Intensive Computation

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PART A

Student's Name

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***Matricola* number**

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Question 1 (6 points)	
Question 2 (6 points)	
Exercise 1 (6 points)	
Exercise 2 (6 points)	
Exercise 3 (8 points)	
Total (32 points)	

Question 1 (6 points)

Briefly describe the main characteristics of the vector architectures.

Question 2 (6 points)

Briefly describe the scheme of pipeline signed addition and multiplication and how they work.

Exercise 1 (6 points) - GPU & CUDA

Consider a matrix of size 2400x2400. You would like to assign one thread to each matrix element.

a) How would you select the **2D grid** dimensions and **2D block** dimensions of your kernel to **minimize the number of idle threads** on a device having **compute capability 3**?

b) Comment on the number of resident blocks, threads and warps.

Technical specifications	**Compute capability (version)**									
	1.0	**1.1**	**1.2**	**1.3**	**2.x**	**3.0**	**3.5**	**3.7**	**5.0**	**5.2**
Maximum dimensionality of grid of thread blocks	2				3					
Maximum x-dimension of a grid of thread blocks	65535					2^{31}-1				
Maximum y-, or z-dimension of a grid of thread blocks	65535									
Maximum dimensionality of thread block	3									
Maximum x- or y-dimension of a block	512				1024					
Maximum z-dimension of a block	64									
Maximum number of threads per block	512				1024					
Warp size	32									
Maximum number of resident blocks per multiprocessor	8					16			32	
Maximum number of resident warps per multiprocessor	24		32		48	64				
Maximum number of resident threads per multiprocessor	768		1024		1536	2048				
Technical specifications	**1.0**	**1.1**	**1.2**	**1.3**	**2.x**	**3.0**	**3.5**	**3.7**	**5.0**	**5.2**
	Compute capability (version)									

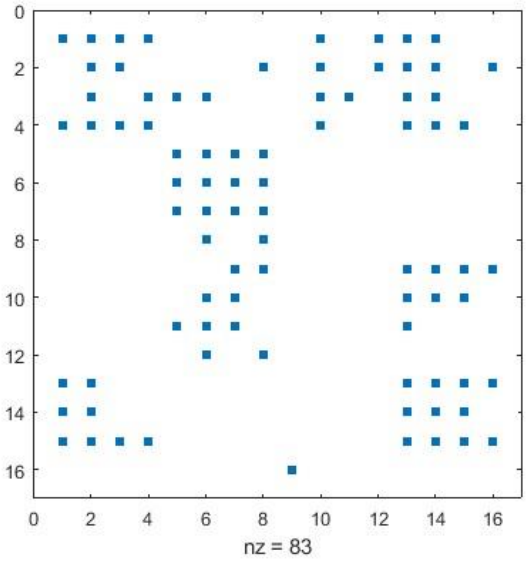
Exercise 2 (6 points) - Number representation

- Represent the natural number range [0; 989] using the residue number system, considering a moduli set T consisting of 3 moduli at your choice.
- Give an estimation of the representational efficiency.
- Represent A= 57 and B=43 using the moduli set T and compute the sum S and the product P.
- Represent S and P in the **mixed radix representation** associated to T.

Exercise 3 **(8 points)**

a) Consider the sparse matrix M whose pattern is shown in the figure on the right.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	7	1	9	6	0	0	0	0	0	2	0	2	4	8	0	0
2	0	2	7	0	0	0	0	3	0	5	0	1	1	2	0	4
3	0	2	0	4	8	4	0	0	0	1	2	0	4	2	0	0
4	9	4	6	3	0	0	0	0	0	2	0	0	4	8	4	0
5	0	0	0	0	9	5	4	2	0	0	0	0	0	0	0	0
6	0	0	0	0	5	3	2	1	0	0	0	0	0	0	0	0
7	0	0	0	0	1	1	2	7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	9	5	0	0	0	0	3	4	6	1
10	0	0	0	0	0	1	2	0	0	0	0	0	3	2	1	0
11	0	0	0	0	1	9	6	0	0	0	0	0	6	0	0	0
12	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0
13	9	6	0	0	0	0	0	0	0	0	0	0	3	4	6	1
14	8	4	0	0	0	0	0	0	0	0	0	0	3	2	1	0
15	9	5	4	2	0	0	0	0	0	0	0	0	9	5	4	2
16	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0



a) Specify which arrays you need for the following compressed representations and how many bytes they occupy in memory.

BSR

Ellpack-Itpack

b) Consider the deletion of element M(16, 9) and explain how arrays change after the reordering and quantify the gain in terms of memory occupation.

BSR

Ellpack-Itpack

c) Considering the last matrix, what scheme would be more advantageous among ones you know? Explain why giving the memory occupation for a comparison.