Introduction

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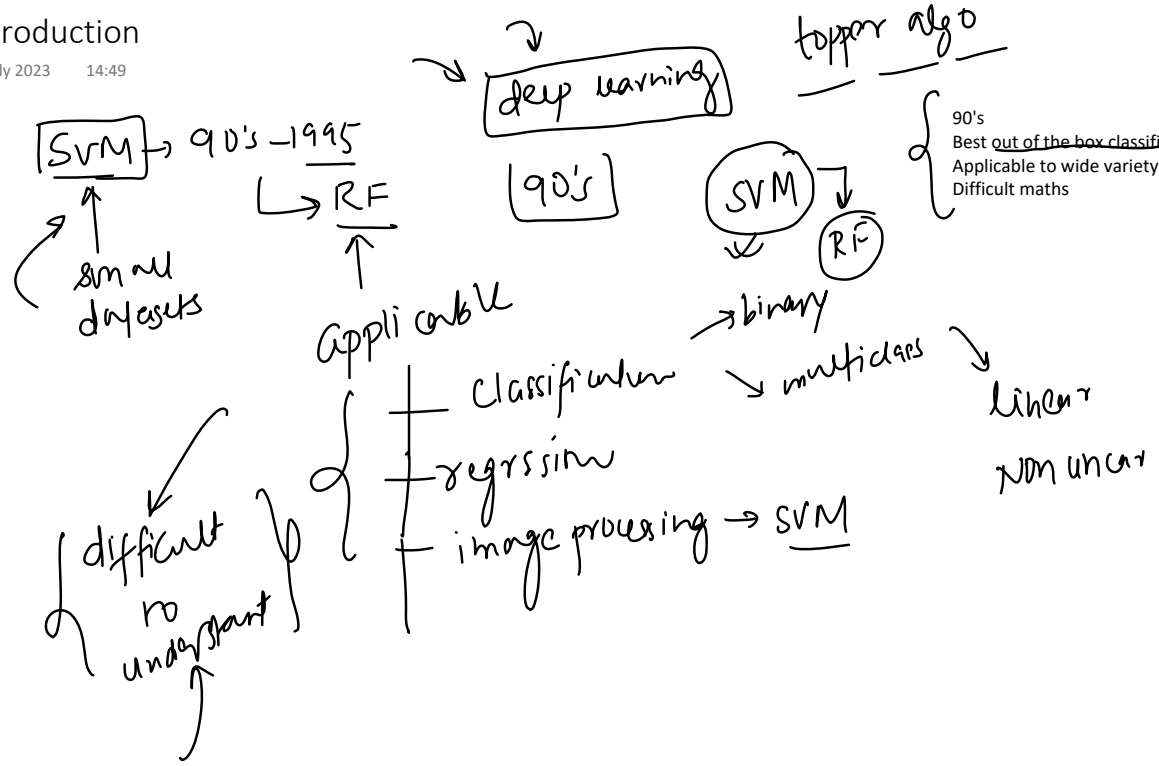

Plan of Attack

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1) Maximal margin classifier → SVM → Hard margin SVM

2) Soft margin SVM → Support vector classifier → SVC → linear data

3) SVM → kernels → non-linear

4) SVM for multiclass setup

5) SVR

Maximal Margin Classifier

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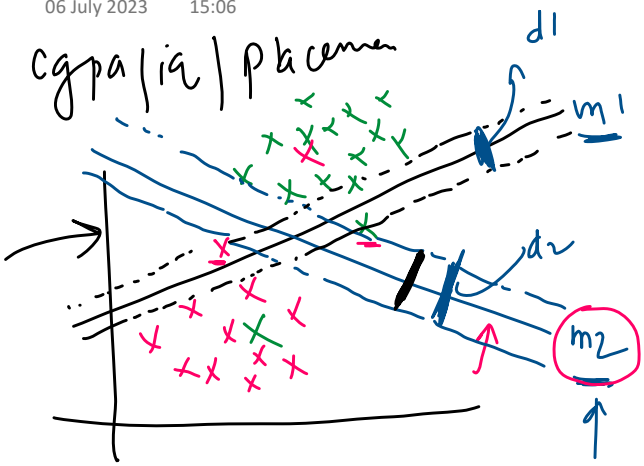
SVM Hard margin



m1 or m2

Basic requirement

$d_2 > d_1$

Linearly separable

better model

Support Vectors

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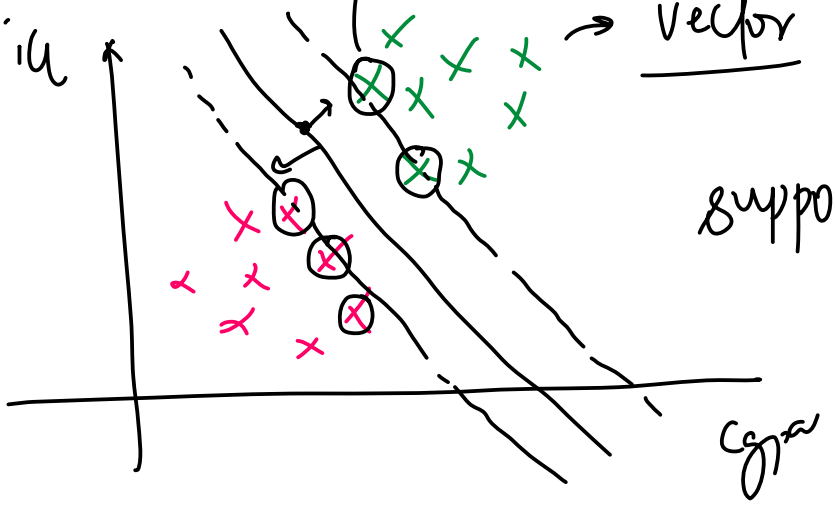
SVM



→ vector

support vector

Mathematical Formulation

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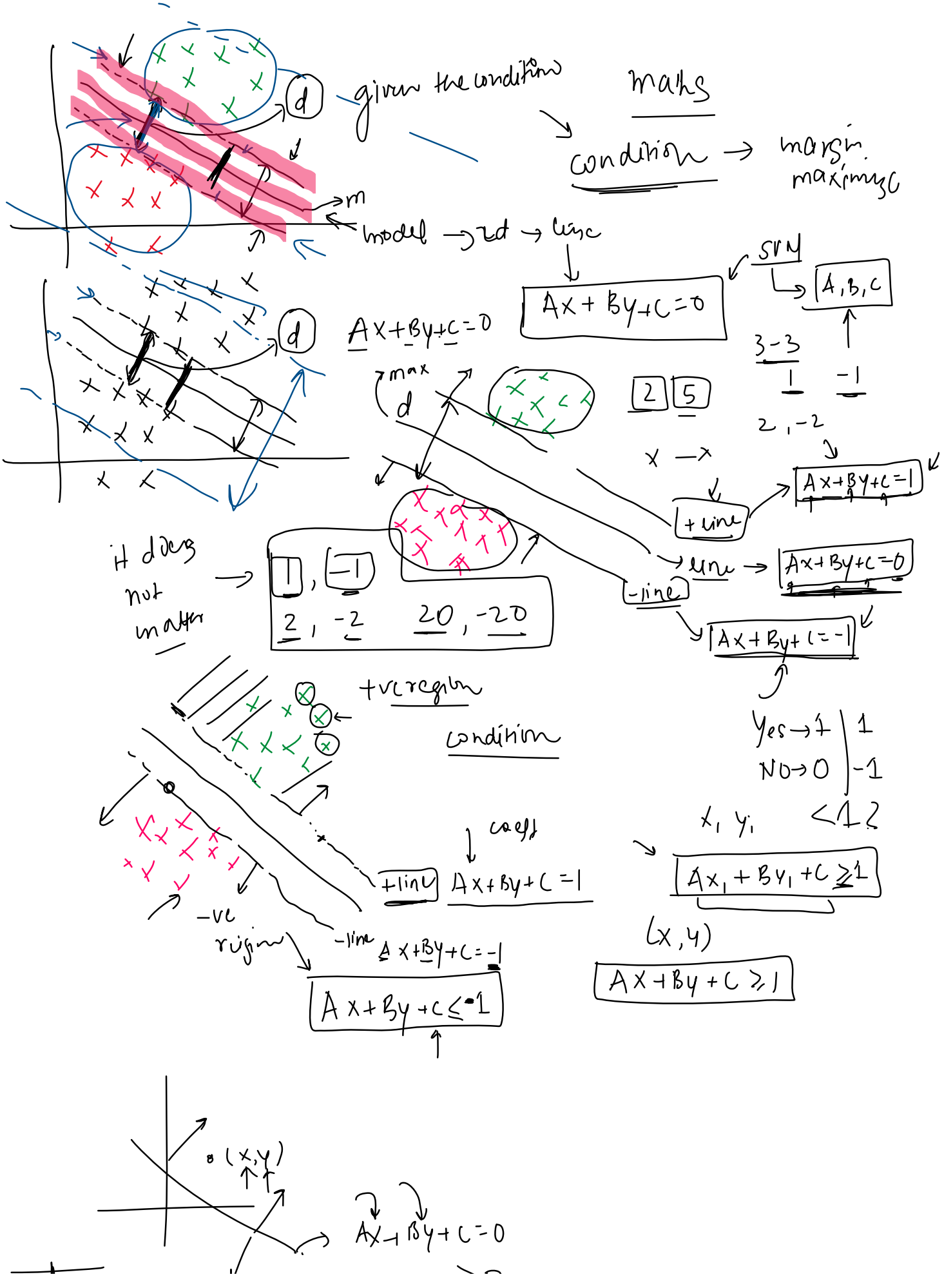
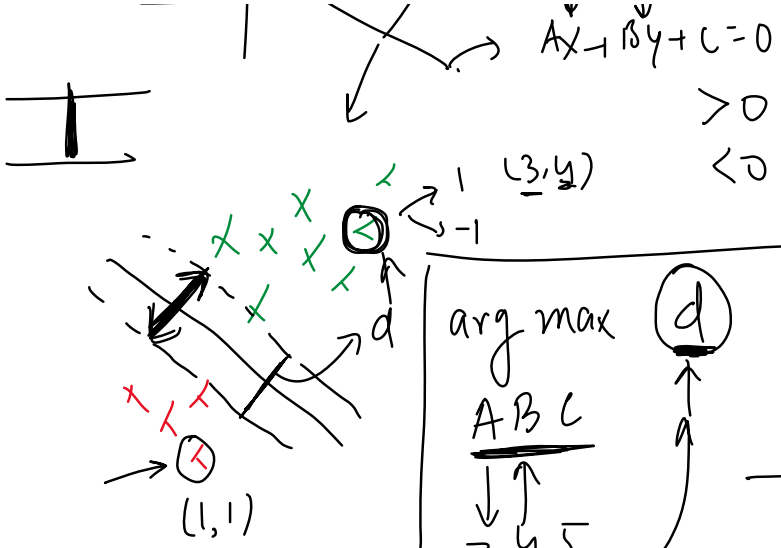




$Ax_1 + Bx_2 + C = 0$

$\arg\max_{A,B,C} \; d$ such that

if $y_i = 1 \Rightarrow y_i(Ax_{1i} + Bx_{2i} + C) \geq 1$

$y_i = -1 \Rightarrow Ax_{1i} + Bx_{2i} + C \leq -1$

+ve

$1(3\times3 + 4\times4 + 5) \geq 1$

$-1(3\times1 + 4\times1 + 5) \leq -1$

$-2 < -1$

$2 \geq 1$

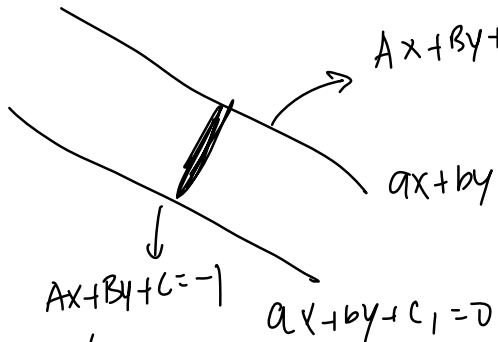
$\rightarrow Ax_{1i} + Bx_{2i} + C \geq 1$

$y_i(Ax_{1i} + Bx_{2i} + C) \geq 1$

+ve
-ve

SVM

$\arg\max_{A,B,C} \; d$ such that $y_i(Ax_{1i} + Bx_{2i} + C) \geq 1$



$Ax + By + C - 1 = 0$

$d = \dfrac{|C_1 - C_2|}{\sqrt{a^2 + b^2}}$

$Ax + By + C + 1 = 0$

$d = \dfrac{|C+1-C+1|}{\sqrt{A^2+B^2}} = \dfrac{2}{\sqrt{A^2+B^2}} = \phi$

$\sqrt{A^2+B^2}$

$\sqrt{A^2+B^2}$

$$\underset{A,B,C}{\operatorname{argmax}} \quad \frac{2}{\sqrt{A^2+B^2}} \quad \text{given} \left\{ y_i (A x_{i1} + B x_{i2} + C) \geq 1 \right\}$$

$$\underset{A,B,C}{\operatorname{argmin}} \quad \frac{\sqrt{A^2+B^2}}{2} \quad \text{given}$$

$$\rightarrow \frac{g^2}{2}$$

How to solve this?

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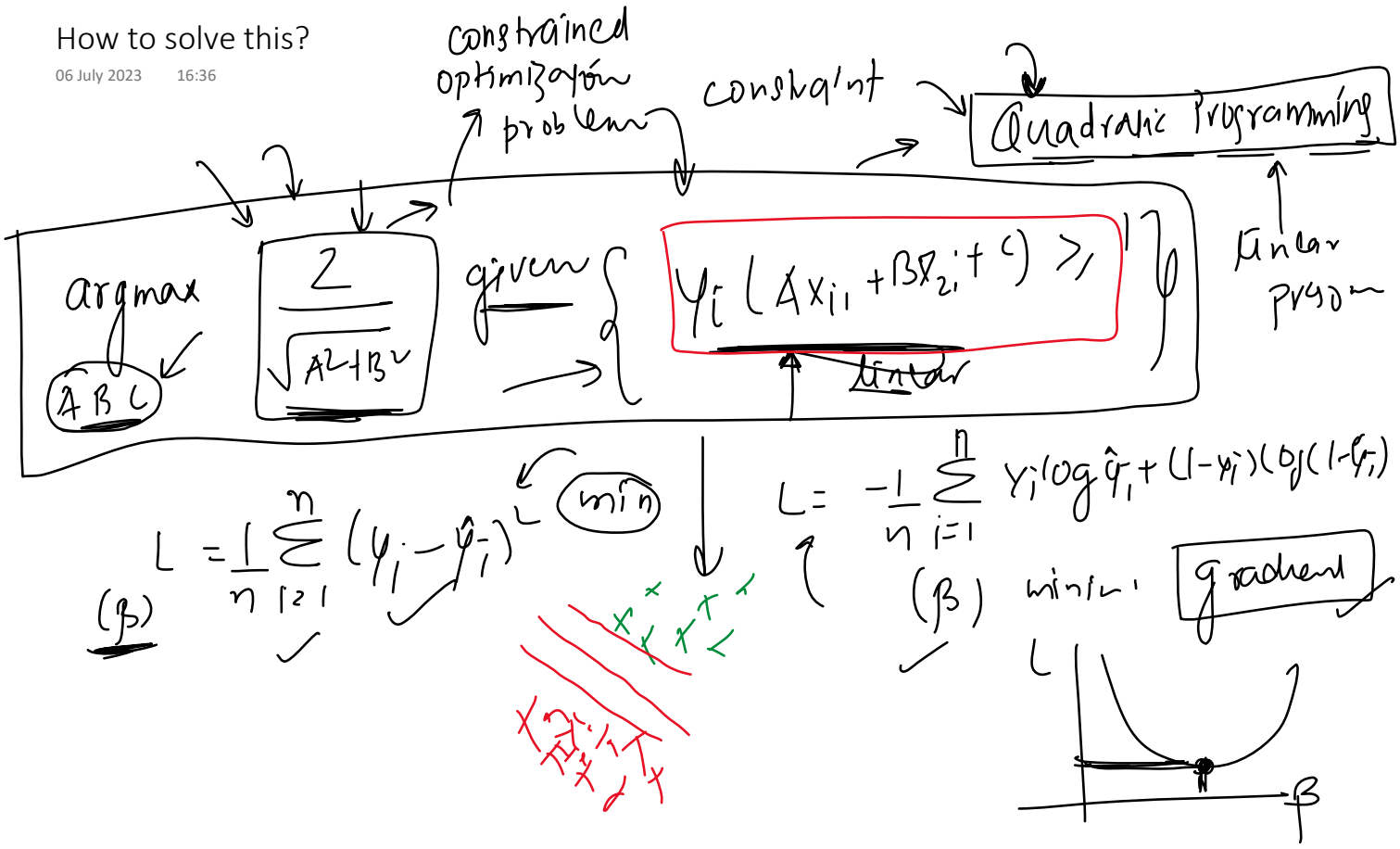

Prediction

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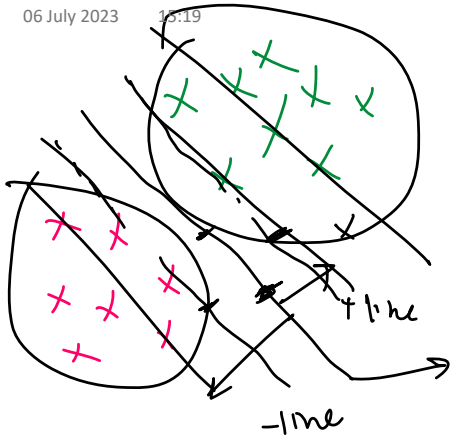

(8, 80)

$Ax8 + Bx80 + C \geq 0 \rightarrow$ placem

$< 0 \rightarrow$ no placement

$Ax + By + C \geq 0$

Hard margin SVM

Code

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Problem with Hard Margin SVM

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