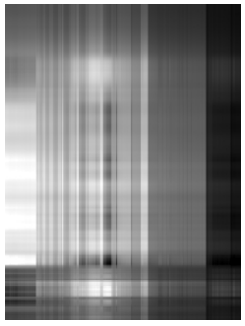
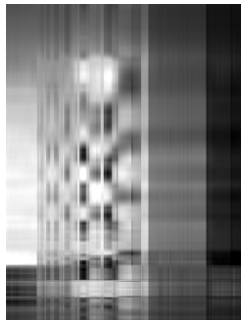
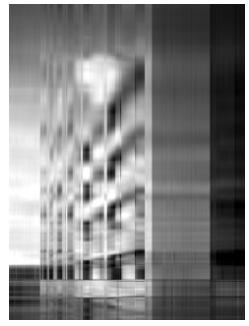
Image Compression with SVD

					
$\mathbf{A}_{230\times322}$	$37,948\mathbf{u}_1\mathbf{v}_1^\mathsf{T}$	$+5,050\mathbf{u}_2\mathbf{v}_2^\mathsf{T}$	$+4,331\mathbf{u}_3\mathbf{v}_3^\mathsf{T}$	$+3,428\mathbf{u}_4\mathbf{v}_4^\mathsf{T}$	$+2.916\mathbf{u}_5\mathbf{v}_5^\mathsf{T}$
$u = 74.060$	$c_1 = 553$	$c_2 = 1,106$	$c_3 = 1,659$	$c_4 = 2,212$	$c_5 = 2,765$
ε_ρ:	$\varepsilon_1 = 27.3$	$\varepsilon_2 = 24.3$	$\varepsilon_3 = 21.6$	$\varepsilon_4 = 20.1$	$\varepsilon_5 = 18.8$
					
$+3,045\mathbf{u}_6\mathbf{v}_6^\mathsf{T}$	$+2,718\mathbf{u}_7\mathbf{v}_7^\mathsf{T}$	$+2,532\mathbf{u}_8\mathbf{v}_8^\mathsf{T}$	$+2,417\mathbf{u}_9\mathbf{v}_9^\mathsf{T}$	$+1,975\mathbf{u}_{10}\mathbf{v}_{10}^\mathsf{T}$	$\ldots + 947\mathbf{u}_{20}\mathbf{v}_{20}^\mathsf{T}$
$c_6 = 3,318$	$c_7 = 3,871$	$\varepsilon_8 = 4,424$	$c_9 = 4,977$	$c_{10} = 5,530$	$c_{20} = 11,060$
$\varepsilon_6 = 15.9$	$\varepsilon_7 = 14.7$	$\varepsilon_8 = 13.7$	$\varepsilon_9 = 13.0$	$\varepsilon_{10} = 12.4$	$\varepsilon_{20} = 7.9$

- $u \equiv mn$ – number of pixels; c_ρ – compressed data volume ($c_\rho = \rho(1 + n + m)$)
- $\varepsilon_\rho = \frac{1}{mn}\sum_{i,j=1,1}^{m.n} |A_{ij} - \widehat{A}_{\rho:ij}|$ – mean absolute reconstruction error per pixel

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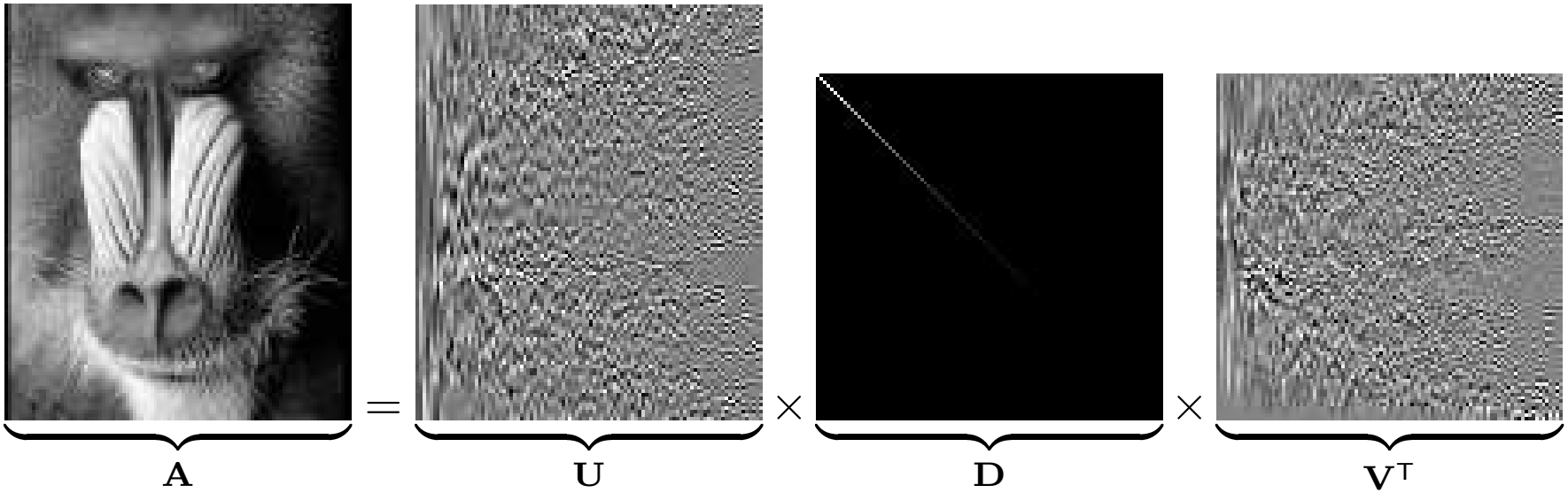
σ_ρ:	$\sigma_{30} = 552$	$\sigma_{40} = 450$	$\sigma_{50} = 360$	$\sigma_{60} = 296$	$\sigma_{70} = 260$
$u = 74.060$	$c_{30} = 16,590$	$c_{40} = 22,120$	$c_{50} = 27,650$	$c_{60} = 33,180$	$c_{70} = 38,710$
ε_ρ:	$\varepsilon_{30} = 6.3$	$\varepsilon_{40} = 4.9$	$\varepsilon_{50} = 4.3$	$\varepsilon_{60} = 4.1$	$\varepsilon_{70} = 3.5$
					
$\sigma_{80} = 226$	$\sigma_{90} = 196$	$\sigma_{100} = 177$	$\sigma_{110} = 155$	$\sigma_{120} = 141$	$\sigma_{130} = 122$
$c_{80} = 44,240$	$c_{90} = 49,770$	$c_{100} = 55,300$	$c_{110} = 60,830$	$c_{120} = 66,360$	$c_{130} = 71,890$
$\varepsilon_{80} = 3.1$	$\varepsilon_{90} = 2.8$	$\varepsilon_{100} = 2.5$	$\varepsilon_{110} = 2.2$	$\varepsilon_{120} = 1.9$	$\varepsilon_{130} = 1.6$

- $u \equiv mn$ – number of pixels; c_ρ – compressed data volume ($c_\rho = \rho(1 + n + m)$)
- $\varepsilon_\rho = \frac{1}{mn} \sum_{i,j=1,1}^{m.n} |A_{ij} - \widehat{A}_{\rho:ij}|$ – mean absolute reconstruction error per pixel

SVD of "Baboon"



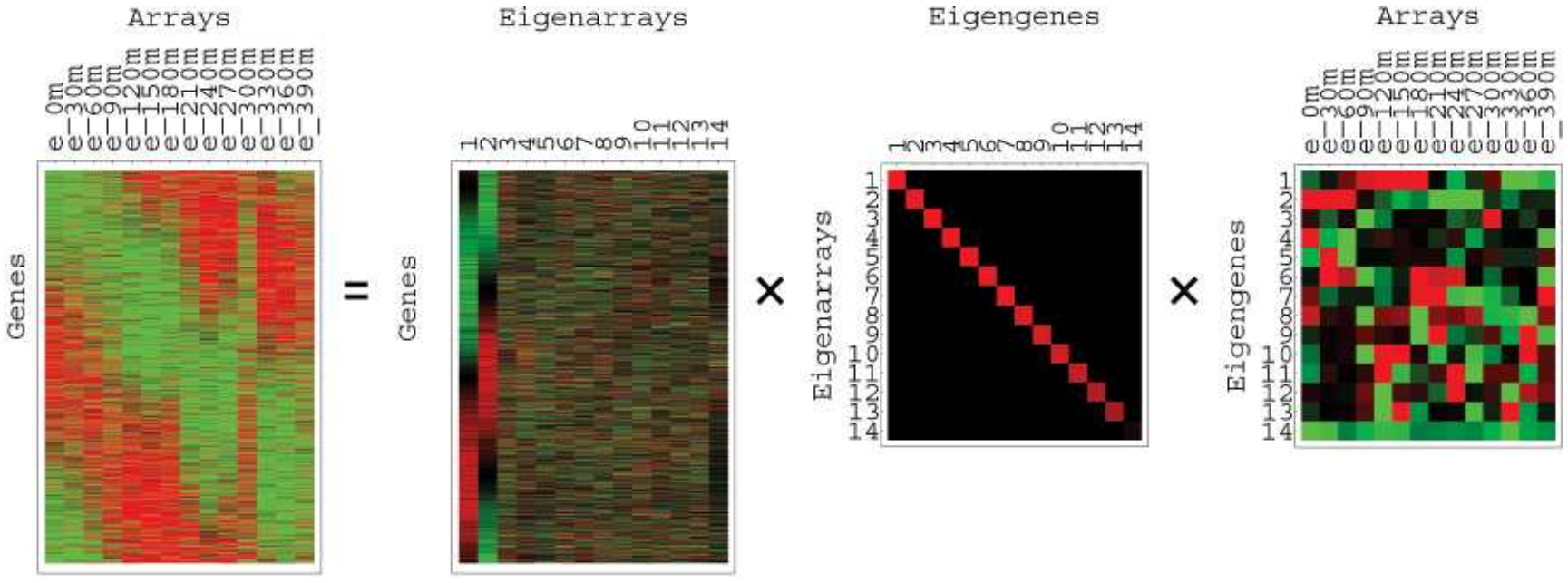
The 120×100 matrix $\mathbf{A}$ of grey values in image points is decomposed into three matrices $\mathbf{A} = \mathbf{U}\mathbf{D}\mathbf{V}^{\mathsf{T}}$: the 120×100 column-orthogonal matrix $\mathbf{U}$, the 100×100 diagonal matrix of singular values $\mathbf{D}$, and the 100×100 orthogonal matrix $\mathbf{V}^{\mathsf{T}}$

Ranges of the matrix elements:

$\mathbf{A}$	$\mathbf{U}$	$\mathbf{D}$	$\mathbf{V}$
[0;255]	[-0.38;0.41]	[1.7; 12,326.7]	[-0.55; 0.59]

Stanford University: SVD of Gene Expression Matrix

http://smd.stanford.edu/images/help/svd_matrices.gif



SVD of Yeast Cell Cycle Data

The $m \times 14$ matrix $\mathbf{A}$ of gene expression values (m genes; 14 arrays) is decomposed into three matrices $\mathbf{A} = \mathbf{U}\mathbf{D}\mathbf{V}^{\mathsf{T}}$: the $m \times 14$ eigenarrays matrix $\mathbf{U}$, the 14×14 eigenexpression levels matrix $\mathbf{D}$, and the 14×14 eigengenes matrix $\mathbf{V}^{\mathsf{T}}$.

The groups of genes that correspond to the higher singular values are the most strongly expressed.