Writing Exercise

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1 Exercise 4.1

1.1

$$\begin{aligned} &\max_{a} a^T B a \\ &\text{s.b.t } a^T W a = 1 \end{aligned}$$

corresponding to the lagrangian

$$\begin{aligned} L_P &= a^T B a - \lambda(a^T W a - 1) \\ \text{Let } \frac{\partial L_P}{\partial a} &= 2Ba - 2\lambda W a = 0 \\ W^{-1} B a &= \lambda a \end{aligned}$$

$\therefore$ a is a eigenvector of $W^{-1}B$

$$\begin{aligned} \because Ba &= \lambda W a \\ \therefore a^T B a &= \lambda a^T W a \\ \because a^T W a &= 1 \\ \therefore a^T B a &= \lambda \end{aligned}$$

$\therefore$ a is the eigenvector corresponding to the biggest eigenvalue of $W^{-1}B$