AMD - TAREA DE ESPACIO AFÍN

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Ejercicio 1. *Dado el polígono de vértices C_0, C_1, C_2, C_3, C_4 en el plano, determina la posición de los $P_0, P_1, \cdots, P_9$ con respecto a dicho polígono, es decir, para cada uno de ellos determinar si están dentro, fuera o en el borde del polígono (Sugerencia: Descomponer el polígono en varios triángulos y resolver cada problema por separado).*

Datos

```
C =  column_matrix(RR,[[-0.172651912033068,0.425473646411074],
[-0.927177836444634,0.730828051174769],
[-0.455968358491447,-0.920601173524937],
[0.406985519949459,-0.882736889806611],
[0.876887465140915,0.916803361839041]])
P =  column_matrix(RR,[
[0.629081226542386,0.741279405121107],
[-0.448184676007223,-0.303402020267078],
[-0.541604965947982,0.633876454181660],
[-0.364100606388708,0.257256981672285],
[0.429547739604162,0.444885711632425],
[0.407307318948960,0.762730650438023],
[-0.992167831095530,-0.468225919921707],
[0.813501066850795,0.380278966484519],
[0.194118465888270,-0.947683683347809],
[0.691495569525582,-0.786581561257583]])
```

$$C_0 = \begin{bmatrix} -0.172651912033068 \\ 0.425473646411074 \end{bmatrix}, C_1 = \begin{bmatrix} -0.927177836444634 \\ 0.730828051174769 \end{bmatrix}, C_2 = \begin{bmatrix} -0.455968358491447 \\ -0.920601173524937 \end{bmatrix},$$
$$C_3 = \begin{bmatrix} 0.406985519949459 \\ -0.882736889806611 \end{bmatrix}, C_4 = \begin{bmatrix} 0.876887465140915 \\ 0.916803361839041 \end{bmatrix},$$
$$P_0 = \begin{bmatrix} 0.629081226542386 \\ 0.741279405121107 \end{bmatrix}, P_1 = \begin{bmatrix} -0.448184676007223 \\ -0.303402020267078 \end{bmatrix}, P_2 = \begin{bmatrix} -0.541604965947982 \\ 0.633876454181660 \end{bmatrix},$$
$$P_3 = \begin{bmatrix} -0.364100606388708 \\ 0.257256981672285 \end{bmatrix}, P_4 = \begin{bmatrix} 0.429547739604162 \\ 0.444885711632425 \end{bmatrix}, P_5 = \begin{bmatrix} 0.407307318948960 \\ 0.762730650438023 \end{bmatrix},$$
$$P_6 = \begin{bmatrix} -0.992167831095530 \\ -0.468225919921707 \end{bmatrix}, P_7 = \begin{bmatrix} 0.813501066850795 \\ 0.380278966484519 \end{bmatrix},$$
$$P_8 = \begin{bmatrix} 0.194118465888270 \\ -0.947683683347809 \end{bmatrix}, P_9 = \begin{bmatrix} 0.691495569525582 \\ -0.786581561257583 \end{bmatrix}$$

Solución:

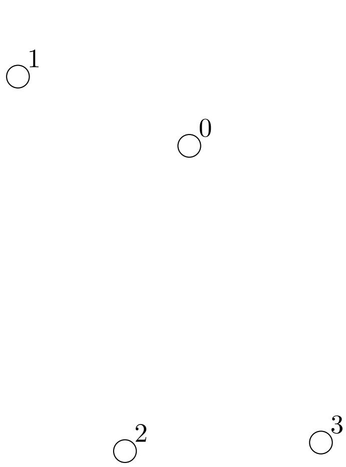
```
CV = C.columns()
PV = P.columns()

h = matrix([1]*10)
hP = block_matrix(2, 1, [h, P]);

T0 = matrix(RR,  [
[1,     1,         1],
[CV[0][0], CV[1][0],     CV[2][0]],
[CV[0][1], CV[1][1],     CV[2][1]]]);
```

```
T1 = matrix(RR,  [
[1,     1,          1],
[CV[0][0], CV[2][0],     CV[3][0]],
[CV[0][1], CV[2][1],     CV[3][1]]]);
T2 = matrix(RR,  [
[1,     1,          1],
[CV[0][0], CV[3][0],     CV[4][0]],
[CV[0][1], CV[3][1],     CV[4][1]]]);

T0iP = T0^-1 * hP
T1iP = T1^-1 * hP
T2iP = T2^-1 * hP
```



Matrices de triangulos 012, 023 y 034

$$T_0 = \begin{bmatrix} 1.00000000000000 & 1.00000000000000 & 1.00000000000000 \\ -0.172651912033068 & -0.927177836444634 & -0.455968358491447 \\ 0.425473646411074 & 0.730828051174769 & -0.920601173524937 \end{bmatrix}$$

$$T_1 = \begin{bmatrix} 1.00000000000000 & 1.00000000000000 & 1.00000000000000 \\ -0.172651912033068 & -0.455968358491447 & 0.406985519949459 \\ 0.425473646411074 & -0.920601173524937 & -0.882736889806611 \end{bmatrix}$$

$$T_2 = \begin{bmatrix} 1.00000000000000 & 1.00000000000000 & 1.00000000000000 \\ -0.172651912033068 & 0.406985519949459 & 0.876887465140915 \\ 0.425473646411074 & -0.882736889806611 & 0.916803361839041 \end{bmatrix}$$

Matrices de puntos transpuestas para que no se salgan del papel, cada fila es un punto

$$(T_0 \cdot P)^T = \begin{bmatrix} 2.33629948258992 & -0.897981763019510 & -0.438317719570415 \\ 0.275535508809464 & 0.149148228193655 & 0.575316262996881 \\ 0.536275721254001 & 0.504175637884187 & -0.0404513591381884 \\ 0.641223454105509 & 0.190576383756701 & 0.168200162137790 \\ 1.91060917163277 & -0.730479994827312 & -0.180129176805460 \\ 2.01317417043040 & -0.621613823738429 & -0.391560346691975 \\ -0.610012889129161 & 0.771149150353677 & 0.838863738775483 \\ 2.45828671892777 & -1.21601197465031 & -0.242274744277454 \\ 0.962483289705000 & -0.800916570278366 & 0.838433280573366 \\ 1.77660801703369 & -1.36695395151956 & 0.590345934485869 \end{bmatrix}$$

$$(T_1 \cdot P)^T = \begin{bmatrix} 1.21042180306362 & -1.07039497151949 & 0.859973168455866 \\ 0.462535588298254 & 0.680299689266831 & -0.142835277565085 \\ 1.16840448002303 & 0.314431072573939 & -0.482835552596965 \\ 0.880165608114317 & 0.302344308368865 & -0.182509916483182 \\ 0.994742997746240 & -0.694304193212990 & 0.699561195466750 \\ 1.23380296462910 & -0.829105933543279 & 0.595302968914180 \\ 0.356843735051543 & 1.38166522525492 & -0.738508960306461 \\ 0.933666958620063 & -1.09820917293404 & 1.16454221431397 \\ -0.0416953325946848 & 0.274678908680821 & 0.767016423913864 \\ 0.0627391988283962 & -0.371834515941200 & 1.30909531711280 \end{bmatrix}$$

$$(T_2 \cdot P)^T = \begin{bmatrix} 0.219239785602417 & 0.0376790322891657 & 0.743081182108417 \\ 1.09249073235925 & 0.379781569677793 & -0.472272302037046 \\ 1.45956655865640 & -0.241284691386244 & -0.218281867270157 \\ 1.16013538516919 & 0.0497557036758608 & -0.209891088845047 \\ 0.351819731782358 & 0.166185869548937 & 0.481994398668705 \\ 0.466053756379459 & -0.0416291594625515 & 0.575575403083092 \\ 1.63626092390483 & 0.322907846668776 & -0.959168770573607 \\ -0.0832709125266348 & 0.320880774176406 & 0.762390138350229 \\ 0.212656380655437 & 0.978029051912552 & -0.190685432567990 \\ -0.281578268535191 & 1.02344623409367 & 0.258132034441520 \end{bmatrix}$$

Puntos que están dentro del poligono (porque sus coordenadas baricentricas están entre 0 y 1 en almenos uno de los triangulos): 0, 1, 3, 4; Por tanto los que están fuera son 2, 5, 6, 7, 8, 9.