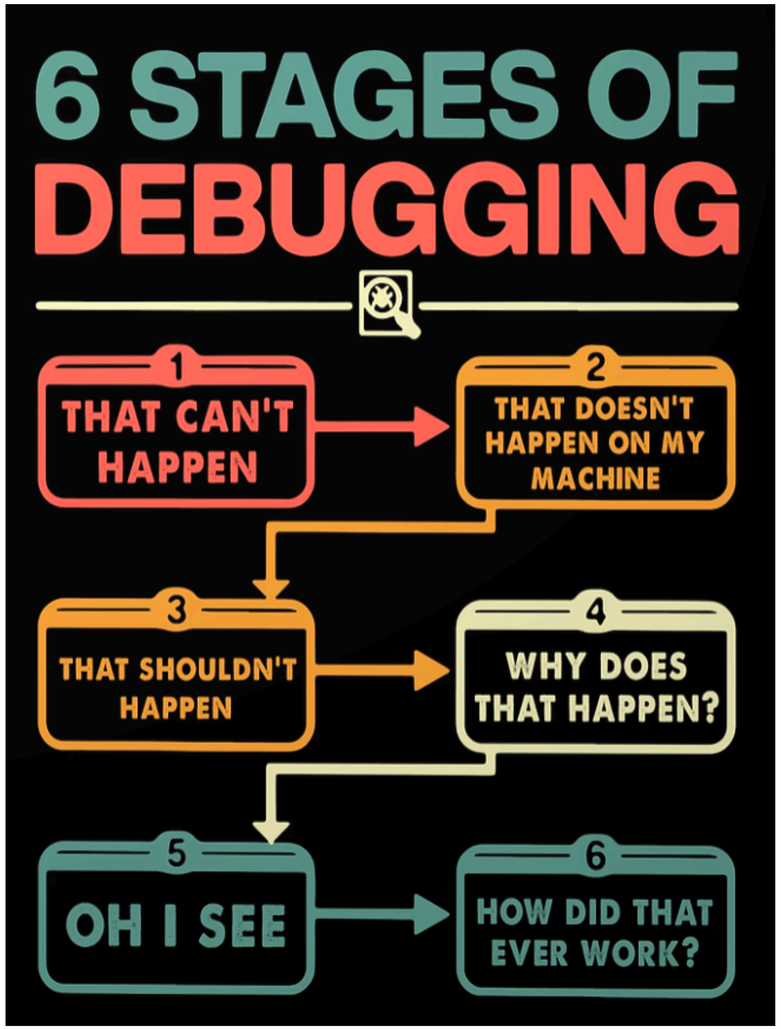
Use a debugger

- Interact at runtime – *change the flow of execution*
- Inspect everything – *private variables… who cares!*

Use a debugger

- Interact at runtime – *change the flow of execution*
- Inspect everything – *private variables… who cares!*
- Use for code exploration – *what actually happens*

What is a debugger?



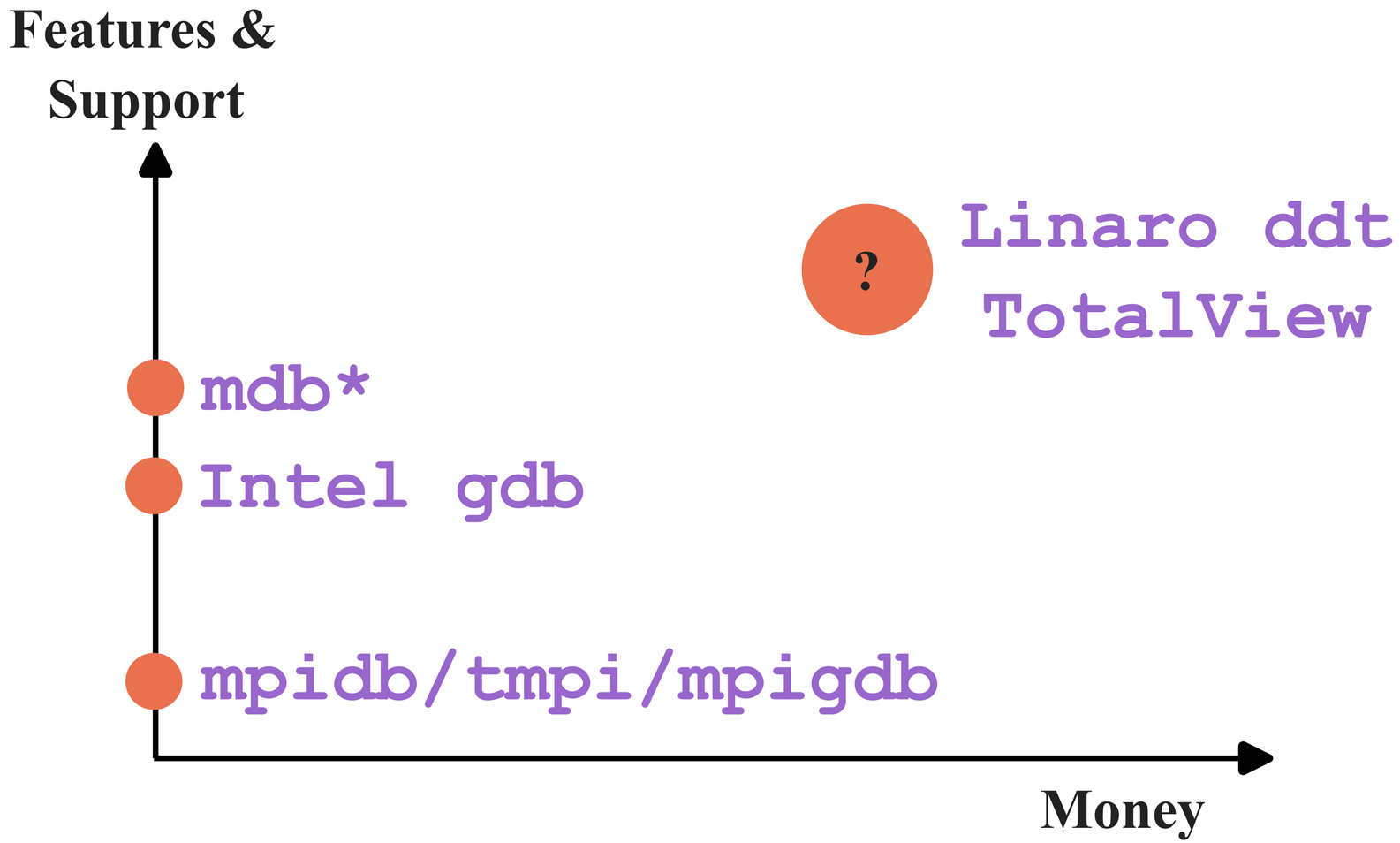
source: displate.com/displate/4420099

A **`program`** used to test another "**`target`**" program. The target program is run in a controlled environment that allows the user to inspect resources, interrupt program flow and even modify code execution.

Serial Debugging Landscape

- `gdb`, `lldb` (and derivatives e.g., `rocgdb`)
- IDE-integrated (vscode, eclipse, jetbrains, vim, emacs etc.)
- GUI-wrappers: (gdbgui, seer, etc.)

MPI Debugging Landscape



* my ~~possibly~~ biased opinion 👀

Key Features of `mdb`

- **Terminal-based** – *debug local to code*
- Supports multiple backends (`rocgdb`, `rust-gdb`)
- Uses Python's `asyncio` library
- Holistic commands (`plot`, `dump`)
- Scriptable & Extensible – *unicode plots*
- `Ctrl-C` is handled correctly (👀 Intel gdb)
- Free and Open-Source – `pip`/`spack`/`uv`-installable

Why terminal?

- Unix philosophy
- Available
- Extensible
- Scriptable

Demo time

github.com/TomMelt/mdb

- where to get help (`man`/rtd/github/`?`)
- `command`, `select` & `broadcast`
- scripting `mdb`

Schmidt Sciences

Institute of Computing for Climate Science

Thanks for Listening

Schmidt Sciences

Institute of Computing for Climate Science