計算機概論 期中專題

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一、Version 1

（一）程式碼

```
#include<stdio.h>
int judge_number(int);
void print_element(int, int, int, int, int a[]);
int main(){
    int arr[] = {0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28};
    int size = sizeof(arr) / sizeof(int);
    int key, i;

    while(1){
        //the user inputs which number need to be searched
        printf("Enter a number between 0 and 28: ");
        scanf("%d", &key);
        //judge the key whether between 0 and 28
        if(judge_number(key) == 1){
            break;
        }
    }
    printf("\nSubscripts:\n");
    //print the index of each element
    for(i=0; i<size; i++){
        printf("%2d", i);
        printf("%*s", 3, " ");
    }
    printf("\n-------------------------------------------------------------
---------------\n");

    int left = 0, right = size-1;  //left 等同索引值 0，right 等同索引值 size-1
    int middle = left + (right - left) / 2;  //取中間值，middle = (left +
right)/2
    int find_index = 0;

    //print array
    print_element(i, left, right, middle, arr);
```

```
    printf("\n");

    //binary search
    do{
        if(key < arr[middle]){
            right = middle - 1;
            middle = left + (right - left) / 2;
            print_element(i, left, right, middle, arr);
        }
        else if(key > arr[middle]){
            left = middle + 1;
            middle = left + (right - left) / 2;
            print_element(i, left, right, middle, arr);
        }
        else{
            find_index = middle;
            break;
        }
        printf("\n");
    }while(left<=right);
    //if the number isn't existed, print not found
    if(find_index == 0){
        printf("%d not found", key);
    }
    //print the index where the number be searched
    else{
        printf("\n%d found in array element %d", key, middle);
    }
    return 0;
}

int judge_number(int num){
    if(num<0 || num>28){
        printf("\nThe number that you enter is out of range. Please enter
again.\n\n");
        return 0;
    }
    return 1;
```

```
}

void print_element(int i, int left, int right, int middle, int a[]){
    for(i=1; i<=left; i++){  //vertical alignment of the elements
        printf("%*s", 5, " ");
    }
    for(i=left; i<=right; i++){
        if(i == middle){
            printf("%2d%c", a[i], '*');  //label the middle index of the
subarray
            printf("%*s", 2, " ");
        }
        else{
            printf("%2d", a[i]);
            printf("%*s", 3," ");
        }
    }
}
```

（二）輸出結果

1. The output with test number 5

```
Enter a number between 0 and 28: 5

Subscripts:
 0    1    2    3    4    5    6    7    8    9   10   11   12   13   14
---------------------------------------------------------------------------
 0    2    4    6    8   10   12   14*  16   18   20   22   24   26   28
 0    2    4    6*   8   10   12
 0    2*   4
           4*

5 not found
```

2. The output with test number 28

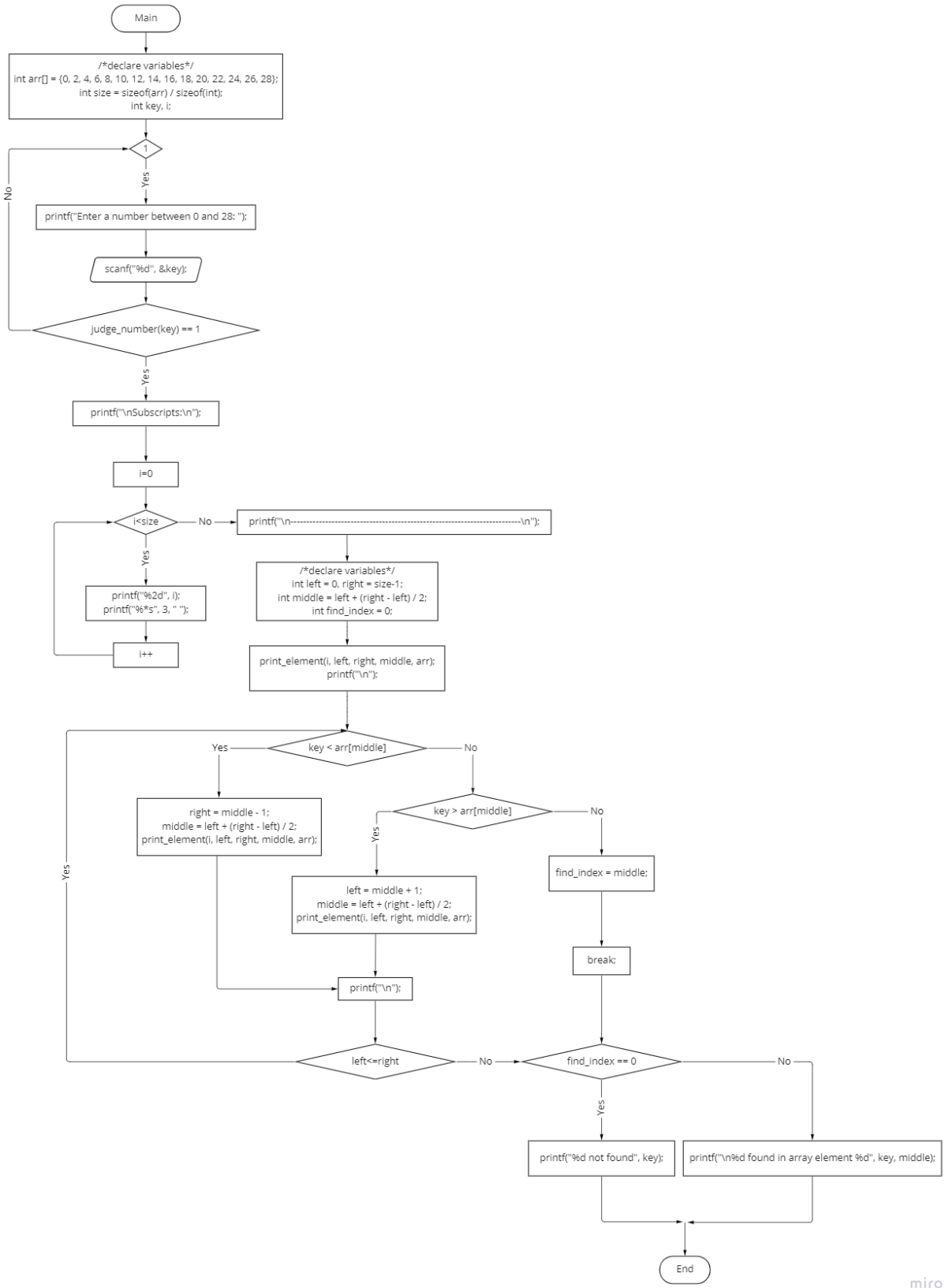
```
Enter a number between 0 and 28: 28

Subscripts:
 0    1    2    3    4    5    6    7    8    9   10   11   12   13   14
---------------------------------------------------------------------------
 0    2    4    6    8   10   12   14*  16   18   20   22   24   26   28
                                       16   18   20   22*  24   26   28
                                                      24   26*  28
                                                           28*

28 found in array element 14
```

（三）流程圖(flowchart)

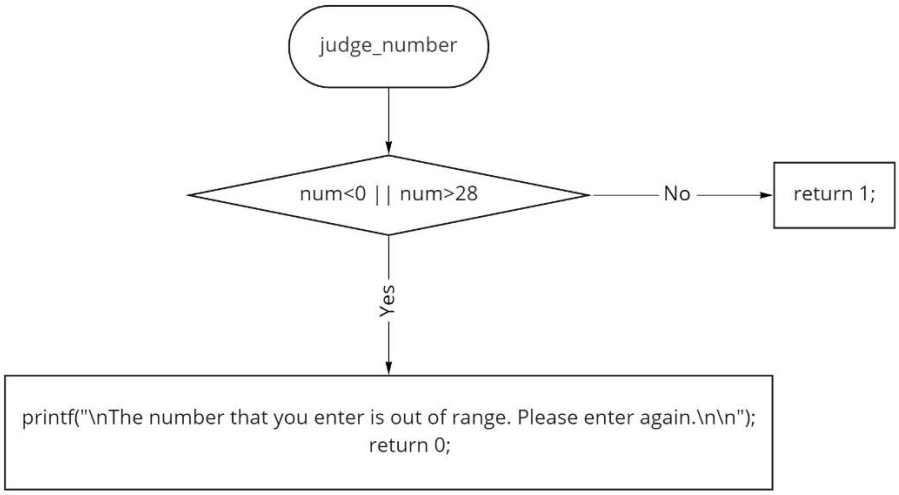
因為 main function 流程圖畫質有點模糊，所以另附網址:

https://miro.com/app/board/uXjVO18V-aE=/?share_link_id=370553248973

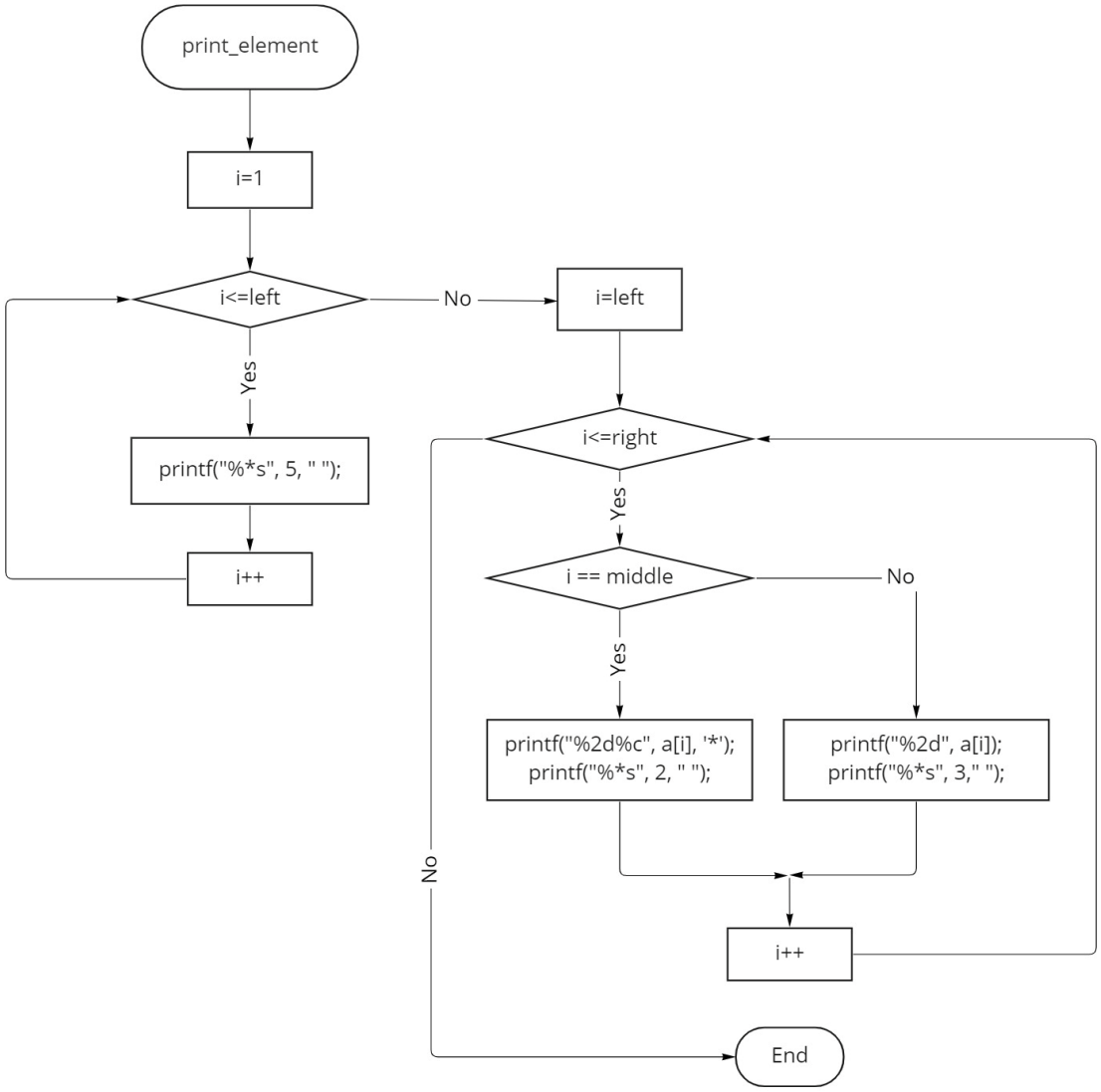
1. main



2. judge_number



3. print_element



二、version 2

改使用 recursive function 及 ternary operator(簡化 if-else)的概念來改寫。並以 assert 來判斷所輸入的 key 是否介於 0~28 之間

（一）程式碼

```
#include<stdio.h>
#include<assert.h>
void print_element(int, int, int, int a[]);
int binary_search(int, int, int, int arr[]);
int main(){
    int arr[] = {0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28};
    int size = sizeof(arr) / sizeof(int);
    int key, i;
    printf("Enter a number between 0 and 28: ");
    scanf("%d", &key);
    assert(key >= 0 && key <=28);

    printf("\nSubscripts:\n");
    //print the index of each element
    for(i=0; i<size; i++){
        printf("%2d", i);
        printf("%*s", 3, " ");
    }
    printf("\n-------------------------------------------------------------
---------------\n");

    int result = binary_search(0, size-1, key, arr);

    //ternary operator
    (result == -1)
        ? printf("%d not found", key)  //if result == -1 is true
        : printf("%d found in array element %d", key, result);  //if result
== -1 is false

    return 0;
}
void print_element(int left, int right, int middle, int a[]){
    int i;
```

```
    for(i=1; i<=left; i++){  //vertical alignment of the elements
        printf("%*s", 5, " ");
    }
    for(i=left; i<=right; i++){
        if(i == middle){
            printf("%2d%c", a[i], '*');  //label the middle index of the
subarray
            printf("%*s", 2, " ");
        }
        else{
            printf("%2d", a[i]);
            printf("%*s", 3," ");
        }
    }
    printf("\n");
}

int binary_search(int left, int right, int key, int a[]){
    int i, middle = left + (right-left) / 2;
    if(left <= right){
        if(key == a[middle]){
            print_element(left, right, middle, a);
            return middle;
        }
        else if(key < a[middle]){
            print_element(left, right, middle, a);
            return binary_search(left, middle-1, key, a);
        }
        else{
            print_element(left, right, middle, a);
            return binary_search(middle+1, right, key, a);
        }
    }
    return -1;
}
```

（二）輸出結果

1. The output with test number 5

```
Enter a number between 0 and 28: 5

Subscripts:
 0    1    2    3    4    5    6    7    8    9   10   11   12   13   14
---------------------------------------------------------------------------
 0    2    4    6    8   10   12   14*  16   18   20   22   24   26   28
 0    2    4    6*   8   10   12
 0    2*   4
           4*
5 not found
```

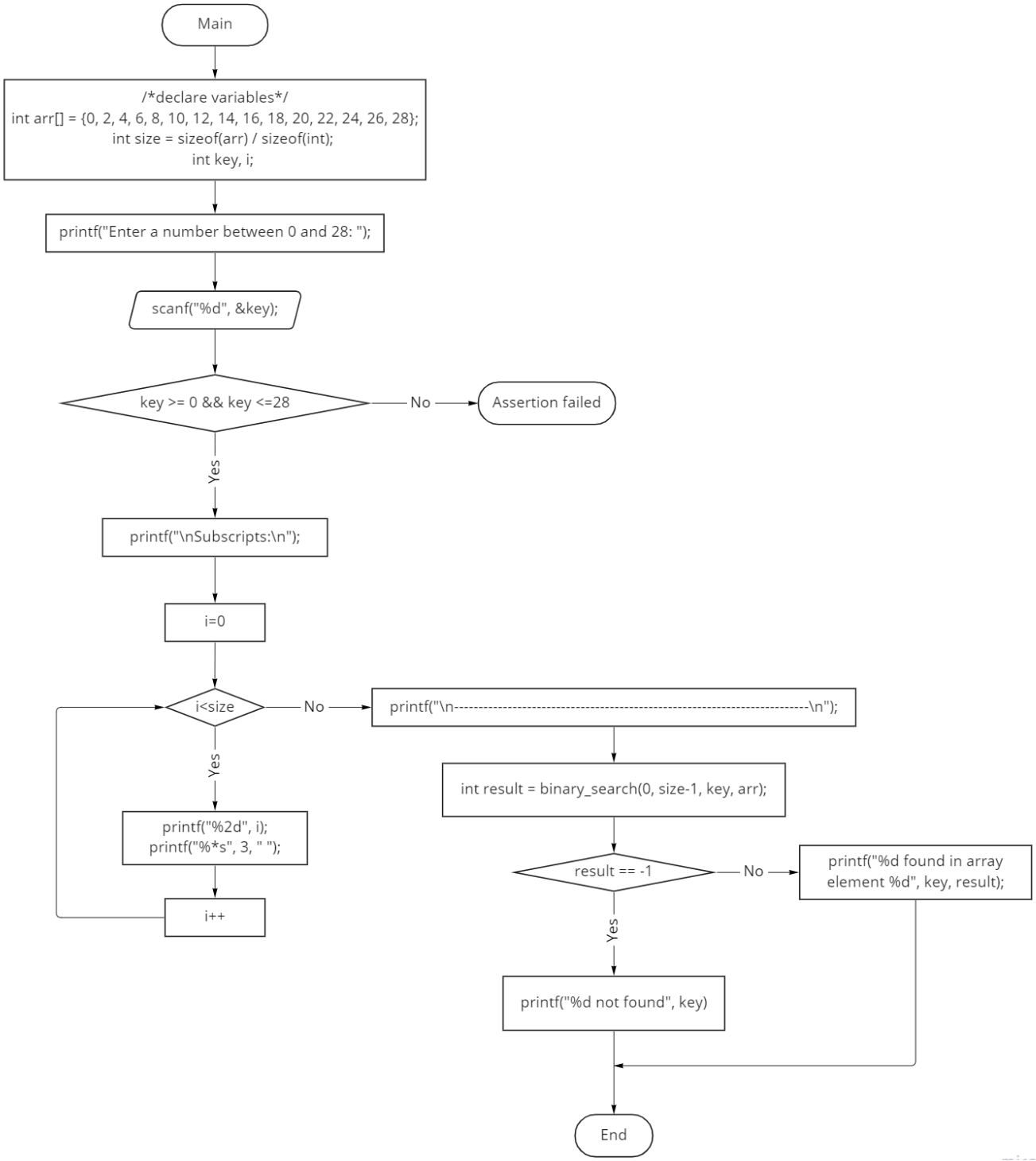
2. The output with test number 28

```
Enter a number between 0 and 28: 28

Subscripts:
 0    1    2    3    4    5    6    7    8    9   10   11   12   13   14
---------------------------------------------------------------------------
 0    2    4    6    8   10   12   14*  16   18   20   22   24   26   28
                                       16   18   20   22*  24   26   28
                                                      24   26*  28
                                                                28*
28 found in array element 14
```

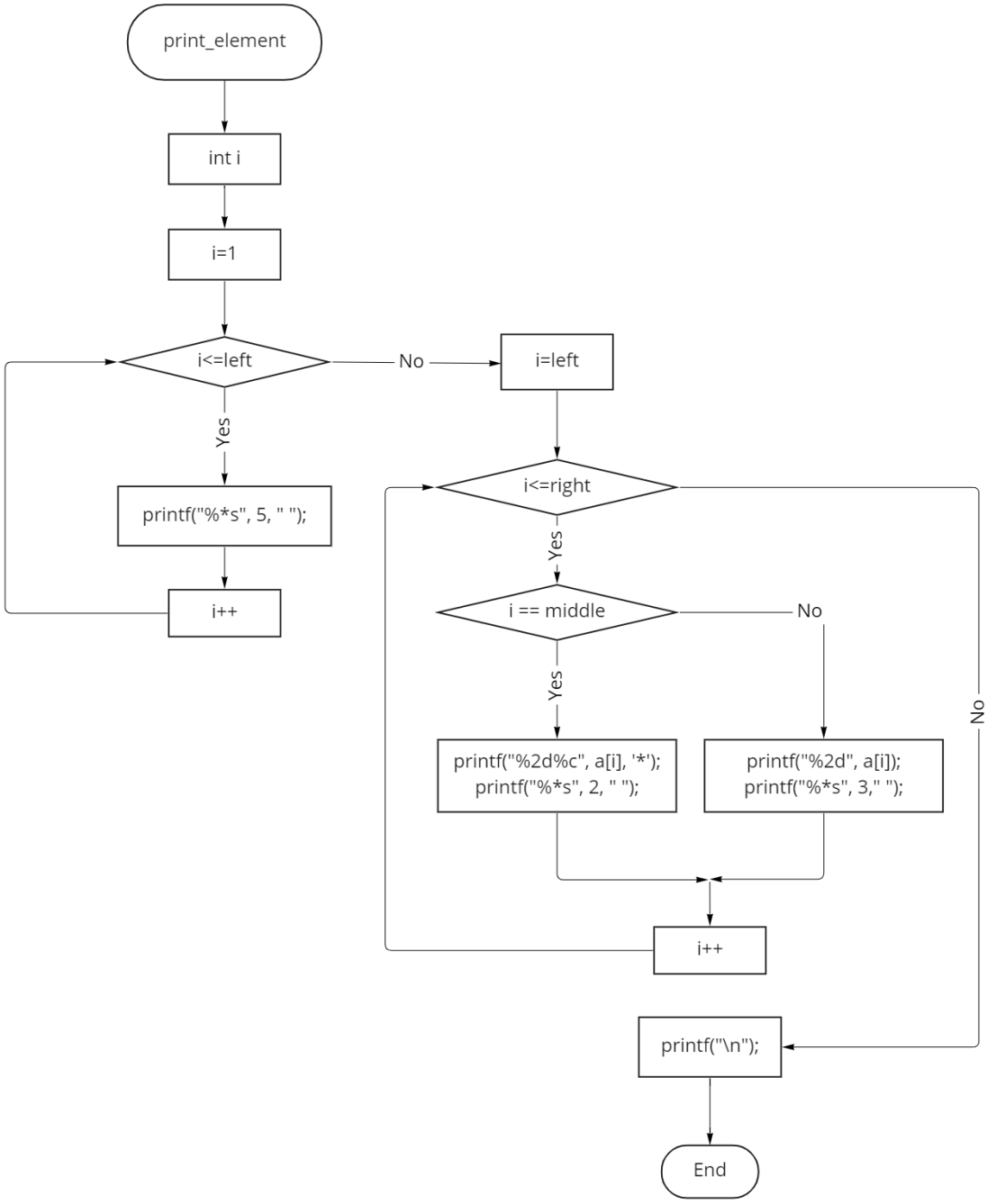
（三）流程圖(flowchart)

https://miro.com/app/board/uXjVO0NgLms=/?share_link_id=481868842412

1. main



2. print_element



3. binary_search