NCKU Programming Contest Training Course
Computational Geometry
2017/05/31

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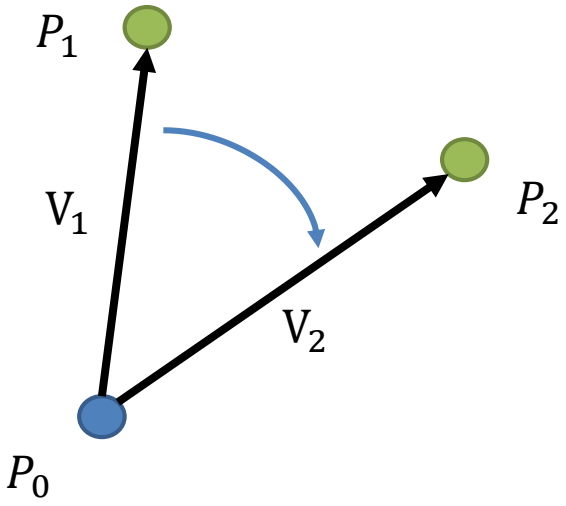
Line intersection

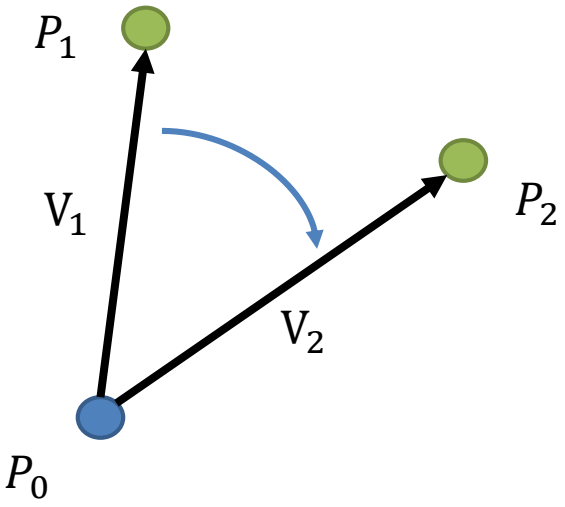
- The vector V_2 is clockwise/counterclockwise from V_1 ?



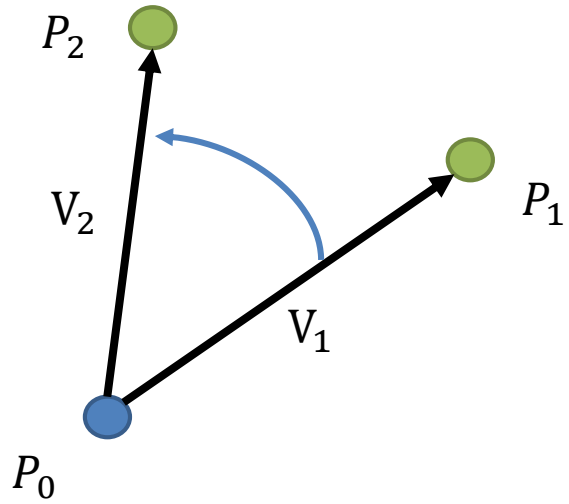
Line intersection

- Cross Product :

$$V_1 \times V_2 = \det\begin{vmatrix} x_1 & x_2 \\ y_1 & y_2 \end{vmatrix} = x_1 y_2 - x_2 y_1 = |V_1||V_2| sin\theta$$



$V_1 \times V_2 < 0$

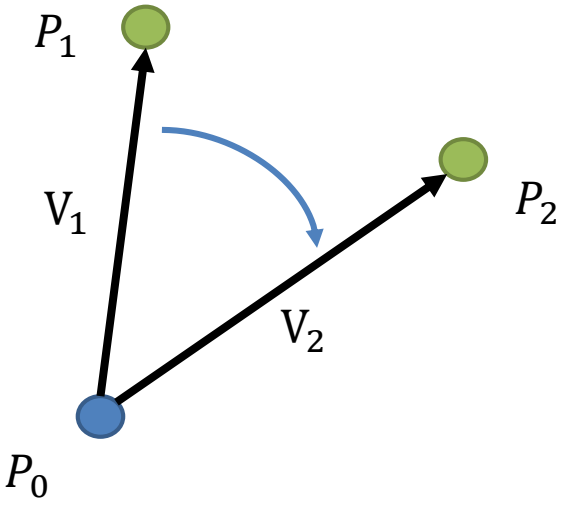


$V_1 \times V_2 > 0$

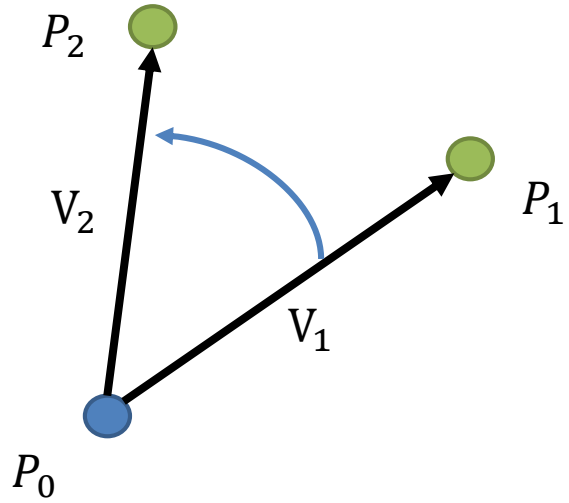
Line intersection

- Cross Product :

$$V_1 \times V_2 = (P_1 - P_0) \times (P_2 - P_0) = (x_1 - x_0)(y_2 - y_0) - (x_2 - x_0)(y_1 - y_0)$$



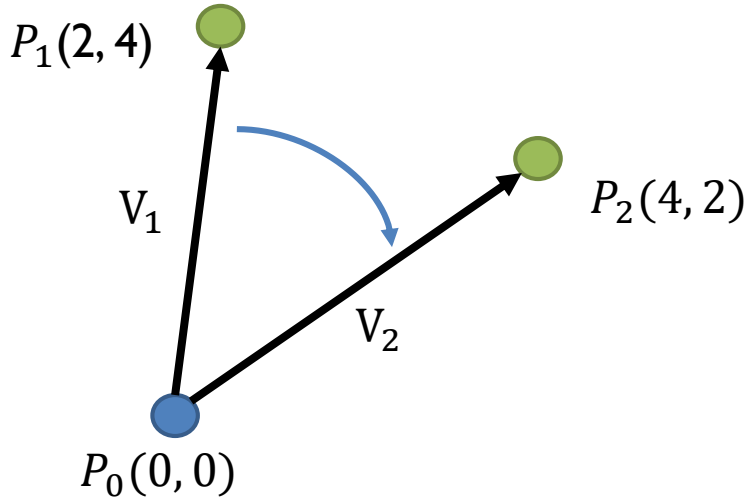
$V_1 \times V_2 < 0$



$V_1 \times V_2 > 0$

Line intersection

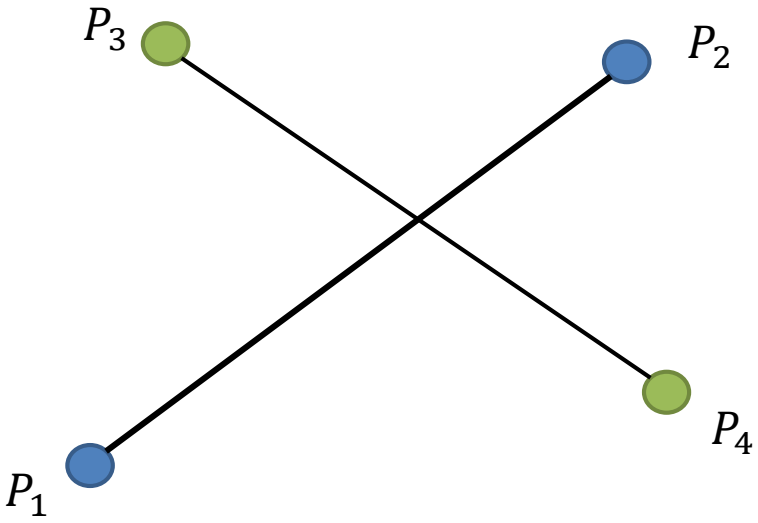
- Cross Product :



$$V_1 \times V_2 = (P_1 - P_0) \times (P_2 - P_0) = (2-0)(2-0) - (4-0)(4-0) = -12$$

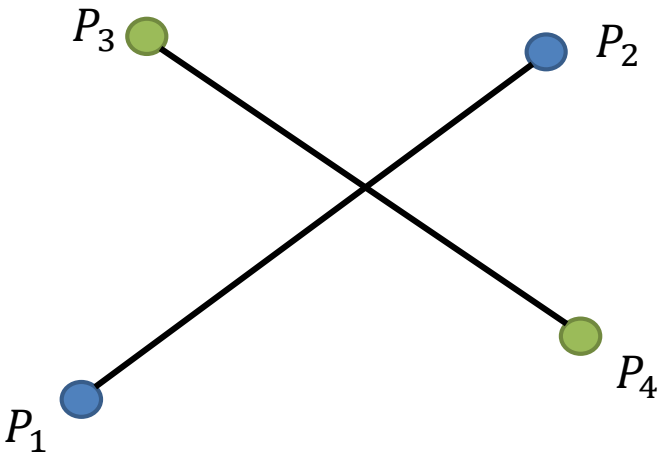
Line intersection

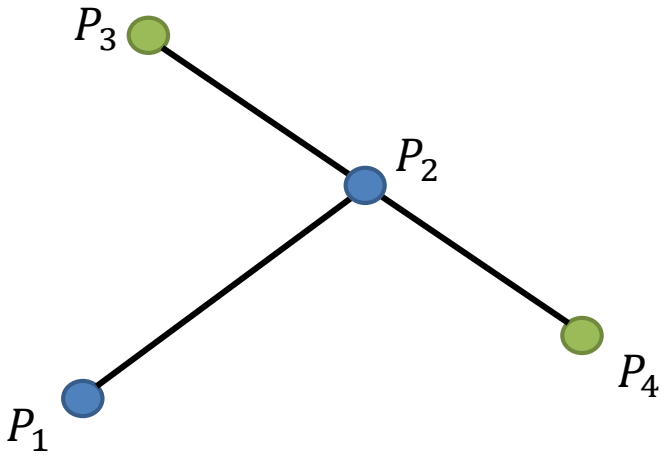
- Line intersection problem



Line intersection

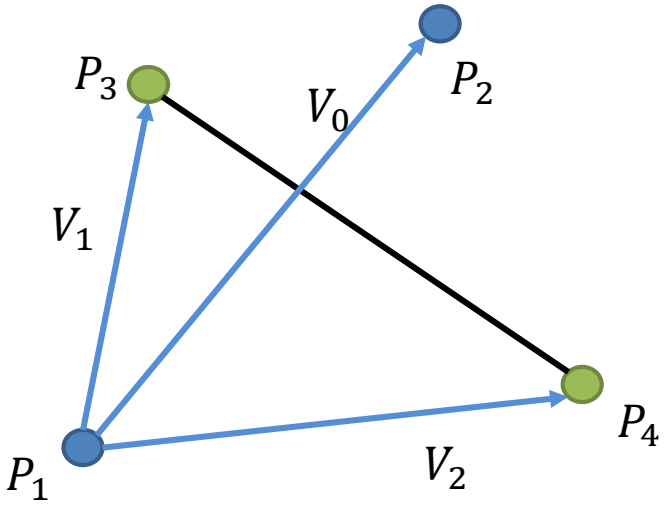
- Two situation





Line intersection

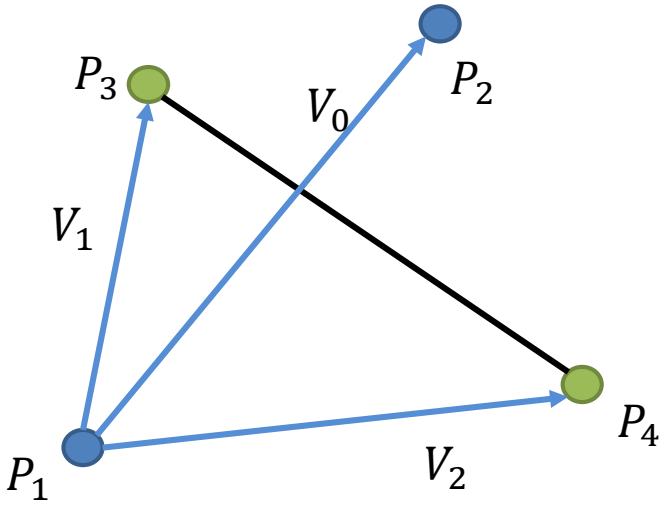
- Cross Product :



$$(V_0 \times V_1) \cdot (V_0 \times V_2) = ?$$

Line intersection

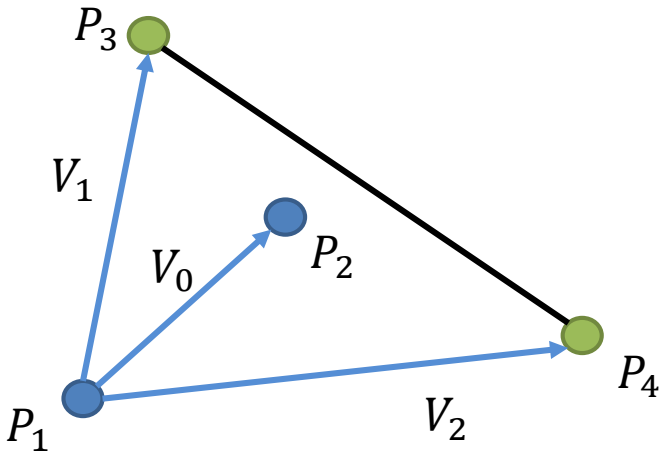
- Cross Product :



$$(V_0 \times V_1) \cdot (V_0 \times V_2) < 0$$

Line intersection

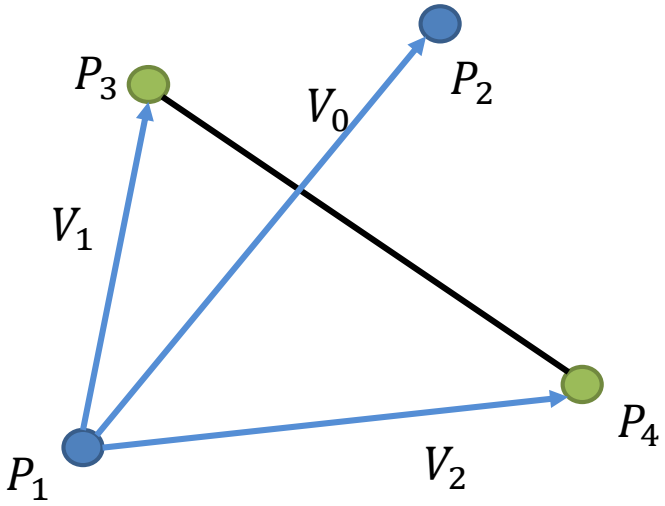
- Cross Product :



$$(V_0 \times V_1) \cdot (V_0 \times V_2) < 0$$

Line intersection

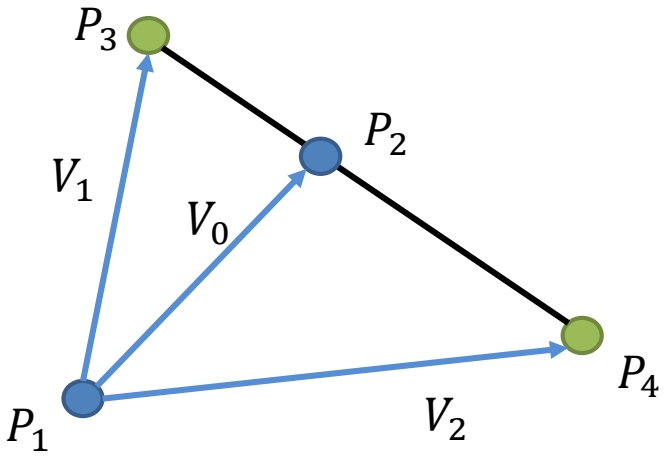
- Cross Product :



$$((P_2 - P_1) \times (P_3 - P_1)) \cdot ((P_2 - P_1) \times (P_4 - P_1)) < 0 \;\&\&\; ((P_4 - P_3) \times (P_1 - P_3)) \cdot ((P_4 - P_3) \times (P_2 - P_3)) < 0$$

Line intersection

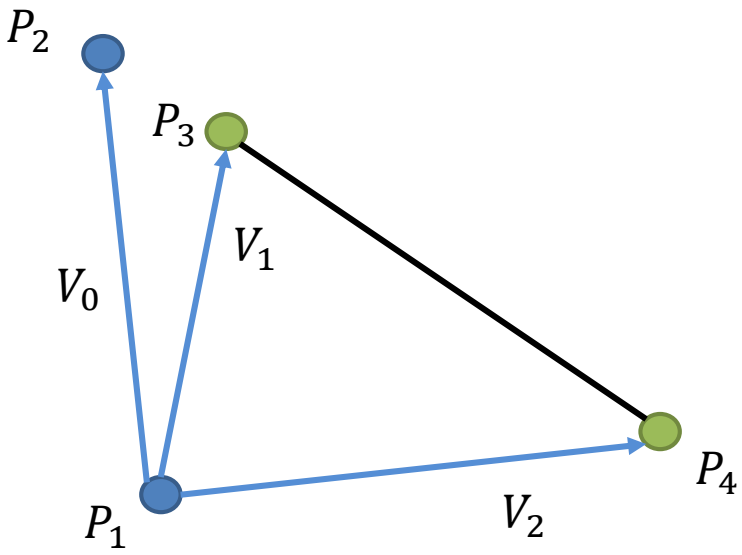
- Cross Product :



$$(P_4 - P_3) \times (P_2 - P_3) = 0$$

Line intersection

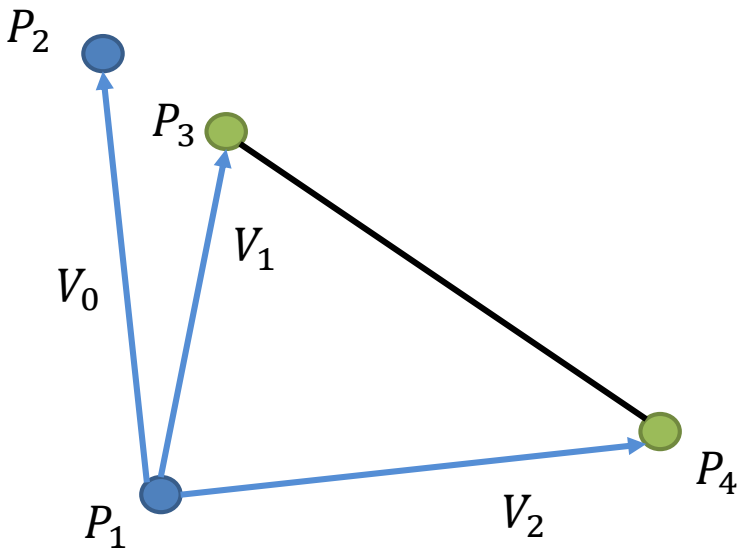
- Cross Product :



$$(P_4 - P_3) \times (P_2 - P_3) = 0$$

Line intersection

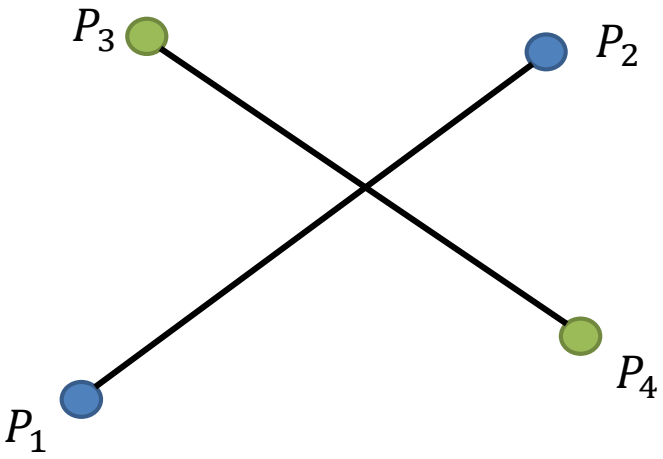
- Cross Product :

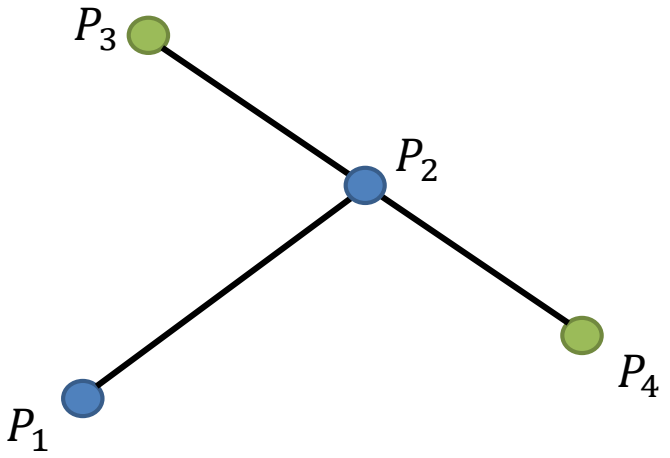


$$\min(x_3, x_4) \leq x_2 \leq \max(x_3, x_4) \;\&\&\; \min(y_3, y_4) \leq y_2 \leq \max(y_3, y_4)$$

Line intersection

- Two situation





Practice - 1

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UVa 191 - Intersection

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Convex Hull

- 中譯「凸包」或「凸殼」。在多維空間中有一群散佈各處的點，「凸包」是包覆這群點的所有外殼當中，表面積暨容積最小的一個外殼，而最小的外殼一定是凸的。
- 「凸」的定義是：圖形內任意兩點的連線不會經過圖形外部。「凸」並不是指表面呈弧狀隆起，事實上凸包是由許多平坦表面組成的。

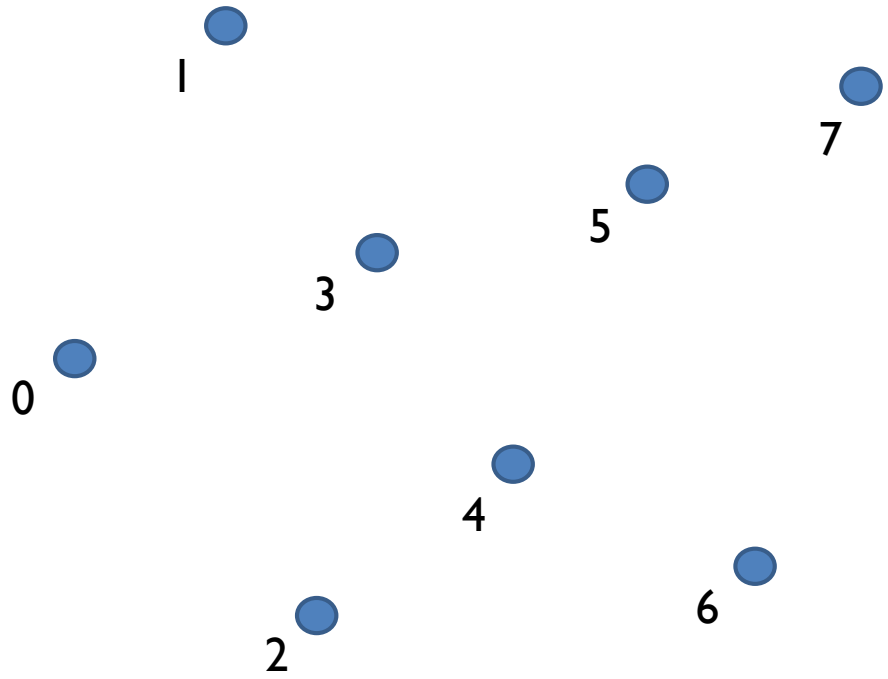
演算法筆記 – Convex Hull

Convex Hull

- Algorithm
  - Brute Force
  - Graham-Scan
  - Andrew's Monotone Chain

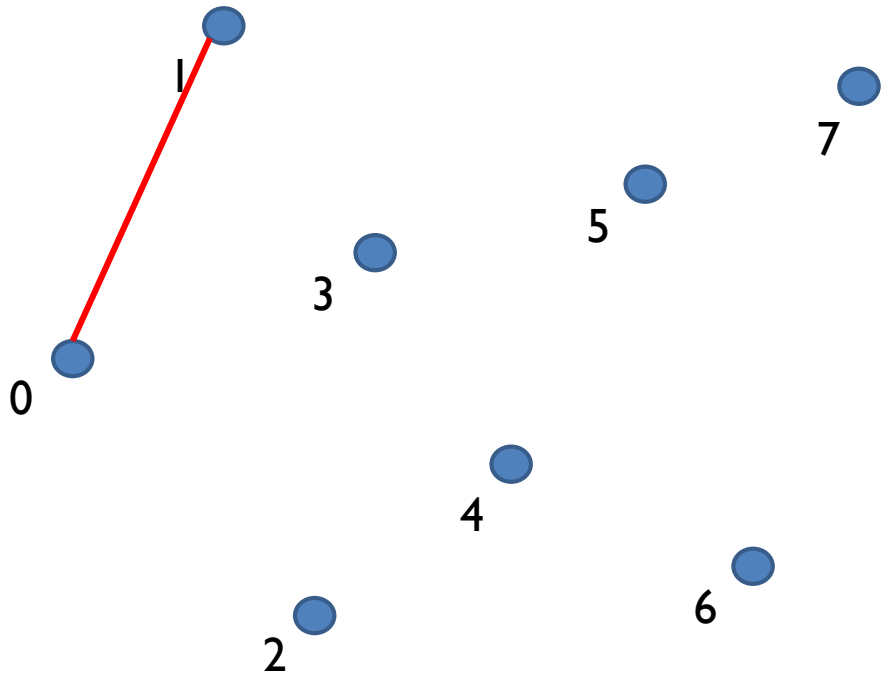
Andrew's Monotone Chain

- Step1 : Sort by x



Andrew's Monotone Chain

- Step2 : Connect points



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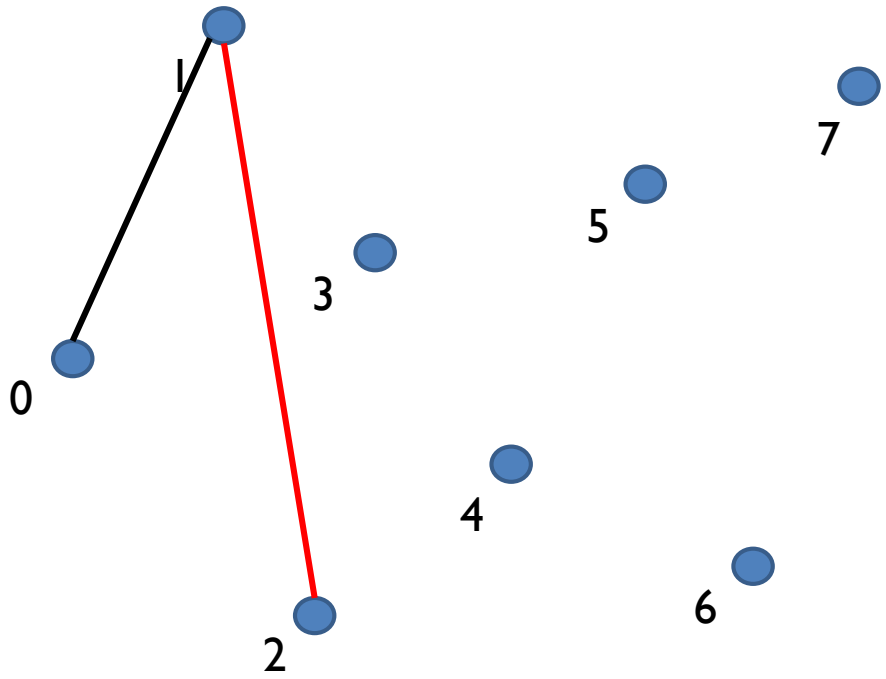
Andrew's Monotone Chain

- Step2 : Connect points



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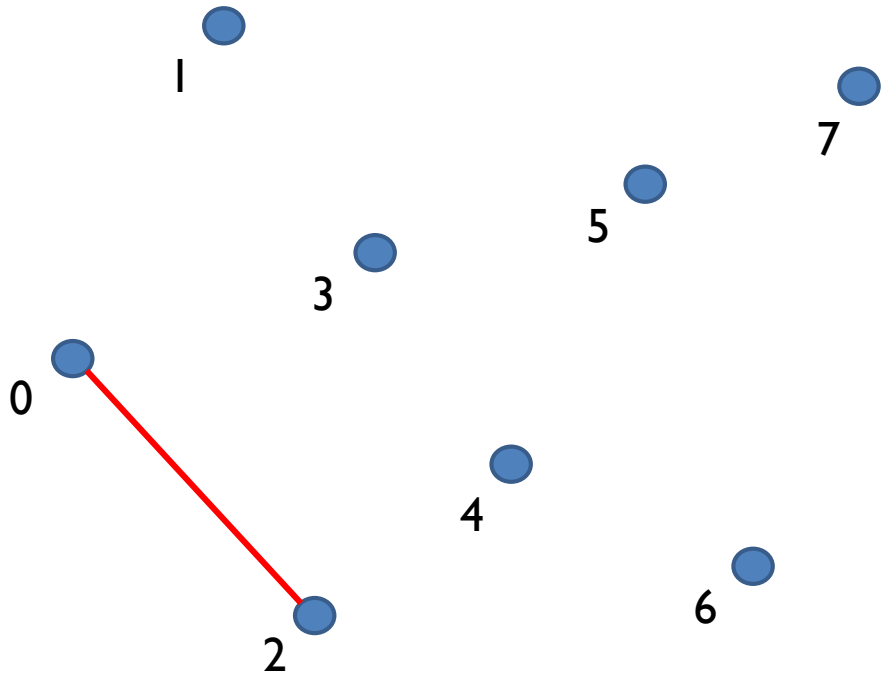
Andrew's Monotone Chain

- Step3 : Use cross product $V_{01} \times V_{02} < 0$



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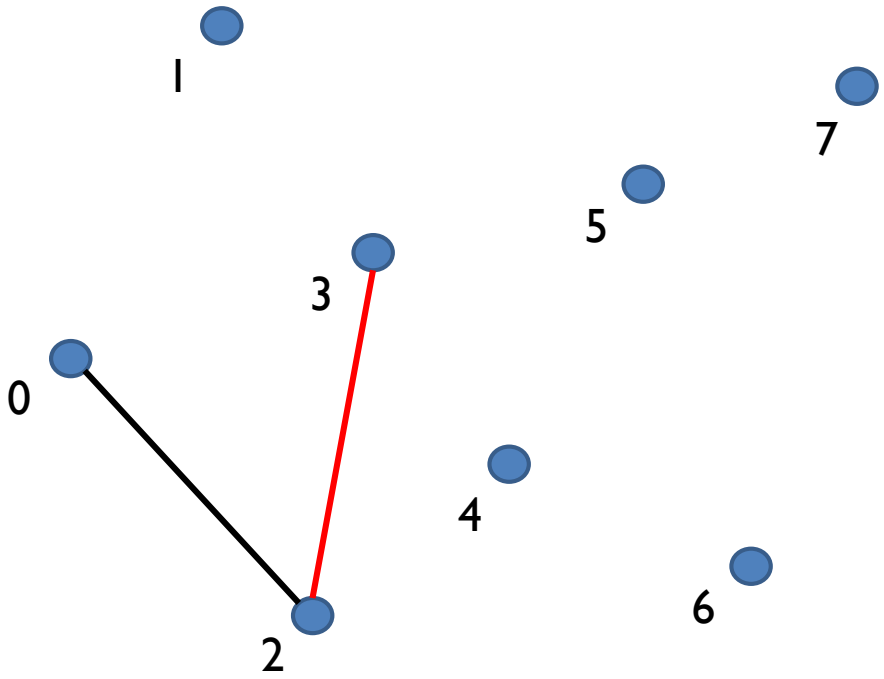
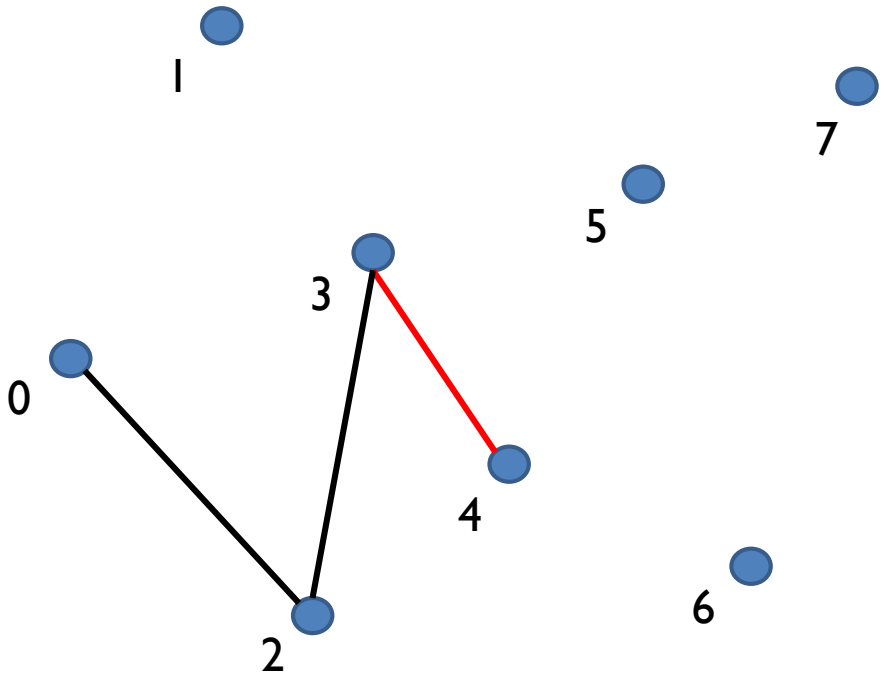
Andrew's Monotone Chain

- Step3 : Use cross product



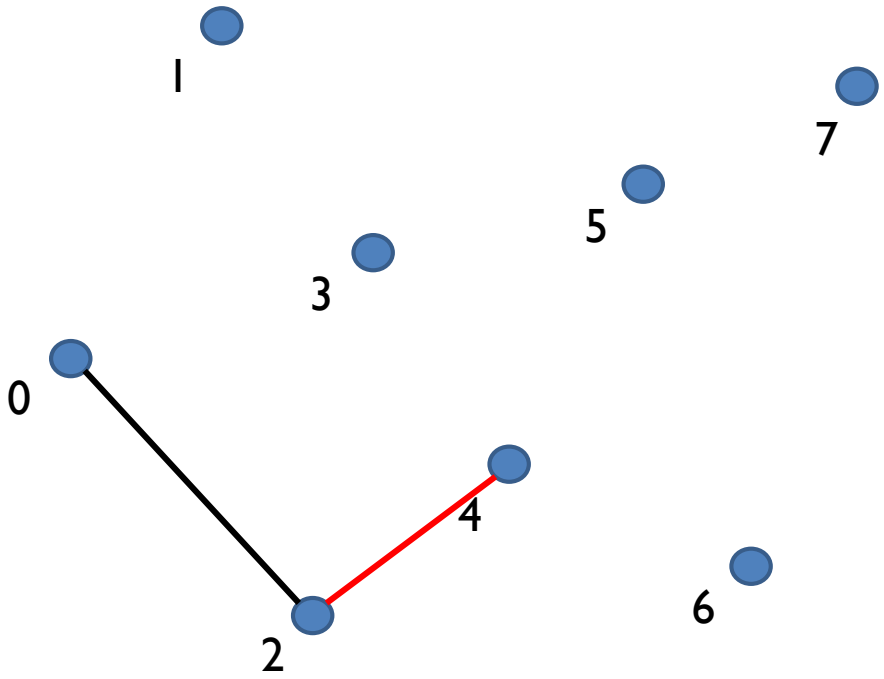
Andrew's Monotone Chain

- Step3 : Use cross product



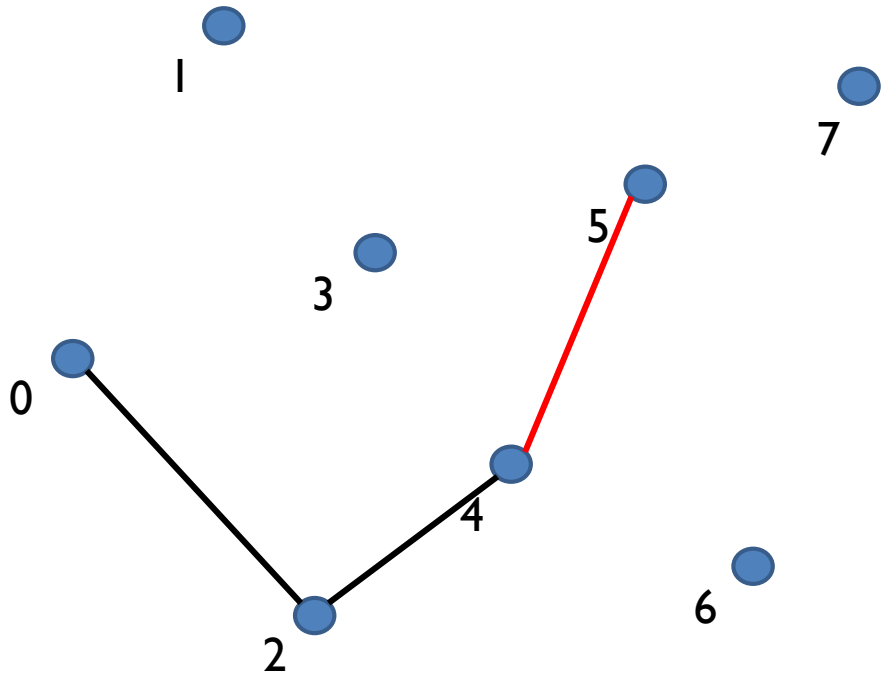
Andrew's Monotone Chain

- Step3 : Use cross product



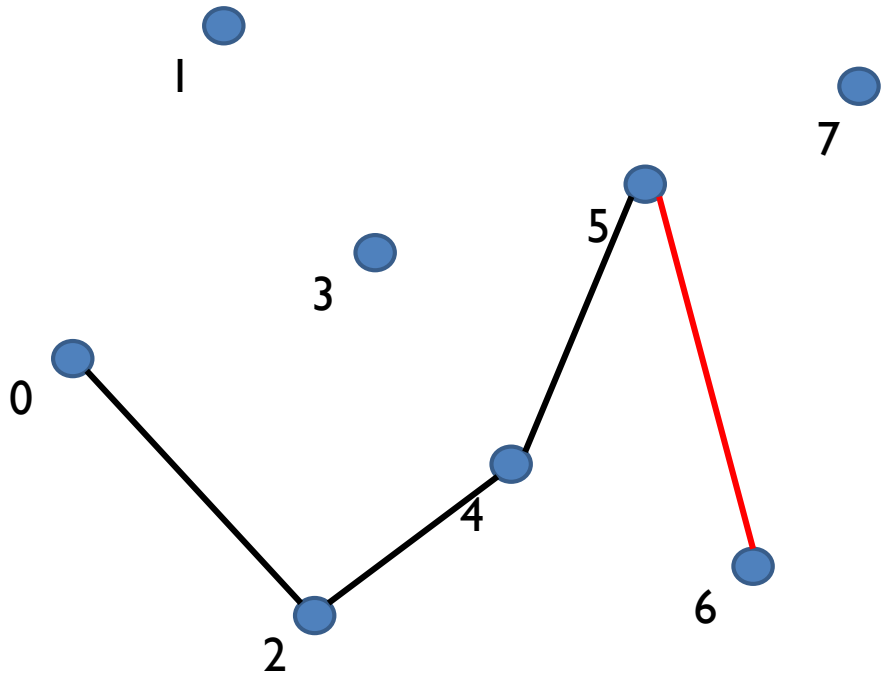
Andrew's Monotone Chain

- Step3 : Use cross product



Andrew's Monotone Chain

- Step3 : Use cross product



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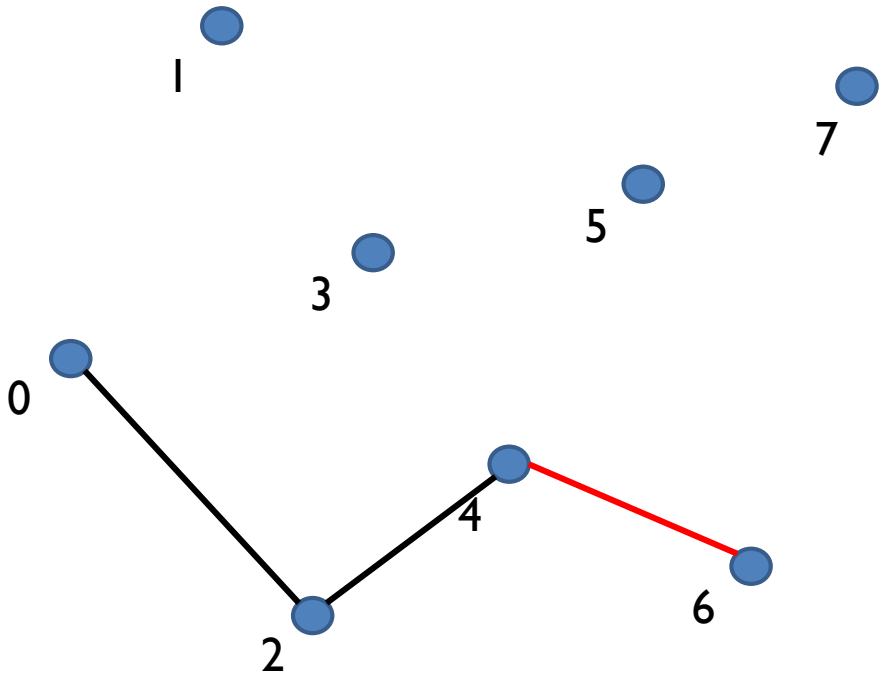
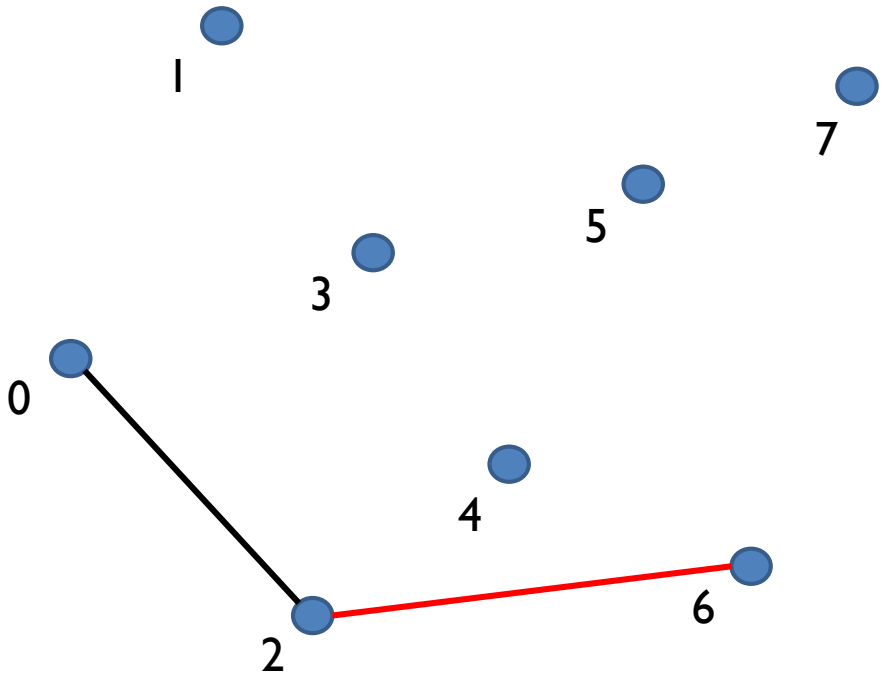
Andrew's Monotone Chain

- Step3 : Use cross product



Andrew's Monotone Chain

- Step3 : Use cross product



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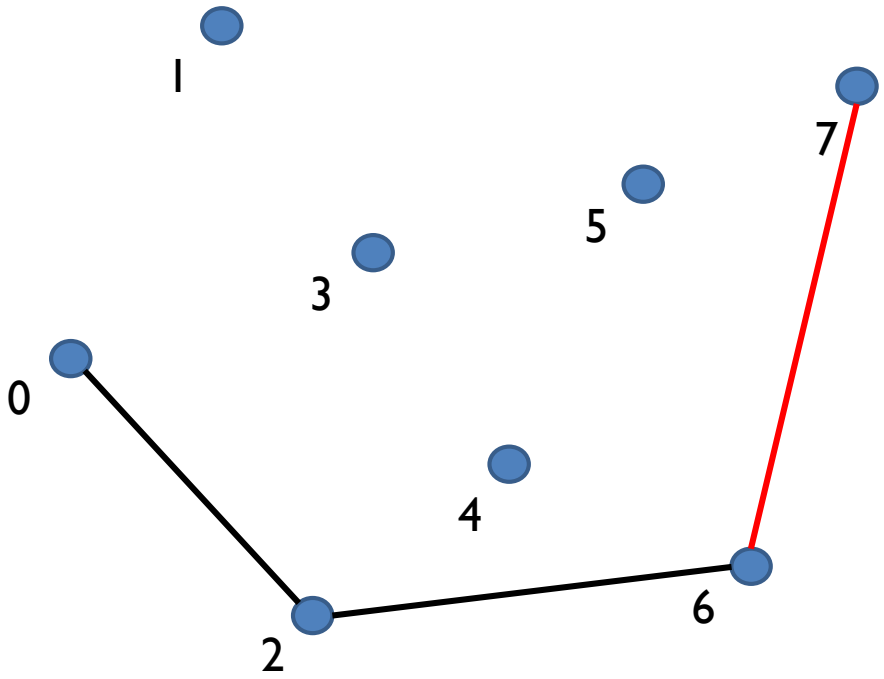
Andrew's Monotone Chain

- Step3 : Use cross product



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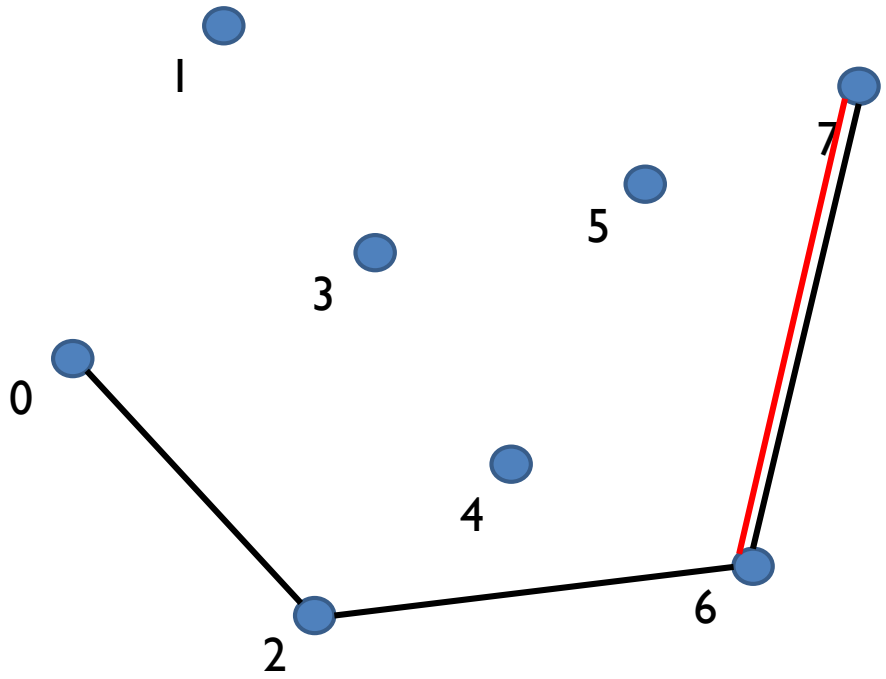
Andrew's Monotone Chain

- Step3 : Use cross product



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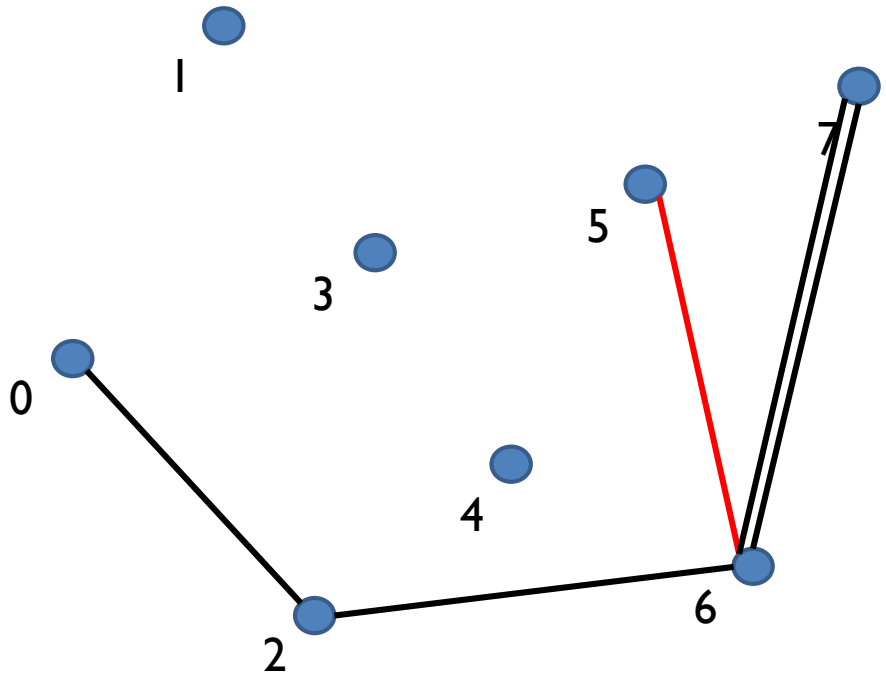
Andrew's Monotone Chain

- Step3 : Use cross product



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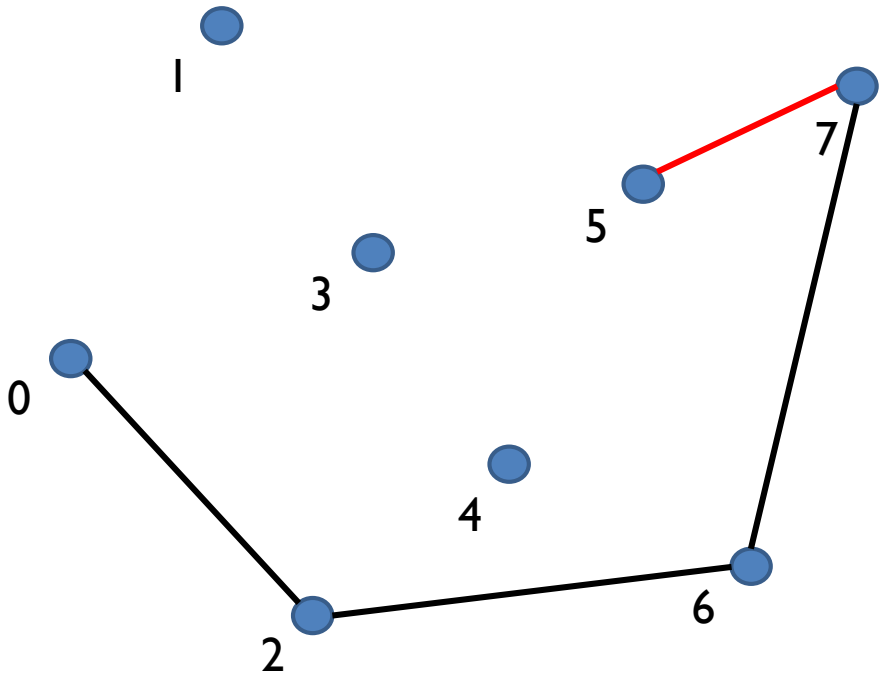
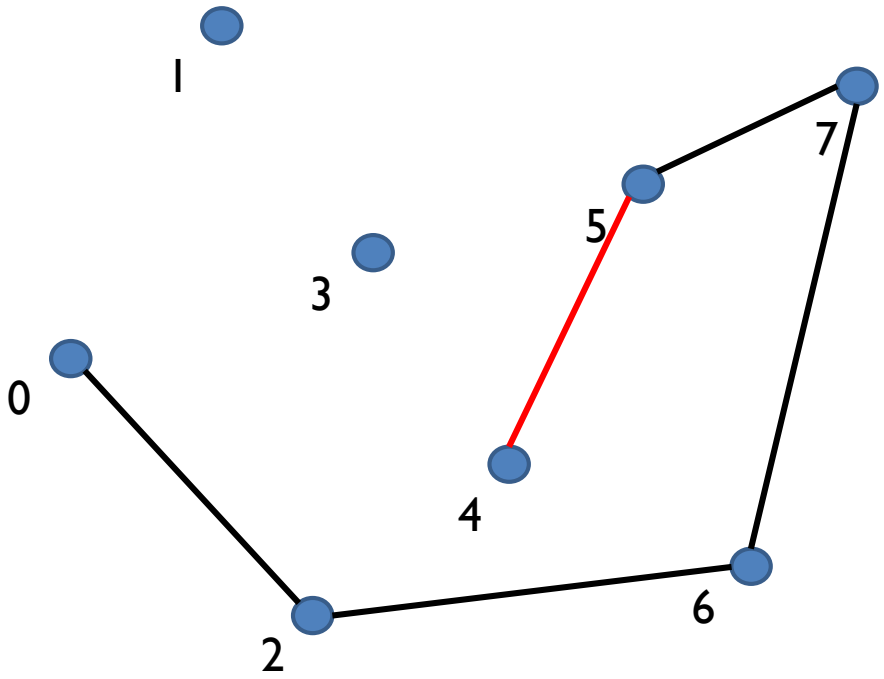
Andrew's Monotone Chain

- Step3 : Use cross product



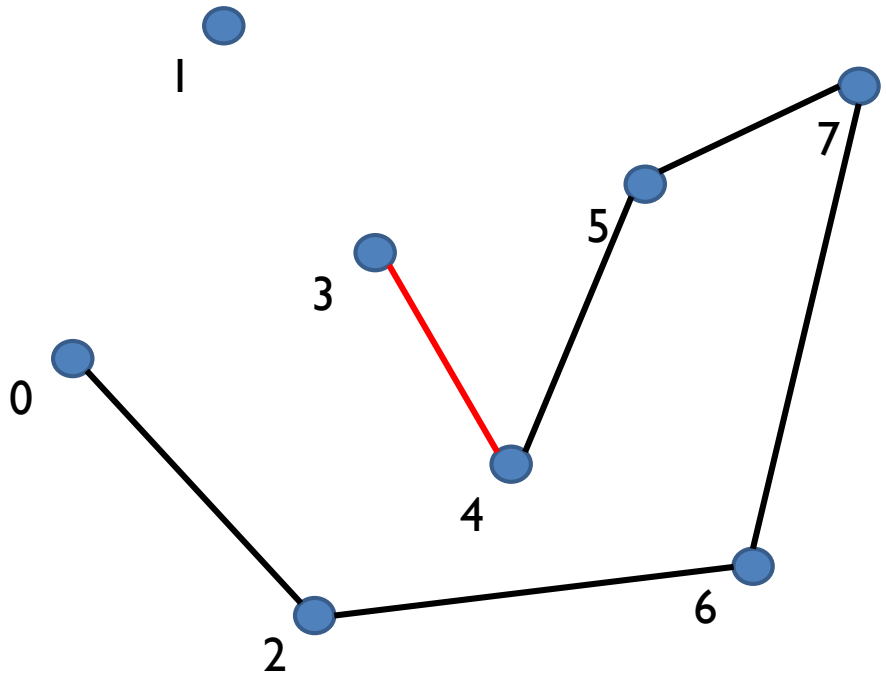
Andrew's Monotone Chain

- Step3 : Use cross product



Andrew's Monotone Chain

- Step3 : Use cross product



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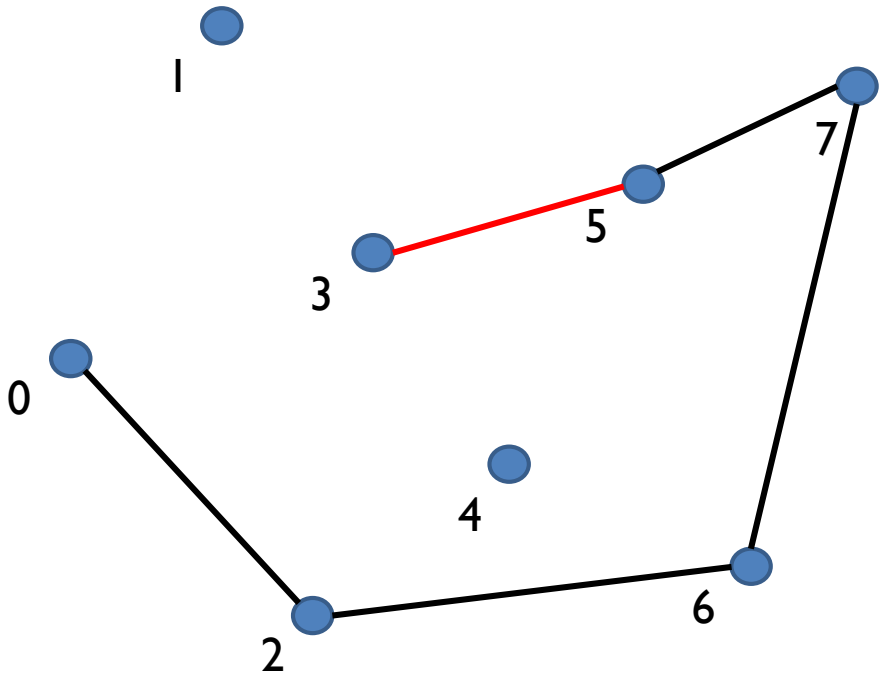
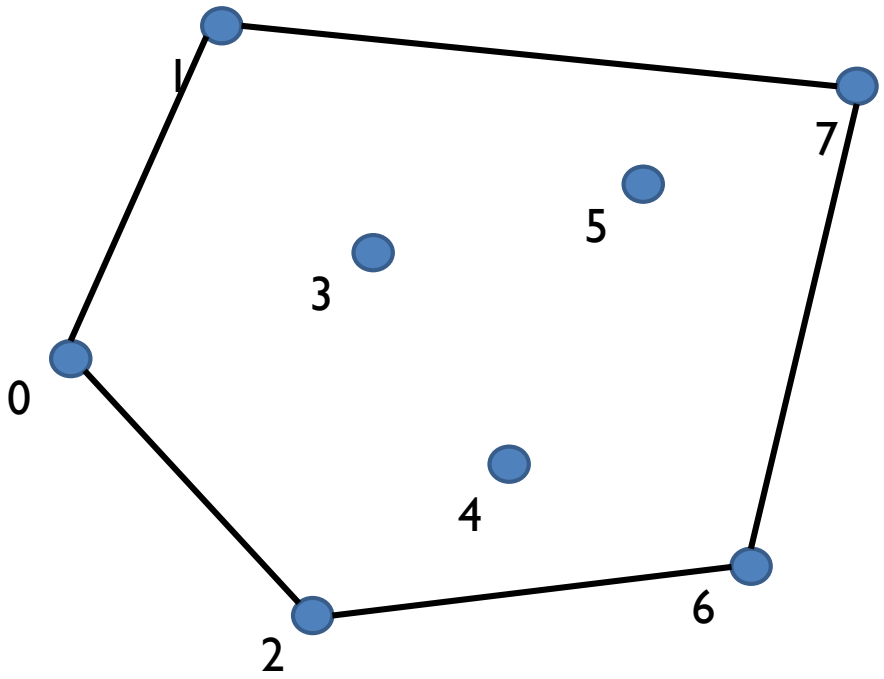
Andrew's Monotone Chain

- Step3 : Use cross product



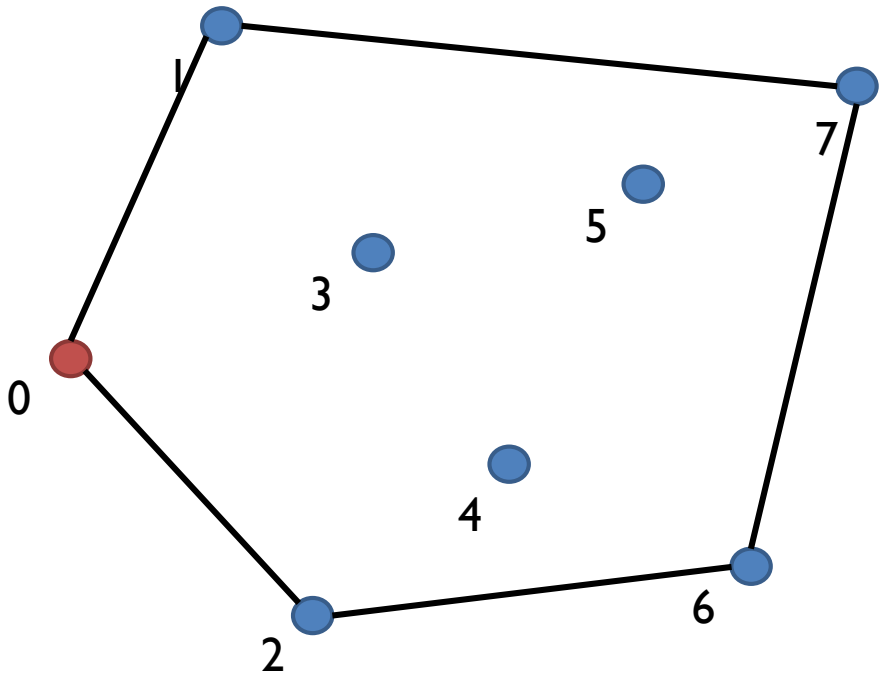
Andrew's Monotone Chain

- Step3 : Use cross product



Andrew's Monotone Chain

- Step4 : Delete starting point



Practice - 1

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UVa 218 - Moth Eradication

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Problem List

- UVa
  - 191, 273, 378, 754, 866, 10902, 109, 132, 218, 361, 596, 675, 681, 811, 10002, 10065, 10078, 10135, 10173, 10256, 11168, 11626

- 門檻：5題
- 第二次修課同學，請從紅字中挑選5題來完成門檻