Find best a such that
$$|f| \cong af^2$$

for f values between $0 < f < 1$. Namely, we want to approximate the abs. val. of f, by an f^2 over the freq. range (0 to 1). By using the integral version of the least squares technique, write the penalty function. Then differentiate with respect to a, set the derivative to zero and find a.

$$\int_0^1 (|f| - af^2)^2 \, df \quad \text{(penalty function)}$$

$$\frac{d}{da} \int_0^1 (|f| - af^2)^2 \, df$$

$$0 = \int_0^1 \frac{d}{da} (|f| - af^2)^2 \, df$$

$$0 = \int_0^1 2f - 6af^2 + 4a^2f^3 \, df$$

$$0 = \left. f^2 - 2af^3 + a^2f^4 \right]_0^1$$

$$0 = (1 - 2a + a^2) - (0)$$

$$-1 = -2a + a^2$$

$$-1 = a(-2 + a)$$

$$a = 1$$

$$\frac{d}{da} (|f| - af^2)^2$$

$$= 2(|f| - af^2)(1 - 2af)$$
$$\qquad \uparrow$$
$$\text{(for positive valued } f)$$
$$\downarrow$$

$$= 2(|f| - 2af|f| - af^2 + 2a^2f^3)$$

$$= 2(f - 2af^2 - af^2 + 2a^2f^3)$$

$$= 2f - 6af^2 + 4a^2f^3$$