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

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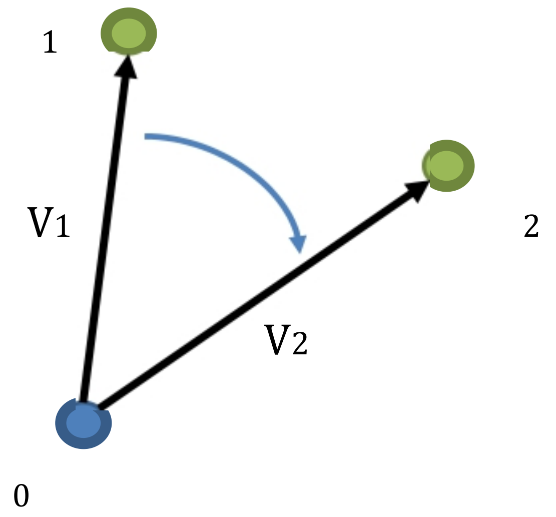
Line intersection

- The vector V_2 is clockwise/counterclockwise from V_1 ?



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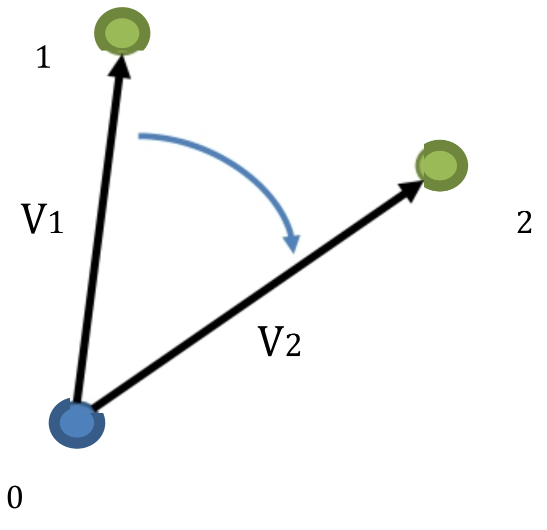
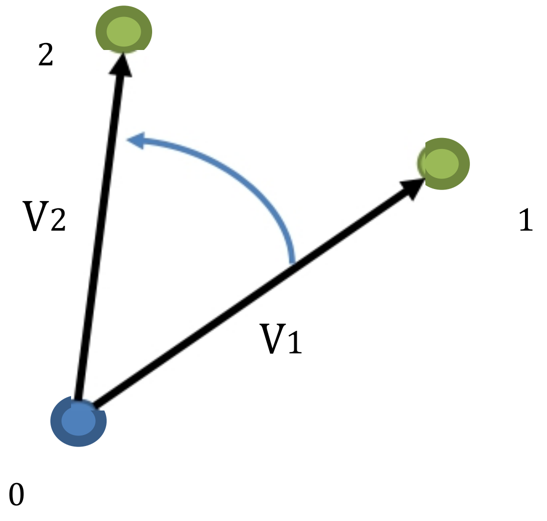
Line intersection

- Cross Product :

$$_1 \times {}_2 = \det\begin{vmatrix} {}_1 & {}_2 \\ {}_1 & {}_2 \end{vmatrix} = {}_1\ {}_2 - {}_2\ {}_1 = \lVert {}_1 \rVert \lVert {}_2 \rVert$$



$_1 \times {}_2 < 0$



$_1 \times {}_2 > 0$

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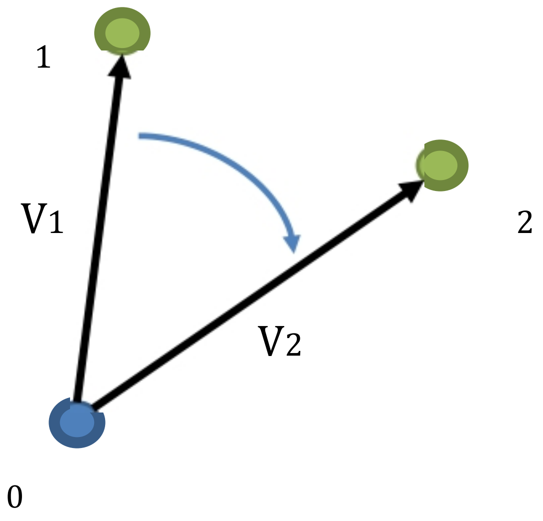
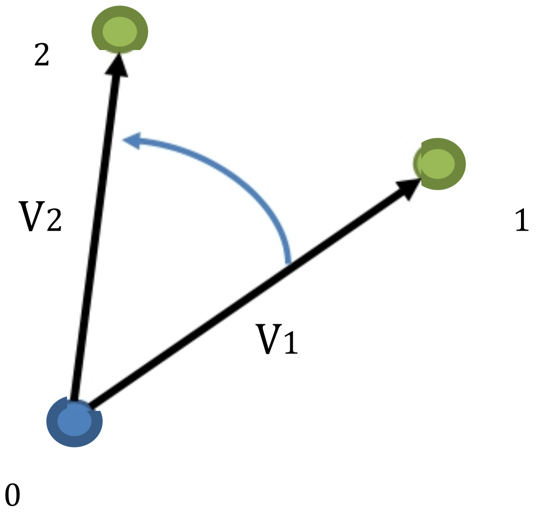
Line intersection

- Cross Product :

$$1 \times 2 = (1 - 0) \times (2 - 0) = (1 - 0)(2 - 0) - (2 - 0)(1 - 0)$$



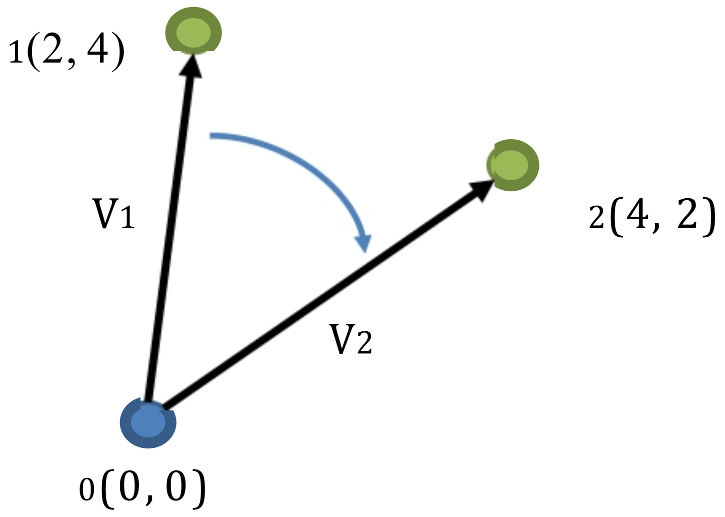
$1 \times 2 < 0$



$1 \times 2 > 0$

Line intersection

- Cross Product :



$$1 \times \quad 2 = (\ 1 - \ 0) \times (\ 2 - \ 0) = (2 - 0)(2 - 0) - (4 - 0)(4 - 0) = -12$$

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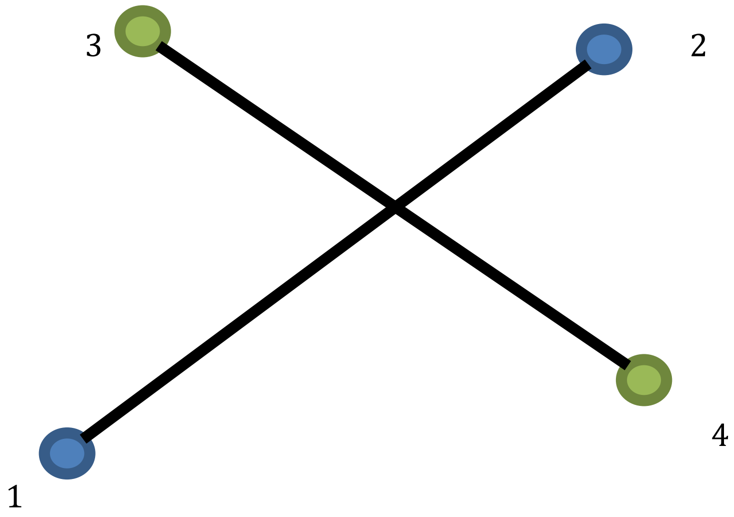
Line intersection

- Line intersection problem



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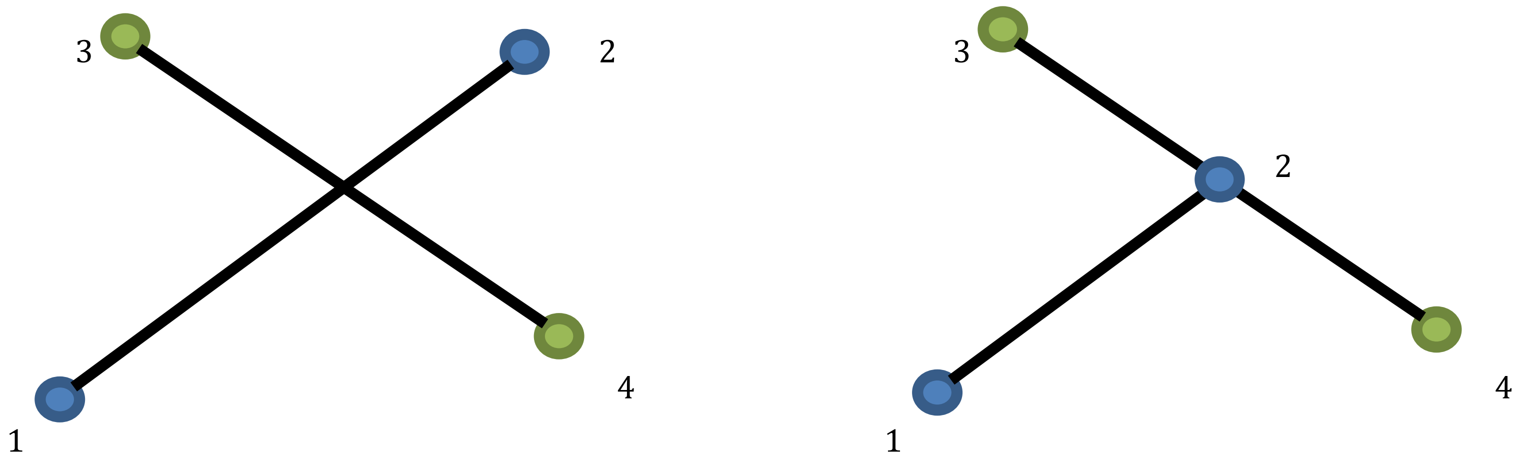
Line intersection

- Two situation



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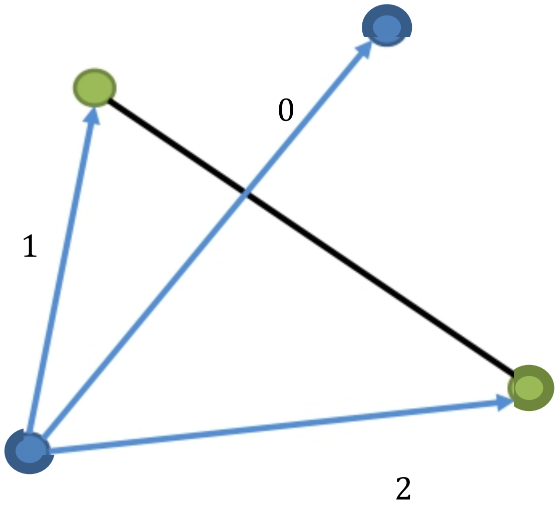
Line intersection

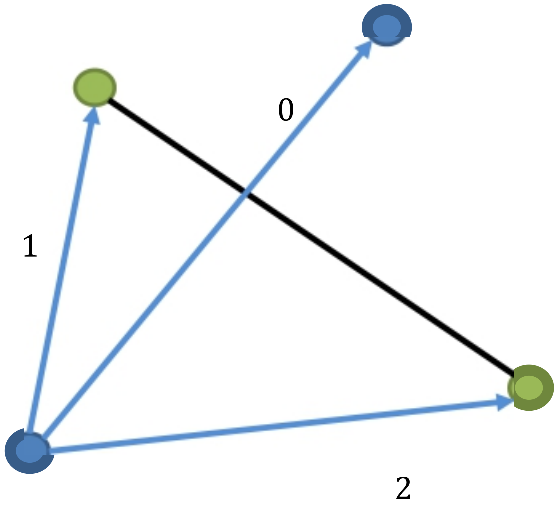
- Cross Product :



$$(0 \times 1) \cdot (0 \times 2) = ?$$

Line intersection

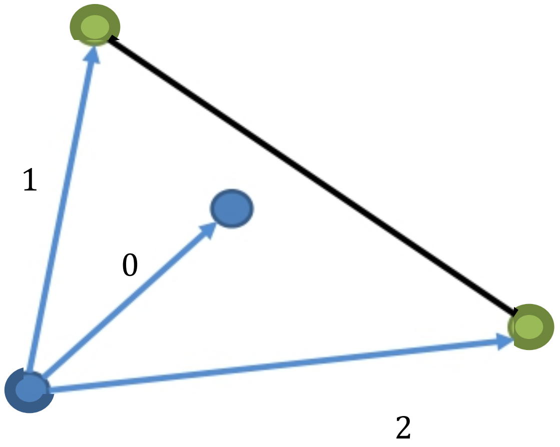
- Cross Product :



$$({}_{0} \times {}_{1}) \cdot ({}_{0} \times {}_{2}) < 0$$

Line intersection

- Cross Product :



$$({}_0 \times {}_1) \cdot ({}_0 \times {}_2) < 0$$

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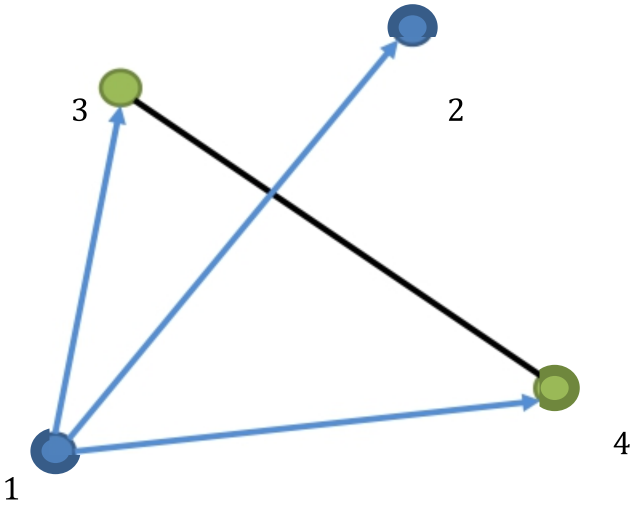
Line intersection

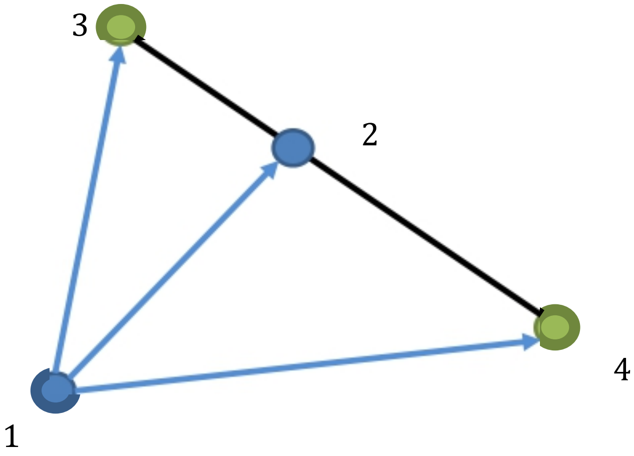
- Cross Product :



$((2-1)\times(3-1))\cdot((2-1)\times(4-1))<0\ \&\&((4-3)\times(1-3))\cdot((4-3)\times(2-3))<0$

Line intersection

- Cross Product :



$$(4-3)\times(2-3)=0$$

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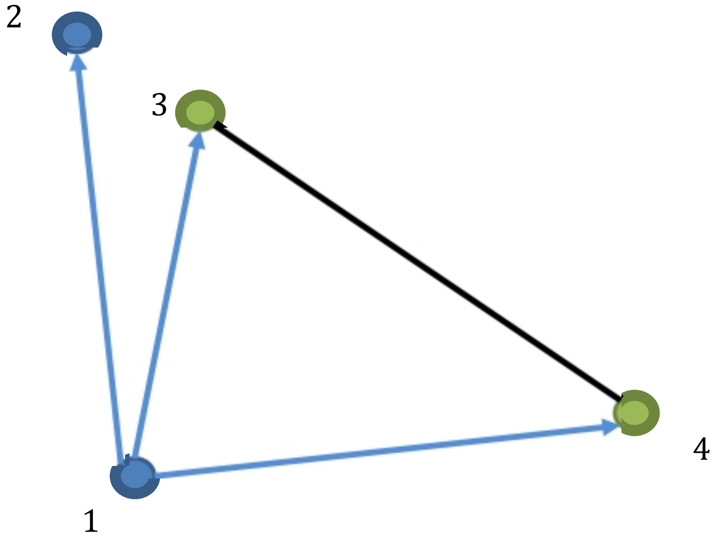
Line intersection

- Cross Product :



$$(4 - 3) \times (2 - 3) = 0$$

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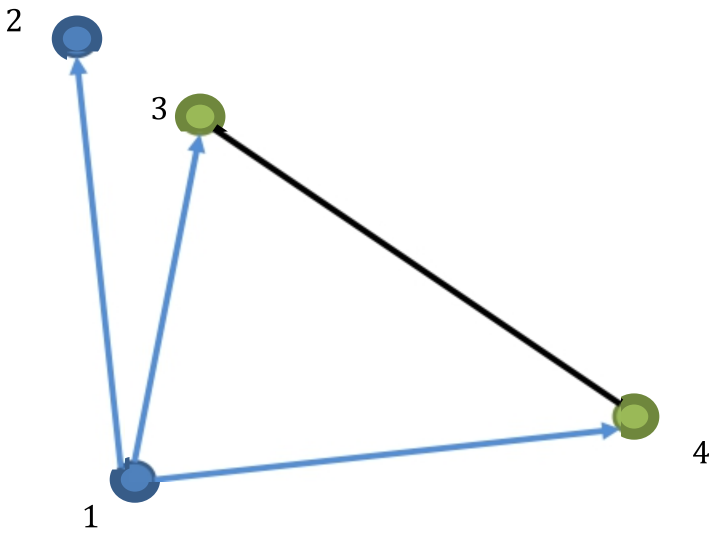
Line intersection

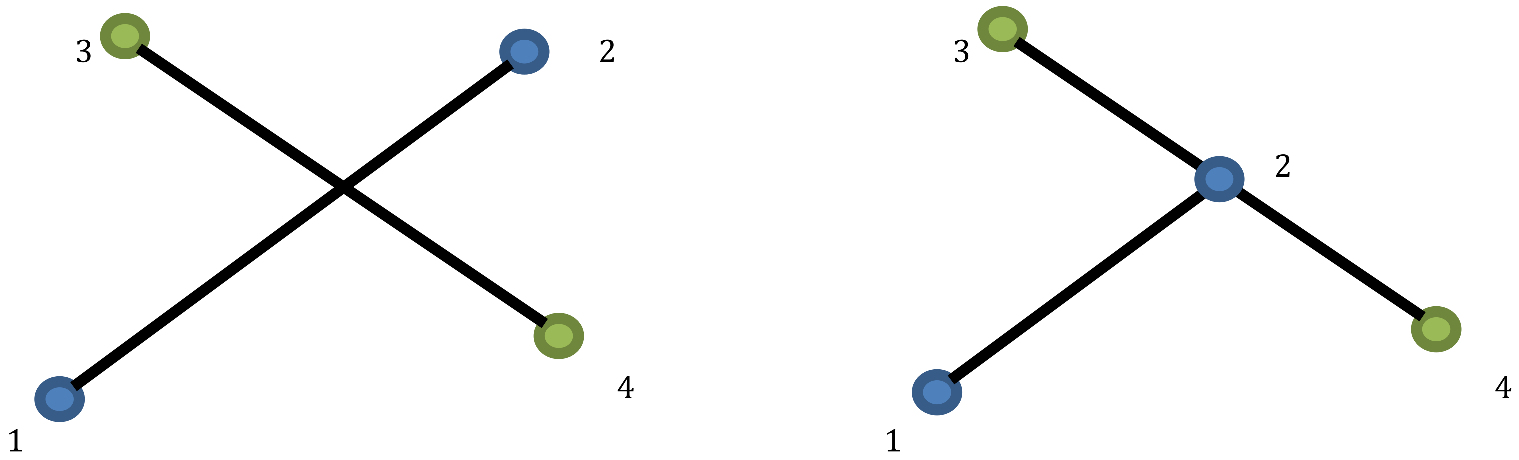
- Cross Product :



xmin(3, 4) ≤ x2 ≤ xmax(3,4) && ymin(3, 4) ≤ y2 ≤ ymax(3,4)

Line intersection

- Two situation



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Practice - 1

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。

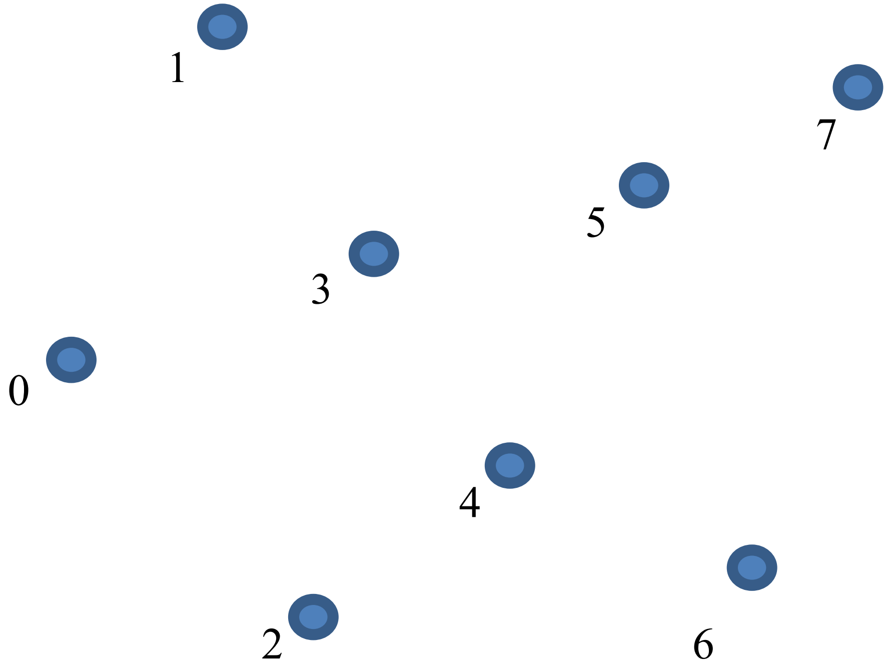
演算法筆記 – Convex Hull

Convex Hull

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

Andrew’s Monotone Chain

- Step1 : Sort by x



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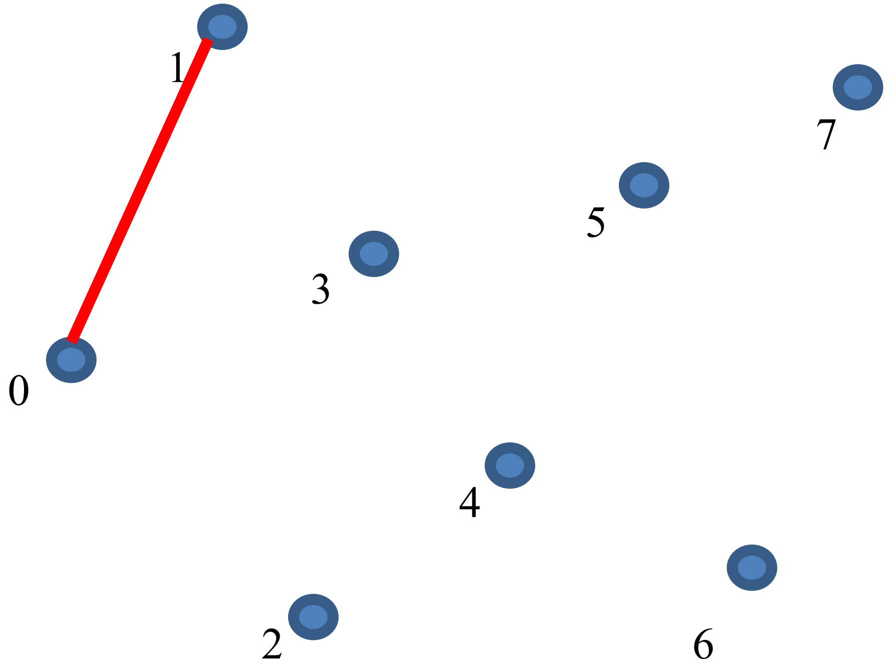
Andrew's Monotone Chain

- Step2 : Connect points



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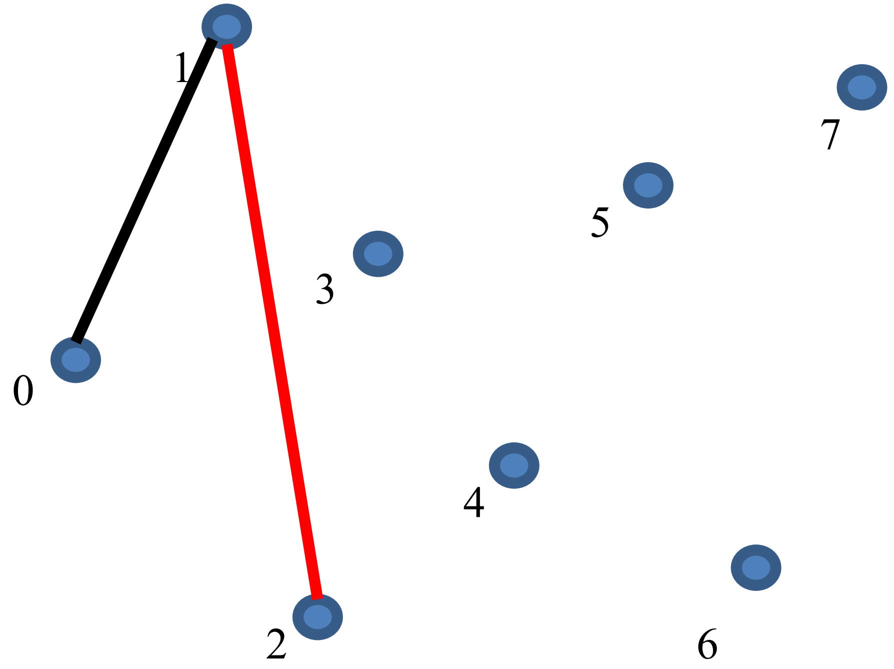
Andrew’s Monotone Chain

- Step2 : Connect points



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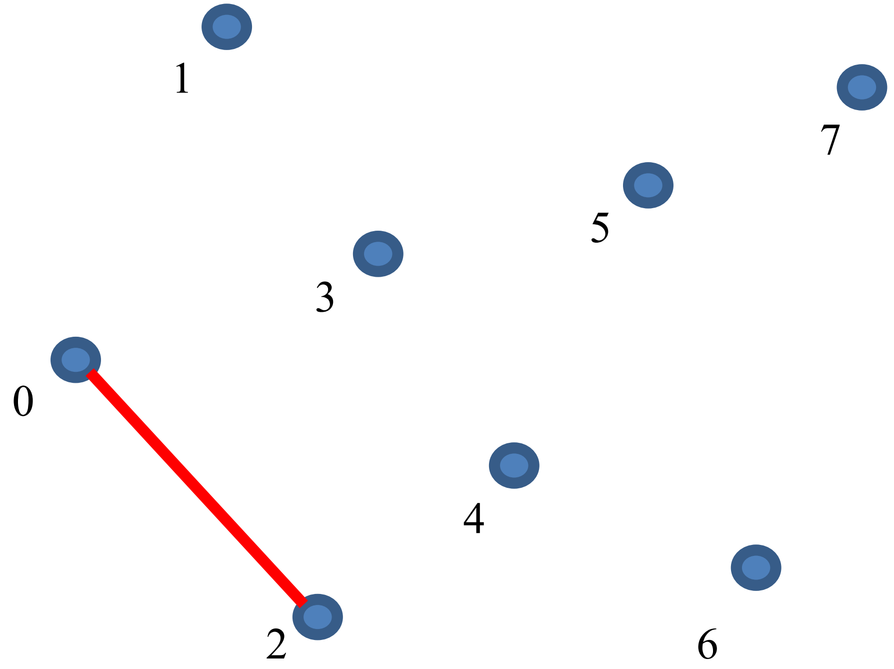
Andrew's Monotone Chain

- Step3 : Use cross product

$01 \times \quad 02 < 0$



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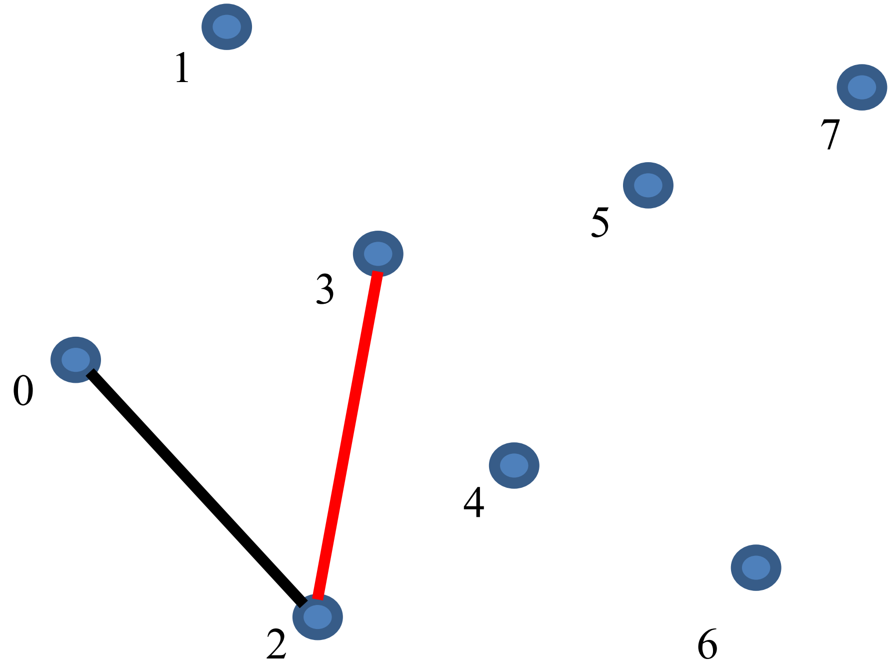
Andrew's Monotone Chain

- Step3 : Use cross product



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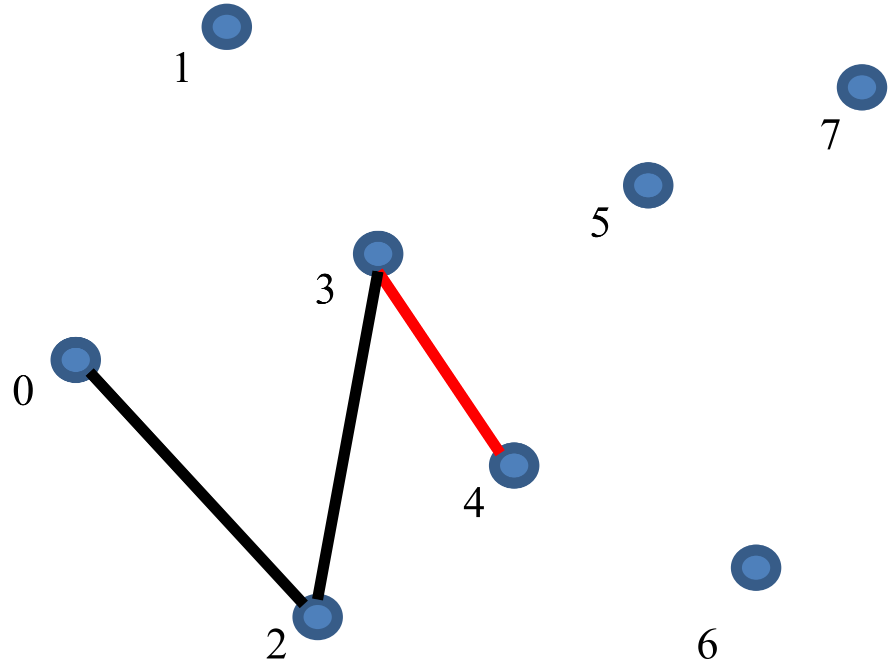
Andrew's Monotone Chain

- Step3 : Use cross product



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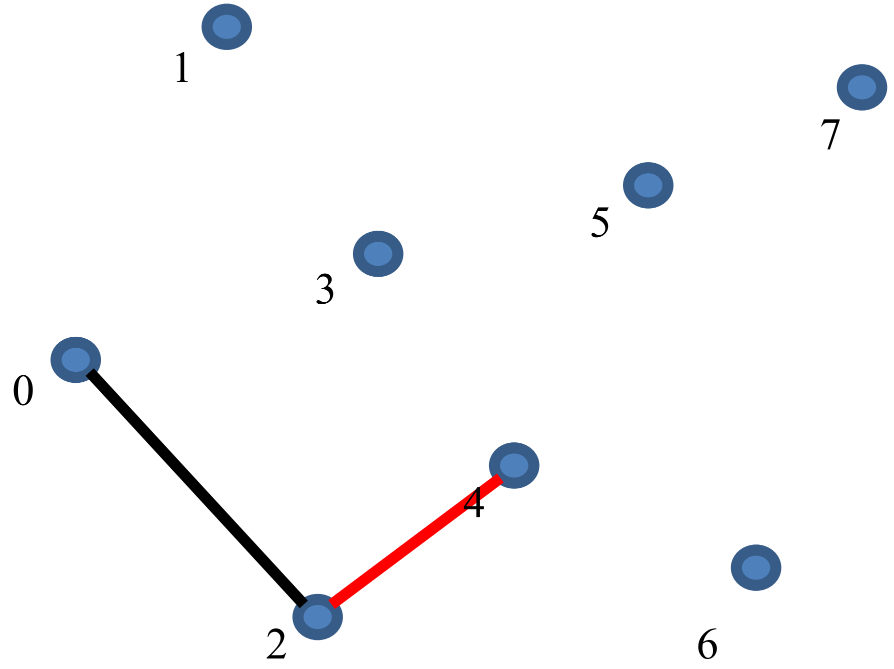
Andrew's Monotone Chain

- Step3 : Use cross product



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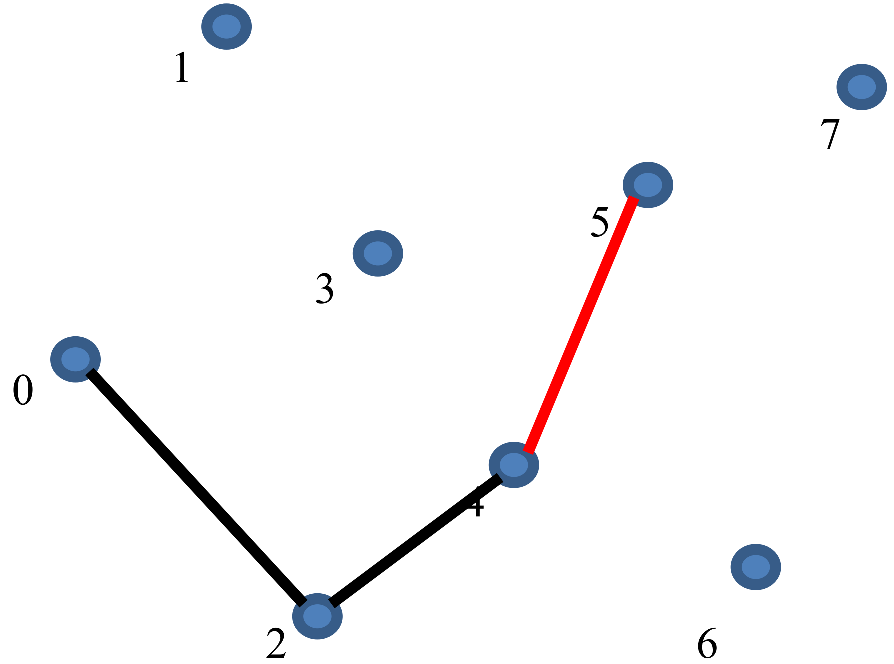
Andrew's Monotone Chain

- Step3 : Use cross product



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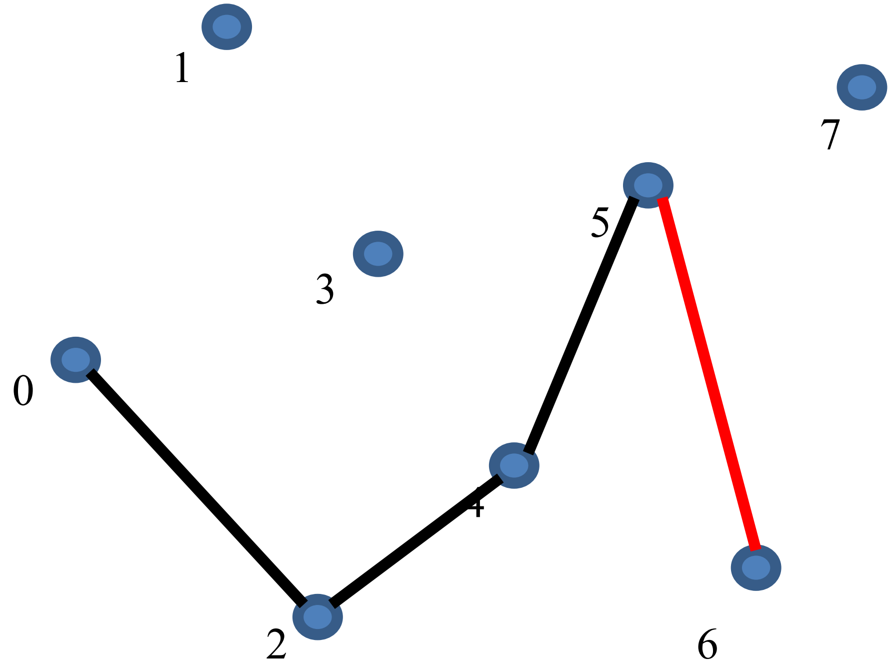
Andrew’s Monotone Chain

- Step3 : Use cross product



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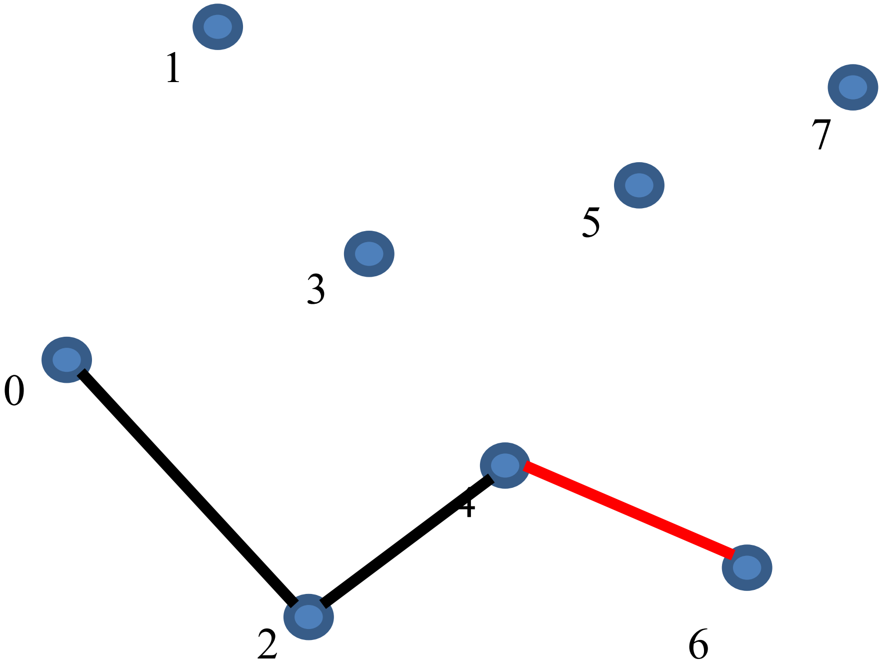
Andrew's Monotone Chain

- Step3 : Use cross product



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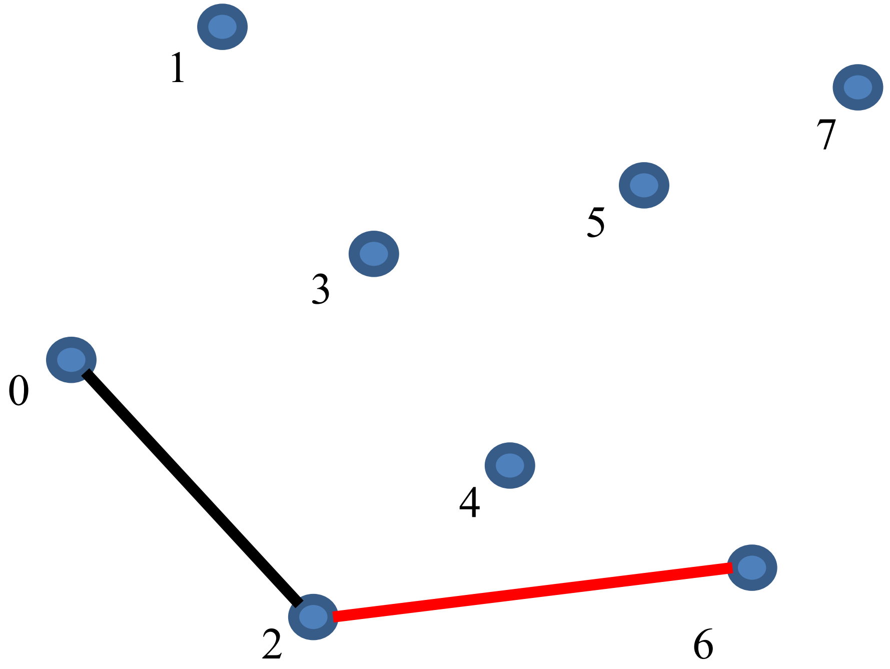
Andrew's Monotone Chain

- Step3 : Use cross product



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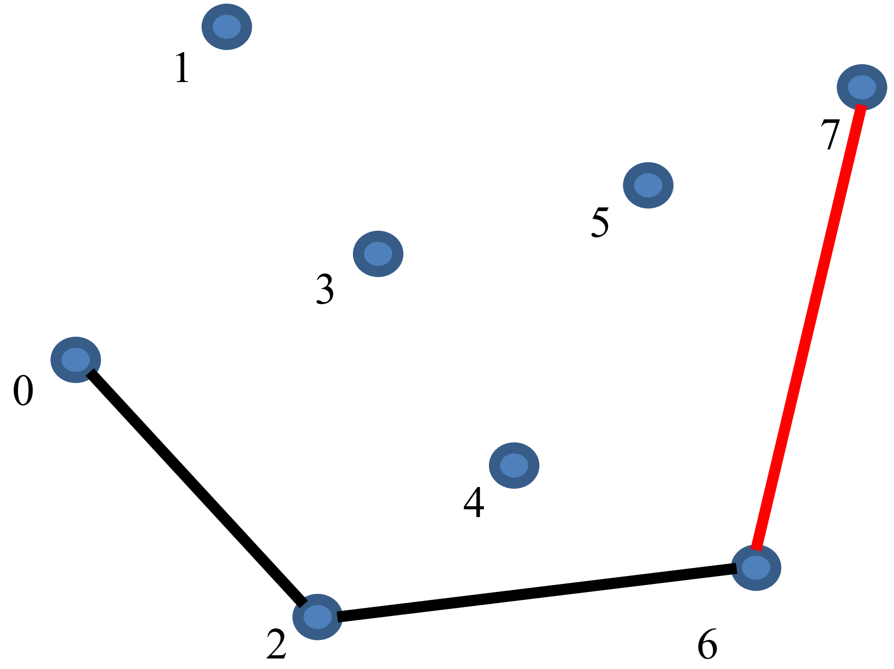
Andrew's Monotone Chain

- Step3 : Use cross product



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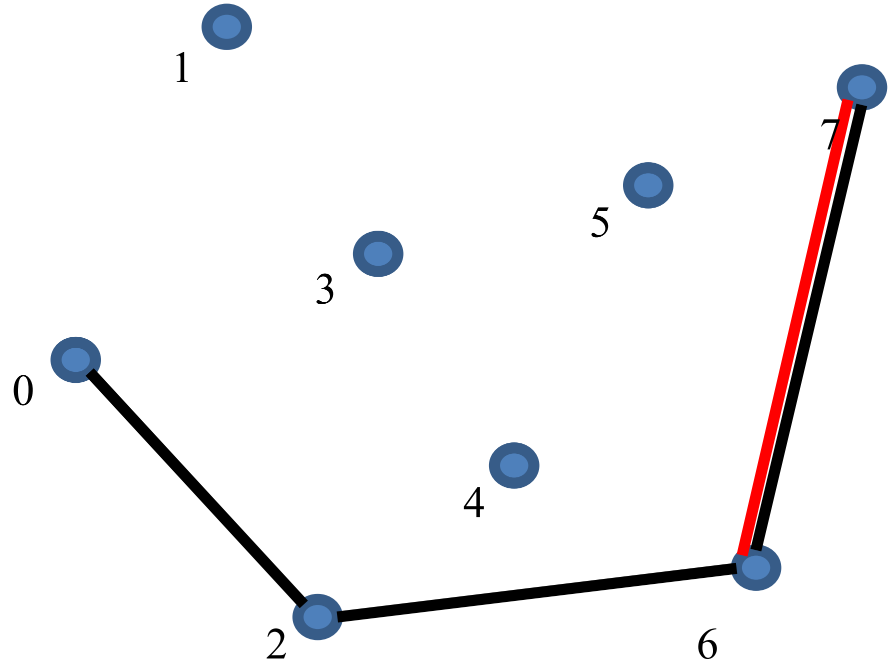
Andrew's Monotone Chain

- Step3 : Use cross product



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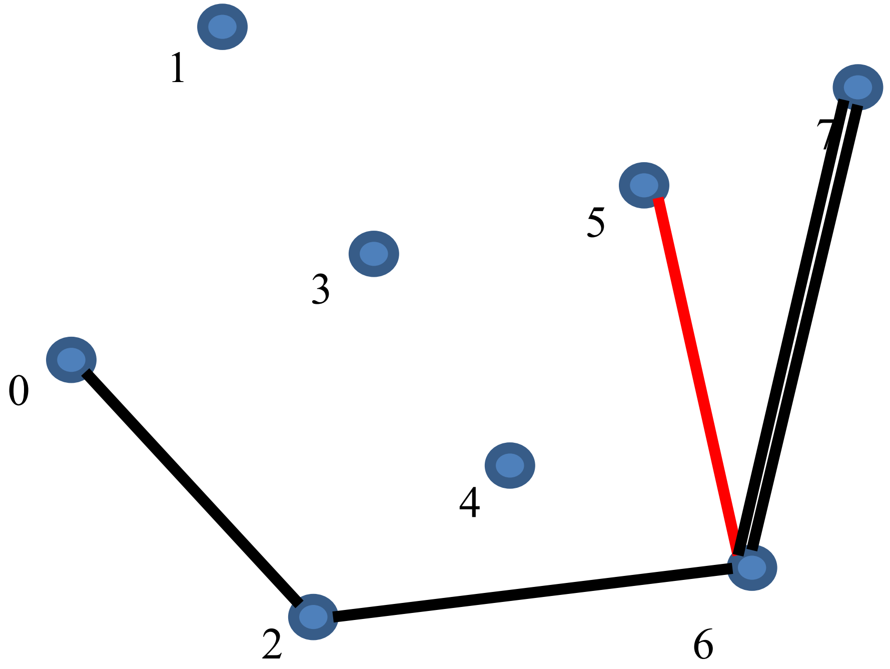
Andrew's Monotone Chain

- Step3 : Use cross product



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Andrew's Monotone Chain

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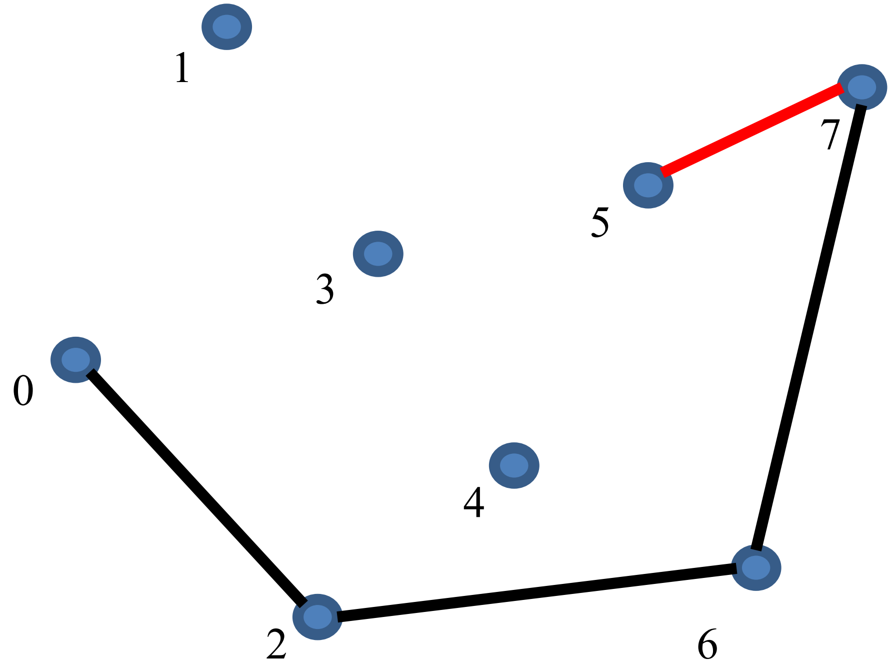

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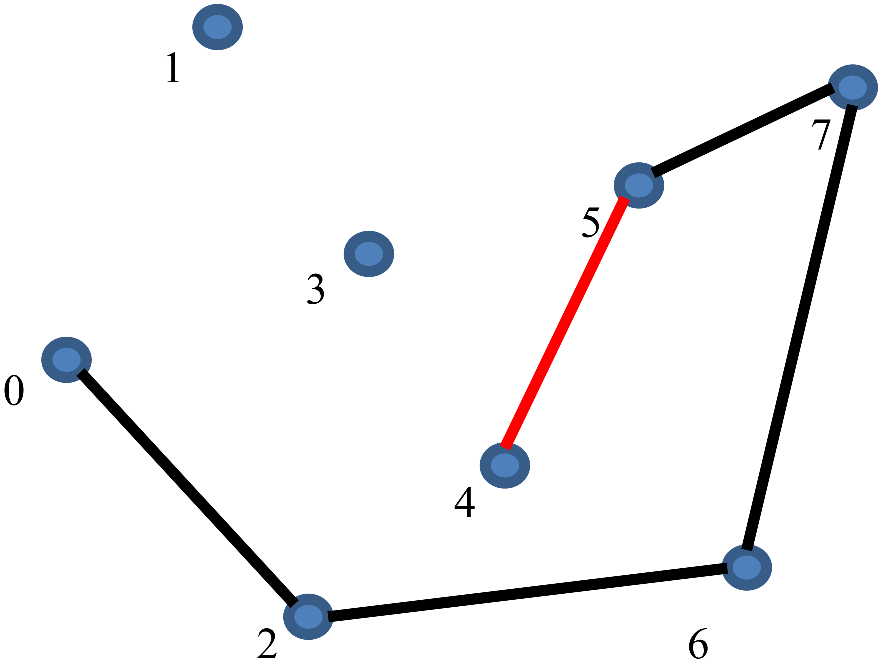
Andrew’s Monotone Chain

- Step3 : Use cross product



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Andrew’s Monotone Chain

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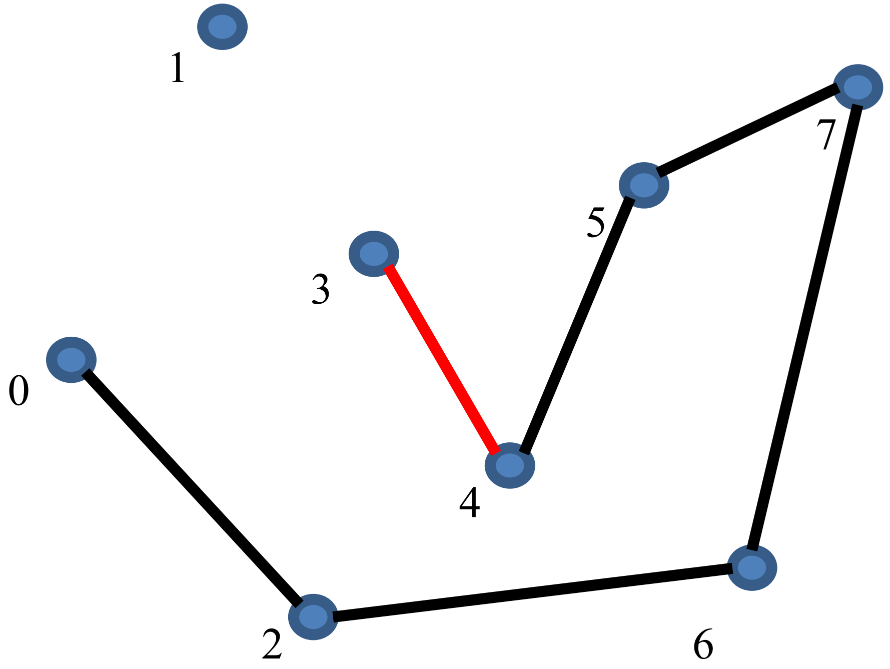

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Andrew's Monotone Chain

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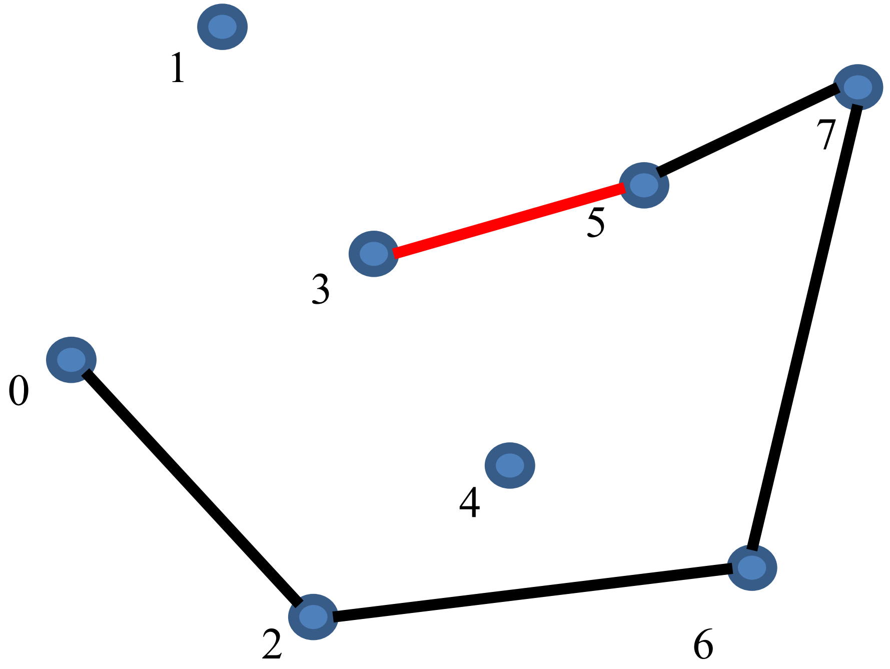

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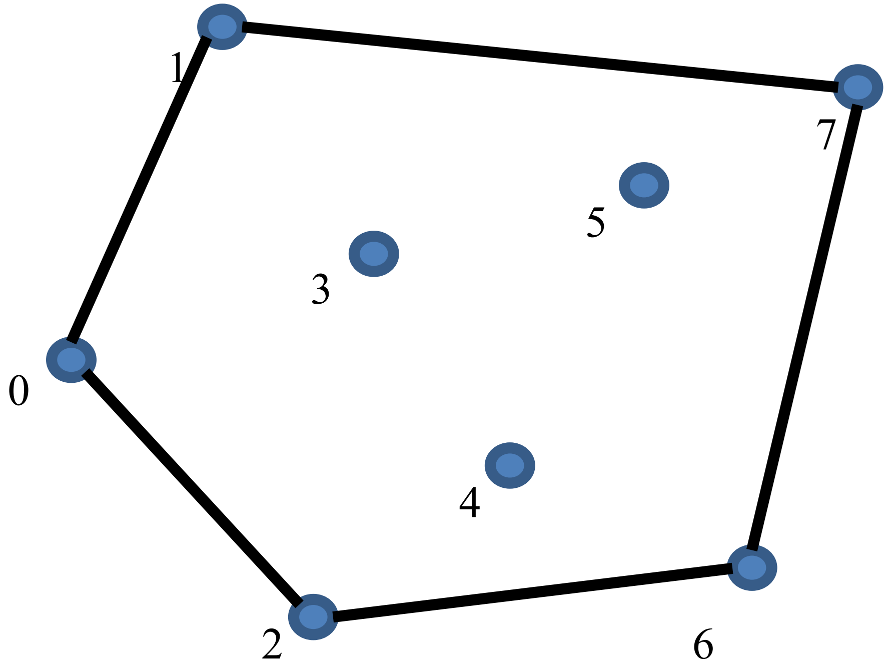
Andrew's Monotone Chain

- Step3 : Use cross product



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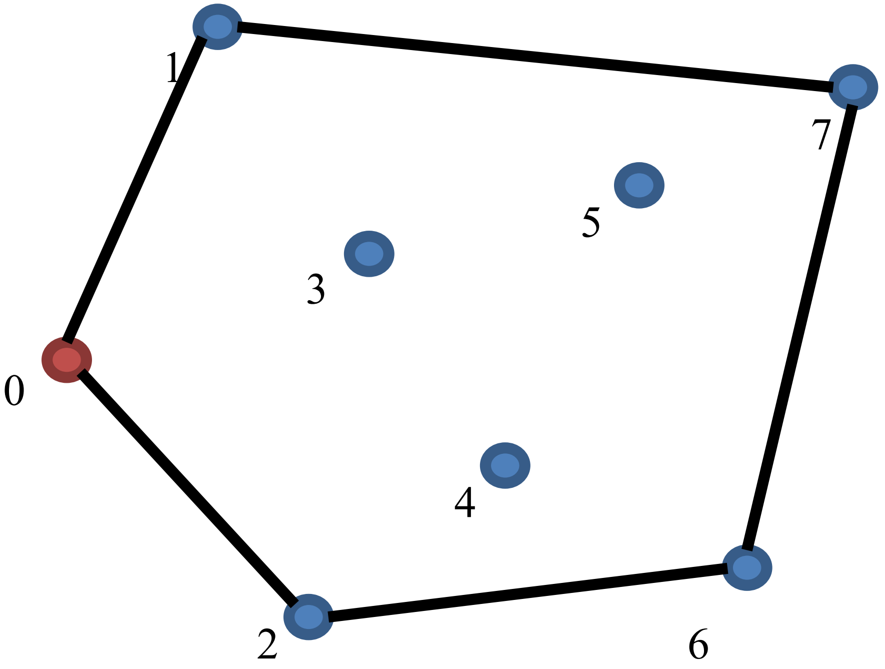
Andrew’s Monotone Chain

- Step4 : Delete starting point



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Practice - 1

UVa 218 - Moth Eradication