Use an ensemble of simple classifiers $h_j = \begin{cases} 1 & |f_i(x) - input_i(x)| \leq \theta \\ 0 & \textbf{else} \end{cases}$

On their own, the simple classifiers will yield high error rates. However, this can be fixed by using ensemble learning as well as choosing the most impactful ones through the ADABoost algorithm. Using this strategy, we can semi-quickly create a strong classifier $H_t = \begin{cases} 1 & \sum \alpha_j h_j(x) \geq \frac{1}{2} \sum \alpha_j \\ 0 & \textbf{else} \end{cases}$

Algorithm 1 Weak Classifier

procedure $weak\_classifier(input[][], output[], label[], f_i, lo\_rng, hi\_rng)$

INPUTS: *input* - SET OF N INPUT IMAGE VECTORS
output - SET OF N OUTPUT DECISIONS (-1 OR 1)
label - SET OF N TRUE LABELS OF INPUT IMAGES (-1 OR 1)
f_i - FEATURE VECTOR
lo_rng - INITIAL LOW THRESHOLD
hi_rng - INITIAL HIGH THRESHOLD

$\theta_{lo} \leftarrow lo\_rng, \theta_{mid} \leftarrow \lfloor \frac{(lo\_rng+hi\_rng)}{2} \rfloor, \theta_{hi} \leftarrow hi\_rng$
while $(\theta_{lo} \neq \theta_{hi})$ **do**
  $error \leftarrow \emptyset, e_{lo} \leftarrow 0, e_{mid} \leftarrow 0, e_{hi} \leftarrow 0$
  for $(i = 0 \rightarrow input.size())$ **do**
    for (*each subregion x*) **do**
      #Determine output decision based on three potential thresholds.
      if $(|f_i - input[i](x)| \leq \theta_{lo})$ **then**
        $output[i] \leftarrow 1$
        $error[i] \leftarrow 0$
      else if $(|f_i - input[i](x)| \leq \theta_{mid})$ **then**
        $output[i] \leftarrow 1$
        $error[i] \leftarrow 1$
      else if $(|f_i - input[i](x)| \leq \theta_{hi})$ **then**
        $output[i] \leftarrow 1$
        $error[i] \leftarrow 2$
      end if
    end for
    if $(output[i] \equiv 0)$ **then**
      $output[i] \leftarrow -1$
      $error[i] \leftarrow -1$
    end if
    #Find the number of misclassifications for each potential threshold.
    if $(error[i] \equiv -1)$ **then**
      if $(output[i] \neq label[i])$ **then**
        $e_{lo}++$
        $e_{mid}++$
        $e_{hi}++$
      end if
    else if $(error[i] \equiv 0)$ **then**
      if $(output[i] \neq label[i])$ **then**
        $e_{lo}++$
        $e_{mid}++$
        $e_{hi}++$
      end if
    else if $(error[i] \equiv 1)$ **then**
      if $(output[i] \equiv label[i])$ **then**
        $e_{low}++$
      else
        $e_{mid}++$
        $e_{hi}++$
      end if

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else if $(error[i] \equiv 2)$ **then**
if $(output[i] \equiv label[i])$ **then**
$e_{low}++$
$e_{mid}++$
else
$e_{hi}++$
end if
end if
end for
#Compute new threshold bounds based on number of misclassifications.
if $(e_{lo} \leq e_{mid}$ && $e_{mid} \leq e_{hi})$ **then**
$\theta_{lo} \leftarrow \theta_{lo}$
$\theta_{hi} \leftarrow \theta_{mid}$
$\theta_{mid} \leftarrow \lfloor \frac{(\theta_{low}+\theta_{hi})}{2} \rfloor$
else if $(e_{mid} \leq e_{lo}$ && $e_{hi} \leq e_{mid})$ **then**
$\theta_{lo} \leftarrow \theta_{mid}$
$\theta_{hi} \leftarrow \theta_{hi}$
$\theta_{mid} \leftarrow \lfloor \frac{(\theta_{low}+\theta_{hi})}{2} \rfloor$
else if $(e_{mid} \geq e_{lo}$ && $e_{mid} \geq e_{hi})$ **then**
if $(e_{lo} \equiv min(e_{lo}, e_{hi}))$ **then**
$\theta_{lo} \leftarrow \theta_{lo}$
$\theta_{hi} \leftarrow \theta_{mid}$
else
$\theta_{lo} \leftarrow \theta_{mid}$
$\theta_{hi} \leftarrow \theta_{hi}$
end if
$\theta_{mid} \leftarrow \lfloor \frac{(\theta_{low}+\theta_{hi})}{2} \rfloor$
else if $(e_{mid} \leq e_{lo}$ && $e_{mid} \leq e_{hi})$ **then**
$\theta_{lo} \leftarrow \theta_{mid} - \lfloor \frac{\theta_{mid}}{2} \rfloor$
$\theta_{hi} \leftarrow \theta_{mid} + \lfloor \frac{\theta_{mid}}{2} \rfloor$
end if
end while
return θ_{lo}
end procedure