

Practical assignment 9. Sparse storage and sparse formats

1) **Sparse storage in Matlab.** Consider discretization of Poisson's equation on a unit segment $[0,1]$ with $u(x)|_{\Gamma} = 0$, where Γ is the boundary of the unit segment $[0,1]$.

- 1) Generate the sparse matrix of the linear system for the discretized Poisson's equation

```
D = sparse(1:n, 1:n, -2*ones(1, n), n, n);  
E = sparse(2:n, 1:n-1, ones(1, n-1), n, n);  
S = E+D+E'
```
- 2) Show the pattern of the resulting matrix (spy command in Matlab).
- 3) Convert the matrix to dense format (full command) and compare the memory used for the storage of dense and sparse matrix (whos command) for different matrix sizes.

2) **Sparse storage formats.** Develop an algorithm that transfers a matrix from a dense format to a given sparse format and vice versa. Write Matlab functions for these two algorithms and (optionally) for an algorithm of matrix-by-vector multiplication, when a matrix is stored in a given sparse format. Demonstrate the work of your functions. **Hint.** To check that your algorithms works correctly, run your functions for a matrix with at least one zero row for CSR or MSR formats and a matrix with at least one zero column for CSC or MSC formats.

Storage formats

Abbreviation	Full name
CSR	Compressed Sparse Row
CSC	Compressed Sparse Column
MSR	Modified Sparse Row
MSC	Modified Sparse Column
DIAG	Diagonal format
Ellpack-Itpack	Ellpack-Itpack

Student name	Storage formats to explore
Бехжа Абир	CSR and MSR
Мабиала Детати Селест Стефен	CSC and MSC
Кашу Салуму Кисангаси	CSR and MSR
Киспе Зурита Эстебан Франсиско	CSC and MSC
Хоссаин Фархад	DIAG and Ellpack-Itpack
Чжан Фан	DIAG and Ellpack-Itpack