13 Some Tricks

Programming in C

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Congratulations

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- The only question is: Do you know how to solve problems?
- *Actually, that is not the object of this class.*

However ...

- You need to read more and write more.
- Besides, there are some tricks and some notes that you need to know.
  - To avoid some errors.
  - To make things easier.
- So in this section, we will browse some of them.

Predefined Macros

Standard Predefined Macros

- __FILE__
- __LINE__
- __FUNCTION__ (gcc); __func__ (C99)
- __DATE__
- __TIME__
- __STDC__
- __STDC_VERSION__

Please see the predef_macro.c .

How can we Use These Macros?

```
fprintf (stderr, "Internal␣error:␣"
                 "at␣%s,␣line␣%d.␣ver␣%s␣%s",
          __FILE__, __LINE__, __DATE__, __TIME__);
```

Define when Compiling

- Please see the debug.c.
- Comparison:
  - gcc debug.c
  - gcc -D__DEBUG__ debug.c
- This is an useful tool to generate different programs.

Other GCC Predefined MACROs

https://gcc.gnu.org/onlinedocs/cpp/Common-Predefined-Macros.html

Comparing Unsigned Integers

uint.c

What is the output of this program?

Comparing Unsigned Integers

- When comparisons between signed and unsigned integers, C will force the signed type to unsigned.
- C99 and C11 section 6.3.1.8.
- It is hard to debug since it looks so nature.

Call Functions at Program Termination

Register a Function to be Called at Normal Process Termination

int atexit(void (*function)(void));

The atexit() function registers the given function to be called at normal process termination, either via exit(3) or via return from the program's main(). Functions so registered are called in the reverse order of their registration; no arguments are passed.

The atexit() function returns the value 0 if successful; otherwise it returns a nonzero value.

Please see the example atexit.c

system and more

System: Execute a Shell Command

int system(const char *command);

The **system()** library function uses fork(2) to create a child process that executes the shell command specified in command.

system() returns after the command has been completed.

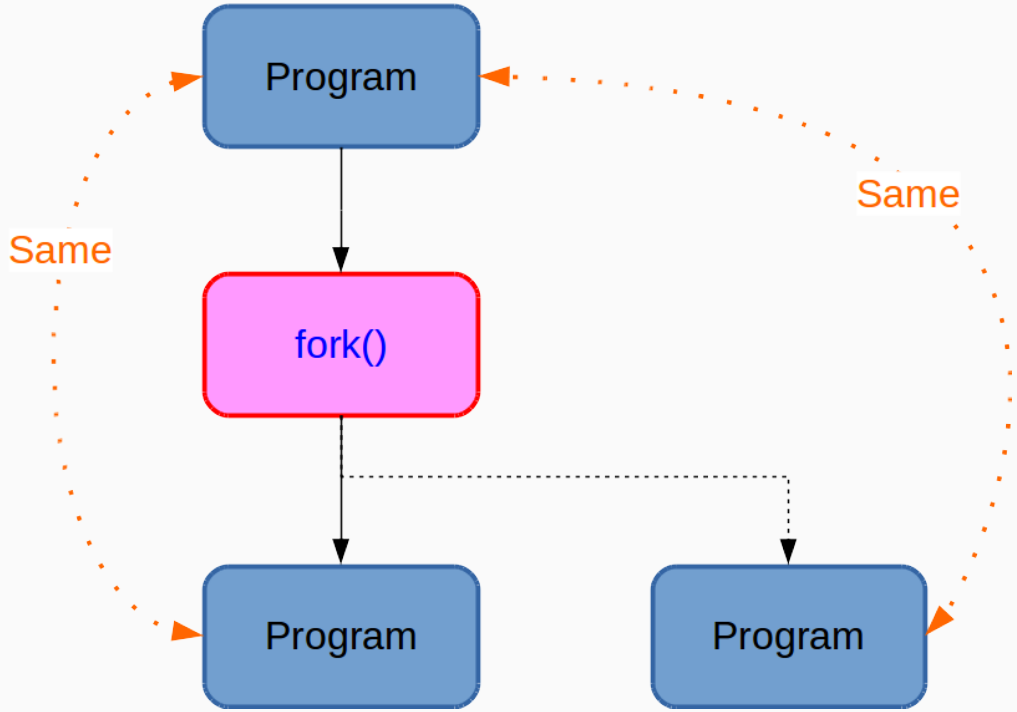
Please see system_example_01.c .

What's the Problem??

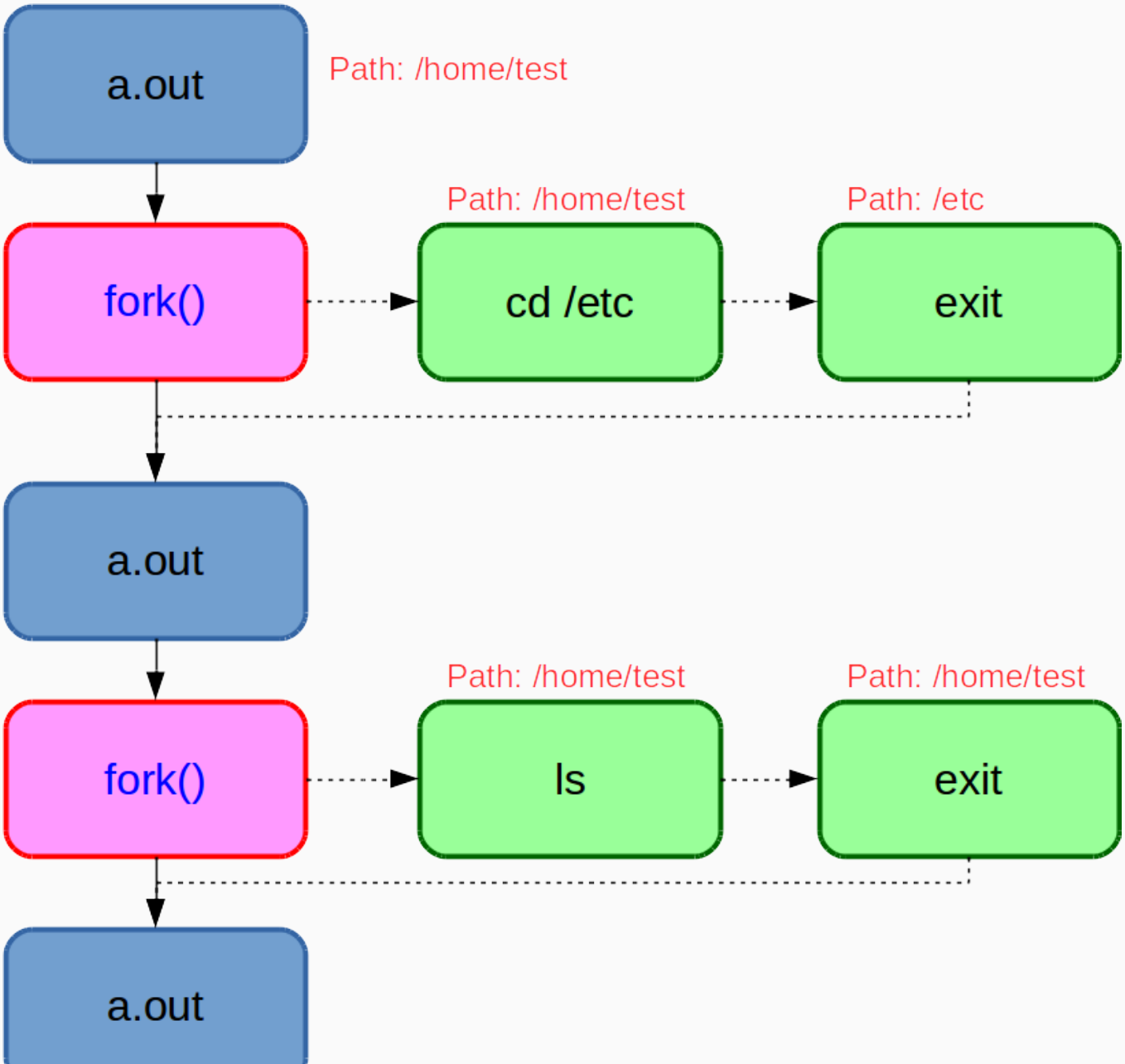
Please see system_example_02.c and explain why we cannot show the content of /etc/passwd.

fork

- **fork()** creates a new process by duplicating the calling process.
- This is an important function. However, I will not talk too much about this function but you will learn more in **System Programming**.



Example 02 Problem



Important Notes

- system() is a **blocking** function.
  - Please see system_example_03.c .
- The system() returns -1 means **your system cannot fork another process instead of your command fails.**
  - You can try a command to delete a non-existing file.
- Every system call is **independent**.
  - So you cannot setup an environment variable and hope other other system calls use this variable.

I Have a Question

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1. Use system() and redirect the output to a file. Then open the file.
2. Use popen().

popen()

FILE *popen(const char *command, const char *type);

The popen() function opens a process by creating a pipe, forking, and invoking the shell.

The popen() function returns NULL if the fork(2) or pipe(2) calls fail, or if it cannot allocate memory.

Please see popen.c.

Do not forget to use pclose.

Practice

Please write a program to get your system's IP address and TX/RX packets.

Hint: you can use the command ifconfig.

Attention

This example is for your practice only.

In fact, you should use another way to get your system's IP address and TX/RX packets.

assert

Assert

- In computer programming, an assertion is a statement that a predicate (Boolean-valued function, i.e. a true-false expression) is always true at that point in code execution.
- It can **help** a programmer read the code, help a compiler compile it, or help the program detect its own defects.
- If the assertion check is not in fact true, an assertion failure, the program considers itself to be broken and typically deliberately crashes or throws an assertion failure exception.

assert()

void assert(scalar expression);

The **macro** assert() prints an error message to standard error and terminates the program by calling **abort(3)** if expression is false.

The purpose of this macro is to help programmers find bugs in their programs.

Please see assert.c .

Comparison with Error Handling

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I can simply use if-else to check the return value. Why do I need **assert**?

- You are right.
- It depends how if you can **gracefully** handle the bug.

Important Note

- Generally speaking, assert is used in development.
- **When release, please remove all asserts**.
- How? Define **NDEBUG**.

qsort

Sorting

- In computer science, arranging in an ordered sequence is called **sorting**.
- This is a very important topic in **data structure** and **algorithm**.
  - which implies that this is not my business :p.
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- Actually, C standard library has already provided us this tool and we will see how to use this.

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- Actually, C standard library has already provided us this tool and we will see how to use this.
- **Note**:
  - Do not use this function in the **algorithm** class or you will learn nothing.

qsort: Sort an Array

void qsort(void *base, size_t nmemb, size_t size, int (*compar)(const void *, const void *));

The qsort() function sorts an array with **nmemb** elements of **size** size. The base argument points to the start of the array.

The comparison function must return an integer less than, equal to, or greater than zero if the first argument is considered to be respectively less than, equal to, or greater than the second. If two members compare as equal, their order in the sorted array is undefined.

Please see qsort.c.

Practice

Please modify the last example to support sorting by total score.

Besides, please support the descending order.

How to Use Other Libraries

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I mean, except your homework in this class.

When You want Some Functions ...

1. **Survey before development**.
2. If there is no solution, develop yourself.
3. If there is a solution,
   - Evaluate the solution and see if the library satisfies your requirements.
   - If no, develop yourself.
   - Otherwise, use it.

When you use a third-party solution, it is your responsibility to fix the bug.

Project: Retrieve Data From Taipei Government

We will develop a program to get data from Taipei government.

Example: 臺北市文化快遞資訊 RID

`https://data.taipei/dataset/detail/api?id=e9bbb0c9-4d23-45b1-96d1-7b18565bbea6&rid=35aa3c53-28fb-423c-91b6-2c22432d0d70`

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What should we do?

- Actually, you should take **Computer Networking** class first.
- To ease your panic, I will give you a library which can handle all web connection works for you, **libcurl**.

Step 1: Install the Library

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  - Now you should know what readme should look like.
- Install the library if you want.
  - I will not install it.

Step 1: Install the Library

- Actually, libcurl is a very popular library. You do not need to build the library your own.
- Other install ways:
  - Debian/Ubuntu: sudo apt-get install libcurl
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- **Pros**:
  - Easy. You do not need to handle the dependency issue.
- **Cons**:
  - Out of date.

How to Handle Dependency Issues?

- Choose a library that does not need other libraries.
- Choose a library that uses libraries.
- Install other libraries.

Step 2: Develop Your Program with Third Party Libraries

- There are lots of example codes on Internet.
  - `https://curl.haxx.se/libcurl/c/example.html`
  - Google.
- Study and Write your code.

Step 3: Build Your Code

- gcc -I curl-7.63.0/include -L curl-7.63.0/lib/.libs/ opendata.c -lcurl
- Actually, you should write a Makefile for this.
- LD_LIBRARY_PATH=curl-7.63.0/lib/.libs/ ./a.out
  - Why do I need LD_LIBRARY_PATH=curl-7.63.0/lib/.libs/?

Done ... ?

- Now we get the information. But the data is so ugly and cannot read.
- Your homework is to parse this file.
  - This is a JSON file.
  - Again, do not invent wheels.
  - CJSON: `https://github.com/DaveGamble/cJSON`
- Besides, make an interface for users to search.