#7 $A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ a_{m1} & \cdots & \cdots & a_{mn} \end{bmatrix}$

$f(y) = g(Ay)$

Chain Rule: $f: \mathbb{R}^k \to \mathbb{R}^m$ and $g: \mathbb{R}^m \to \mathbb{R}^n$

let $h: \mathbb{R}^k \to \mathbb{R}^n$ be defined by $h(x) = g(f(x))$.

$\Rightarrow \nabla h(x) = \nabla f(x)\, \nabla g(f(x)) \quad \forall x \in \mathbb{R}^k$

let $K(y) = Ay$.

$\Rightarrow f(y) = g(K(y))$

$\nabla f(y) = \nabla K(y)\, \nabla g(K(y))$

$\nabla(f(y)) = \nabla(g(Ay)) = A^T \nabla g(Ay)$

$\nabla^2(f(y)) = \nabla^2(g(Ay)) = A^T \nabla^2 g(Ay) \cdot A$