

Error Handling

Issues and Ideas



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System Calls and Errors

- In general, systems calls return a negative number to indicate an error.
 - We often want to find out what error.
 - Servers generally add this information to a log.
 - Clients generally provide some information to the user.

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```
extern int errno;
```

- Whenever an error occurs, system calls set the value of the global variable **errno**.
 - You can check **errno** for specific errors.
 - You can use support functions to print out or log an ASCII text error message.

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When is `errno` valid?

- `errno` is valid only after a system call has returned an error.
 - System calls don't *clear* `errno` on success.
 - If you make another system call you may lose the previous value of `errno`.
 - `printf` makes a call to `write!`

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Error codes

```
#include <errno.h>
```

Error codes are defined in `errno.h`

```
EAGAIN      EBADF      EACCESS
EBUSY       EINTR     EINVAL
EIO         ENODEV   EPIPE
...
```

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Support Routines

```
void perror(const char *string);
```

↑
In `stdio.h`

```
char *strerror(int errnum);
```

↑
In `string.h`

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General Strategies

- Include code to check for errors after every system call.
- Develop "wrapper functions" that do the checking for you.
- Develop layers of functions, each hides some of the error-handling details.

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Example wrapper

```
int Socket( int f,int t,int p) {  
    int n;  
    if ( (n=socket(f,t,p)) < 0 ) {  
        perror("Fatal Error");  
        exit(1);  
    }  
    return(n);  
}
```

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What is fatal?



- How do you know what should be a fatal error (program exits)?
 - Common sense.
 - If the program can continue – it should.
- Example – if a server can't create a socket, or can't bind to it's port - there is no sense continuing...

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Wrappers are great!

- Wrappers like those used in the text can make code much more readable.
- There are always situations in which you cannot use the wrappers
 - Sometimes system calls are "interrupted" (EINTR) – this is not always a fatal error !

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Word of Caution

- If you use the code from the book for your projects, you must understand it!
- The library of code used in the text is extensive:
 - Wrappers call custom error handling code.
 - Custom error handling code make assumptions about having other custom library functions.
 - ...

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Another approach

- Instead of simple wrapper functions, you might develop a *layered system*.
 - higher-level functions that match your application better.
- The idea is to "hide" the `sockaddr` and error handling details behind a few custom functions:

```
int tcp_client(char *server, int port);
int tcp_server(int port);
```

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Layers and Code Re-use

- Developing general functions that might be re-used in other programs is obviously “a good thing”.
- Layering is beneficial even if the code is not intended to be re-used:
 - hide error-handling from “high-level” code.
 - hide other details.
 - often makes debugging easier.

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The Best Approach to handling errors



- There is no *best approach*.
- Do what works for you.
- Make sure you check *all* system calls for errors!!!!
 - Not checking can lead to security problems!
 - Not checking can lead to bad grades on homework projects!

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