COMP20005 Workshop Week 7

Preparation:

- open `grok`, `jEdit`, and `minGW` (or `Terminal` if yours is a `Mac`)
- download this slide set (`ws7.pdf`) from github.com/anhvir/c205 if you like
- build `data.txt` (using `grok` or `jEdit`) that has around 15 numbers like:

```
1  3  4  6  4  3  6  10  3  5  4  3  1  6  4  3  1
```

1 **Discussion 1: Arrays:** concept, representation, usage

2 **Do it together:** Ex 7.4

→ *Conventional ways to work with arrays*

→ *Redirection:* reading data from a file (instead of from the keyboard)

→ *Selection Sort* (don't confuse with *Insertion* Sort)

3 **Group Work:** Exercise 7.1 + Exercise 3.06 revisited

4 **Discussion 2: An approach to** exercise 7.5

→ *Using* `struct` *and* `typedef`

5 **Assignment 1:** Q&A

6 **Lab:**

- do your assignment 1 and test the submission, or
- do exercises 7.1, 7.7 – 7.10

Discussion 1: Arrays

Situation:

We need to manipulate a series of number like `1, 4, 10, 8, 7, 9`

Mathematically speaking, we are working with the sequence

$x_1, x_2, x_3, x_4, x_5, x_6$

where

$x_1 = 1$

$x_2 = 4$

...

$x_6 = 9$

With $i=3$ we can say that x_i has the value of 10. We even can:

```
set S to 0
for i from 1 to 6
    add x_i to S
```

Quite convenient!

Can we do a similar thing in C?

Arrays

Situation:

We need to manipulate a series of number like `1, 4, 10, 8, 7, 9`
Mathematically speaking, we are working with the sequence

$x_1, x_2, x_3, x_4, x_5, x_6$

Can we do a similar thing in C?

YES. Here, we will declare `x` as an *array* of 6 `int` elements.

```
int x[6]= {1, 4, 10, 8, 7, 9};
```

then: `x`

the first element of `x` is referred to as `x[0]`
the second element of `x` is referred to as `x[1]`
the `i`-th element of `x` is referred to as `x[i]`, with 0 `..` 5
Note: we don't have `x[6]`, the last element is `x[6-1]`

arrays: declaration & use

	statements	variables in memory (*after* LHS statements)					
		i	A[0]	A[1]	A[2]	A[3]	A[4]
1	**int i, A[5];** /* equivalent to declaring 6 variables, each is of data type **int** */						

2	**A[0] = 10;**
	i= A[0] * 2;
		20	10				

3	**i= 2;**
	A[i]= 20;
		2	10		20		

4	**for (i=0; i<5; i++) {**
	A[i]= i*i;
	}
		5	0	1	4	9	16

5	**for (i=0; i<3; i++) {**
	scanf (“%d”, &A[i]);
	} /* supposing that input from keyboard is **10 20 30** */
		3	10	20	30	9	16

arrays…

	statements	variables in memory (*after* LHS statements)						
		i	sum	A[0]	A[1]	A[2]	A[3]	A[4]

1	`int i, sum=0,`
	`A[5]= {0,1,2,3,4};`
			0	0	1	2	3	4

2	`for (i=0; i<5; i++)`
	`sum += A[i];`							

arrays…

	statements	variables in memory (*after* LHS statements)						
		i	sum	A[0]	A[1]	A[2]	A[3]	A[4]

1	`int i, sum=0,`
	`A[5]= {0,1,2,3,4};`
			0	0	1	2	3	4

2	`for (i=0; i<5; i++)`
	`sum += A[i];`
		5	10	0	1	2	3	4

3	`for (i=0; i<4; i++) {`
	`A[i+1]= A[i];`
	`}`
		4	10					

arrays…

	statements	variables in memory (*after* LHS statements)						
		i	sum	A[0]	A[1]	A[2]	A[3]	A[4]

1	`int i, sum=0,`
	`A[5]= {0,1,2,3,4};`
			0	0	1	2	3	4

2	`for (i=0; i<5; i++)`
	`sum += A[i];`
		5	10	0	1	2	3	4

3	`for (i=0; i<4; i++) {`
	`A[i+1]= A[i];`
	`}`
		0	10	0	0	0	0	0

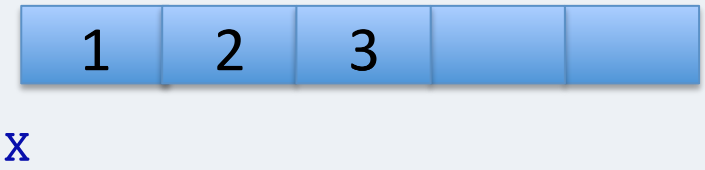
Notes: No operation with *whole arrays* is allowed. With declaration:

```
int A[3]={10,20,30}, B[3];
```

we cannot write:

```
B= A;
if (A==B) A= A+B;
```

Arrays : using in C



```
#define SIZE 5
...

int X[SIZE]= {1, 2, 3};
int n= 3;   // n <= SIZE
```

In computer memory, an array is stored as *a block of contiguous cells*, one cell for one array's element.

Essentially, an array is defined by 4 objects:

- `X:` the array's name, which is actually a pointer to the memory block
- `int:` the data type of each element of the array
- `SIZE`: an `int` constant representing the array's size
- `n`: a buddy `int` variable, representing the number of elements that are currently employed

Arrays as function arguments

- With a function prototype, say:

```
 int change_array(int A[], int n);
```

we should note that:

  - the formal parameter `A[]` is an array of `int`, but no size is specified in “`int A[]`”,
  - instead, there is another parameter, `n`, which specifies the *current* size of `A[],`
  - the array formal parameter `A[]` is an array, is a pointer, so it can imply *both input and output* of function `change_array`.

- With the call “`change_array(B, 10)`”:
  - the action in formal parameter `A[]` is actually happen to `B[].`
- With the above function and the declarations:

```
int B[10]= {1,2,4,2,3,3,1,1,9,8};
int n= 10;
```

What do the following calls mean:

```
1) change_array(B, 10);
2) change_array(&B[0], 10);
3) change_array(B, 8);
```

Do Together: Exercise 7.4

Write a program that reads as many as 1,000 integer values, and counts the frequency of each value in the input:

```
./program
Enter as many as 1000 values, ^D to end
1 3 4 6 4 3 6 10 3 5 4 3 1 6 4 3 1
17 values read into array
Value Freq
   1    3
   3    5
   4    4
   5    1
   6    3
  10    1
```

How?

Exercise 7.4

Write a program that reads as many as 1,000 integer values, and counts the frequency of each value in the input:

So we need to:

1. *Input value for an array*
2. *Sort an array in increasing order*
3. *Count and print out frequencies*

We will do together steps 1 and 2, and will demonstrate how to read data from a file (instead of from the keyboard).

Please use `jEdit` *and do together with Anh (e.g. you should at least follow Anh's speed in your own* `jEdit` *window). If your* `jEdit/gcc` *are not ready, you can employ* `grok`*, but it will be inconvenient.*

Important note: First, build data file `data.txt` *that contains around 15-20 small integers. For example:*

```
1  3  4  6  4  3  6  10  3  5  4  3  1  6  4  3  1
```

Group Work: Exercises 7.1 and 3.06 revisited

Then, group work with:

- Exercise 7.1 and 3.06 from grok W7
- If have time, do an exercise from W7X (we will discuss 7.4 soon)

PLEASE: use `jEdit` and `gcc` if possible.

NOTES:

For 7.1: (Write function `int all_zero(int A[], int n)` that returns 1 or 0)

You can save your time by simplifying the main function to

```
    int A[8]= {0,0,0,0,0,0,1,0};
    printf(“all_zero(A,5))= %d, all_zero(A,8)= %d\n”,
                all_zero(A,5), all_zero(A,8));
    /* should print out 0 and 1, why? */
```

For 3.06: Start with copy the solution of 3.06 (from grok W3), then change it with the use of array,

Discussion 2: typedef and struct for exercise 7.5

Suppose that a set of "student number, mark" pairs are provided, one pair of numbers per line, with the lines in no particular order. Write a program that reads this data and outputs the same data, but ordered by student number. For example:

```
823678  66
765876  94
864876  48
785671  68
854565  89
```

On this input your program should output:

```
Enter as many as 1000 "studnum mark" pairs, ^D to end
5 pairs read into arrays
studnum  mark
765876  94
785671  68
823678  66
854565  89
864876  48
```

Discussion 2: typedef and struct for exercise 7.5

Use `typedef` *to define a new data type. For example:*

```
typedef int integer;

integer fact(integer n) {
   …
}
```

Discussion 2: typedef and struct for exercise 7.5

Use `typedef` *to define a new data type.*

Use struct to define a multi-component data type. For example:

```
typedef struct{
   int stud_id;
   double mark;
} student_t;

/*  return the average mark of n students,
    the pairs (student_id, mark) are stored in array A[]  */
double average_mark(student_t A[], int n) {
   …
}
```

Discussion 2: examples of using typedef and struct

```
#include <stdio.h>
typedef struct{
   int stud_id;
   double mark;
} student_t;

int main(...) {
   student_t s1= {211111, 99.5), s2;
   student_t A[10];
   int i;
   s2= s1;
   s2.stud_id= 1000001;
   printf(“id= %d mark=%f\n”, s1.stud_id, s1.mark);
   for (i=0; i<10; i++) {
      scanf(“%d %d”, &(A[i].stud_id), &A[i].mark);
   }
   ...
```

Discussion 2: typedef and struct for exercise 7.5

Suppose that a set of "student number, mark" pairs are provided, one pair of numbers per line, with the lines in no particular order. Write a program that reads this data and outputs the same data, but ordered by student number. For example:

```
823678 66
765876 94
```

We can start with, for example:

```
typedef struct{
   int stud_id;
   double mark;
} mark_t;

#define SIZE 30000
int main(…) {
   mark_t unimelb[SIZE];
   int n= 0;
   ...
```

And write functions to:

- input data to an array of `mark_t`
- sort an array of `mark_t`
- ouput data of an array of `mark_t`

Remember to a) create a data file, and b) use redirection for inputting data.

testing

LAB: do Assignment 1 OR exercises in W7 / W7X

Notes:

- `grok` is great for in-class practice, but
- use `grok` for the assignments might bring some unexpected headache!
- Use `jEdit` and `gcc` for assignments and serious programming projects!

Assignment 1: A reasonable way to start with minGW/Terminal

	command/action	explanation
1	`cd ~`	set your home directory as your *current directory*
2	`mkdir ASS1`	*make a new directory, and of assignment files will be placed in that directory*
3	`cd ASS1`	*change current directory to ASS1*
4	`ls`	*list the content of the current directory, it should be empty*
5	navigate to the assignmen1 FAQ page and download file ass1-skel.c (2nd link of point 1), and all the files listed in point 7. You should download the files to the ASS1 directory.	
6	`ls`	*now you should see the downloaded files*
7	`mv ass1-skel.c ass1.c`	*rename the skeleton file to your assignment*
8	using `jEdit` to do your assignment	
9	`gcc –Wall –o ass1 ass1.c`	*compile the program*
10	`./ass1 <wagons0.tsv >out0.txt`	*run program with redirection*
11	`diff wagon0-out-mac.txt out0.txt`	*check if your output is the same as the expected*

Assignments: advices

- *Be active in the subject's Discussion Forum!*
- *Visit* **LMS→Assignment 1** *frequently!*
- *Read the specifications carefully.*
- *Read the marking rubric carefully and try to maximize your marks!*
- *Read the* ***sample solution to 2015*** *(in LMS.Assignment1, point 6), focusing on* `main()`*. You can learn something from there.*
- *Check your program carefully, at least with all supplied data files. Make sure that your outputs are the same as the expected outputs.*
- *Make as many submissions as you want, only the last one (before deadline) counts:*

  Remember to wait after clicking "Submit" and

  Read the verify report to make sure that your program works well

- *START EARLY, START RIGHT NOW! SUBMIT EARLY, SUBMIT EVERY DAY!*