

$$EPE(f) = \int (y - f(x))^2 Pr(dx, dy)$$

$$= \int_x \left[ \int_y (y - f(x))^2 p(y|x) dy \right] p(x) dx$$

$$= \int_x E_{y|x} (y - f(x))^2 p(x) dx$$

$$= E_x E_{y|x} (y - f(x)|x)^2$$

$$f(x) = E(y|x=x)$$