Práctica 3: Implementación del Algoritmo Split & Merge

A1.

```
Segment:  [0 0] - [0 1]
Segment:  0 - 1
Distancia al punto (1,1):  1.0
Segment:  [0 0] - [2 2]
Segment:  0 - 1
Ángulo entre segmentos:  45.0
```

```
Segment:  [0 0] - [1 0]
Segment:  0 - 1
Distancia al punto (1,1):  1.0
Segment:  [0 0] - [2 2]
Segment:  0 - 1
Ángulo entre segmentos:  45.0
```

Con puntos como el (0,0) y el (1,0) o (0,1) comprobamos que la distancia se calcula correctamente, después con los puntos (0,0) y (2,2) comprobamos que el ángulo es correcto.

A2.

Los segmentos se procesan de forma recursiva. Vamos a ver una secuencia de procesado de segmentos:

Seg1: [(0.592000007629,0.0),(-1.622930888145286,0.27461140428007236)]
Dist1: 2.2124501193708923
Seg2: [(0.592000007629,0.0),(0.8604169450245687,-1.6264325388877918)]
Dist2: 1.581048472764494
[Seg3: (0.592000007629,0.0),(2.1923851547282514,-0.721326374351465)]
Dist3: 1.461571480651852
Seg4: [(0.592000007629,0.0),(0.5950454429915626,-0.03371853395815679)]
Dist4: 0.02948896005976066

Salida de terminal:

```
[(0.592000007629,0.0),(-1.622930888145286,0.27461140428007236)]
2.2124501193708923
[(0.592000007629,0.0),(0.8604169450245687,-1.6264325388877918)]
1.581048472764494
[(0.592000007629,0.0),(2.1923851547282514,-0.721326374351465)]
1.461571480651852
[(0.592000007629,0.0),(0.5950454429915626,-0.03371853395815679)]
0.02948896005976066
[(2.1923851547282514,-0.721326374351465),(2.2527024888062455,-1.5877240718114944)]
0.7505061865108774
[(2.1923851547282514,-0.721326374351465),(2.1140095120107576,-0.7991018333149021)]
0.08358793620548838
```

Empezamos con el segmento 1, como este segmento supera el umbral de distancia lo partimos y obtenemos el segmento 2 y 3, como estes segmentos también superan el umbral se parten y obtenemos el segmento 4, el primer segmento que cumple la distancia umbral, por lo que guardamos este segmento, así sucesivamente hasta tener todos los segmentos.

A3. Obtenemos los 15 segmentos siguientes con sus distancias utilizando idx 10:

```
Segmento:  [(0.592000007629,0.0),(2.1923851547282514,-0.721326374351465)] Distancia:  0.02948896005976066
Segmento:  [(2.1923851547282514,-0.721326374351465),(2.2527024888062455,-1.5877240718114944)] Distancia:  0.08358793620548838
Segmento:  [(2.2527024888062455,-1.5877240718114944),(0.9781879906558694,-0.762068421203656)] Distancia:  0.0169095206339171
Segmento:  [(0.9781879906558694,-0.762068421203656),(0.7016415584509026,-1.2091745650628567)] Distancia:  0.03679217699619125
Segmento:  [(0.7016415584509026,-1.2091745650628567),(0.8604169450245687,-1.6264325388877918)] Distancia:  0.04229628738218197
Segmento:  [(0.8604169450245687,-1.6264325388877918),(0.12694901201403663,-0.37615549987414537)] Distancia:  0.050037263725541306
Segmento:  [(0.12694901201403663,-0.37615549987414537),(-0.5044899698413614,-0.44695179130916435)] Distancia:  0.0650366575706103
Segmento:  [(-0.5044899698413614,-0.44695179130916435),(-1.3880557954876251,-1.1459934279764517)] Distancia:  0
Segmento:  [(-1.3880557954876251,-1.1459934279764517),(-1.4972001034846878,-1.079864661963434)] Distancia:  0.07509429298391374
Segmento:  [(-1.4972001034846878,-1.079864661963434),(-1.622930888145286,0.27461140428007236)] Distancia:  0.017237219869399748
Segmento:  [(-1.622930888145286,0.27461140428007236),(0.6372738949261781,0.5191974833773284)] Distancia:  0.04538155175384047
Segmento:  [(0.6372738949261781,0.5191974833773284),(0.6229938236273201,0.3235471009280594)] Distancia:  0.008791143635399318
Segmento:  [(0.6229938236273201,0.3235471009280594),(1.090832712720499,0.33800577122978026)] Distancia:  0.09807643884548742
Segmento:  [(1.090832712720499,0.33800577122978026),(0.6137469965779236,0.18142382941934213)] Distancia:  0
Segmento:  [(0.6137469965779236,0.18142382941934213),(0.5919098408788409,0.010331955454864367)] Distancia:  0.021535839284496584
```

Si ahora cambiamos a idx 2 obtenemos 17

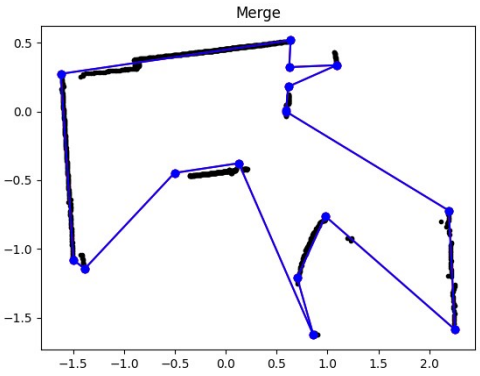
```
Segmento:  [(0.59399998188,0.0),(2.1892235633110486,-0.7308656476066745)] Distancia:  0.028541266347793255
Segmento:  [(2.1892235633110486,-0.7308656476066745),(2.2288100923507517,-0.9324489464154518)] Distancia:  0.02848035961956643
Segmento:  [(2.2288100923507517,-0.9324489464154518),(2.2559719713185307,-1.590028431181148)] Distancia:  0.053608654774419874
Segmento:  [(2.2559719713185307,-1.590028431181148),(0.9908097966582377,-0.7719015819711628)] Distancia:  0.02190423132227407
Segmento:  [(0.9908097966582377,-0.7719015819711628),(0.7013510859340479,-1.2208892794897708)] Distancia:  0.05376543549630176
Segmento:  [(0.7013510859340479,-1.2208892794897708),(0.8622873925279327,-1.6299682162118432)] Distancia:  0.03984352222822097
Segmento:  [(0.8622873925279327,-1.6299682162118432),(0.13021988933358894,-0.3750357211771381)] Distancia:  0.050919270103361475
Segmento:  [(0.13021988933358894,-0.3750357211771381),(-0.5029929416773038,-0.44562550246386534)] Distancia:  0.0668001810938641
Segmento:  [(-0.5029929416773038,-0.44562550246386534),(-1.394580422607666,-1.1412053320373798)] Distancia:  0
Segmento:  [(-1.394580422607666,-1.1412053320373798),(-1.4923338601609162,-1.0763548544302755)] Distancia:  0.07140410991571333
Segmento:  [(-1.4923338601609162,-1.0763548544302755),(-1.6241112198116219,0.26754221487220703)] Distancia:  0.019822833850079893
Segmento:  [(-1.6241112198116219,0.26754221487220703),(0.6395285500531203,0.5164177355268568)] Distancia:  0.0411602875676513
Segmento:  [(0.6395285500531203,0.5164177355268568),(0.6172810645251761,0.31717518080833723)] Distancia:  0.005061555871608009
Segmento:  [(0.6172810645251761,0.31717518080833723),(1.0644647661328521,0.4508334543433668)] Distancia:  0
Segmento:  [(1.0644647661328521,0.4508334543433668),(1.090832712720499,0.33800577122978026)] Distancia:  0.003346665674897322
Segmento:  [(1.090832712720499,0.33800577122978026),(0.6106903089443454,0.17763253658794761)] Distancia:  0
Segmento:  [(0.6106903089443454,0.17763253658794761),(0.5939095105163675,0.010366860259941935)] Distancia:  0.02146069083905326
```

Los datos tienen distintos valores debido a que las mediciones del robot no son perfectas y tienen pequeños errores que pueden afectar a la creación y longitud de los segmentos.

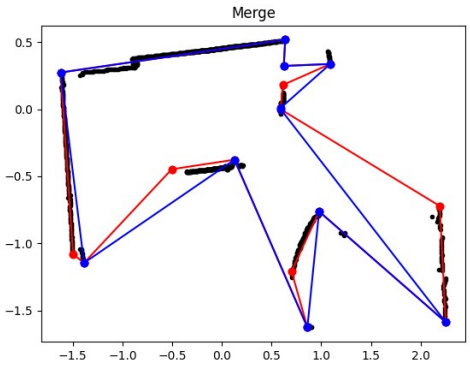
A4. El valor que elegí del threshold angular es 0.1. En mi caso con este valor no se ha unido ningún segmento, por lo que seguimos teniendo el mismo número de segmentos.

A5. Para conseguir que el algoritmo de merge elimine algún punto es aumentar el threshold significativamente. Para ello elegimos el valor de 1.15 para este threshold, obteniendo lo siguiente:

Threshold 0.1



Threshold 1.15 (en rojo segmentos eliminados)



Threshold 0.1:

```
Press a key and hit enter to continueSegmento:  [(0.592000007629,0.0),(2.1923851547282514,-0.721326374351465)] Distancia:  1.7554328
Segmento:  [(2.1923851547282514,-0.721326374351465),(2.2527024888062455,-1.5877240718114944)] Distancia:  0.8684948
Segmento:  [(2.2527024888062455,-1.5877240718114944),(0.9781879906558694,-0.762068421203656)] Distancia:  1.5185829
Segmento:  [(0.9781879906558694,-0.762068421203656),(0.7016415584509026,-1.2091745650628567)] Distancia:  0.52572024
Segmento:  [(0.7016415584509026,-1.2091745650628567),(0.8604169450245687,-1.6264325388877918)] Distancia:  0.44644582
Segmento:  [(0.8604169450245687,-1.6264325388877918),(0.12694901201403663,-0.37615549987414537)] Distancia:  1.4495406
Segmento:  [(0.12694901201403663,-0.37615549987414537),(-0.5044899698413614,-0.44695179130916435)] Distancia:  0.6353954
Segmento:  [(-0.5044899698413614,-0.44695179130916435),(-1.3880557954876251,-1.1459934279764517)] Distancia:  1.1266534
Segmento:  [(-1.3880557954876251,-1.1459934279764517),(-1.4972001034846878,-1.079864661963434)] Distancia:  0.12761469
Segmento:  [(-1.4972001034846878,-1.079864661963434),(-1.622930888145286,0.27461140428007236)] Distancia:  1.360299
Segmento:  [(-1.622930888145286,0.27461140428007236),(0.6372738949261781,0.5191974833773284)] Distancia:  2.2734
Segmento:  [(0.6372738949261781,0.5191974833773284),(0.6229938236273201,0.3235471009280594)] Distancia:  0.19617082
Segmento:  [(0.6229938236273201,0.3235471009280594),(1.090832712720499,0.33800577122978026)] Distancia:  0.46806225
Segmento:  [(1.090832712720499,0.33800577122978026),(0.6137469965779236,0.18142382941934213)] Distancia:  0.50212413
Segmento:  [(0.6137469965779236,0.18142382941934213),(0.5919098408788409,0.010331955454864367)] Distancia:  0.17247982
Media longitud:  0.8950945
```

Threshold 1.15:

```
Segmento:  [(0.592000007629,0.0),(2.2527024888062455,-1.5877240718114944)] Distancia:  2.297564
Segmento:  [(2.2527024888062455,-1.5877240718114944),(0.9781879906558694,-0.762068421203656)] Distancia:  1.5185829
Segmento:  [(0.9781879906558694,-0.762068421203656),(0.8604169450245687,-1.6264325388877918)] Distancia:  0.87235045
Segmento:  [(0.8604169450245687,-1.6264325388877918),(0.12694901201403663,-0.37615549987414537)] Distancia:  1.4495406
Segmento:  [(0.12694901201403663,-0.37615549987414537),(-1.3880557954876251,-1.1459934279764517)] Distancia:  1.6993794
Segmento:  [(-1.3880557954876251,-1.1459934279764517),(-1.622930888145286,0.27461140428007236)] Distancia:  1.4398905
Segmento:  [(-1.622930888145286,0.27461140428007236),(0.6372738949261781,0.5191974833773284)] Distancia:  2.2734
Segmento:  [(0.6372738949261781,0.5191974833773284),(0.6229938236273201,0.3235471009280594)] Distancia:  0.19617082
Segmento:  [(0.6229938236273201,0.3235471009280594),(1.090832712720499,0.33800577122978026)] Distancia:  0.46806225
Media segmentos 1.3572156
```

A6. Para el método purge eliminamos los segmentos que son menores a una cierta longitud. En mi caso para idx 10 y un threshold de 0.01 no se elimina ningún segmento.

A7.

Segmentos con idx 10:

```
Press a key and hit enter to continueSegmento:  [(0.592000007629,0.0),(2.1923851547282514,-0.721326374351465)] Distancia:  1.7554328
Segmento:  [(2.1923851547282514,-0.721326374351465),(2.2527024888062455,-1.5877240718114944)] Distancia:  0.8684948
Segmento:  [(2.2527024888062455,-1.5877240718114944),(0.9781879906558694,-0.762068421203656)] Distancia:  1.5185829
Segmento:  [(0.9781879906558694,-0.762068421203656),(0.7016415584509026,-1.2091745650628567)] Distancia:  0.52572024
Segmento:  [(0.7016415584509026,-1.2091745650628567),(0.8604169450245687,-1.6264325388877918)] Distancia:  0.44644582
Segmento:  [(0.8604169450245687,-1.6264325388877918),(0.12694901201403663,-0.37615549987414537)] Distancia:  1.4495406
Segmento:  [(0.12694901201403663,-0.37615549987414537),(-0.5044899698413614,-0.44695179130916435)] Distancia:  0.6353954
Segmento:  [(-0.5044899698413614,-0.44695179130916435),(-1.3880557954876251,-1.1459934279764517)] Distancia:  1.1266534
Segmento:  [(-1.3880557954876251,-1.1459934279764517),(-1.4972001034846878,-1.079864661963434)] Distancia:  0.12761469
Segmento:  [(-1.4972001034846878,-1.079864661963434),(-1.622930888145286,0.27461140428007236)] Distancia:  1.360299
Segmento:  [(-1.622930888145286,0.27461140428007236),(0.6372738949261781,0.5191974833773284)] Distancia:  2.2734
Segmento:  [(0.6372738949261781,0.5191974833773284),(0.6229938236273201,0.3235471009280594)] Distancia:  0.19617082
Segmento:  [(0.6229938236273201,0.3235471009280594),(1.090832712720499,0.33800577122978026)] Distancia:  0.46806225
Segmento:  [(1.090832712720499,0.33800577122978026),(0.6137469965779236,0.18142382941934213)] Distancia:  0.50212413
Segmento:  [(0.6137469965779236,0.18142382941934213),(0.5919098408788409,0.010331955454864367)] Distancia:  0.17247982
Media longitud:  0.8950945
```

Segmentos con idx 2:

```
Segmento:  [(0.59399998188,0.0),(2.1892235633110486,-0.7308656476066745)] Distancia:  1.7546803
Segmento:  [(2.1892235633110486,-0.7308656476066745),(2.2288100923507517,-0.9324489464154518)] Distancia:  0.20543346
Segmento:  [(2.2288100923507517,-0.9324489464154518),(2.2559719713185307,-1.590028431181148)] Distancia:  0.6581402
Segmento:  [(2.2559719713185307,-1.590028431181148),(0.9908097966582377,-0.7719015819711628)] Distancia:  1.5066408
Segmento:  [(0.9908097966582377,-0.7719015819711628),(0.7013510859340479,-1.2208892794897708)] Distancia:  0.5342063
Segmento:  [(0.7013510859340479,-1.2208892794897708),(0.8622873925279327,-1.6299682162118432)] Distancia:  0.43959752
Segmento:  [(0.8622873925279327,-1.6299682162118432),(0.13021988933358894,-0.3750357211771381)] Distancia:  1.4528518
Segmento:  [(0.13021988933358894,-0.3750357211771381),(-0.5029929416773038,-0.44562550246386534)] Distancia:  0.63713527
Segmento:  [(-0.5029929416773038,-0.44562550246386534),(-1.394580422607666,-1.1412053320373798)] Distancia:  1.1308224
Segmento:  [(-1.394580422607666,-1.1412053320373798),(-1.4923338601609162,-1.0763548544302755)] Distancia:  0.117308706
Segmento:  [(-1.4923338601609162,-1.0763548544302755),(-1.6241112198116219,0.26754221487220703)] Distancia:  1.3503424
Segmento:  [(-1.6241112198116219,0.26754221487220703),(0.6395285500531203,0.5164177355268568)] Distancia:  2.2772799
Segmento:  [(0.6395285500531203,0.5164177355268568),(0.6172810645251761,0.31717518080833723)] Distancia:  0.20048079
Segmento:  [(0.6172810645251761,0.31717518080833723),(1.0644647661328521,0.4508334543433668)] Distancia:  0.46673098
Segmento:  [(1.0644647661328521,0.4508334543433668),(1.090832712720499,0.33800577122978026)] Distancia:  0.1158678
Segmento:  [(1.090832712720499,0.33800577122978026),(0.6106903089443454,0.17763253658794761)] Distancia:  0.50621766
Segmento:  [(0.6106903089443454,0.17763253658794761),(0.5939095105163675,0.010366860259941935)] Distancia:  0.16810533
Media longitud:  0.79540247
```

En nuestro caso si disminuimos la variable idx vemos que la media de la longitud también disminuye, pasa de 0.89 a 0.79. Esto es debido a que con idx10 obtenemos menos segmentos que con idx2, por lo que tiene sentido que estos sean más grandes.

Comparando con el caso Q5:

Idx 2:

```
Segmento:  [(0.59399998188,0.0),(2.1892235633110486,-0.7308656476066745)] Distancia:  1.7546803
Segmento:  [(2.1892235633110486,-0.7308656476066745),(2.2288100923507517,-0.9324489464154518)] Distancia:  0.20543346
Segmento:  [(2.2288100923507517,-0.9324489464154518),(2.2559719713185307,-1.590028431181148)] Distancia:  0.6581402
Segmento:  [(2.2559719713185307,-1.590028431181148),(0.9908097966582377,-0.7719015819711628)] Distancia:  1.5066408
Segmento:  [(0.9908097966582377,-0.7719015819711628),(0.7013510859340479,-1.2208892794897708)] Distancia:  0.5342063
Segmento:  [(0.7013510859340479,-1.2208892794897708),(0.8622873925279327,-1.6299682162118432)] Distancia:  0.43959752
Segmento:  [(0.8622873925279327,-1.6299682162118432),(0.13021988933358894,-0.3750357211771381)] Distancia:  1.4528518
Segmento:  [(0.13021988933358894,-0.3750357211771381),(-0.5029929416773038,-0.44562550246386534)] Distancia:  0.63713527
Segmento:  [(-0.5029929416773038,-0.44562550246386534),(-1.394580422607666,-1.1412053320373798)] Distancia:  1.1308224
Segmento:  [(-1.394580422607666,-1.1412053320373798),(-1.4923338601609162,-1.0763548544302755)] Distancia:  0.117308706
Segmento:  [(-1.4923338601609162,-1.0763548544302755),(-1.6241112198116219,0.26754221487220703)] Distancia:  1.3503424
Segmento:  [(-1.6241112198116219,0.26754221487220703),(0.6395285500531203,0.5164177355268568)] Distancia:  2.2772799
Segmento:  [(0.6395285500531203,0.5164177355268568),(0.6172810645251761,0.31717518080833723)] Distancia:  0.20048079
Segmento:  [(0.6172810645251761,0.31717518080833723),(1.0644647661328521,0.4508334543433668)] Distancia:  0.46673098
Segmento:  [(1.0644647661328521,0.4508334543433668),(1.090832712720499,0.33800577122978026)] Distancia:  0.1158678
Segmento:  [(1.090832712720499,0.33800577122978026),(0.6106903089443454,0.17763253658794761)] Distancia:  0.50621766
Media segmentos 0.83460855
```

Idx 10:

```
Segmento:  [(0.592000007629,0.0),(2.1923851547282514,-0.721326374351465)] Distancia:  1.7554328
Segmento:  [(2.1923851547282514,-0.721326374351465),(2.2527024888062455,-1.5877240718114944)] Distancia:  0.8684948
Segmento:  [(2.2527024888062455,-1.5877240718114944),(0.9781879906558694,-0.762068421203656)] Distancia:  1.5185829
Segmento:  [(0.9781879906558694,-0.762068421203656),(0.7016415584509026,-1.2091745650628567)] Distancia:  0.52572024
Segmento:  [(0.7016415584509026,-1.2091745650628567),(0.8604169450245687,-1.6264325388877918)] Distancia:  0.44644582
Segmento:  [(0.8604169450245687,-1.6264325388877918),(0.12694901201403663,-0.37615549987414537)] Distancia:  1.4495406
Segmento:  [(0.12694901201403663,-0.37615549987414537),(-0.5044899698413614,-0.44695179130916435)] Distancia:  0.6353954
Segmento:  [(-0.5044899698413614,-0.44695179130916435),(-1.3880557954876251,-1.1459934279764517)] Distancia:  1.1266534
Segmento:  [(-1.3880557954876251,-1.1459934279764517),(-1.4972001034846878,-1.079864661963434)] Distancia:  0.12761469
Segmento:  [(-1.4972001034846878,-1.079864661963434),(-1.622930888145286,0.27461140428007236)] Distancia:  1.360299
Segmento:  [(-1.622930888145286,0.27461140428007236),(0.6372738949261781,0.5191974833773284)] Distancia:  2.2734
Segmento:  [(0.6372738949261781,0.5191974833773284),(0.6229938236273201,0.3235471009280594)] Distancia:  0.19617082
Segmento:  [(0.6229938236273201,0.3235471009280594),(1.090832712720499,0.33800577122978026)] Distancia:  0.46806225
Segmento:  [(1.090832712720499,0.33800577122978026),(0.6137469965779236,0.18142382941934213)] Distancia:  0.50212413
Media segmentos 0.9467098
```

Vemos que en el caso Q5, después de aplicar el merge, la media de idx 2 (0.83) es menor que idx10 (0.94), como ya explicamos anteriormente, aún así vemos que ambas medias son inferiores a las obtenidas después del purge (último paso), por lo que vemos que con el método purge conseguimos segmentos más pequeños.