$\boxed{a^T b = b^T a\ ?}$

$$\begin{pmatrix} I & \mathbb{E}\left[\cancel{g}\, g(t)\, g(s)^T\right] \\ \mathbb{E}\left[g(s) g(t)^T\right] & I \end{pmatrix}$$

have $\cancel{g(t)}$ $g(s) = g(t) + \overbrace{(\nabla g)(s-t)}^{\in \mathbb{R}^n}$ $\cancel{+ o(s-t)}$

$+ \underbrace{\nabla^2 g(s-t, s-t)}_{\in \mathbb{R}^n}$

$$\Rightarrow \mathbb{E}[g(t) g(s)^T]$$

$$= \underbrace{\mathbb{E}[g(t) g(t)^T]}_{= I} + \mathbb{E}[g(t)\, \boxed{\nabla^T g (s-t)}]$$

$$+ \mathbb{E}[g(t)\, \nabla^2 g\, (s-t, s-t)]$$

just transpose the above!

~~so on~~

and $\mathbb{E}[g(s) g(t)^T] = I + \mathbb{E}[\,(s-t)^T\, \boxed{\nabla g\ g(t)}\,]$

$$\mathbb{E}[g(t) \nabla^T g (s-t)]_{ij} = (g_i (\nabla^T g\ (s-t))_j)$$

$$= g_i \left(\frac{\partial g_k}{\partial g_j}\right)^T (s-t)_k$$

$$= g_i (\nabla^T g)_{jk} (s-t) = g_i \sum_k \frac{\partial g_k}{\partial t_j} (s-t)_k$$

and $\mathbb{E}[(s-t)^T \nabla g\, g(t))_{ij} = ((s-t)^T \nabla g)_i\, g_j$

$$= \sum_k \cancel{(s_k - t_k) \frac{\partial g_k}{\partial}}$$