

Agenda

- VI editor
- Makefile
- Bitwise operators

VI editor

Makefile

PHONY target

- Pseudo target -- no output file is created.
- Examples:
 - clean: used to delete all output files.
 - rule: `rm -f *.o *.out`
 - all: to build multiple outputs
 - no rule
 - all: `executable1.out executable2.out executable3.out`
- They are mentioned (optionally) at the end of Makefile.
 - .PHONY: all clean

Make builtin variables

- `$@`: Target
- `{{content}}It;`: First dependency
- `$$^`: All dependencies

GDB: GNU Debugger

- Developed by Richard Stallman.
- Command line debugging.
- The debugging is possible only when debug symbols/info is available in executable file. Hence file must be compiled/linked using `-g` option.

<code>gdb executable_path</code>

- gdb commands

```
help
help data
break main
break subtract
run
list
list 10,
list ,10
step
next
print varname
display varname
undisplay num
cont
backtrace
quit
```

- GUI frontends for gdb
 - ddd: Data Display Debugger

Bitwise Operators

- Operate on bits (not whole value).
- Operators
 - AND: &
 - OR: |
 - NOT: ~
 - XOR: ^
 - Left Shift: <<
 - Right Shift: >>

Negative numbers

- Negative numbers are stored as 2's complement.

- 2's complement = 1's complement + 1
- 1's complement = 2's complement - 1

Shift Operators

Left Shift

- When left shift by 1
 - MSB is discarded.
 - 0 is added at LSB.
- Left shift by 1 is equivalent to multiply by 2.
- Left shift by n is equivalent to multiply by 2^n .
- When n -bit number is left shifted by n , result is 0.

Right Shift

- When unsigned number is right shift by 1
 - LSB is discarded.
 - 0 is added at MSB.
- When signed number is right shift by 1
 - LSB is discarded.
 - sign-bit/MSB is added at MSB.
- Right shift by 1 is equivalent to divide by 2.
- Right shift by n is equivalent to divide by 2^n .