15-410
"...#ifndef DSFLK_FSFDDS_FSDFDS..."

#include
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Outline

#ifndef DSFLK_FSFDDS_FSDFDS

What's _STDIO_H_ anyway?

```
#ifndef _STDIO_H_
#define _STDIO_H_

typedef struct FILE {
  ...
} ...;


#endif /* _STDIO_H_ */
```

Archaeology

C is old

C doesn't have modules

C has *compilation units*

- "Compilation unit" is the secret ANSI code word for "file"
- Compilers sort of know some file types: .c, .s
- Compilers *don't* really know about .h
  - Auxiliary "pre-processor" brain (/lib/cpp) hides them

People use *conventions* to get module-like C

- These conventions evolved slowly

The ".h Responsibility" Dilemma

Assume: "stdio module"

Assume: "network stack module"
- **(Trust us, it's modular!)**

Both need to know
- **What's a `size_t` on this machine, anyway?**
- **#include <sys/types.h>**

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Nested Responsibility

Program 1:
- **#include <stdio.h>**

Program 2:
- **#include <netinet/tcp_var.h>**

Assume
- **Program 1, 2 don't need sys/types.h themselves**

Solution 1
- **stdio.h and netinet/tcp_var.h each include sys/types.h**

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Too Much

Program 3:
- #include <stdio.h>
- #include <netinet/tcp_var.h>

Problem
- Now we get *two* copies sys/types.h
- Lots of whining about redefinitions
- Maybe compilation fails

Too Much

Program 3:

- #include <stdio.h>
- #include <netinet/tcp_var.h>

Problem

- Now we get *two* copies sys/types.h
- Lots of whining about redefinitions
- Maybe compilation fails

Solution?

- Blame the programmer!

Passing the Buck

Solution 2

- Require *main program* to #include <sys/types.h>
- Then the other .h files don't have to

Problem

- Extra work for the programmer
- Modules' needs *change over time*
  - Didn't you know? Since last night xxx needs yyy...

Solution: Idempotent .h files

.h responsibility

- **Activate only once**
- **No matter how many times included**
- **Choose string "unlikely to be used elsewhere"**

```
#ifndef _STDIO_H_
#define _STDIO_H_
...
#endif /* _STDIO_H_ */
```

What *Belongs* in a .h?

Types (C: *declarations*, not *definitions*)

Exported interface routines ("public methods")

Constants (#define or enum)

Macros (when *appropriate*)

Data items exported by module
- Try to avoid this
- Same reason as other languages: data != semantics

No code!

But What About...?

Real modules have multiple .c files

- libx/logging.c, libx/data.c, libx/interface.c
- Who declares *internal* functions?
- Who declares *internal* data structures?
  - "internally exporting" data structures is legitimate: internally, we agree on semantics and can agree on structural changes

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Maybe a ".i" file?

- Help?

Use the *Other* .h File!

stdio.h
- Included by module clients
- Included by module parts
- Available in /usr/include when stdio is installed

stdio_private.h
- Included only by module parts
- Not made available in a public location (ideally)

*_private.h should be idempotent, too

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Summary

#ifndef DSFLK_FSFDDS_FSDFDS

- **Well, use a better string**
- **Used to make .h files idempotent**

What *should* go here, anyway?

- **There are two "here"'s here**
  - **foo.h: public interface, available to public**
  - **foo_private.h: internal communication, maybe unpublished**