**Homework: Arrays**

**Problem 1. Allocate array**

* Write a program that allocates array of 20 integers and initializes each element by its index multiplied by 5.
* Print the obtained array on the console.

**Problem 2. Compare arrays**

* Write a program that reads two integer arrays from the console and compares them element by element.

**Problem 3. Compare char arrays**

* Write a program that compares two char arrays lexicographically (letter by letter).

**Problem 4. Maximal sequence**

* Write a program that finds the **maximal sequence** of equal elements in an array.

*Example:*

| **input** | **result** |
| --- | --- |
| 2, 1, 1, 2, 3, 3, **2, 2, 2**, 1 | 2, 2, 2 |

**Problem 5. Maximal increasing sequence**

* Write a program that finds the maximal increasing sequence in an array.

*Example:*

| **input** | **result** |
| --- | --- |
| 3, **2, 3, 4**, 2, 2, 4 | 2, 3, 4 |

**Problem 6. Maximal K sum**

* Write a program that reads two integer numbers N and K and an array of N elements from the console.
* Find in the array those K elements that have maximal sum.

**Problem 7. Selection sort**

* **Sorting** an array means to arrange its elements in increasing order. Write a program to sort an array.
* Use the [Selection sort](http://en.wikipedia.org/wiki/Selection_sort) algorithm: Find the smallest element, move it at the first position, find the smallest from the rest, move it at the second position, etc.

**Problem 8. Maximal sum**

* Write a program that finds the sequence of maximal sum in given array.

*Example:*

| **input** | **result** |
| --- | --- |
| 2, 3, -6, -1, **2, -1, 6, 4**, -8, 8 | 2, -1, 6, 4 |

* *Can you do it with only one loop (with single scan through the elements of the array)?*

**Problem 9. Frequent number**

* Write a program that finds the most frequent number in an array.

*Example:*

| **input** | **result** |
| --- | --- |
| **4**, 1, 1, **4**, 2, 3, **4**, **4**, 1, 2, **4**, 9, 3 | 4 (5 times) |

**Problem 10. Find sum in array**

* Write a program that finds in given array of integers a sequence of given sum S (if present).

*Example:*

| **array** | **S** | **result** |
| --- | --- | --- |
| 4, 3, 1, **4, 2, 5**, 8 | 11 | 4, 2, 5 |

**Problem 11. Binary search**

* Write a program that finds the index of given element in a sorted array of integers by using the [Binary search](http://en.wikipedia.org/wiki/Binary_search_algorithm) algorithm.

**Problem 12. Index of letters**

* Write a program that creates an array containing all letters from the alphabet (A-Z).
* Read a word from the console and print the index of each of its letters in the array.

**Problem 13.\* Merge sort**

* Write a program that sorts an array of integers using the [Merge sort](http://en.wikipedia.org/wiki/Merge_sort) algorithm.

**Problem 14. Quick sort**

* Write a program that sorts an array of integers using the [Quick sort](http://en.wikipedia.org/wiki/Quicksort) algorithm.

**Problem 15. Prime numbers**

* Write a program that finds all prime numbers in the range [1...10 000 000]. Use the [Sieve of Eratosthenes](http://en.wikipedia.org/wiki/Sieve_of_Eratosthenes) algorithm.

**Problem 16.\* Subset with sum S**

* We are given an array of integers and a number S.
* Write a program to find if there exists a subset of the elements of the array that has a sum S.

*Example:*

| **input array** | **S** | **result** |
| --- | --- | --- |
| 2, **1**, **2**, 4, 3, **5**, 2, **6** | 14 | yes |

**Problem 17.\* Subset K with sum S**

* Write a program that reads three integer numbers N, K and S and an array of N elements from the console.
* Find in the array a subset of K elements that have sum S or indicate about its absence.

**Problem 18.\* Remove elements from array**

* Write a program that reads an array of integers and removes from it a minimal number of elements in such a way that the remaining array is sorted in increasing order.
* Print the remaining sorted array.

*Example:*

| **input** | **result** |
| --- | --- |
| 6, **1**, 4, **3**, 0, **3**, 6, **4**, **5** | 1, 3, 3, 4, 5 |

**Problem 19.\* Permutations of set**

* Write a program that reads a number N and generates and prints all the permutations of the numbers [1 … N].

*Example:*

| **N** | **result** |
| --- | --- |
| 3 | {1, 2, 3}  {1, 3, 2}  {2, 1, 3}  {2, 3, 1}  {3, 1, 2}  {3, 2, 1} |

**Problem 20.\* Variations of set**

* Write a program that reads two numbers N and K and generates all the variations of K elements from the set [1..N].

*Example:*

| **N** | **K** | **result** |
| --- | --- | --- |
| 3 | 2 | {1, 1}  {1, 2}  {1, 3}  {2, 1}  {2, 2}  {2, 3}  {3, 1}  {3, 2}  {3, 3} |

**Problem 21.\* Combinations of set**

* Write a program that reads two numbers N and K and generates all the combinations of K distinct elements from the set [1..N].

*Example:*

| **N** | **K** | **result** |
| --- | --- | --- |
| 5 | 2 | {1, 2}  {1, 3}  {1, 4}  {1, 5}  {2, 3}  {2, 4}  {2, 5}  {3, 4}  {3, 5}  {4, 5} |