Derivation of the equations

The mutual information can be calculated as,

$$I(W;S) = H(S) - H(S|W) = H(S) - \sum P(w)\cdot H(S|W=w) = H(S) - \int_{-q}^{q} f_w(w)\cdot H(S|W=w)\,dw \quad (1)$$

with

$$\begin{aligned} H(S|W=w) &= \sum_{s_i\in S} P(s_i|w)\log\frac{1}{P(s_i|w)} \\ &= P(S=1|W=w)\log\frac{1}{P(S=1|W=w)} + P(S=0|W=w)\log\frac{1}{P(S=0|W=w)} \end{aligned} \quad (2)$$

We have $p_{w0} = P(S=0|W=w)$ and $p_{w1} = P(S=1|W=w)$. Therefore,

$$H(S|W=w) = -\left(p_{w1}\log p_{w1} + p_{w0}\log p_{w0}\right) \quad (3)$$

Substituting (2) and (3) into (1), it gives,

$$\begin{aligned} I(W;S) &= H(S) + \int_{-q}^{q}\left(p_{w1}\log p_{w1} + p_{w0}\log p_{w0}\right) f_w(w)\,dw \\ &= H(S) + \int_{-q}^{q}\left(p_{w1}\log p_{w1} + p_{w0}\log\left(1-p_{w1}\right)\right) f_w(w)\,dw \end{aligned}$$

(Instead of $I(W;S) = H(S) + \int_{-q}^{q}\left(p_{w1}\log p_{w1} + p_{w0}\log\left(1-p_{w0}\right)\right) f_w(w)\,dw$ given in the paper).

I think the paper has a typo, for this result is in accord with equations presented in its rest part.