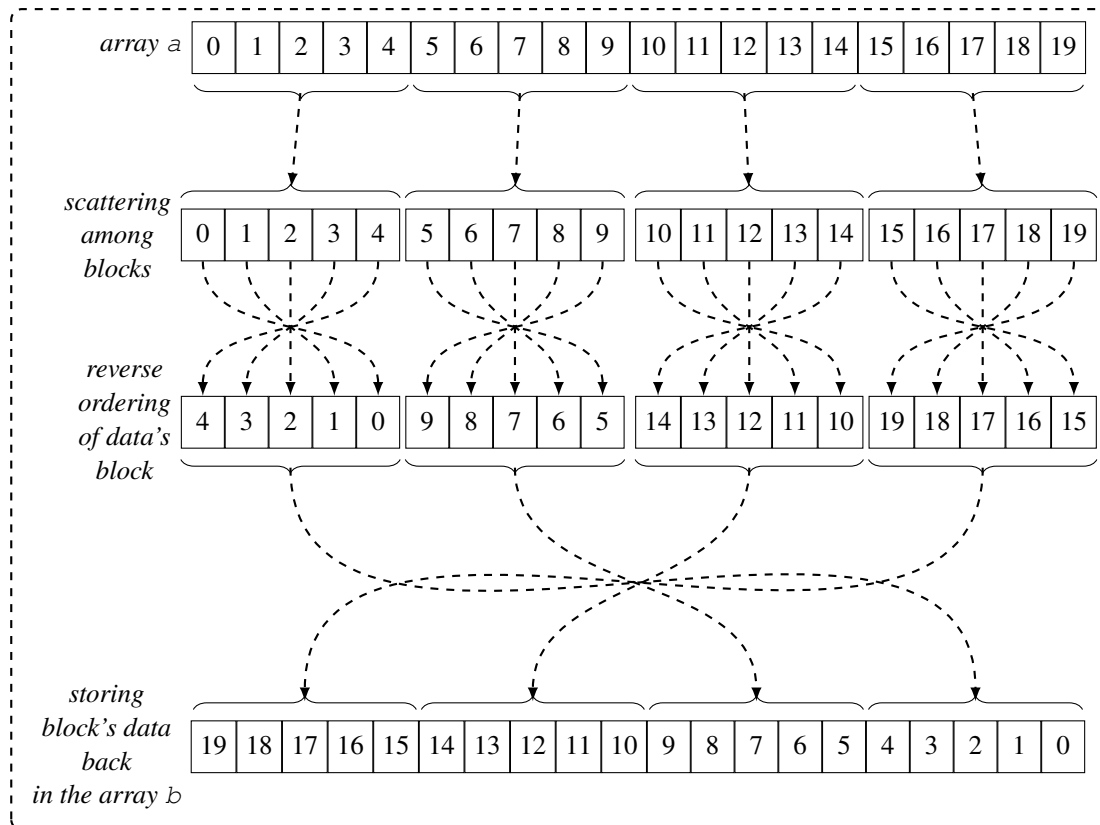


Duration : 1h30 — Permitted access to documents

1– We want to write a **CUDA program** putting the elements of an array in **reverse order** :

- 10pts** ▷ the array *a* contains *N* elements ;
 ▷ each block of the grid use 256 threads ;
 ▷ each block :
 ◊ gets 256 associated elements of the array *a* ;
 ◊ performs the reverse ordering of these elements ;
 ◊ puts the reverse ordered elements back in the second array *b*.

Example with an array of 20 slots and 5 threads per block :



Questions :

- Are there some **constraints** on the number *N* of elements of the array *a* by using blocks of 256 threads, (1pt)
 with each thread associated to a slot of the array *a* ?
 Give the **definition of the grid** according to blocks of 256 threads and an array of *N* elements.
- Write a **CUDA program** performing the given algorithm. (4pts)
 The array *a* resides in the host memory, its values are defined out of the scope of your program.
 the array *b* resides in the host memory too.
- Now, we want store the **reverse ordered** data back in the array *a* : (1pt)
 Is this possible ?
 What precautions must be taken ?
- Write a **CUDA program** that performs the reverse ordering of the data et puts back the results in the (4pts)
 array *a*.
 The array *b* doesn't exist anymore.

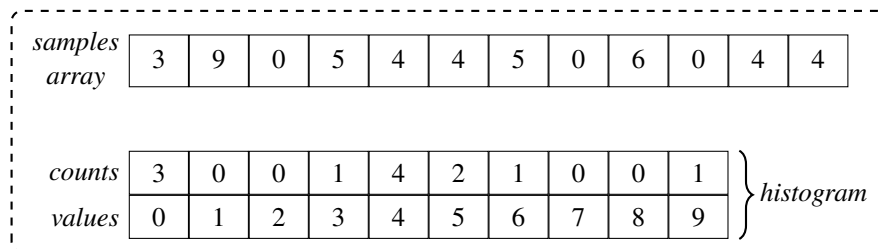


2– We have an array of samples of 10bits, *i.e.* between 0 and 1023 ($2^{10} = 1024$).

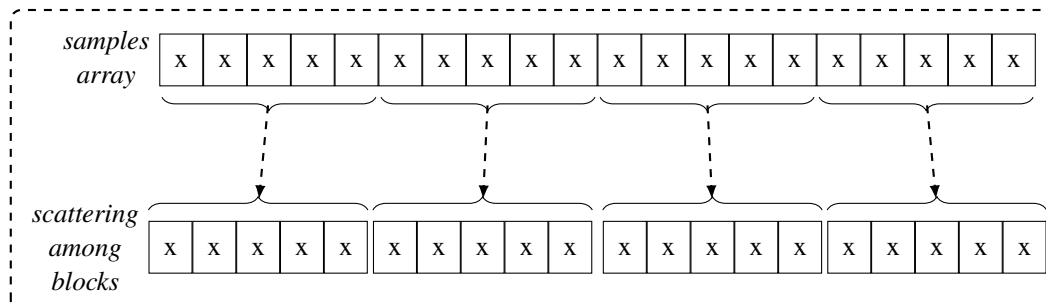
10pts

We want to compute the **histogram**, *i.e.* count the number of times each value is present :

- ▷ traverse each slot of the array ;
- ▷ for each encountered value increments its count ;



We want to scatter the array of samples among different blocks :



Questions :

- a. If each block manages a piece of the array of samples, how will we obtain the **histogram** for all the samples of the array ? (1pt)
- b. What is the **work of each thread** ? (1pt)
How much threads per block will be needed ?
 What is the **size** of the array histogram ?
- c. Can the whole computation be performed **only on the GPU** ? (1pt)
 Why ?
- d. Give the **grid configuration** for an array of samples with a size of 65536 samples. (1pt)
- e. Write a **CUDA program** computing the histogram. (5pts)
 - ◊ the array `samples` has a size of 65536, it resides in the host memory ;
 - ◊ the array `histogram` is on the host too and will be populated by the GPU.
- f. If the samples are now on 12bits, *i.e.* with a value between 0 and 4095 ($2^{12} = 4096$), is there **any problems** with your provided solution ? (1pt)
 Why ?