8. $\vec{\mu}, X \in \mathbb{R}^n \quad \Sigma \in \mathbb{R}^{n \times n}$

$Y = A \cdot X$

$S = (X - \vec{\mu})^T \Sigma^{-1} (X - \vec{\mu})$

$S = (Y - A\vec{\mu})^T (A \Sigma A^T)^{-1} (Y - A\vec{\mu}) =$

$= (AX - A\vec{\mu})^T (A \Sigma A^T)^{-1} (AX - A\vec{\mu}) =$

~~$A^T (X - \vec{\mu})^T (A \Sigma A^T)^{-1} A (X - \vec{\mu}) =$~~

~~$= A^T (X - \vec{\mu})^T A^{-1} \Sigma^{-1} (A^T)^{-1} A (X - \vec{\mu}) =$~~

$= (A(X - \vec{\mu}))^T (A^T)^{-1} \Sigma^{-1} A^{-1} A (X - \vec{\mu}) =$

$= (X - \vec{\mu})^T A^T (A^T)^{-1} \Sigma^{-1} A^{-1} A (X - \vec{\mu}) =$

$= (X - \vec{\mu})^T Id \, \Sigma^{-1} Id (X - \vec{\mu}) =$

$= (X - \vec{\mu})^T \Sigma^{-1} (X - \vec{\mu})$

4.