Notations

$\mathbf{o}$	Acoustic vectors (observations)
O	Set of acoustic vectors
π_c	Prior probability of the cth mixture component
$\boldsymbol{\mu}_c$	The mean vector of the cth mixture component
$\boldsymbol{\Sigma}_c$	The covariance matrix of the cth mixture component
C	The number of mixture components in GMMs
ℓ_c	Indicator variable for the cth mixture in a GMM
$\gamma(\ell_c)$ and $\gamma_c(\cdot)$	Posterior probability of mixture c
$\mathbf{x}$	I-vector
$\mathcal{X}$	A set of i-vectors
$\mathbf{V}$	Speaker loading matrix of PLDA and JFA
$\mathbf{V}^{\mathsf{T}}$	Transpose of matrix $\boldsymbol{V}$
$\mathbf{U}$	SNR loading matrix in SNR-invariant PLDA and channel loading matrix in JFA
$\mathbf{G}$	Channel loading matrix in PLDA model
$\boldsymbol{\epsilon}$	Residue term of the PLDA model or the factor analysis model in i-vector systems
$\boldsymbol{\Sigma}$	Covariance matrix of $\boldsymbol{\epsilon}$ in PLDA
$\mathbf{z}$	Latent factor in PLDA
$\mathcal{Z}$	Set of latent factors $\mathbf{z}$
$\mathbf{m}$	Global mean of i-vectors
$\mathbb{E}\{\mathbf{x}\}$	Expectation of $\mathbf{x}$
$\langle\mathbf{x}\rangle$	Expectation of $\mathbf{x}$
$\boldsymbol{\Lambda}$	A set of model parameters
$\mathbf{0}$	Vector with all elements equal to 0
$\mathbf{1}$	Vector with all elements equal to 1
$\mathbf{I}$	Identity matrix
$\langle\mathbf{z}_i\,\vert\mathbf{x}_i\rangle$	Conditional expectation of $\mathbf{z}_i$ given $\mathbf{x}_i$
$Q(\cdot)$	Auxiliary function of EM algorithms
$\mathbf{T}$	Total variability matrix in i-vector systems
$\mathbf{w}_i$	Latent factor of the factor analysis (FA) model in i-vector systems
$\boldsymbol{\mu}^{(b)}$	Supervector of the UBM in the FA model of i-vector systems
$\boldsymbol{\mu}_i$	Utterance-dependent supervector in i-vector systems

$\mathbf{y}$	Indicator vector in PLDA mixture models
$\mathcal{Y}$	Set of indicator vectors, complete data or target labels
$y_{\cdot,\cdot,c}$	indicator variables for the cth mixture in i-vector FA model
$\mathcal{H}_{\cdot,c}$	Set comprising the frame indexes whose acoustic vectors are aligned to mixture c
$\mathbf{N}$	Matrix comprising the zeroth order sufficient statistics in its diagonal
n_c	Zeroth order sufficient statistics of mixture c
$\tilde{\mathbf{f}}$	Vector comprising the first order sufficient statistics
ξ_i	Slack variables in SVM
α_i	Lagrange multipliers in SVM
$\boldsymbol{\phi}(\cdot)$	Feature map in SVM
$K(\cdot,\cdot)$	Kernel function in SVM
b	Bias
$\mathcal{L}(\cdot)$	Lower bound of a log likelihood function
$\mathbb{R}^D$	Real numbers in D-dimensional space
$\mathbf{v}$	Visible units $\{v_i\}$ in RBM
$\mathbf{h}$	Hidden units $\{h_j\}$ in RBM
$E(\mathbf{v},\mathbf{h})$	Energy function of visible units $\mathbf{v}$ and hidden units $\mathbf{h}$ in RBM
$E(\mathbf{w})$	Error function with DNN parameters $\mathbf{w}$
$\mathbf{X}_n$	Minibatch data with length T_n
E_n	Error function using minibatch data $\mathbf{X}_n$
$\mathbf{y}(\mathbf{x}_t,\mathbf{w})$	Regression outputs corresponding to inputs $\mathbf{x}_t$ in DNN
$\mathbf{r}_t$	Regression targets in DNN
$\mathbf{z}_t$	Hidden units in DNN
a_{tk}	Activation of unit k
$\mathbb{H}[\cdot]$	Entropy function
$q(\mathbf{h}\|\mathbf{v})$	Variational distribution of hidden units $\mathbf{h}$ given visible units $\mathbf{v}$ in RBM
$\widetilde{\mathbf{x}}$	Corrupted version of an original sample $\mathbf{x}$ in DAE
$\widehat{\mathbf{x}}$	Reconstructed data in DAE
$\mathbf{h}$	Deterministic latent code in DAE
$\boldsymbol{\theta}$	Model parameter in VAE
$\boldsymbol{\phi}$	Variational parameter in VAE
L	Total number of samples
$\mathbf{z}^{(l)}$	The lth latent variable sample
$\mathcal{D}_{\mathrm{KL}}(q\,\|\,p)$	Kullback–Leibler divergence between distributions q and p
$\mathcal{D}_{\mathrm{JS}}(q\,\|\,p)$	Jensen–Shannon divergence between distributions q and p
$p_{\mathrm{data}}(\mathbf{x})$	Data distribution
$p_{\mathrm{model}}(\mathbf{x})$	Model distribution
$p_g(\mathbf{x})$	Distribution of generator (or equivalently model distribution $p_{\mathrm{model}}(\mathbf{x})$)
G	Generator with distribution $p_g(\mathbf{x})$ in GAN

D	Discriminator in GAN
$\boldsymbol{\theta}_g$	Parameter of generator in GAN
$\boldsymbol{\theta}_d$	Parameter of discriminator in GAN
$\boldsymbol{\theta}_e$	Parameter of encoder in an AAE
$\boldsymbol{\theta}_{\text{enc}}$	Parameter of encoder in manifold or adversarial learning
$\boldsymbol{\theta}_{\text{dec}}$	Parameter of decoder in manifold or adversarial learning
$\boldsymbol{\theta}_{\text{dis}}$	Parameter of discriminator in manifold or adversarial learning
$\boldsymbol{\theta}_{\text{gen}}$	Parameter of generator in manifold or adversarial learning
t_n	Target value of an i-vector $\mathbf{x}_n$
t_{nm}	Target value for indication if $\mathbf{x}_n$ and $\mathbf{x}_m$ belong to the same class
$\mathcal{T}$	A set of target values
θ_g	Parameter of decoder in VDANN
θ_e	Parameter of encoder in VDANN
θ_c	Parameter of classifier in VDANN
θ_d	Parameter of discriminator in VDANN
$\boldsymbol{\mu}_\phi$	Mean vector of encoder's output in a VAE
$\boldsymbol{\sigma}_\phi$	Standard deviation vector of encoder's output in a VAE