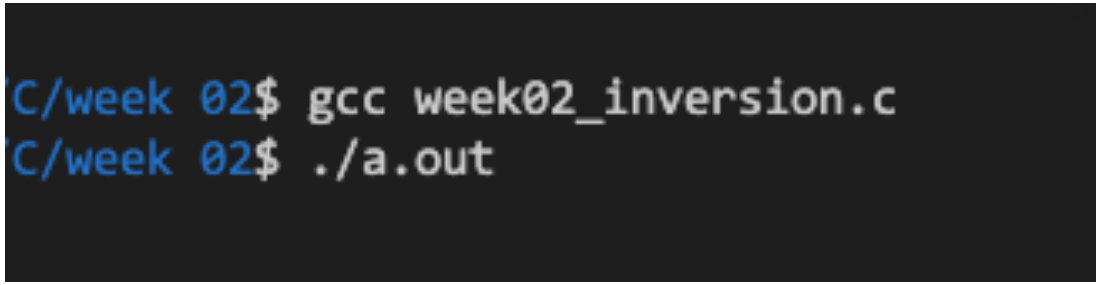
Environment

- **Don‘t use Dev C++ !!!!**

- If you use windows, please install mingw
  - You can use “gcc” to compile
  - Then, use “./a.out” to execute
- For the editor, just use anyone you like
  - I would like to use VScode



Week 1 assignment

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

int main(void)
{
    char user_input[16];
    int length = 0, inversions = 0;
    int i, j = 0;
    printf("Please input a character sequence: ");
    scanf("%s%n", user_input, &length);

    for (i=0; i<length; i++)
    {
        for (j=i+1; j<length; j++)
        {
            if (user_input[i] > user_input[j])
            {
                inversions ++;
            }
        }
    }
    printf("  number of inversions: %d\n", inversions);
    return 0;
}
```

Topic 1: Pointer concepts

Pointer & reference

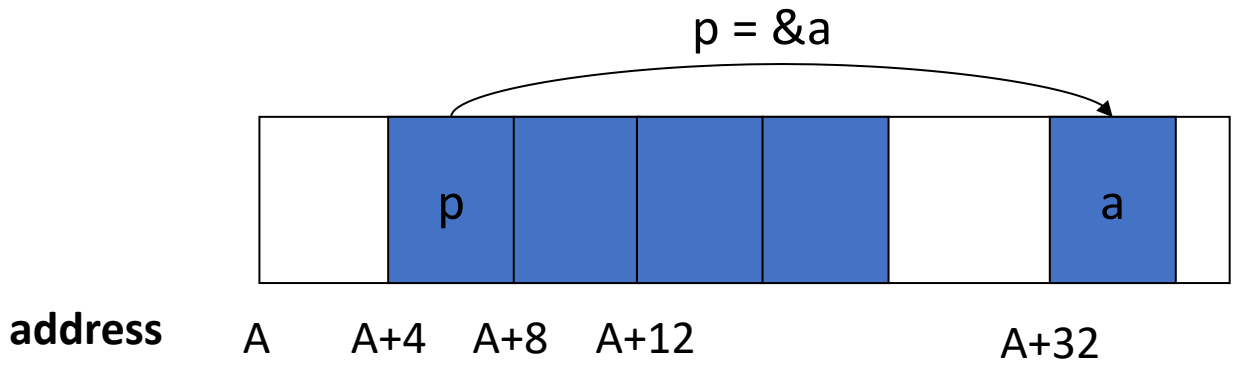
- Pointer concept
  - Pointer is still a variable but with a special usage
  - Declaration of a pointer → int *p
    - p is an address
      - A shortcut to a space
    - *p means the content that p points to
- Reference concept
  - Reference is the address space of a variable

Pointer & reference

```
#include <stdio.h>
int main (void)
{
    int *p;
    int a;

    a = 10;
    p = &a;

    return 0;
}
```




```
*p = 10
 p = A+32
&p = A+4
&(*p) = A+32
```

```
a = 10
&a = A+32
```

```c
int main(void)
{
    int a = 4;
    int *p;

    p=&a;
    printf("%p %p %p %p\n", &a, &p, &(*p), p);

}
```

```
ryanpan@RyanPanPC /Volumes/MyWorks/D_Data/teaching/110/C/week 03$ ./a.out
0x7ffee94da85c 0x7ffee94da850 0x7ffee94da85c 0x7ffee94da85c
```

Pointer & array

- The interaction between pointer and array
  - int ex_arr [5]
  - int *ptr;
  - ptr = ex_arr;

  - → ex_arr[i] equals to *(ptr+i)

ptr = ptr + i will move to the next i element of ex_arr

  - Don't use → ptr = &ex_arr;
    Because that array can be considered as a form of pointer

```
warning: incompatible pointer types assigning to 'int *' from 'int (*)[3]' [-Wincompatible-pointer-types]
```

Pointer & array (Quiz)

```
#include <stdio.h>

#define N 4
int main (void)
{
    int array[N] = {0};
    int *p;
    int i;

    p = array;

    array[0] = 1;
    p[0] = 2;
    *(p+1) = 3;

    p++;

    *(p+2) = 4;
    *(p+3) = 5;
```

Legal ! But abnormal
May not error !

```
  p = array;

    for (i=0; i < N; i++)
    {
        printf("array[%d]: %d, *(p+%d): %d\n",
                    i, array[i], i, *(p+i));
    }

}
```

array[0]: 2, *(p+0): 2
array[1]: 3, *(p+1): 3
array[2]: 0, *(p+2): 0
array[3]: 4, *(p+3): 4

Pointer & array (Don't do this!)

```
#include <stdio.h>

#define N 4
int main (void)
{
    int array[N] = {0};
    int arrayy[N] = {0};
    int *p;
    int i;

    printf("Array_ref: %p, Arrayy_ref: %p,  \
            p_ref: %p, i_ref: %p\n",
            array, arrayy, &p, &i);

    p = array;
    array[0] = 1;
    p[0] = 2;
    *(p+1) = 3;
    p++;
    *(p+2) = 4;
    p = array;

    for (i=0; i < N; i++)
    {
        printf("array[%d]: %d, *(p+%d): %d\n",
                    i, array[i], i, *(p+i));
    }

    p = arrayy;
    *(p+4) = 300;

    for (i=0; i < N; i++)
    {
        printf("array[%d]: %d\n", i, array[i]);
    }
}
```

Array_ref: 0xbfbfebe0,
Arrayy_ref: 0xbfbfebd0,
p_ref: 0xbfbfebcc,
i_ref: 0xbfbfebc8

```
array[0]: 2, *(p+0): 2
array[1]: 3, *(p+1): 3
array[2]: 0, *(p+2): 0
array[3]: 4, *(p+3): 4
```

Overwrite array[N]
(Memory pollution)

```
array[0]: 300
array[1]: 3
array[2]: 0
array[3]: 4
```

Array allocation

```
#include <stdio.h>
#include <stdlib.h>
#define N 4
int main (void)
{
    int *array;
    int *p;
    int i;

    array = (int *) malloc (sizeof(int)*4);
    p = array;

    array[0] = 1;
    p[0] = 2;
    *(p+1) = 3;

    p++;

    *(p+2) = 4;
    *(p+3) = 5;
    p = array;

    for (i=0; i < N; i++)
    {
        printf("array[%d]: %d, *(p+%d): %d\n",
                    i, array[i], i, *(p+i));
    }

}
```

Week 2 assignment

- Input $1+x^2$ numbers
  (The first number is total number, x>3)
- After alignment, change first row and third row, and then first column and third column

```
$ ./a.exe 16 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
 1  2  3  4
 5  6  7  8
 9 10 11 12
13 14 15 16

 9 10 11 12
 5  6  7  8
 1  2  3  4
13 14 15 16

11 10  9 12
 7  6  5  8
 3  2  1  4
15 14 13 16
```

Requirements

- Let you know how to get rid of “array accessing”
- Only one set of brackets, i.e., [], is allowed in your program
  - That is command line argument → int main(int argc, char *argv[])
- Don‘t use [] to access (read or write) array elements

Something you may need

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

→ You can check out from the Internet