??
??
sup-
port
vec-
tor
ma-
chines
?
?
?

$$\begin{aligned} \min_{C \in U_{ad}, \tilde{w} \in {}^{k}} \quad & \mathcal{L}_{upp}(C, \tilde{w}) \qquad upperlevel \\ s.t. \quad & \mathcal{G}_{upp}(C, \tilde{w}) \leq 0 \qquad .lowerlevel \\ & \tilde{w} \in {}_{\tilde{w} \in W} \qquad \mathcal{L}_{low}(C, \tilde{w}) \\ s.t. \quad & \mathcal{G}_{low}(C, \tilde{w}) \leq 0 \end{aligned}$$

(1)

$\mathcal{L}_{upp}$
$\mathcal{L}_{low}$
$^{n} \times ^{k}$
$\mathcal{G}_{upp}$
$\mathcal{G}_{low}$
$^{n} \times ^{k}$
l
s
up-
per
outer
level
lower
in-
ner
level
?
so-
lu-
tion
map
$S(C) =$
$\{w \in {}^{k} |$
w
$C\}$
?
?
?
x
y
$x^{i} \in {}^{n_f}$
fea-
ture
space
$y_i \in$
$\{-1, 1\}$
out-
put
do-
main
x^{i}
C
$f : {}^{n} \times {}^{k} \rightarrow$
gra-
di-
ent
$(C, \bar{\tilde{w}})$
$\nabla f(C, \bar{\tilde{w}}) \in {}^{n+k}$
$\tilde{w}$
$\nabla_{\tilde{w}} f(\bar{C}, \bar{\tilde{w}}) \in {}^{k}$
$F : {}^{n} \times {}^{k} \rightarrow {}^{m}$
Ja-
co-
bian
ma-
trix
$\mathcal{J}F(\bar{C}, \bar{\tilde{w}}) \in {}^{m \times (n+k)}$
$\tilde{w}$
$\mathcal{J}_{\tilde{w}} F(\bar{C}, \bar{\tilde{w}}) \in {}^{m \times k}$
$M \in {}^{n \times k}$
$I \subset$
$\{1, ..., n\}$
M_I
M
I
?
?
?
?
$\tilde{X} \subset {}^{n_f}$
in-
put
space
$Y =$
$\{-1, 1\}$