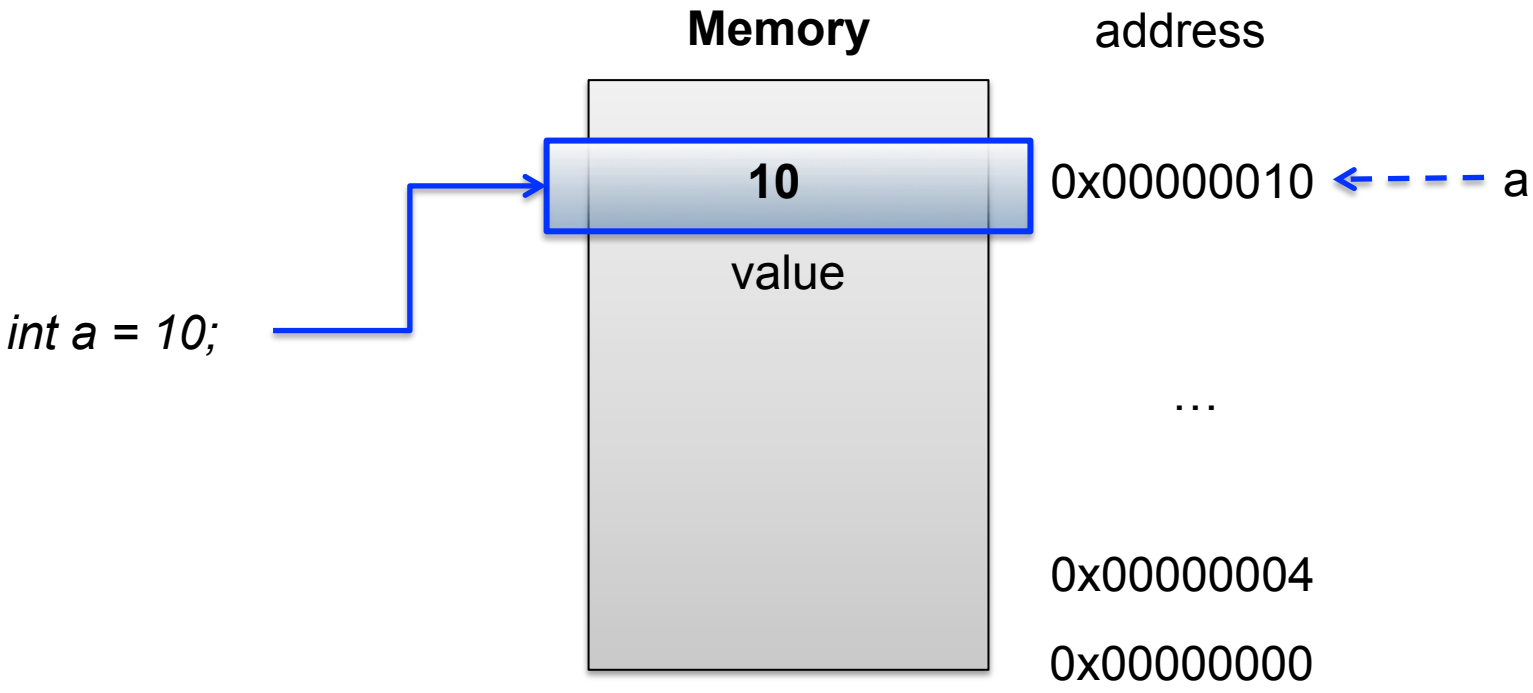
Basic and Practice in Programming

Lab7

Variable and Its Address (1/2)

- What is the variable?
  - Abstracted representation of allocated memory
  - Having address & value



Variable and Its Address (2/2)

```
/* Practice 1 : Variable and Address */
#include <stdio.h>

int main(void)
{
   int a = 10;

   printf("value: %d address: %p\n", a, &a);

   return 0;
}
```

A Consideration

- Let’s consider follow function form

```
int add (int x, int y)
{
    x += y;
    return x;
}
```

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- Let's consider follow function form

```
int add (int x, int y)
{
    x += y;
    return x;
}
```

Realistic executable function form

```
int add (_x, _y)
{
    int x, y;
    x = _x;
    y = _y;
    x += y;
    return x;
}
```

The function uses arguments as form of local variables

A Consideration

- Let's consider follow function form

```
int add (int x, int y)
{
    x += y;
    return x;
}
```

```
int main (void)
{
    int x = 10, y = 10, sum;
    sum = add(x, y);
    return 0;
}
```

What is the value of x?

Realistic executable function form

```
int add (_x, _y)
{
    int x, y;
    x = _x;
    y = _y;
    x += y;
    return x;
}
```

The function uses arguments as form of local variables

Call by Value

```
/* Practice 2 : Call by value */
#include <stdio.h>

int add (int x, int y)
{
   x += y;
   return x;
}

int main(void)
{
   printf("%d + %d = %d\n", 10, 20, add(10, 20));

   return 0;
}
```

Call by Value

```
/* Practice 3 : Call by value 2 */
#include <stdio.h>

int add (int x, int y)
{
   x += y;
   printf (“x: %p y: %p”, &x, &y);
   return x;
}

int main(void)
{
   int x = 10, y = 20;
   printf(“x: %p y: %p”, &x, &y);
   printf(“%d + %d = %d\n”, x, y, add(x, y));

   return 0;
}
```

A Question

- How to use same “variable”
  - Across two functions

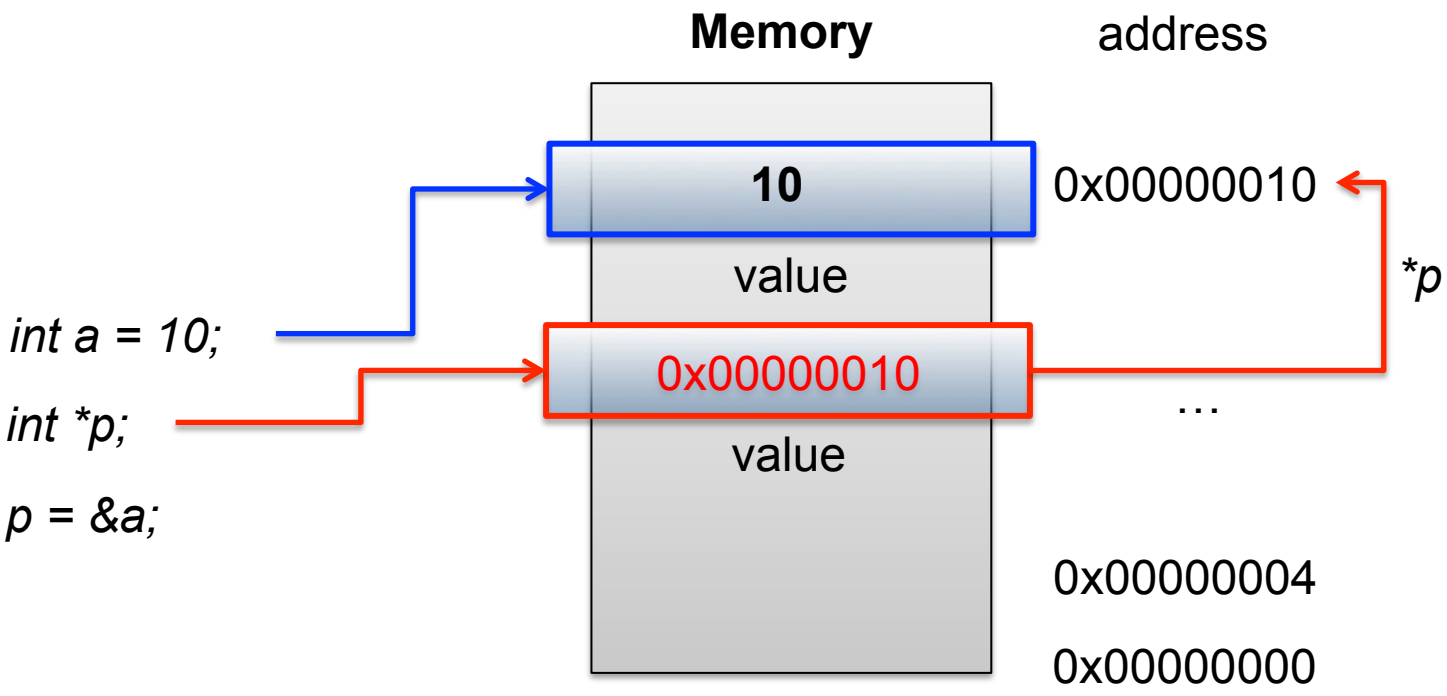
- The answers are
  - Using global variable but,
    - Using global variable is **NOT** recommended
    - Security, consistency, reliability problems
  - Using variable’s address instead of variable itself
    - **Pointer**

Pointer

- It is not a concept
  - Just a method
  - There is no serious “philosophy” in the pointer
  - Pointer is just variable for containing address

```
int a = 10;
int *p = &a;  //declaration form of pointer

//p == &a, *p == a
```

Pointer


Memory
address
10
0x00000010
value
*p
int a = 10;
0x00000010
int *p;
…
value
p = &a;
0x00000004
0x00000000

Functions

- Two types of function call
  - Call by value
  - Call by reference

```
void func1(int a)
{
    …
}
```

Call by value

- Call by value
  - Argument is just “value”

```
void func2(int *a)
{
    …
}
```

Call by reference

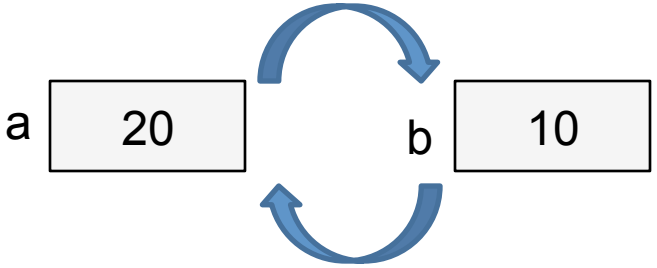
- Call by reference
  - Argument is given by “variable’s address”

Call by Reference (1/3)

- Swap function
  - Exchange two variable's contents

```
int a = 10, b = 20;
```


```
swap(a, b);
```



Call by Reference (2/3)

```
/* Practice 4 :
    Call by reference example1*/
#include <stdio.h>

void swap (int x, int y)
{
   int temp;
   temp = y;
   y = x;
   x = temp;
}
```

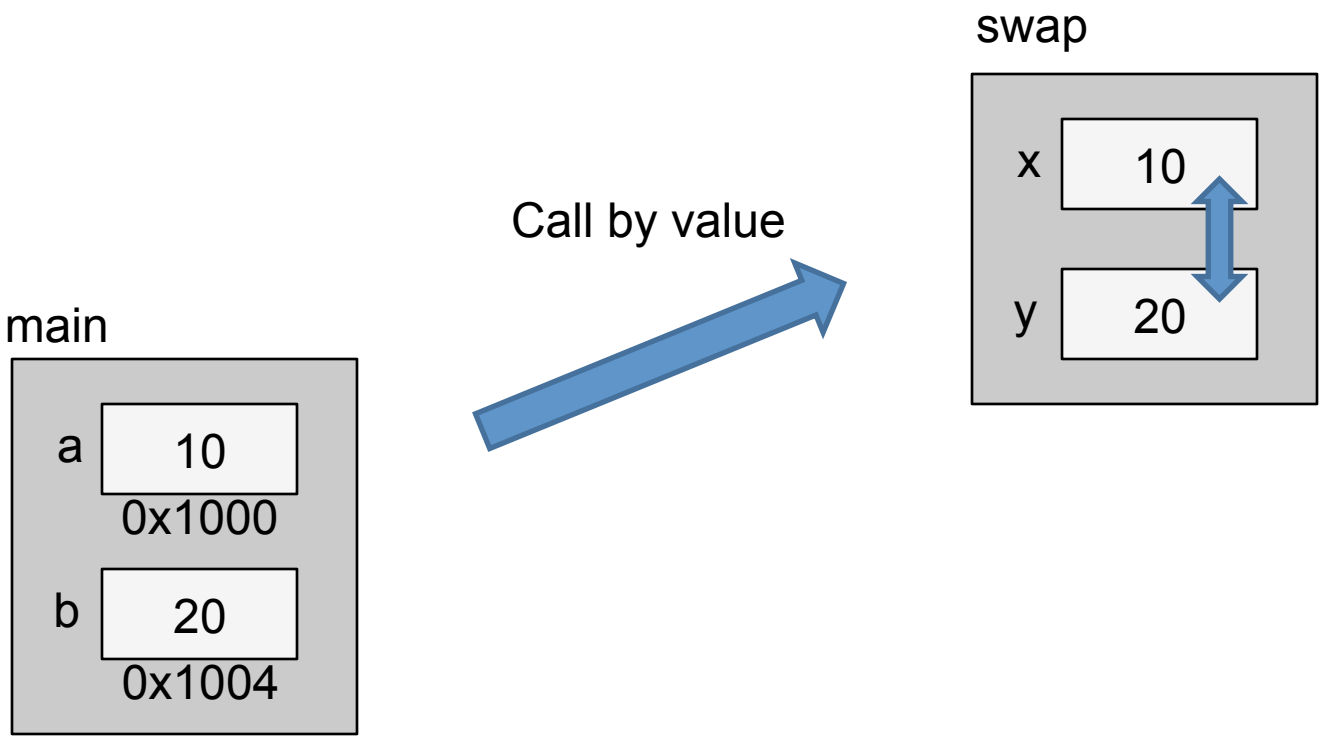
```
int main(void)
{
   int a = 10, b = 20;

   printf("a : %d b : %d", a, b);
   swap(a, b);
   printf("a : %d b : %d", a, b);

   return 0;
}
```

Call by Reference (3/3)

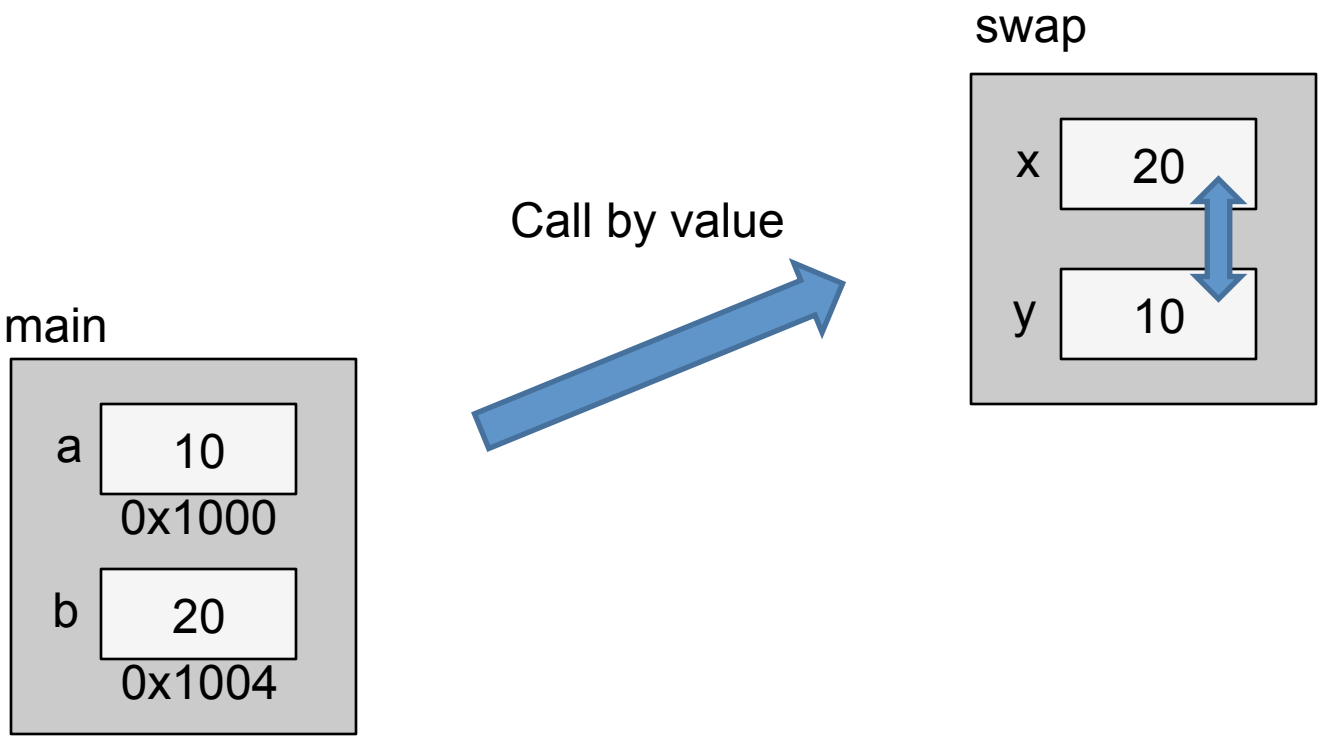
```
/* Practice 5 :
    Call by reference example2*/
#include <stdio.h>

void swap (int *x, int *y)
{
   int temp;
   temp = *y;
   *y = *x;
   *x = temp;
}
```

```
int main(void)
{
   int a = 10, b = 20;

   printf("a : %d b : %d", a, b);
   swap(&a, &b);
   printf("a : %d b : %d", a, b);

   return 0;
}
```

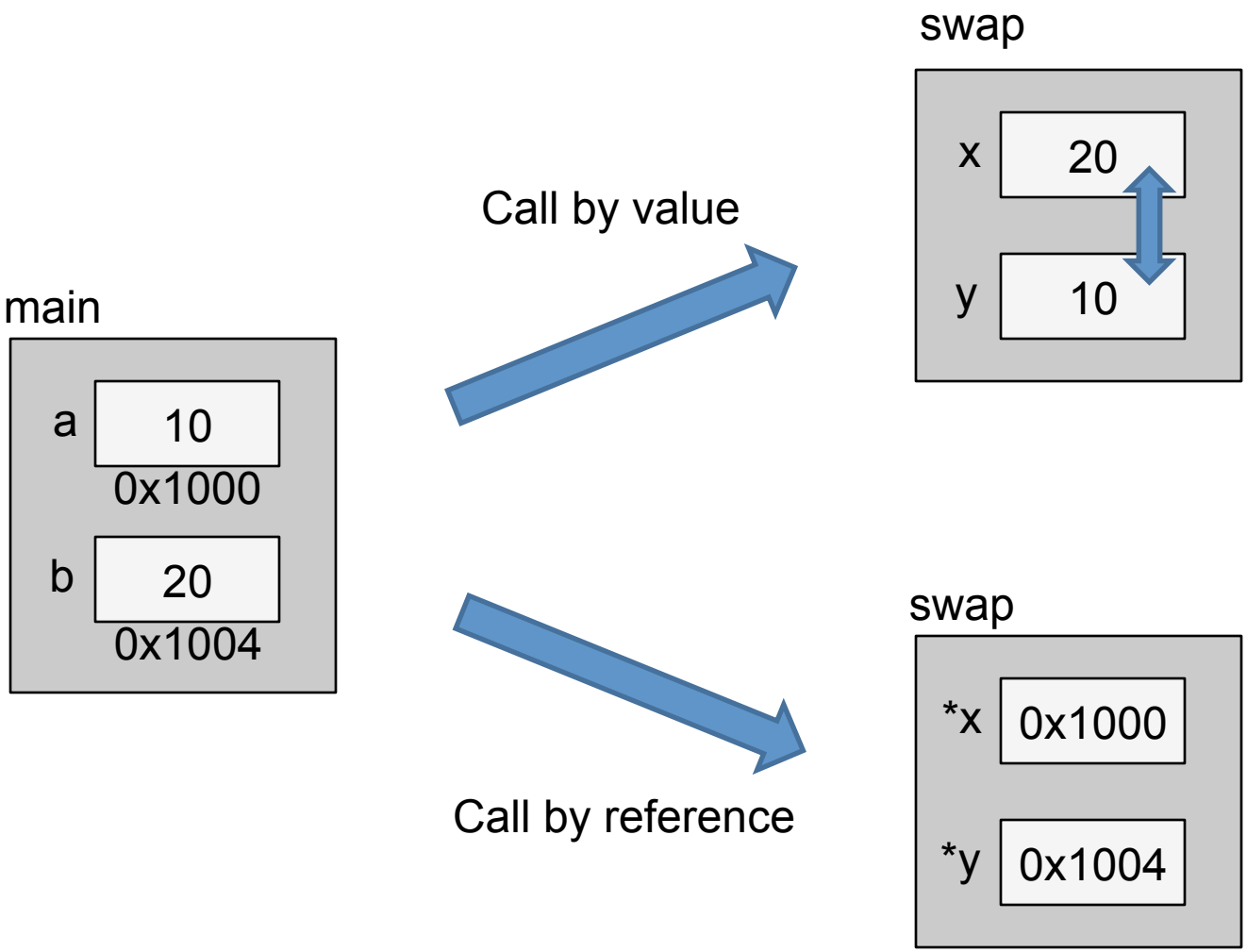
Reference?



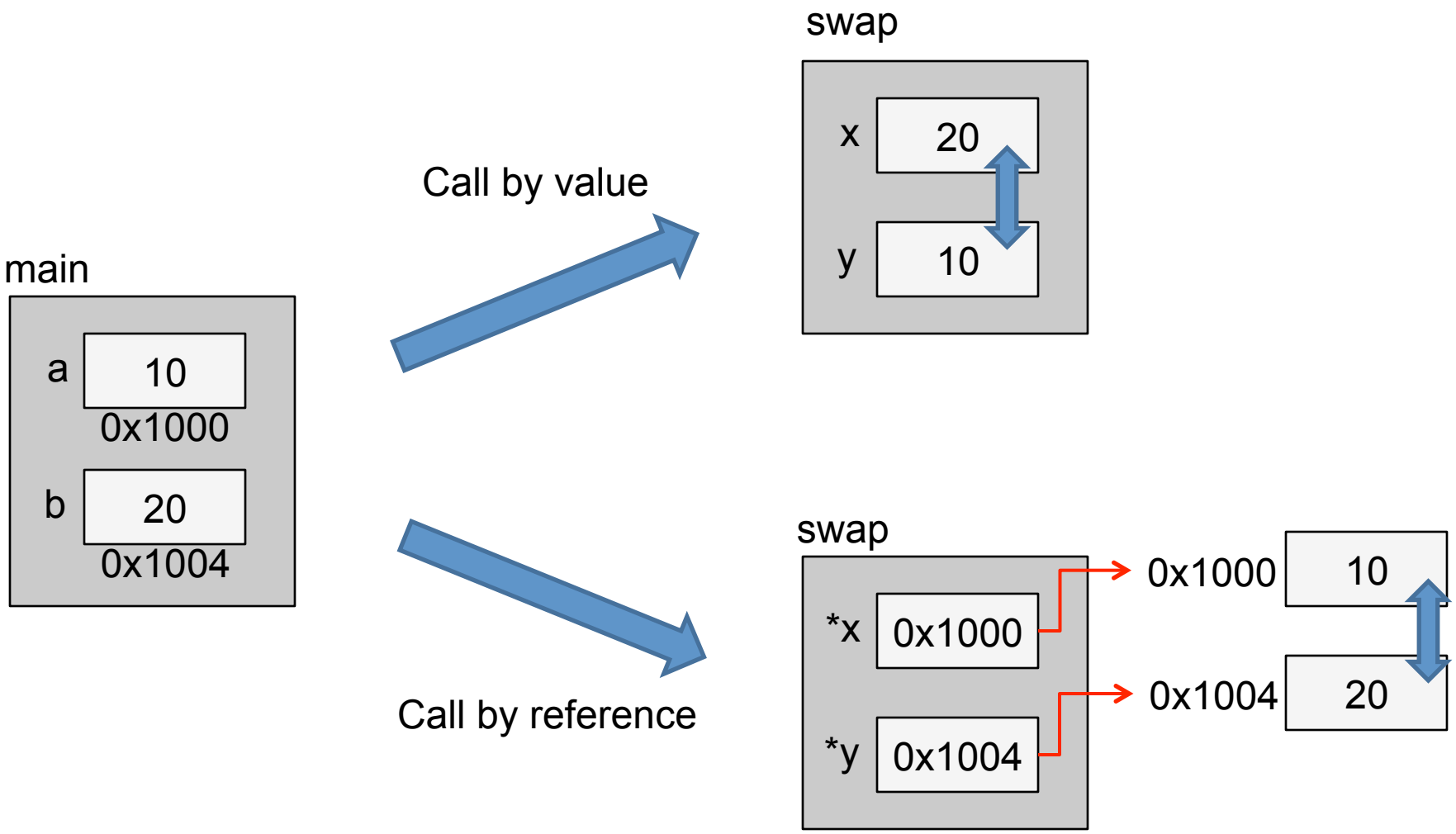
Reference?



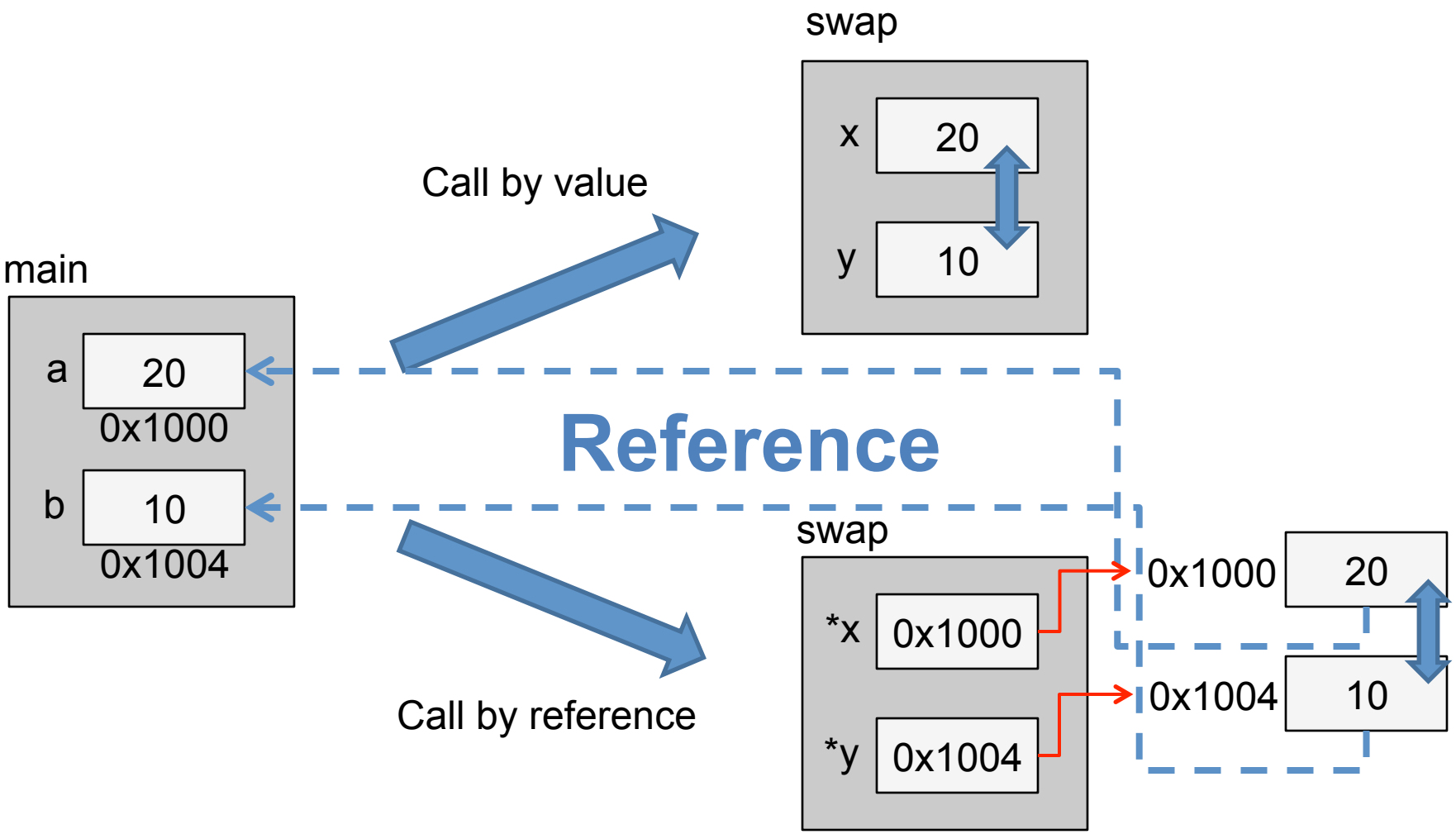
Reference?


swap
x
20
y
10
Call by value
main
a
10
0x1000
b
20
0x1004
swap
*x
0x1000
*y
0x1004
Call by reference

Reference?

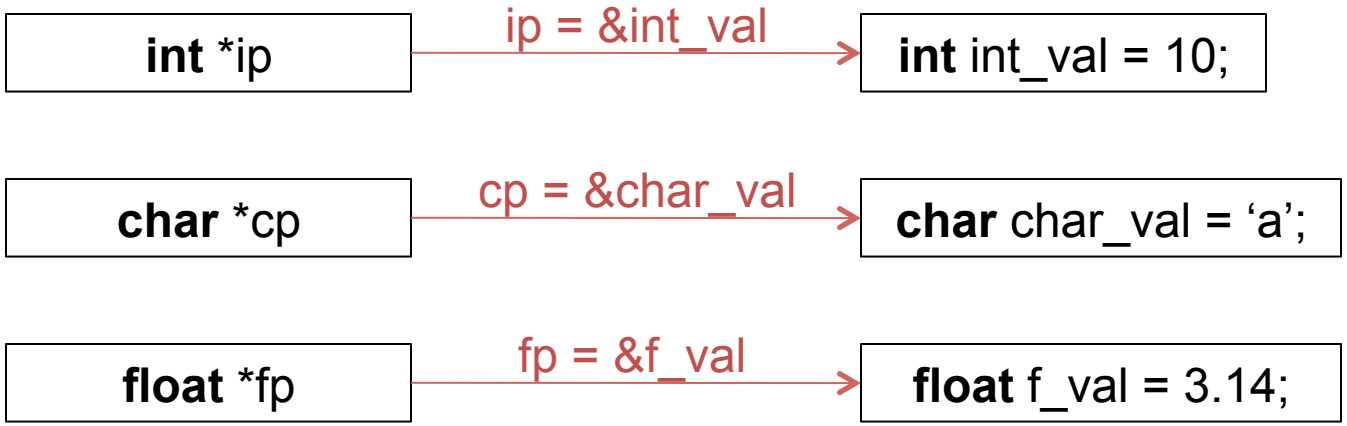

swap
x
20
y
10
Call by value
main
a
10
0x1000
b
20
0x1004
swap
*x
0x1000
*y
0x1004
0x1000
10
0x1004
20
Call by reference

Reference?


swap
x
20
y
10
Call by value
main
a
20
0x1000
b
10
0x1004
Reference
swap
*x
0x1000
*y
0x1004
Call by reference
0x1000
20
0x1004
10

Type

- Pointer has ‘type’
  - Integer, character, floating point…
  - Pointer must be used to point to same type variable



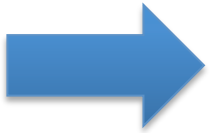
Pointer of Pointer

- Pointer is just a variable
  - Of course, it has its address

```
/* Practice 4 :
   Pointer of pointer */
#include <stdio.h>

int main (void)
{
   int x = 10, *p, **pp;
   p = &x;
   pp = &p;
   printf (“%d %d %d\n”, x, *p, **pp);
   printf (“%p %p %p\n”, &x, p, *pp);
   printf (“%p %p\n”, &p, pp);

   return 0;
}
```

Exercise 1

- Left shifter
  - Input is given as form of sequence of 5 distinct charac ters
  - Last input is “the number of shift”
  - Skeleton code is given
    - Check the homepage
  - You must not print last input

A B C D E 3  D E A B C

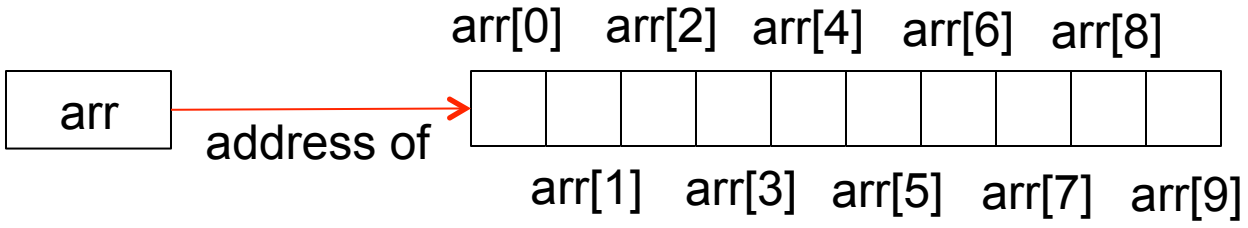
Array (1/8)

- Pointer
  - Container of memory address
  - Accessing variable's value by using '*'

```
int *p;
p = &a;
```

- Array
  - Reference of continuous memory addresses
  - Not a variable

```
int arr[10]
```




```
arr == &arr[0]
*arr?
```

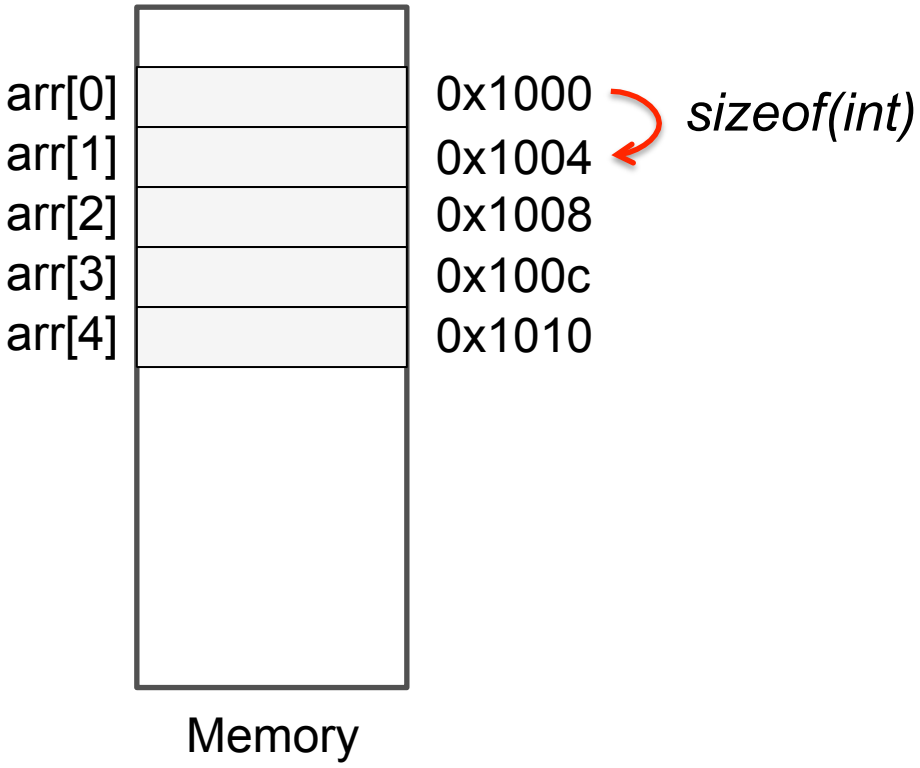
Array (2/8)

```
/* Practice 1 : Array 1*/
#include <stdio.h>

int main (void)
{
   int arr[10] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};

   printf("%p %p\n", &arr[0], arr);
   printf("%d %d\n", arr[0], *arr);

   return 0;
}
```

Array (3/8)

- Array in memory
  - Address is linearly increasing
    - By size of type

int arr[5]



Array (4/8)

```
/* Practice 2 : Array 2*/
#include <stdio.h>

int main (void)
{
   int arr[10] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};
   int i;

   for (i=0;i<10;i++)
        printf("%p %p\n", &arr[i], arr+i);

   for (i=0;i<10;i++)
        printf("%d %d\n", arr[i], *(arr+i));

   return 0;
}
```

arr[i]

==

arr+i

==

&arr[0] + i*sizeof(int)

Array (5/8)

```
/* Practice 3 : Array 3*/
#include <stdio.h>

int main (void)
{
   char arr[10] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};
   int i;

   for (i=0;i<10;i++)
        printf("%p %p\n", &arr[i], arr+i);

   for (i=0;i<10;i++)
        printf("%d %d\n", arr[i], *(arr+i));

   return 0;
}
```

arr[i]

==

arr+i

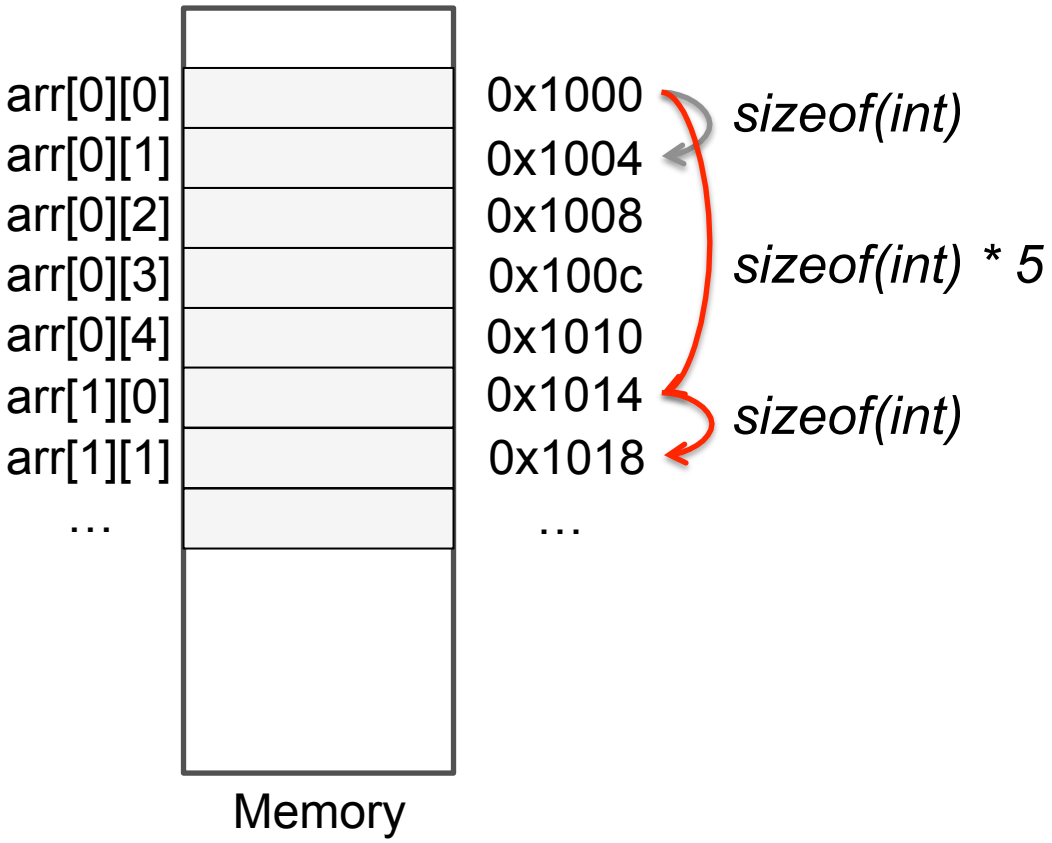
==

&arr[0] + i*sizeof(**char**)

Array (6/8)

- 2D array

int arr[2][5]



Array (7/8)

```
/* Practice 4 : 2D Array 1*/
#include <stdio.h>

int main (void)
{
   int arr[2][5] = {{0, 1, 2, 3, 4}, {5, 6, 7, 8, 9}};

   printf("%p %p %p\n", arr, arr[0], &arr[0][0]);
   printf("%p %p %p\n", arr+1, arr[1], &arr[1][0]);
   printf("%p %p %p\n", *(arr+1)+2, arr[1]+2, &arr[1][2]);

   return 0;
}
```

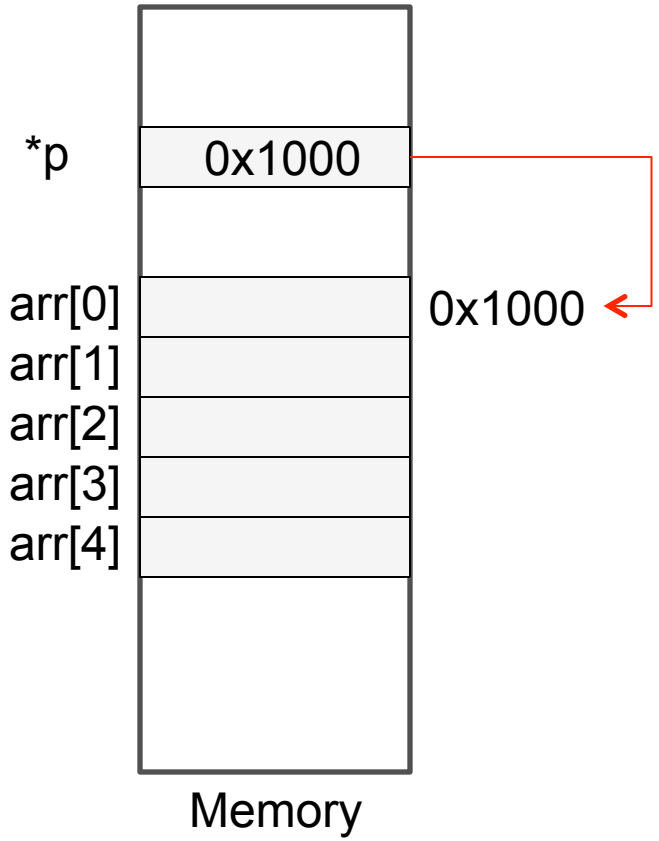
Array (8/8)

```
/* Practice 5 : 2D Array 2*/
#include <stdio.h>

int main (void)
{
   int arr[2][5] = {{0, 1, 2, 3, 4}, {5, 6, 7, 8, 9}};

   printf(“%p %p %p\n”, arr, arr[0], &arr[0][0]);
   printf(“%p %p %p\n”, arr+1, arr[1], &arr[1][0]);
   printf(“%p %p %p\n”, *(arr+1)+2, arr[1]+2, &arr[1][2]);

   printf("%d %d %d\n", **arr, *arr[0], arr[0][0]);
   printf("%d %d %d\n", **(arr+1), *arr[1], arr[1][0]);
   printf("%d %d %d\n", *(*(arr+1)+2), *(arr[1]+2), arr[1][2]);

   return 0;
}
```

Pointer (1/6)

- Pointer can be used as array

```
int arr[5];
int *p;
p = &arr[0]; //same as p = arr;
```



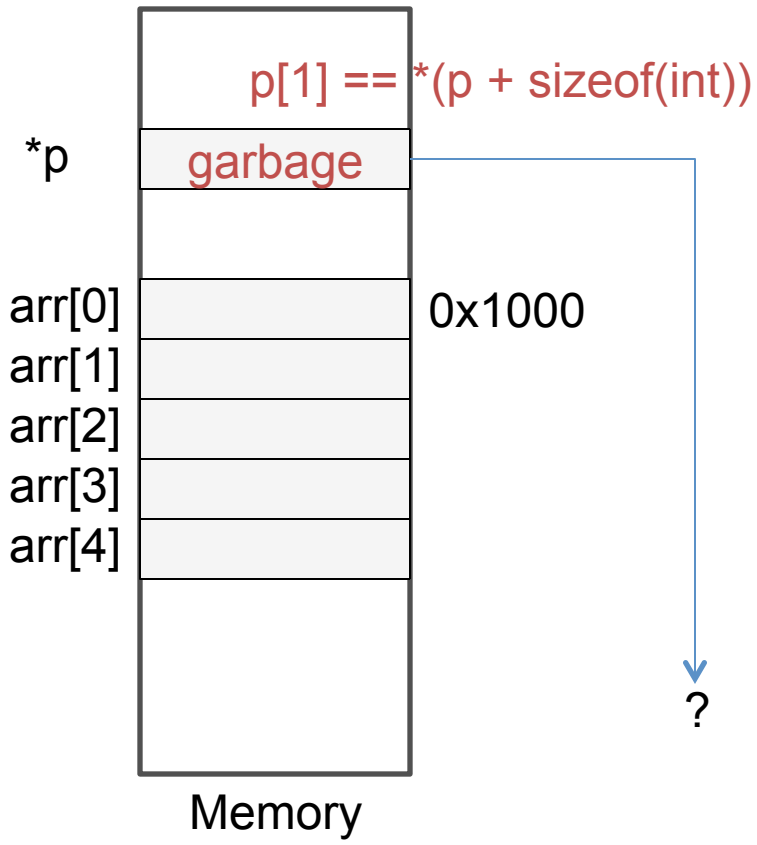
Pointer (2/6)

```
/* Practice 6: Pointer 1*/
#include <stdio.h>

int main (void)
{
   int arr[10] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};
   int i;
   int *p;
   p = &arr[0]; //same as p = arr

   for (i=0;i<10;i++)
        printf("%p %p %p\n", &p[i], p+i, &arr[i]);

   for (i=0;i<10;i++)
        printf("%d %d %d\n", p[i], *(p+i), arr[i]);

   return 0;
}
```

Pointer (3/6)

- Pointer must be carefully used

```
int arr[5];
int *p;
printf("%d\n", p[1]);
```



Pointer (4/6)

```
/* Practice 7 : Pointer misuse*/
#include <stdio.h>

int main (void)
{
   int arr[10] = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9};
   int i;
   int *p;
   //p = &arr[0];

   for (i=0;i<10;i++)
        printf("%p %p %p\n", &p[i], p+i, &arr[i]);

   for (i=0;i<10;i++)
        printf("%d %d %d\n", p[i], *(p+i), arr[i]);

   return 0;
}
```

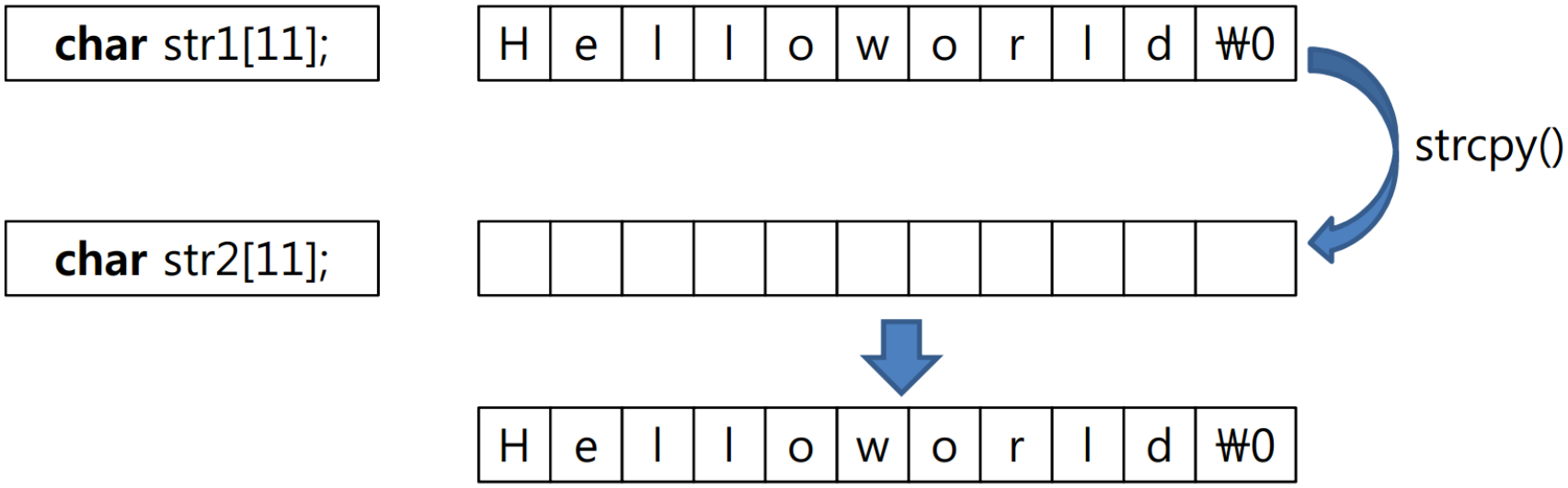
Pointer (5/6)

```
/* Practice 8 : Pointer 2*/
#include <stdio.h>

int string_length(char *s) {
   int n;
   for (n = 0;*s != '\0';s++)
      n++;
   return n;
}
```

```
int main (void)
{
   char str[10];

   scanf("%s", &str[0]);

   printf("%s\nLength : %d\n", str, string_lenth(str));

   return 0;
}
```

Pointer (6/6)

- String copy
  - “strcpy()” is defined in standard C library



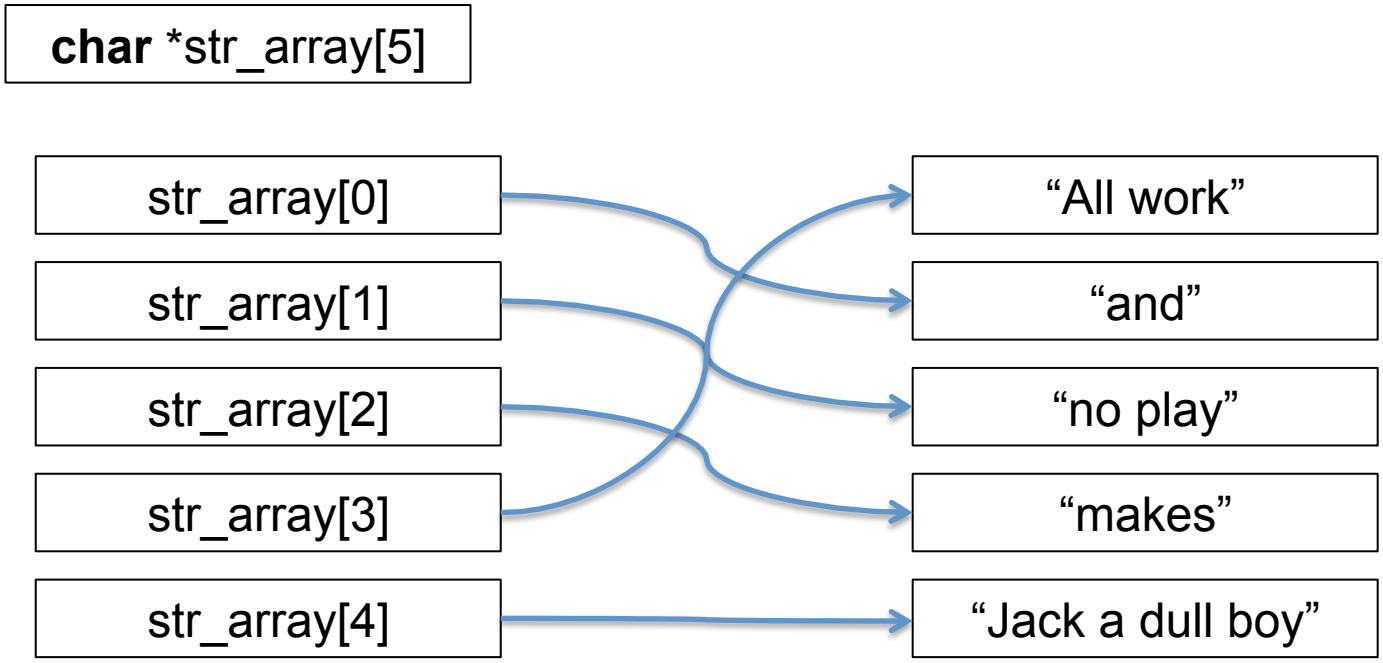
Pointer Example

```
/* Practice 9 : String copy 2*/
#include <stdio.h>

void mystrcpy(char s[], char d[]) {
   int i;
   for (i = 0; s[i] != '\0'; i++)
       d[i] = s[i];
   d[i] = s[i];
}
```

```
int main (void)
{
   char str[10], dest[10];

   scanf("%s", &str[0]);

   printf("%s\nLength : %d\n", str, string_lenth(str));

   return 0;
}
```

Pointer Array

- Pointer can be declared as array
  - Example: string array



Pointer Array

```
/* Practice 10 : Pointer array */
int main (void)
{
   char *str_array[5] = {“All work”, “and”, “no play”,
                “makes”, “Jack a dull boy”};

   printf(“%s %s %s %s %s\n”, str_array[0], str_array[1],
          str_array[2], str_array[3], str_array[4]);

   return 0;
}
```

Pointer Array

```
/* Practice 11 : Pointer array 2 */
int main (void)
{
   char *str_array[5] = {“All work”, “and”, “no play”,
                “makes”, “Jack a dull boy”};

   printf(“%s %s %s %s %s\n”, str_array[0], str_array[1],
          str_array[2], str_array[3], str_array[4]);
   str_swap(&str_array[0], &str_array[2]);
   printf(“%s %s %s %s %s\n”, str_array[0], str_array[1],
          str_array[2], str_array[3], str_array[4]);

   return 0;
}
```

```
void str_swap (char **s, char **d)
{
   char *temp;
   temp = *s;
   *s = *d;
   *d = *s;
}
```

Exercise 1

- Modifying strcpy()
  - Two arguments
    - Source string
    - Destination string
  - Don’t use local variable
    - Using pointer operations
  - Modifying practice 9’s code

Exercise 2

- Word changer
  - Input is composed of three strings
    - A sentence not including white space
    - Target word
    - Changing word
  - You find target words in a sentence, and change by c hanging word
    - Two words have same length

Allworkandnoplaymakes Jackadullboy work play

Allplayandnoplaymakes Jackadullboy