Old Sinod - US

1 Outline

1.1 Basics

JSON ⇒ Structure ⇒ Algorithm ⇒ Structure ⇒ JSON

1.2 Explanation

1.2.1 JSON

Plane information

1.2.2 Structure

Plane information + relation between objects

1.2.3 Algorithm

Rule to determine positions of objects

2 Preliminaries

2.1 Color index

	abbreviations
	structure key
	acronym explanation
	partial result

2.2 Abbreviations

2.2.1 Boolean

TR	true
FA	false

2.2.2 Conditional

IF	if
EI	else if
EL	else

2.2.3 For

FE	for each
FO	for
BR	break

2.3 Notations

2.3.1 ≡ **equal**

$A \equiv B$	A equals B

2.3.2 ≠ **not equal**

$A \neq B$	A does not equal B

2.3.3 = **assignment**

$A = B$	Assign B to A

2.3.4 ∥ **parallel** **or** **tangent**

$A \parallel B$	IF	A and B are lines or segment	A and B are parallel
	EL	A and B are tangent	

2.3.5 And $\wedge$

$\wedge$	a_1
	a_2
	$\cdots$
	a_n

$= a_1 \wedge a_2 \wedge \cdots \wedge a_n$

2.3.6 Or $\vee$

$\vee$	a_1
	a_2
	$\cdots$
	a_n

$= a_1 \vee a_2 \vee \cdots \vee a_n$

2.3.7 Coordinates

$[x, y]$

2.3.8 Set

Regard a set as an array $[a, b, \ldots]$

2.3.9 Function composition

$f_1 \circ f_2 \circ \cdots \circ f_n(\mathbf{x}) = f_1(f_2(\cdots(f_n(\mathbf{x}))\cdots)$

2.3.10 Conditional statement

1. | IF | A |
   |---|---|

   1 If $A \equiv$ TR, then

2. | IF | A | B |
   |---|---|---|

   1 If $A \equiv$ TR, then B.

3. | EI | A |
   |---|---|

   1 Else if $A \equiv$ TR, then

4. | EI | A | B |
   |---|---|---|

   1 Else if $A \equiv$ TR, then B.

5. | EL |
   |---|

   1 Else

6. | EL | B |
   |---|---|

   1 Else B

2.3.11 Loops

1. | FO | A |
   |---|---|

   1 For A

2. | FO | A | B |
   |---|---|---|

   1 For A do B

3. | FE | A |
   |---|---|

   1 For each A

4. | FE | A | B |
   |---|---|---|

   1 For each A do B

2.3.12 Operator

1. | A | $\circ$ | B |
   |---|---|---|

   1 $A \circ B$

2.4 Functions

2.4.1 $\mathrm{m}(r, s)$ **mod**

1. **Definition**
   Remainder obtained by dividing r by s

2. **Computation**
   $\mathrm{m}(r, s) = \left\lfloor \frac{r}{s} \right\rfloor$

3. **Example**
   $\mathrm{m}(3, 2) = 1$

2.4.2 $\mathrm{a}(\theta)$ **angle**

1. **Definition**
   Polar coordinates angle of θ

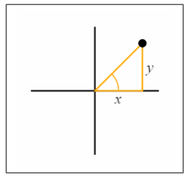
2. **Computation**
   $\mathrm{a}(\theta) = \left\lfloor \frac{\theta}{2\pi} \right\rfloor$

3. **Example**
   $\mathrm{a}(3\pi) = \pi$

2.4.3 $\mathrm{a}(y, x)$ **angle**

1. **Definition**

   1 Angle θ $(0 \leq \theta < 2\pi)$ obtained by representing $[x, y]$ as polar coordinates

   2
   

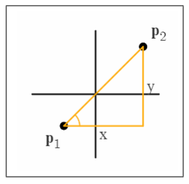
2. **Computation**
   $\mathrm{a}(y, x) = \mathrm{m}(\mathrm{atan2}(y, x), 2\pi)$

3. **Example**
   $\mathrm{a}(\sqrt{3}, 1) = \frac{\pi}{3}$

2.4.4 $\mathrm{a}(\mathbf{p}_1, \mathbf{p}_2)$ **angle**

1. **Definition**

   1 Angle obtained by representing $\mathbf{p} = [x, y] = \mathbf{p}_2 - \mathbf{p}_1$ as polar coordinates

   2
   

2. **Computation**
   $\mathrm{a}(\mathbf{p}_1, \mathbf{p}_2) = \mathrm{a}(y, x)$

3. **Example**
   $\mathrm{a}([1, 1], [2, 1 + \sqrt{3}]) = \mathrm{a}(\sqrt{3}, 1) = \frac{\pi}{3}$

2.4.5 $\mathrm{d}(\mathbf{p}_1, \mathbf{p}_2)$ **distance**

1. **Definition**
   Distance between two points $\mathbf{p}_1 = [x_1, y_1]$, $\mathbf{p}_2 = [x_2, y_2]$

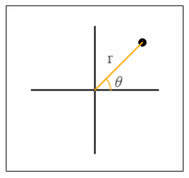
2. **Computation**
   $\mathrm{d}(\mathbf{p}_1, \mathbf{p}_2) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$

3. **Example**
   $\mathrm{d}([1, 1], [2, 3]) = \sqrt{5}$

2.4.6 c(r, θ) **Cartesian**

1. **Definition**

   1 Cartesian coordinates representation of polar coordinates $[r, \theta]$

   2 

2. **Computation**
   $\mathrm{c}(r, \theta) = [r \cos\theta, r \sin\theta]$

3. **Example**
   $\mathrm{c}(2, \frac{\pi}{6}) = [1, \sqrt{3}]$

2.4.7 s(r) **sign**

1. **Definition**
   Sign of r

2. **Computation**

$$\mathrm{s}(r) = \begin{array}{|c|c|c|} \hline \text{IF} & r < 0 & \text{-1} \\ \hline \text{EI} & r \equiv 0 & 0 \\ \hline \text{EL} & 1 & \\ \hline \end{array}$$

3. **Example**
   $\mathrm{s}(-3) = -1$

2.4.8 k$(v, \mathcal{A})$ **key**

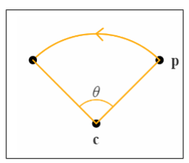
1. **Definition**
   Key of v in an array $\mathcal{A}$

2. **Computation**
   $\mathcal{A}[\mathrm{k}(v, \mathcal{A})] = v$

2.4.9 r$(\mathbf{p}, \mathbf{c}, \theta)$ **rotation**

1. **Definition**

   1 Point obtained by rotating $\mathbf{p} = [x, y]$ around $\mathbf{c} = [x_1, y_1]$ with angle θ

   2 

2. **Computation**

$$\mathrm{r}(\mathbf{p}, \mathbf{c}, \theta) = (\mathbf{p} - \mathbf{c}) \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix} + \mathbf{c}$$

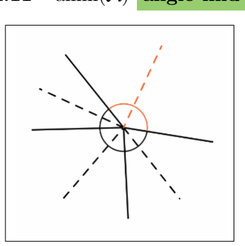
3. **Example**
   $\mathrm{r}([3, 3], [1, 1], \frac{\pi}{2}) = [-3, 3]$

2.4.10 s$(\mathbf{p}_1, \mathbf{p}_2)$ **segment**

1. **Definition**
   Line segment whose end points are $\mathbf{p}_1$, $\mathbf{p}_2$

2. **Computation**
   $\mathrm{s}(\mathbf{p}_1, \mathbf{p}_2) = [t\mathbf{p}_1 + (1-t)\mathbf{p}_2 \mid 0 \leq t \leq 1]$

2.4.11 amm$(\mathcal{A})$ **angle mid max**



1. **Definition**

   1. Sort $\mathcal{A} = [\theta_0, \theta_1 \ldots, \theta_n]$ $(\theta_0 \leq \theta_1 \leq \ldots \leq \theta_n)$
   2. $\delta_0 = \theta_0 - \theta_n, \delta_1 = \theta_1 - \theta_0, \ldots, \delta_n = \theta_n - \theta_{n-1}$
   3. $\text{amm}(\mathcal{A}) = \text{a}(\theta_i - \frac{\delta_i}{2})$ $(\delta_i = \max[\delta_0, \ldots, \delta_n])$

2. **Example**

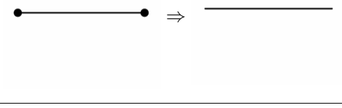
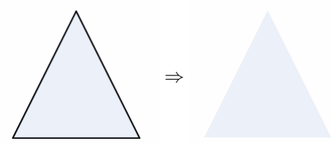
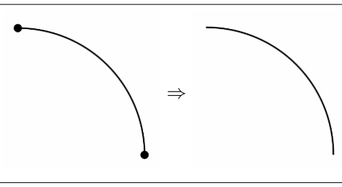
   1. $\mathcal{A} = [\frac{3\pi}{4}, \pi, \frac{3\pi}{2}, \frac{7\pi}{4}] = [\theta_0, \theta_1, \theta_2, \theta_3]$
   2. | |
      |---|
      | $\delta_0 = \pi$ |
      | $\delta_1 = \frac{\pi}{4}$ |
      | $\delta_2 = \frac{\pi}{2}$ |
      | $\delta_3 = \frac{\pi}{4}$ |
   3. $\text{amm}(\mathcal{A}) = \text{a}(\frac{3\pi}{4} - \frac{\pi}{2}) = \frac{\pi}{4}$

2.4.12 int(O) interior

1. **Definition**

   1. Interior of an object O

   2.

Segment2D	
Face2D	
Arc2D	

3 Structure

3.1 Values

3.1.1 Boolean

TR
FA

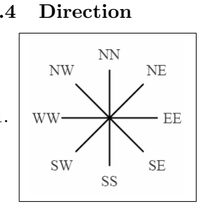
3.1.2 Color

number	XX0	XX1	XX2	XX3	XX4	XX5
color	gray	blue	red	blue	yellow	YellowGreen

3.1.3 Coordinates

[real number, real number]

3.1.4 Direction

1. 

2.

name	EE	NE	NN	NW	WW	SW	SS	SE	CM
direction	East	N.East	North	N.West	West	S.West	South	S.East	Center
degree	0°	45°	90°	135°	180°	225°	270°	315°	

3.2 Objects

1. **Structure**

key	value

2. **Elements**

function	structure key	definition	function name meaning

3. **Functions**

function	definition	function name meaning

3.2.1 Geometry2D: G geometry

1. **Structure**

type	Geometry2D
object	object array
window	$[[-x_{min}, x_{max}], [-y_{min}, y_{max}]]$
rotate	radian

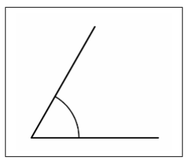
2. **Elements**

o(G)	object	object on G	object
s(G)	window	size of G	size
a(G)	rotate	rotation angle	angle

3. **Functions**

r(G)	$\frac{y_{max}-y_{min}}{x_{max}-x_{min}}$	ratio

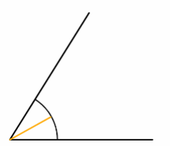
3.2.2 Angle2D: A



1. **Structure**

type	AngleThreePt2D
height	real number
dash	boolean
color	color
visible	boolean
tickLabel	none, right, double, dot, circle, dash, dbldash, tpldash
selectable	boolean
selected	boolean
label	type: Static mode: math value: latex
labelSign	direction
id	natural number
vertexPoint	natural number
sourcePoint	natural number
targetPoint	natural number

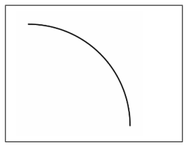
2. **Elements**

c(A)	vertex	center	center
s(A)	source	start	start
e(A)	target	end	end
h(A)	height	distance form $c(A)$ to angle mark 	height
r(A)	right	right mark or not	right
se(A)	selectable	selectable or not	selectable
t(A)	tickLabel	tickLabel arc form: none, double, dash, dbldash, tpldash nonarc form: dot, circle	tick label

3. **Functions**

a(A)	angle	angle

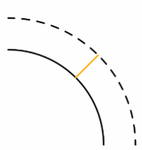
3.2.3 Arc2D: A



1. **Structure**

type	ArcFree2D
angle	radian
dash	boolean
color	color
visible	boolean
tickLabel	none, single, double, triple
selectable	boolean
selected	boolean
label	type: Static mode: math value:
labelSign	direction
measure	visible: boolean height: real number color: color label: type: Static; mode: math; value: labelSign: direction tickLabel: none, single, double, triple type: MeasureArcGeo2D center: coordinates pointStart: coordinates angle: radian
id	natural number
centerPoint	natural number
startPoint	natural number

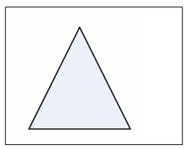
2. **Elements**

c(A)	center	center	center
s(A)	pointStart	start	start
a(A)	angle	angle	angle
m(A)	measure	measure	measure
h ∘ m(A)	height	distance between c(A) and $m(A)$ 	height
ld ∘ m(A)	labelSign	label direction	label direction

3. **Functions**

$e(A)$	end	end
r(A)	d(c(A), s(A))	radius

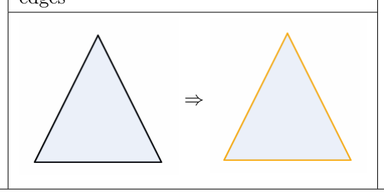
3.2.4 Face2D: F



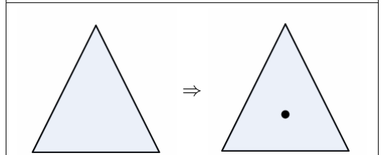
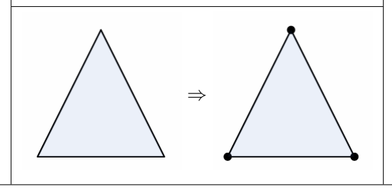
1. **Structure**

type	FaceBoundaries2D
color	color
visible	boolean
selectable	boolean
selected	boolean
label	type: Static mode: math value:
labelSign	direction
id	natural number
boundaries	[natural numbrer, natural number, natural number]

2. **Elements**

e(F)	boundaries	edges 	edge

3. **Functions**

c(F)	center 	center
v(F)	vertices 	vertex

3.2.5 Label2D: L

1. **Structure**

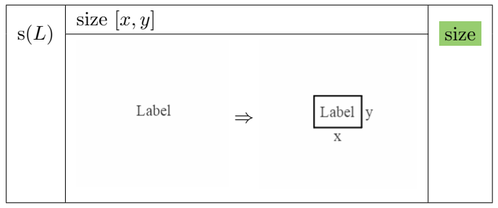
type	LabelFree2D
coord	coordinates
color	color
selectable	boolean
selected	boolean
label	type: Static mode: math value: latex
labelSign	direction
labeledObject	natural number
labelType	
labelUnit	
id	natural number

2. **Elements**

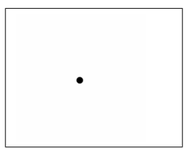
c(L)	coord	center	center
o(L)	labeledObject	id of object to label	object
ld(L)	labelSign	label direction	label direction

3. **Functions**

s(L)	size $[x, y]$	size



3.2.6 Point2D: P



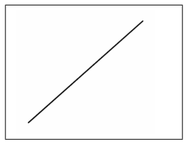
1. **Structure**

type	PointFree2D
coord	coordinates
isFill	boolean
color	color
visible	boolean
selectable	boolean
selected	boolean
label	type: Static mode: math value:
labelSign	direction
id	natural number

2. **Elements**

c(P)	coord	coordinates	coordinates

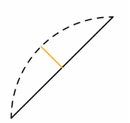
3.2.7 Segment2D: S



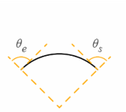
1. **Structure**

type	LineSegFree2D
source	arrow: boolean
target	arrow: boolean
dash	boolean
color	color
visible	boolean
tickLabel	none, single, double, triple, quadruple, dot, circle
parallel	none, single, double, triple
selectable	boolean
selected	boolean
label	type: Static mode: math value:
labelSign	direction
measure	height: real number color: color label: type: Static; mode: math; value: labelSign: direction tickLabel: none, single, double type: MeasureGeo2D source: coordinates target: coordinates
id	natural number
sourcePoint	natural number
targetPoint	natural number

2. **Elements**

s(S)	source	start	start
e(S)	target	end	end
c(S)	color	color	color
m(S)	measure	measure	measure
h ∘ m(S)	height	distance between center of S and center of m(S) 	height
c ∘ m(S)	color	color of m(S)	color
l ∘ m(S)	label	label of m(S)	label
ld ∘ m(S)	labelSign	label direction	label direction
l(S)	label	label	label
ld(S)	labelSign	label direction	label direction

3. **Functions**

v(S)	e(S) − s(S)	vector
a(S)	a(s(S), e(S))	angle
l(S)	l(s(S), e(S))	length
a ∘ m(S)	$[\theta_s, \theta_e]$: start and end angles of m(S) 	angle
r ∘ m(S)	radius of Arc2D containing m(S)	radius
s ∘ l ∘ m(S)	size of l ∘ m(S)	size

3.3 Functions or elements

3.3.1 Function index (O: object)

a(O)	angle
c(O)	center or coordinates
co(O)	color
e(O)	end or edges
h(O)	height
l(O)	label or length
ld(O)	label direction
o(O)	object
d(O)	distance
m(O)	measure
r(O)	radius or ratio or right
s(O)	start or size
se(O)	selectable
t(O)	tick label
v(O)	vertex

3.3.2 Functions

1. lc(A, L) | center of Label2D L when Angle2D A satisfies o(L) ≡ A | Label2D center

2. lr(A, L) | radius of area by Angle2D A and Label2D L (c(L) is not determined yet) | Label2D radius

1

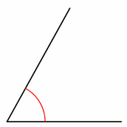
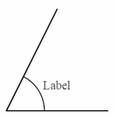
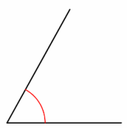
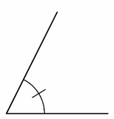
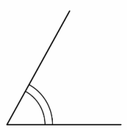
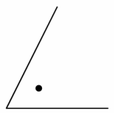
lr(A, L) = h(A)

IF	L exists	$\mathbf{p}_o = [\,]$
		IF: c(A)[i] ≤ lc(A, L)[i] → $\mathbf{p}_o[\,] = \text{lc}(A, L)[i] + \frac{\text{s}(L)[i]}{2}$
		EL: $\mathbf{p}_o[\,] = \text{lc}(A, L)[i] + \frac{\text{s}(L)[i]}{2}$
		lr(A, L) = max(r, d(c(A), $\mathbf{p}_o$))

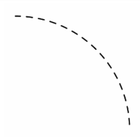
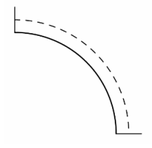
4 Algorithm

4.1 Classification of objects

4.1.1 Angle2D: $\mathcal{AN}$

$\mathcal{AN}_c$	set of colored Angle2D 	Angle2D color
$\mathcal{AN}_l$	set of labeled Angle2D 	Angle2D label
$\mathcal{AN}_s$	set of selectable Angle2D 	Angle2D selectable
$\mathcal{AN}_t$	set of tickLabel marked Angle2D 	Angle2D tickLabel
$\mathcal{AN}_t$	set of Angle2D whose tickLabel is arc form 	Angle2D tickLabel arc
$\mathcal{AN}_{tn}$	set of Angle2D whose tickLabel is not arc form 	Angle2D tickLabel nonarc
$\mathcal{AN}_{\bar{t}}$	$\mathcal{AN} - \mathcal{AN}_t$	Angle2D tickLabel complement

4.1.2 Arc2D: $\mathcal{AR}$

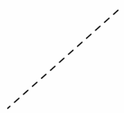
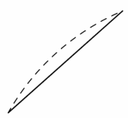
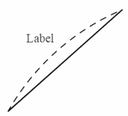
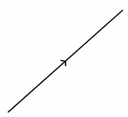
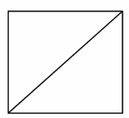
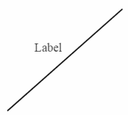
$\mathcal{AR}_d$	set of dashed Arc2D 	Arc2D dash
$\mathcal{AR}_m$	set of Arc2D with measure 	Arc2D measure

4.1.3 Face2D: $\mathcal{F}$

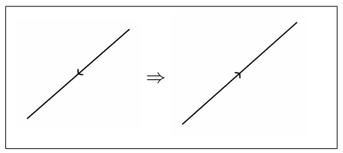
4.1.4 Label2D: $\mathcal{L}$

4.1.5 Point2D: $\mathcal{P}$

4.1.6 Segment2D: $\mathcal{S}$

$\mathcal{S}_d$	set of dashed Segment2D 	Segment2D dash
$\mathcal{S}_m$	set of Segment2D with measure 	Segment2D measure
$\mathcal{S}_{ml}$	set of Segment2D whose measure is labeled 	Segment2D measure label
$\mathcal{S}_p$	set of Segment2D with parallel mark 	Segment2D parallel
$\mathcal{S}_{li}$	set of Segment2D which touches boundaries 	Segment2D line
$\mathcal{S}_l$	set of labeled Segment2D 	Segment2D label

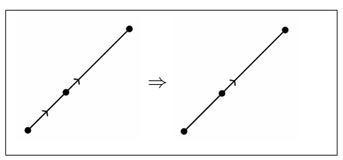
4.2 Unification of parallel mark of Segment2D

1 

2

FE	$S \in \mathcal{S}_p$	IF	$180° \leq \mathrm{a}(S) < 360°$	Switch s(S) and e(S)

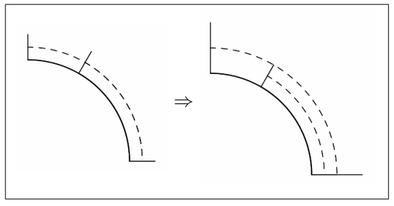
4.3 Simplification of parallel mark of Segment2D

1 

2

FE	$S_1 \in \mathcal{S}_p$	IF	$\wedge$	$S_2 \in \mathcal{S}_p$ $S_1 \neq S_2$	IF	$S_1 \subseteq S_2$	Remove parallel mark in S_1
					EI	$S_2 \subsetneq S_1$	Remove parallel mark in S_2

4.4 Determination of measure height of Arc2D



4.4.1 Initial measure heights

1	FE	$A \in \mathcal{AR}_m$	$\mathrm{h} \circ \mathrm{m}(A) = \min(0.2 \cdot \mathrm{r}(A), 2)$

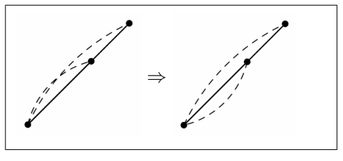
4.4.2 Determine heights of overlapping measures

1	$h_{io} = 0.5$	height increment overlap
	$h_{ic} = 2.5$	height increment contained
	$h_{icl} = 3$	height increment contained label
	h_{icla}	height increment contained label angle

2	FO	i	FO	j	IF	$\wedge$	$j < i$ $\mathcal{AR}_m[i] \not\subseteq \mathcal{AR}_m[j]$ $\mathcal{AR}_m[j] \not\subseteq \mathcal{AR}_m[i]$ $\mathcal{AR}_m[i]$ and $\mathcal{AR}_m[j]$ overlap $\mathrm{h} \circ \mathrm{m}(\mathcal{AR}_m[i]) = \mathrm{h} \circ \mathrm{m}(\mathcal{AR}_m[j])$	$\mathrm{h} \circ \mathrm{m}(\mathcal{AR}_m[i]) = \mathrm{h} \circ \mathrm{m}(\mathcal{AR}_m[j]) + h_{io}$

3	FE	$A_1 \in \mathcal{AR}_m$	FE	$A_2 \in \mathcal{AR}_m$	IF	$\wedge$	$A_2 \in \mathcal{AR}_{ml}$ $A_2 \subsetneq A_1$	$\theta_m = \mathrm{a}(\mathrm{a}(\mathrm{c}(A_2), \mathrm{s}(A_2)) + \frac{\mathrm{a}(A_2)}{2})$ IF $\vee$ $0 \le \theta_m < \frac{9\pi}{8}$ / $\frac{11\pi}{8} < \theta_m < 2\pi$: $h_{icla} = 0$ EL : $h_{icla} = 0.8$ $\mathrm{h} \circ \mathrm{m}(A_1) = \max(\mathrm{h} \circ \mathrm{m}(A_1), \mathrm{h} \circ \mathrm{m}(A_2) + h_{icl} + h_{icla})$
					EL			$\mathrm{h} \circ \mathrm{m}(A_1) = \max(\mathrm{h} \circ \mathrm{m}(A_1), \mathrm{h} \circ \mathrm{m}(A_2) + h_{ic})$

4.5 Determination of measure height of Segment2D



4.5.1 Determine initial measure height

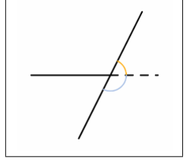
	$h_{mi} = 0.001$	height measure initial
	$h_{it} = 1$	height initial tickLabel
1	FE $S \in \mathcal{S}_m$	IF tickLabel of S is none: $\mathrm{h} \circ \mathrm{m}(S) = h_{mi}$ EL: $\mathrm{h} \circ \mathrm{m}(S) = h_{it} \cdot \mathrm{r}(G)$
		$h_{ic} = 1$ height increment
		$i_c =$ FA is containing
		FE $S_1 \in \mathcal{S}_m$: IF $S_1 \subsetneq S$: $i_c =$ TR; BR
		IF $i_c \equiv$ TR: $\mathrm{h} \circ \mathrm{m}(S) += h_{ic}$

4.5.2 Collect angles of objects O passing S

1	$\mathcal{A}_s$ angles of objects passing $\mathrm{s}(S)$	angle start
	$\mathcal{A}_e$ angles of objects passing $\mathrm{e}(S)$	angle end
	$\theta_s = \mathrm{a}(-\mathrm{a}(S))$	angle start
	$\theta_e = \mathrm{a}(S)$	angle end

2 IF

$O \equiv S_1 \in \mathcal{S}$



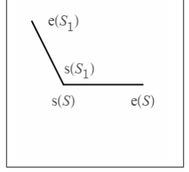
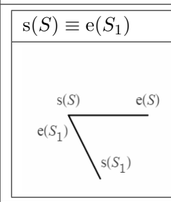
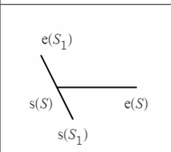
IF

$\wedge$

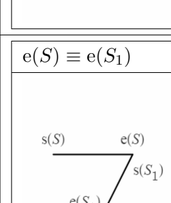
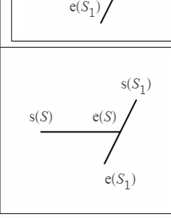
- $S \nparallel S_1$
- $S \not\subset S_1$
- $S_1 \not\subset S$

$\theta_{1s} = \mathrm{a}(-\mathrm{a}(S_1))$	angle 1 start
$\theta_{1e} = \mathrm{a}(S_1)$	angle 1 end

IF $\mathrm{s}(S) \in S_1$

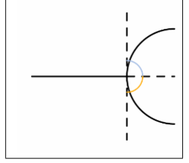
IF	$\mathrm{s}(S) \equiv \mathrm{s}(S_1)$ 	$\mathcal{A}_s[\,] = \theta_{1s}$
EI	$\mathrm{s}(S) \equiv \mathrm{e}(S_1)$ 	$\mathcal{A}_s[\,] = \theta_{1e}$
EL		$\mathcal{A}_s[\,] = \theta_{1s}$ $\mathcal{A}_s[\,] = \theta_{1e}$

EI $\mathrm{e}(S) \in S_1$

IF	$\mathrm{e}(S) \equiv \mathrm{s}(S_1)$ 	$\mathcal{A}_s[\,] = \theta_{1s}$
EI	$\mathrm{e}(S) \equiv \mathrm{e}(S_1)$ 	$\mathcal{A}_s[\,] = \theta_{1e}$
EL		$\mathcal{A}_s[\,] = \theta_{1s}$ $\mathcal{A}_s[\,] = \theta_{1e}$

3 IF

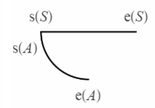
$O \equiv A \in \mathcal{AR}$



IF $\mathrm{s}(S) \in A$

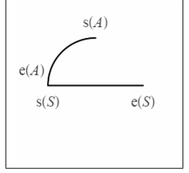
$\theta_{cs} = \mathrm{a}(\mathrm{c}(A), \mathrm{s}(S))$ angle center start

IF $\mathrm{s}(S) \equiv \mathrm{s}(A)$



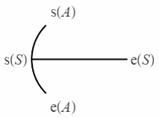
$\mathcal{A}_s[\,] = \mathrm{a}(\theta_{cs} + \frac{\pi}{2})$

EI $\mathrm{s}(S) \equiv \mathrm{e}(A)$



$\mathcal{A}_s[\,] = \mathrm{a}(\theta_{cs} - \frac{\pi}{2})$

EL



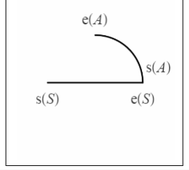
$\mathcal{A}_s[\,] = \mathrm{a}(\theta_{cs} + \frac{\pi}{2})$

$\mathcal{A}_s[\,] = \mathrm{a}(\theta_{cs} - \frac{\pi}{2})$

IF $\mathrm{e}(S) \in A$

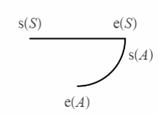
$\theta_{ce} = \mathrm{a}(\mathrm{c}(A), \mathrm{e}(S))$ angle center end

IF $\mathrm{e}(S) \equiv \mathrm{s}(A)$



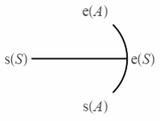
$\mathcal{A}_e[\,] = \mathrm{a}(\theta_{ce} + \frac{\pi}{2})$

EI $\mathrm{e}(S) \equiv \mathrm{e}(A)$



$\mathcal{A}_e[\,] = \mathrm{a}(\theta_{ce} - \frac{\pi}{2})$

EL

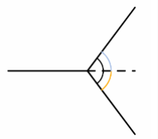


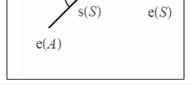
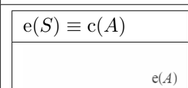
$\mathcal{A}_e[\,] = \mathrm{a}(\theta_{ce} + \frac{\pi}{2})$

$\mathcal{A}_e[\,] = \mathrm{a}(\theta_{ce} - \frac{\pi}{2})$

4 IF

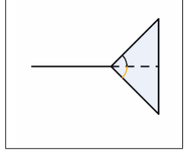
$O \equiv A \in \mathcal{AN}$



$\theta_{cs} = \mathrm{a}(\mathrm{c}(A), \mathrm{s}(A))$	angle center start				
$\theta_{ce} = \mathrm{a}(\mathrm{c}(A), \mathrm{e}(A))$	angle center end				
$n_a = \left\lceil \frac{6\mathrm{a}(A)}{\pi} \right\rceil$	number angle				
IF	$\mathrm{s}(S) \equiv \mathrm{c}(A)$ 	IF	$\theta_s \equiv \theta_{cs}$	FO	$0 \le i \le n_a$ $\mathcal{A}_s[\,] = \mathrm{a}(\theta_{cs} + \frac{\mathrm{a}(A)}{n_a} i)$
		EI	$\theta_s \equiv \theta_{ce}$	FO	$0 \le i \le n_a$ $\mathcal{A}_s[\,] = \mathrm{a}(\theta_{ce} - \frac{\mathrm{a}(A)}{n_a} i)$
EI	$\mathrm{e}(S) \equiv \mathrm{c}(A)$ 	IF	$\theta_e \equiv \theta_{cs}$	FO	$0 \le i \le n_a$ $\mathcal{A}_e[\,] = \mathrm{a}(\theta_{cs} + \frac{\mathrm{a}(A)}{n_a} i)$
		EI	$\theta_e \equiv \theta_{ce}$	FO	$0 \le i \le na$ $\mathcal{A}_e[\,] = \mathrm{a}(\theta_{ce} - \frac{\mathrm{a}(A)}{n_a} i)$

5 IF

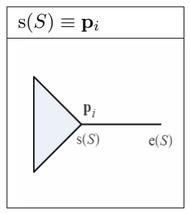
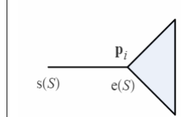
$O \equiv F \in \mathcal{F}$



$\mathrm{v}(F) = [\mathbf{p}_0, \mathbf{p}_1, \ldots, \mathbf{p}_{n-1}]$

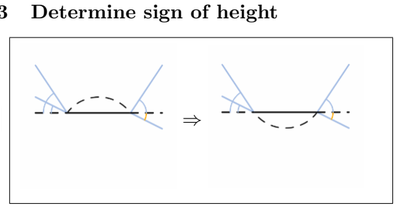
$\mathbf{p}_n = \mathbf{p}_0$

$\mathbf{p}_{-1} = \mathbf{p}_{n-1}$

IF	$\mathrm{s}(S) \equiv \mathbf{p}_i$ 	$\theta_{si} = \mathrm{a}(\mathbf{p}_i, \mathbf{p}_{i+1})$		angle start i
		$\theta_{ei} = \mathrm{a}(\mathbf{p}_i, \mathbf{p}_{i-1})$		angle end i
		IF $\mathrm{a}(\theta_{ei} - \theta_{si}) \le \pi$	$\theta_{di} = \mathrm{a}(\theta_{ei} - \theta_{si})$; $s = 1$	angle difference i; sign
		EL	$\theta_{di} = 2\pi - \mathrm{a}(\theta_{ei} - \theta_{si})$; $s = -1$	
		$n_{ai} = \left\lceil \frac{6\theta_{di}}{\pi} \right\rceil$		number angle i
		$\theta_{ui} = \frac{\theta_{di}}{n_{ai}}$		angle unit i
		FO $0 \le i \le n_{ai}$	$\mathcal{A}_s[\,] = \mathrm{a}(\theta_{si} + s \cdot j \cdot \theta_{ui})$	
EI	$\mathrm{e}(S) \equiv \mathbf{p}_i$ 	$\theta_{si} = \mathrm{a}(\mathbf{p}_i, \mathbf{p}_{i+1})$		angle start i
		$\theta_{ei} = \mathrm{a}(\mathbf{p}_i, \mathbf{p}_{i-1})$		angle end i
		IF $\mathrm{a}(\theta_{ei} - \theta_{si}) \le \pi$	$\theta_{di} = \mathrm{a}(\theta_{ei} - \theta_{si})$; $s = 1$	angle difference i; sign
		EL	$\theta_{di} 2\pi - \mathrm{a}(\theta_{ei} - \theta_{si})$; $s = -1$	
		$n_{ai} = \left\lceil \frac{6\theta_{di}}{\pi} \right\rceil$		number angle i
		$\theta_{ui} = \frac{\theta_{di}}{n_{ai}}$		angle unit i
		FO $0 \le i \le n_{ai}$	$\mathcal{A}_e[\,] = \mathrm{a}(\theta_{si} + s \cdot j \cdot \theta_{ui})$	

4.5.3 Determine sign of height

1

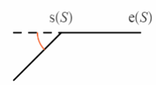
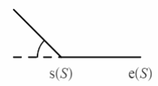
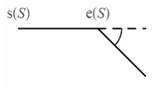
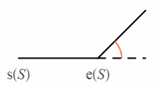


2 IF

$\wedge$ $|\mathcal{A}_s| \equiv 0$; $|\mathcal{A}_e| \equiv 0$

IF	$\vee$ $0 \le \theta_e \le \frac{\pi}{2}$; $\frac{3\pi}{2} < \theta_e < 2\pi$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EL	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$	

3 EL

$\mathcal{A}_{sl} = [0, \theta \in \mathcal{A}_s \mid \mathrm{a}(\theta - \theta_s) < \pi]$		angle start left
$\mathcal{A}_{sr} = [0, \theta \in \mathcal{A}_s \mid \mathrm{a}(\theta_s - \theta) < \pi]$		angle start right
$\mathcal{A}_{el} = [0, \theta \in \mathcal{A}_e \mid \mathrm{a}(\theta - \theta_e) < \pi]$		angle end left
$\mathcal{A}_{er} = [0, \theta \in \mathcal{A}_e \mid \mathrm{a}(\theta_e - \theta) < \pi]$		angle end right

$\theta_{sl} = \max(\mathcal{A}_{sl})$	angle start left
$\theta_{sr} = \max(\mathcal{A}_{sr})$	angle start right
$\theta_{el} = \max(\mathcal{A}_{el})$	angle end left
$\theta_{er} = \max(\mathcal{A}_{er})$	angle end right
$\theta_l = \max(\theta_{sr}, \theta_{el})$	angle left
$\theta_r = \max(\theta_{sl}, \theta_{er})$	angle right

3 | 1

IF $\theta_l \neq \theta_r$

IF	$\theta_l < \theta_r$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EI	$\theta_l > \theta_r$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$

EL

IF ∧ ($\theta_{sl} \equiv \theta_r$, $\theta_{sr} \equiv \theta_l$) ∧ ($\theta_{el} \neq \theta_l$, $\theta_{er} \neq \theta_r$)

IF	$\theta_{el} < \theta_{er}$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EI	$\theta_{el} > \theta_{er}$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$

EI ∧ ($\theta_{sl} \neq \theta_r$, $\theta_{sr} \neq \theta_l$) ∧ ($\theta_{el} \equiv \theta_l$, $\theta_{er} \equiv \theta_r$)

IF	$\theta_{sl} < \theta_{sr}$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EI	$\theta_{sl} > \theta_{sr}$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$

EI ∧ ($\theta_{sl} \equiv \theta_r$, $\theta_{sr} \neq \theta_l$) ∧ ($\theta_{el} \equiv \theta_l$, $\theta_{er} \neq \theta_r$)

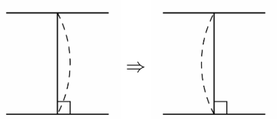
IF	$\theta_{sr} < \theta_{tr}$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EI	$\theta_{sr} > \theta_{tr}$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$

EI ∧ ($\theta_{sl} \neq \theta_r$, $\theta_{sr} \equiv \theta_l$) ∧ ($\theta_{el} \neq \theta_l$, $\theta_{er} \equiv \theta_r$)

IF	$\theta_{sl} < \theta_{tl}$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EI	$\theta_{sl} > \theta_{tl}$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$

3 2 IF

S represents the distance between two parallel lines (edge of right angle)



IF

$\wedge$
- $\theta_{sl} \neq 0$
- $\theta_{sr} \neq 0$
- $\theta_{el} \neq 0$
- $\theta_{er} \neq 0$
- $\theta_{sl} \equiv \theta_{sr}$
- $\theta_{el} \equiv \theta_{er}$
- $\theta_{sl} + \theta_{sr} \equiv \pi$
- $\theta_{el} + \theta_{er} \equiv \pi$

- $v_{sl} =$ FA — visible start left
- $v_{sr} =$ FA — visible start right
- $v_{el} =$ FA — visible end left
- $v_{er} =$ FA — visible end right

FE $A \in \mathcal{AN}$

- $\theta_{cs} = \mathrm{a}(\mathrm{c}(A), \mathrm{s}(A))$ — angle center start
- $\theta_{ce} = \mathrm{a}(\mathrm{c}(A), \mathrm{e}(A))$ — angle center end

IF $\mathrm{s}(S) \equiv \mathrm{c}(A)$

IF	$\wedge$ $\theta_e \equiv \theta_{ce}$; $\mathrm{a}(\theta_s + \theta_{sl}) \equiv \theta_{cs}$	$v_{sl} =$ TR
EI	$\wedge$ $\theta_e \equiv \theta_{cs}$; $\mathrm{a}(\theta_s - \theta_{sr}) \equiv \theta_{ce}$	$v_{sr} =$ TR

EI $\mathrm{e}(S) \equiv \mathrm{c}(A)$

IF	$\wedge$ $\theta_s \equiv \theta_{ce}$; $\mathrm{a}(\theta_e + \theta_{el}) \equiv \theta_{cs}$	$v_{el} =$ TR
EI	$\wedge$ $\theta_s \equiv \theta_{cs}$; $\mathrm{a}(\theta_e - \theta_{er}) \equiv \theta_{ce}$	$v_{er} =$ TR

IF
- $\wedge$
  - $\vee$: $v_{sl} \equiv$ TR; $v_{er} \equiv$ TR
  - $\wedge$: $v_{sr} \equiv$ FA; $v_{el} \equiv$ FA

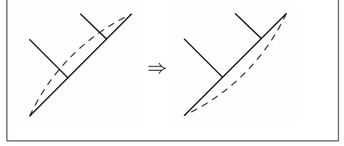
$\mathrm{h} \circ \mathrm{m}(S) = |\mathrm{h} \circ \mathrm{m}(S)|$

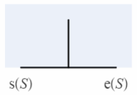
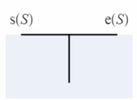
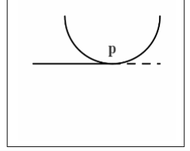
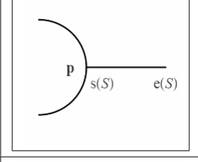
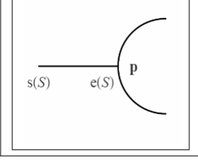
EI
- $\wedge$
  - $\wedge$: $v_{sl} \equiv$ FA; $v_{er} \equiv$ FA
  - $\vee$: $v_{sr} \equiv$ TR; $v_{el} \equiv$ TR

$\mathrm{h} \circ \mathrm{m}(S) = -|\mathrm{h} \circ \mathrm{m}(S)|$

3 3 IF

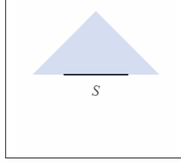
branches exists



$n_l = 0$	number of left branches 	number left			
$n_r = 0$	number of right branches 	number right			
IF	there is an object crossing S	$n_l+ = 1$ $n_r+ = 1$			
IF	$\wedge$ $S_1 \in \mathcal{S}$ $S \nparallel S_1$	IF	$\mathrm{s}(S_1) \in \mathrm{int}(S)$	IF	$0 < \mathrm{a}(\mathrm{a}(S) - \mathrm{a}(S_1)) < \pi$ → $n_l+ = 1$
				EI	$\pi < \mathrm{a}(\mathrm{a}(S) - \mathrm{a}(S_1)) < 2\pi$ → $n_r+ = 1$
		EI	$\mathrm{e}(S_1) \in \mathrm{int}(S)$	IF	$0 < \mathrm{a}(\mathrm{a}(-S) - \mathrm{a}(S_1)) < \pi$ → $n_l+ = 1$
				EI	$\pi < \mathrm{a}(\mathrm{a}(-S) - \mathrm{a}(S_1)) < 2\pi$ → $n_r+ = 1$
IF	$\wedge$ $A \in \mathcal{AR}$ $\lvert A \cap S \rvert \equiv \{\mathbf{p}\}$ $\mathbf{p} \in \mathrm{int}(S)$	IF	$S \parallel A$ 	IF	$0 < \mathrm{a}(\mathrm{a}(\mathbf{p}, \mathrm{c}(A)) - \mathrm{a}(S)) < \pi$ → $n_l+ = 1$
				EI	$\pi < \mathrm{a}(\mathrm{a}(\mathbf{p}, \mathrm{c}(A)) - \mathrm{a}(S)) < 2\pi$ → $n_r+ = 1$
		EI	$\mathrm{s}(S) \equiv \mathbf{p}$ 		$n_l+ = 1$ $n_r+ = 1$
		EI	$\mathrm{e}(S) \equiv \mathbf{p}$ 		$n_l+ = 1$ $n_r+ = 1$
IF	$\wedge$ $n_l \neq 0$ $n_r \equiv 0$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$			
EI	$\wedge$ $n_l \equiv 0$ $n_r \neq 0$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$			

4 IF

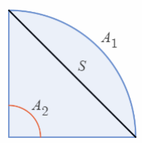
an edge S_1 of $F \in \mathcal{F}$ satisfies $S \subsetneq S_1$



$\theta_{cs} = \mathrm{a}(\mathrm{c}(F), \mathrm{s}(S))$	angle center start		
$\theta_{ce} = \mathrm{a}(\mathrm{c}(F), \mathrm{e}(S))$	angle center end		
IF	$\mathrm{a}(\theta_{ce} - \theta_{cs}) < \pi$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$	
EI	$\mathrm{a}(\theta_{ce} - \theta_{cs}) > \pi$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$	

5 IF

∧
- S is the longest chord of Arc2D A_1 in sector S_1
- Angle2D A_2가 $A_2 \subset S_1$

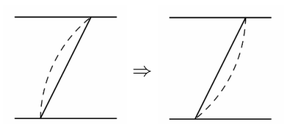


IF $\mathrm{c}(A_1) \equiv \mathrm{c}(A_2)$

IF	∧ $\mathrm{s}(S) \equiv \mathrm{s}(A_2)$, $\mathrm{e}(S) \equiv \mathrm{e}(A_2)$	IF	$\mathrm{a}(A_1) < \frac{\pi}{2}$: $\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
		EL	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EI	∧ $\mathrm{s}(S) \equiv \mathrm{e}(A_2)$, $\mathrm{e}(S) \equiv \mathrm{s}(A_2)$	IF	$\mathrm{a}(A_1) < \frac{\pi}{2}$: $\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
		EL	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$

6 IF

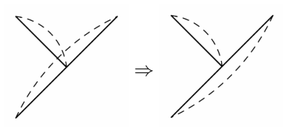
vertices of S are on two different parallel lines $S_1, S_2 \in \mathcal{S}_l$

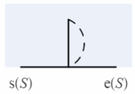


IF	$\mathrm{a}(S) < \pi$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EL	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$	

7 IF

there is an $S_1 \in \mathcal{S}_m$ $(S \neq S_1)$ one of whose vertex is on S



$n_l = 0$	number of S_1 in the left side of S 	number left
$n_r = 0$	number of S_1 in the right side of S 	number right

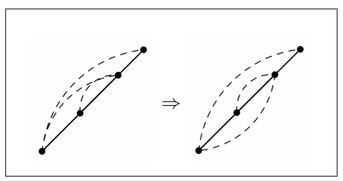
FE ∧ $S_1 \in \mathcal{S}_m$, $S_1 \neq S$

IF	∧ $S \cap S_1 \equiv \mathrm{s}(S_1)$, $\mathrm{s}(S_1) \in \mathrm{int}(S)$	IF	$0 < \mathrm{a}(\mathrm{a}(S_1) - \mathrm{a}(S)) < \pi$: $n_l \mathrel{+}= 1$
		EI	$\pi < \mathrm{a}(\mathrm{a}(S_1) - \mathrm{a}(S)) < 2\pi$: $n_r \mathrel{+}= 1$
EI	∧ $S \cap S_1 \equiv \mathrm{e}(S_1)$, $\mathrm{e}(S_1) \in \mathrm{int}(S)$	IF	$0 < \mathrm{a}(-\mathrm{a}(S_1) - \mathrm{a}(S)) < \pi$: $n_l \mathrel{+}= 1$
		EI	$\pi < \mathrm{a}(-\mathrm{a}(S_1) - \mathrm{a}(S)) < 2\pi$: $n_r \mathrel{+}= 1$

IF	∧ $n_l \neq 0$, $n_r \equiv 0$	$\mathrm{h} \circ \mathrm{m}(S) = -\lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$
EI	∧ $n_l \equiv 0$, $n_r \neq 0$	$\mathrm{h} \circ \mathrm{m}(S) = \lvert \mathrm{h} \circ \mathrm{m}(S) \rvert$

4.5.4 Adjust heights of overlapping measures

1



2 Figure out inclusion relations in $\mathcal{S}_m$ for $|\mathcal{S}_m| \geq 2$

$\mathcal{T}_e = [\,]$	a tree on $\mathcal{S}_m$

FO	i	FO	$\wedge$ j / $i \neq j$	IF	$\mathcal{S}_m[i] \subsetneq \mathcal{S}_m[j]$	$\mathcal{T}_e[\,] = [j, i]$
				EI	$\mathcal{S}_m[j] \subsetneq \mathcal{S}_m[i]$	$\mathcal{T}_e[\,] = [i, j]$

$\mathcal{T}_p = \mathcal{T}_e$	paths formed by edges in $\mathcal{T}_e$

FO	i	FO	j	IF	$\mathcal{T}_e[i][0] \equiv \mathcal{T}_p[j][\lvert\mathcal{T}_p[j]\rvert - 1]$	$\mathcal{T}_p[j][\,] = \mathcal{T}_e[i][1]$
				EI	$\mathcal{T}_p[i][1] \equiv \mathcal{T}_p[j][0]$	$\mathcal{T}_p[j] = [\mathcal{T}_e[i][0]] \cup \mathcal{T}_p[j]$

Note	$[i_0, i_1, \ldots, i_l] \in \mathcal{T}_p \Rightarrow [i_0, i_1], \ldots, [i_{l-1}, i_l] \in \mathcal{T}_e$

2 1

FO	i	$s_i = 1$	sign i					
		$d_i = 0$	depth i					
		FE	$p \in \mathcal{T}_p$	IF	$i \in p$	d_{ip}	key of i in p	depth i p
						IF	$d_i < d_{ip}$	$d_i = d_{ip}$
								IF $\quad \mathrm{a}(\mathcal{S}_m[i]) \equiv \mathrm{a}(\mathcal{S}_m[p[0]])$ $\quad s_i = (-1)^{d_i} \cdot \mathrm{s} \circ \mathrm{h} \circ \mathrm{m}(\mathcal{S}_m[p[0]])$
								EL $\quad s_i = (-1)^{(d_i+1)} \cdot \mathrm{s} \circ \mathrm{h} \circ \mathrm{m}(\mathcal{S}_m[p[0]])$
		IF	$d_i \neq 0$	$\mathrm{h} \circ \mathrm{m}(\mathcal{S}_m[i]) = s_i \cdot \lvert\mathrm{h} \circ \mathrm{m}(\mathcal{S}_m[i])\rvert$				

3 Unify colors of $S \in \mathcal{S}_m$ and $\mathrm{m}(S)$ when $\mathrm{h}(\mathrm{m}(S))$ is unchanging

3 1

FE	$S \in \mathcal{S}_m$	IF	$\mathrm{h} \circ \mathrm{m}(S) \equiv h_{mi}$	$\mathrm{c} \circ \mathrm{m}(S) = \mathrm{c}(S)$

4.6 Determination of label direction

4.6.1 Functions

1. $\mathcal{D}$ | direction array | direction

1

key	0	1	2	3	4	5	6	7
value	EE	NE	NN	NW	WW	SW	SS	SE

2. $\mathrm{d}(\theta)$ | direction determined by an angle θ | direction

1

IF	$\vee$ $2\pi - \frac{\pi}{8} \leq \mathrm{a}(\theta)$ / $\mathrm{a}(\theta) < \frac{\pi}{8}$	$\mathrm{d}(\theta) = \mathrm{EE}$
EI	$\frac{\pi}{4} - \frac{\pi}{8} \leq \mathrm{a}(\theta) < \frac{\pi}{4} + \frac{\pi}{8}$	$\mathrm{d}(\theta) = \mathrm{NE}$
EI	$\frac{2\pi}{4} - \frac{\pi}{8} \leq \mathrm{a}(\theta) < \frac{2\pi}{4} + \frac{\pi}{8}$	$\mathrm{d}(\theta) = \mathrm{NN}$
EI	$\frac{3\pi}{4} - \frac{\pi}{8} \leq \mathrm{a}(\theta) < \frac{3\pi}{4} + \frac{\pi}{8}$	$\mathrm{d}(\theta) = \mathrm{NW}$
EI	$\frac{4\pi}{4} - \frac{\pi}{8} \leq \mathrm{a}(\theta) < \frac{4\pi}{4} + \frac{\pi}{8}$	$\mathrm{d}(\theta) = \mathrm{WW}$
EI	$\frac{5\pi}{4} - \frac{\pi}{8} \leq \mathrm{a}(\theta) < \frac{5\pi}{4} + \frac{\pi}{8}$	$\mathrm{d}(\theta) = \mathrm{SW}$
EI	$\frac{6\pi}{4} - \frac{\pi}{8} \leq \mathrm{a}(\theta) < \frac{6\pi}{4} + \frac{\pi}{8}$	$\mathrm{d}(\theta) = \mathrm{SS}$
EI	$\frac{7\pi}{4} - \frac{\pi}{8} \leq \mathrm{a}(\theta) < \frac{7\pi}{4} + \frac{\pi}{8}$	$\mathrm{d}(\theta) = \mathrm{SE}$

3. $\mathrm{d}(d, n)$ | direction switch | direction

1

d	direction	direction
n	integer	number
$\mathrm{d}(d, n) = \mathcal{D}[\mathrm{k}(\mathcal{D}, \mathrm{m}(d + n, 8)]$		

4. $\mathrm{ld}_{am}(A)$ | label direction of $\mathrm{m}(A)$ of $A \in \mathcal{AR}$ | label direction Arc2D measure

1 $\quad \mathrm{ld}_{am}(A) = \mathrm{d} \circ \mathrm{a}(\mathrm{a}(\mathrm{c}(A), \mathrm{s}(A)) + \frac{\mathrm{a}(A)}{2} - \mathrm{a}(G))$

5. $\mathrm{ld}_{sm}(\theta)$ | label direction of $\mathrm{m}(S)$ of $S \in \mathcal{S}$ by angle θ | label direction Segment2D measure

1

IF	$\vee$	$\mathrm{a}(-3,2) \leq \theta$ $\theta \leq \mathrm{a}(3,2)$	$\mathrm{ld}_{sm}(\theta) = \mathrm{EE}$
EI	$\mathrm{a}(3,2) < \theta < \mathrm{a}(3,-2)$		$\mathrm{ld}_{sm}(\theta) = \mathrm{NN}$
EI	$\mathrm{a}(3,-2) \leq \theta \leq \mathrm{a}(-3,-2)$		$\mathrm{ld}_{sm}(\theta) = \mathrm{WW}$
EI	$\mathrm{a}(-3,-2) < \theta < \mathrm{a}(-3,2)$		$\mathrm{ld}_{sm}(\theta) = \mathrm{SS}$

6. $\mathrm{ld}_{ssm}(\theta, s)$ | label direction of $\mathrm{m}(S)$ of $S \in \mathcal{S}$ by angle θ and label size s | label direction size Segment2D measure

1

$d_w = 0.5$			distance width
$d_h = 0.5$			distance height
$\theta_l = \mathrm{a}(\theta + \frac{\pi}{2})$			angle left
$\theta_r = \mathrm{a}(\theta - \frac{\pi}{2})$			angle right
$w_h = \frac{s[0]}{2}$			width half
$h_h = \frac{s[1]}{2}$			height half
$\theta_{d1} = \mathrm{a}(h_h, w_h)$			angle diagonal 1
$\theta_{d2} = \mathrm{a}(h_h, -w_h)$			angle diagonal 2
$\theta_{d3} = \mathrm{a}(-h_h, -w_h)$			angle diagonal 3
$\theta_{d4} = \mathrm{a}(-h_h, w_h)$			angle diagonal 4
$\theta_{w1} = \mathrm{a}(d_h, w_h)$			angle width 1
$\theta_{w2} = \mathrm{a}(d_h, -w_h)$			angle width 2
$\theta_{w3} = \mathrm{a}(-d_h, -w_h)$			angle width 3
$\theta_{w4} = \mathrm{a}(-d_u, w_h)$			angle width 4
$\theta_{h1} = \mathrm{a}(h_h, d_w)$			angle height 1
$\theta_{h2} = \mathrm{a}(h_h, -d_w)$			angle height 2
$\theta_{h3} = \mathrm{a}(-h_h, -d_w)$			angle height 3
$\theta_{h4} = \mathrm{a}(-h_h, d_w)$			angle height 4

2

IF	$\theta < \frac{\pi}{4}$	IF	$\frac{3\pi}{2} \leq \theta_r < \theta_{h4}$ $\mathrm{ld}_{ssm}(\theta, s) = \mathrm{EE}$
		EL	$\mathrm{ld}_{ssm}(\theta, s) = \mathrm{NE}$
EI	$\frac{\pi}{4} \leq \theta < \frac{\pi}{2}$	IF	$\theta_{w2} < \theta_l \leq \pi$ $\mathrm{ld}_{ssm}(\theta, s) = \mathrm{NN}$
		EL	$\mathrm{ld}_{ssm}(\theta, s) = \mathrm{NE}$
EI	$\frac{\pi}{2} \leq \theta < \frac{3\pi}{4}$	IF	$\theta_r < \theta_{w1}$ $\mathrm{ld}_{ssm}(\theta, s) = \mathrm{NN}$
		EL	$\mathrm{ld}_{ssm}(\theta, s) = \mathrm{NW}$
EI	$\frac{3\pi}{4} \leq \theta < \pi$	IF	$\theta_{h3} < \theta_l \leq \frac{3\pi}{2}$ $\mathrm{ld}_{ssm}(\theta, s) = \mathrm{WW}$
		EL	$\mathrm{ld}_{ssm}(\theta, s) = \mathrm{NW}$
EI	$\pi \leq \theta < \frac{5\pi}{4}$	IF	$\frac{\pi}{2} \leq \theta_r < \theta_{h2}$ $\mathrm{ld}_{ssm}(\theta, s) = \mathrm{WW}$
		EL	$\mathrm{ld}_{ssm}(\theta, s) = \mathrm{SW}$
EI	$\frac{5\pi}{4} \leq \theta < \frac{3\pi}{2}$	IF	$\theta_{w4} < \theta_l$ $\mathrm{ld}_{ssm}(\theta, s) = \mathrm{SS}$
		EL	$\mathrm{ld}_{ssm}(\theta, s) = \mathrm{SW}$
EI	$\frac{3\pi}{2} \leq \theta\theta < \frac{7\pi}{4}$	IF	$\pi \leq \theta_r < \theta_{w3}$ $\mathrm{ld}_{ssm}(\theta, s) = \mathrm{SS}$
		EL	$\mathrm{ld}_{ssm}(\theta, s) = \mathrm{SE}$
EI	$\frac{7\pi}{4} \leq \theta < 2\pi$	IF	$\theta_{h1} < \theta \leq \frac{3\pi}{2}$ $\mathrm{ld}_{ssm}(\theta, s) = \mathrm{EE}$
		EL	$\mathrm{ld}_{ssm}(\theta, s) = \mathrm{SE}$

7. $\mathrm{d}_u(\theta)$ | upper direction determined by angle θ | direction upper

IF	$\vee$	$2\pi - \frac{\pi}{8} \leq \theta$ $\theta < \frac{\pi}{8}$	$\mathrm{d}_u(\theta) = \mathrm{EE}$
EI	$\frac{\pi}{8} - \frac{\pi}{4} \leq \theta < \frac{\pi}{8} + \frac{\pi}{4}$		$\mathrm{d}_u(\theta) = \mathrm{NE}$
EI	$\frac{2\pi}{4} - \frac{\pi}{8} \leq \theta < \frac{2\pi}{4} + \frac{\pi}{8}$		$\mathrm{d}_u(\theta) = \mathrm{NN}$
EI	$\frac{3\pi}{4} - \frac{\pi}{8} \leq \theta < \frac{3\pi}{4} + \frac{\pi}{8}$		$\mathrm{d}_u(\theta) = \mathrm{NW}$
EI	$\frac{4\pi}{4} - \frac{\pi}{8} \leq \theta < \frac{4\pi}{4} + \frac{\pi}{8}$		$\mathrm{d}_u(\theta) = \mathrm{EE}$
EI	$\frac{5\pi}{4} - \frac{\pi}{8} \leq \theta < \frac{5\pi}{4} + \frac{\pi}{8}$		$\mathrm{d}_u(\theta) = \mathrm{NE}$
EI	$\frac{6\pi}{4} - \frac{\pi}{8} \leq \theta < \frac{6\pi}{4} + \frac{\pi}{8}$		$\mathrm{d}_u(\theta) = \mathrm{NN}$
EI	$\frac{7\pi}{4} - \frac{\pi}{8} \leq \theta < \frac{7\pi}{4} + \frac{\pi}{8}$		$\mathrm{d}_u(\theta) = \mathrm{NW}$

8. $\mathrm{ld}_s(S)$ | label direction of Segment2D S | label direction Segment2D

$\theta_s = \mathrm{a}(\mathrm{a}(S) - \mathrm{a}(G))$	angle Segment2D				
IF	$\mathrm{m}(S)$ is visible	IF	$\mathrm{s} \circ \mathrm{h} \circ \mathrm{m}(S) > 0$	$\mathrm{ld}_s(S) = \mathrm{d}(\theta_s - \frac{\pi}{2})$	
		EI	$\mathrm{s} \circ \mathrm{h} \circ \mathrm{m}(S) < 0$	$\mathrm{ld}_s(S) = \mathrm{d}(\theta_s + \frac{\pi}{2})$	
EL	$\mathrm{ld}_s(S) = \mathrm{d}_u(\theta_s - \frac{\pi}{2})$				

9. $\mathrm{ld}_{sm}(S)$ | label direction of $\mathrm{m}(S)$ | label direction Segment2D measure

$\theta_s = \mathrm{a}(\mathrm{a}(S) - \mathrm{a}(G))$	angle Segment2D		
IF	$\mathrm{h} \circ \mathrm{m}(S) > 0$	$\mathrm{ld}_{sm}(S) = \mathrm{ld}_{ssm}(\mathrm{a}(\theta_s + \frac{\pi}{2}), \mathrm{s} \circ \mathrm{l} \circ \mathrm{m}(S))$	
EL	$\mathrm{ld}_{sm}(S) = \mathrm{ld}_{ssm}(\mathrm{a}(\theta_s - \frac{\pi}{2}), \mathrm{s} \circ \mathrm{l} \circ \mathrm{m}(S))$		

4.6.2 Segment2D measure

1 Initial label direction

1 1	FE	$S \in \mathcal{S}_{ml}$	$\mathrm{ld} \circ \mathrm{m}(S) = \mathrm{d}_{sm}(S)$

2 When Segment2Ds have inclusion relation and their measure labels overlap other objects

2 1	FE	$A \in \mathcal{AR}$	IF	$\wedge$	$\frac{\mathrm{l}(S)}{2} \equiv \mathrm{r}(A)$	$\mathrm{ld} \circ \mathrm{m}(S) = \mathrm{d}(\mathrm{ld} \circ \mathrm{m}(S), \mathrm{s} \circ \mathrm{h} \circ \mathrm{m}(S))$
				$\vee$	$\mathrm{s}(S) \equiv \mathrm{c}(A)$	
					$\mathrm{e}(S) \equiv \mathrm{c}(A)$	

4.6.3 Segment2D

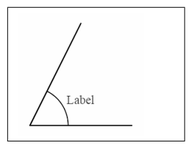
1	FE	$S \in \mathcal{S}_l$	$\mathrm{ld}(S) = \mathrm{ld}_s(S)$

4.6.4 Arc2D measure

1	FE	$A \in \mathcal{AN}_m$	$\mathrm{ld} \circ \mathrm{m}(A) = \mathrm{ld}_{am}(A)$

4.7 Determination of heights of Angle2Ds and $\mathrm{c}(L)$ where $\mathrm{o}(L) \in \mathcal{AN}$

1



4.7.1 Initial heights

$h = 1$	height				
$r_r = \frac{1}{\sqrt{2}}$	ratio right				
1	FE	$A \in \mathcal{AN}_t$	IF	$\mathrm{r}(A) \equiv$ TR	$\mathrm{h}(A) = h$
			EL	$\mathrm{h}(A) = h \cdot r_r$	
	FE	$A \in \mathcal{AN}_{tn}$	IF	$\mathrm{a}(A) \leq \pi$	IF ∨ $\mathrm{s}(A) \neq 0$, $\mathrm{c}(A) \neq 0$ → $\mathrm{h}(A) = h$; EL → $\mathrm{h}(A) = 0$
			EL	$\mathrm{h}(A) = h$	

4.7.2 Initial label positions

$\mathrm{d}(L) = \mathrm{CM}$					
1	FE	∧ $A \in \mathcal{AN}$, $\mathrm{o}(L) \equiv A$			

$\theta_s = \mathrm{a}(\mathrm{c}(A), \mathrm{s}(A))$	angle start				
$\theta_e = \mathrm{a}(\mathrm{c}(A), \mathrm{e}(A))$	angle end				
	height angle	IF	$\mathrm{t}(A) \equiv$ none	$h_a = \mathrm{h}(A)$	
		EL	$h_a = \mathrm{h}(A) + 0.2$		
1 1 $s_{max} = \max[\mathrm{s}(L)[0], \mathrm{s}(L)[1]]$	size max				
	is angle on axis	IF	∨ $\theta_s \equiv 0$, $\theta_s \equiv \pi$, $\theta_e \equiv \pi$, $\theta_e \equiv 2\pi$	$i_{aoa} =$ TR	
		EL	$i_{aoa} =$ FA		

1 2	IF	$\mathrm{a}(A) \leq \pi$	IF: $\mathrm{a}(A) < \frac{\pi}{2}$ → $d = \max(0.7, h_a)$; EL → $d = \max(0.5, h_a)$	distance
			$\theta_d = \mathrm{a}(\mathrm{s}(L)[1], \mathrm{s}(L)[0])$	angle diagonal
			$\theta = \mathrm{a}(\theta_s + \frac{\mathrm{a}(A)}{2})$	angle
			$\theta_m = \mathrm{m}(\theta, \pi)$	angle mod
			$l_{dh} = \frac{\sqrt{\mathrm{s}(L)[0]^2 + \mathrm{s}(L)[1]^2}}{2}$	length diagonal half
			IF $\theta_m \neq 0$: IF $\mathrm{m}(\mathrm{a}(A), \frac{\pi}{2}) \equiv 0$ → $r = \frac{\max(d, \mathrm{s}(L)[1])}{2\tan(\frac{\mathrm{a}(A)}{2})} + \frac{\mathrm{s}(L)[0]}{2}$; EL → $r = \frac{\max(d, \mathrm{s}(L)[0])}{2\tan(\frac{\mathrm{a}(A)}{2})} + \frac{\mathrm{s}(L)[1]}{2}$	radius
			EL: IF $\theta_m > \frac{\pi}{2}$ → $\theta_m = \pi - \theta_m$	
			$\mathcal{A} = [\lvert\theta_d - \theta_m\rvert, \pi - \theta_d - \theta_m, \theta_d + \theta_m]$	angle
			$r_1 = \max[\sin(\pi - \frac{\mathrm{a}(A)}{2} - \mathcal{A}[i]) \frac{l_{dh}}{\sin(\frac{\mathrm{a}(A)}{2})} \mid 0 \leq i \leq 2]$	radius 1
			$s = d\frac{\sin \mathcal{A}[0]}{l_{dh}}$	sin
			$c = \sqrt{1 - s^2}$	cos
			$r_2 = dc + l_{dh} \cos \mathcal{A}[0]$	radius 2
			$r = \max(r_1, r_2)$	
			IF $\wedge$ ($\circ \in L$, $\frac{\pi}{2} < \mathrm{a}(A) < \pi$): IF $\frac{\pi}{2} \leq \theta_s < \pi$ → $r+ = \min(1, \frac{8\max(\theta_s, \pi - \theta_s)}{\pi})$; EI $\frac{3\pi}{2} < \theta_e < 2\pi$ → $r+ = \min(1, \frac{8\max(\theta_s - \frac{3\pi}{2}, 2\pi - \theta_s)}{\pi})$	
			$r = \min(\max(r, d + 0.7), d + 2 + l_{dh})$	
			$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(r, \theta)$	
1 3	EL		$d = \max(1.5, \mathrm{h}(A))$	distance
			$\theta = \mathrm{a}(\theta_s + \frac{\mathrm{a}(A)}{2})$	angle
			$l_d = \sqrt{\mathrm{s}(L)[0]^2 + \mathrm{s}(L)[1]^2}$	length diagonal
			IF $\frac{l_d}{2} < 0.5$ → $d = d + 0.3$	
			$\theta_d = \mathrm{a}(\mathrm{s}(L)[1], \mathrm{s}(L)[0])$	angle diagonal
			$\theta_{h1} = \frac{3\pi}{16}$	angle height 1
			$\theta_{h2} = \frac{\pi}{16}$	angle height 2
			IF $\vee$ ($2\pi - \theta_{h1} < \theta$, $\theta < \theta_{h1}$)	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(d, \theta) + \mathrm{c}(\frac{\mathrm{s}(L)[0]}{2}, 0)$
			EI $\frac{\pi}{4} - \theta_{h2} \leq \theta \leq \frac{\pi}{4} + \theta_{h2}$	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(d, \theta + \frac{\pi}{16}) + \mathrm{c}(\frac{l_d}{2}, \theta_d)$
			EI $\frac{2\pi}{4} - \theta_{h1} < \theta < \frac{2\pi}{4} + \theta_{h1}$	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(d, \theta) + \mathrm{c}(\frac{\mathrm{s}(L)[1]}{2}, \frac{\pi}{2})$
			EI $\frac{3\pi}{4} - \theta_{h2} \leq \theta \leq \frac{3\pi}{4} + \theta_{h2}$	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(d, \theta - \frac{\pi}{8}) + \mathrm{c}(\frac{l_d}{2}, \mathrm{a}(\pi - \theta_d))$
			EI $\frac{4\pi}{4} - \theta_{h1} < \theta < \frac{4\pi}{4} + \theta_{h1}$	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(d, \theta) + \mathrm{c}(\frac{\mathrm{s}(L)[0]}{2}, \pi)$
			EI $\frac{5\pi}{4} - \theta_{h2} \leq \theta \leq \frac{5\pi}{4} + \theta_{h2}$	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(d, \theta + \frac{\pi}{16}) + \mathrm{c}(\frac{l_d}{2}, \mathrm{a}(\pi + \theta_d))$
			EI $\frac{6\pi}{4} - \theta_{h1} < \theta < \frac{6\pi}{4} + \theta_{h1}$	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(d, \theta) + \mathrm{c}(\frac{\mathrm{s}(L)[1]}{2}, \frac{3\pi}{2})$
			EI $\frac{7\pi}{4} - \theta_{h2} \leq \theta \leq \frac{7\pi}{4} + \theta_{h2}$	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(d, \theta - \frac{\pi}{8}) + \mathrm{c}(\frac{l_d}{2}, \mathrm{a}(2\pi - \theta_d))$
			IF $\wedge$ ($\mathrm{a}(A) < \frac{\pi}{2}$, $\theta_e \equiv \pi$)	$\mathrm{c}(L)[0] = \mathrm{c}(L) - 0.3$

4.7.3 Label position and height of Angle2D whose tickLabel is arc form

1	Sort $\mathcal{AN}_{ta}$ as $i < j \Rightarrow \mathrm{a}(\mathcal{AN}_{ta}[i]) \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$

2 **FO** ∧
- i
- $\mathrm{o}(L) \equiv \mathcal{AN}_{ta}[i]$

2 1
- $\theta_{si} = \mathrm{a}(\mathrm{c}(\mathcal{AN}_{ta}[i]), \mathrm{s}(\mathcal{AN}_{ta}[i]))$ — angle start i
- $\theta_{ei} = \mathrm{a}(\mathrm{c}(\mathcal{AN}_{ta}[i]), \mathrm{e}(\mathcal{AN}_{ta}[i]))$ — angle end i
- $r_{li} = \mathrm{lr}(\mathcal{AN}_{ta}[i])$ — radius Label2D i
- $\mathcal{R}_a = [\,]$ — radius arc
- $\mathcal{R}_{na} = [\,]$ — radius nonarc
- $\mathcal{A}_p = [\,]$ — angle Poin2D
- $\mathcal{A}_l = [\,]$ — angle Label2D

2 2 **FE** $S \in \mathcal{S}$

IF $\mathrm{c}(\mathcal{AN}_{ta}[i]) \equiv \mathrm{s}(S)$

$\theta = \mathrm{a}(S)$

IF ∧
- $\mathrm{a}(\theta - \theta_{si}) \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$
- $\theta \neq \theta_{si}$
- $\theta \neq \theta_{ei}$

→
- $\mathcal{A}_p[\,] = \mathrm{a}(\mathrm{a}(S) - \theta_{si})$
- $\mathcal{R}_a[\,] = 1$

EI $\mathrm{c}(\mathcal{AN}_{ta}[i]) \equiv \mathrm{e}(S)$

$\theta = \mathrm{a}(-\mathrm{a}(\mathcal{AN}_{ta}[i]))$

IF ∧
- $\mathrm{a}(\theta - \theta_{si}) \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$
- $\theta \neq \theta_{si}$
- $\theta \neq \theta_{ei}$

→
- $\mathcal{A}_p[\,] = \mathrm{a}(\mathrm{a}(S) - \theta_{si})$
- $\mathcal{R}_a[\,] = 1$

EI $\mathrm{c}(\mathcal{AN}_{ta}[i]) \in \mathrm{int}(S)$

- $\theta_1 = \mathrm{a}(S)$ — angle 1
- $\theta_2 = \mathrm{a}(-\mathrm{a}(S))$ — angle 2

IF ∧
- $\mathrm{a}(\theta_1 - \theta_{si}) < \theta_{ei}$
- $\theta_1 \neq \theta_{si}$
- $\theta_1 \neq \theta_{ei}$
- $\theta_2 \neq \theta_{si}$
- $\theta_2 \neq \theta_{ei}$

→
- $\mathcal{A}_p[\,] = \mathrm{a}(\theta_1 - \theta_{si})$
- $\mathcal{R}_a[\,] = 1$

IF ∧
- $\mathrm{a}(\theta_2 - \theta_{si}) < \theta_{ei}$
- $\theta_1 \neq \theta_{si}$
- $\theta_1 \neq \theta_{ei}$
- $\theta_2 \neq \theta_{si}$
- $\theta_2 \neq \theta_{ei}$

→
- $\mathcal{A}_p[\,] = \mathrm{a}(\theta_2 - \theta_{si})$
- $\mathcal{R}_a[\,] = 1$

2 3 $i_{rac} =$ **FA** — is right Angle2D contained

2 4 **FE** ∧
- $A \in \mathcal{AN}_{tna}$
- A overlaps $\mathcal{AN}_{ta}[i]$

$h_a = \mathrm{h}(A)$ — height Angle2D

IF $\mathrm{t}(A) \equiv \mathrm{right}$
- $i_{rac} =$ TR
- $h_a = h_a \cdot \sqrt{2}$

IF no $L_1 \in \mathcal{L}$ with $\mathrm{o}(L_1) \equiv A$ → $\mathcal{R}_{na}[\,] = h_a$

EL

$\theta_p = \mathrm{a}(\mathrm{a}(\mathrm{c}(A), \mathrm{s}(A)) - \theta_{si})$ — angle Point2D

IF $\theta_p \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$ → $\mathcal{A}_p[\,] = \theta_p$

$\theta_p = \mathrm{a}(\mathrm{a}(\mathrm{c}(A), \mathrm{e}(A)) - \theta_{si})$ — angle Point2D

IF $\theta_p \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$ → $\mathcal{A}_p[\,] = \theta_p$

$\theta_l = \mathrm{a}(\mathrm{a}(\mathrm{c}(A), \mathrm{c}(L_1) - \theta_{si})$ — angle Label2D

IF $\theta_l \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$ → $\mathcal{A}_l[\,] = \theta_l$

$r_l = \mathrm{lr}(A)$ — radius Label2D

IF ∨
- $h_a \leq \mathrm{h}(\mathcal{AN}_{ta}[i]) \leq r_a$
- $\mathrm{h}(\mathcal{AN}_{ta}[i]) \leq r_{li} \leq r_l$

→ $\mathcal{R}_{na}[\,] = r_l$

2 5 FO ∧ [j ; $j < i$]

$r_{lj} = \mathrm{lr}(\mathcal{AN}_{ta}[j])$ — radius Label2D j

IF $\mathcal{AN}_{ta}[i]$ and $\mathcal{AN}_{ta}[j]$ overlap

IF ∧ [$L_1 \in \mathcal{L}$; $\mathrm{o}(L_1) \equiv \mathcal{AN}_{ta}[j]$]

$\theta_p = \mathrm{a}(\mathrm{a}(\mathrm{c}(\mathcal{AN}_{ta}[j]), \mathrm{s}(\mathcal{AN}_{ta}[j])) - \theta_{si})$ — angle Point2D

IF $\theta_p \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$ — $\mathcal{A}_p[\,] = \theta_p$

$\theta_p = \mathrm{a}(\mathrm{a}(\mathrm{c}(\mathcal{AN}_{ta}[j]), \mathrm{e}(\mathcal{AN}_{ta}[j])) - \theta_{si})$ — angle Point2D

IF $\theta_p \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$ — $\mathcal{A}_p[\,] = \theta_p$

$\theta_l = \mathrm{a}(\mathrm{a}(\mathrm{c}(\mathcal{AN}_{ta}[j]), \mathrm{c}(L_1)) - \theta_{si})$ — angle Label2D

IF $\theta_l \leq \mathrm{a}(\mathcal{AN}_{ta}[i])$ — $\mathcal{A}_l[\,] = \theta_l$

IF ∨ [$\mathrm{h} \circ \mathrm{c}(\mathcal{AN}_{ta}[j]) \leq \mathrm{h} \circ \mathrm{c}(\mathcal{AN}_{ta}[i]) \leq r_{lj}$; $\mathrm{h} \circ \mathrm{c}(\mathcal{AN}_{ta}[j]) \leq r_{li} \leq r_{lj}$] — $\mathcal{R}_a[\,] = r_{lj}$

2 6 IF ∧ [$|\mathcal{R}_a| \neq 0$; $i_{rac} \equiv$ TR] — $\mathrm{h}(\mathcal{AN}_{ta}[i]) = \max(\mathrm{h}(\mathcal{AN}_{ta}[i]), \max(\mathcal{R}_{na}), \max(\mathcal{R}_a) + 0.15)$

2 7 $A_{pl} = \mathcal{AN}_{ta}[i]$ — angle part Label2D

$i_c = 0.15$ — increment

$\mathrm{h}(A_{pl}) = \max(\mathrm{h}(A_{pl}), \max(\mathcal{R}_{na} + i_c, \mathcal{R}_a + i_c))$

2 8 IF $|\mathcal{A}_p| \neq 0$

$\mathcal{A}_p = \mathcal{A}_p \cup [0, \mathrm{a}(\mathcal{AN}_{ta}[i])]$

Sort $\mathcal{A}_p$, $\mathcal{A}_l$ in ascending order

$\mathcal{K}_{la} = [\,]$ — key Label2D angle

FO k

$i_{lo} =$ FA — is Label2D occupied

$\theta_p = \mathrm{a}(\mathcal{A}_p[k+1] - \mathcal{A}_p[k])$ — angle Point2D

FO ∧ [l ; $l \neq k$]

IF $\mathrm{a}(\mathcal{A}_l[l] - \mathcal{A}_p[k]) \leq \theta_p$ — $i_{lo} =$ TR

IF $i_{lo} \equiv$ FA — $\mathcal{K}_{la}[\,] = [\theta_p, k]$

IF $|\mathcal{K}_{la}| \neq 0$

Sort $\mathcal{K}_{la}$ as $m_1 < m_2 \Rightarrow$ ∨ [$\mathcal{K}_{la}[m_1][0] < \mathcal{K}_{la}[m_2][0]$; ∧ [$\mathcal{K}_{la}[m_1][0] \equiv \mathcal{K}_{la}[m_2][0]$; $\mathcal{K}_{la}[m_1][1] < \mathcal{K}_{la}[m_2][1]$]]

$k_l = \mathcal{K}_{la}[0][1]$ — key Label2D

EL $k_l = 0$

$\theta_{sl} = \mathrm{a}(\theta_s + \mathcal{A}_p[k_l])$ — angle start Label2D

$\theta_{el} = \mathrm{a}(\theta_s + \mathcal{A}_p[k_l + 1])$ — angle end Label2D

$\mathrm{s}(A_{pl}) = \mathrm{c}(A_{pl}) + [\cos(\theta_{sl}), \sin(\theta_{sl})]$

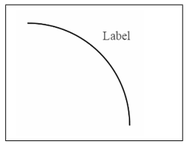
$\mathrm{e}(A_{pl}) = \mathrm{c}(A_{pl}) + [\cos(\theta_{el}), \sin(\theta_{el})]$

2 9 $\mathrm{c}(L) = \mathrm{lc}(A_{pl}, L)$

4.8 Determination of $\mathrm{c}(L)$ of Label2D L not satisfying $\mathrm{o}(L) \in \mathcal{AN}$

4.8.1 IF $\mathrm{o}(L) \equiv A \in \mathcal{AR}$

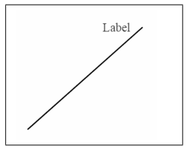
1



	$\mathrm{d}(L) = \mathrm{CM}$	
2	$\mathrm{d}(\mathrm{c}(A), \mathrm{s}(A)) + 1$	raidus
	$\theta = \mathrm{a}(\mathrm{c}(A), \mathrm{s}(A)) + \frac{\mathrm{a}(A)}{2}$	angle
	$\mathrm{c}(L) = \mathrm{c}(A) + \mathrm{c}(r, \theta)$	

4.8.2 IF $\mathrm{o}(L) \equiv S \in \mathcal{S}$

1

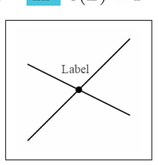


	$\mathrm{d}(L) = \mathrm{CM}$		
	$\theta_s = \mathrm{a}(S)$		angle Segment2D
	$\theta_{sr} = \mathrm{a}(-\mathrm{a}(S))$		angle Segment2D reverse
	$\theta_a = \frac{3\pi}{4}$		angle addition
	$d_l = 0.7$		distance Label2D
	$l_d = \sqrt{\mathrm{s}(L)[0]^2 + \mathrm{s}(L)[1]^2}$		length diagonal
	$r = \frac{l_d}{2} + d_l$		radius
2	IF	$0 \leq \theta_s \leq \pi$	$\theta_u = \theta_s$ angle up $\theta_d = \theta_{sr}$ angle down $\mathbf{p}_t = \mathrm{e}(S)$ point top $\mathbf{p}_b = \mathrm{s}(S)$ point bottom
	EL		$\theta_u = \theta_{sr}$ angle up $\theta_d = \theta_s$ angle down $\mathbf{p}_t = \mathrm{s}(S)$ point top $\mathbf{p}_b = \mathrm{e}(S)$ point bottom
	IF	$0 \leq \theta_u \leq \frac{\pi}{2}$	$\mathcal{C}_l = [\mathbf{p}_t + \mathrm{c}(r, \mathrm{a}(\theta_u \pm \theta_a)), \mathbf{p}_b + \mathrm{c}(r, \mathrm{a}(\theta_d \pm \theta_a))]$
	EL	$\mathcal{C}_l = [\mathbf{p}_t + \mathrm{c}(r, \mathrm{a}(\theta_u \pm \theta_a)), \mathbf{p}_b + \mathrm{c}(r, \mathrm{a}(\theta_d \pm \theta_a))]$	center Label2D

	$\mathrm{c}(L) = [\,]$		
	$\mathcal{D}_l = [\,]$	distance Label2D	
	$n_{ip} = 0$	number invalid Point2D	
3	FE	$\mathbf{c} \in \mathcal{C}_l$	$\mathcal{D} = [\,]$ distance FE: $\wedge$ $S_1 \in \mathcal{S}$, $S_1 \neq S$ → d distance from $\mathbf{c}$ to the line that contains S_1 distance; $\mathcal{D}[\,] = d$; IF $r > d$ $n_{ip} += 1$ IF $n_{ip} \neq 0$ $\mathrm{c}(L) = \mathbf{c}$ EL $\mathcal{D}_l[\min(\mathcal{D})] = \mathbf{c}$

4.8.3 IF $\mathrm{o}(L) \equiv P \in \mathcal{P}$

1



2

$\mathrm{d}(L) = \mathrm{CM}$	
$\theta = \mathrm{a}(\frac{\pi}{2} - \mathrm{a}(G))$	angle
$r_{lr} = \frac{\sqrt{\mathrm{s}(L)[0]^2 + \mathrm{s}(L)[1]^2}}{2}$	radius Label2D rectangle
$r_l = 0.5 + \min(r_r, 0.5)$	radius Label2D
$r_{lmin} = 0.75$	radius Label2D min
$r_{lmax} = 1.25$	radius Label2D max
$r = 2$	radius
IF $r_l < r_{lmin}$	$r = r_{lmin}$
EI $r_{lmax} < r_l$	$r = r_{lmax}$
$\mathcal{A}_s = [\,]$	angle Segment2D

3 Determine n_{md} which is the number of Segment2Ds in $\mathcal{S}_m$ that contain P

3 1

$n_{md} = 0$	number measure direction
$\mathcal{S}_{mp} = [S \in \mathcal{S}_m \mid P \in \mathrm{int}(S)]$	Segment2D measure Point2D

IF $\mathcal{S}_{mp} \neq [\,]$

$n_{md} += 1$

FO i

$\theta_i = \mathrm{a}(\mathcal{S}_{mp}[i])$	angle i
$s_i = \mathrm{s} \circ \mathrm{h} \circ \mathrm{m}(\mathcal{S}_{mp}[i])$	sign i
$n_{dd} = 0$	number different direction

FO ∧ j; $j < i$

$\theta_j = \mathrm{a}(\mathcal{S}_{mp}[j])$	angle j
$s_j = \mathrm{s} \circ \mathrm{h} \circ \mathrm{m}(\mathcal{S}_{mp}[j])$	sign j

IF ∨

- ∧ $\theta_i \neq \theta_j$; $\theta_i \neq \mathrm{a}(-\theta_j)$
- ∧ $\theta_i \equiv \theta_j$; $s_i \neq s_j$
- ∧ $\theta_i \equiv \mathrm{a}(-\theta_j)$; $s_i \equiv s_j$

$n_{dd} += 1$

IF $n_{dd} \equiv i - 1$ $n_{md} += 1$

4 FE ∧ $S \in \mathcal{S}$; $P \in S$

$s_m = \mathrm{s} \circ \mathrm{h} \circ \mathrm{m}(S)$	sign measure
$\theta_s = \mathrm{a}(-\mathrm{a}(S))$	angle start
$\theta_e = \mathrm{a}(S)$	angle end

IF $\mathrm{c}(P) \equiv \mathrm{s}(S)$

$\mathcal{A}_s[\,] = \theta_t$

IF $S \in \mathcal{S}_m$

$s_{ml} = \mathrm{s} \circ \mathrm{l} \circ \mathrm{m}(S)$ — size measure Label2D

IF $\mathrm{l}(S) \leq s_{ml}[0]$

$n_a = 90$ — number angle

$\theta_a = \mathrm{a}(\theta_t + s_m \frac{\pi}{2})$ — angle Angle2D

FO $0 \leq i \leq n_a$: $\mathcal{A}_s[\,] = \mathrm{a}(\theta_a - \frac{\pi}{180 n_a} i)$

IF $\mathrm{h} \circ \mathrm{m}(S) > h_{mi}$: $\mathcal{A}_s[\,] = \mathrm{a}(\theta_t - \mathrm{a}(\mathrm{m}(S))[0])$

EI $\mathrm{c}(P) \equiv \mathrm{e}(S)$

$\mathcal{A}_s[\,] = \theta_s$

IF $S \in \mathcal{S}_m$

$s_{ml} = \mathrm{s} \circ \mathrm{l} \circ \mathrm{m}(S)$ — size measure Label2D

IF $\mathrm{l}(S) \leq s_{ml}[0]$

$n_a = 90$ — number angle

$\theta_a = \mathrm{a}(\theta_s - s_m \frac{\pi}{2})$ — angle Angle2D

FO $0 \leq i \leq n_a$: $\mathcal{A}_s[\,] = \mathrm{a}(\theta_a + \frac{\pi}{180 n_a} i)$

IF $\mathrm{h} \circ \mathrm{m}(S) > h_{mi}$: $\mathcal{A}_s[\,] = \mathrm{a}(\theta_s + \mathrm{a}(\mathrm{m}(S))[1])$

EI

$\mathcal{A}_s[\,] = \theta_s$

$\mathcal{A}_s[\,] = \theta_t$

EL

IF $S \in \mathcal{S}_m$

$\theta_a = \frac{5\pi}{180}$ — angle Angle2D

$n_a = \frac{180}{5}$ — number angle

FO $0 \leq i \leq n_a$: $\mathcal{A}_s[\,] = \mathrm{a}(\theta_t + s_m \theta_a i)$

5

$\mathcal{A}_f = [\,]$ — angle Face2D

FE $F \in \mathcal{F}$

FE $L_1 \in \mathcal{L}$

IF ∧ $\mathrm{o}(L_1) \neq F$; $\mathrm{c}(P) \in \mathrm{v}(F)$; $\mathrm{d}(\mathrm{c}(P), \mathrm{c}(L_1)) \leq \frac{3}{\mathrm{r}(G)}$

$\mathcal{A}_f[\,] = \mathrm{a}(\mathrm{c}(P), \mathrm{c}(L_1))$

6

$\mathcal{A}_{arl} = [\,]$	angle Arc2D left
$\mathcal{A}_{arr} = [\,]$	angle Arc2D right
$\mathcal{A}_{arml} = [\,]$	angle Arc2D measure left
$\mathcal{A}_{armr} = [\,]$	angle Arc2D measure right

7 | FE | $A \in \mathcal{AR}$

IF $P \in A$

$\theta_p = \mathrm{a}(\mathrm{c}(A), \mathrm{c}(P))$	angle point
$\theta_l = \mathrm{a}(\theta_p - \frac{\pi}{2})$	angle left
$\theta_r = \mathrm{a}(\theta_p + \frac{\pi}{2})$	angle right
$n_a = \left\lceil \frac{\frac{\pi}{2}}{\frac{5\pi}{180}} \right\rceil$	number angle

IF $P \in \mathrm{int}(A)$

- IF $0 \leq i \leq 5$: $\mathcal{A}_{arl}[\,] = \mathrm{a}(\theta_l - \frac{\pi}{180} i)$
- FO $0 \leq i \leq 5$: $\mathcal{A}_{arr}[\,] = \mathrm{a}(\theta_l + \frac{\pi}{180} i)$
- IF $A \in \mathcal{AR}_m$
  - FO $0 \leq i \leq n_a$: $\mathcal{A}_{arml}[\,] = \mathrm{a}(\theta_p - \frac{\frac{\pi}{2}}{n_a})$
  - FO $0 \leq i \leq n_a$: $\mathcal{A}_{armr}[\,] = \mathrm{a}(\theta_p + \frac{\frac{\pi}{2}}{n_a})$

EL

$n_d = 0$ number direction

- IF $\mathrm{c}(P) \equiv \mathrm{s}(A)$
  - $\mathcal{A}_{arr}[\,] = \theta_r$
  - $n_d = n_d + 1$
  - IF $A \in \mathcal{AR}_m$ — FO $0 \leq i \leq n_a$: $\mathcal{A}_{armr}[\,] = \mathrm{a}(\theta_p + \frac{\frac{\pi}{2}}{n_a} i)$
- IF $\mathrm{c}(P) \equiv \mathrm{e}(P)$
  - $\mathcal{A}_{arl}[\,] = \theta_l$
  - $n_d += 1$
  - IF $A \in \mathcal{AR}_m$ — FO $0 \leq i \leq n_a$: $\mathcal{A}_{arml}[\,] = \mathrm{a}(\theta_p - \frac{\frac{\pi}{2}}{n_a} i)$
- IF $n_d = 2$
  - FO $1 \leq i \leq 5$: $\mathcal{A}_{arl}[\,] = \theta_l - \frac{\pi}{180} i$
  - FO $1 \leq i \leq 5$: $\mathcal{A}_{arr}[\,] = \theta_r + \frac{\pi}{180} i$

8

$S_c = \mathrm{null}$ Segment2D contained

FE $S \in \mathcal{S}$ — IF $P \in \mathrm{int}(S)$: $S_c = S$

IF $\wedge$
- $S_c \neq \mathrm{null}$
- S_c is a chord of A
- $\mathrm{r}(A) - 1 \leq \mathrm{d}(\mathrm{c}(A), \mathrm{c}(P)) \leq \mathrm{r}(A) + 1$

$\theta_s = \mathrm{a}(\mathrm{c}(A), \mathrm{s}(S))$	angle start
$\theta_e = \mathrm{a}(\mathrm{c}(A), \mathrm{e}(S))$	angle end
IF $0 \leq \mathrm{a}(\theta_e - \theta_s) \leq \pi$: $s = -1$ EL : $s = 1$	sign
FO $0 \leq i \leq 36$: $\mathcal{A}_s[\,] = \mathrm{a}(\mathrm{a}(S) + s \frac{5\pi}{180} i)$	

9

$\mathcal{A}_{an} = [\,]$	angle Angle2D
$\mathcal{A}_{ansi} = [\,]$	angle Angle2D start in
$\mathcal{A}_{anso} = [\,]$	angle Angle2D start out
$\mathcal{A}_{anei} = [\,]$	angle Angle2D end in
$\mathcal{A}_{aneo} = [\,]$	angle Angle2D end out

10 IF $\mathcal{AN} \neq [\,]$

10 | 1

FE $A \in \mathcal{AN}$

IF | $\mathrm{o}(L_1) \equiv A$ | $L_1 =$ Label2D of A

EL | $L_1 =$ null

$r_l = \sqrt{\mathrm{s}(L_1)[0]^2 + \mathrm{s}(L_1)[1]^2}$ — radius Label2D

$n_a = \left\lceil \frac{\mathrm{a}(A)}{\frac{5\pi}{180}} \right\rceil$ — number angle

IF | $\wedge$ | $\mathrm{c}(P) \equiv \mathrm{c}(A)$

$\vee$ | $\mathrm{a}(A) \geq \pi$

$\mathrm{h}(A) \neq 0$

$L_1 \neq$ null

FO | $0 \leq i \leq n_a$ | $\mathcal{A}_s[\,] = \mathrm{a}(\mathrm{a}(\mathrm{c}(A), \mathrm{s}(A)) + \frac{\mathrm{a}(A)}{n_a} i)$

FO | $0 \leq i \leq n_a$ | $\mathcal{A}_{an}[\,] = \mathrm{a}(\mathrm{a}(\mathrm{c}(A), \mathrm{s}(A)) + \frac{\mathrm{a}(A)}{n_a} i)$

$\mathcal{D} = [\,]$ — direction

FE $A \in \mathcal{AN}$

IF | $\mathrm{c}(P) \equiv \mathrm{s}(A)$ | $\mathcal{D}[\,] =$ start

EI | $\mathrm{c}(P) \equiv \mathrm{e}(A)$ | $\mathcal{D}[\,] =$ end

EL

FE | $S \in \mathcal{S}$

IF | $P \in S$

IF | $\wedge$ | $\mathrm{c}(A) \equiv \mathrm{s}(S)$; $\mathrm{s}(A) \equiv \mathrm{e}(S)$ | $\mathcal{D}[\,] =$ start

EI | $\wedge$ | $\mathrm{c}(A) \equiv \mathrm{s}(S)$; $\mathrm{e}(A) \equiv \mathrm{e}(S)$ | $\mathcal{D}[\,] =$ end

10 | 2

IF | $|\mathcal{D}| \equiv 1$ | $i_{uad} =$ TR

EL | $i_{uad} =$ FA

is unique angle direction

FE $A \in \mathcal{AN}$

IF | $\wedge$ | $i_{uad} \equiv$ TR; $\mathrm{d}(\mathrm{c}(P), \mathrm{c}(A)) < r_{lr}$

$\theta_p = \mathrm{a}(\mathrm{c}(P), \mathrm{c}(A))$ — angle point

$\theta_s = \mathrm{a}(\mathrm{s}(A), \mathrm{c}(A))$ — angle start

$\theta_e = \mathrm{a}(\mathrm{e}(A), \mathrm{c}(A))$ — angle end

FE $S \in \mathcal{S}$

IF | $\wedge$ | $P \in \mathrm{int}(S)$; $\mathrm{c} \in S$

IF | $\theta_p \equiv \theta_s$ | $\mathcal{A}_{si} = \mathcal{A}_{ansi} \cup [\theta_p]$; $\mathcal{A}_{so} = \mathcal{A}_{anso} \cup [\mathrm{a}(\theta_p + \pi)]$

EI | $\theta_p \equiv \theta_e$ | $\mathcal{A}_{ei} = \mathcal{A}_{anei} \cup [\theta_p]$; $\mathcal{A}_{eo} = \mathcal{A}_{aneo} \cup [\mathrm{a}(\theta_p + \pi)]$

$i_{sba} =$ FA — is surrounded by angle

$\mathcal{D} = [\,]$ — degree

FE $A \in \mathcal{AN}$

IF | $\mathrm{c}(P) \equiv \mathrm{c}(A)$

$\theta_s = \left\lfloor \frac{\mathrm{a}(\mathrm{c}(A), \mathrm{s}(A))}{\frac{180}{\pi}} \right\rfloor$ — angle start

$\theta_e = \left\lceil \frac{\mathrm{a}(\mathrm{c}(A), \mathrm{e}(A))}{\frac{180}{\pi}} \right\rceil$ — angle end

IF | $\theta_s < \theta_e$ | FO | $0 \leq i \leq \theta_e - \theta_s$ | $\mathcal{D}[\,] = \theta_s + i$

EI | $\theta_s > \theta_e$ | FO | $\vee$ | $0 \leq i \leq \theta_e$; $\theta_s \leq i \leq 360$ | $\mathcal{D}[\,] = i$

10 | 3

IF | $|\mathcal{D}| \geq 360$ | $i_{sba} =$ TR

IF | $i_{sba} \equiv$ FA | $\mathcal{A}_p = \mathcal{A}_s \cup \mathcal{A}_f \cup \mathcal{A}_{arr} \cup \mathcal{A}_{arl} \cup \mathcal{A}_{arml} \cup \mathcal{A}_{armr} \cup \mathcal{A}_{an}$

EL | $\mathcal{A}_p = \mathcal{A}_s \cup \mathcal{A}_f \cup \mathcal{A}_{arr} \cup \mathcal{A}_{arl} \cup \mathcal{A}_{arml} \cup \mathcal{A}_{armr}$

angle point

$n_{an} = \lvert\mathcal{A}_{an}\rvert$	number Angle2D
$n_{ans} = \lvert\mathcal{A}_{anso}\rvert + \lvert\mathcal{A}_{ansi}\rvert$	number Angle2D start
$n_{ane} = \lvert\mathcal{A}_{aneo}\rvert + \lvert\mathcal{A}_{anei}\rvert$	number Angle2D end
$n_{arl} = \lvert\mathcal{A}_{arl}\rvert$	number Arc2D left
$n_{arr} = \lvert\mathcal{A}_{arr}\rvert$	number Arc2D right
11 $n_{ar} = n_{arl} + n_{arr}$	number arc
$n_{arml} = \lvert\mathcal{A}_{arml}\rvert$	number Arc2D measure left
$n_{armr} = \lvert\mathcal{A}_{armr}\rvert$	number Arc2D measure right
$n_s = \lvert\mathcal{A}_s\rvert$	number Segment2D
$n_p = \lvert\mathcal{A}_p\rvert$	number Point2D
$i_{gc} =$ FA	is general case

12 IF $n_a \neq 0$

12 1 IF

$\wedge$	$n_{ar} \equiv 0$
	$n_{an} \equiv 0$

12 1 1 IF $n_s \equiv 1$ $i_{gc} =$ TR

12 1 2 EI $n_s \equiv 2$

IF	$\wedge$ $n_{ans} \equiv 2$, $n_{ane} \equiv 0$	$\theta = \mathrm{a}(\mathcal{A}_{anso}[0] - \frac{\pi}{2})$
EI	$\wedge$ $n_{ans} \equiv 0$, $n_{ane} \equiv 2$	$\theta = \mathrm{a}(\mathcal{A}_{aneo}[0] + \frac{\pi}{2})$

12|1|2|1

EL

$S_c = \mathrm{null}$ — Segment2D containing

FE $S \in \mathcal{S}$ — IF $P \in S$ — $S_c = S$

$i_{gc} =$ FA

IF $S_c \equiv \mathrm{null}$ — $i_{gc} =$ TR

EL

$i_{gcs} =$ FA — is general case Segment2D

$\theta_{lmax} = 0$ — angle left max

$\theta_{rmax} = 0$ — angle right max

FE — $\wedge$ $S \in \mathcal{S}$, $S \neq S_c$

IF $\mathrm{s}(S_c) \in \mathrm{int}(S)$ — $\theta_d = \mathrm{a}(\mathrm{a}(S) - \mathrm{a}(S_c))$ — angle difference

- IF $0 < \theta_d < \pi$ — $\theta_{lmax} = \max(\theta_{lmax}, \pi - \theta_d)$; $\theta_{rmax} = \max(\theta_{rmax}, \theta_d)$
- EI $\pi < \theta_d < 2\pi$ — $\theta_{lmax} = \max(\theta_{lmax}, 2\pi - \theta_d)$; $\theta_{rmax} \max(\theta_{rmax}, \theta_d - \pi)$

EI $\mathrm{e}(S_c) \in \mathrm{int}(S)$ — $\theta_d = \mathrm{a}(-\mathrm{a}(S) - \mathrm{a}(S_c))$ — angle difference

- IF $0 < \theta_d < \pi$ — $\theta_{lmax} = \max(\theta_{lmax}, \theta_d)$; $\theta_{rmax} = \max(\theta_{rmax}, \pi - \theta_d)$
- EI $\pi < \theta_d < 2\pi$ — $\theta_{lmax} = \max(\theta_{lmax}, \theta_d - \pi)$; $\theta_{rmax} = \max(\theta_{rmax}, 2\pi - \theta_d)$

EI $\mathrm{s}(S_c) \equiv \mathrm{e}(S)$ — $\theta_d = \mathrm{a}(\mathrm{a}(S) - \mathrm{a}(S_c))$ — angle difference

- IF $0 < \theta_d < \pi$ — $\theta_{lmax} = \max(\theta_{lmax}, \pi - \theta_d)$
- EI $\pi < \theta_d < 2\pi$ — $\theta_{rmax} = \max(\theta_{rmax}, \theta_d - \pi)$

EI $\mathrm{e}(S_c) \equiv \mathrm{e}(S)$ — $\theta_d = \mathrm{a}(-\mathrm{a}(S) - \mathrm{a}(S_c))$ — angle difference

- IF $0 < \theta_d < \pi$ — $\theta_{lmax} = \max(\theta_{lmax}, \pi - \theta_d)$
- EI $\pi < \theta_d < 2\pi$ — $\theta_{rmax} = \max(\theta_{rmax}, \theta_d - \pi)$

12|1|2|2

IF	$\theta_{lmax} < \theta_{rmax}$	$\theta = \mathrm{a}(\mathrm{a}(S_c) + \frac{\pi}{2})$
EI	$\theta_{lmax} > \theta_{rmax}$	$\theta = \mathrm{a}(\mathrm{a}(S_c) - \frac{\pi}{2})$
EL	$i_{gcs} =$ TR	

$\mathcal{F}_c = [\,]$	Face2D containing		
FE	$F \in \mathcal{F}$	FE	$S \in \mathrm{e}(F)$
IF	$P \in \mathrm{int}(S)$	$\mathcal{F}_c[\,] = F$	

$i_{gcf} =$ FA	is general case Face2D		
IF	$\lvert\mathcal{F}_l\rvert \neq 0$	$\mathcal{S}_f = [\,]$	sign Face2D

FE	$F \in \mathcal{F}_c$	FE	$\wedge$	$S \in \mathrm{e}(\mathcal{F}_c)$ $S \neq S_c$	IF	$\vee$	$\mathrm{s}(S) \equiv \mathrm{s}(S_c)$ $\mathrm{s}(S) \equiv \mathrm{e}(S_c)$

$\theta_d = \mathrm{a}(\mathrm{a}(S) - \mathrm{a}(S_c))$	angle difference		
IF	$0 < \theta_d < \pi$	$\mathcal{S}_f[\,] = -1$	
EI	$\pi < \theta_d < 2\pi$	$\mathcal{S}_f[\,] = 1$	

FE	$F \in \mathcal{F}_c$	FE	$\wedge$	$S \in \mathrm{e}(\mathcal{F}_c)$ $S \neq S_c$	EI	$\vee$	$\mathrm{e}(S) \equiv \mathrm{s}(S_c)$ $\mathrm{e}(S) \equiv \mathrm{e}(S_c)$

$\theta_d = \mathrm{a}(\mathrm{a}(S) - \mathrm{a}(S_c))$	angle difference		
IF	$0 < \theta_d < \pi$	$\mathcal{S}_f[\,] = -1$	
EI	$\pi < \theta_d < 2\pi$	$\mathcal{S}_f[\,] = 1$	

$i_{gcf} =$ FA			
IF	$\lvert\mathcal{S}_f\rvert \equiv 1$	$\theta = \mathrm{a}(\mathrm{a}(S_c) + \mathcal{S}_f[0] \cdot \frac{\pi}{2})$	
EL	$i_{gcf} =$ TR		

12 1 2 4	IF	$\wedge$	$i_{gcs} \equiv$ TR $i_{gcf} \equiv$ TR	$i_{gc} =$ TR	
12 1 3	EL	$i_{gc} =$ TR			

12 2	EI	$\wedge$	$n_{arl} \equiv 1$ $n_{arr} \equiv 1$ $n_a \equiv 0$ $\mathcal{A}_{al}[0] \equiv \mathcal{A}_{ar}[0]$	IF	$\wedge$ $n_{arml} \equiv 0$ $n_{armr} \neq 0$
					$\theta = \mathrm{a}(\mathcal{A}_{armr}[0] + \frac{\pi}{4})$
				EI	$\wedge$ $n_{arml} \neq 0$ $n_{armr} \equiv 0$
					$\theta = \mathrm{a}(\mathcal{A}_{arml}[0] - \frac{\pi}{4})$
				EI	$\wedge$ $n_{arml} \equiv 0$ $n_{armr} \equiv 0$ $n_s \equiv 0$
					$\theta = \mathrm{a}(\mathcal{A}_{arl}[0] + \frac{\pi}{2})$
				EL	$i_{gc} =$ TR

IF	$i_{sba} \equiv$ TR	$\mathrm{c}(L) = \mathrm{c}(P) + \mathrm{c}(0.5, \theta)$	
EL	Sort $\mathcal{A}_p$ increasingly		
	$\mathcal{A}_p[n] = \mathcal{A}_p[0]$		
	$\theta_{di} = \mathrm{a}(\mathcal{A}_p[i] - \mathcal{A}_p[i-1])$	angle difference i	
	$m = \min[i \mid \theta_{di} \geq \theta_{dj}\ \forall j]$		
	$\theta_s = \mathcal{A}_p[m-1]$	angle start	
	$\theta_e = \mathcal{A}_p[m]$	angle end	

12 3	EL	IF	$i_{gc} \equiv$ TR	
		EL	$\theta_s = \mathrm{a}(\theta - \frac{\pi}{2})$	angle start
			$\theta_e = \mathrm{a}(\theta + \frac{\pi}{2})$	angle end

IF: $\lvert\theta_e - \theta_s\rvert < \frac{\pi}{180}$	$\theta_m = \mathrm{a}(\theta_s + \pi)$	angle mid
EL	$\theta_m = \mathrm{a}(\theta_s + \frac{\mathrm{a}(\theta_e - \theta_s)}{2})$	
$\theta_{ro} = \mathrm{a}(\frac{\pi}{2} - \theta_m)$		angle rotation
$\theta_l = \min(\mathrm{a}(\theta_e + \theta_{ro}), \pi)$		angle left
$\theta_r = \mathrm{a}(\theta_s + \theta_{ro})$		angle right
IF: $\pi \leq \theta_r$	$\theta_r = 0$	
$\theta_{lr} = \mathrm{a}(\frac{\pi}{2}i + \theta_{ro}) < \frac{\pi}{2}\ (i \in [0,1,2,3])$		angle Label2D right
$\theta_{ll} = \mathrm{a}(\theta_{lr} + \frac{\pi}{2})$		angle Label2D left
$d_{min} = 0.35$		distance min
$d_{minac} = 0$		distance min addition center
$d_{minc} = d_{min} + d_{minac}$		distance min center
IF: $\mathrm{m}(i,2) \equiv 0$	$l_{ll} = \mathrm{s}(L)[1]$; $l_{lr} = \mathrm{s}(L)[0]$	length Label2D left length Label2D right
EL	$l_{ll} = \mathrm{s}(L)[0]$; $l_{lr} = \mathrm{s}(L)[1]$	
$w_{ll} = l_{ll}\cos(\pi - \theta_{ll})$		width Label2D left
$w_{lr} = l_{lr}\cos(\theta_{lr})$		width Label2D right
$h_{ll} = l_{lr}\sin(\pi - \theta_{ll})$		height Label2D left
$h_{lr} = l_{lr}\sin(\theta_{lr})$		height Label2D right
$h_{lmin} = \min(h_{ll}, h_{lr})$		height Label2D min
$h_{lmax} = \max(h_{ll}, h_{lr})$		height Label2D max

12 | 4

x_{lmin}	x Label2D min		
y_{lminf}	y Label2D min fit		
IF	$\theta_r \leq \theta_{lr}$ ∧ $\theta_{ll} \leq \theta_l$	IF: $\theta_{lr} \leq \frac{\pi}{4}$	$x_{lmin} = \sqrt{2}\frac{l_{lr}}{2}\cos(\theta_{lr} + \frac{\pi}{4})$
		EL	$x_{lmin} = \sqrt{2}\frac{l_{ll}}{2}\cos(\pi - \theta_{ll} + \frac{\pi}{4})$
		$y_{lminf} = \lvert x_{lmin}\rvert\tan\theta_r + \frac{d_{min}}{\cos\theta_r}$	
EI	$\theta_r \leq \theta_{lr}$ ∧ $\theta_l < \theta_{ll}$	$w_r = \frac{h_{ll}}{\tan\theta_r}$	width right
		$x_{lmin} = \frac{w_{ll} - w_r}{2}$	
		$w_t = w_{ll} + w_r + 2\frac{d_{min}}{\sin\theta_r}$	width top
		$y_{lminf} = \frac{w_t}{2}\tan(\pi - \theta_r) - h_{ll}$	
EI	$\theta_{lr} < \theta_r$ ∧ $\theta_{ll} \leq \theta_l$	$w_l = \frac{h_{lr}}{\tan(\pi - \theta_l)}$	width left
		$x_{lmin} = \frac{w_l - w_{lr}}{2}$	
		$w_t = w_l + w_{lr} + 2\frac{d_{min}}{\tan\theta_r} - h_{lr}$	width top
		$y_{lminf} = \frac{w_t}{2}\tan\theta_r - h_{lr}$	
EL	$x_{lmin} = \frac{w_{ll} - w_{lr} + \frac{h_{lr} - h_{ll}}{\tan\theta_r}}{2}$		
	$w_t = w_{ll} + w_{lr} + \frac{\lvert h_{ll} - h_{lr}\rvert}{\tan\theta_r} + 2\frac{d_{min}}{\sin\theta_r}$		width top
	$y_{lminf} = \frac{w_t}{2\tan\theta_r} - h_{lmax}$		

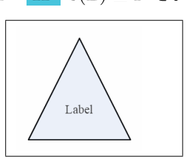
12 | 5

	$x_{cl} = d_{minc} \cos(\theta_l - \frac{\pi}{2})$		x contact left
	$y_{cl} = \sqrt{d_{minc}^2 - x_{cl}^2}$		y contact left
	$x_{cr} = d_{minc} \cos(\theta_{lr} + \frac{\pi}{2})$		x contact right
	$y_{cr} = \sqrt{d_{minc}^2 - x_{cl}^2}$		y contact right
12 6	IF	$x_{lmin} \leq x_{cr}$	$y_{lminc} = y_{cr} - \lvert x_{cr} - x_{lmin} \rvert \tan \theta_{lr}$	y Label2D min contact
	EI	$x_{cr} < x_{lmin} < x_{cl}$	$y_{lminc} = \sqrt{d_{minc}^2 - x_{lmin}^2}$	
	EL	$y_{lminc} = y_{cl} - \lvert x_{cl} - x_{lmin} \rvert \tan(\pi - \theta_{ll})$		
	$y_{lmin} = \max(y_{lminf}, y_{lminc})$			y Label2D min

	$l_{dh} = \frac{\sqrt{l_{ll}^2 + l_{lr}^2}}{2}$	length diagonal half
	$\theta_d = \mathrm{a}(l_{ll}, l_{lr})$	angle diagonal
	$x_t = x_{lmin} + l_{dh} \cos(\theta_{lr} + \theta_d)$	x translated
12 7	$y_t = x_{lmin} + l_{dh} \sin(\theta_{lr} + \theta_d)$	y translated
	$x_r = x_t \cos(-\theta_{ro}) + y_t \sin \theta_{ro}$	x rotated
	$y_r = x_t \sin(-\theta_{ro}) + y_t \cos(-\theta_{ro})$	y rotated
	$\mathrm{c}(L) = \mathrm{c}(P) + [x_r, y_r]$	

4.8.4 IF $\mathrm{o}(L) \equiv F \in \mathcal{F}$

1



	$\mathrm{d}(L) = \mathrm{CM}$		
	$\mathrm{c}(L) = \mathrm{c}(F)$		
	$\mathcal{A}_f = [\,]$	angle Face2D	
	$n_i = 0$	number incidence	
2	FE	$P \in \mathcal{P}$	IF $\mathrm{c}(L) \equiv \mathrm{c}(P)$: $n_i{+}{=}1$
			EI $\mathrm{d}(\mathrm{c}(L), \mathrm{c}(P)) \leq 1$: $\mathcal{A}_f[\,] = \mathrm{a}(\mathrm{c}(L), \mathrm{c}(P))$
	FE	$\wedge$ $L_1 \in \mathcal{L}$, $L \neq L_1$	IF $\mathrm{c}(L) \equiv \mathrm{c}(L_1)$: $n_i{+}{=}1$
			EI $\mathrm{d}(\mathrm{c}(L), \mathrm{c}(L_1)) \leq 1$: $\mathcal{A}_f[\,] = \mathrm{a}(\mathrm{c}(L_1), \mathrm{c}(P))$
	IF	$\wedge$ $n_i \neq 0$, $\lvert \mathcal{A}_f \rvert \equiv 0$	$\mathrm{c}(L){+}{=}[0, 1]$
	EI	$\lvert \mathcal{A}_f \rvert \neq 0$	$\mathrm{c}(L){+}{=}\mathrm{c}(1, \mathrm{amm}(\mathcal{A}_f))$

4.9 Update of heights by $\mathrm{r}(G)$

	FE	$A \in \mathcal{AN}$	$\mathrm{h}(A){\times}{=}\mathrm{r}(G)$
1	FE	$A \in \mathcal{AR}$	$\mathrm{h} \circ \mathrm{m}(A){\times}{=}\mathrm{r}(G)$
	FE	$S \in \mathcal{S}$	$\mathrm{h} \circ \mathrm{m}(S){\times}{=}\mathrm{r}(G)$