

# The History of UMFPACK and AMD ... back to CERFACS Days

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joint work with  
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UMFPACK, AMD, and COLAMD are three codes with a long history, dating back to my post-doc at CERFACS in 1989-1990. UMFPACK (the unsymmetric multifrontal method) was a single paragraph in my PhD thesis that Iain Duff thought would make a good project for my post-doc under his direction. By the time I left CERFACS in December of 1990, I had the first version of UMFPACK working, using approximate degrees to keep track of the number of nonzeros in each row and column. UMFPACK is a right-looking LU factorization method that maintains its matrix as a collection of rectangular frontal matrices. Each row and column can be computed by traversing an element list, which records the frontal matrices that affect each row or column, and where within that front the given row or column can be found.

In 1994, Patrick Amestoy, Iain Duff, and I took this approximation of the degree and added it to Iain Duff and John Reid's MA27 minimum degree ordering ... resulting in the AMD ordering. To our surprise the quality was not reduced, but (as expected) the time was greatly reduced.

UMFPACK forms the basis of  $\mathbf{x}=\mathbf{A}\backslash\mathbf{b}$  in MATLAB when A is sparse; AMD and COLAMD are also used in  $\mathbf{x}=\mathbf{A}\backslash\mathbf{b}$ .

I will present the history of these codes and overview of how the degree approximations work in UMFPACK and AMD.

If time permits ... you will also hear a new poem composed just for the occasion.