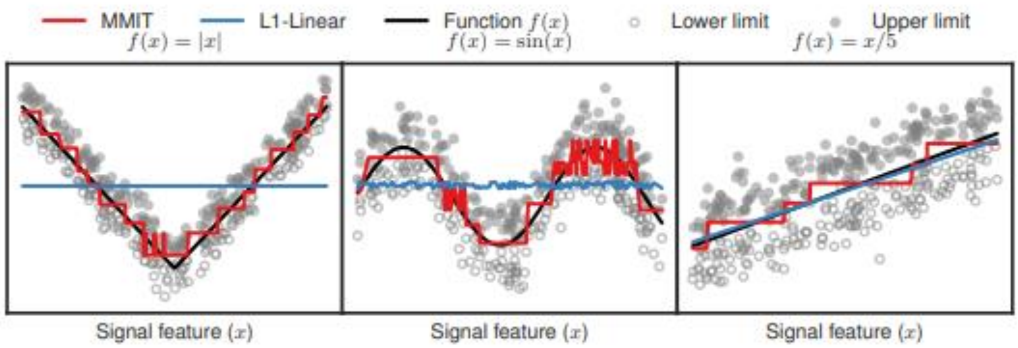
CS599 ML Project2 Week 1
Qingkun Liu

1. Original Figure:



2. Citation:
   Alexandre Drouin, Toby Dylan Hocking, Francois Laviolette, “Maximum Margin Interval Tree”, Figure 4:

3. Problem setting

   Input: xi belong to R^p is a feature vector, $\mathbf{y}_i \stackrel{\text{def}}{=} (\underline{y_i}, \overline{y_i})$, with $\underline{y_i}, \overline{y_i} \in \overline{\mathbb{R}}$; are lower and upper limits of a target interval.
   Output: D is an unknown data generating distribution
   Desire function:

$$\underset{h}{\text{minimize}} \underset{(\mathbf{x}_i,\mathbf{y}_i)\sim D}{\mathbf{E}} \phi_\ell(-h(\mathbf{x}_i)+\underline{y_i}) + \phi_\ell(h(\mathbf{x}_i)-\overline{y_i}),$$

   This function is the requirement, we need minimize the erroneous, the erroneous is decided by the number of predicted values that outside of the target interval.

4. Data sources:
   https://github.com/aldro61/mmit-data
   The data that the figure use is in the folder simulated.abs, simulated.linear and simulated.sin

5. Algorithm:

Algorithm 1 Dynamic programming algorithm for computing minimum total hinge loss.

Input: limits $\mathbf{y} \in \mathbb{R}^n$, signs $s \in \{-1, 1\}$, margin $\epsilon \in \mathbb{R}$.
Initialize: $B \leftarrow$ map$\{\}$, $J \leftarrow B$.end(), $M \leftarrow$ Coefs(0)
for data points t from 1 to n:
  $f \leftarrow$ Coefs$[s_t \ell(s_t(\mu - y_t) + \epsilon)]$
  $b \leftarrow y_t - s_t \epsilon$
  B.insert(b, f)
  if $0 < s_t(B[J]$.breakpoint $- y_t) + \epsilon$:
    $M \leftarrow M +$ Coefs$[\ell(s_t(\mu - y_t) + \epsilon)]$
  while !MinInInterval(M, B, J):
    if Increasing(M): $J \leftarrow J - 1$; $M \leftarrow M - B[J]$.function
    else: $M \leftarrow M + B[J]$.function; $J \leftarrow J + 1$
  $\mu_t^*, P_t^* \leftarrow$ Minimize(M, B, J)
Output: $\mu^* \in \mathbb{R}^n$, $P^* \in \mathbb{R}^n$