# DEBUGGING

## GENERAL DEBUGGING

- `gdb` = GNU Project debugger
- lets you look at what's going on inside a program as it runs
- helpful for identifying:
    - segfaults
    - logical errors

## RUNNING GDB

```
gcc -g program.c
gdb a.out
```

- inside gdb:
  - `run` - start execution form beginning
  - `run < input_file > output_file` if you want to run with input/output redirection
  - `kill` - stop program execution
  - `quit` - exit gdb

$$\underset{\text{m rows by n cols}}{\overset{A}{\begin{bmatrix} a_{00} & a_{01} \\ a_{10} & a_{11} \\ a_{20} & a_{21} \\ a_{30} & a_{31} \end{bmatrix}}} \underset{\substack{\Big\uparrow \\ \text{n rows by 1 col}}}{\overset{x}{\begin{bmatrix} x_0 \\ x_1 \end{bmatrix}}} = \underset{\text{m rows by 1 col}}{\begin{bmatrix} a_{00}x_0 + a_{01}x_1 \\ a_{10}x_0 + a_{11}x_1 \\ a_{20}x_0 + a_{21}x_1 \\ a_{30}x_0 + a_{31}x_1 \end{bmatrix}}$$

$$\begin{bmatrix} 0 & 2 \\ 4 & 6 \\ 8 & 10 \\ 12 & 14 \end{bmatrix} \begin{bmatrix} 0 \\ 2 \end{bmatrix} = \begin{bmatrix} 0*0 + 2*2 \\ 4*0 + 6*2 \\ 8*0 + 10*2 \\ 12*0 + 14*2 \end{bmatrix} = \begin{bmatrix} 21 \\ 12 \\ 20 \\ 28 \end{bmatrix}$$

## BASIC COMMANDS

- `p variable_name` - print a specific variable
- `p *array@len` - print array with certain length (you specify array and len)
- `backtrace` - how did your program get to this point
  - often helpful after a segfault
  - can also use `bt` (abbreviated command)
- `step` - execute one line of code
  - `step nsteps` - execute a specified number of lines of code

## BREAKPOINTS

- Setting breakpoints
  - `break function_name`
  - `break line_number`
  - `break line_number if condition`
- `continue` - step until next break boint
- `info break` - list all breakpoints

## BREAKPOINTS (CONT.)

- Enabling/disabling
  - `disable breakpoint_number`
  - `enable breakpoint_number`
- Deleting breakpoints
  - `delete` - delete all breakpoints
  - `delete breakpoint_number` - delete a specific breakpoint

## VALGRIND

```
gcc -g program.c
valgrind --leak-check=yes ./a.out
```

- tool used to debug memory leaks
- may be other errors at the top -- don't just ignore them