COMP20003
Algorithms and Data Structures
Header Files and Makefiles

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Multifile programs

- Multifile programs allow you to reuse code
- For example:
  - Functions associated with a dictionary can be used over and over in different programs
  - Can change underlying data structure for the same program, *e.g.* change from a list dictionary to a BST

Header files

- Header files allow:
  - write a function prototype or definition once
  - then use it in different files
- For example:

```
#define TRUE 1
#define FALSE 0
```

- or

```
int comp(char *, char *);
```


Header files

- To avoid retyping (and likely errors!), put the definitions in a header file, *e.g.*
  `header.h`
- And in your program file(s) include the header:

```
#include "header.h"
```

Including header files

```
#include <stdio.h>
#include "dict.h"

int main()
{
   /* code in here can use
    definitions and prototypes in
    header*/
}
```


Compiling multifile programs

- `gcc -o dict1 dict1.c bst1.c`
  - Prone to typing errors
  - Recompiles everything from the ground up
- Makefiles
  - Simplify the compilation command:
    - `make dict1`
  - Checks which files have been changed, and only recompile them

Makefile

```
dict1: dict1.o bst1.o
     gcc -o dict1 dict.o bst1.o

bst1.o: bst1.c bst1.h
     gcc -c -Wall bst1.c

dict1.o: dict1.c dict.h
     gcc -c -Wall dict1.c
```


Makefile

```
dict1: dict1.o bst1.o
     gcc -o dict1 dict.o bst1.o

bst1.o: bst1.c bst1.h
     gcc -c -Wall bst1.c

dict1.o: dict1.c dict.h
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```

target

target

target

Makefile

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     gcc -o dict1 dict.o bst1.o

bst1.o: bst1.c bst1.h
     gcc -c -Wall bst1.c

dict1.o: dict1.c dict.h
     gcc -c -Wall dict1.c
```

dependencies

Makefile

```
dict1: dict1.o bst1.o
     gcc -o dict1 dict.o bst1.o

bst1.o: bst1.c bst1.h
     gcc -c -Wall bst1.c

dict1.o: dict1.c dict.h
     gcc -c -Wall dict1.c
```

instructions

Makefile

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dict1: dict1.o bst1.o
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instructions

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instructions

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```

instructions

tabs

Makefile

```
dict1: dict1.o bst1.o
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bst1.o: bst1.c bst1.h
    gcc -c -Wall bst1.c

dict1.o: dict1.c dict.h
    gcc -c -Wall dict1.c

# comments start with hash
```


More on .o files, linkers, etc.

- http://www.lurklurk.org/linkers/linkers.html

David Drysdale, “Beginner’s Guide to Linkers”

Header files

- Contains
  - function declarations
  - macro definitions
  - shared among several source files

Another example: `list.h`

```
#ifndef LISTH
#define LISTH

typedef struct node{
    data_t  data;
    node_t* next;
} node_t;

int search_sorted( list_t* list, data_t value );

#endif
```


`list.c`

```
#include "list.h"

int search_sorted( list_t* list, data_t value ) {
    //code for the search_sorted function here

}
```