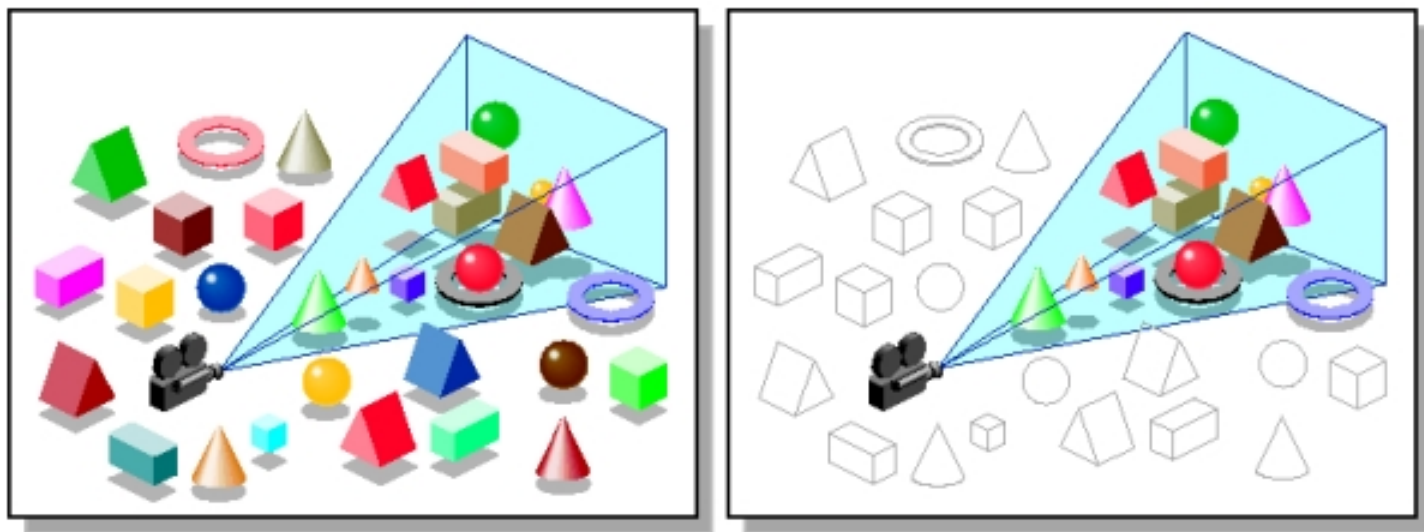




Clipping di Poligoni

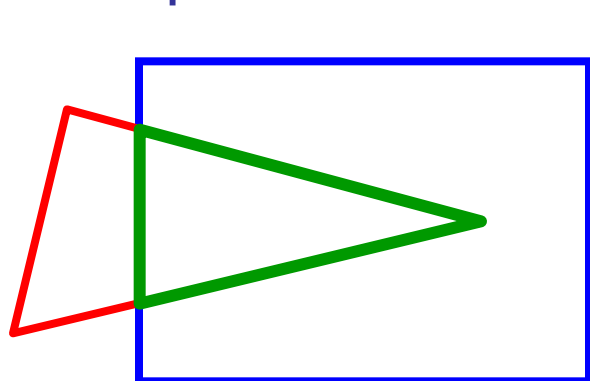


Clipping di Poligoni in 2D

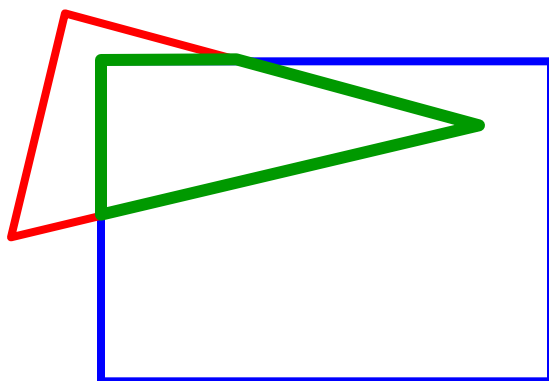
Il Clipping di Poligoni è complicato!

Cosa accade ad un triangolo durante il clipping?

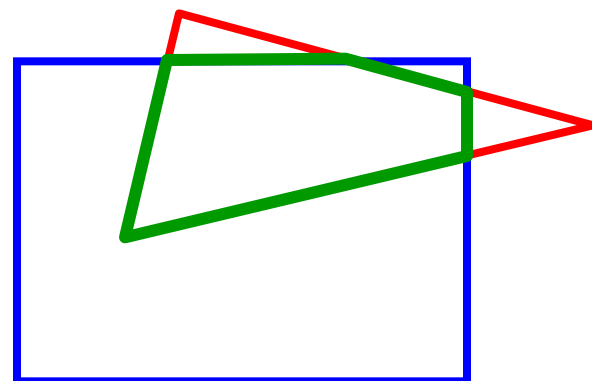
- possibili situazioni:



triangolo → triangolo



triangolo → quadrilatero



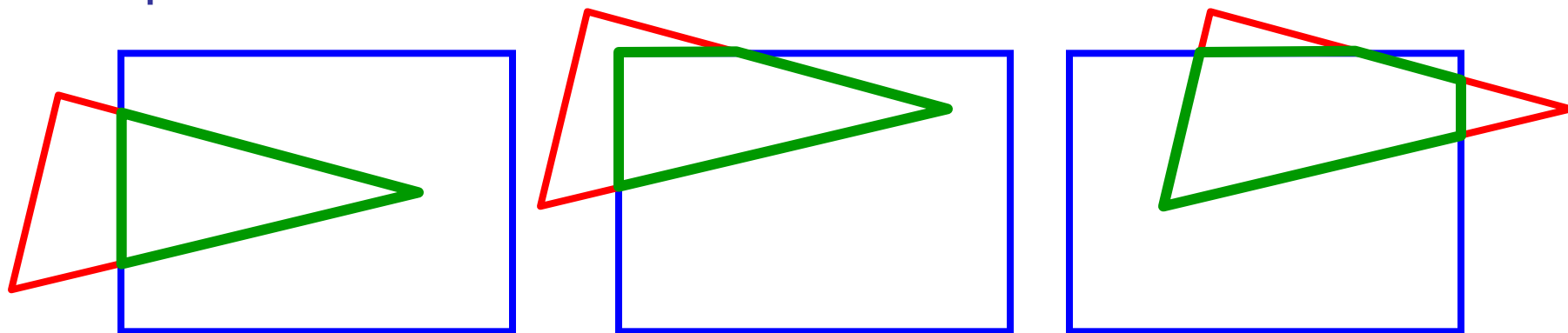
triangolo → pentagono

Clipping di Poligoni in 2D

Il Clipping di Poligoni è complicato!

Cosa accade ad un triangolo durante il clipping?

- possibili situazioni:



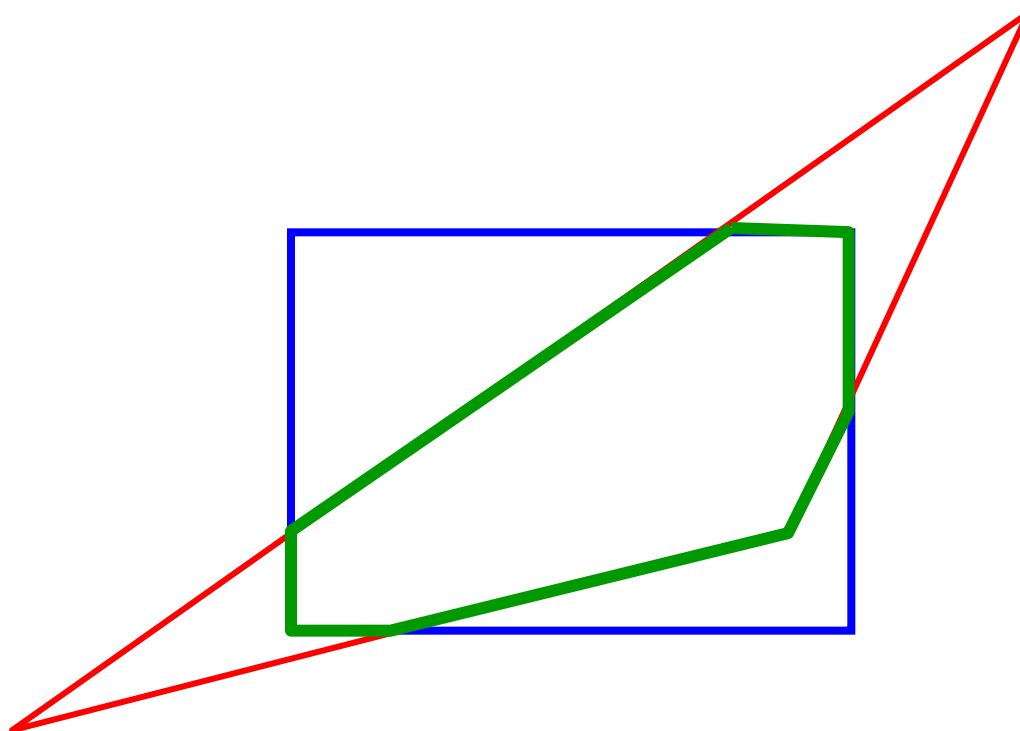
triangolo → triangolo

triangolo → quadrilatero

triangolo → pentagono

Quanti lati può avere un triangolo dopo il Clipping?

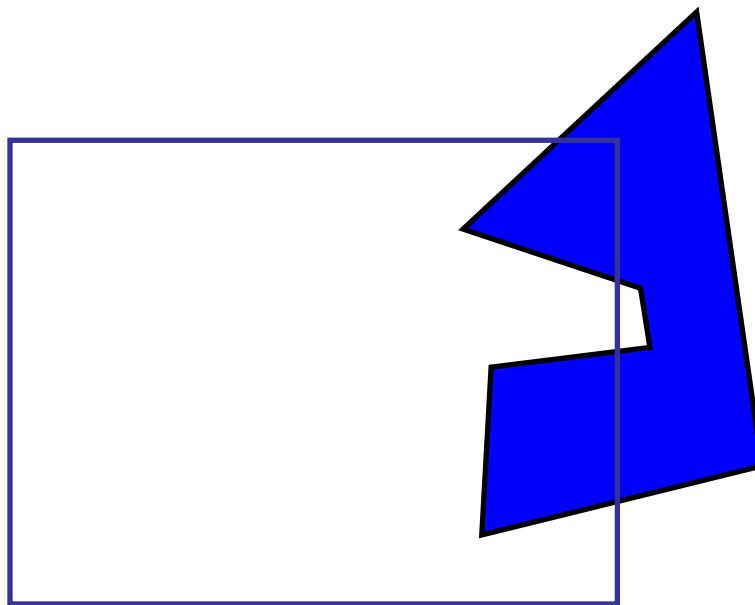
Quanti lati?



fino a 7 lati



Il Clipping di Poligoni è complicato!

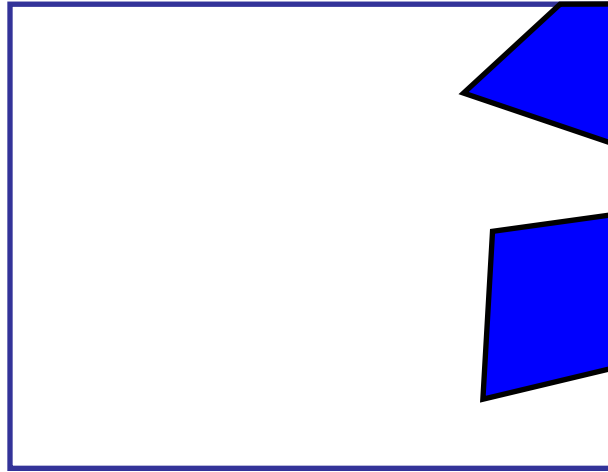


Poligono concavo → più poligoni



Il Clipping di Poligoni è complicato!

Un caso veramente difficile!



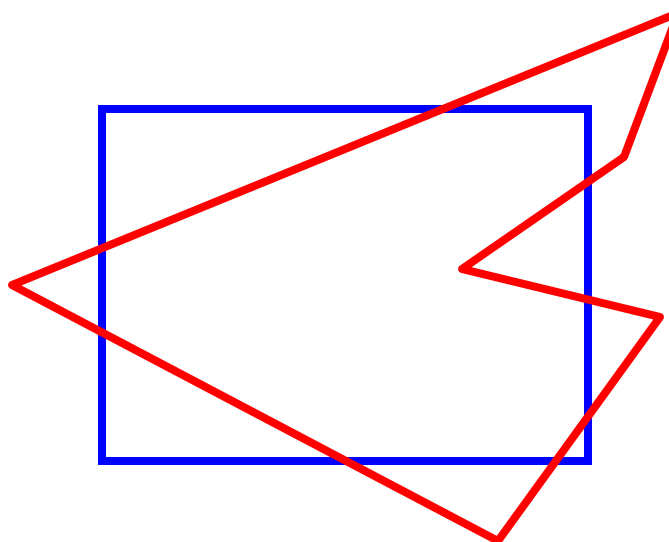


Sutherland-Hodgman Clipping

Idea base:

- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window

....vediamo

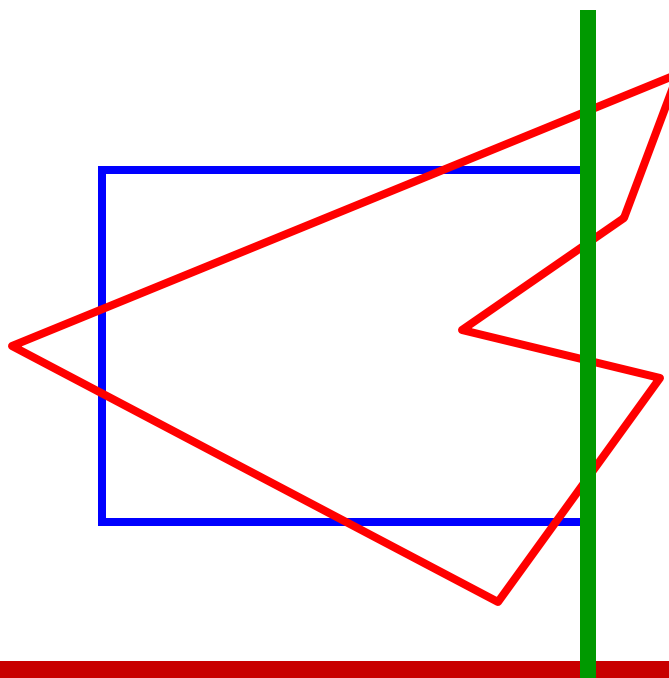




Sutherland-Hodgman Clipping

Idea base:

- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window

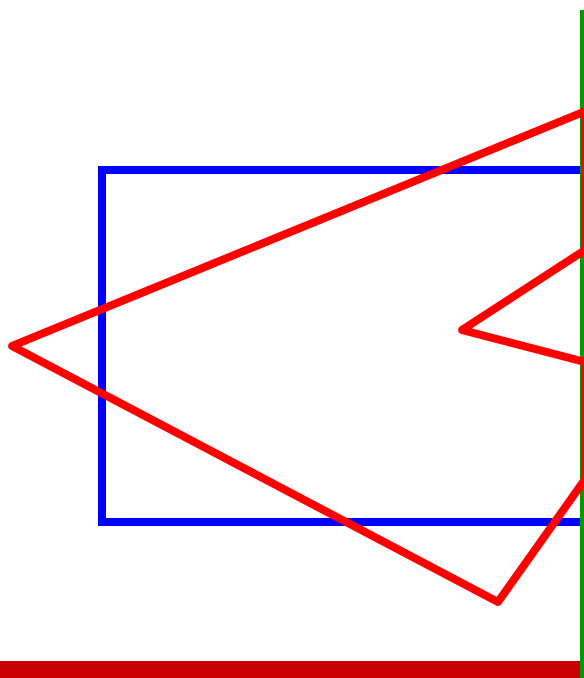




Sutherland-Hodgman Clipping

Idea base:

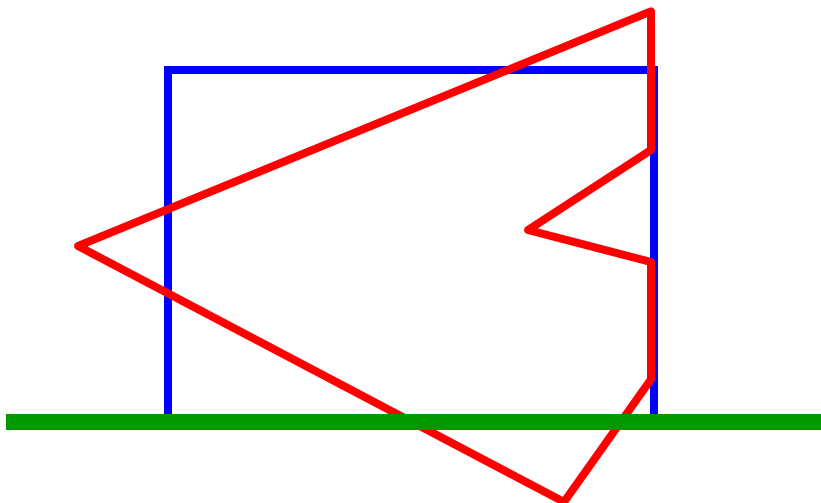
- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window



Sutherland-Hodgman Clipping

Idea base:

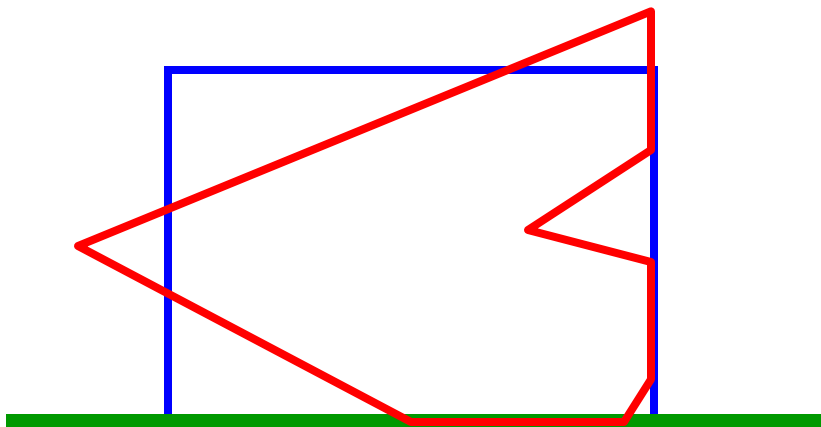
- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window



Sutherland-Hodgman Clipping

Idea base:

- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window

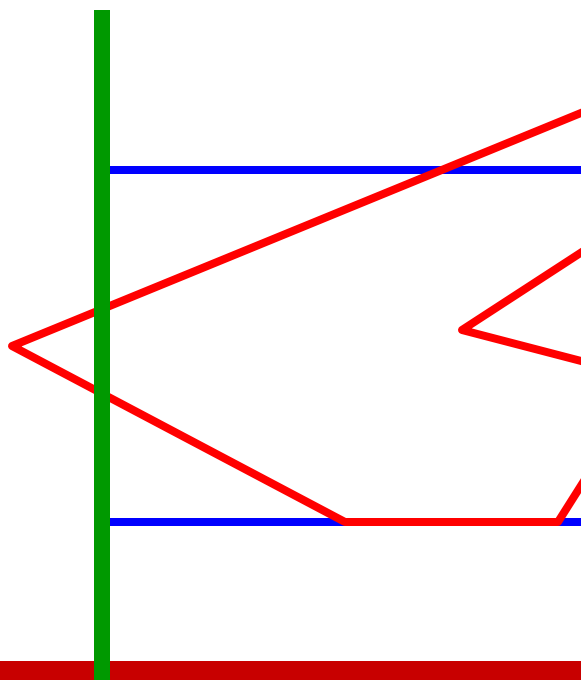




Sutherland-Hodgman Clipping

Idea base:

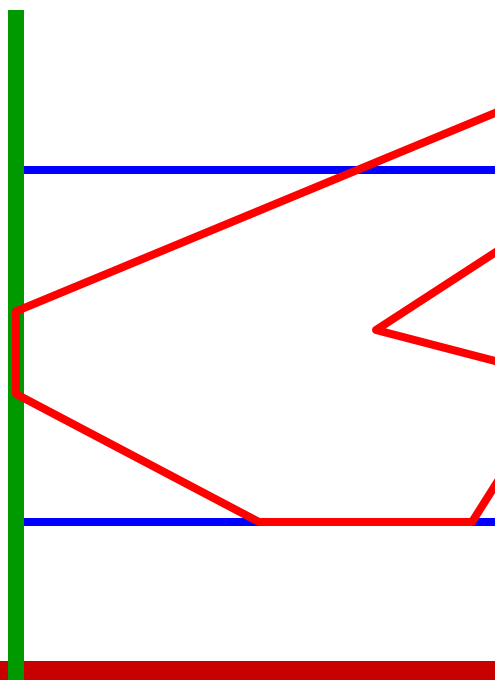
- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window



Sutherland-Hodgman Clipping

Idea base:

- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window

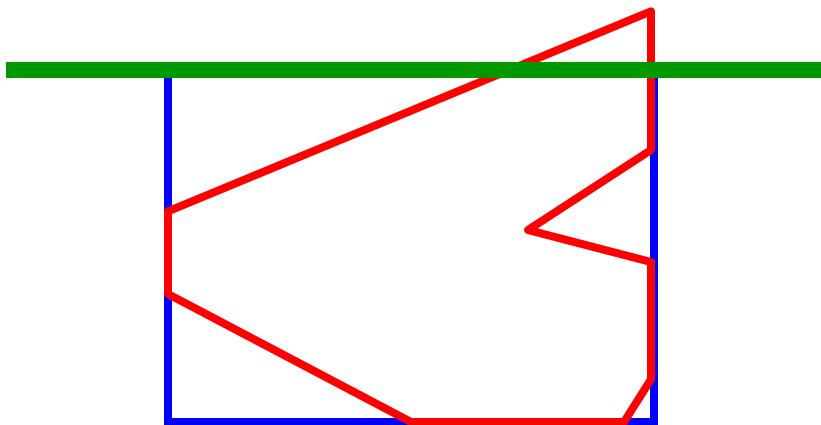




Sutherland-Hodgman Clipping

Idea base:

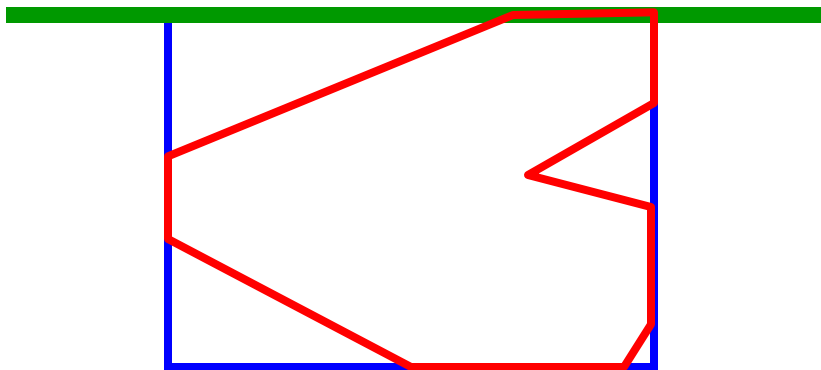
- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window



Sutherland-Hodgman Clipping

Idea base:

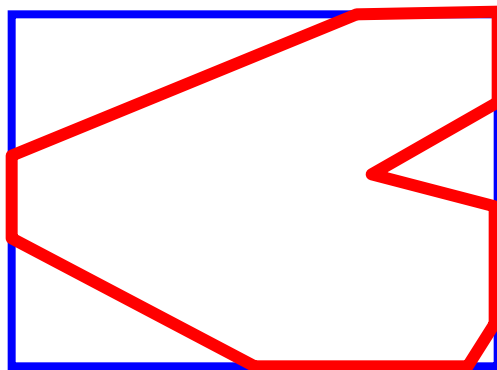
- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window



Sutherland-Hodgman Clipping

Idea base:

- si considera ogni lato della window individualmente
- si fa il clip del poligono rispetto ai lati della window
- dopo aver processato ogni lato, il clipping del poligono sarà completo

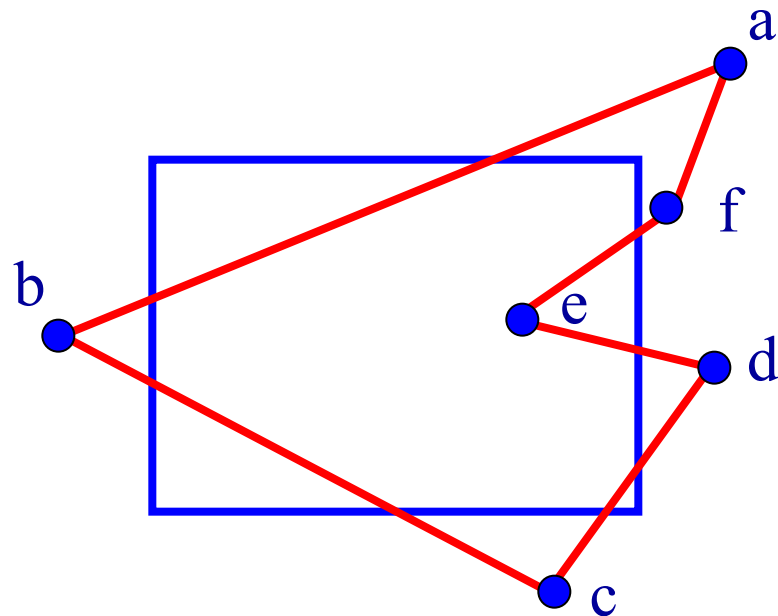




Sutherland-Hodgman Clipping

Input/output dell'algoritmo:

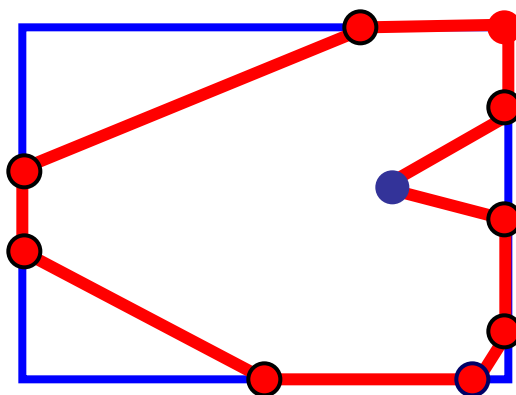
- input: lista dei vertici del poligono nell'ordine $\{a, b, c, d, e, f\}$



Sutherland-Hodgman Clipping

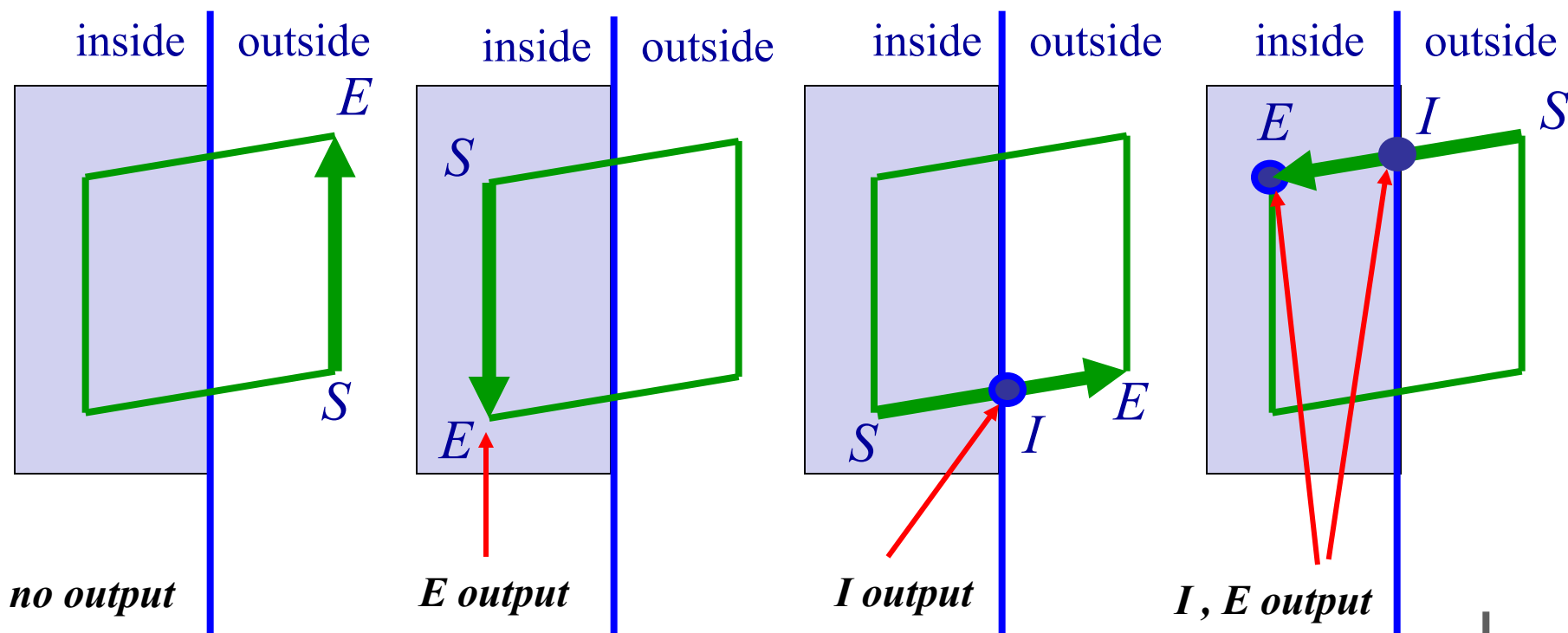
Input/output dell'algoritmo:

- input: lista dei vertici del poligono nell'ordine $\{a, b, c, d, e, f\}$
- output: lista dei vertici del poligono, che consiste in alcuni di quelli iniziali e alcuni nuovi



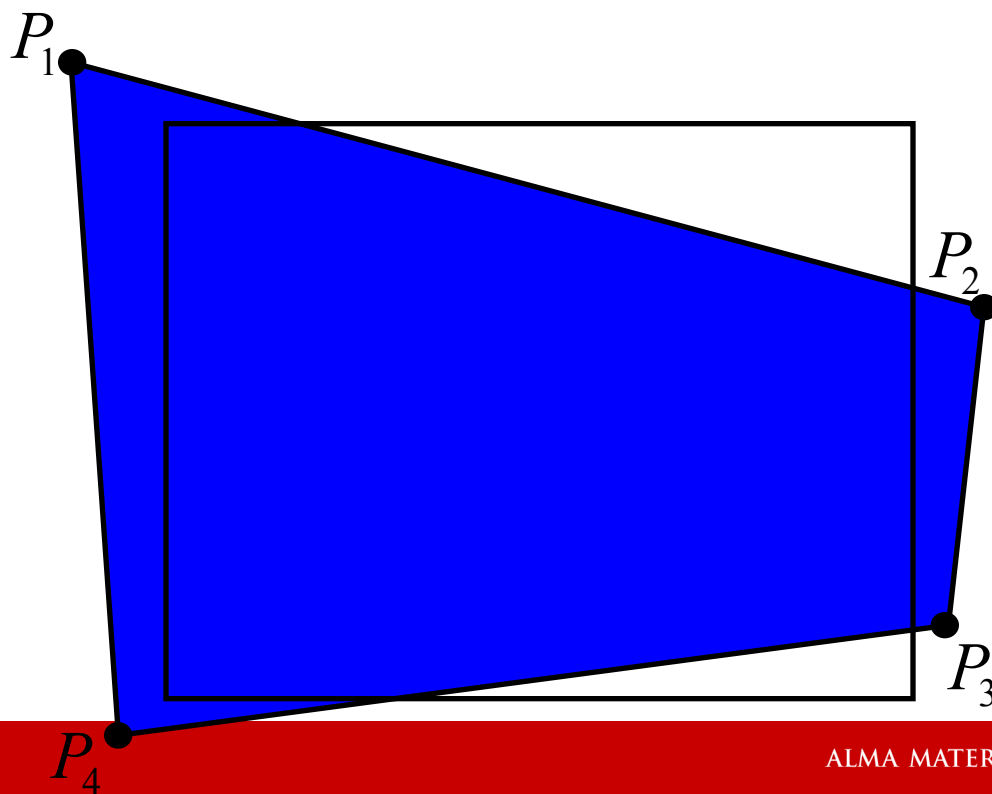
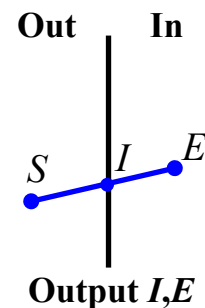
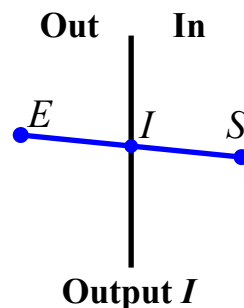
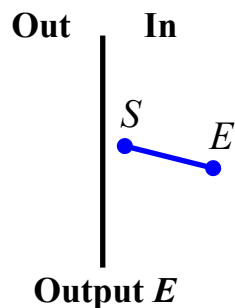
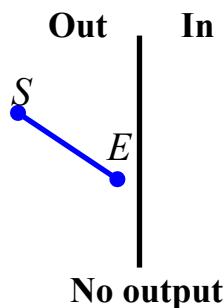
Sutherland-Hodgman Clipping

Il lato che va dal vertice S (Start) al vertice E (End) può trovarsi in uno dei seguenti quattro casi:



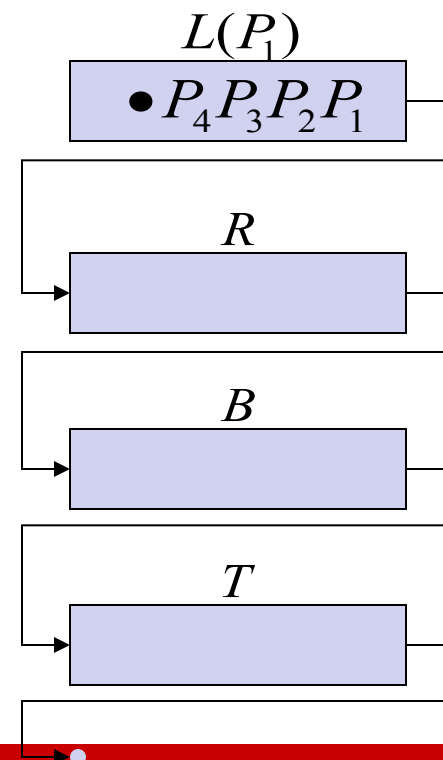
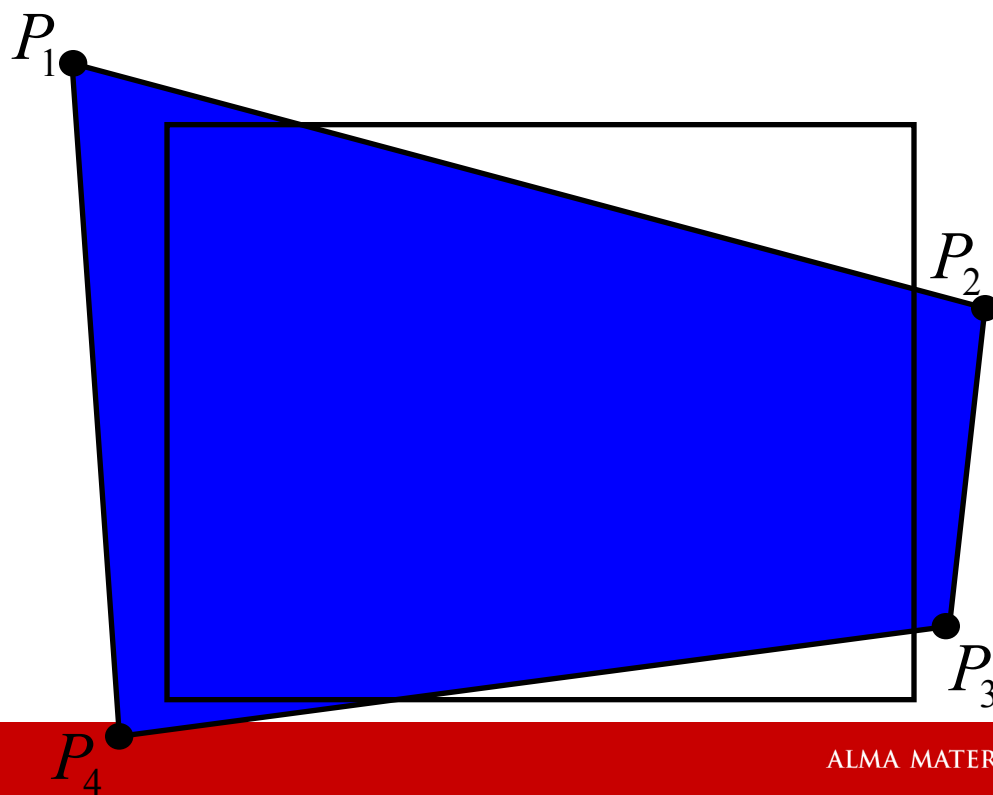
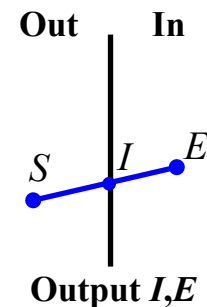
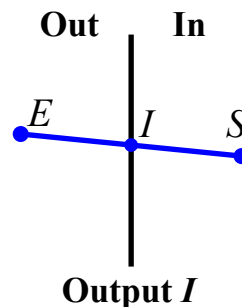
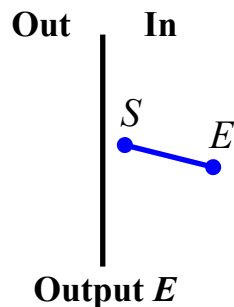
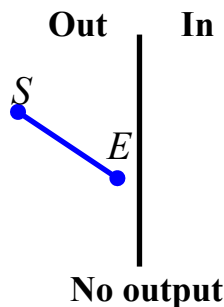


Algoritmo di Sutherland-Hodgman

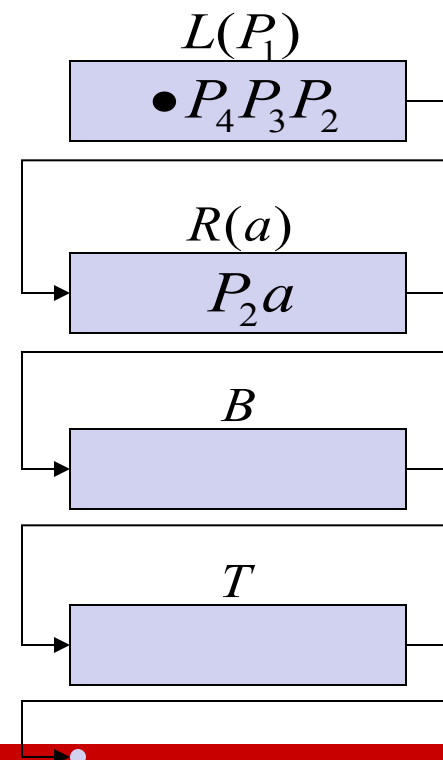
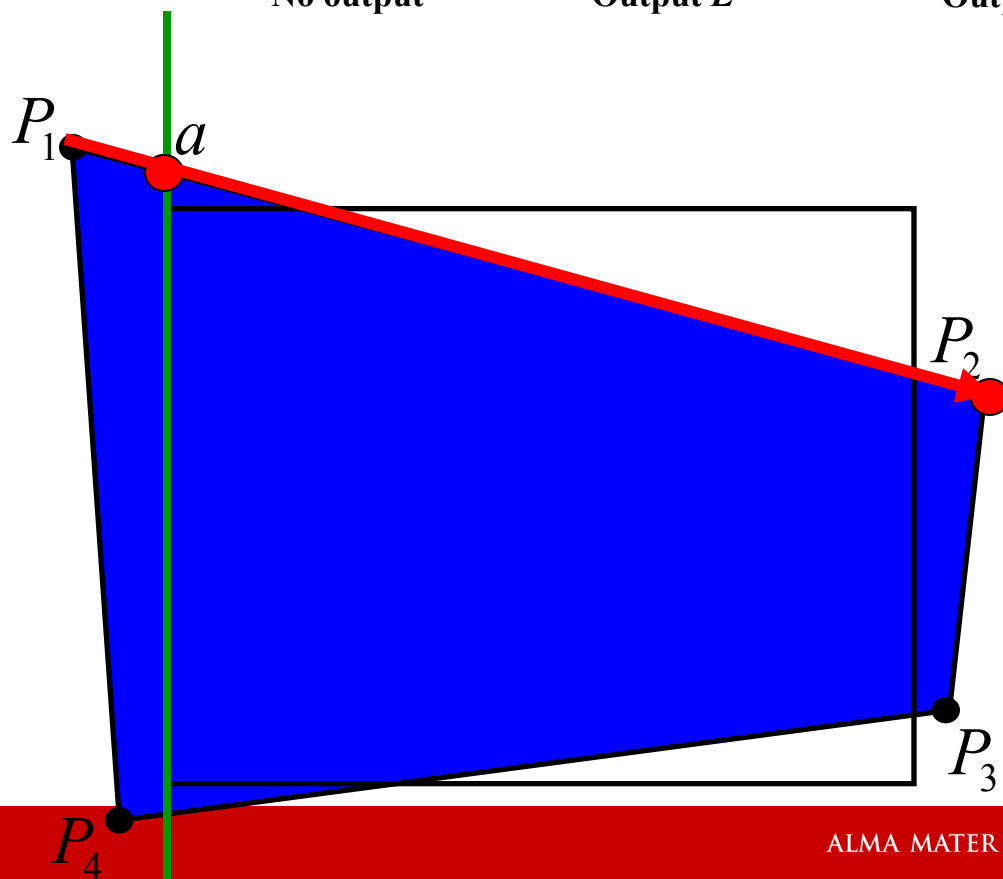
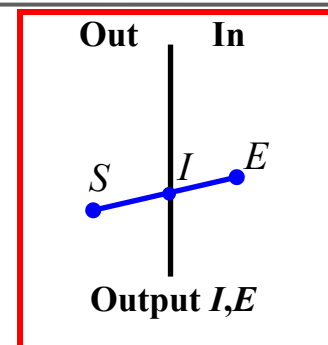
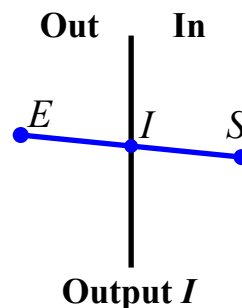
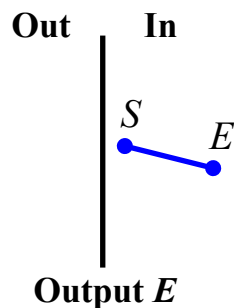
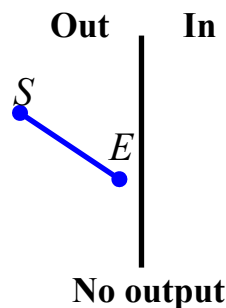




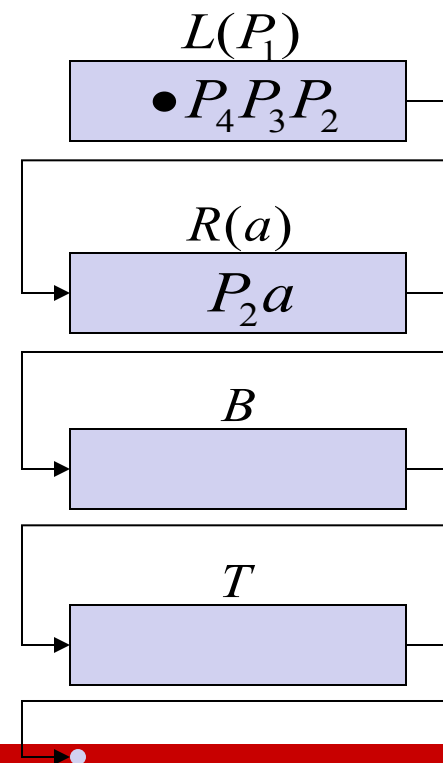
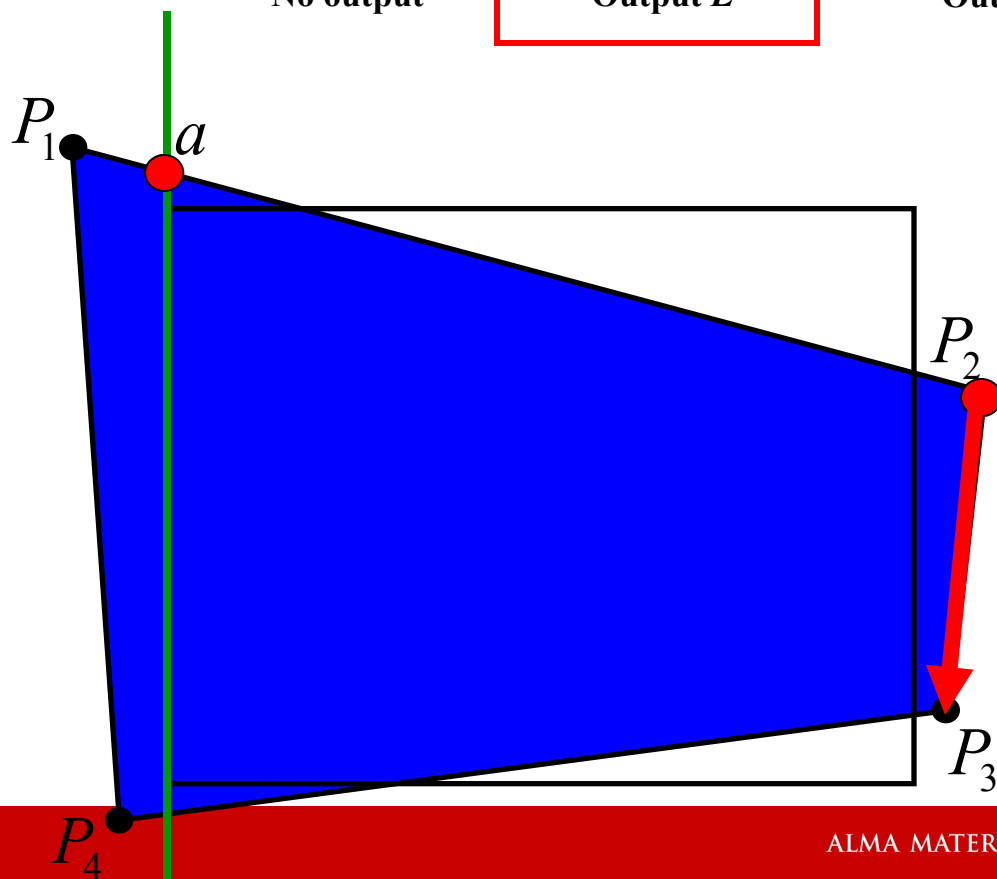
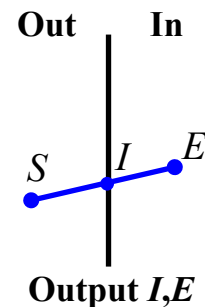
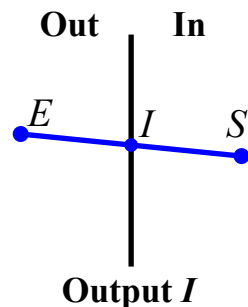
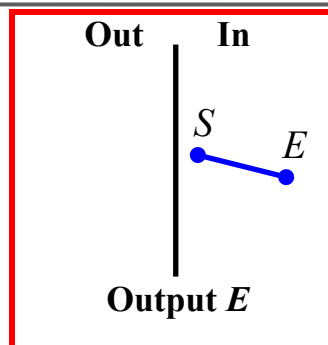
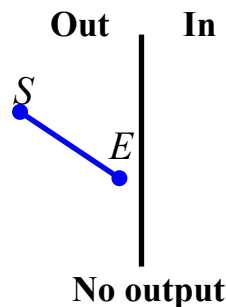
Algoritmo di Sutherland-Hodgman



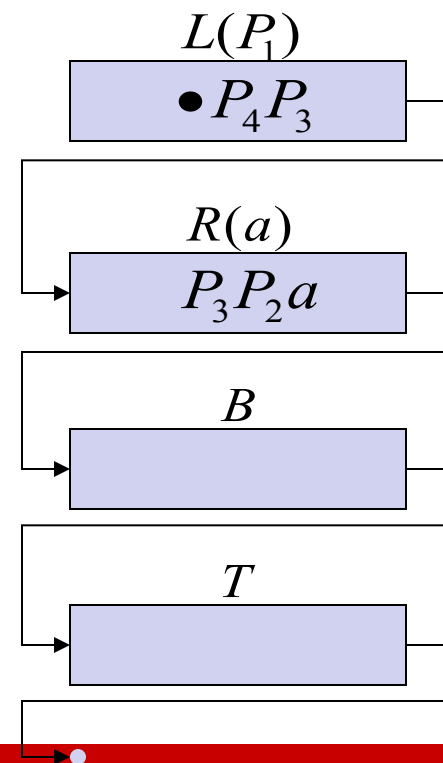
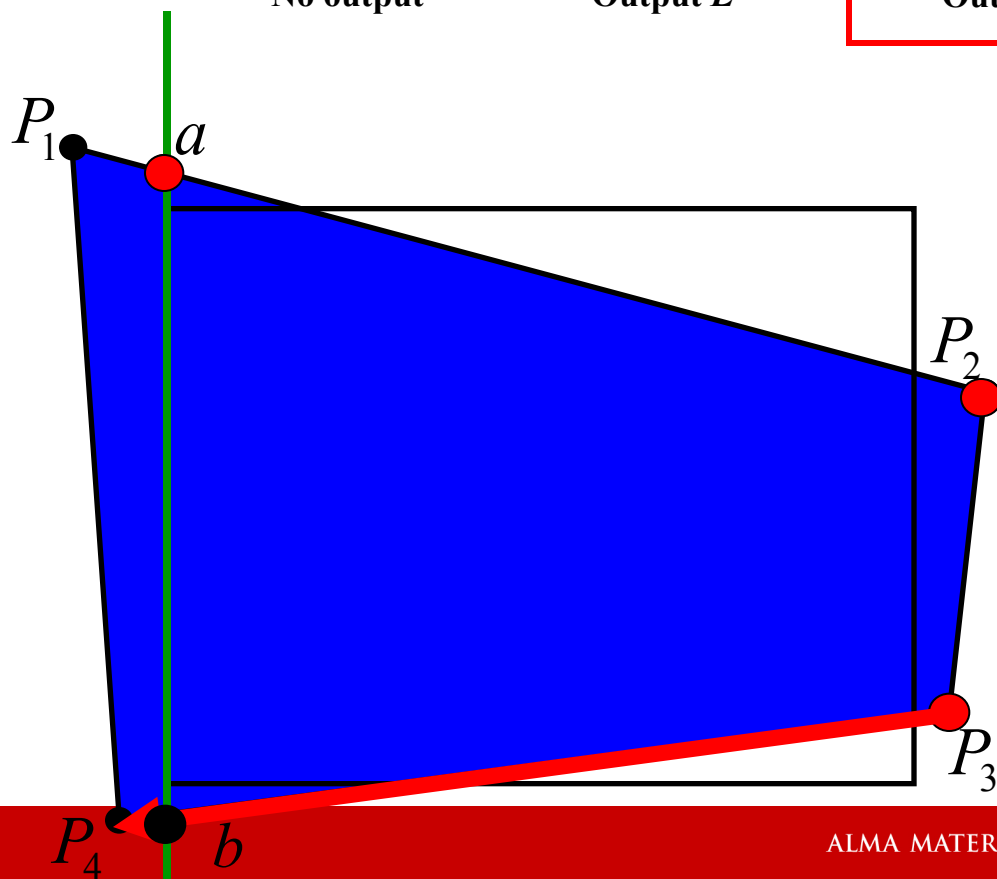
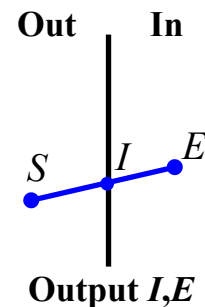
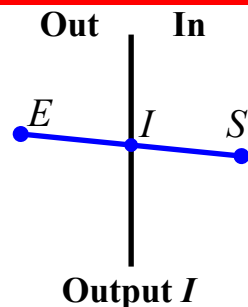
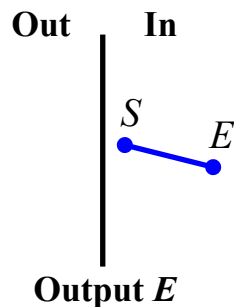
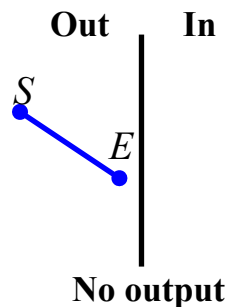
Algoritmo di Sutherland-Hodgman



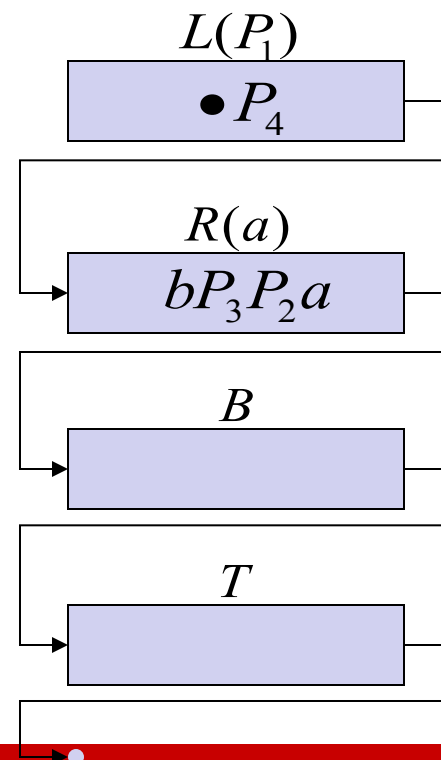
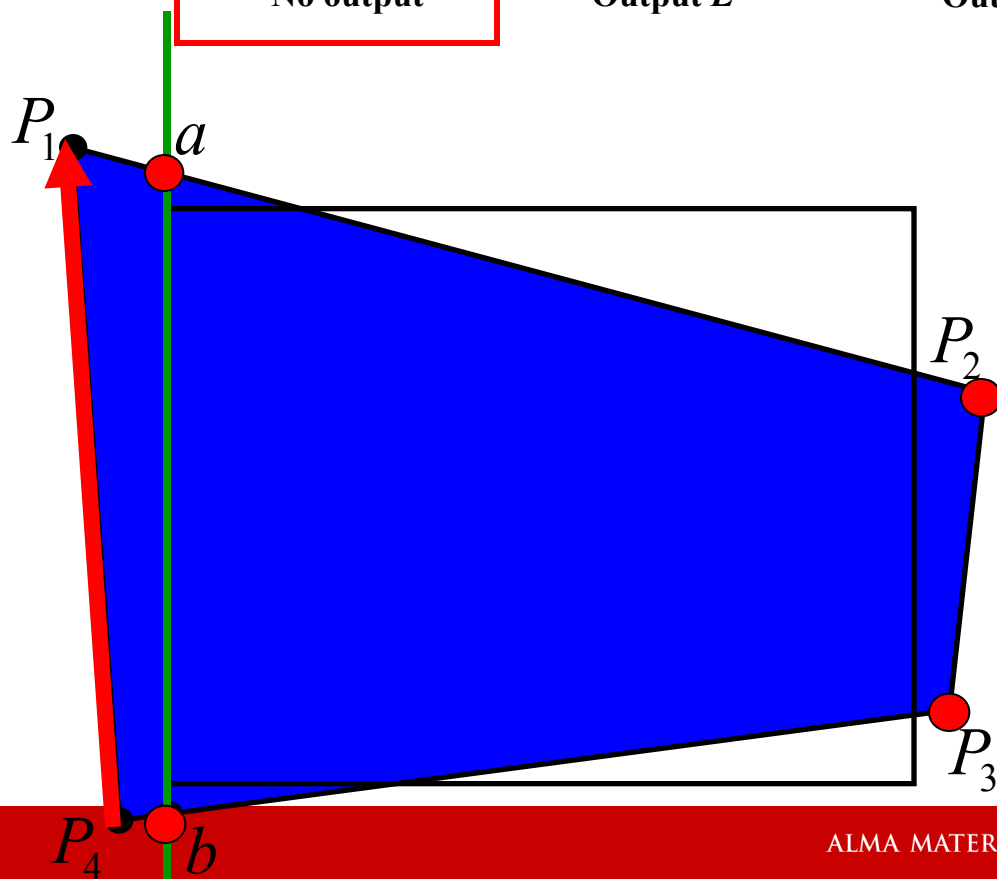
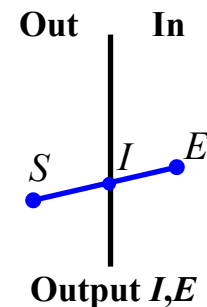
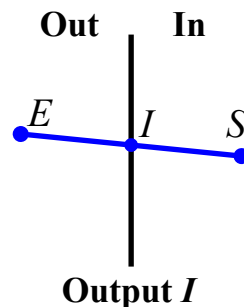
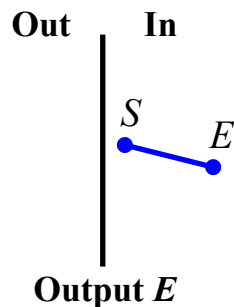
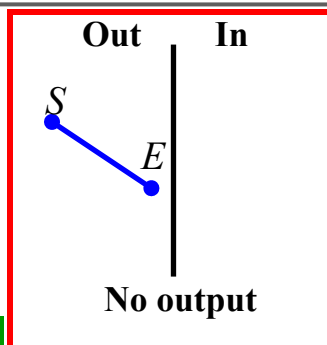
Algoritmo di Sutherland-Hodgman



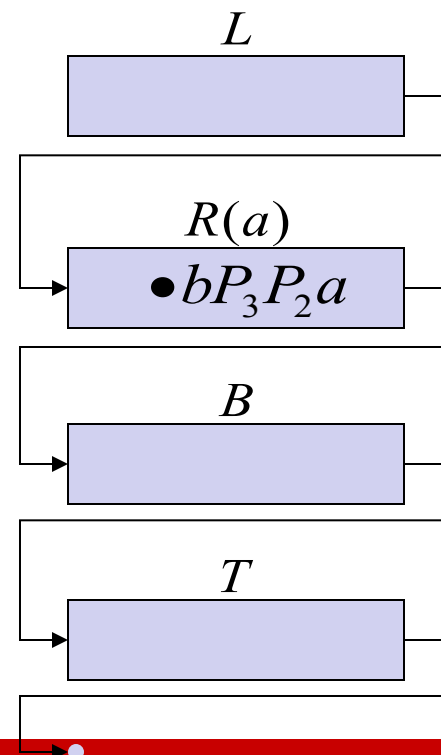
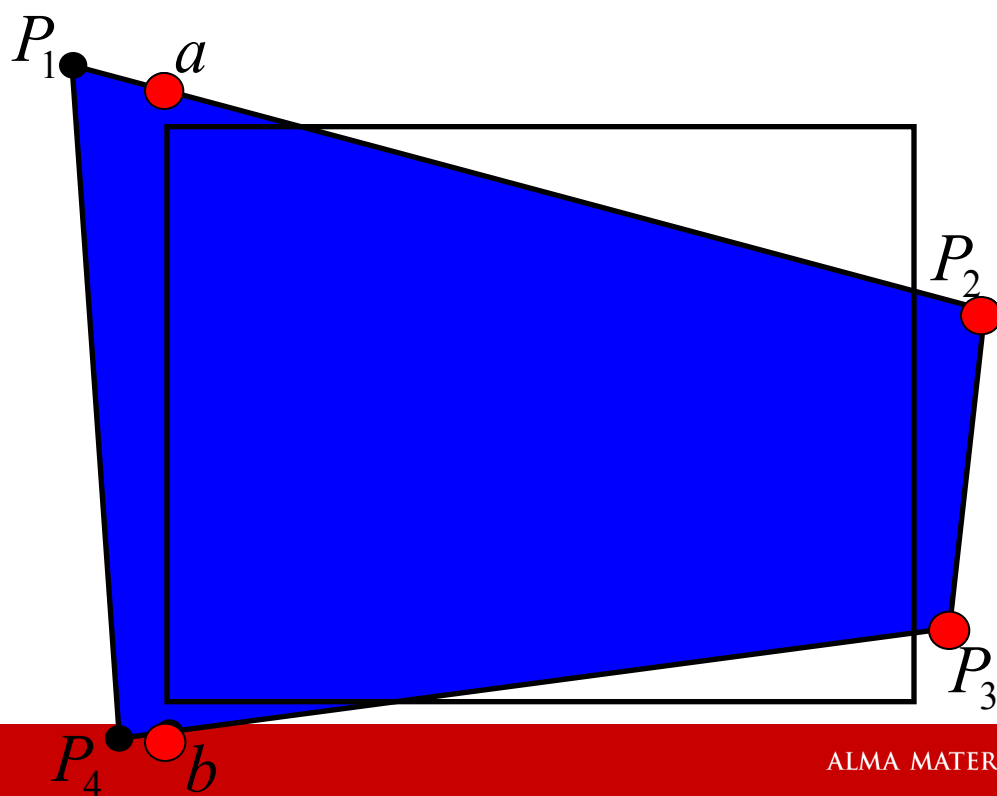
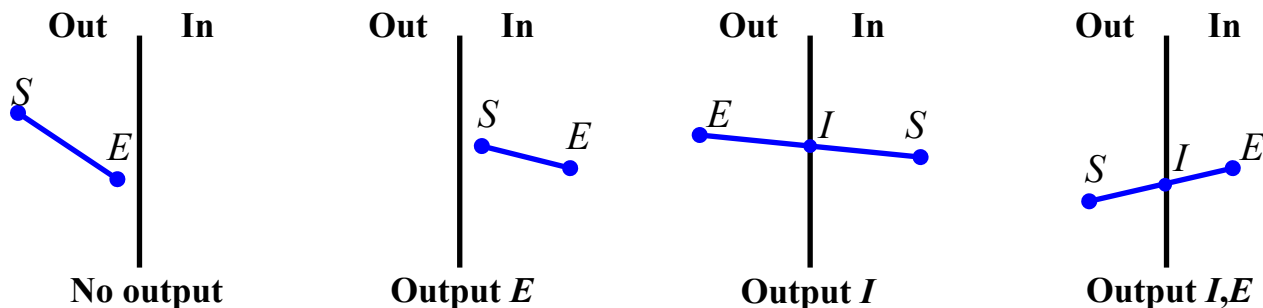
Algoritmo di Sutherland-Hodgman



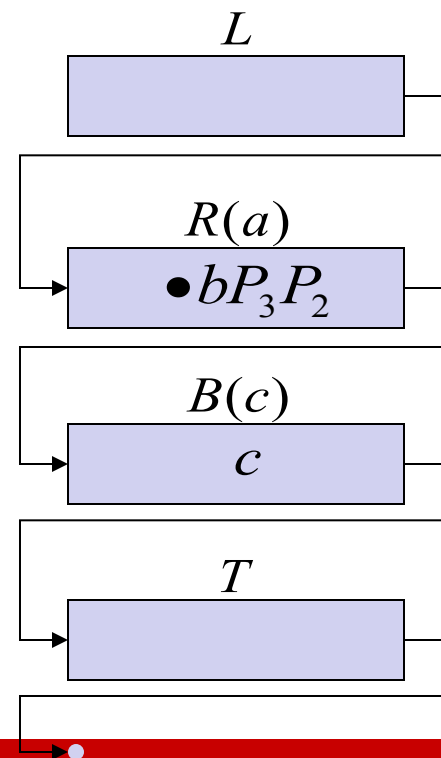
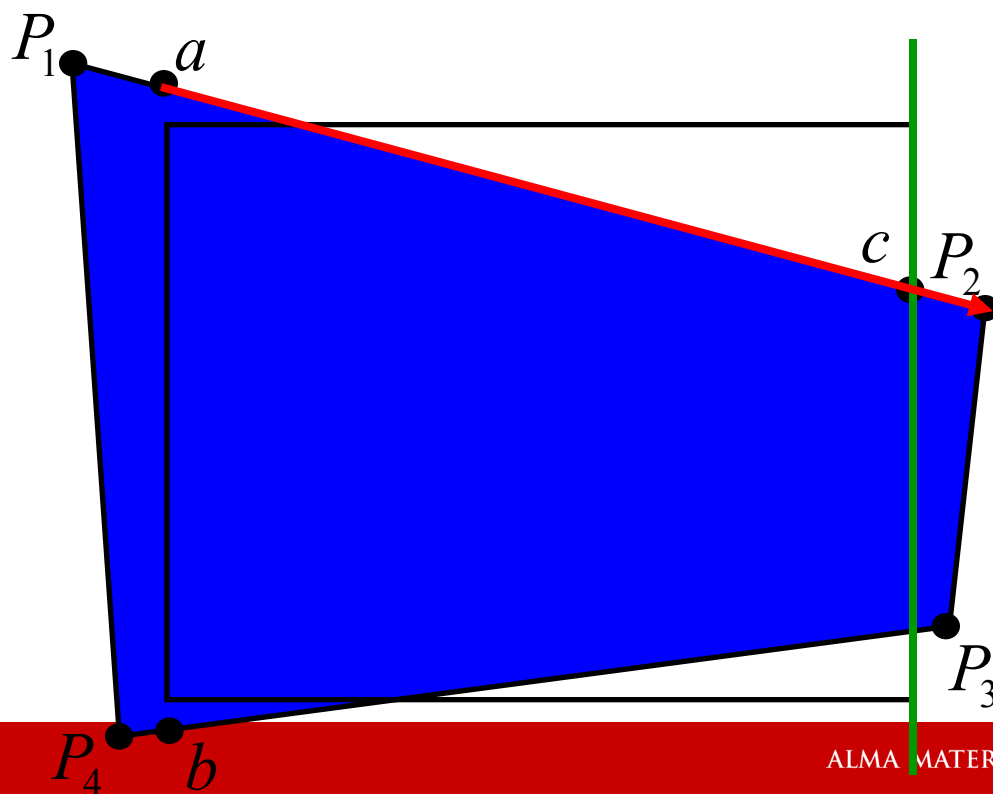
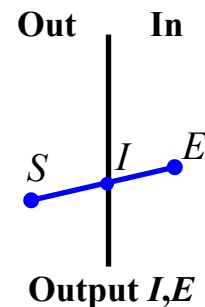
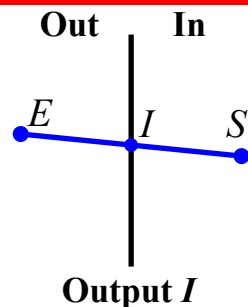
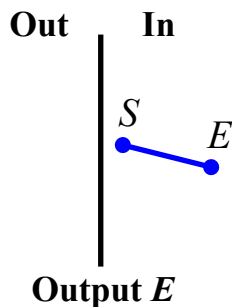
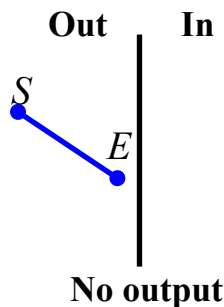
Algoritmo di Sutherland-Hodgman



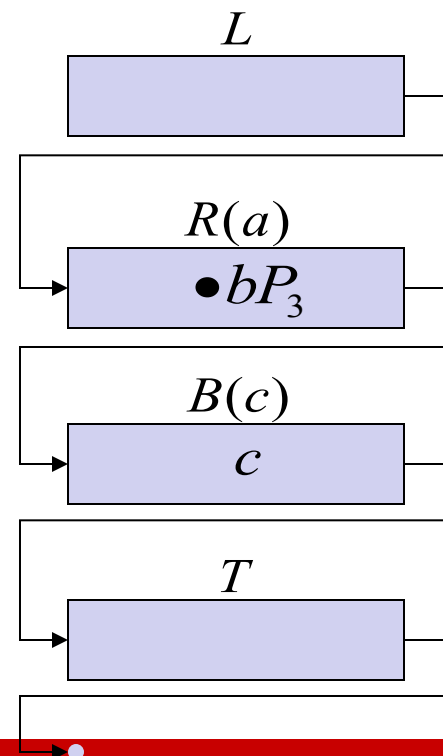
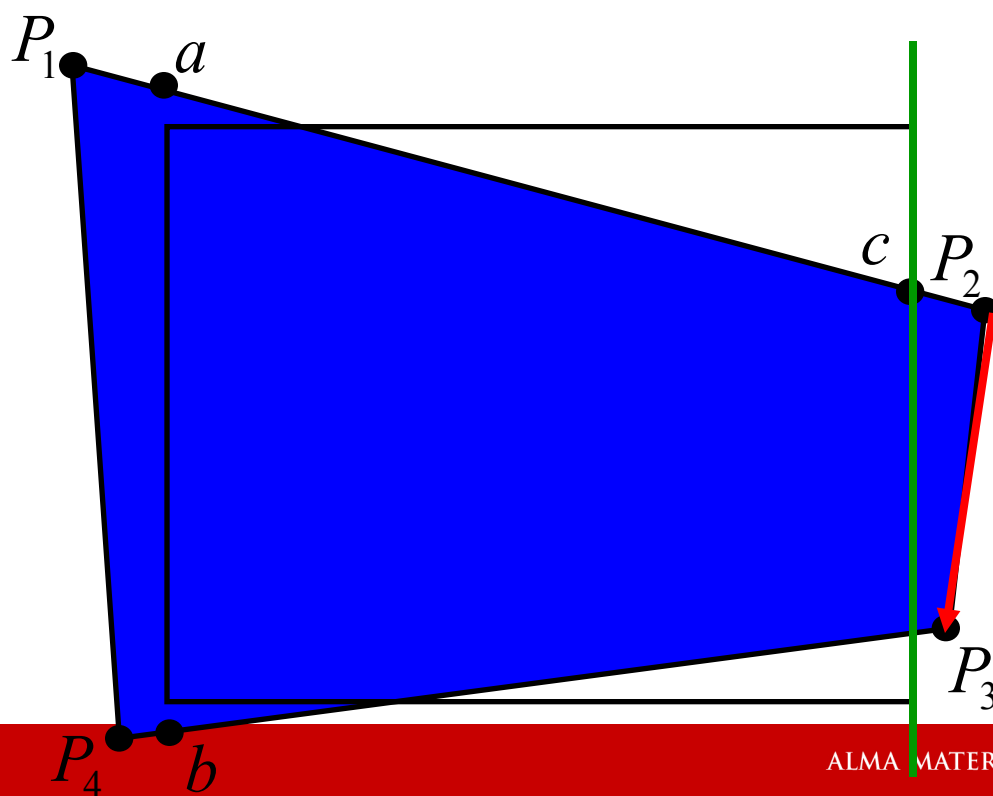
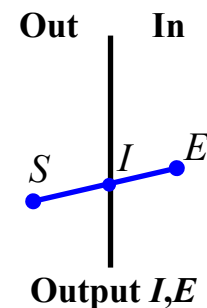
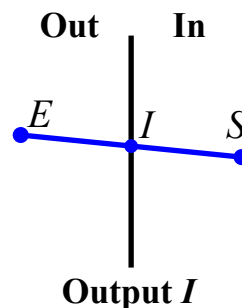
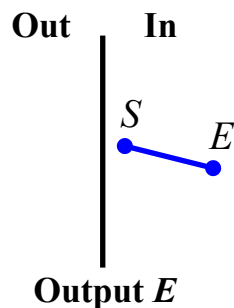
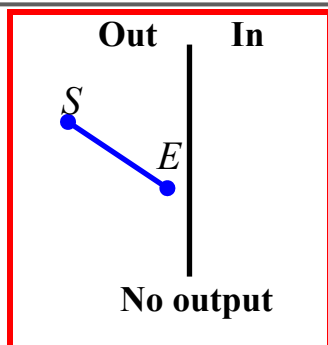
Algoritmo di Sutherland-Hodgman



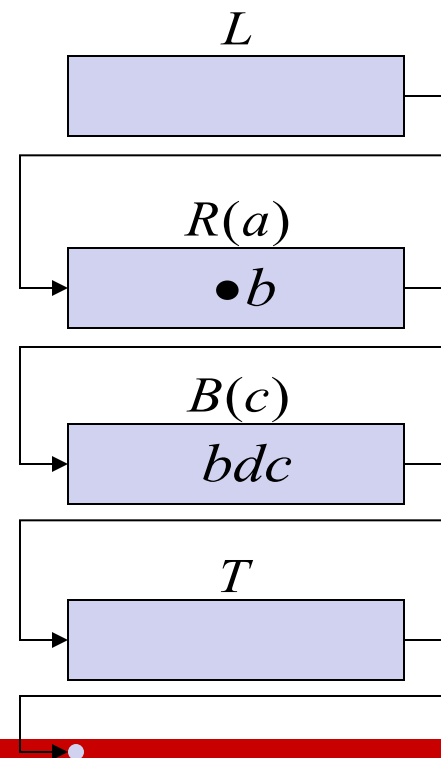
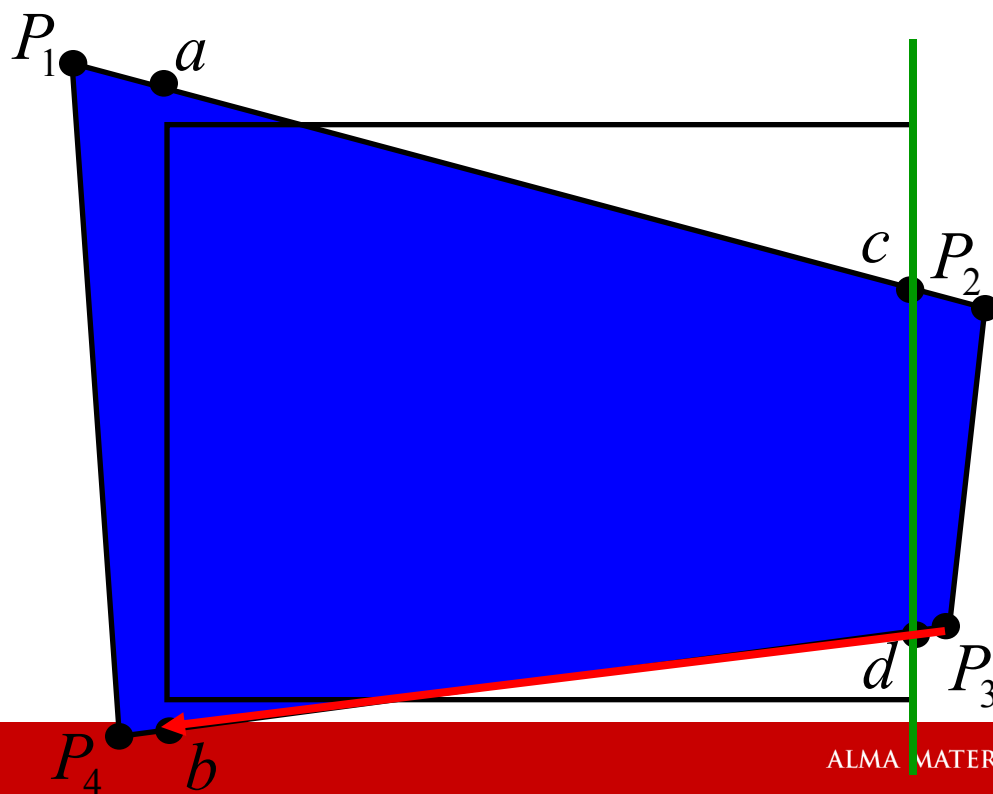
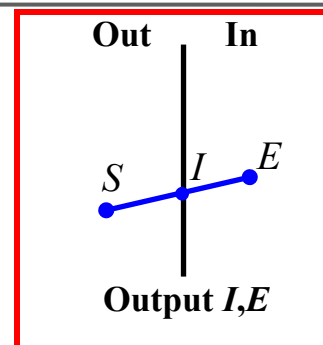
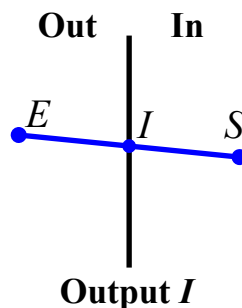
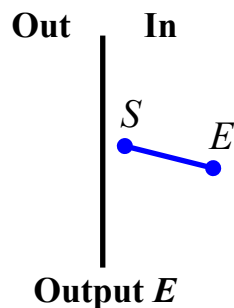
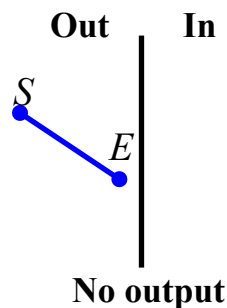
Algoritmo di Sutherland-Hodgman



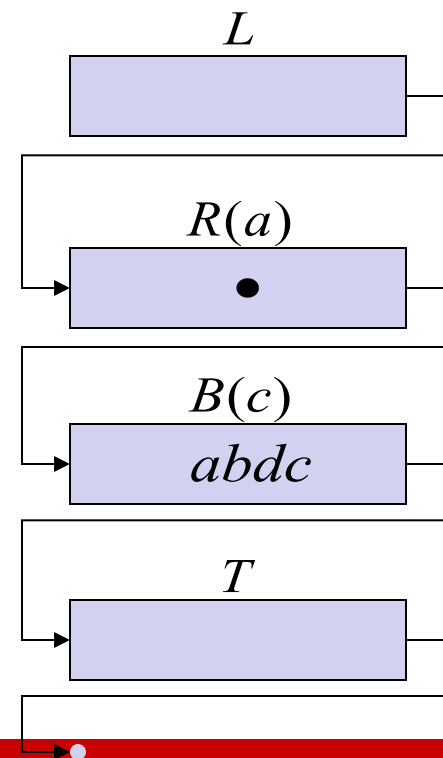
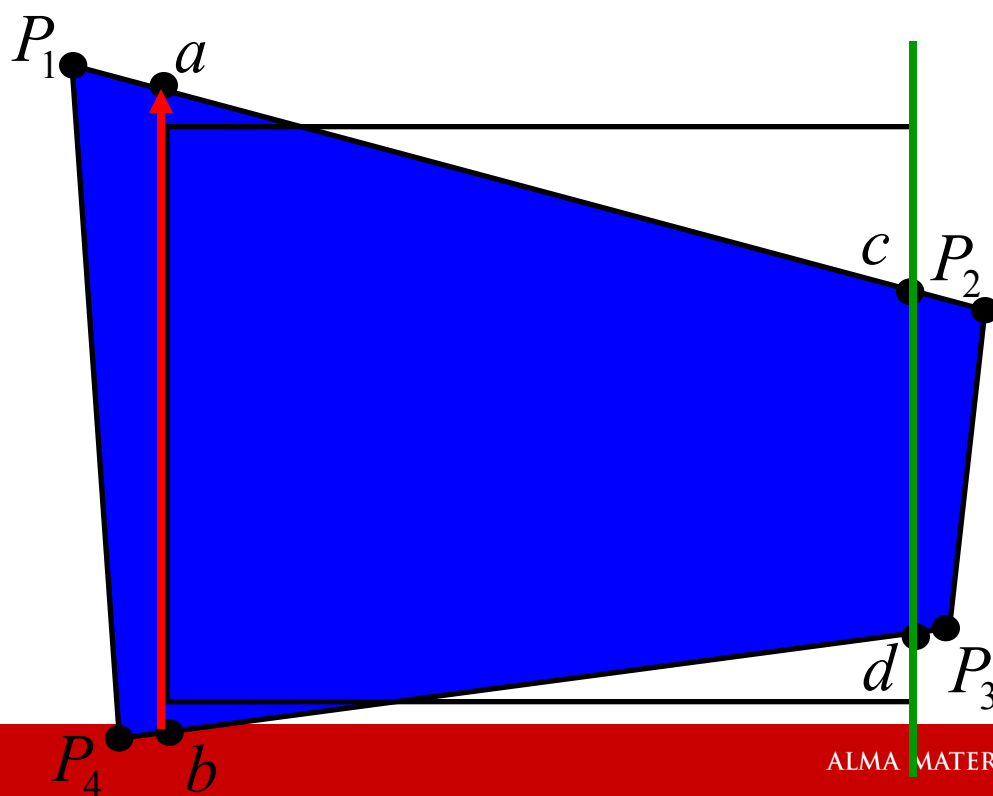
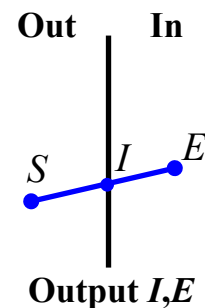
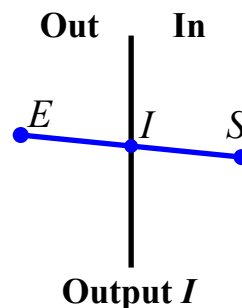
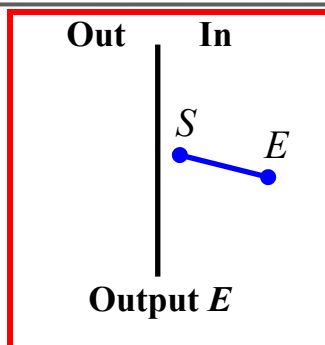
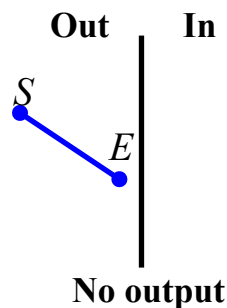
Algoritmo di Sutherland-Hodgman



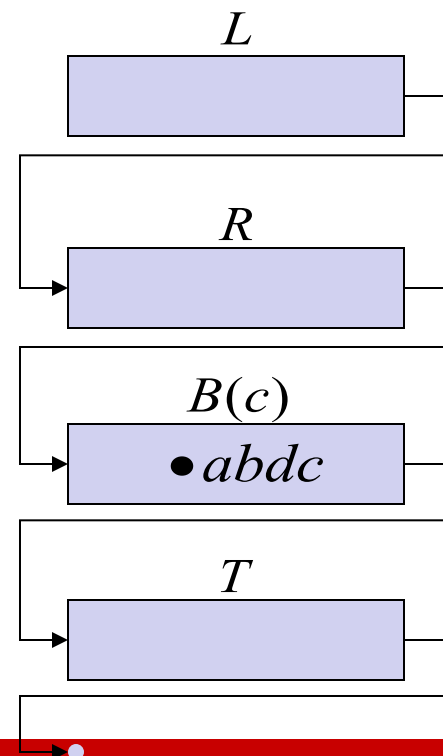
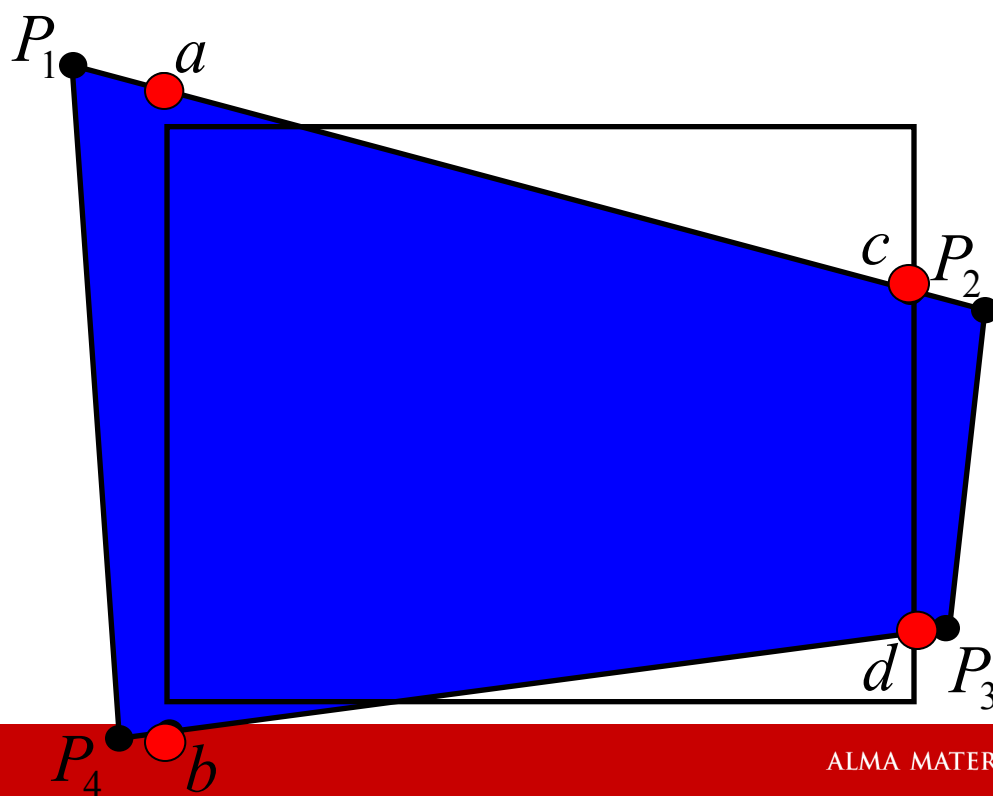
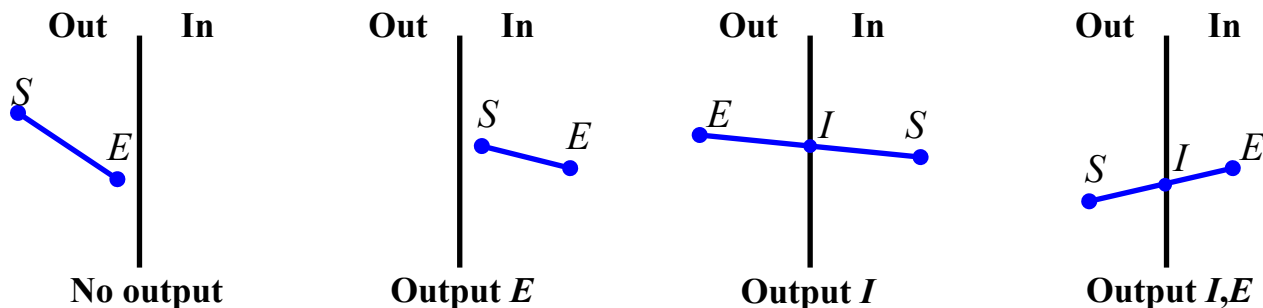
Algoritmo di Sutherland-Hodgman



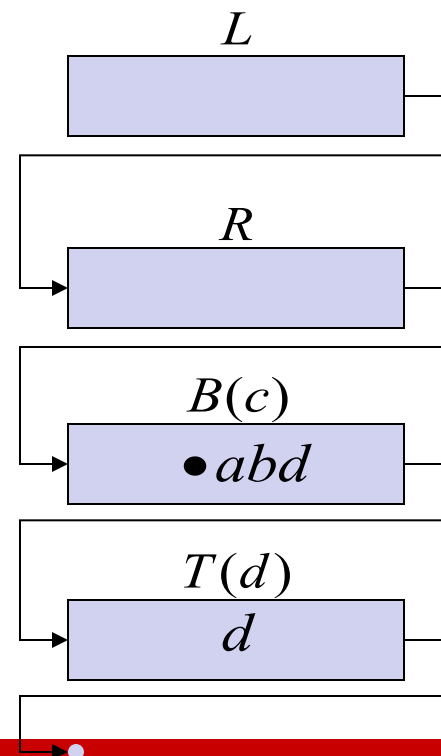
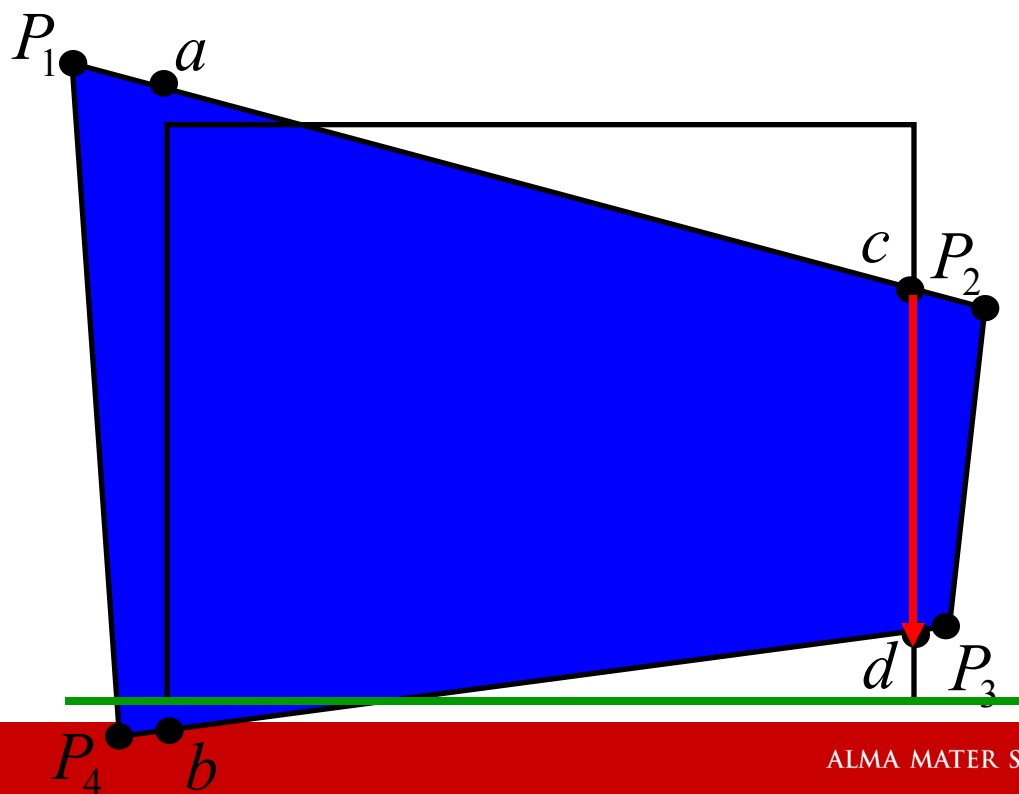
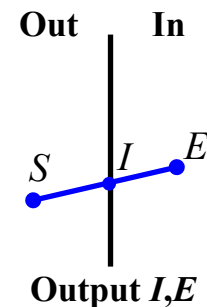
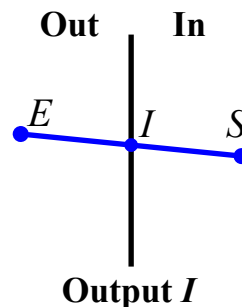
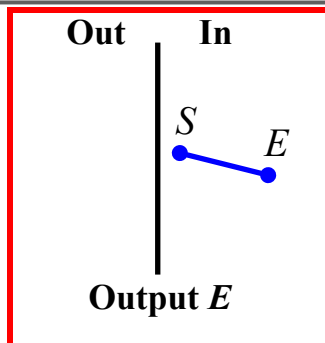
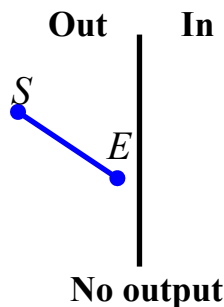
Algoritmo di Sutherland-Hodgman



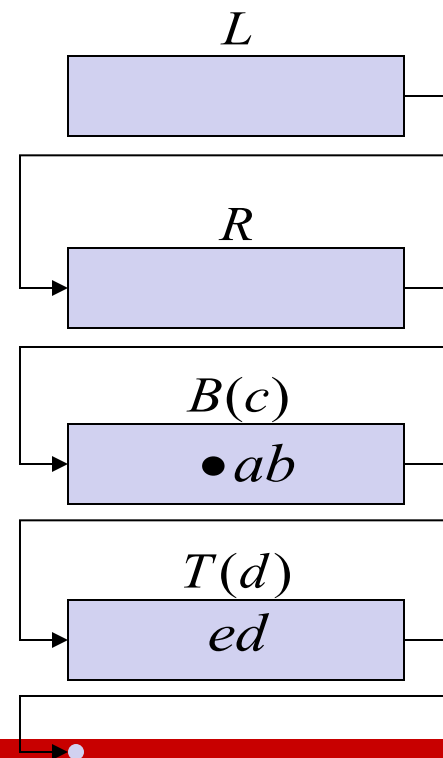
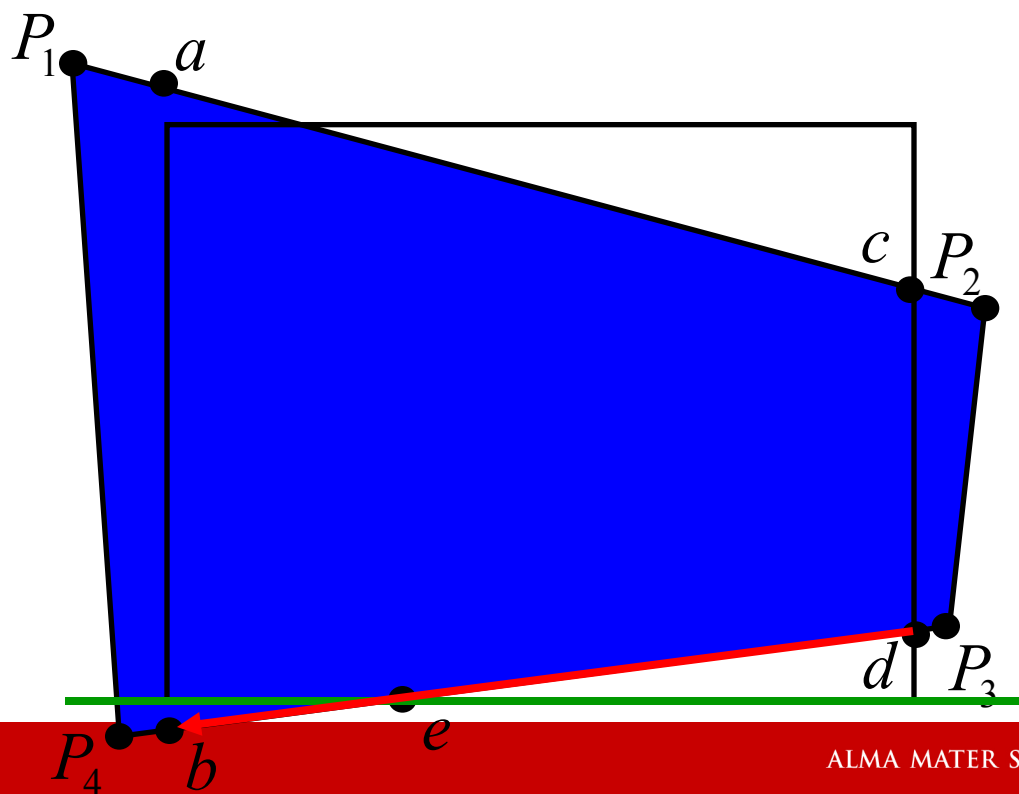
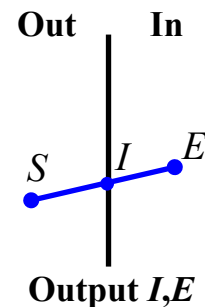
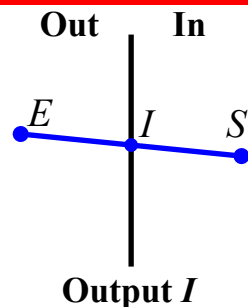
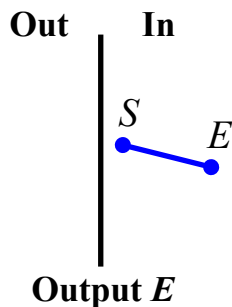
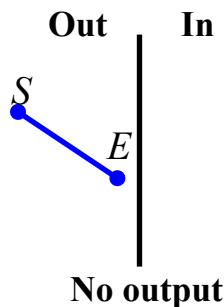
Algoritmo di Sutherland-Hodgman



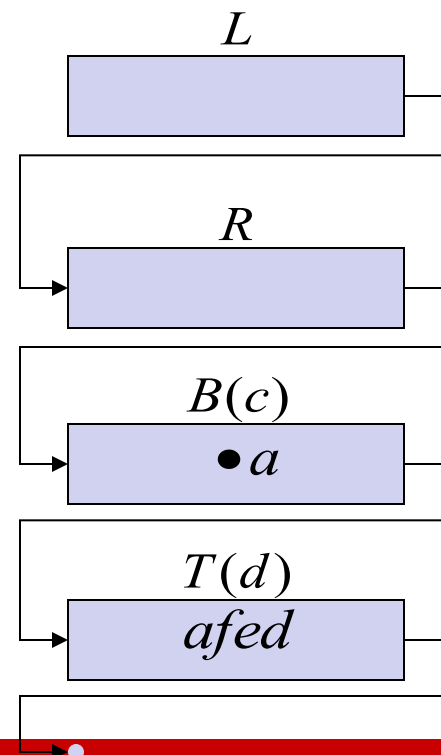
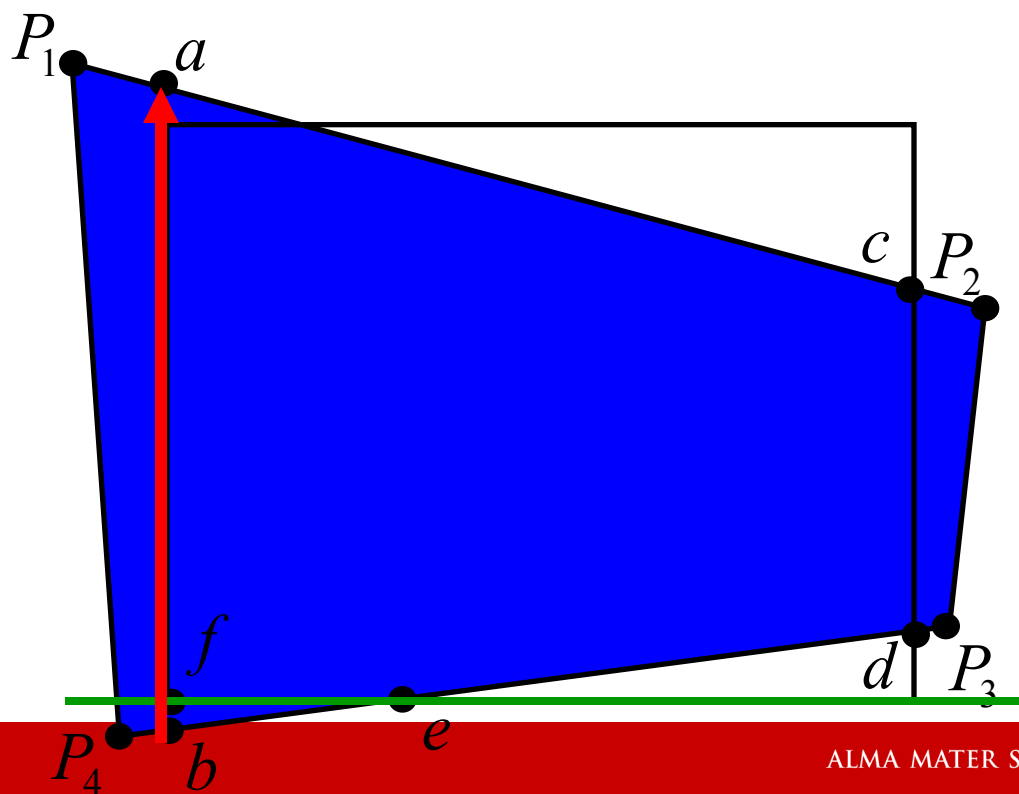
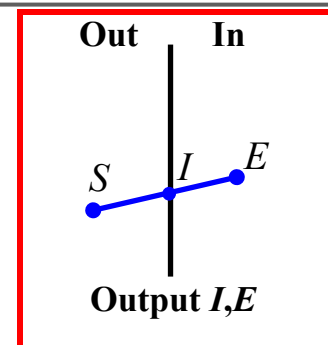
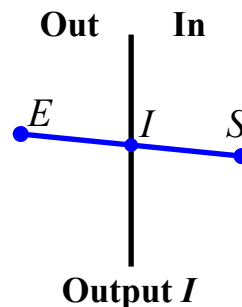
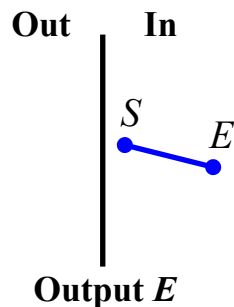
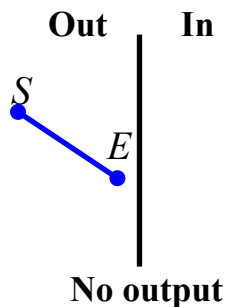
Algoritmo di Sutherland-Hodgman



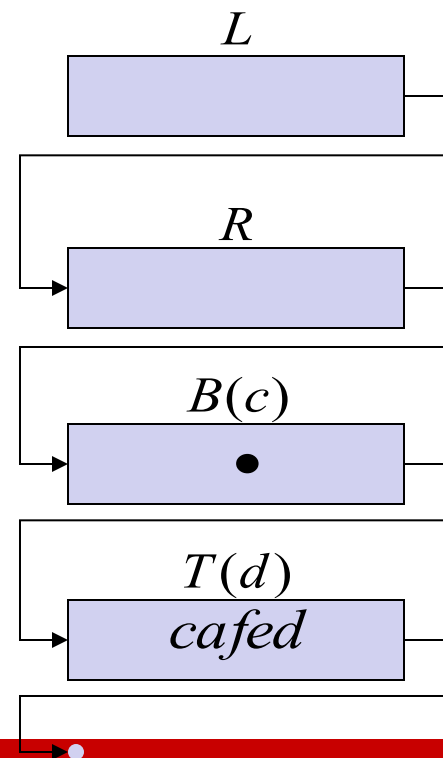
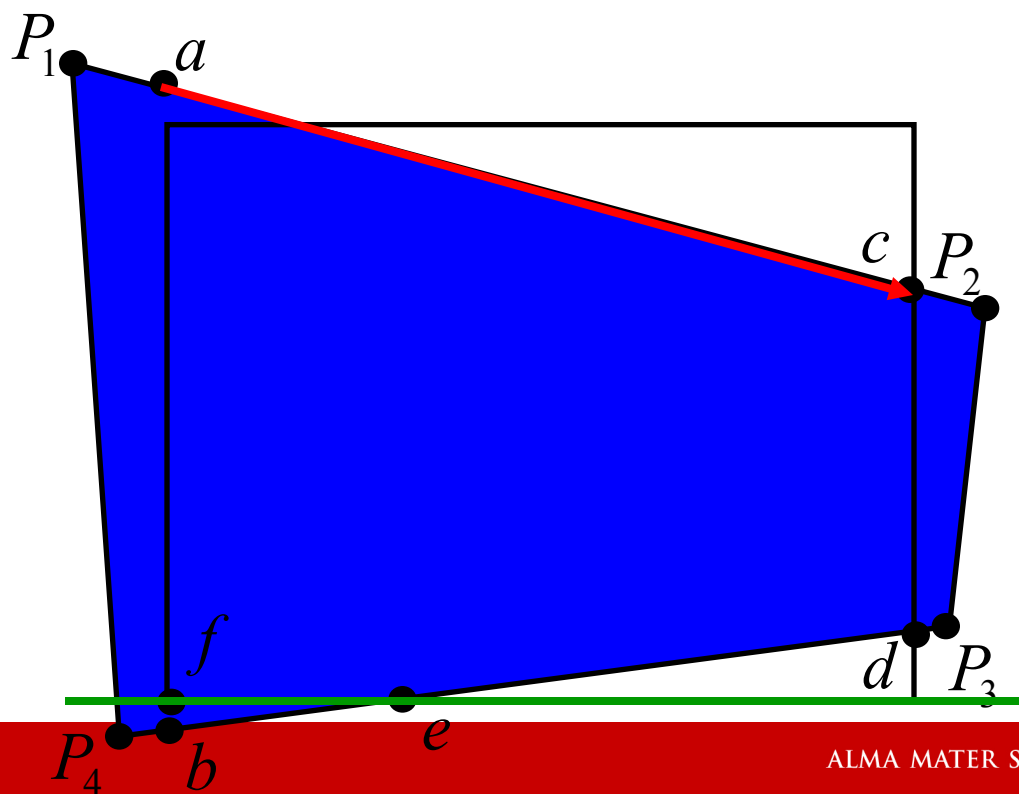
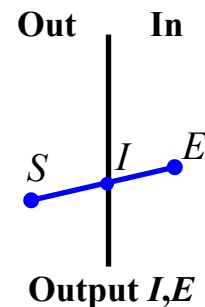
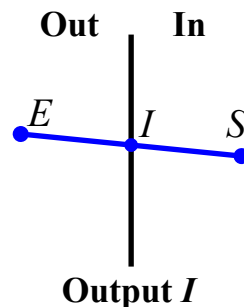
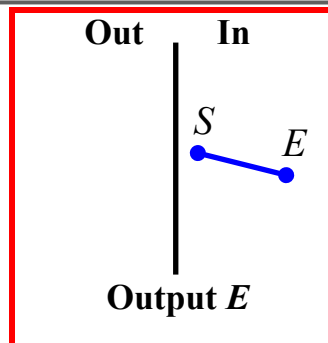
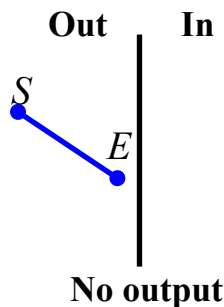
Algoritmo di Sutherland-Hodgman



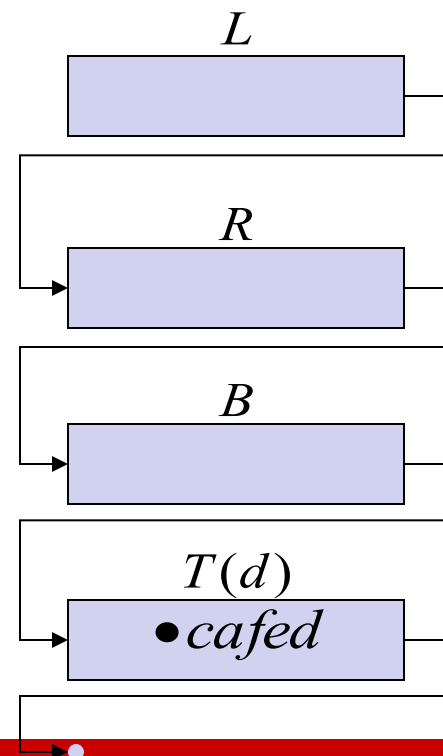
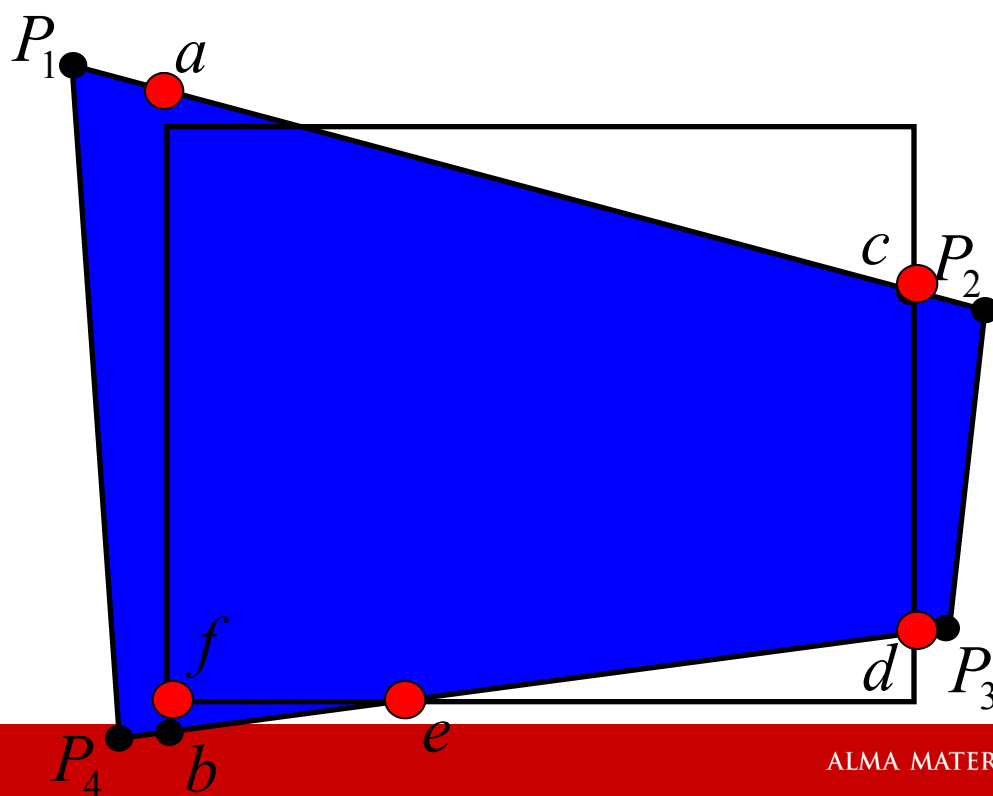
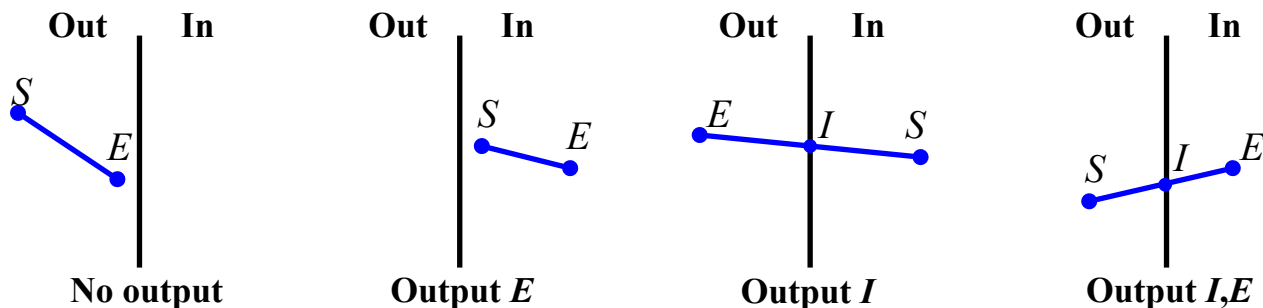
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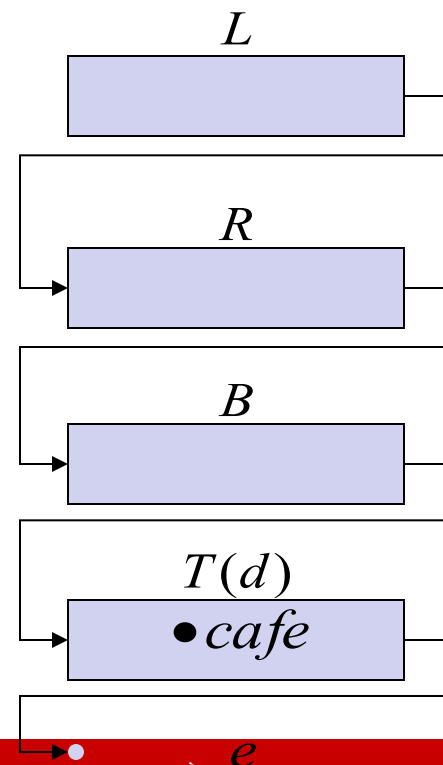
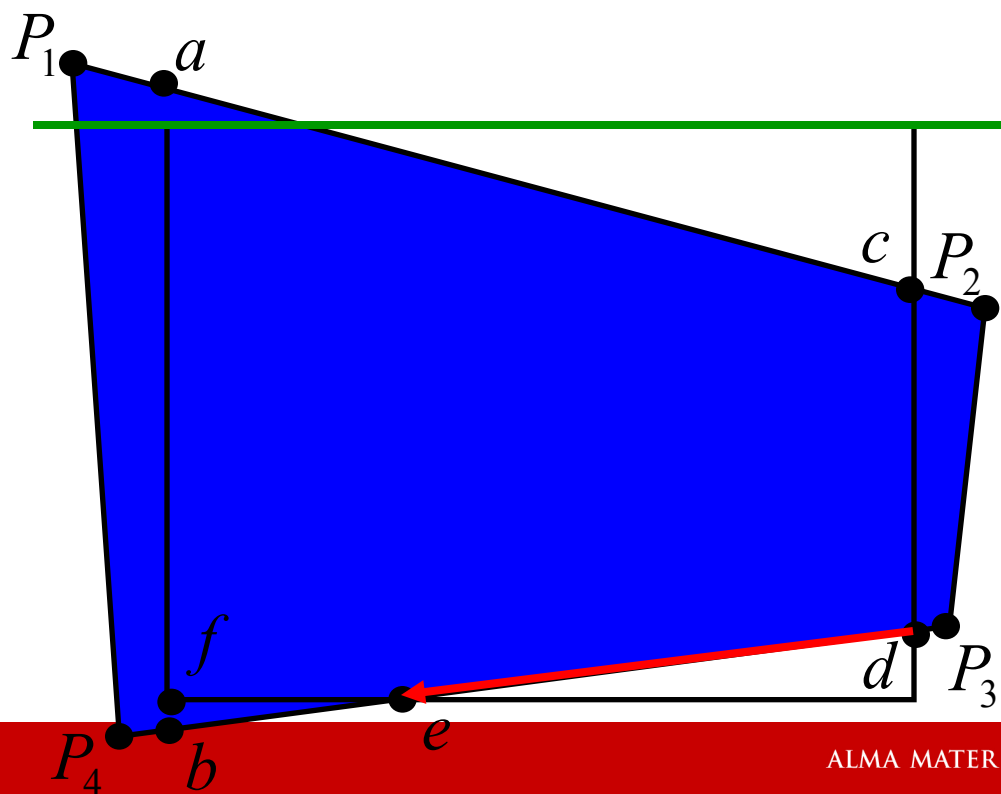
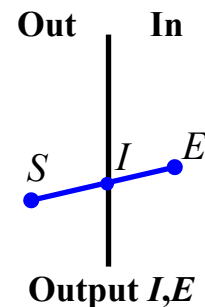
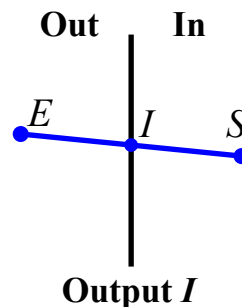
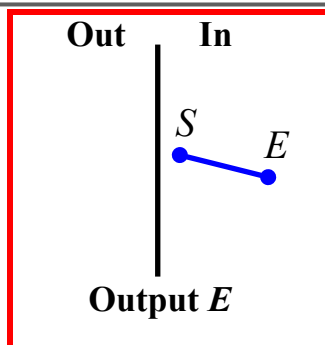
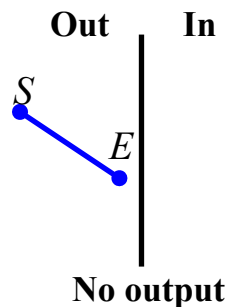
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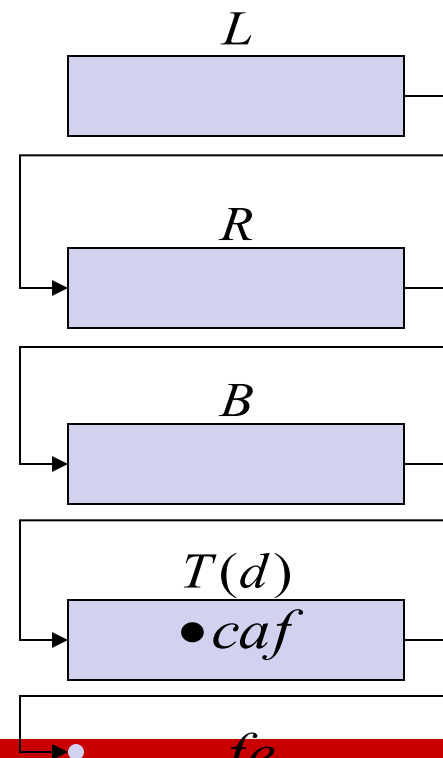
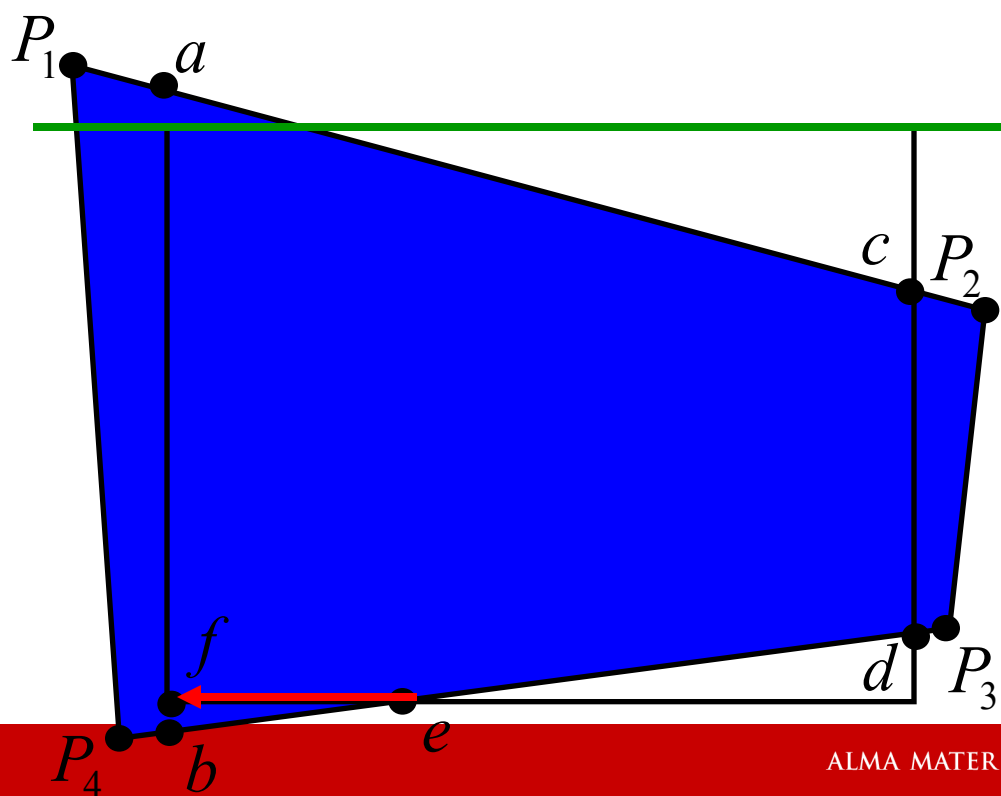
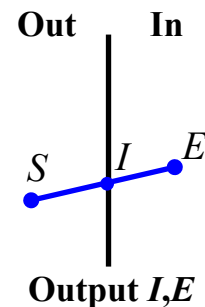
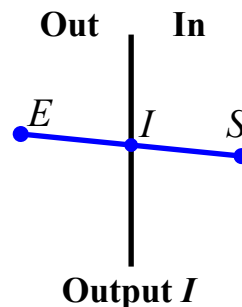
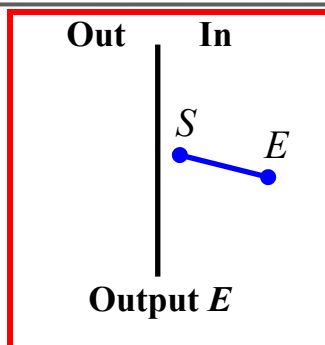
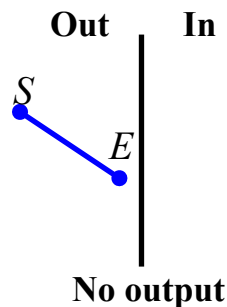
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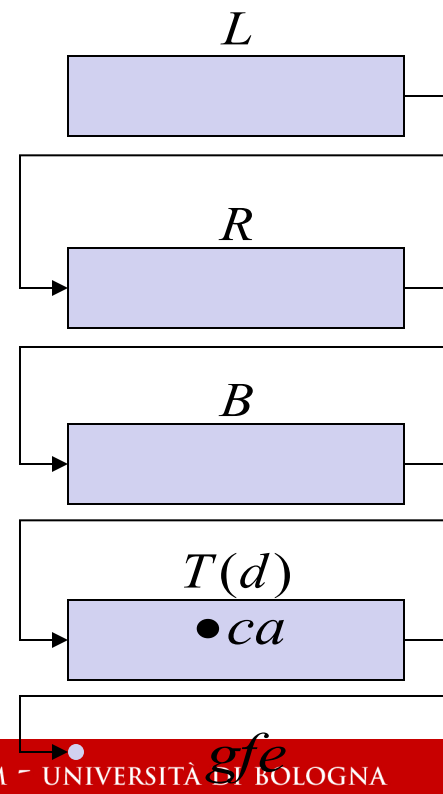
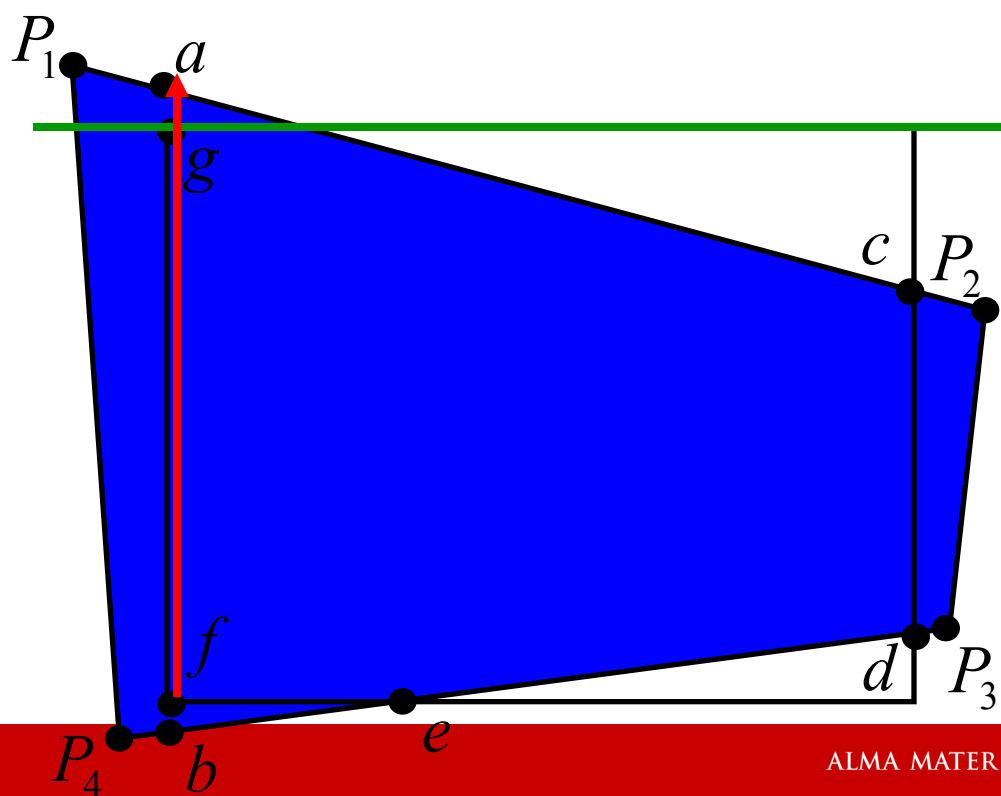
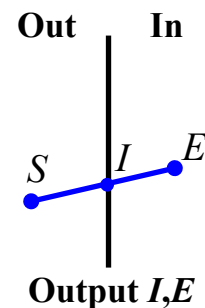
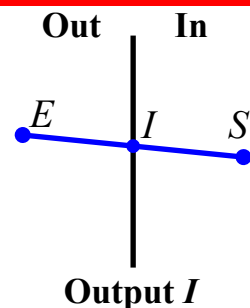
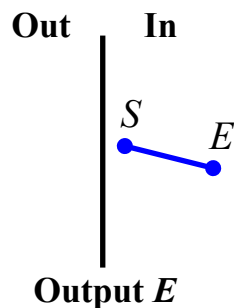
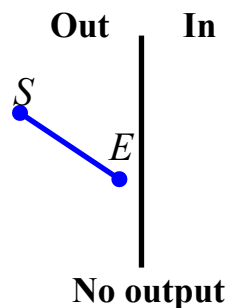
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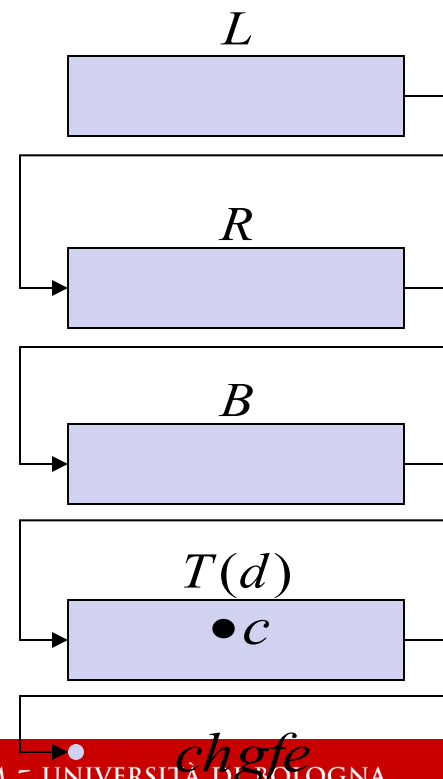
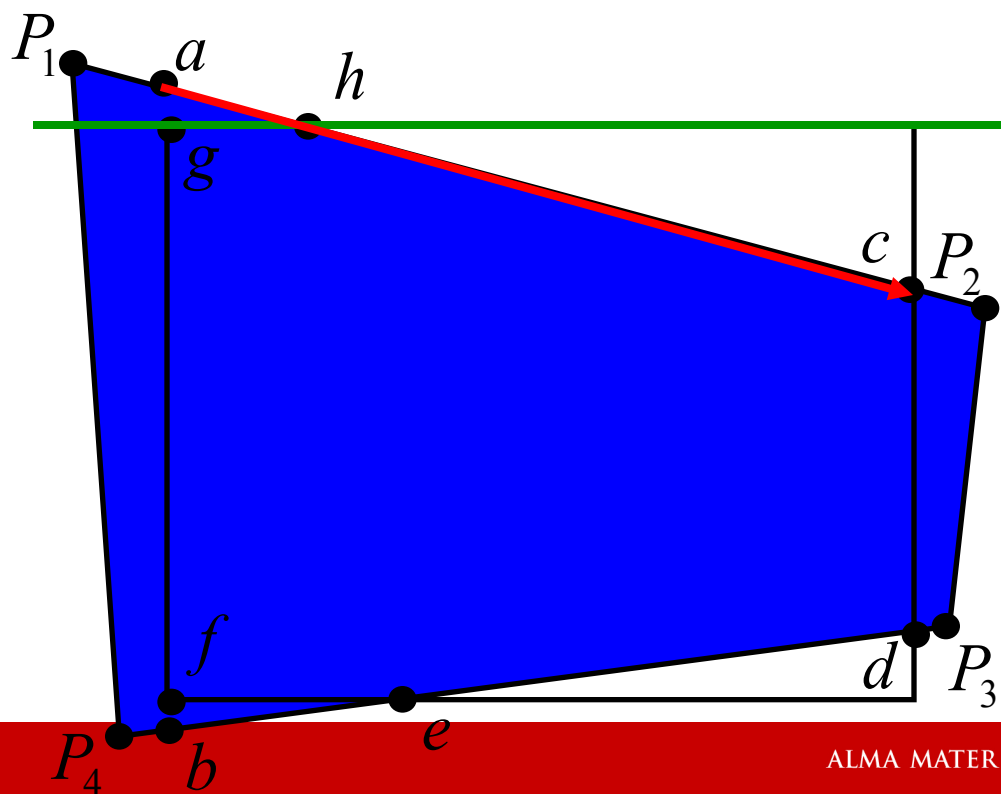
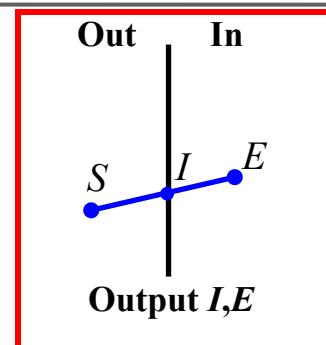
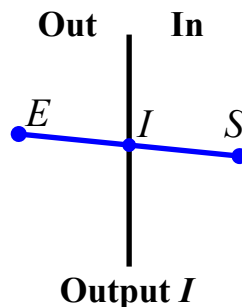
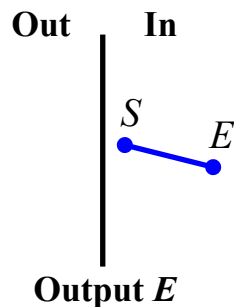
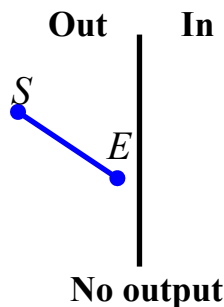
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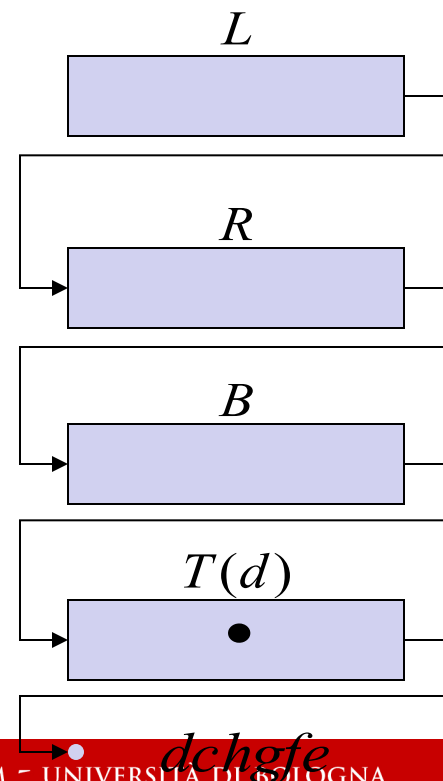
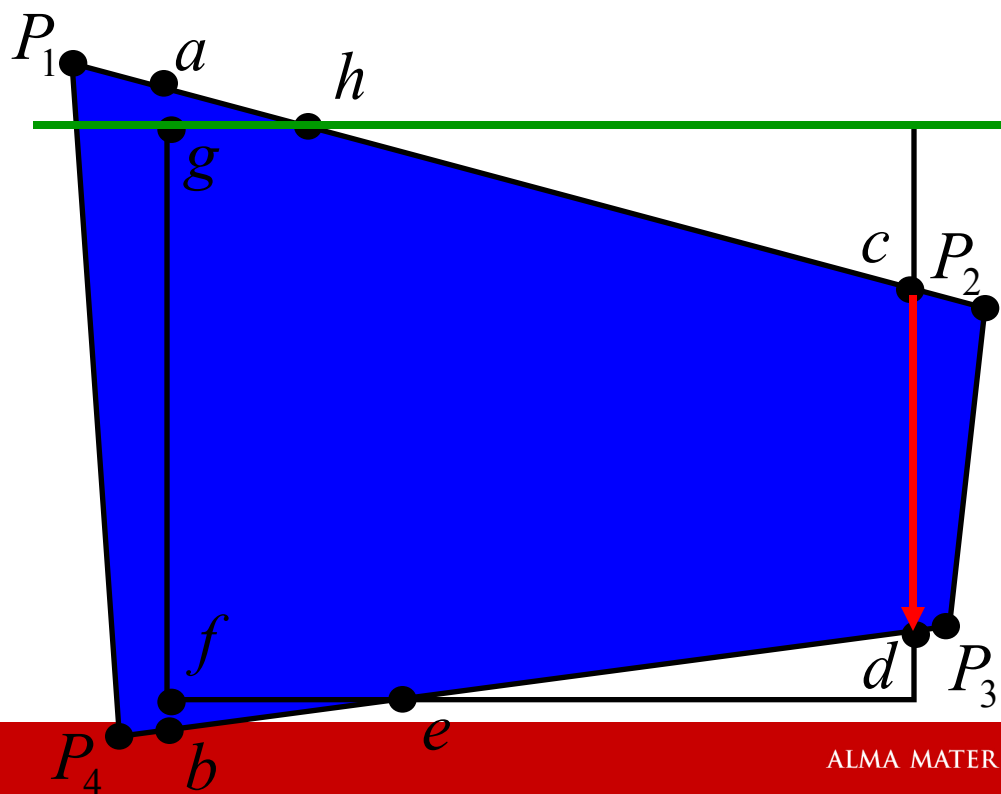
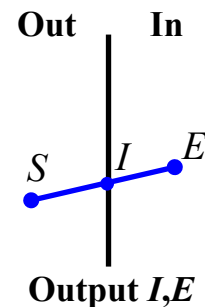
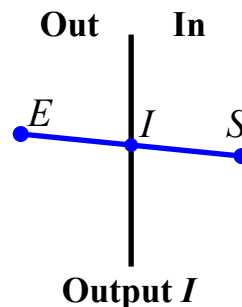
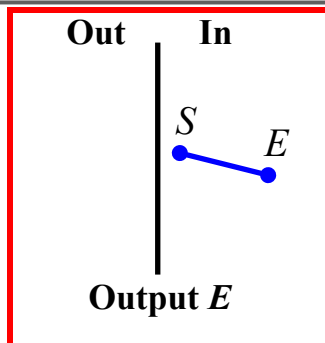
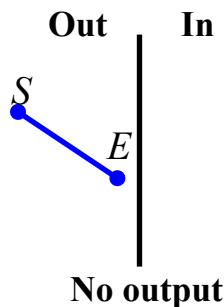
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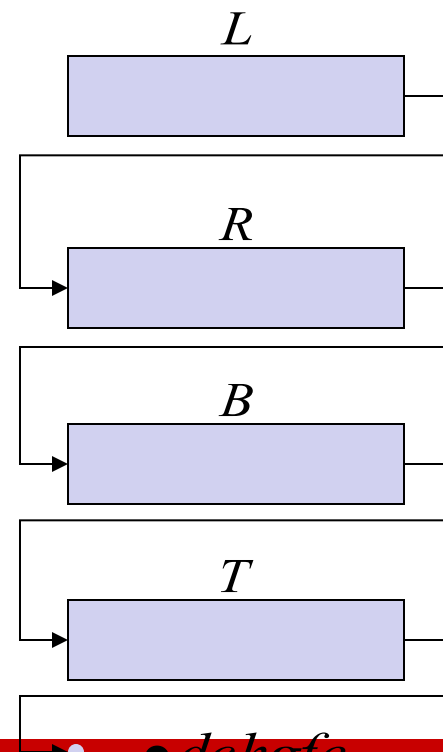
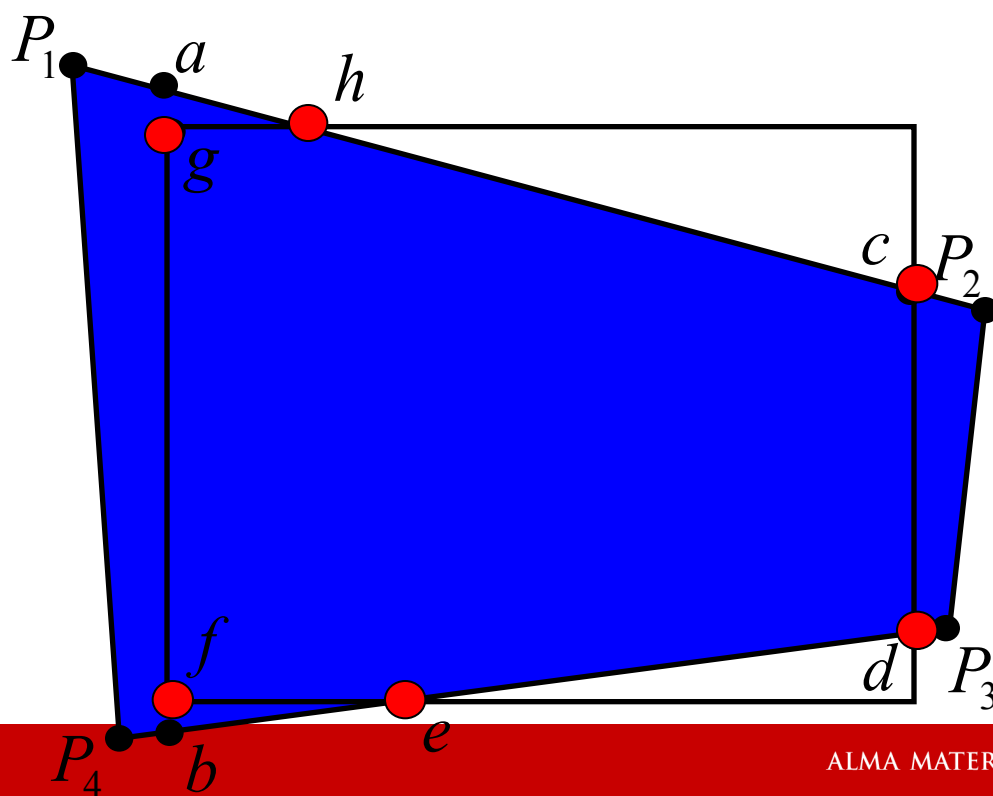
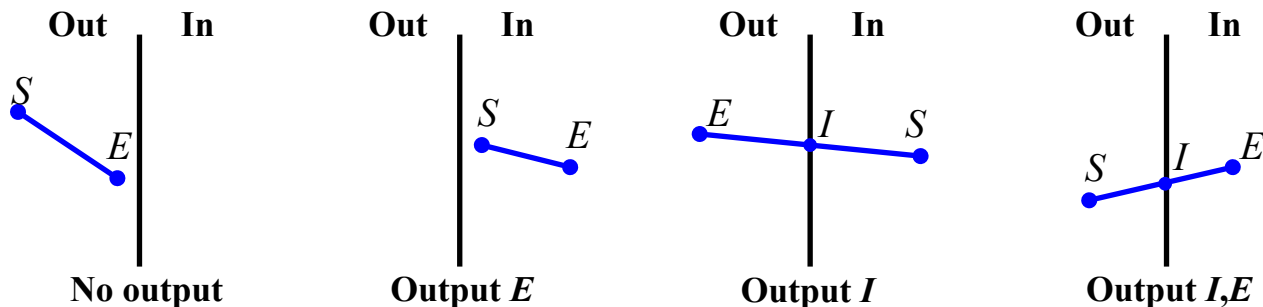
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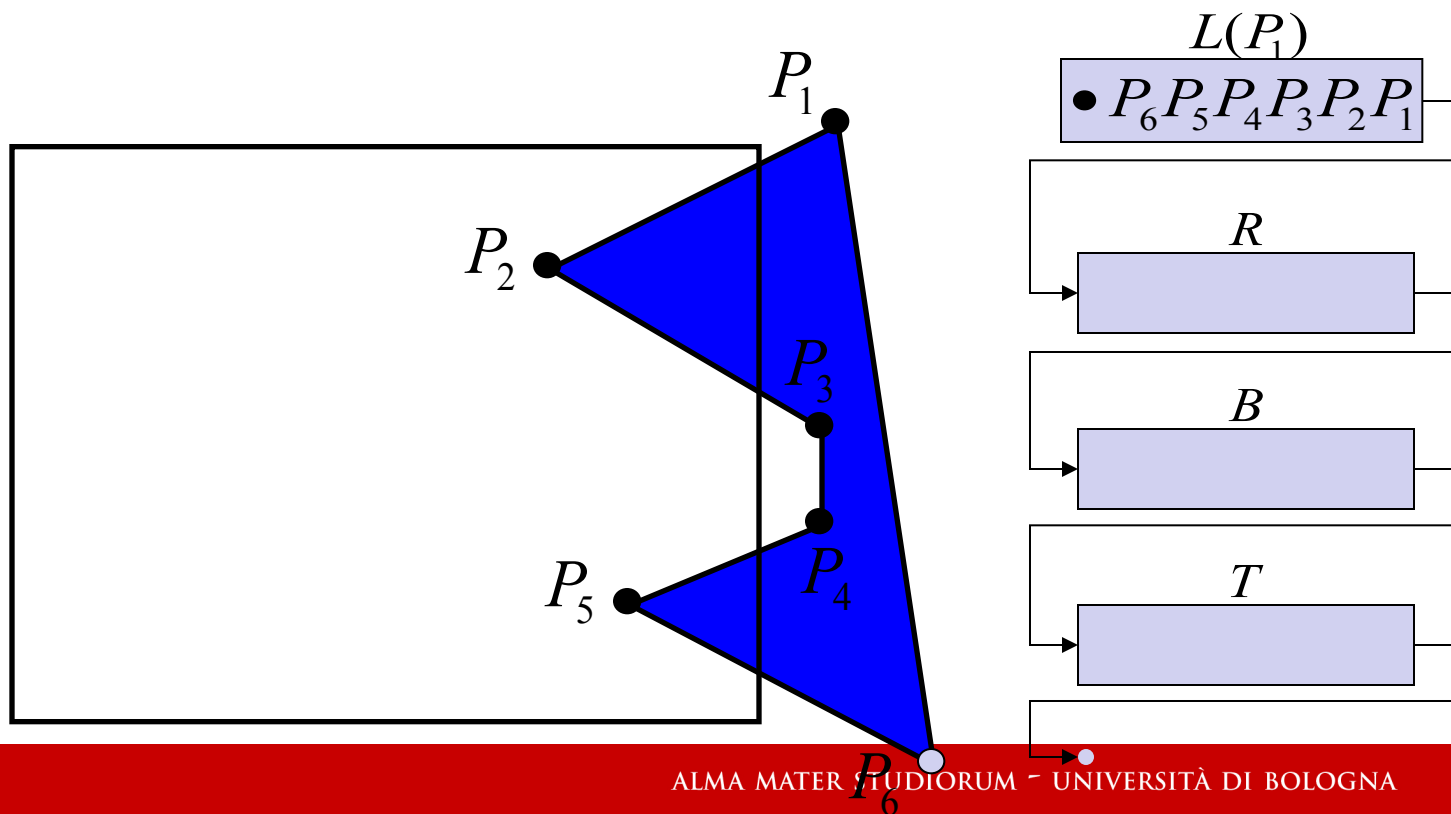
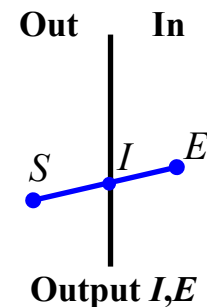
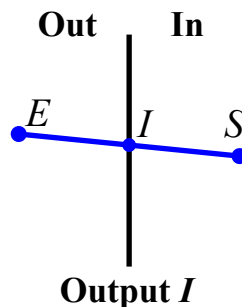
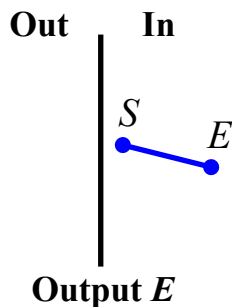
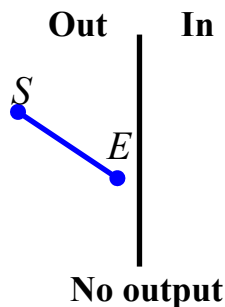


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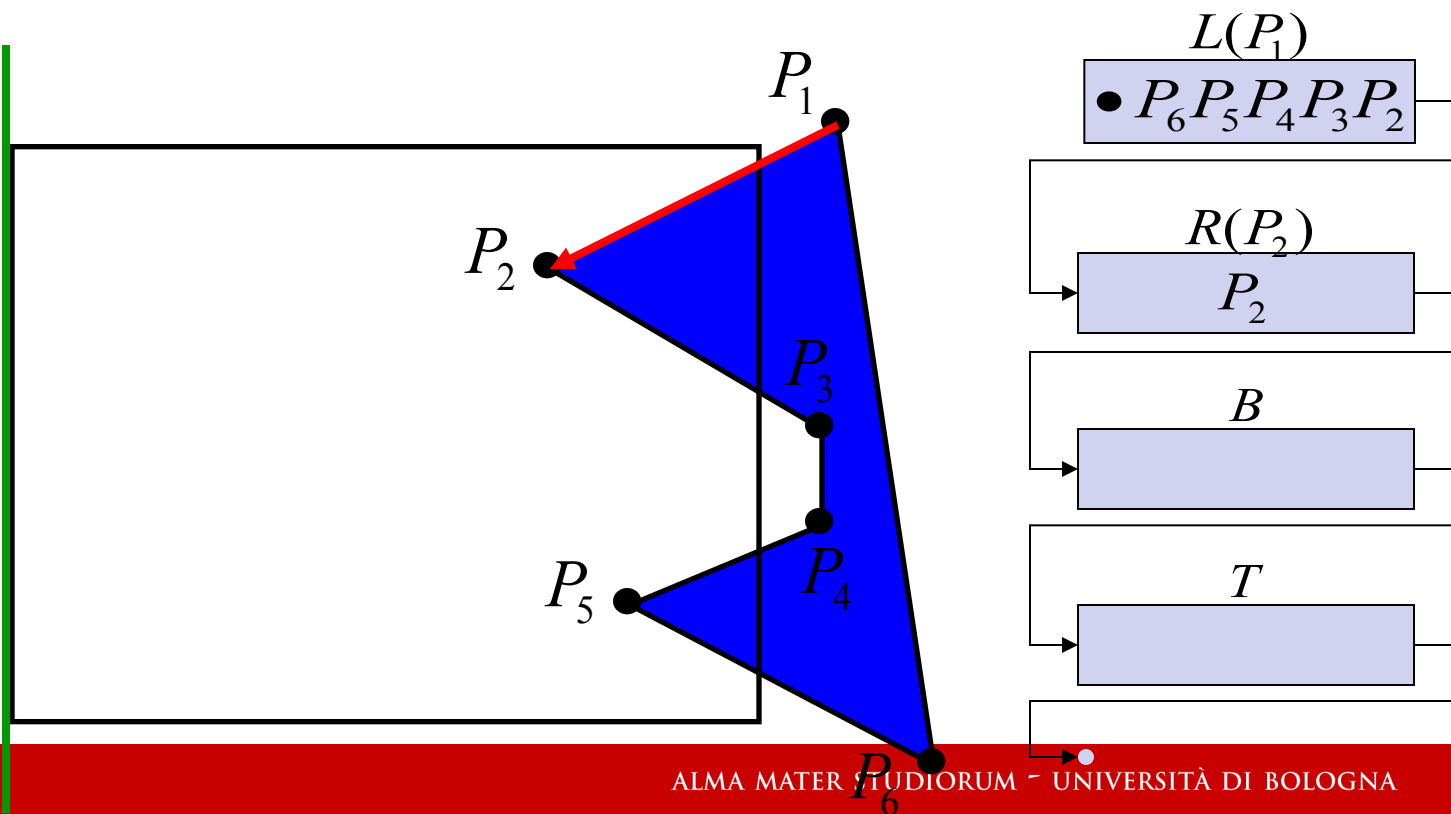
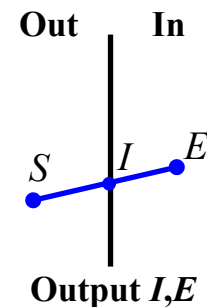
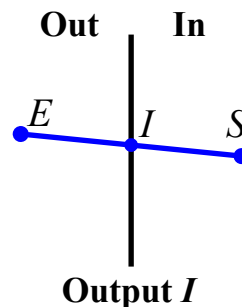
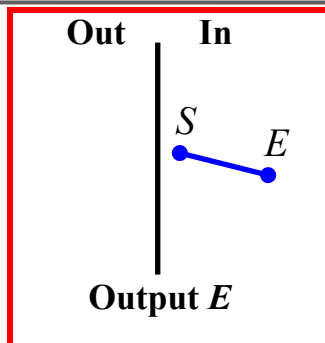
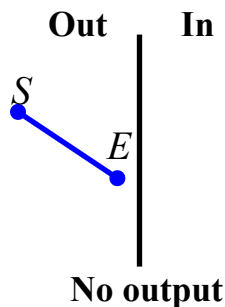


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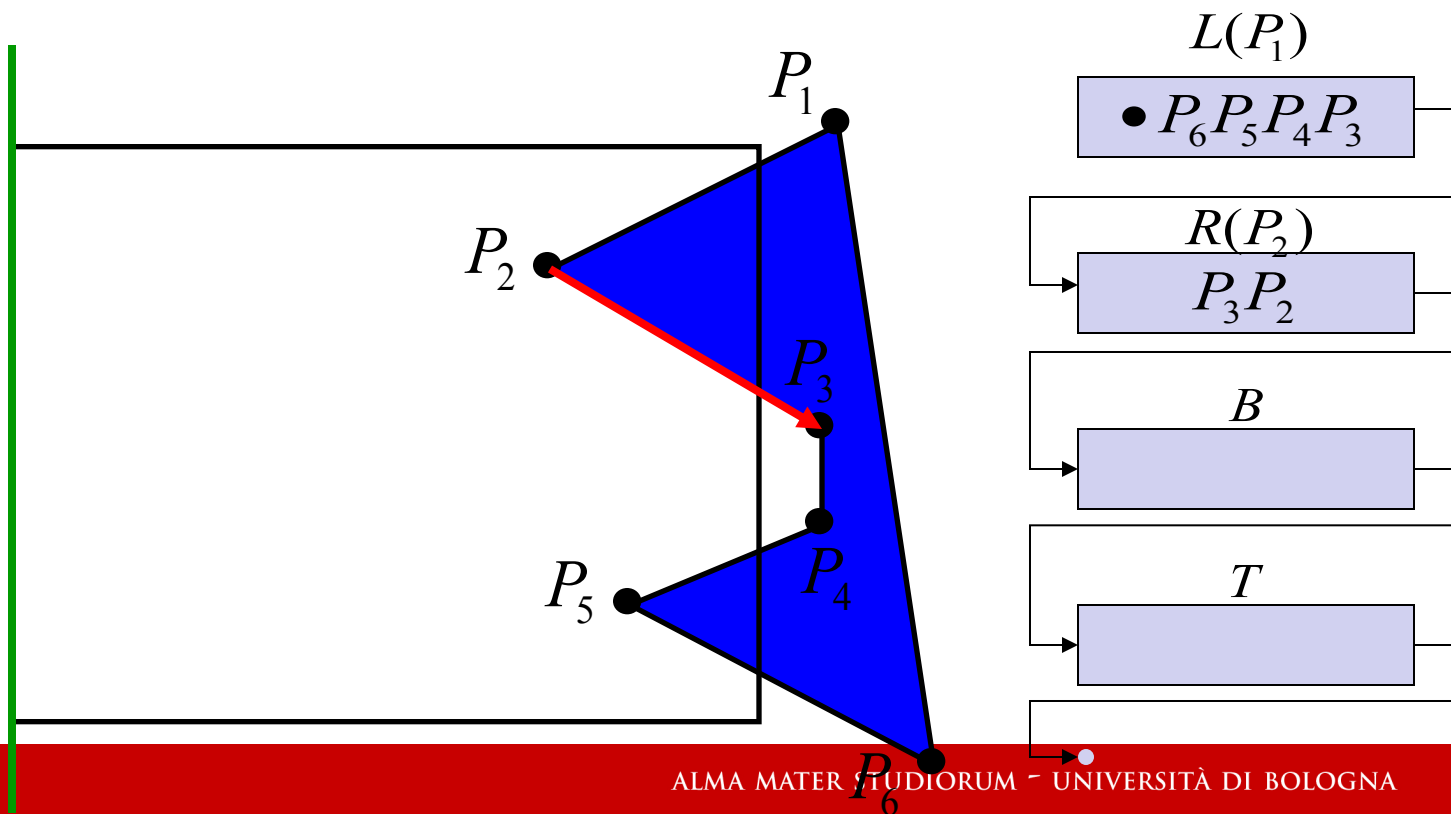
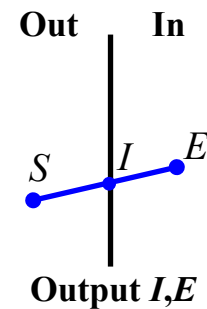
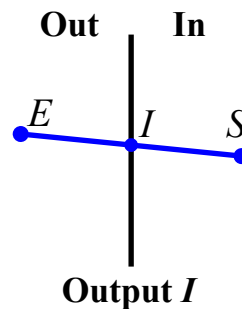
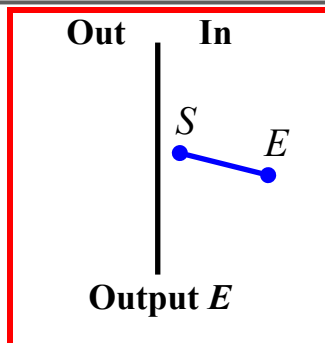
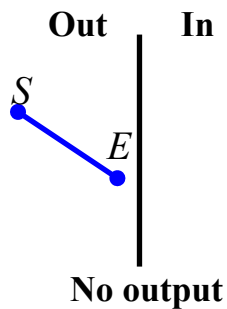


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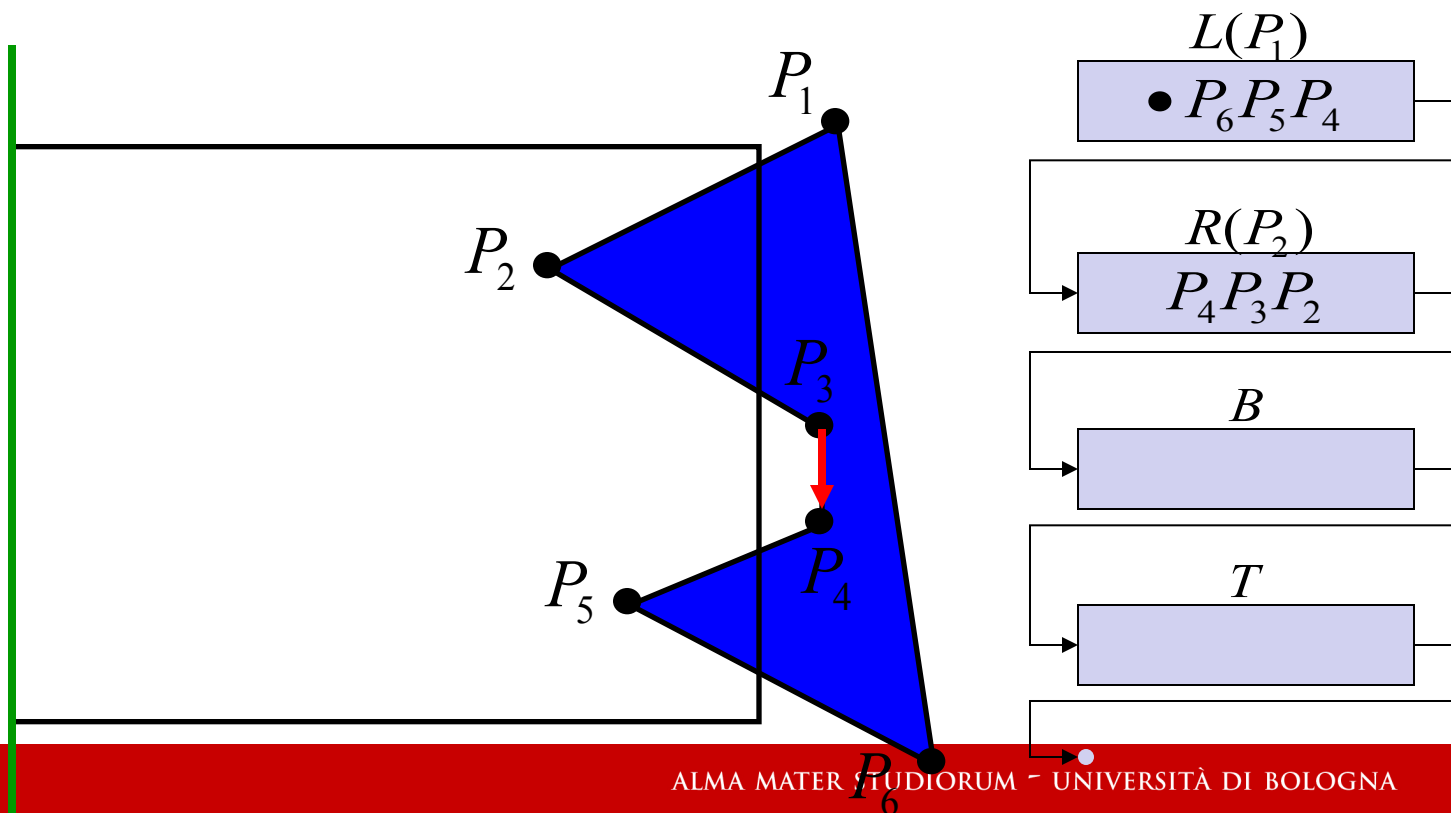
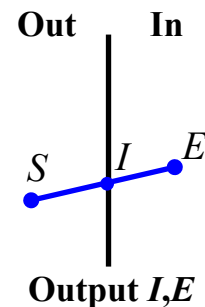
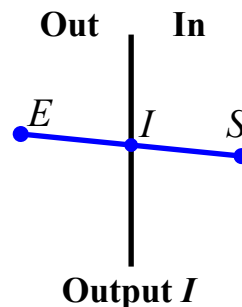
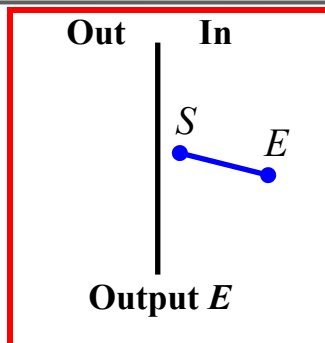
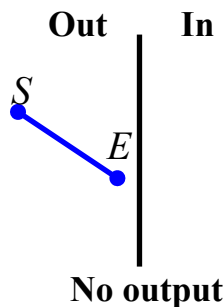


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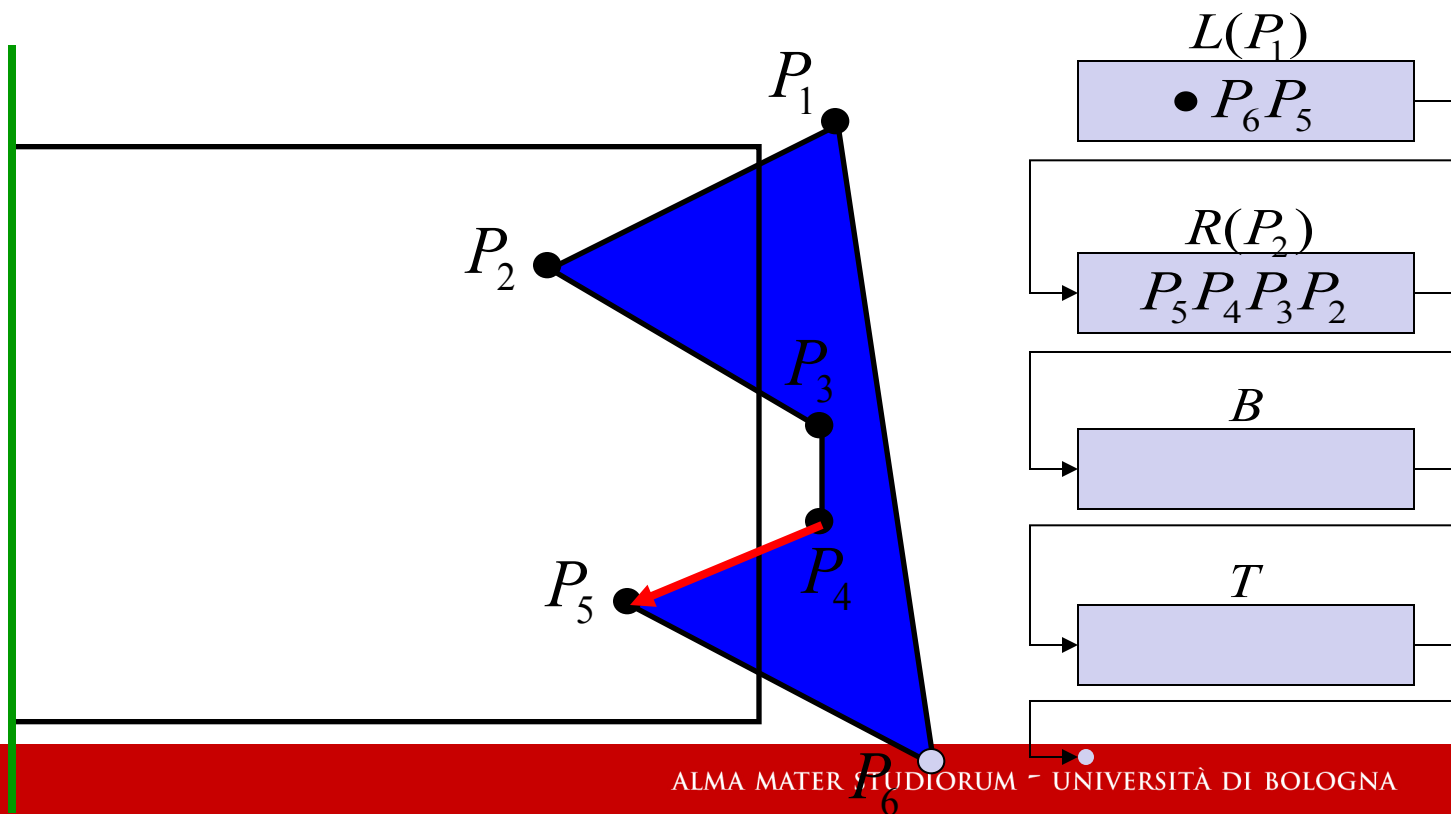
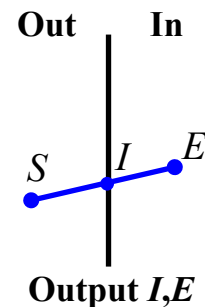
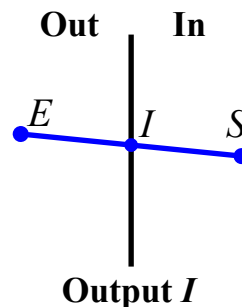
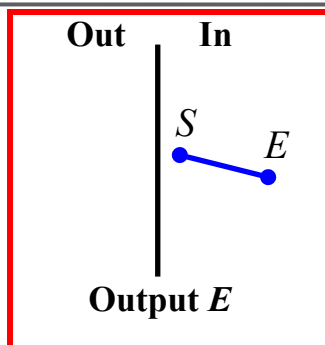
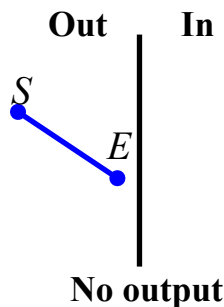


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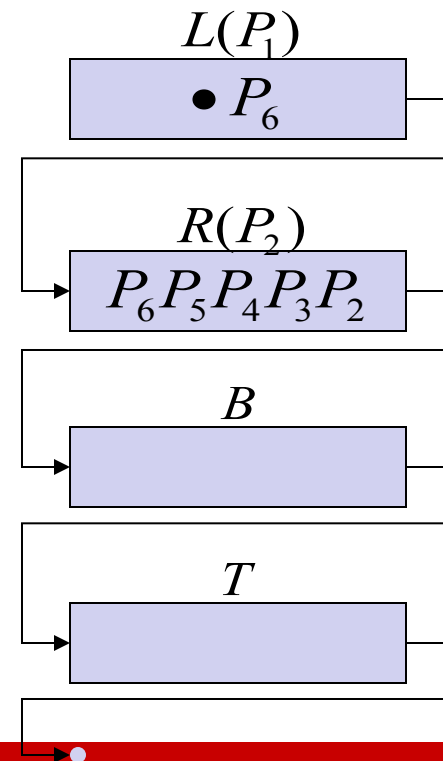
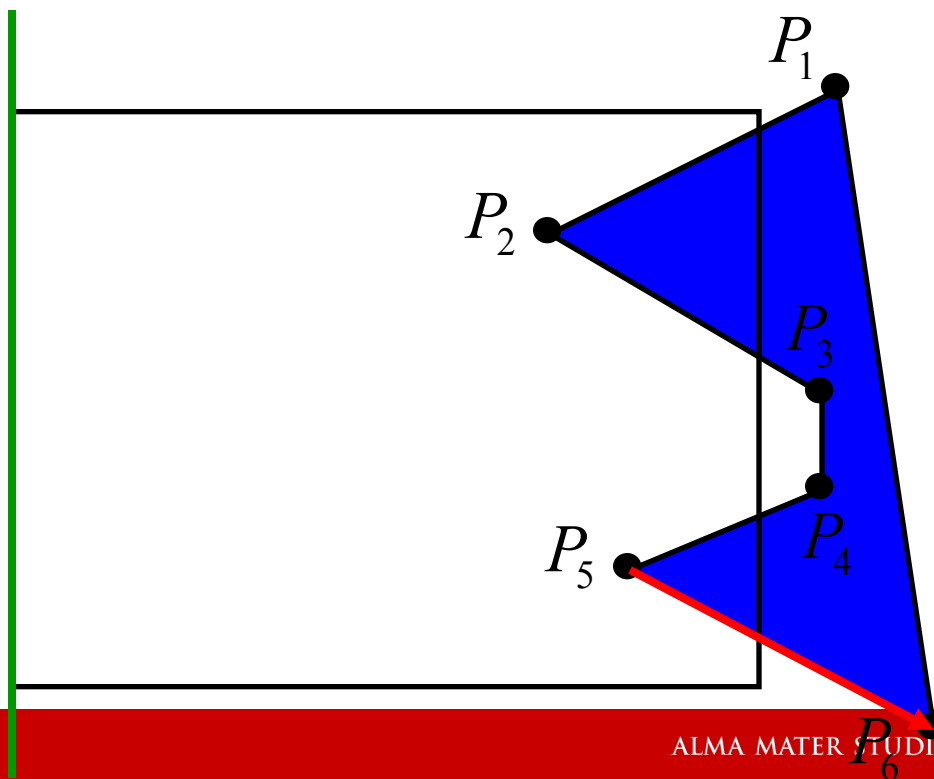
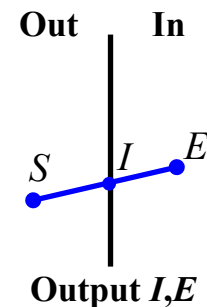
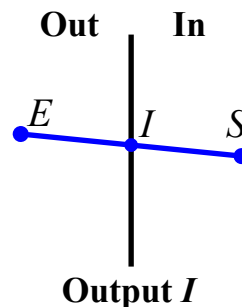
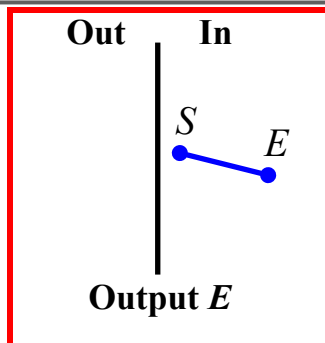
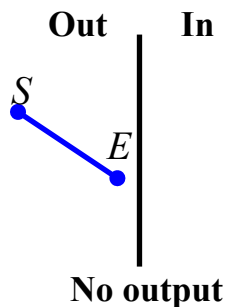


Algoritmo di Sutherland-Hodgman



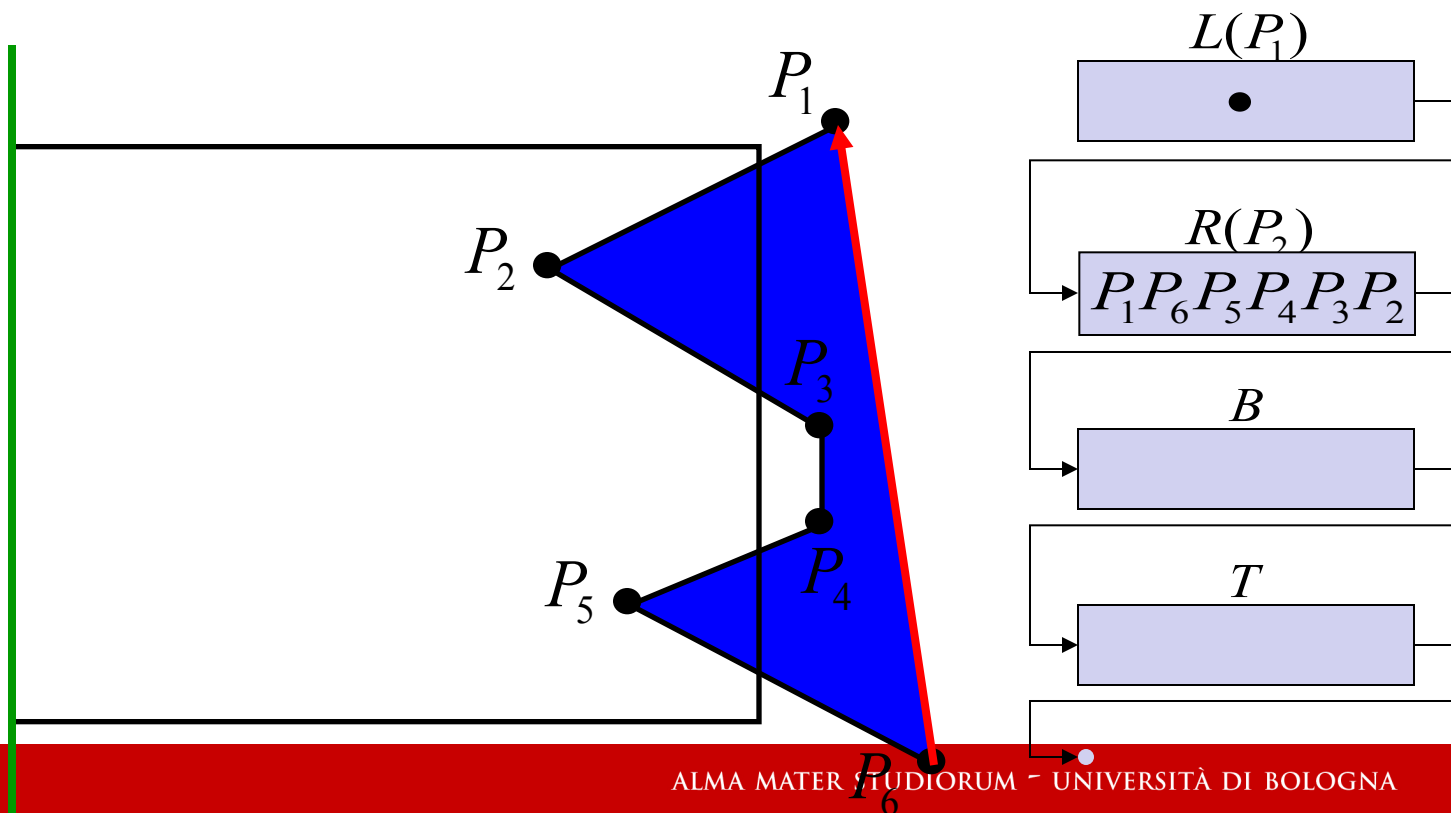
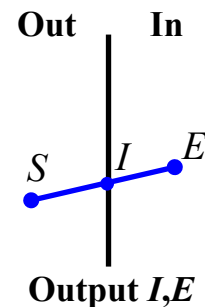
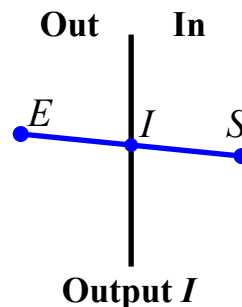
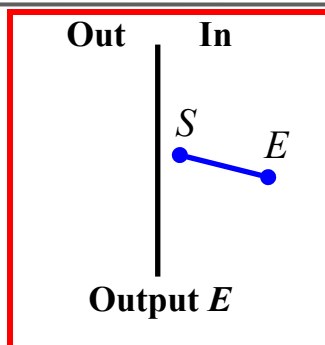
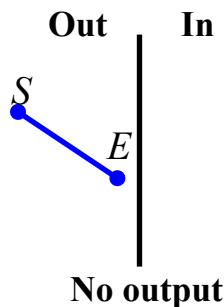


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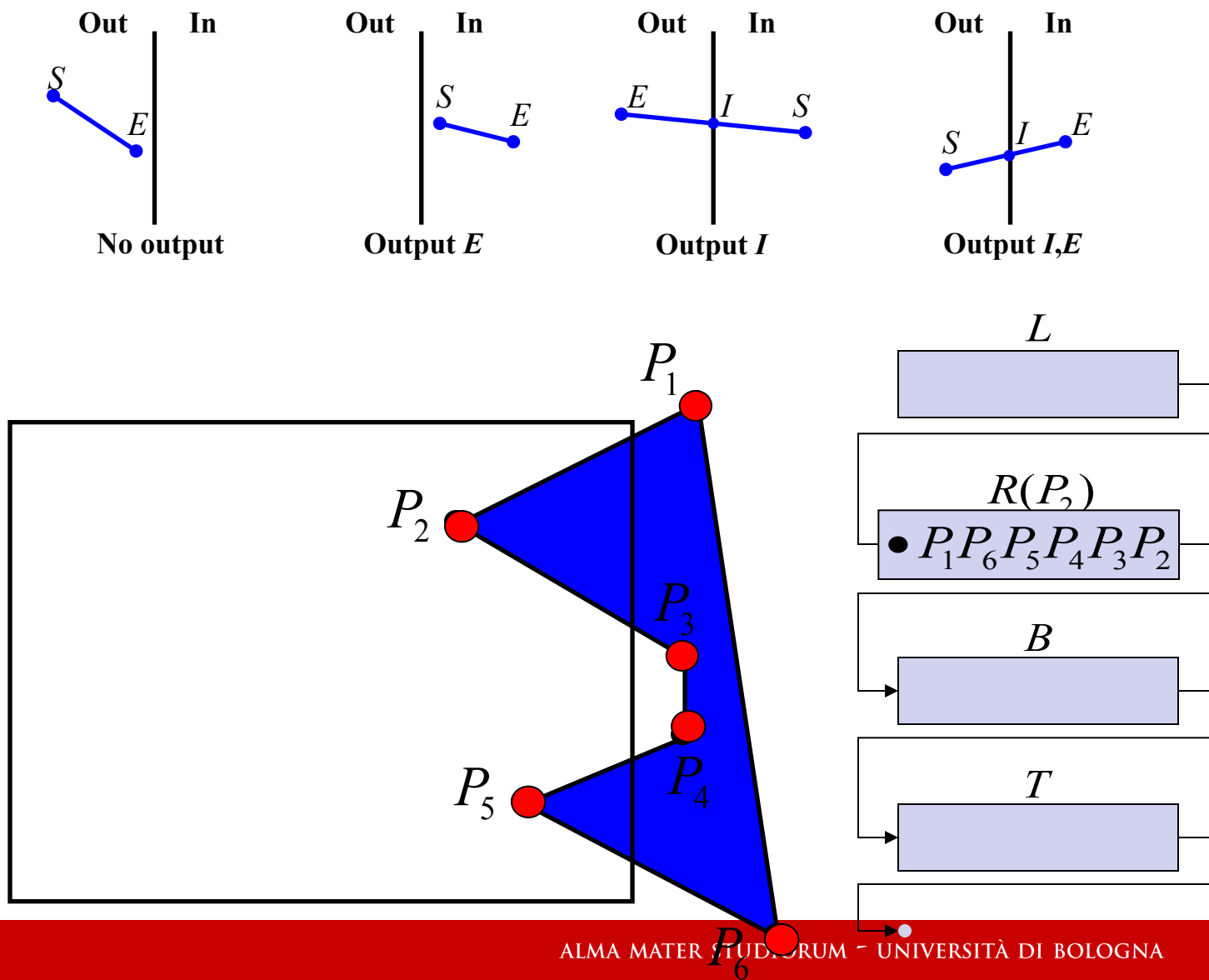


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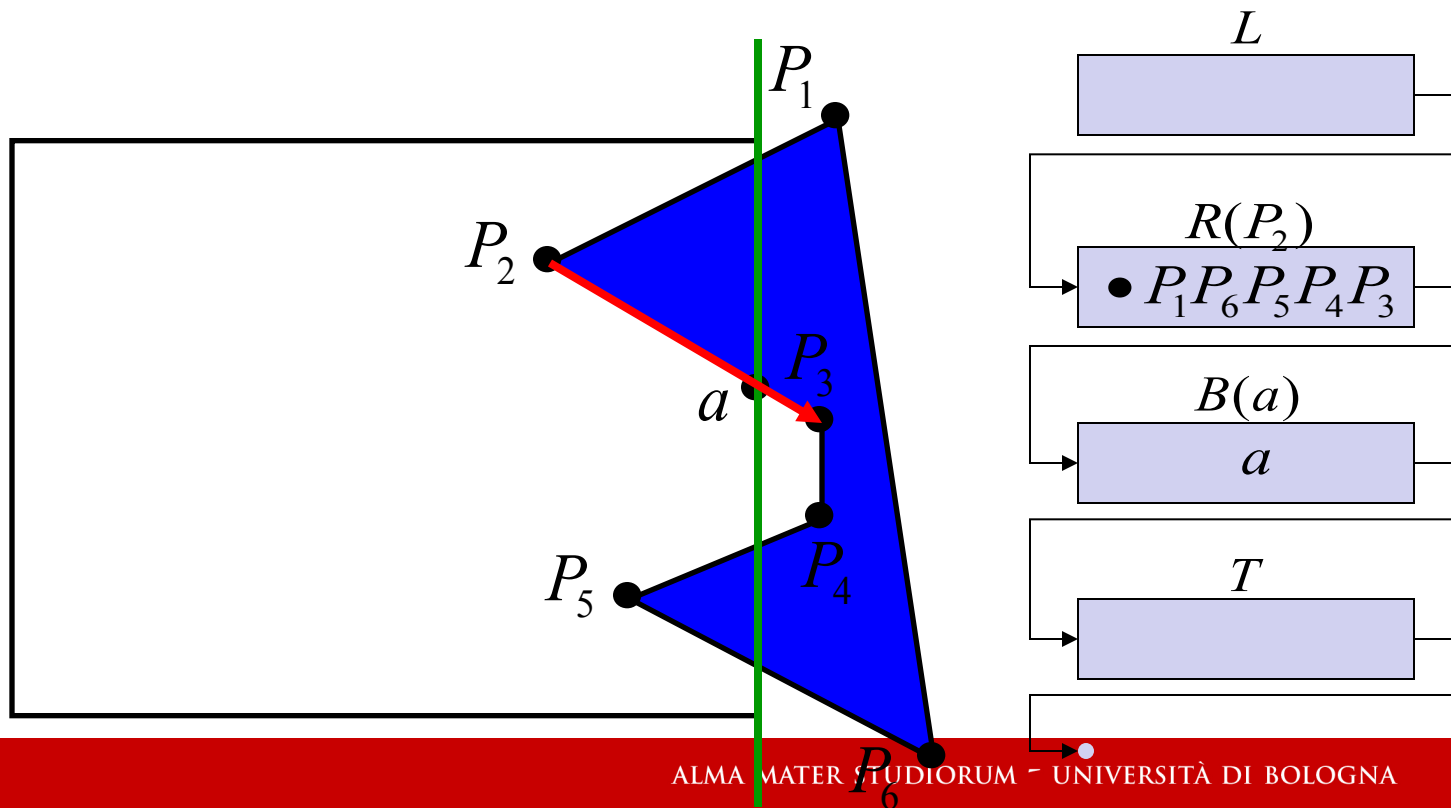
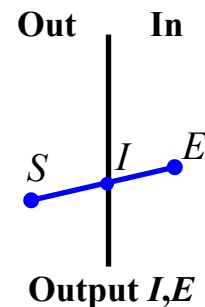
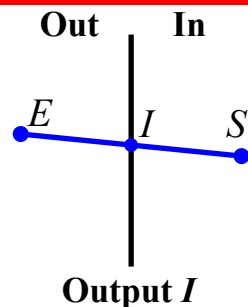
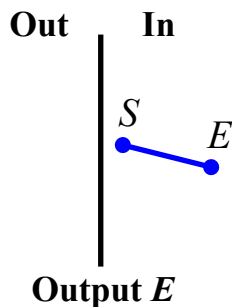
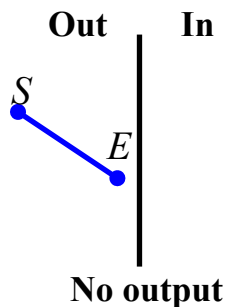




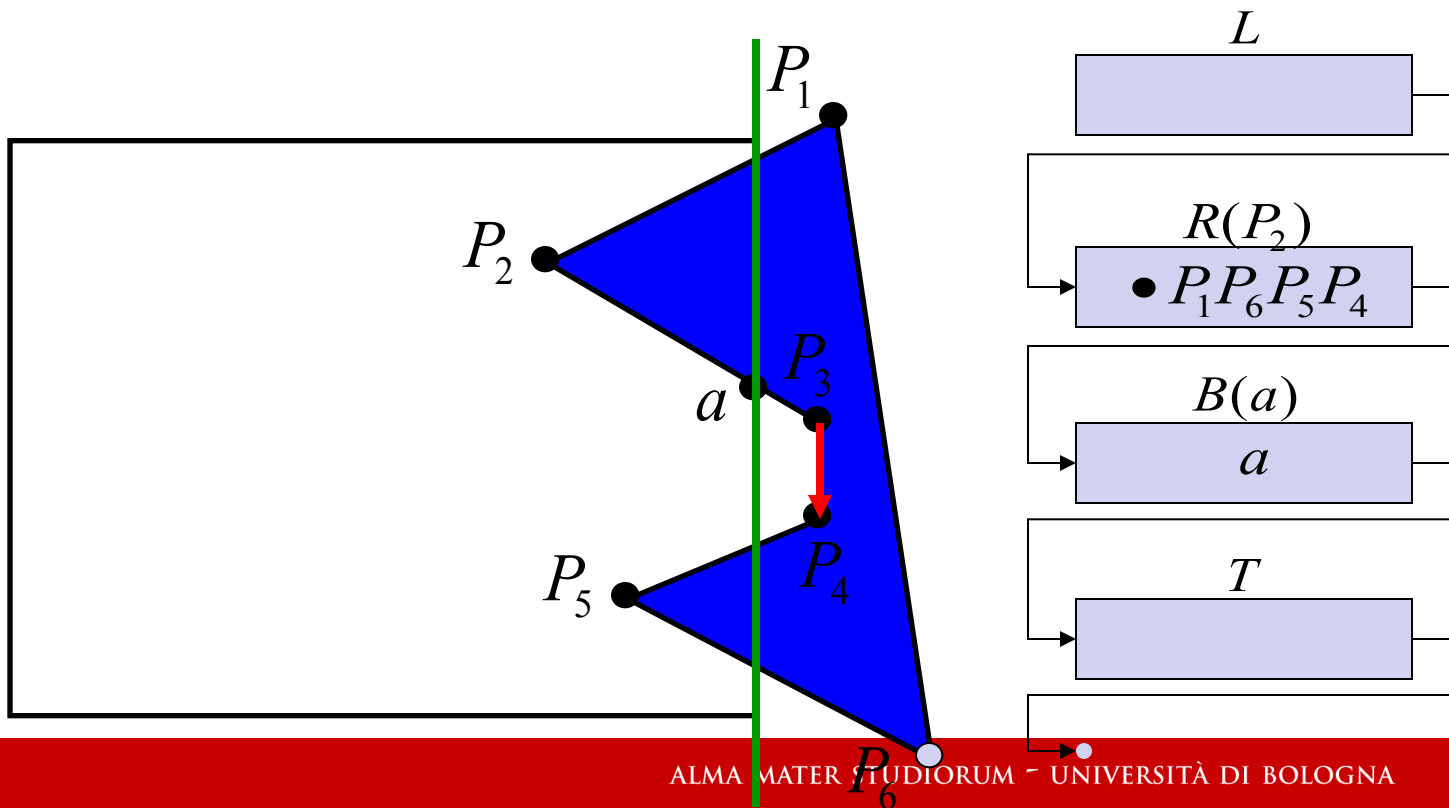
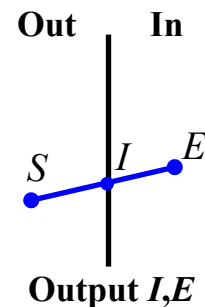
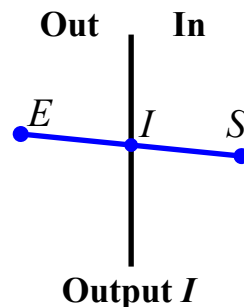
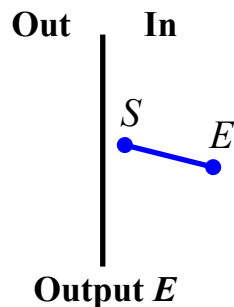
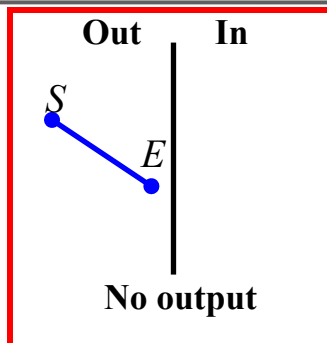
Algoritmo di Sutherland-Hodgman



Algoritmo di Sutherland-Hodgman

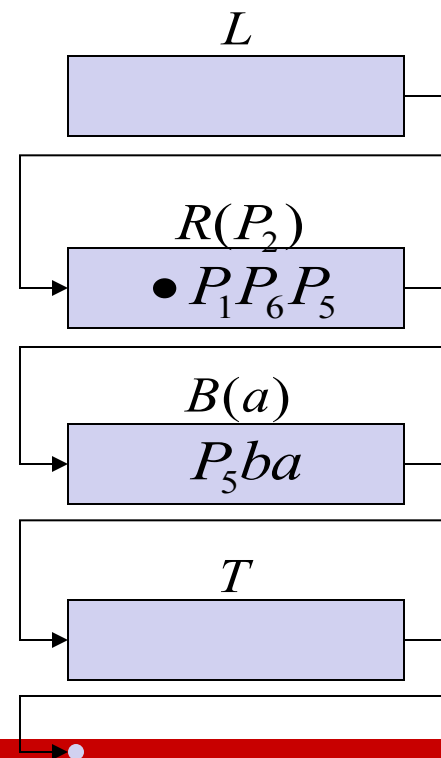
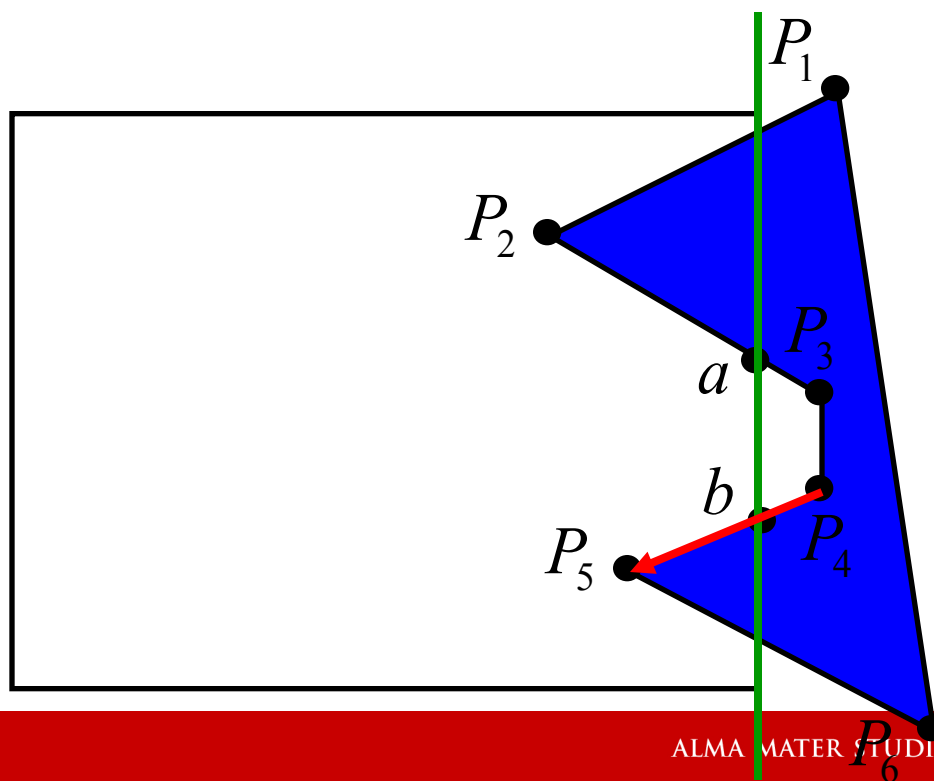
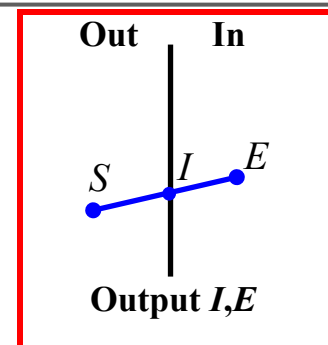
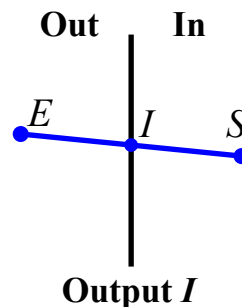
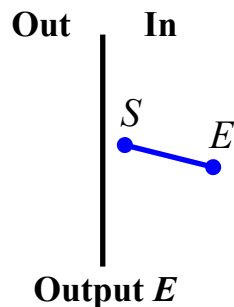
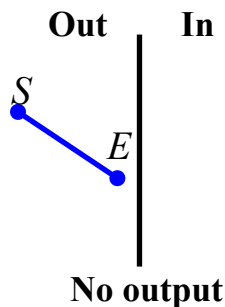


Algoritmo di Sutherland-Hodgman



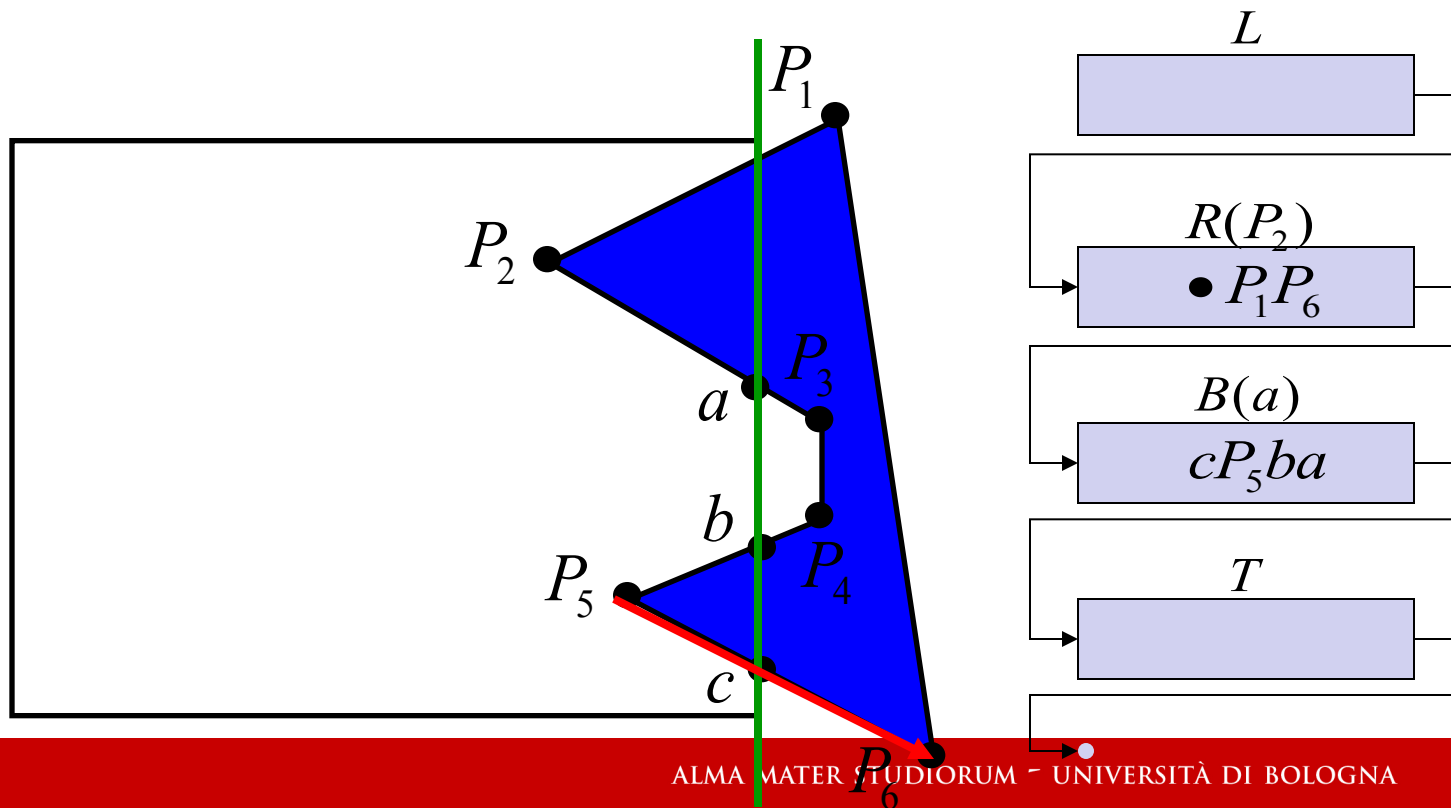
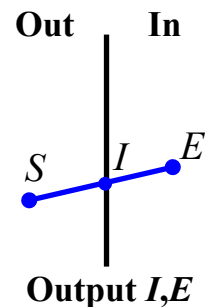
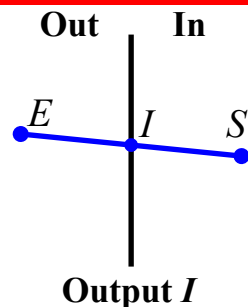
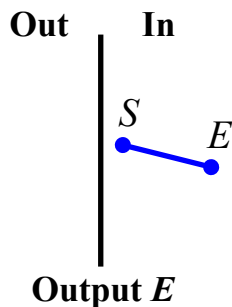
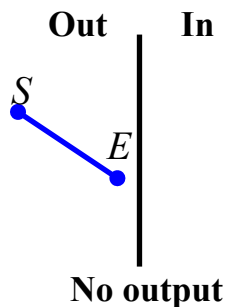


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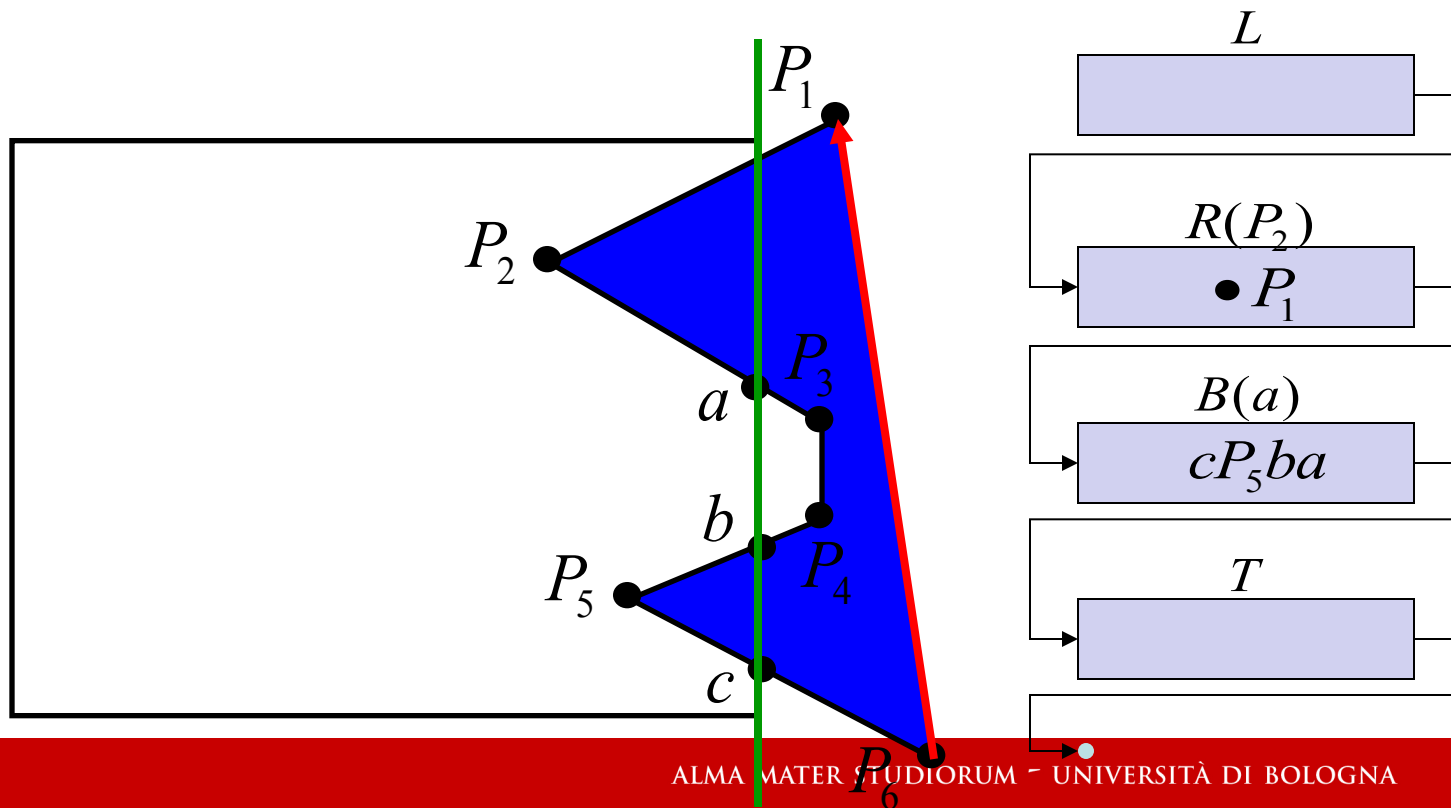
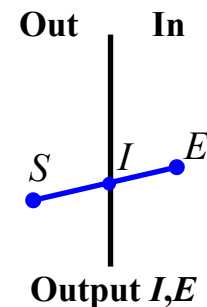
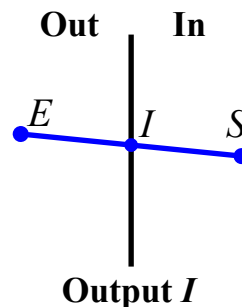
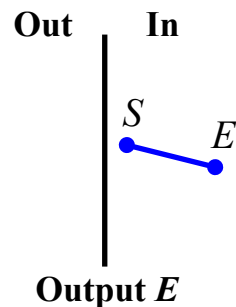
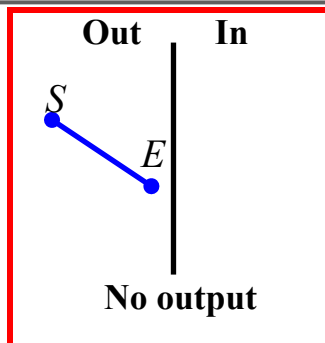




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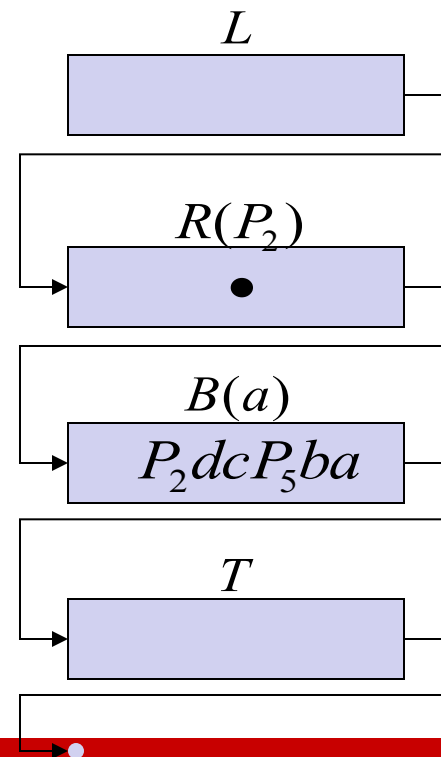
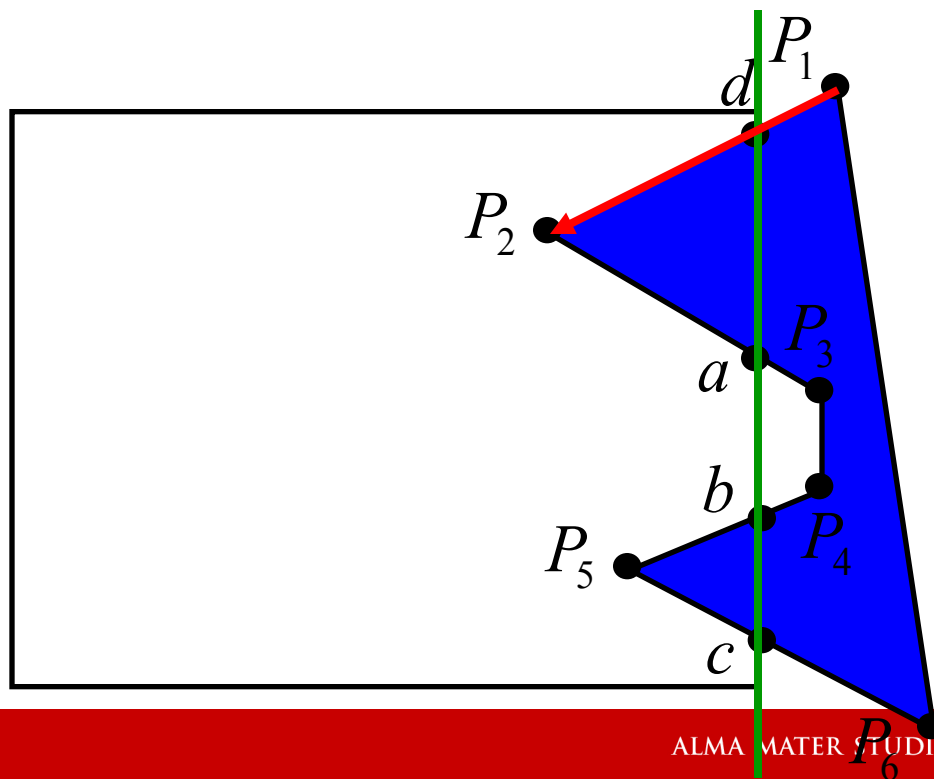
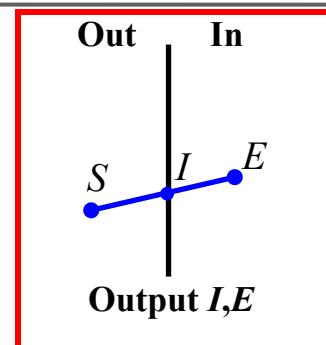
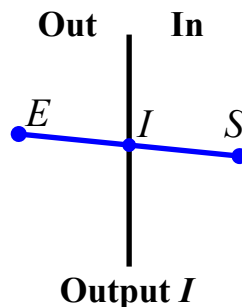
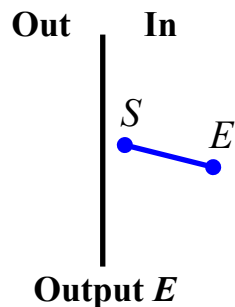
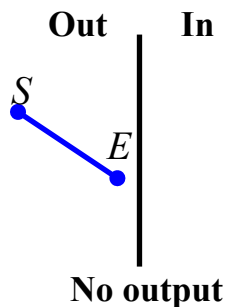


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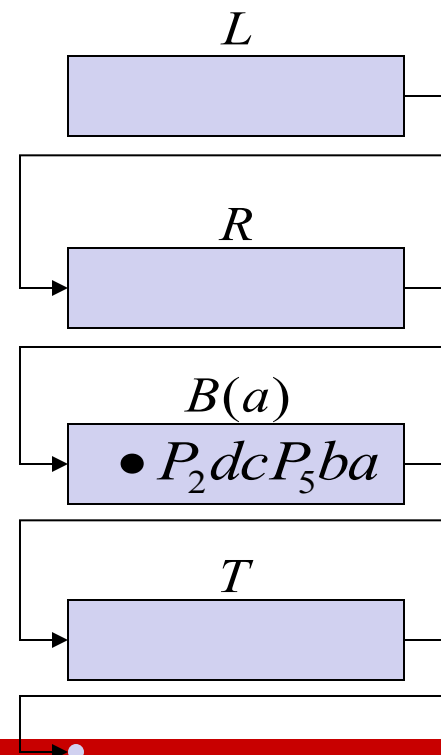
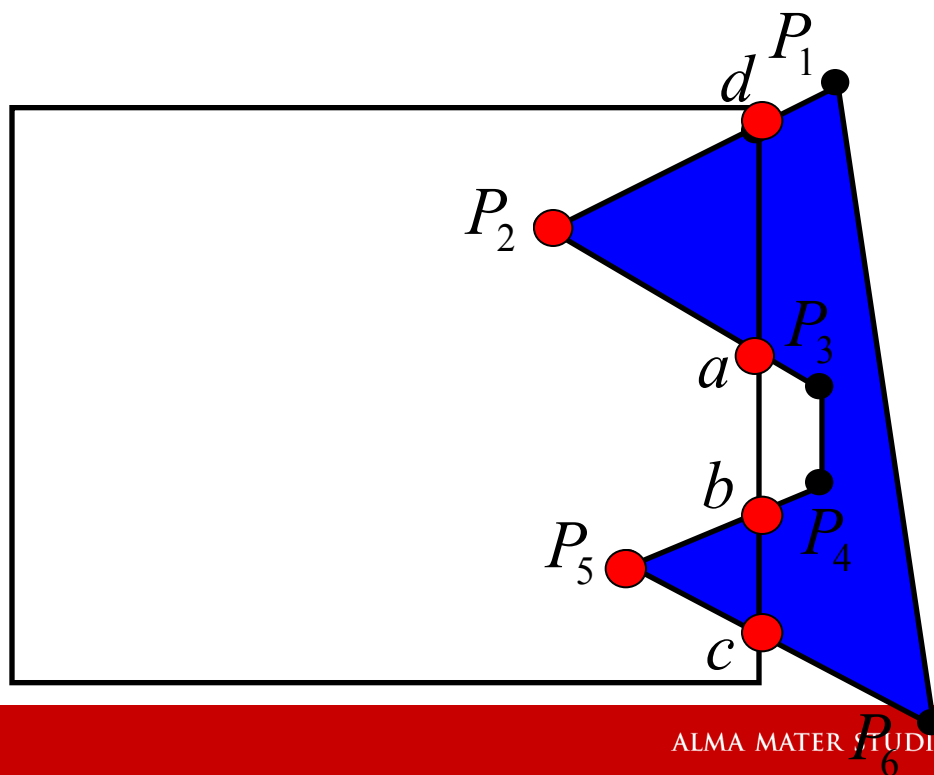
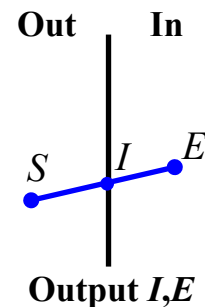
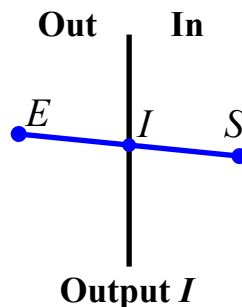
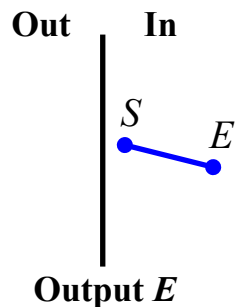
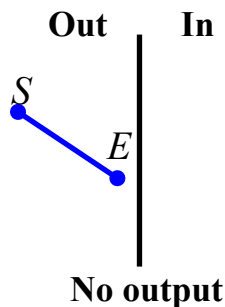


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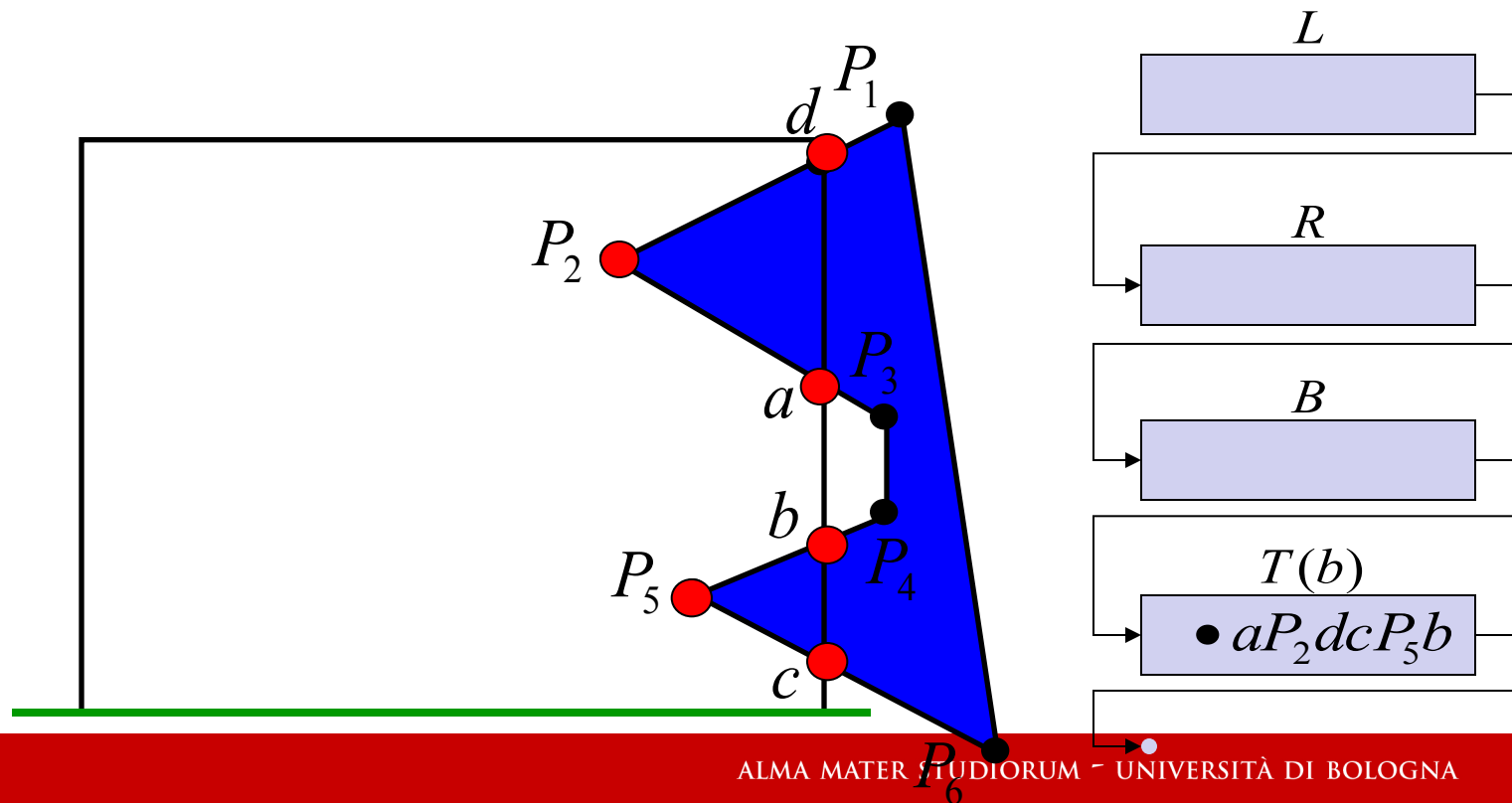
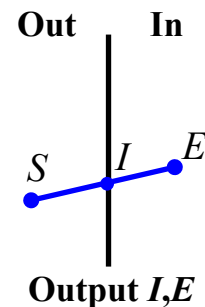
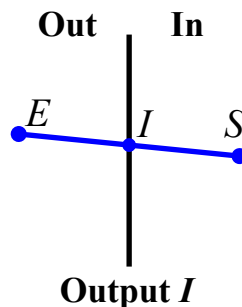
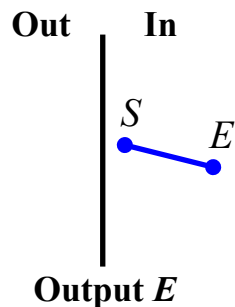
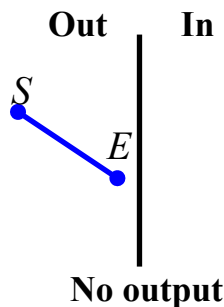


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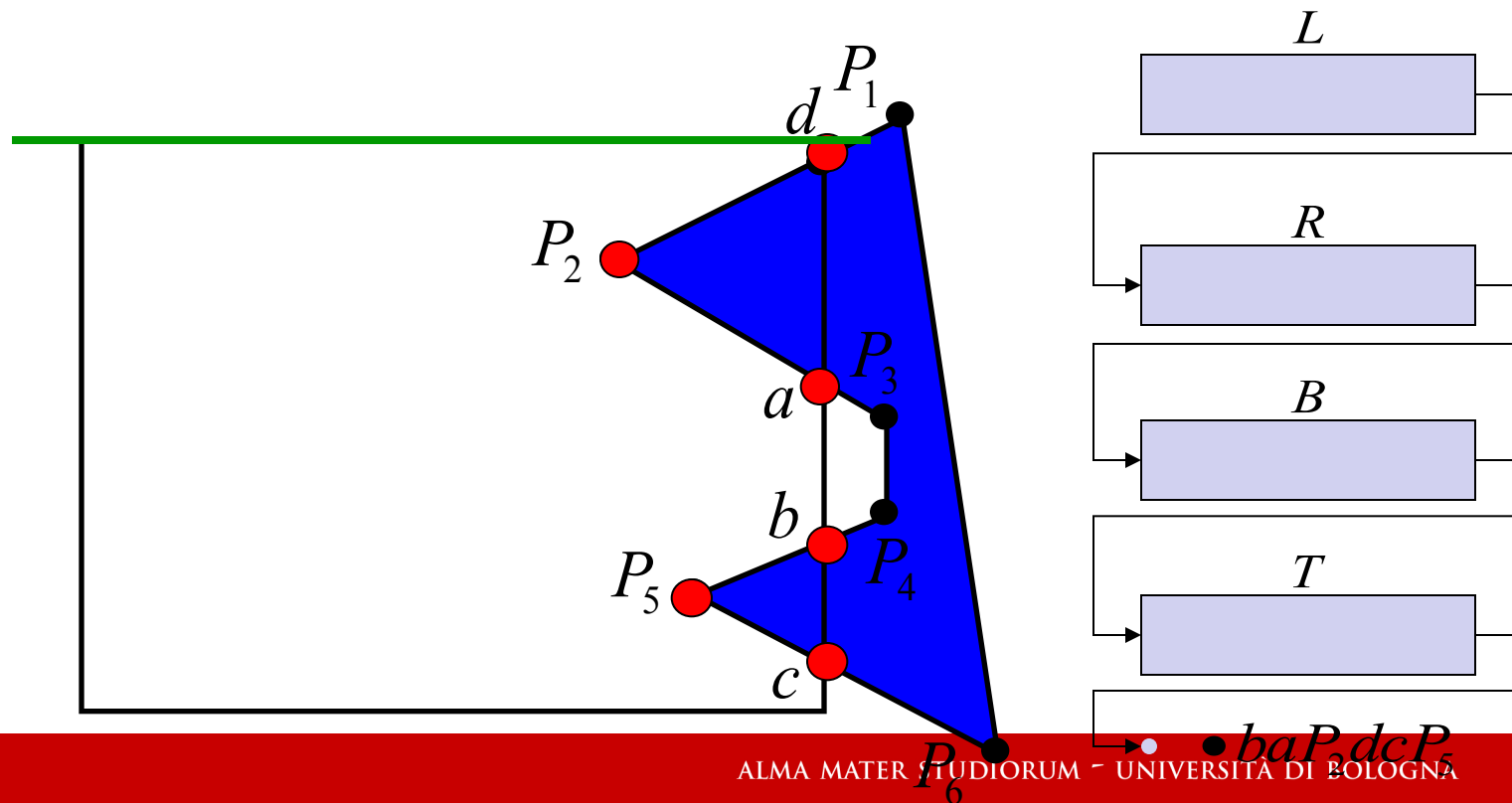
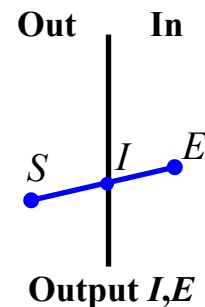
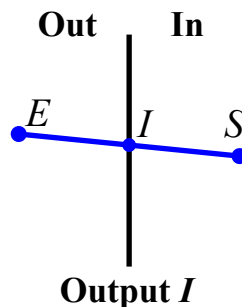
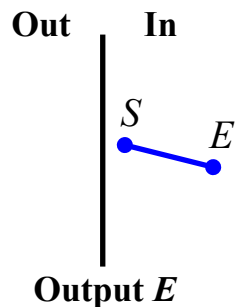
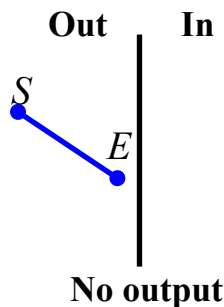


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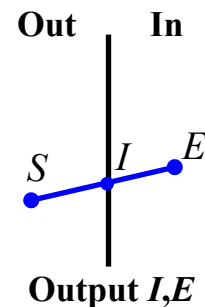
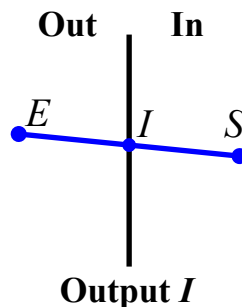
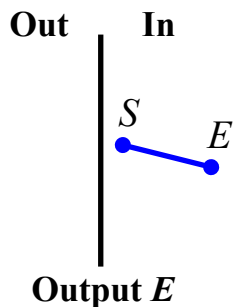
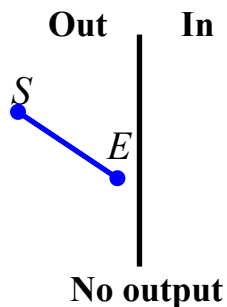




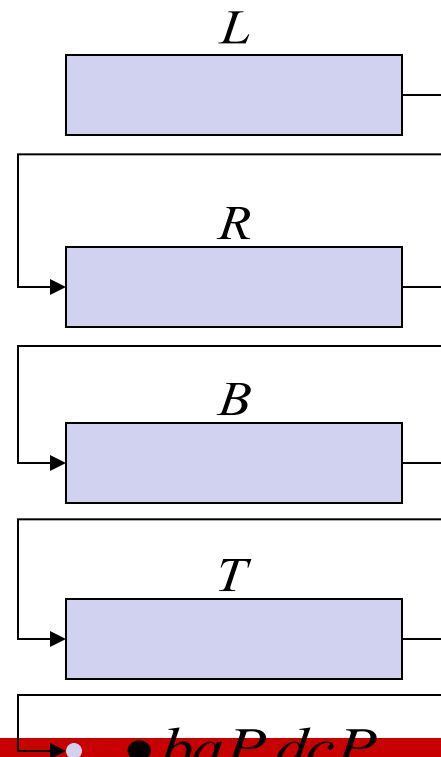
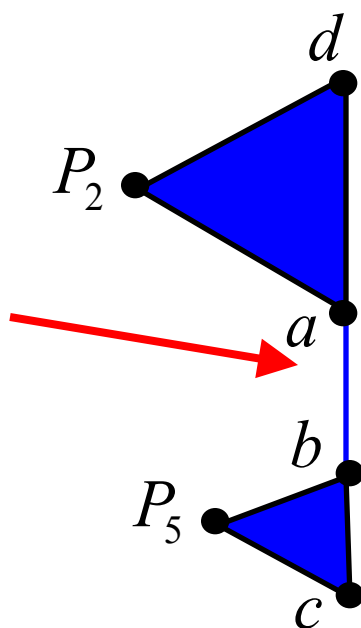
Algoritmo di Sutherland-Hodgman



Algoritmo di Sutherland-Hodgman



Possibile errore nel caso di poligoni non convessi





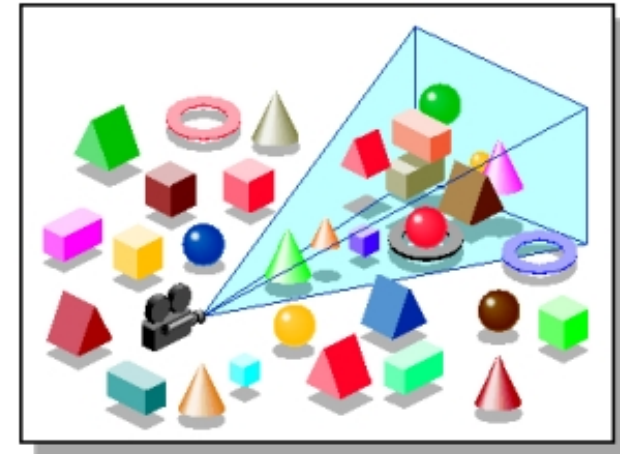
Algoritmo di Sutherland-Hodgman

- Ideale per l'elaborazione in pipe-line.
Il clipping di un lato del poligono non è necessario che sia terminato per cominciare con il lato successivo
- Ideale per l'elaborazione in fasi successive.
Si può operare il clipping solo su due lati e portare a termine il procedimento in una seconda fase

Algoritmo di Sutherland-Hodgman 3D

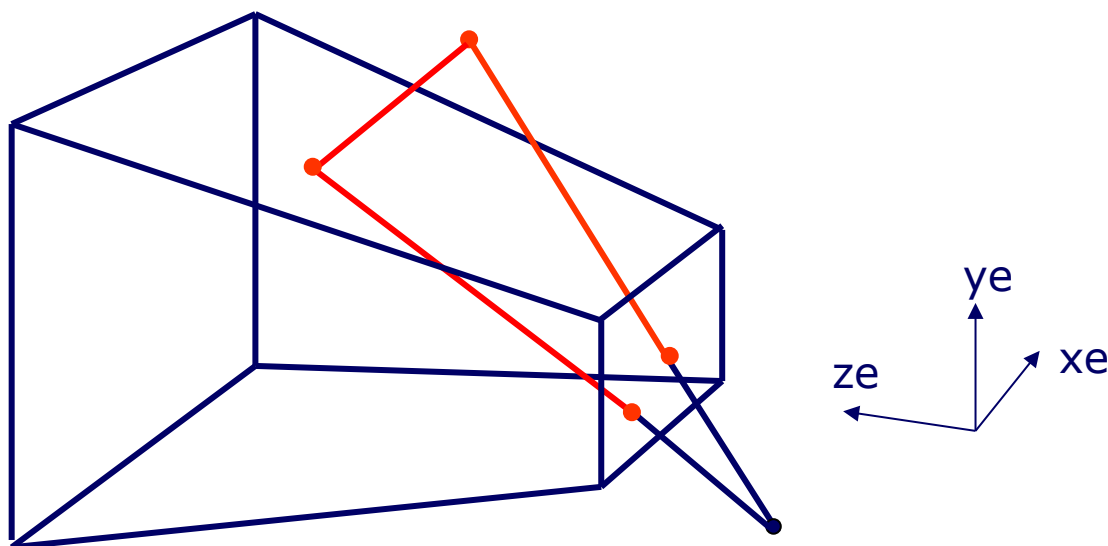
L'algoritmo di Sutherland-Hodgman può essere generalizzato rispetto ad un View Volume 3D.

Prima di applicare l'algoritmo si controlla se l'oggetto è esterno al Frustum, utilizzando un Bounding Volume, o completamente interno;



Poi si esegue il clipping dei singoli poligoni utilizzando l'algoritmo di Sutherland-Hodgman;

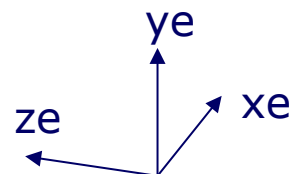
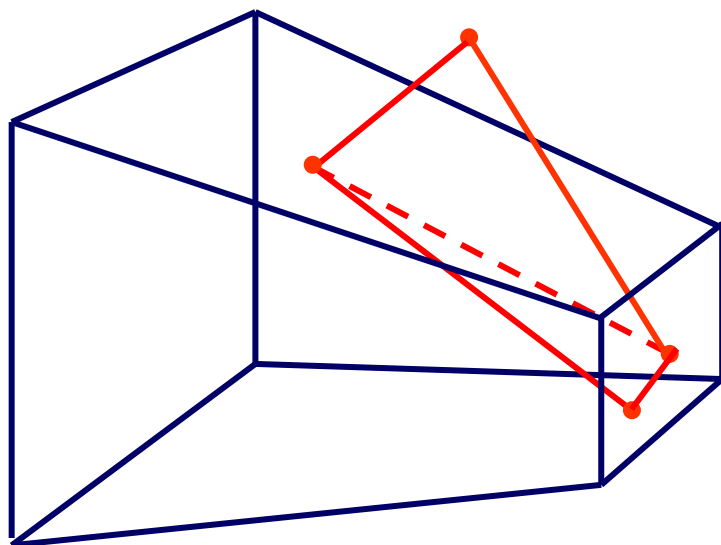
Algoritmo di Sutherland-Hodgman 3D



Prima si applica l'algoritmo rispetto al **front** e al **back** plane del tronco di piramide scalato ...

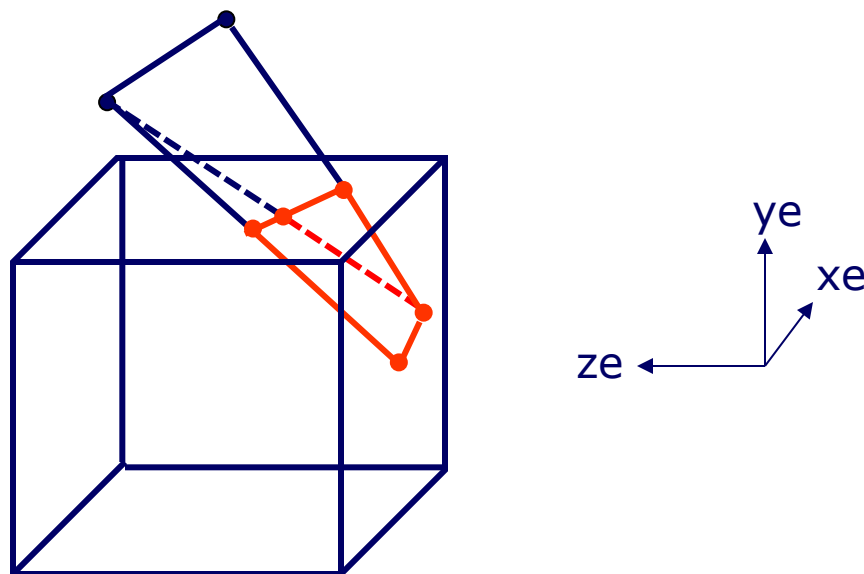


Algoritmo di Sutherland-Hodgman 3D



I poligoni risultanti, se non sono triangoli, devono essere opportunamente suddivisi.

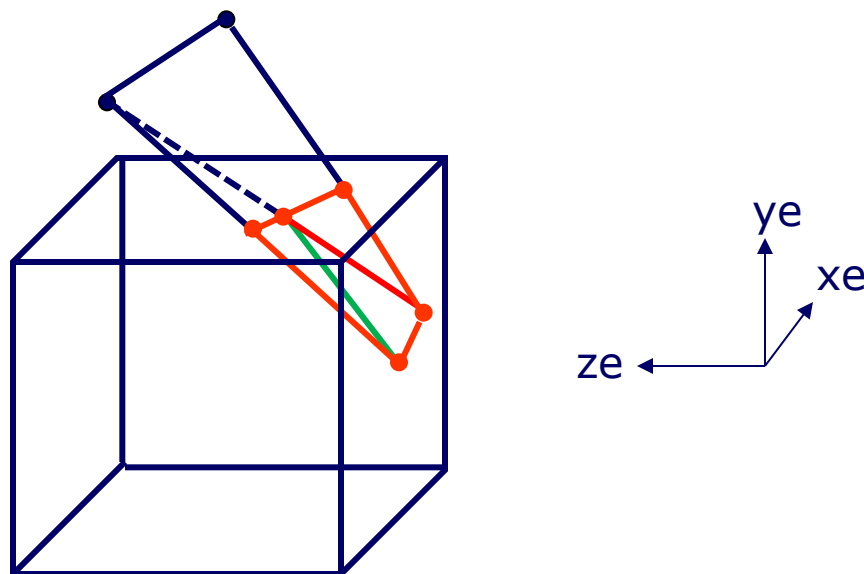
Algoritmo di Sutherland-Hodgman 3D



... poi una volta applicata la proiezione prospettica con profondità che trasforma il tronco di piramide in un parallelepipedo si procede al clipping di linea rispetto alle facce **left**, **right**, **down** e **up** del parallelepipedo.



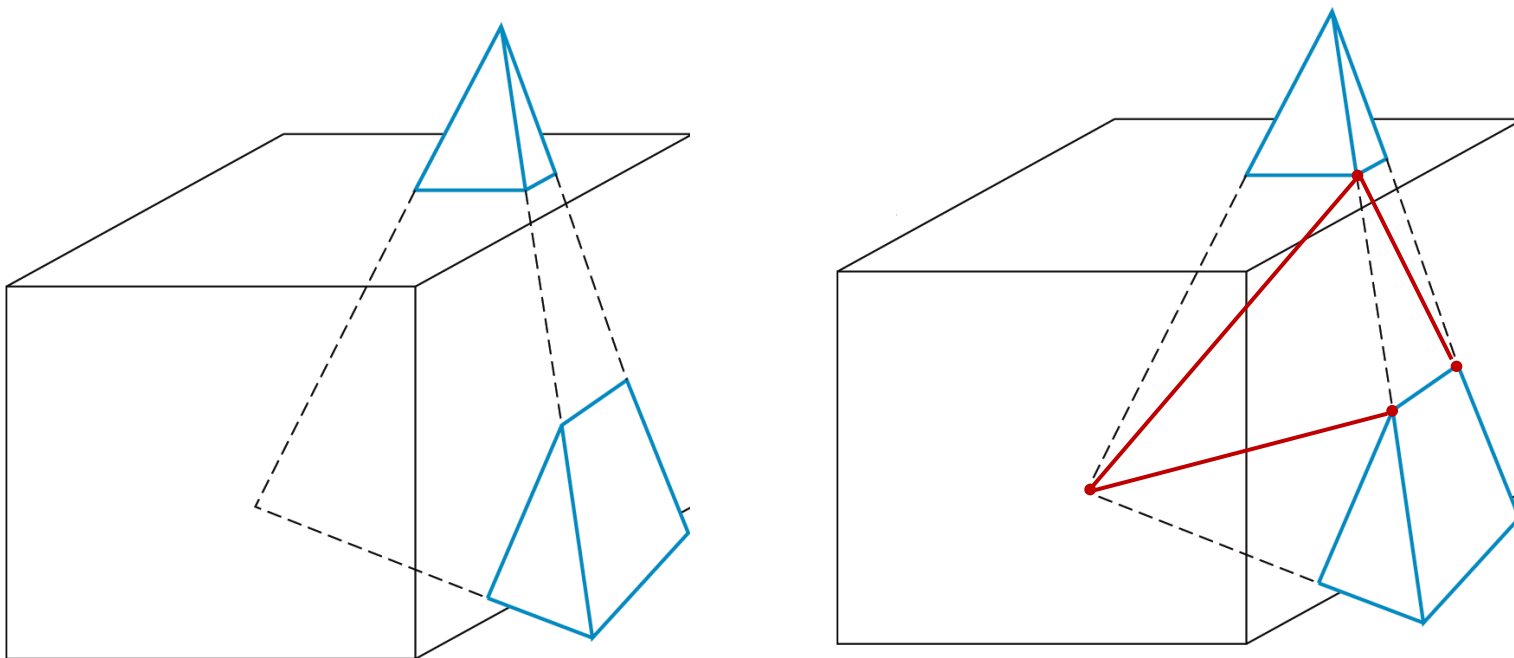
Algoritmo di Sutherland-Hodgman 3D



I poligoni risultanti, se non sono triangoli, devono essere opportunamente suddivisi.

Algoritmo di Sutherland-Hodgman 3D

Il caso più comune di clipping 3D è quello di oggetti mesh con facce poligonali ed in particolare triangolari.



Come già detto, poligoni risultanti, se non sono triangoli, devono essere opportunamente suddivisi.



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