REVIEW C PROGRAMING

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Content

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

Data type

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

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Size of Type

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

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Condition and Loop Structure

- `if … else`
- `switch`
- `for`
- `while, do … while`

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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

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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;
```

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switch

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

Example:

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

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for

- `expr1, expr3`: assignments or function calls
- `expr2`: generally is 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);
}
```

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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)
```

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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 */
```

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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 { }.

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Example of function

```
#include <stdio.h>
int squaresub(int a)
{
    return a*a;
}

int main()
{
    int  b = 10;
    printf("%d\n", squaresub(5));
    return 0;
}
```

Data type of function

Return value statement

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

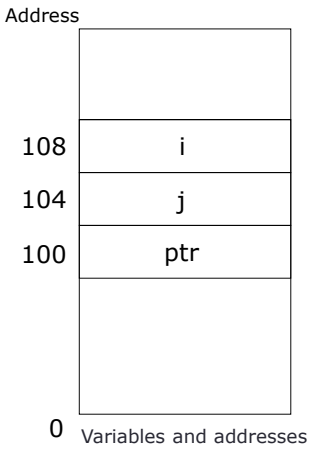
arg[2]: 456

arg[3]: 789

Pointer

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

  int **p;



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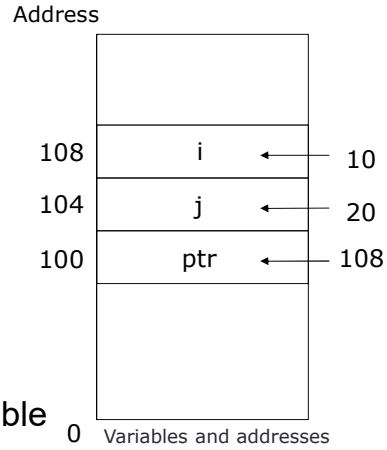
Pointer (cont)

- 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



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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] */

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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 ?

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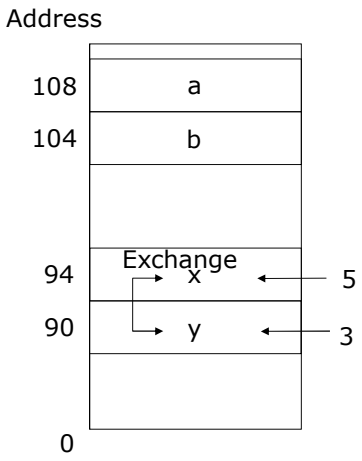
Pointer and function (cont)

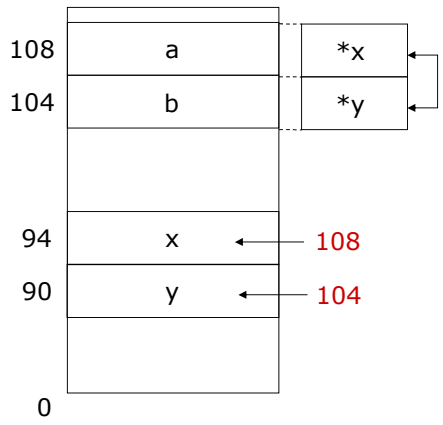
```
#include <stdio.h>
void swap(int x, int y)
{
        int temp;
        temp = x;
        x = y;
        y = temp;
}

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



Pointer and function (cont)

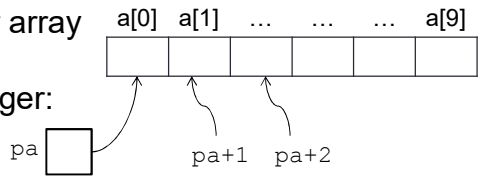
```
#include <stdio.h>
void swap(int *x, int *y)
{
        int temp;
        temp = *x;
        *x = *y;
        *y = temp;
}

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

```c
#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’
```

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Pointer to constant

```c
#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’
```

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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'
```

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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;
}
```

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`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 typcasted 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;
}
```

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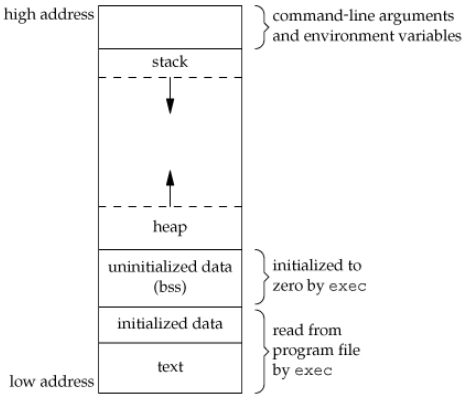
Dynamic Memory Allocation

- 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



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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
  - Asigment: `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 allocates memory block to zero
  - Asigment: `ptr = (cast-type*)calloc(n, element-size);`
  - Equivalent:

```
ptr = malloc(size);
memset(ptr, 0, size);
```

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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>
```

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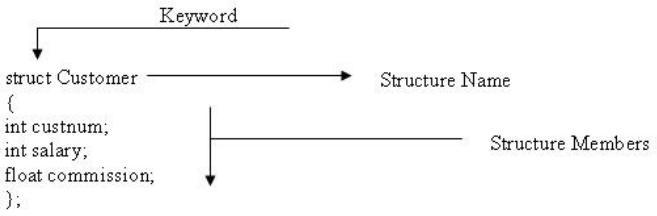
Structure

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



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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>
```

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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;
}
```

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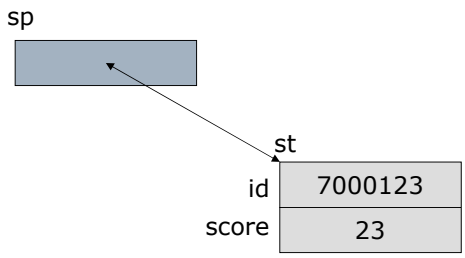
Structure and Pointer

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



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

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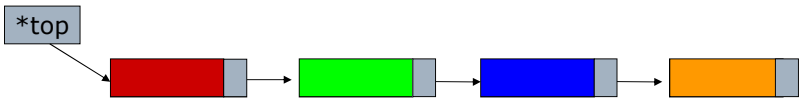
Link list

- 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*



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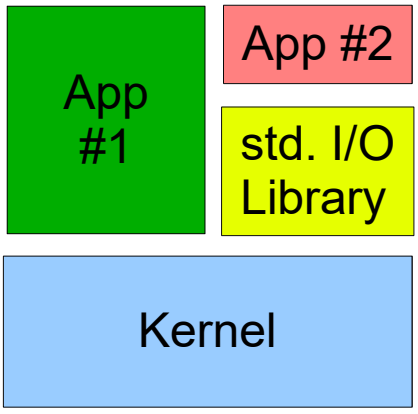
I/O function

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



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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

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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()

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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;
}
```

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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)

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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;
}
```

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