Polygon Selection Strategy for Generalized MV Coordinates

Key Points

- We know the location of support points
- We don't know the shape of the support polygon
- Generalized MV coordinate (or Barycentric Coordinate in general) is sensitive to the shape of the polygon.
- If all the support points are part of convex problem, there is a unique sequencing.
- If the polygon is nonconvex, in some cases there is decision to be made for deciding which polygon to choose.
- Unless we know the polygon, we can't compute weights

Generalized MV Coordinates

▪ It is a form of generalized Barycentric coordinate

▪ It works for some cases of non-convex polygon

  - The polygon should be Star Shaped Polygon

    - Point G (or mean value coordinate) should be in the kernel of the polygon i.e. it should be visible from every point of all the edges

Star Polygon Strategy

Objective: Draw a polygon such that all points of the edges are visible from G (center of gravity projection)

Algorithm

1) Calculate the counter-clockwise angle of all support points with horizontal line passing through G (angles are in degrees)

2) Sort the angles in increasing order

3) If (Max_Angle – Min_Angle > 180), follow further from point 4

   else G is outside polygon

4) Polygon will start with the vertex having smallest angle and next vertex of polygon will be next smallest angle and so on

5) Calculate the weights for all the vertices using MV coordinate
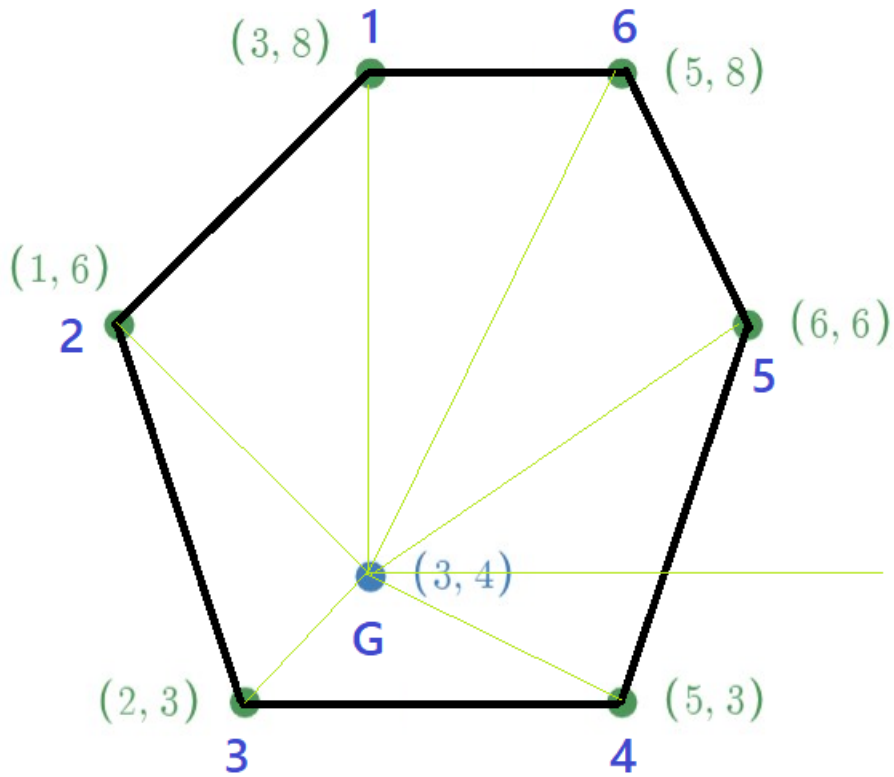
Index	Angles	Sorted Index	Sorted Angles
1	90.0	5	33.7
2	135.0	6	63.4
3	225.0	1	90.0
4	333.4	2	135.0
5	33.7	3	225.0
6	63.4	4	333.4

Index	Original MV Coordinates	MV Coordinates after Sorting	Sorted Index
1	4.5	6.6	5
2	14.0	3.1	6
3	47.2	4.5	1
4	24.6	14.0	2
5	6.6	47.2	3
6	3.1	24.6	4

Difference between minimum angle and maximum angle = 333.4-33.7

= 299.7   >180

- G inside Polygon
- Sequence of polygon formation: 5-6-1-2-3-4-5
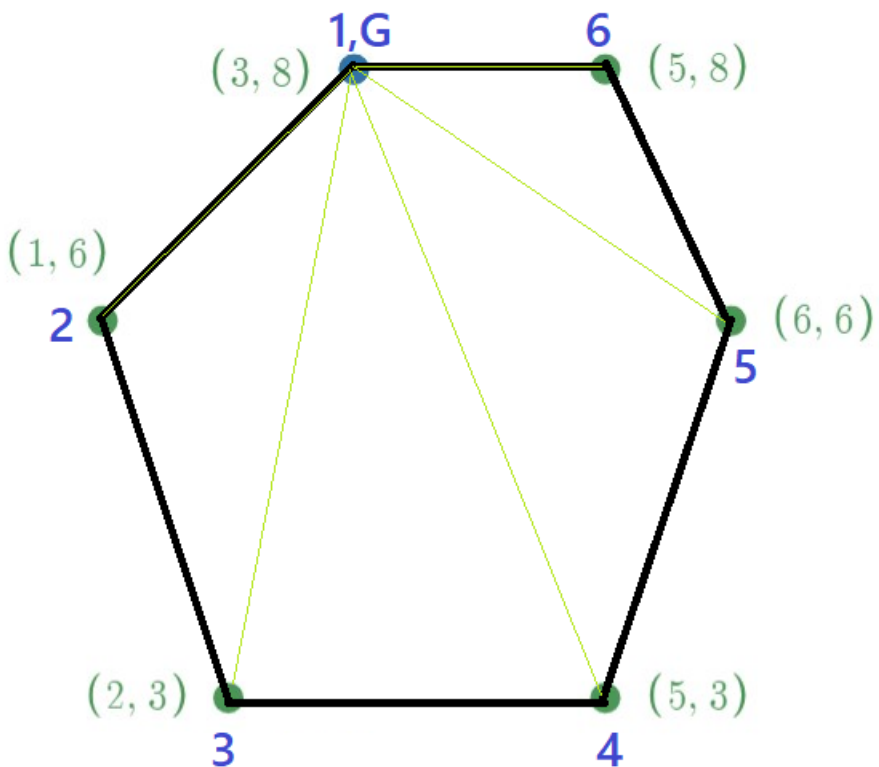
Index	Angles	Sorted Index	Sorted Angles
1	0.0	6	0.0
2	225.0	1	0.0
3	258.7	2	225.0
4	291.8	3	258.7
5	326.3	4	291.8
6	0.0	5	326.3

Index	Original MV Coordinates	MV Coordinates after Sorting	Sorted Index
1	100	0	6
2	0	100	1
3	0	0	2
4	0	0	3
5	0	0	4
6	0	0	5

Difference between minimum angle and maximum angle = 326.3-0

= 326.3 >180

- G ∈ Polygon
- Sequence of polygon formation: 6-1-2-3-4-5-6
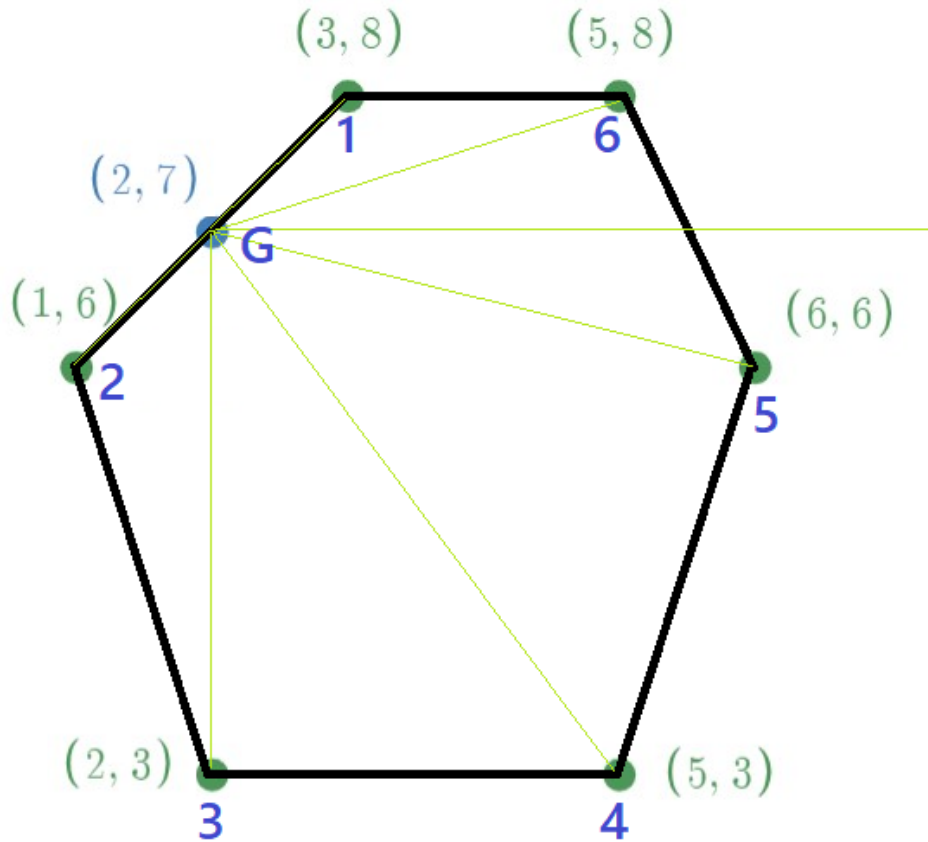
Index	Angles	Sorted Index	Sorted Angles
1	45.0	6	18.4
2	225.0	1	45.0
3	270.0	2	225.0
4	306.9	3	270.0
5	346.0	4	306.9
6	18.4	5	346.0

Index	Original MV Coordinates	MV Coordinates after Sorting	Sorted Index
1	50	0	6
2	50	50	1
3	0	50	2
4	0	0	3
5	0	0	4
6	0	0	5

Difference between minimum angle and maximum angle = 346-18.4

= 327.6   >180

▪   G ∈ Polygon
▪   Sequence of polygon formation: 6-1-2-3-4-5-6

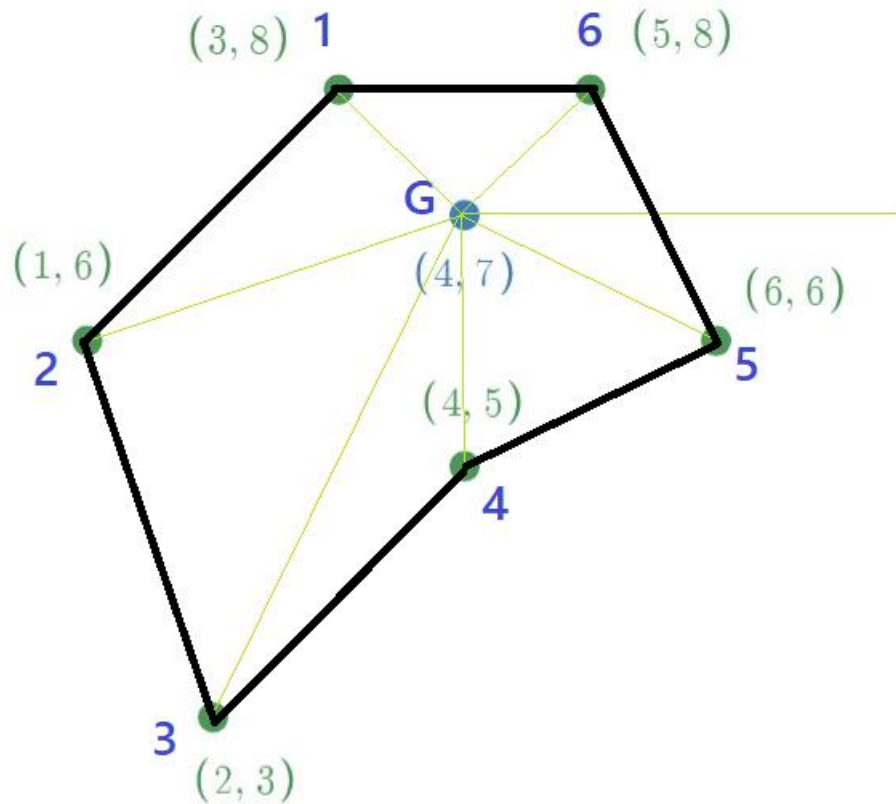| Index	Angles	Sorted Index	Sorted Angles
1	135.0	6	45.0
2	198.4	1	135.0
3	243.4	2	198.4
4	270.0	3	243.4
5	333.4	4	270.0
6	45.0	5	333.4

Index	Original MV Coordinates	MV Coordinates after Sorting	Sorted Index
1	29.7	31.5	6
2	8.5	29.7	1
3	3.8	8.5	2
4	11.1	3.8	3
5	15.5	11.1	4
6	31.5	15.5	5

Difference between minimum angle and maximum angle = 333.4-45

= 288.4   >180

- G ∈ Polygon
- Sequence of polygon formation: 6-1-2-3-4-5-6

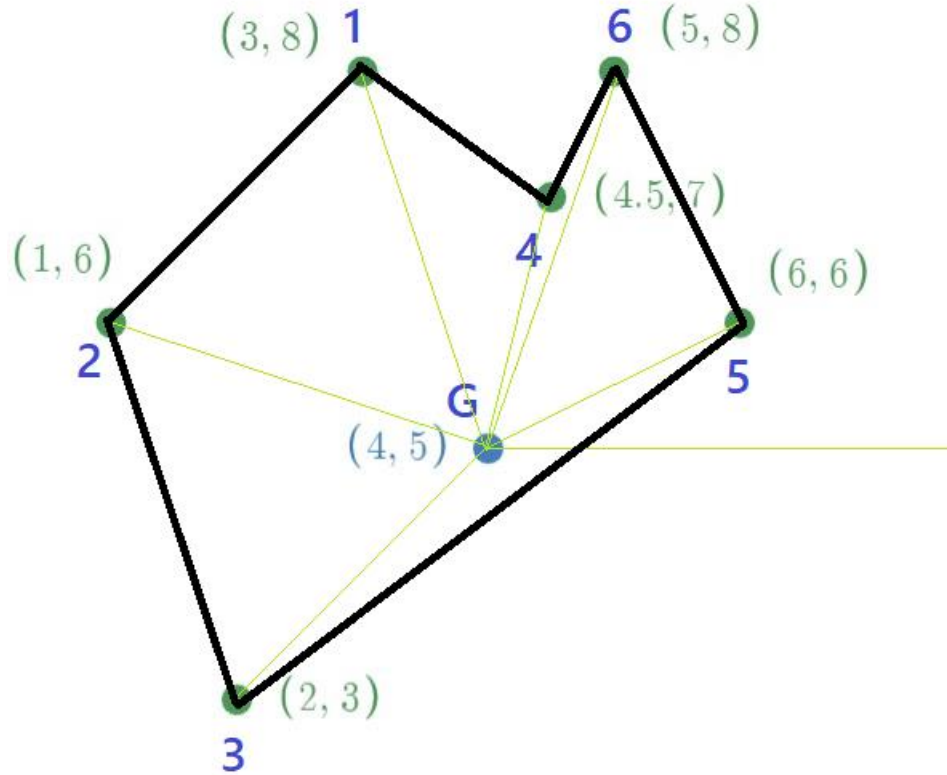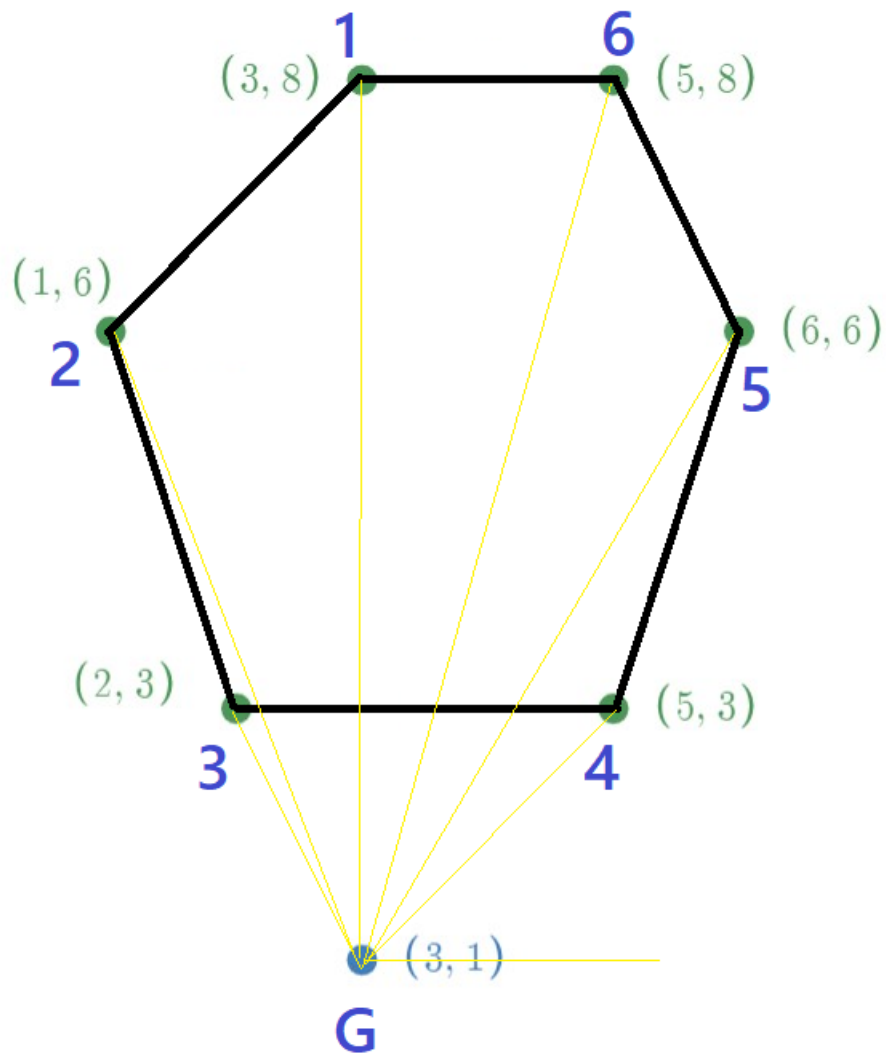| Index	Angles	Sorted Index	Sorted Angles
1	108.4	5	26.6
2	161.6	6	71.6
3	225.0	4	76.0
4	76.0	1	108.4
5	26.6	2	161.6
6	71.6	3	225.0

Index	Original MV Coordinates	MV Coordinates after Sorting	Sorted Index
1	6.7	47.1	5
2	9.1	2.3	6
3	27.1	2.6	4
4	50.5	4.0	1
5	0.5	5.7	2
6	6.1	38.4	3

Difference between minimum angle and maximum angle = 225-26.6

= 198.4 >180

- G ∈ Polygon
- Sequence of polygon formation: 5-6-4-1-2-3-5

Index	Angles	Sorted Index	Sorted Angles
1	90.0	4	45.0
2	111.8	5	59.0
3	116.6	6	74.1
4	45.0	1	90.0
5	59.0	2	111.8
6	74.1	3	116.6

Index	Original MV Coordinates	MV Coordinates after Sorting	Sorted Index
1	6.9	30.8	4
2	6.3	6.4	5
3	44.2	5.4	6
4	30.8	6.9	1
5	6.4	6.3	2
6	5.4	44.2	3

Difference between minimum angle and maximum angle = 116.9-45

= 71.9 <180

- G outside polygon
- We can't calculate MV coordinate for this polygon (table above gives wrong result)