

## DPST1092 23T2 — Makefiles

<https://www.cse.unsw.edu.au/~dp1092/23T2/>

# Makefiles

Please see Moodle for pre-recorded lecture video that cover this material

Makefiles lecture video

# Multi-module C Programs and Makefiles

All large systems written in C ...

- are built as a large number of .c files
- which are compiled separately
- and then combined to form an executable

Small (tiny) example:

```
$ gcc -c Stack.c           # produces Stack.o
$ gcc -c main.c           # produces main.o
$ gcc -o main main.o Stack.o # links Stack.o + main.o
```

# Multi-module C Programs and Makefiles

While developing a large system ...

- edit one `.c` file at a time (e.g. `gedit Stack.c`)
- recompile just that `.c` file (e.g. `gcc -c Stack.c`)
- then combine all `.o` files again (e.g. `gcc *.o`)

If you edit several `.c` files ...

- need to keep track of which ones you changed
- compile all the modified files (and just those?)
- then combine all `.o` files again

# Multi-module C Programs and Makefiles

Within a large software system ...

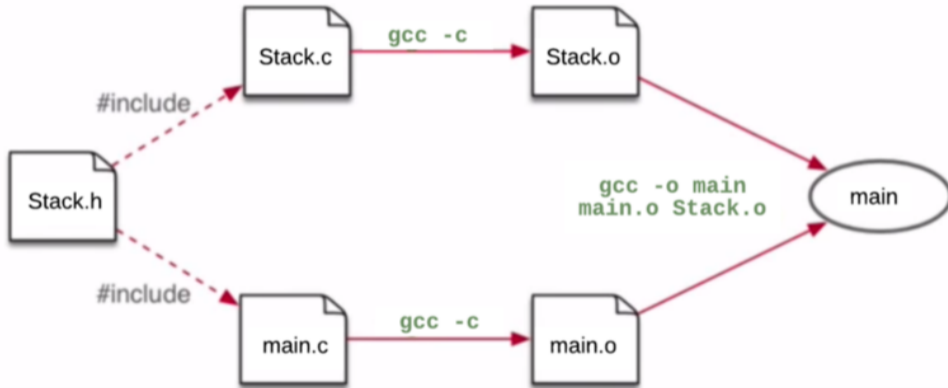
- *dependencies* exist between files, e.g.
  - ▶ `main.o` depends on `main.c` and `Stack.h`
- *actions* state how to produce *targets* from *sources*, e.g.
  - ▶ can create `main.o` from `main.c` and `Stack.h` using `gcc`
- *rules* combine dependencies and actions
  - ▶ if `main.c` or `Stack.h` changes, rebuild `main.o` with `gcc`

A **Makefile** contains definitions and rules

The **make** command uses a `Makefile` to rebuild a system

# Multi-module C Programs and Makefiles

Example dependencies and actions



# Multi-module C Programs and Makefiles

Example Makefile (i)

```
main : main.o Stack.o
    gcc -o main main.o Stack.o
```

```
main.o : main.c Stack.h
    gcc -c -Wall -Werror main.c
```

```
Stack.o : Stack.c Stack.h
    gcc -c -Wall -Werror Stack.c
```

Legend: target, source, action

Note: The lines with actions MUST begin with a tab (not spaces).

# Multi-module C Programs and Makefiles

Example Makefile (ii)

```
CC = gcc
```

```
CFLAGS = -Wall -Werror
```

```
main : main.o Stack.o
```

```
main.o : main.c Stack.h
```

```
Stack.o : Stack.c Stack.h
```



# Multi-module C Programs and Makefiles

## Example Makefile (iii)

```
CC = gcc
```

```
CFLAGS = -Wall -Werror
```

```
main : main.o Stack.o
```

```
main.o : main.c Stack.h
```

```
Stack.o : Stack.c Stack.h
```

```
clean :
```

```
    rm -f *.o core main
```