

Introduction to Support Vector Machine

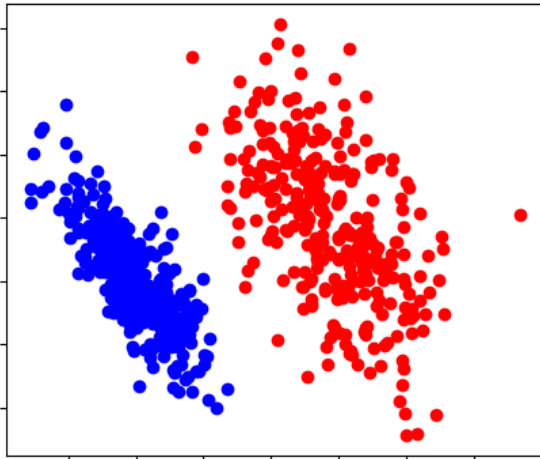
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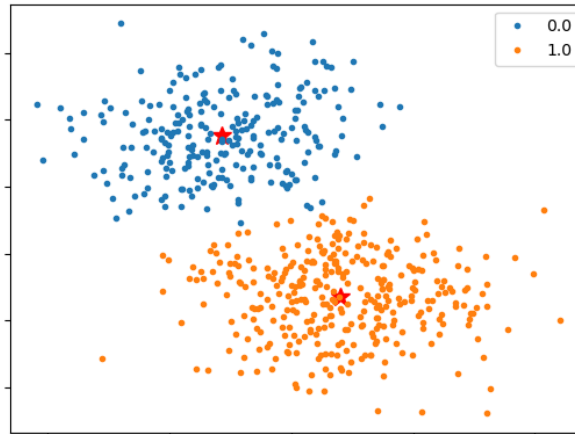
Revisit Clustering & Classification

Is there Anything in Common?

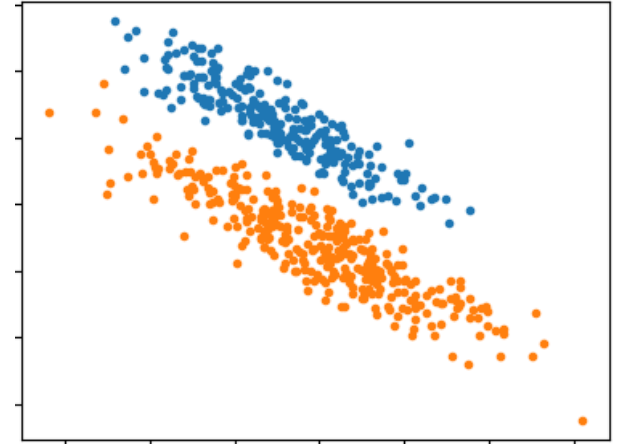
Logistic Regression



k-Means



GMM Clustering

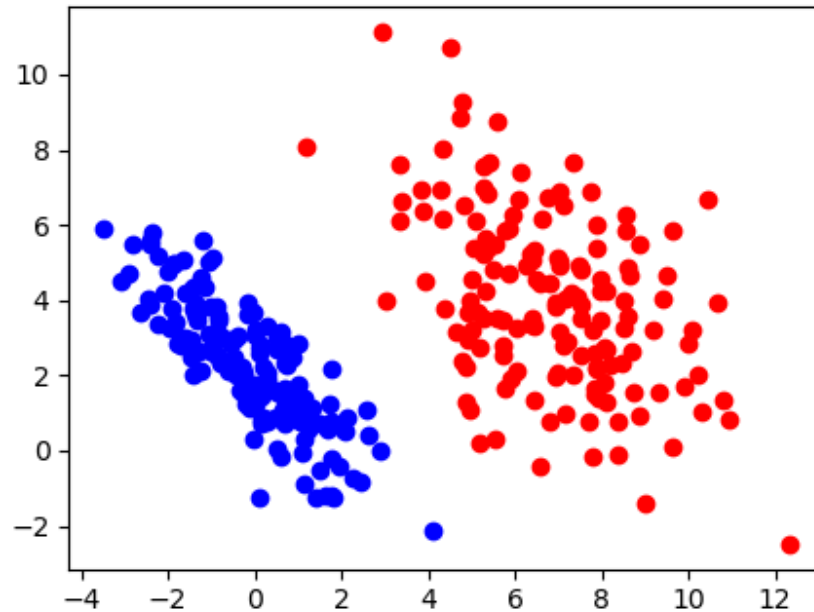


- There are (invisible) boundaries.

➔ What is more natural is to decide the boundary

Boundary based Classification Law

- Which is easier to establish a law? Supervised or unsupervised?
➔ Of course, supervised. Let's start from classification dataset.

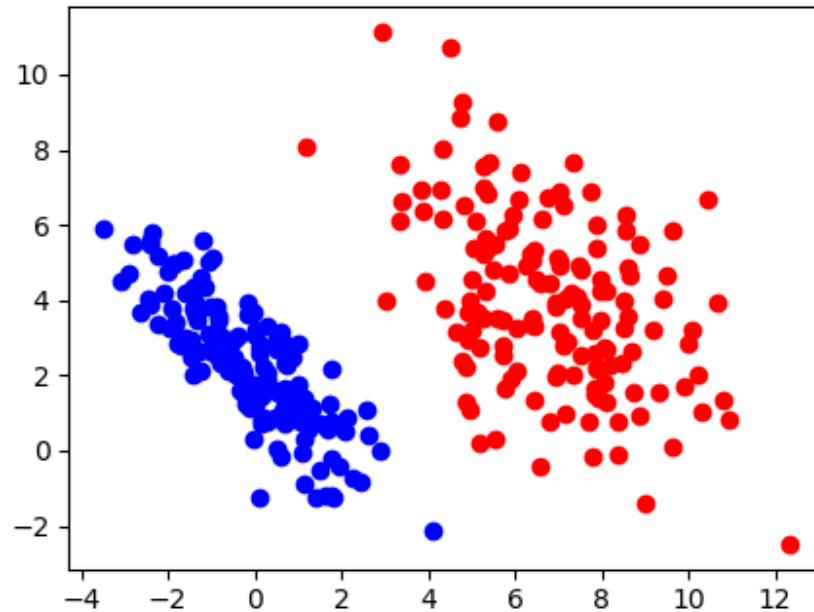


How can you establish a boundary
systematically?

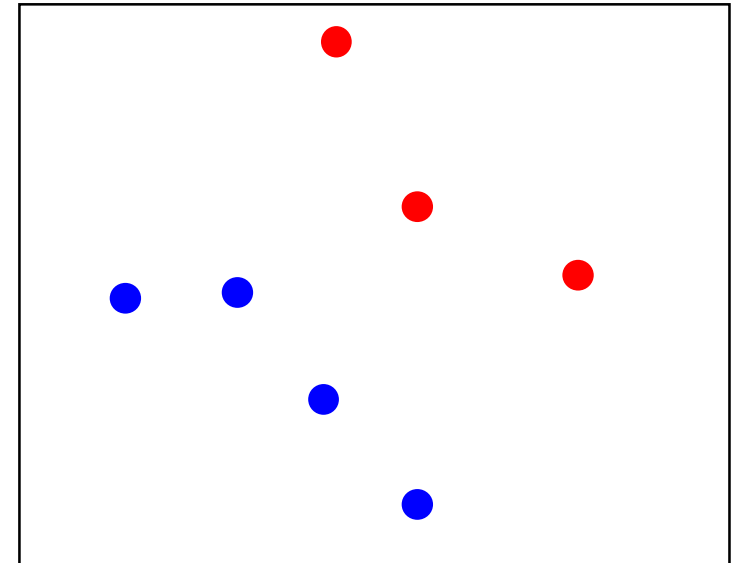
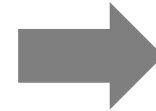
How Can We Determine a Boundary?

- What aspects should we consider?
- What would be the best boundary?

- ✓ Line boundary
- ✓ Start from your natural thought
- ✓ Rethink the reason for your choice!
- ✓ What is criterion?
- ✓ Criterion for **Position & Direction**

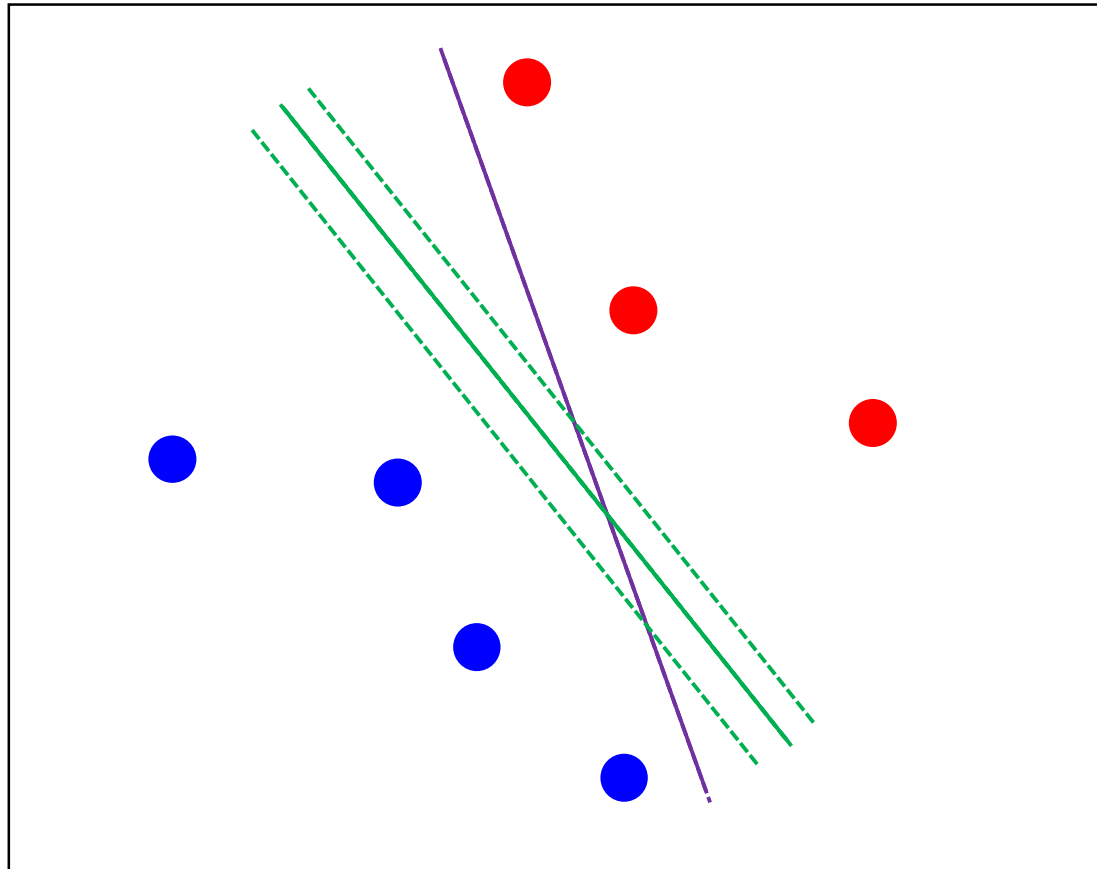


Focus!



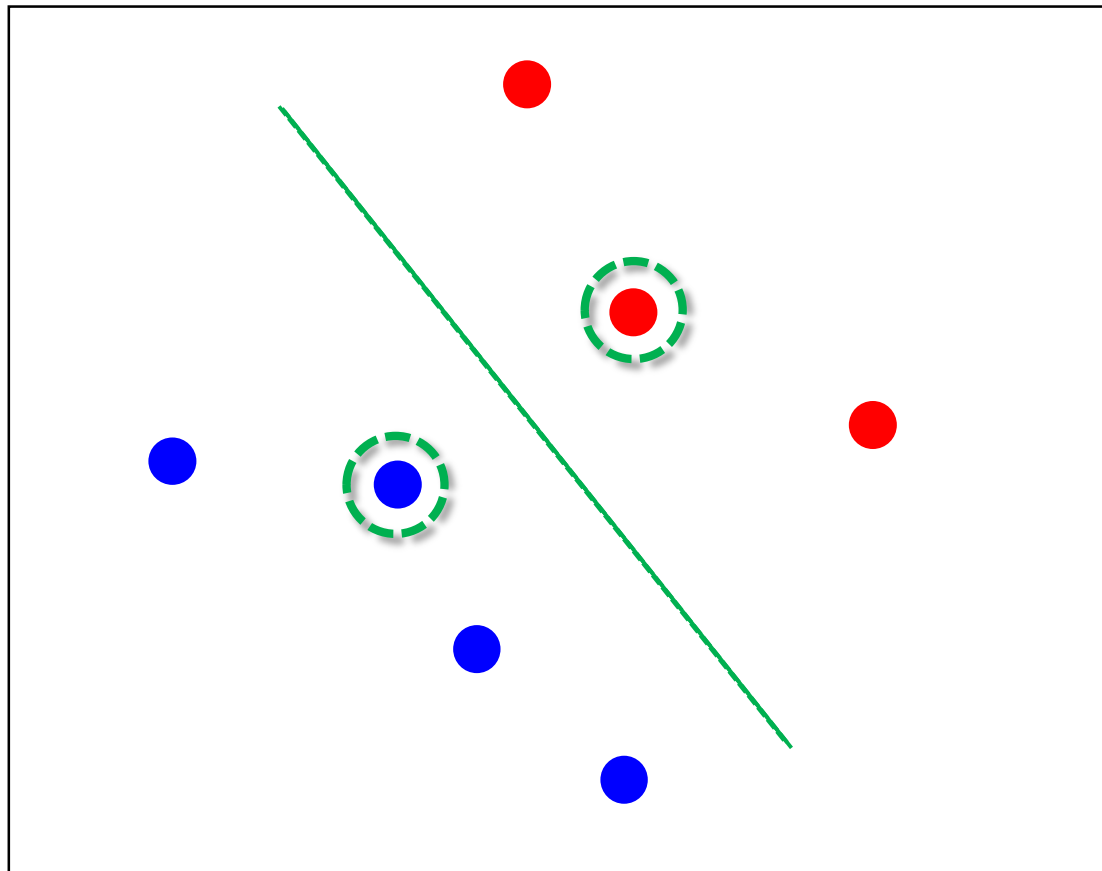
Approach Specifically & Systematically!

- 1) Given direction criterion, which position criterion? → **Center!**
- 2) Given position criterion, which direction criterion? → **Maximizing Margin!**



Then Only We Should Determine is...

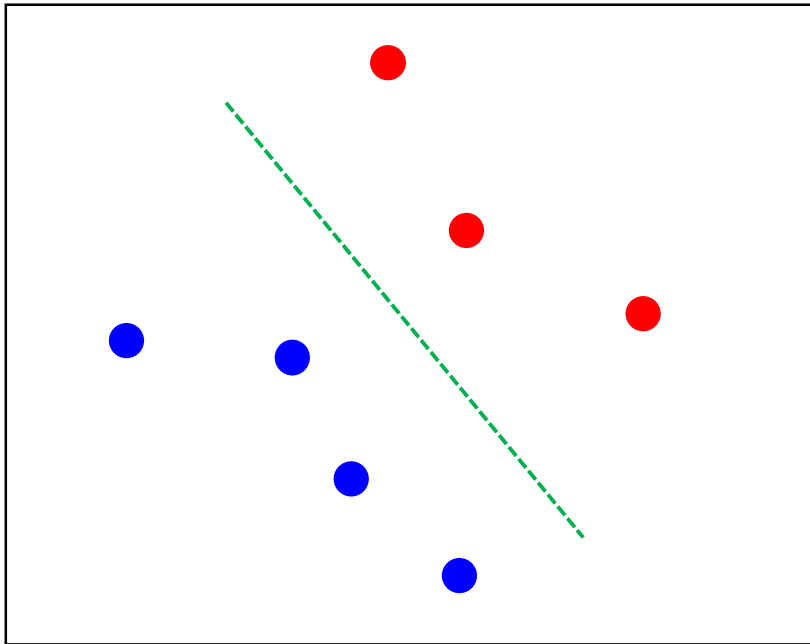
- The two points (=vectors) that **support** the boundary



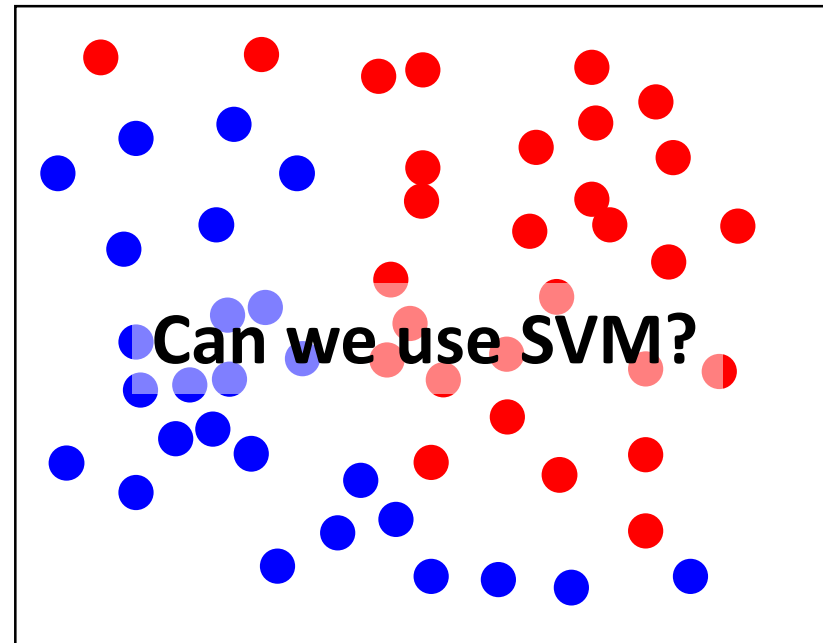
**Support
Vector
Machine
(SVM)**

Naturally, We Select Linear Boundary

- Why?



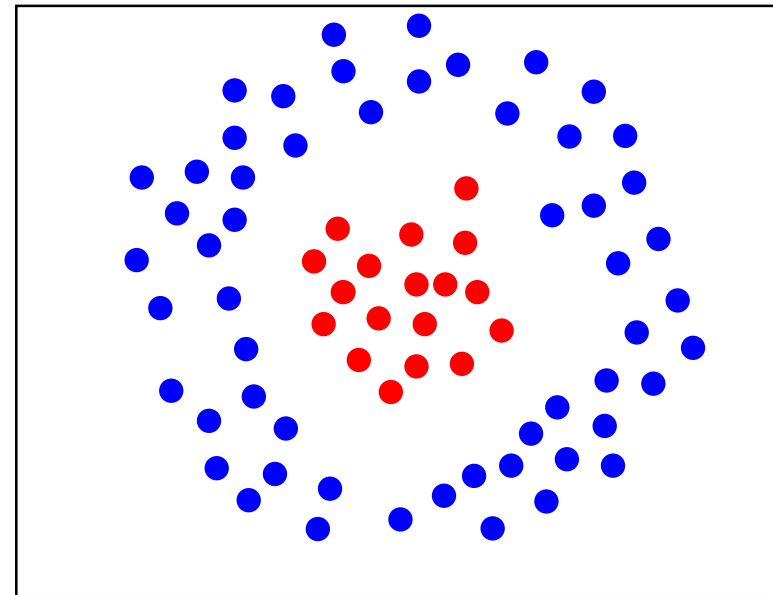
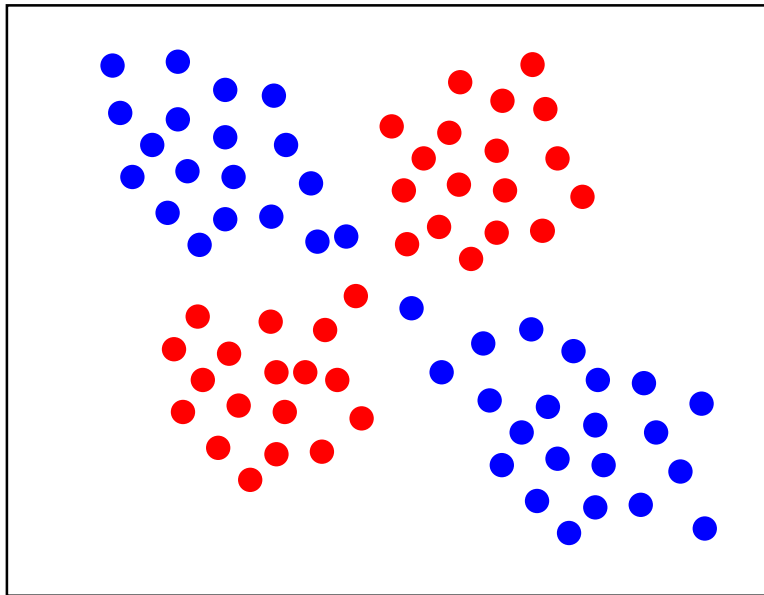
But how about this?



How About This?

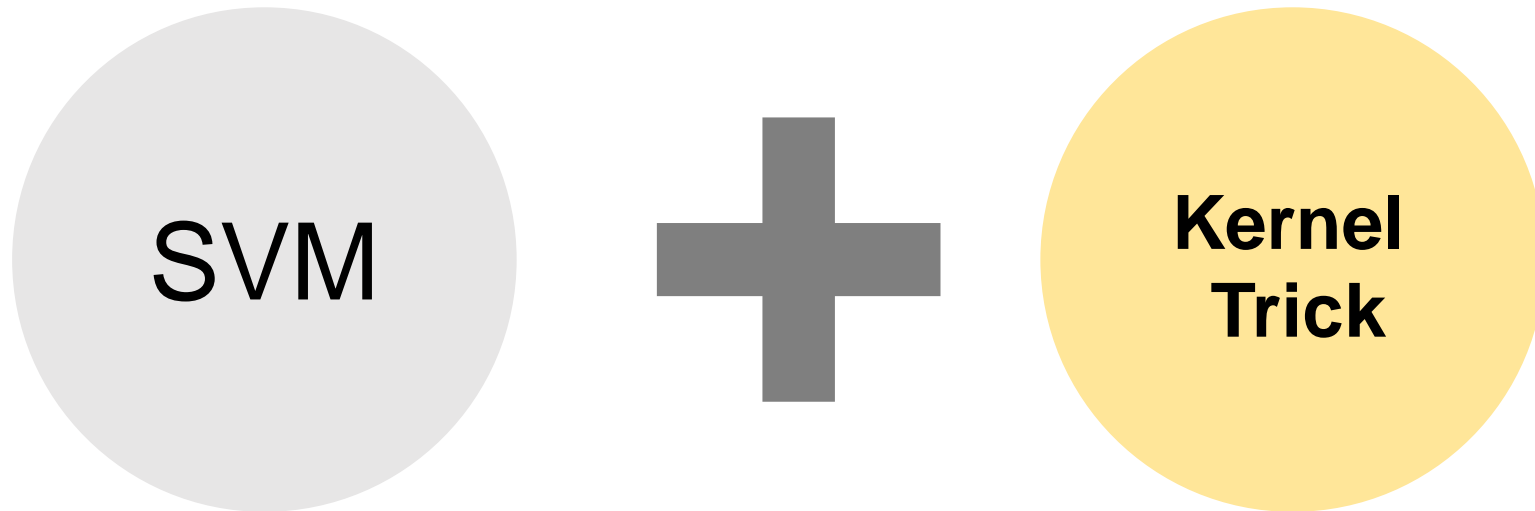
Using $\vec{w} \cdot \vec{x}$

- Should we give up the strength of linear boundary in SVM?
- ➔ Not only that! We can't use the systematic procedure for SVM we developed so hard..



Can We Upgrade SVM?

- If we only can use SVM for linear separable data, SVM would be almost nothing.



→ Applicable for linearly inseparable data!

Then, What Do We Learn to Understand Support Vector Machine?

- 0) Some Backgrounds!
 - ✓ Kernel Trick itself
 - ✓ Lagrange multiplier for optimization (Math backgrounds)
- 1) How to **mathematically/systematically** develop the **classification model** for linearly separable data
- 2) How to upgrade SVM to enable classify linearly inseparable data? How to apply kernel trick for SVM?
- 3) Python coding for SVM + kernel trick