

REVIEW C PROGRAMING

Dựa trên slide của bộ môn TTM

Content

- Basic notations
- Data type
- Condition and Iteration
- Function
- Command line argument
- Pointer
- Structure
- Link listed
- I/O function

Tập ký tự

- Tập ký tự trong C
 - 26 chữ cái hoa: A B C ... X Y Z
 - 26 chữ cái thường: a b c ... x y z.
 - 10 chữ số: 0 1 2 3 4 5 6 7 8 9.
 - Các kí hiệu toán học: + - * / = < >
 - Các dấu ngăn cách: . ; , : space tab
 - Các dấu ngoặc: () [] { }
 - Các kí hiệu đặc biệt: _ ? \$ & # ^ \ ! ' " ~ .v.v.

Từ khóa

- Từ khóa hay dùng trong

<code>break</code>	<code>case</code>	<code>char</code>	<code>const</code>	<code>continue</code>	<code>default</code>
<code>do</code>	<code>double</code>	<code>else</code>	<code>enum</code>	<code>float</code>	<code>for</code>
<code>goto</code>	<code>if</code>	<code>int</code>	<code>interrupt</code>	<code>long</code>	<code>return</code>
<code>short</code>	<code>signed</code>	<code>sizeof</code>	<code>static</code>	<code>struct</code>	<code>switch</code>
<code>typedef</code>	<code>union</code>	<code>unsigned</code>	<code>void</code>	<code>while</code>	

Định danh

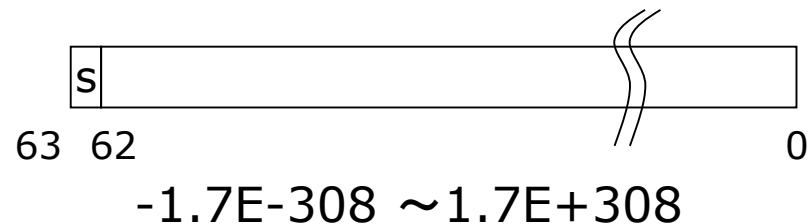
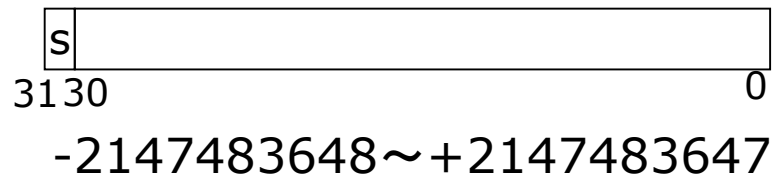
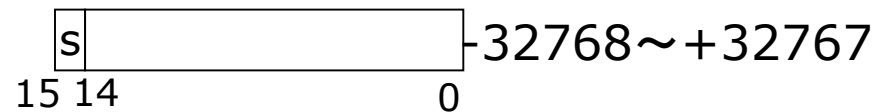
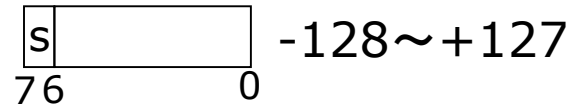
- Quy tắc đặt tên định danh trong C
 - Các kí tự được sử dụng: chữ cái, chữ số và dấu gạch dưới “_” (*underscore*)
 - Bắt đầu của định danh phải là chữ cái hoặc dấu gạch dưới “_”, không được bắt đầu định danh bằng chữ số.
 - Định danh do người lập trình đặt không được trùng với các từ khóa của C
- Chú ý: *C là ngôn ngữ có phân biệt chữ hoa và chữ thường*

Data type

- Integer
 - int, char, short, long
- Floating
 - double, float
- Array
 - Collection of A data type
 - Declare : `int a[10];`

Size of Type

- size of char: 1 bytes
- size of short: 2 bytes
- size of int: 4 bytes
- size of long: 4 bytes
- size of float: 4 bytes
- size of double: 8 bytes



Condition and Loop Structure

- if ... else
- switch
- for
- while, do ... while

Condition

- $a == b$
 - b equals to a
- $a != b$
 - b is different to a
- $a > b$
 - b is smaller than a
- $a >= b$
 - b isn't greater than a
- $a < b$
 - b is greater than a
- $a <= b$
 - b isn't smaller than a

if ... else

```
if(condition) {  
    statement1;  
    ...  
}  
else{  
    statement2;  
    ...  
}
```

Example :

```
if( x == 1){  
    y = 3;  
    z = 2;  
}  
else{  
    y = 5;  
    z = 4;  
}
```

```
if (condition)  
    task1;  
else task 2;
```

is equivalent?

```
if (condition)  
task1;  
if (!condition)  
task2;
```

switch

```
switch(condition) {  
    case value1: statement1 ; ...; break;  
    case value2: statement2 ; ...; break;  
    ...  
    default: statementn ; ...; break;  
}
```

Example :

```
int monthday( int month ) {  
    switch(month) {  
        case 1: return 31;  
        case 2: return 28;  
        ...  
        case 12: return 31;  
    }  
}
```

for

- `expr1`, `expr3`: assignments or function calls
- `expr2`: relational expression

Any of the three expression can be omitted

- the semicolons must remain

```
for (expr1 ; expr2 ; expr3) {  
    statements ;  
    ...  
}
```

Example :

```
for ( x = 0; x < 10; x++) {  
    printf("%d\n", x);  
}
```

while, do..while

- If there is no initialization or re-initialization, the `while` is most natural

```
while ((c = getchar()) == ' ' || c == '\n' || c == '\t')  
    /* skip white space characters */
```

```
while(condition){  
    statement;  
    ...  
}
```

Example :

```
x = 0;  
while(x < 10){  
    printf("%d\n", x);  
    x = x + 1;  
}
```

```
do{  
    statement;  
    ...  
} while(condition)
```

Example :

```
x = 0;  
do{  
    printf("%d\n", x);  
    x = x + 1;  
} while(x < 10)
```

break

- break
 - Terminates the execution of the nearest enclosing loop or conditional statement in which it appears.
- continue
 - Pass to next iteration of nearest enclosing do, for, while statement in which it appears
- Example

```
/* trim: remove trailing blanks, tabs, newlines */
char s[MAX]
int n;
for (n = strlen(s)-1; n >= 0; n--)
    if (s[n] != ' ' && s[n] != '\t' && s[n] != '\n')
        break;
s[n+1] = '\0';
```

```
for (i = 0; i < n; i++)
    if (a[i] < 0) /* skip negative elements */
        continue;
... /* do positive elements */
```

Function

- A function is a group of statements that is executed when it is called from some point of the program. The following is its format:

```
type name ( parameter1, parameter2, ...) {  
    statements;  
}
```

- where:
 - `type` is the data type specifier of the data returned by the function.
 - `name` is the identifier by which it will be possible to call the function.
 - `parameters` (as many as needed): Each parameter consists of a data type specifier followed by an identifier
 - `statements` is the function's body. It is a block of statements surrounded by braces { }.

Example of function

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

```
int squaresub(int a)
```

```
{
```

```
    return a*a;
```

```
}
```

Data type of function

Return value statement

```
int main()
```

```
{
```

```
    int b = 10;
```

```
    printf("%d\n", squaresub(5));
```

```
    return 0;
```

```
}
```

Use function

Usage of command line arguments

- `main(int argc, char **argv)`
- `main(int argc, char *argv[])`

- `Argc` : number of arguments
- `argv[0]` : argument 0
- `argv[1]` : argument 1
- `argv[2]` : argument 2

Example :

`%./a.out 123 456 789`

`arg[0]: ./a.out`

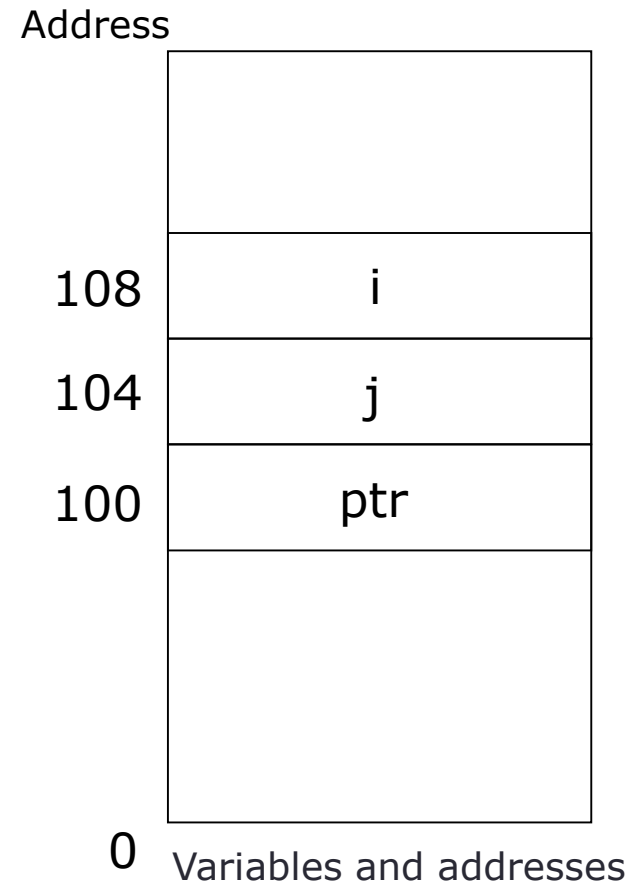
`arg[1]: 123`

`arg[2]: 456`

`arg[3]: 789`

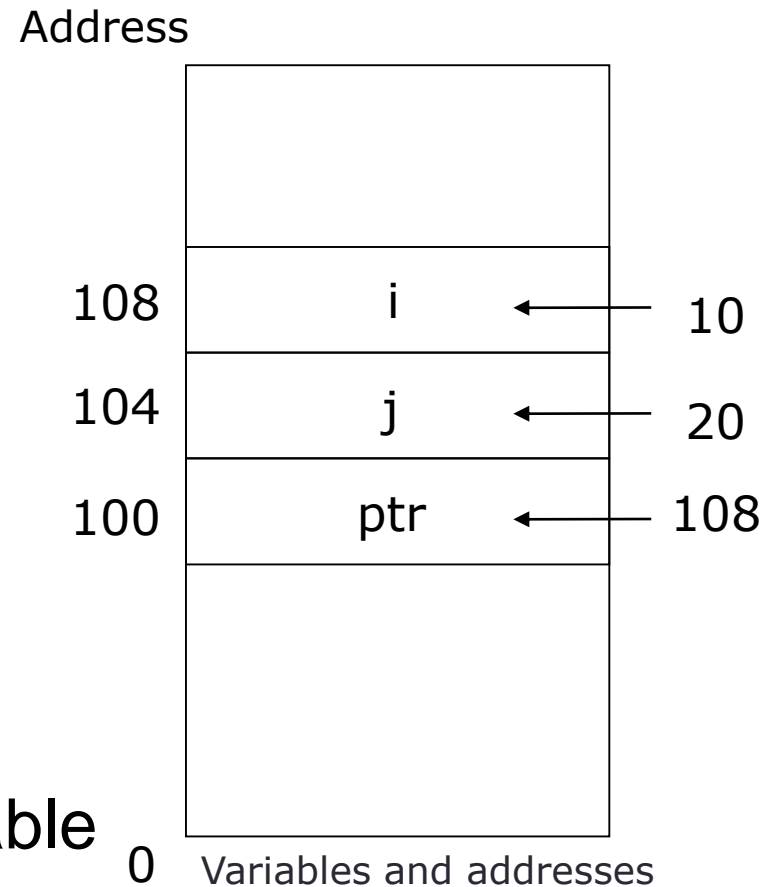
Pointer

- Pointer variable
 - "Variable" refers to variable
- `int i = 10;`
- `int j = 20;`
- `int *ptr;`
- Pointer to pointer:
`int **p;`



Pointer (cont)

- `int i = 10;`
- `int j = 20;`
- `int *ptr = &i;`
- `printf("i=%d\n", &i)`
- `printf("ptr=%d\n", ptr)`
- `printf("i=%d\n", i)`
- `printf("*ptr=%d\n", *ptr)`
- Ptr refers to the pointer variable



```
#include <stdio.h>

int main ()
{
    int var = 20;    /* actual variable declaration */
    int *ip;         /* pointer variable declaration */

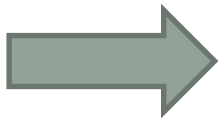
    ip = &var; /* store address of var in pointer variable*/

    printf("Address of var variable: %x\n", &var );

    /* address stored in pointer variable */
    printf("Address stored in ip variable: %x\n", ip );

    /* access the value using the pointer */
    printf("Value of *ip variable: %d\n", *ip );

    return 0;
}
```



```
Address of var variable: bffd8b3c
Address stored in ip variable: bffd8b3c
Value of *ip variable: 20
```

Pointer (cont)

- `int x=1, y=5;`
- `int z[10];`
- `int *p;`
- `p=&x; /* p refers to x */`
- `y=*p; /* y is assigned the value of x */`
- `*p = 0; /* x = 0 */`
- `p=&z[2]; /* p refer to z[2] */`

Pointer and function

```
#include <stdio.h>
void swap(int x, int y)
{
    int temp;
    temp = x;
    x = y;
    y = temp;
}

int main() {
    int a = 5;
    int b = 3;
    swap (a, b);
    printf("a=%d\n", a);
    printf("b=%d\n", b);
    return 0;
}
```

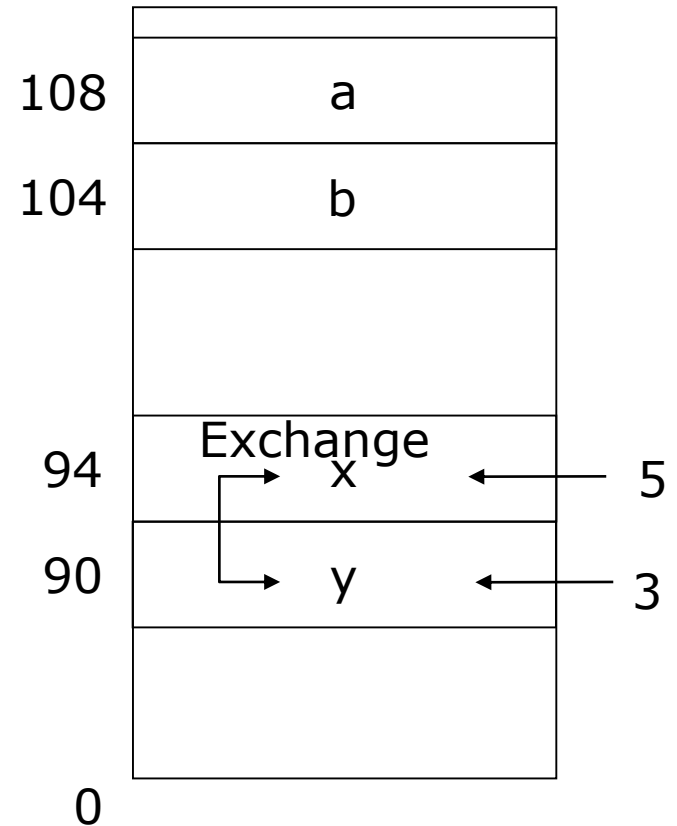
Result ?

Pointer and function (cont)

```
#include <stdio.h>
void swap(int x, int y)
{
    int temp;
    temp = x;
    x = y;
    y = temp;
}

int main() {
    int a = 5;
    int b = 3;
    swap (a, b);
    printf("a=%d\n", a);
    printf("b=%d\n", b);
    return 0;
}
```

Address

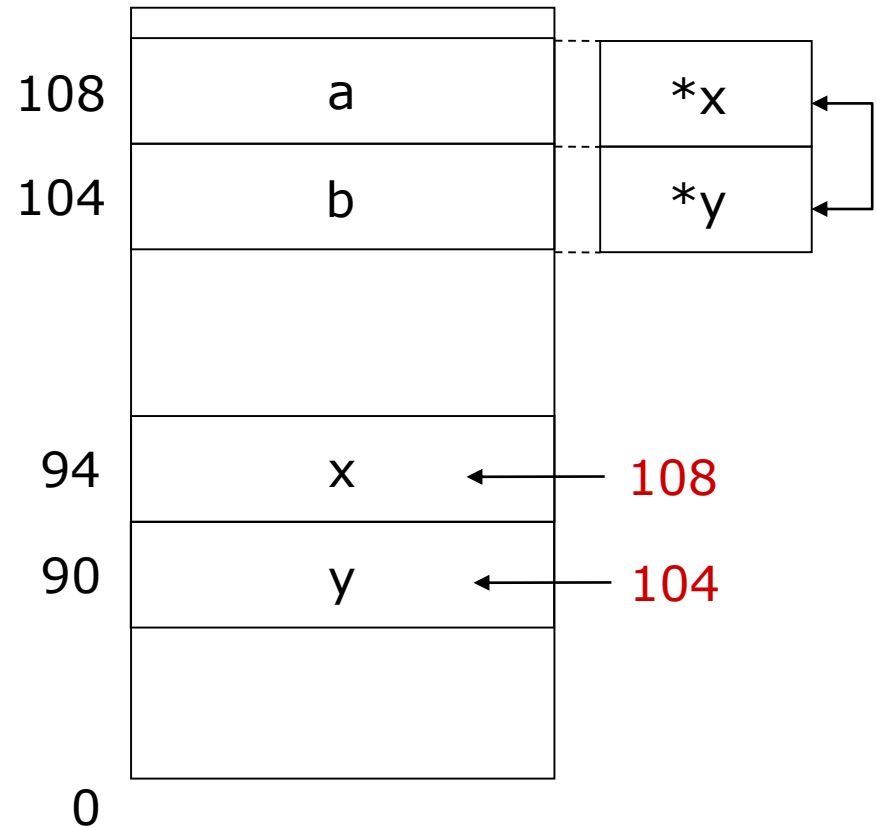


Pointer and function (cont)

```
#include <stdio.h>
void swap(int *x, int *y)
{
    int temp;
    temp = *x;
    *x = *y;
    *y = temp;
}

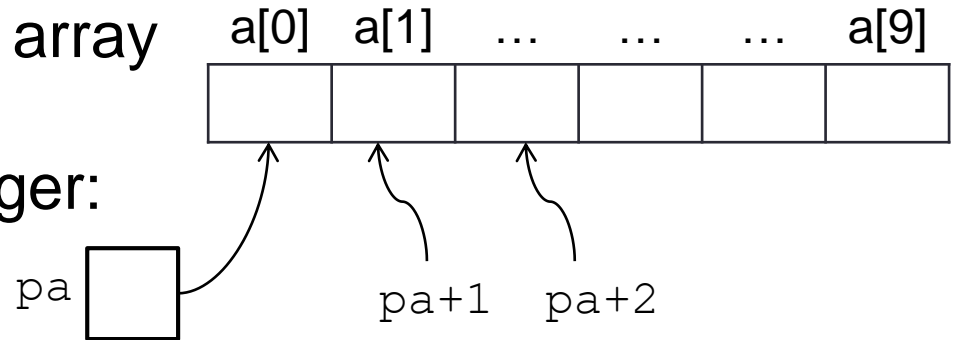
int main() {
    int a = 5;
    int b = 3;
    swap (&a, &b);
    printf("a=%d\n", a);
    printf("b=%d\n", b);
    return 0;
}
```

Program to exchange 2 value of variables



Pointer and Array

- The declaration an integer array
`int a[10];`
- If `pa` is a pointer to an integer:
`int *pa;`
`pa = &a[0];`
- Similarity: `pa` and `a` are pointers
- Difference: `pa` is a variable but `a` is not
 - legal: `pa ++;` `pa = a;`
 - Illegal: `a ++;` `a = pa;`
- `a`: constant pointer



Constant pointer vs Pointer to constant

- Constant pointer: a pointer that cannot change the address its holding.
 - Declaration: `<type> *const <name of pointer>`
- Pointer to constant: a pointer through which one cannot change the value of variable it points
 - Declaration: `const <type>* <name of pointer>`
- Constant Pointer to a Constant: mixture of the above two types of pointers
 - Declaration:
`const <type of pointer>* const <name of pointer>`

Constant pointer

```
#include <stdio.h>
int main(void)
{
    int var1 = 0, var2 = 0;
    int *const ptr = &var1;
    ptr = &var2;
    printf("%d\n", *ptr);

    return 0;
}
```

```
$ gcc -Wall constptr.c -o constptr
constptr.c: In function 'main':
constptr.c:7: error: assignment of read-only variable
'ptr'
```

Pointer to constant

```
#include <stdio.h>
int main(void)
{
    int var1 = 0;
    const int* ptr = &var1;
    *ptr = 1;
    printf("%d\n", *ptr);

    return 0;
}
```

```
$ gcc -Wall constptr.c -o constptr
constptr.c: In function 'main':
constptr.c:7: error: assignment of read-only location
'*ptr'
```

Constant Pointer to a Constant

```
#include <stdio.h>
int main(void)
{
    int var1 = 0, var2 = 0;
    const int* const ptr = &var1;
    *ptr = 1;
    ptr = &var2;
    printf("%d\n", *ptr);

    return 0;
}
```

```
$ gcc -Wall constptr.c -o constptr
constptr.c: In function 'main':
constptr.c:7: error: assignment of read-only location
'*ptr'
constptr.c:8: error: assignment of read-only variable
'ptr'
```

Return pointer from functions vs Function pointer

- Return pointer from functions:

`<type>* <name of function> (<types of parameter>)`

- Function pointer: pointers to functions

`<type> (*<name of function>) (<types of parameter>)`

```
int func (int a, int b)
{
    printf("\n a = %d\n",a);
    printf("\n b = %d\n",b);

    return 0;
}
```

```
int main(void)
{
    // Function pointer
    int (*fptr) (int,int);
    // Assign address to
    // function pointer
    fptr = func;
    func(2,3);
    fptr(2,3);

    return 0;
}
```

void pointer

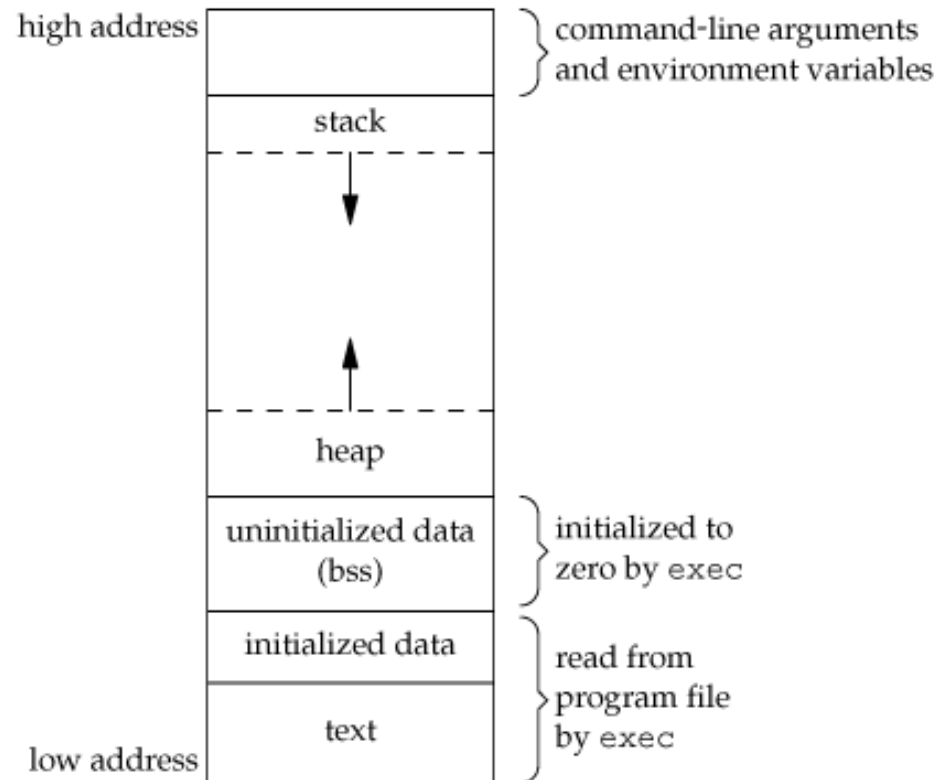
- `void` pointer: a special a pointer that has no associated data type with it
 - Can hold address of any type and can be typecasted to any type.
 - Generic programming
- **Declaration:** `void *<name of pointer>;`
- The void pointer cannot be dereferenced directly
 - The void pointer must first be explicitly cast to another pointer type before it is dereferenced.

```
#include <stdio.h>
int main()
{
    int a = 10;
    void *ptr = &a;
    printf("%d", *(int *)ptr);
    return 0;
}
```

Dynamic Memory Allocation

- A typical memory representation of C program consists of following sections.

1. Text segment: code segment
2. Initialized data segment
3. Uninitialized data segment
4. Stack
5. Heap: the segment where dynamic memory allocation usually takes place



Dynamic Memory Allocation

- `void * malloc(size_t size);`
 - Allocates requested size of bytes and returns a pointer first byte of allocated space
 - Doesn't initialize the allocated memory
 - Assignment: `ptr = (cast-type*) malloc(byte-size)`
- `void * calloc(size_t num, size_t size);`
 - Allocates space for an array elements, initializes to zero and then returns a pointer to memory
 - Initializes the allocated memory block to zero
 - Assignment: `ptr = (cast-type*)calloc(n, element-size);`
 - Equivalent:
`ptr = malloc(size);`
`memset(ptr, 0, size);`

Dynamic Memory Allocation

- `void *realloc(void *ptr, size_t size);`
 - Deallocates the old object pointed to by `ptr` and returns a pointer to a new object that has the size specified by `size`
 - `ptr = realloc(ptr, newsize);`
- `void free(void *ptr);`
 - Deallocate the previously allocated space
- **Memory Leak**
 - Create a memory in heap and forget to delete it
 - To avoid memory leaks, memory allocated on heap should always be freed when no longer needed
- **valgrind**: suite of tools for debugging and profiling programs.
 - `$ valgrind -leak-check=full <program>`

Structure

- Structure is a collection of variables under a single name. Variables can be of any type: int, float, char etc.
- ***Declaring a Structure:***

```
struct Customer  
{  
    int custnum;  
    int salary;  
    float commission;  
};
```

The diagram illustrates the components of a C structure declaration. The word `struct` is identified as the **Keyword** by a horizontal arrow pointing down to it. The word `Customer` is identified as the **Structure Name** by a horizontal arrow pointing right to it. The opening curly brace `{` is identified as the start of the **Structure Members** by a horizontal arrow pointing right to it. The closing curly brace `};` is identified as the end of the **Structure Members** by a horizontal arrow pointing right to it.

Using variable structure

- Declare structure variable?
 - This is similar to variable declaration.
 - Example

```
int a;  
struct Customer John;
```

- Access structure members: use the dot operator
 <structure variable name>.<member name>
- Access to members of a pointer to the variable structure:
using operators →

 <structure variable name> -> <member name>

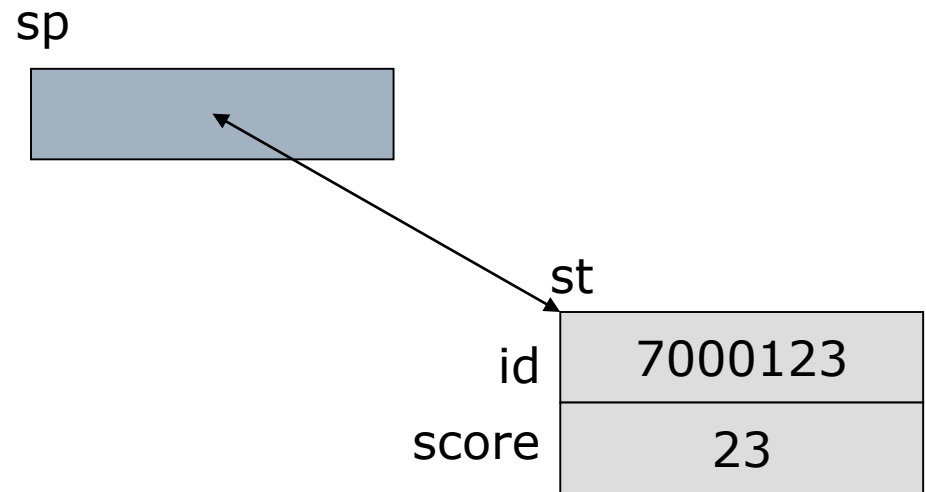
Example

```
struct student{
    int id;
    int score;
};

int main()
{
    int i;
    struct student students[5];
    for(i=0; i<5; i++){
        students[i].id = i;
        students[i].score = i;
    }
    for(i=0;i<5;i++){
        printf("student id:%d, score:%d\n",
            students[i].id, students[i].score);
    }
    return 0;
}
```

Structure and Pointer

```
struct student st;  
struct student *sp;  
sp = &st;  
sp->id = 7000123;  
(*sp).score = 23;
```



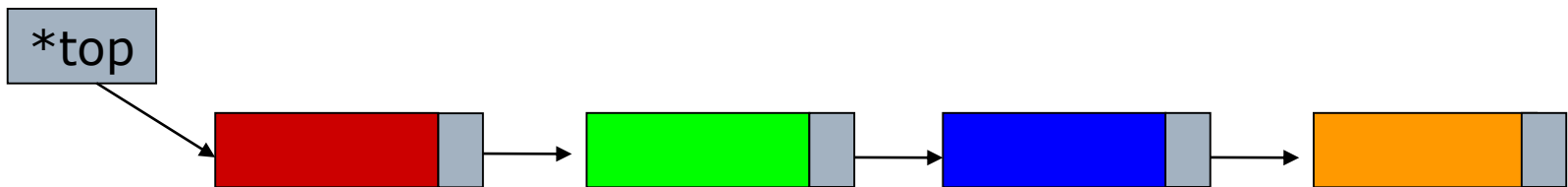
```
printf("%d\n", sp->score);
```

Link list

- Store a pointer to the next structure in the structure

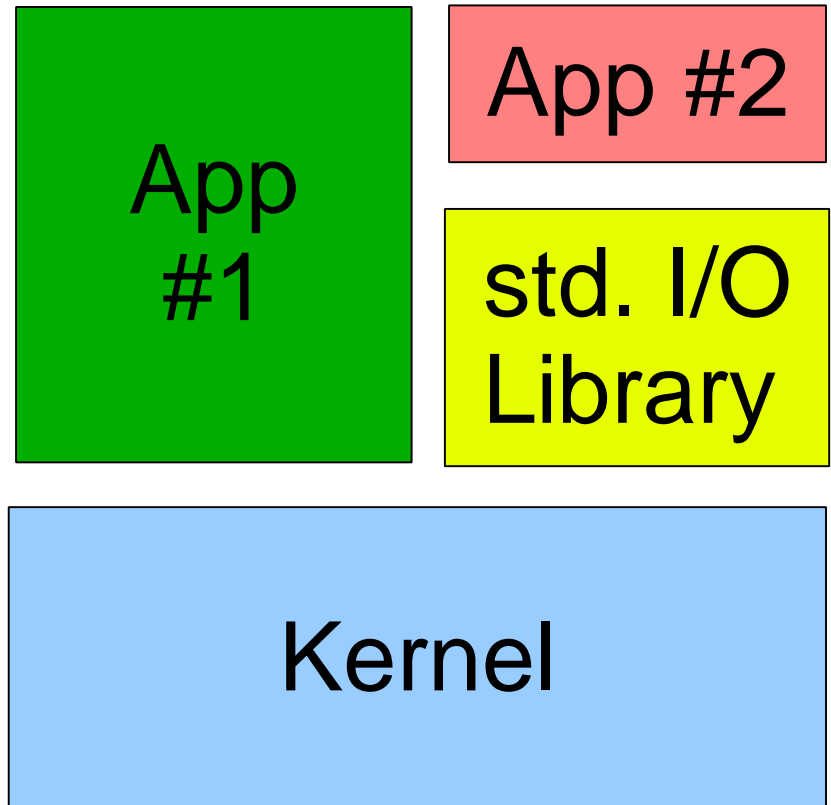
```
struct student {  
    int id;  
    int score;  
    struct student *next;  
}
```

- *Warning : allocate memory before use and release memory after use*



I/O function

- All I/O calls ultimately go to the kernel
- I/O library helps with buffering, formatting, interpreting (esp. text strings & conversions)



Input function (include in stdio.h)

- Functions

- printf()
 - Print formatted data to stdout
- fprintf()
 - Write formatted output to stream
- gets()
 - Read one line from standard input
 - **NEVER EVER USE THIS!**
- fgets()
 - Get string from stream, a newline character makes fgets stop reading
 - **USE THIS INSTEAD**

- getc()
 - Character read from standard input
- putc()
 - Export one character to standard output

- Deprecated functions

- scanf()
 - Read formatted data from stdin
- fscanf()
 - Read formatted data from stream

Input function (include in unistd.h)

- Function
 - read()
 - Argument : number of bytes read and target
 - write()
 - Argument : the number of bytes to write to output
 - open()
 - close()
 - start()

open() / read() / write() / close()

```
#include <fcntl.h>
#include <sys/types.h>
#include <sys/uio.h>
#include <unistd.h>
#define BUFSIZE 1024

int main()
{
    char buf[BUFSIZE];
    int fd;
    int nbyte;
    fd = open("test.txt", O_RDONLY, 0);
    while((nbyte = read(fd, buf, BUFSIZE)) > 0) {
        write(1, buf, nbyte);
    }
    close(fd);

    return 0;
}
```

File handling functions

- `fopen(char *filename, char *mode)`
 - `r, w, a, r+, w+, a+`
- `fgets(char *s, int length, FILE *fd)`
- `fgetc(FILE *fd)`
- `fclose(FILE *fd)`

Example

```
#include <stdio.h>

int main(int argc, char *argv[])
{
    FILE *fp;
    char buf[1024];
    int c;
    fp = fopen(argv[1], "r");
    while((fgets(buf, sizeof(buf), fp)) != NULL) {
        fputs(buf, stdout);
    }
    fclose(fp);

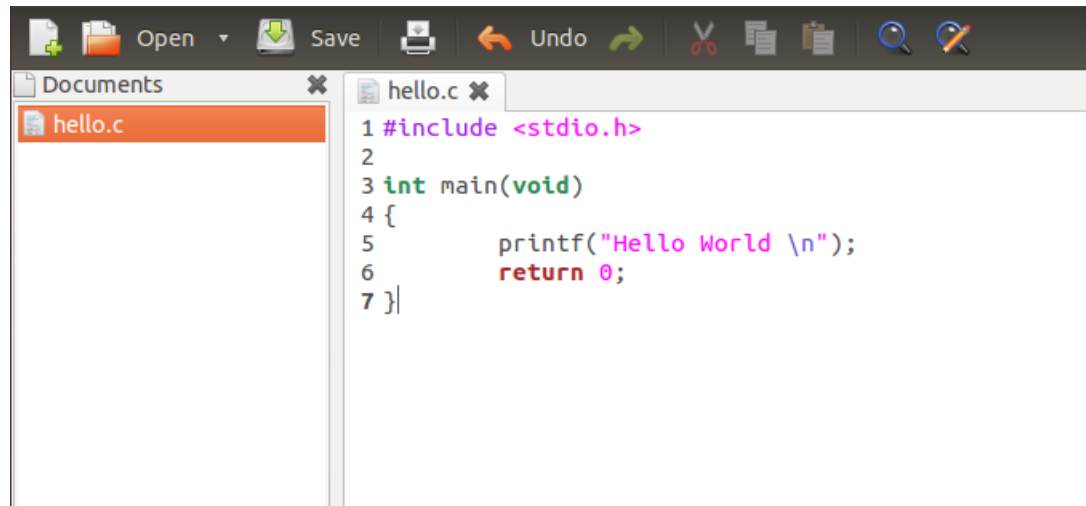
    return 0;
}
```

Chuẩn bị

- 3 thứ cần thiết để lập trình C trên Linux
 - Text editor
 - Compiler
 - C standard library

Text editor

- Vi
- nano
- gedit
- V.V...



A screenshot of a text editor window. The window has a dark gray title bar with icons for file operations (Open, Save, Print) and editing (Undo, Redo, Cut, Copy, Paste, Find, Replace). Below the title bar is a tab bar with two tabs: 'Documents' and 'hello.c'. The 'hello.c' tab is active. The main editing area shows a C program with the following code:

```
1 #include <stdio.h>
2
3 int main(void)
4 {
5     printf("Hello World \n");
6     return 0;
7 }
```

Compiling & Running

- Cài đặt gcc

```
sudo apt-get install gcc
```

- Dịch

```
gcc -o hello hello.c
```

- Chạy

```
./hello
```


Make