New Sinod

New Sinod - Basic

1 Preliminaries

1.1 Color index

abbreviation
next level
partial result

1.2 Abbreviation

BR	break
CA	case
CO	construct
CT	continue
FA	false
FO	for
IF	if
IN	infinity
NU	null
SW	switch
TR	true
WH	while

1.3 Notation

1.3.1 Object

1. **Empty object**

$\emptyset$	null
	[ ]
	“”

2. **Interior**

O°	interior of O

1.3.2 Operator

1. **Operation**

$\boxed{\circ}\begin{bmatrix} a \\ b \end{bmatrix}$	$a \circ b$

2. **Assignment**

$a \overset{\circ}{=} b$	$a = a \circ b$

	$a \overset{-}{=} b$	$a = a - b$
	$a \overset{+}{=} b$	$\boxed{\vee}\begin{bmatrix} a = a + b \\ \text{add } b \text{ to an array or set } a \end{bmatrix}$
$\boxed{1}$	$a \overset{\times}{=} b$	$a = a \times b$
	$a \overset{\div}{=} b$	$a = a \div b$
	$a \overset{\cup}{=} b$	$a = a \cup b$
	$a \overset{\cap}{=} b$	$a = a \cap b$

3. **Increment**

$\overset{+}{+}a$	$++a$
$a\overset{+}{+}$	$a++$
$\overset{-}{-}a$	$--a$
$a\overset{-}{-}$	$a--$

4. **Comparison**

$a \equiv b$	a is equal to b
$b \neq b$	a is not equal to b

5. **Multiplication**

$a \times matrix$	scalar product
$coordinates \times coordinates$	inner product
$matrix \times matrix$	matrix multiplication

6. **Negation**

$\neg a$	not a

7. **Absolute value** | |

$\lvert real \rvert$	absolute value of $real$
$\lvert array \rvert$	number of elements in $array$
$\lvert matrix \rvert$	determinant of $matrix$
$\lvert \mathbf{xy} \rvert$	norm of **xy**
$\lvert \mathbf{Point2D} \rvert$	norm of **Point2D**
$\lvert \mathbf{Segment2D} \rvert$	length of **Segment2D**

1.3.3 Array

1. $\left[\begin{array}{c|c} value\_1 & value\_2 \end{array}\right]$
2. $\left[\begin{array}{c|c} key\_1 & key\_2 \\ \hline value\_1 & value\_2 \end{array}\right]$
3. $\begin{array}{|c|c|} \hline array \left[\begin{array}{c} key\_1 \\ key\_2 \end{array}\right] & array[key\_1][key\_2] \\ \hline \end{array}$
4. We regard array as a set if there is no confusion.

1.3.4 Control

1. **Conditional**

IF	condition 1	excution 1
	condition 2	excution 2
	excution 3	

2. **For**

1

FO	condition
	excution

2

FO	*initial*	*condition*	*increment*
	excution		

3

FO	*array*	*value*
	excution	

4

FO	*array*	*key*	*value*
	excution		

3. **Switch**

SW	*value*	
	value 1	excution 1
	value 2	excution 2
	excution 3	

4. **While**

WH	condition
	excution

1.3.5 Function

1. **Define**

name	*variable*
	algorithm

2. **Call**

name $\begin{pmatrix} value \\ value \end{pmatrix}$	name$(value, value)$

1.3.6 Class

1. **Define**

name	*property*
	construct
	method

1			
	construct	CO	*variable*
			algorithm
	method	name	*variable*
			algorithm

2. **Assign**

1	**name** $(value)$

2 We regard **name** as **name**() if there is no confusion

3. **Access**

1	**name** ▶ *sub*	
	name ▶ *sub*_1 ▶ *sub*_2	**name** ▶ $\begin{bmatrix} sub\_1 \\ sub\_2 \end{bmatrix}$

2 We regard method as method() if there is no confusion

4. **Extend**

this ◀ *parent*

1.4 Types

1.4.1 Boolean

1. Every expression is either TH or FA.

2 JSON

2.1 Cartesian2D

menu	
elements	
axis	
grid	
font	color: text, background size decoration: underline, bold, italic
position	left, top
margin	top, bottom, left, right
size	
ratio	
rotation	
flip	x, y
bounds	x: min, max y: min, max
display	
elmAlign	
interaction	zooming, panning, rotation

2.2 Angle2D

coords	center: x, y start: x, y end: x, y
style	color height curve rigntAngle fill dash arrow: start, end marker markerHegiht
interaction	interactive, selected

2.3 Arc2D

measure	
coords	center: x, y start: x, y
angle	
style	color dash arrow: start, end marker1 marker2 marker3
interaction	

2.4 Curve2D

domain	x: min, max y: min, max
points	[x, y]
equation	
style	color dash
interaction	movable-mode selectable removable domain

2.5 Face2D

coords	[x, y]
interaction	interactive selected selectable movable
style	color

2.6 Label2D

label	
coords	x, y
target	x, y
arrowColor	
dash	

2.7 Measure2D

style	height color dash arrow: x, y marker

2.8 MeasureArc2D

style	height	
	color	
	dash	
	arrow	start ☐ end ☐
	marker	
	handle	
	handleDash	
interaction	selectable ☐ movable ☐	

2.9 Point2D

coord	x ☐ y ☐	
style	fill ☐ color ☐	
interaction	selected ☐ selectable ☐ movable ☐ removable ☐	

2.10 Region2D

curves	[object]
fill	[< fill | > fill]
style	color ☐
interaction	selectable ☐

2.11 Segment2D

measure		
coords	start	x ☐ y ☐
	end	x ☐ y ☐
style	color	
	dash	
	arrow	start ☐ end ☐
	marker1	
	marker2	
	marker3	
interaction	interactive ☐ selected ☐	

3 Structure

3.1 Cartesian2D

type	Cartesian2D
elements	[ ]
rotation	
size	
zoom	

3.2 Angle-free

type	arc-free	
_id		
struct	coords	center: x, y
		start: x, y
		end: x, y
	style	height
		rightAngle

3.3 Arc-free

type	angle-free	
_id		
struct	coords	center: x, y
		start: x, y
	angle	
	height	

3.4 Curve-free

type	curve-free
_id	
struct	

3.5 Face-free

type	face-free	
_id		
struct	coords	[x, y]

3.6 Label-free

type	label-free	
_id		
struct	coords	x, y
	target	x, y
	label	type
		content
	dependency	[ ]

3.7 Point-free

type	point-free	
_id		
struct	coord	x, y

3.8 Region-free

type	region-free
_id	
struct	

3.9 Segment-free

type	segment-free		
_id			
struct	coords	start	x y
		end	x y
	measure	height	

4 Basic

4.1 Math

4.1.1 numeric

1. **Definition**

numeric	
	method

2. **Note**

   We omit **numeric** ▶ if there is no confusioion.

3. **Method**

   1 mod: compute remainder of division *real_1* by *real_2*

mod	real_1	real_2
RE	$-\left[real\_1 \times \left[\lfloor real\_2 \rfloor \div \left[real\_1 \mid \lfloor real\_2 \rfloor \right] \right] \right]$	

   2 sign: sign of *real*

sign	*real*	$sign\_zero = 0$
IF	$real < 0$	RE -1
	$real \equiv 0$	RE *sign_zero*
	RE 1	

   3 vector_angle: vector angle of point $\left[x \mid y \right]$

vector_angle	x	y
RE	$\operatorname{atan2}\left(\begin{matrix} y \\ x \end{matrix} \right)$	

4.1.2 angle (radian)

1. **Definition**

angle	
	method

2. **Note**

   We omit **angle** ▶ if there is no confusioion.

3. **Method**

   1 polar: polar coordinate angle of *angle*

polar	*angle*	$angle\_start = 0$
RE	$+\left[angle\_start \bmod \left(-\left[\begin{matrix} angle \\ angle\_start \end{matrix} \right] \right)_{2\pi} \right]$	

4.1.3 xy

1. **Descritption**

   [1] A class to reprensent coordinates in xy-plane.

   [2] For simplicity, we regard it as a point $\left[\begin{array}{c|c} x & y \end{array}\right]$ in xy-plane.

2. **Definition**

xy	$type = \mathsf{xy}$
	x
	y
	method

3. **Method**

   [1] construct

CO	a | b | $type$		
	SW	$type$	
		Cartesian	$this = \left[\begin{array}{c\|c} a & b \end{array}\right]$
		polar	$this = \left[\begin{array}{c\|c} a\cos(b) & a\sin(b) \end{array}\right]$

   [2] angle: vector angle of $this$

angle	
RE	$\text{vector\_angle}\begin{pmatrix} this \blacktriangleright x \\ this \blacktriangleright y \end{pmatrix}$

   [3] rotation: rotated this arround $center$ with angle $angle$ anticlockwisely

rotation	$center$ | $angle$
RE	$\boxed{+}\left[\begin{array}{l} center \\ \boxed{\times}\left[\begin{array}{l} \boxed{-}\left[\begin{array}{l} this \\ center \end{array}\right] \\ \begin{bmatrix} \cos(angle) & -\sin(angle) \\ \sin(angle) & \cos(angle) \end{bmatrix} \end{array}\right] \end{array}\right]$

   [4] vector_angle: vetctor angle of $xy - this$

vector_angle	xy
RE	$\text{vector\_angle}\left(\begin{array}{l} \boxed{-}\left[\begin{array}{l} xy \blacktriangleright y \\ this \blacktriangleright y \end{array}\right] \\ \boxed{-}\left[\begin{array}{l} xy \blacktriangleright x \\ this \blacktriangleright x \end{array}\right] \end{array}\right)$

4.1.4 Bezier

1. **Definition**

Bezier	$start$
	mid
	end
	method

2. **Method**

   [1] construct

CO	$start$ | mid | end
	$\boxed{=}\left[\begin{array}{l} this \blacktriangleright start \\ start \end{array}\right]$
	$\boxed{=}\left[\begin{array}{l} this \blacktriangleright mid \\ mid \end{array}\right]$
	$\boxed{=}\left[\begin{array}{l} this \blacktriangleright end \\ end \end{array}\right]$

   [2] cener: center of $this$

center

$$mid\_segment = \boxed{+} \begin{bmatrix} this \blacktriangleright start \\ this \blacktriangleright end \end{bmatrix} \times \frac{1}{2}$$

$$radius = \frac{1}{2} \times \left| \boxed{-} \begin{bmatrix} mid\_segment \\ this \blacktriangleright mid \end{bmatrix} \right|$$

$$\boxed{=} \begin{bmatrix} angle \\ mid\_segment \blacktriangleright \text{vector\_angle}(this \blacktriangleright mid) \end{bmatrix}$$

$$translation = \mathbf{xy} \begin{pmatrix} radius \\ angle \\ \text{polar} \end{pmatrix}$$

RE $\boxed{+} \begin{bmatrix} mid\_segment \\ translation \end{bmatrix}$

3 coordinates: coordinates of *this* at t

coordinates t

RE $\boxed{+} \begin{bmatrix} \boxed{\times} \begin{bmatrix} (1-t)^2 \\ this \blacktriangleright start \end{bmatrix} \\ \boxed{\times} \begin{bmatrix} 2(1-t)t \\ this \blacktriangleright mid \end{bmatrix} \\ \boxed{\times} \begin{bmatrix} t^2 \\ this \blacktriangleright end \end{bmatrix} \end{bmatrix}$

4 height: height of *this*

height

RE $\left| \boxed{+} \begin{bmatrix} this \blacktriangleright start \\ this \blacktriangleright end \\ -2 \times this \blacktriangleright mid \end{bmatrix} \right| \times \frac{1}{4}$

5 interval: interval of *this* with given *axis*

interval *axis*

RE $this \blacktriangleright \begin{bmatrix} \text{quadratic}(axis) \\ \text{image} \left(\mathbf{Interval} \begin{pmatrix} 0 \\ 1 \end{pmatrix} \right) \end{bmatrix}$

6 quadratic: qudartic equation of *this*

quadratic *axis*

$$a = \boxed{+} \begin{bmatrix} this \blacktriangleright \begin{bmatrix} start \\ axis \end{bmatrix} \\ -2 \times this \blacktriangleright \begin{bmatrix} mid \\ axis \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ axis \end{bmatrix} \end{bmatrix}$$

$$b = \boxed{-} \begin{bmatrix} this \blacktriangleright \begin{bmatrix} mid \\ axis \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ axis \end{bmatrix} \end{bmatrix} \times 2$$

$$c = this \blacktriangleright \begin{bmatrix} start \\ axis \end{bmatrix}$$

RE $\mathbf{Quadratic} \begin{pmatrix} a \\ b \\ c \end{pmatrix}$

7 vector_tangent: tangent vector at t

vector_tangent	t
	$= \begin{bmatrix} quadratic\_x \\ this \blacktriangleright \text{quadratic(x)} \end{bmatrix}$
	$= \begin{bmatrix} quadratic\_y \\ this \blacktriangleright \text{quadratic(y)} \end{bmatrix}$
	$x = + \begin{bmatrix} 2t \times quadratic\_x \blacktriangleright a \\ quadratic\_x \blacktriangleright b \end{bmatrix}$
	$y = + \begin{bmatrix} 2t \times quadratic\_y \blacktriangleright a \\ quadratic\_y \blacktriangleright b \end{bmatrix}$
	RE $\mathbf{xy} \begin{pmatrix} x \\ y \end{pmatrix}$

4.1.5 index

1. **Definition**

index	$type =$ index
	CO $value$
	IF is_array($value$) — FO $index \in value$: $= \begin{bmatrix} this \blacktriangleright index \\ \emptyset \end{bmatrix}$
	IF is_string($value$) — SW value: direction: $= \begin{bmatrix} this \blacktriangleright left \\ \emptyset \end{bmatrix}$, $= \begin{bmatrix} this \blacktriangleright right \\ \emptyset \end{bmatrix}$; position: $= \begin{bmatrix} this \blacktriangleright start \\ \emptyset \end{bmatrix}$, $= \begin{bmatrix} this \blacktriangleright end \\ \emptyset \end{bmatrix}$; sign: $= \begin{bmatrix} this \blacktriangleright positive \\ \emptyset \end{bmatrix}$, $= \begin{bmatrix} this \blacktriangleright negative \\ \emptyset \end{bmatrix}$

4.1.6 Interval

1. **Definition**

Interval	$type =$ Interval
	$min = \emptyset$
	$max = \emptyset$
	method

2. **Method**

1 construct

CO	min	max
IF	$min \leq max$	$= \begin{bmatrix} this \blacktriangleright min \\ min \end{bmatrix}$, $= \begin{bmatrix} this \blacktriangleright max \\ max \end{bmatrix}$, $this = \emptyset$

2 extension: compute the minimal interval that contains *this* and *real*

extension	real
RE	**Interval** $\left(\begin{array}{l} \min \left(\begin{array}{l} this \blacktriangleright min \\ real \end{array} \right) \\ \max \left(\begin{array}{l} this \blacktriangleright max \\ real \end{array} \right) \end{array} \right)$

3 indicator: determine if *this* contains *real* or not

indicator	real
IF	$real \in this$ → RE 1
	RE 0

4 translation: translated *this*

translation	*real*
=	$\left[\begin{array}{l} this\_translated \\ this \end{array} \right]$
$\pm$	$\left[\begin{array}{l} this\_translated \blacktriangleright min \\ real \end{array} \right]$
$\pm$	$\left[\begin{array}{l} this\_translated \blacktriangleright max \\ real \end{array} \right]$
RE	*this_translated*

4.1.7 Interval_angle

1. **Definition**

Interval_angle	$type =$ Interval_angle
	$start = \emptyset$
	$size = \emptyset$
	method

2. **Method**

1 construct

CO	*start* *size*
	$this \blacktriangleright start = \left[\begin{array}{l} start \\ \times \left[\begin{array}{l} \min \left(\begin{array}{l} 0 \\ \text{sign}(size) \end{array} \right) \\ size \end{array} \right] \end{array} \right]$
	$\left[\begin{array}{l} this \blacktriangleright size \\ \lvert size \rvert \end{array} \right]$

2 end: end of *this*

end	
IF	$this \equiv \emptyset$ → RE NU
RE	$\left[\begin{array}{l} this \blacktriangleright start \\ this \blacktriangleright size \end{array} \right]$

3 mid: mid angle of *this*

mid	
RE	$\left[\begin{array}{l} this \blacktriangleright start \\ \frac{1}{2} \times this \blacktriangleright size \end{array} \right]$

4.1.8 Matrix

1. **Description**

   We regard a 2×2 matrix M as a 2-dimensional matrix with $M = \begin{bmatrix} M[0][0] & M[0][1] \\ M[1][0] & M[1][1] \end{bmatrix}$

2. **Definition**

Matrix ◀ Array	*array*
	method

3. **Method**

1 linear_equation_solution: compute linear equation solution

linear_equation_solution	$constants = \left[\begin{array}{c\|c} a & b \end{array}\right]$
	IF $this \blacktriangleright \lvert this \rvert \equiv 0$ | RE | NU
	RE $constants \times (this)^{-1}$

4.1.9 Poset

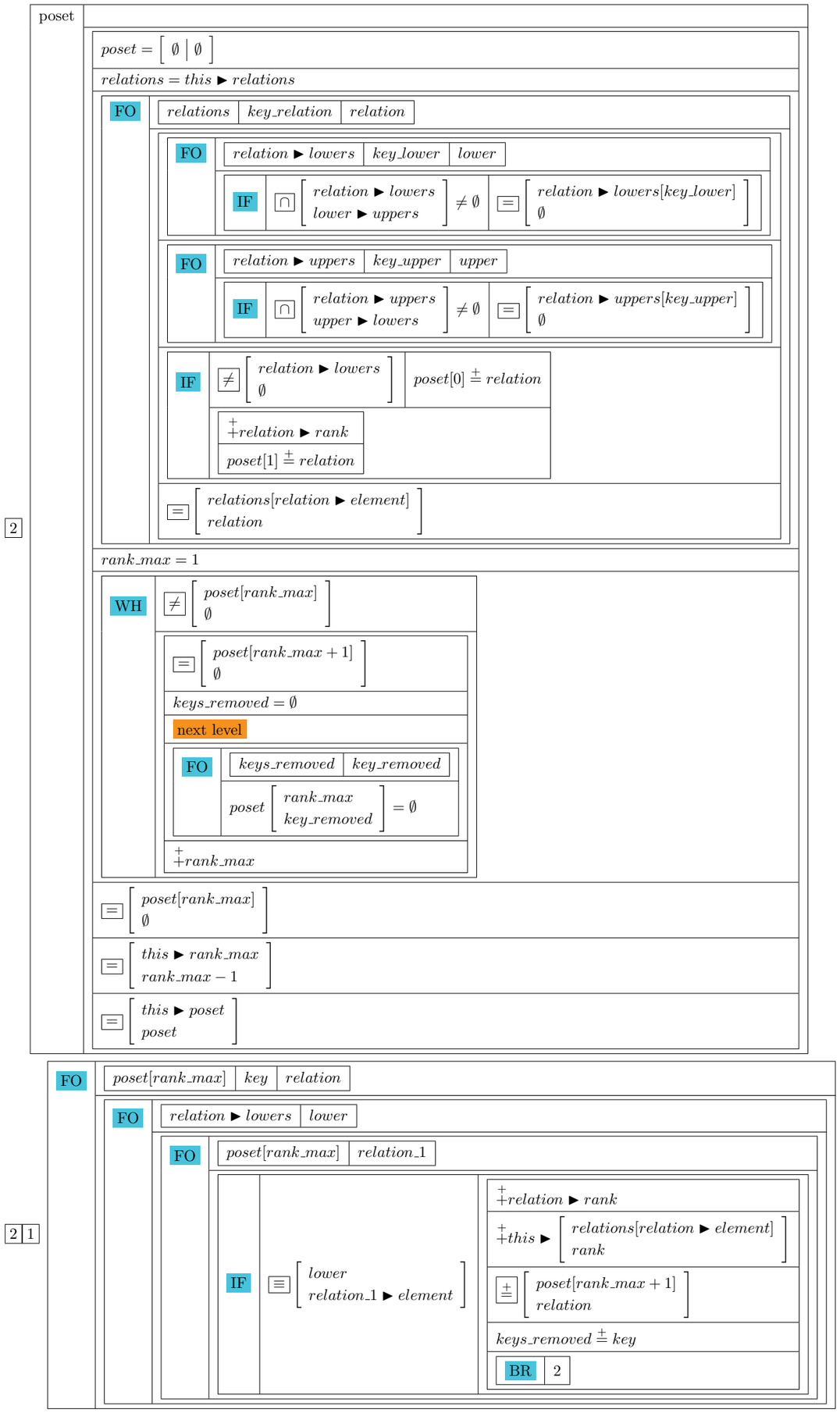
1. **Definition**

Poset	*relations*
	poset
	$rank\_max = 0$
	method

2. **Method**

1 construct

CO	*relations*
	$= \left[\begin{array}{l} this \blacktriangleright relations \\ relations \end{array}\right]$
	$this \blacktriangleright$ poset()



4.1.10 Relation

1. **Definiton**

Relation	*element*
	lowers
	uppers
	rank
	method

2. **Method**

1 construct

CO	*element*	$uppers = \emptyset$	$lowers = \emptyset$	$rank = 0$
	$= \begin{bmatrix} this \blacktriangleright element \\ element \end{bmatrix}$			
	$= \begin{bmatrix} this \blacktriangleright uppers \\ uppers \end{bmatrix}$			
	$= \begin{bmatrix} this \blacktriangleright lowers \\ lowers \end{bmatrix}$			
	$= \begin{bmatrix} this \blacktriangleright rank \\ rank \end{bmatrix}$			

4.1.11 Quadratic

1. **Definition**

Quadratic	$type = \mathsf{Quadratic}$
	a
	b
	c
	method

2. **Method**

1 construct

CO	a	b	c
	$= \begin{bmatrix} this \blacktriangleright a \\ a \end{bmatrix}$		
	$= \begin{bmatrix} this \blacktriangleright b \\ b \end{bmatrix}$		
	$= \begin{bmatrix} this \blacktriangleright c \\ c \end{bmatrix}$		

2 discriminat: compute discriminant of *this*

discriminant		
	RE	$- \begin{bmatrix} (this \blacktriangleright a)^2 \\ \times \begin{bmatrix} 4 \times this \blacktriangleright a \\ this \blacktriangleright c \end{bmatrix} \end{bmatrix}$

3 evaluation: eveluate *this* with x

evaluation	x	
	RE	$+ \begin{bmatrix} x^2 \times this \blacktriangleright a \\ x \times this \blacktriangleright b \\ this \blacktriangleright c \end{bmatrix}$

4 image: image of *this* with *domain*

image	*domain*
	$\boxed{=}\begin{bmatrix} evaluation\_min \\ this \blacktriangleright \text{evaluation}(domain \blacktriangleright min) \end{bmatrix}$
	$\boxed{=}\begin{bmatrix} evaluation\_max \\ this \blacktriangleright \text{evaluation}(domain \blacktriangleright max) \end{bmatrix}$
	$image = \textbf{Interval}()$
	$image \blacktriangleright min = \min\begin{pmatrix} evaluation\_min \\ evaluation\_max \end{pmatrix}$
	$image \blacktriangleright max = \max\begin{pmatrix} evaluation\_min \\ evaluation\_max \end{pmatrix}$
	IF $\boxed{\equiv}\begin{bmatrix} this \blacktriangleright a \\ 0 \end{bmatrix}$ RE $image$
	$x\_apex = \boxed{\div}\begin{bmatrix} -2 \times this \blacktriangleright b \\ this \blacktriangleright a \end{bmatrix}$
	IF $x\_apex \notin domain$ RE $image$
	$\boxed{=}\begin{bmatrix} y\_apex \\ this \blacktriangleright \text{evaluation}(x\_apex) \end{bmatrix}$
	$image \blacktriangleright min = \min\begin{pmatrix} image \blacktriangleright min \\ y\_apex \end{pmatrix}$
	$image \blacktriangleright max = \max\begin{pmatrix} image \blacktriangleright max \\ y\_apex \end{pmatrix}$
	RE $image$

5 preimage: preimage of *this* with *codomain*

preimage	*codomain*
	$\boxed{=}\begin{bmatrix} solutions\_min \\ this \blacktriangleright \text{solution}(codomain \blacktriangleright min) \end{bmatrix}$
	$\boxed{=}\begin{bmatrix} solutions\_max \\ this \blacktriangleright \text{solution}(codomain \blacktriangleright max) \end{bmatrix}$
	$preimage = \textbf{Interval}()$
	IF $\boxed{\wedge}\begin{bmatrix} solutions\_min \equiv \emptyset \\ solutions\_max \equiv \emptyset \end{bmatrix}$ RE $preimage$
	$solutions\_min \overset{+}{=}$ IN
	$solutions\_max \overset{+}{=} -$ IN
	IF $this \blacktriangleright a \equiv 0$ RE $preimage$
	$y\_apex = \boxed{\div}\begin{bmatrix} \boxed{+}\begin{bmatrix} -(this \blacktriangleright b)^2 \\ \boxed{\times}\begin{bmatrix} 4 \times this \blacktriangleright a \\ this \blacktriangleright c \end{bmatrix} \end{bmatrix} \\ 4 \times this \blacktriangleright a \end{bmatrix}$
	IF $y\_apex \notin codomain$ RE $preimage$
	$x\_apex = \boxed{\div}\begin{bmatrix} -2 \times this \blacktriangleright b \\ this \blacktriangleright a \end{bmatrix}$
	$preimage \blacktriangleright min = \min\begin{pmatrix} preimage \blacktriangleright min \\ x\_apex \end{pmatrix}$
	$preimage \blacktriangleright max = \min\begin{pmatrix} preimage \blacktriangleright max \\ x\_apex \end{pmatrix}$
	RE $preimage$

6 solution: solve equation $this \equiv constant = 0$

solution	*constant*
	$quadratic = \textbf{Quadratic}\left(\begin{array}{l} this \blacktriangleright a \\ this \blacktriangleright b \\ \boxed{-}\left[\begin{array}{l} this \blacktriangleright c \\ constant \end{array}\right] \end{array}\right)$
	$\boxed{=}\left[\begin{array}{l} d \\ quadratic \blacktriangleright \text{discriminant}() \end{array}\right]$
	$solutions = \emptyset$
	IF $d < 0$ → RE *solutions*
	$\boxed{\neq}\left[\begin{array}{l} quadratic \blacktriangleright a \\ 0 \end{array}\right]$ → $solutions \overset{\pm}{=} \boxed{\div}\left[\begin{array}{l} -\sqrt{d} - quadratic \blacktriangleright b \\ 2 \times quadratic \blacktriangleright a \end{array}\right]$; $solutions \overset{\pm}{=} \boxed{\div}\left[\begin{array}{l} \sqrt{d} - quadratic \blacktriangleright b \\ 2 \times quadratic \blacktriangleright a \end{array}\right]$; RE *solutions*
	$\boxed{\neq}\left[\begin{array}{l} quadratic \blacktriangleright b \\ 0 \end{array}\right]$ → $solutions \overset{\pm}{=} \boxed{\div}\left[\begin{array}{l} -quadratic \blacktriangleright c \\ quadratic \blacktriangleright b \end{array}\right]$; RE *solutions*
	RE *solutions*

4.1.12 Union_interval_angle

1. **Definition**

Union_interval_angle ◄ Array	
	method

2. **Method**

1 construct

CO	*intervals_angle*
	$\boxed{=}\left[\begin{array}{l} intervals\_angle\_unioned \\ \emptyset \end{array}\right]$
	next level
	parent ▶ CO(*intervals_angle_unioned*)

1 1

FO $0 \leq i < |intervals\_angle|$

IF $\equiv \begin{bmatrix} intervals\_angle[i] \\ \emptyset \end{bmatrix}$ CT

IF $|intervals\_angle[i]| \equiv 2\pi$

$= \begin{bmatrix} intervals\_angle\_unioned \\ [intervals\_angle[i]] \end{bmatrix}$

BR

$= \begin{bmatrix} interval\_angle\_unioned \\ intervals\_angle[i] \end{bmatrix}$

$key\_unioned = 0$

FO $0 \leq i < |intervals\_angle\_unioned|$

IF $\cap \begin{bmatrix} interval\_angle\_unioned \\ intervals\_angle\_unioned[i] \end{bmatrix} \neq \emptyset$

$interval\_angle\_unioned = \cup \begin{bmatrix} interval\_angle\_unioned \\ intervals\_angle\_unioned[i] \end{bmatrix}$

$= \begin{bmatrix} intervals\_angle\_unioned[i] \\ \emptyset \end{bmatrix}$

IF $< \begin{bmatrix} intervals\_angle\_unioned[i] \blacktriangleright start \\ intervals\_angle\_unioned \blacktriangleright start \end{bmatrix}$ $\overset{+}{+} key\_unioned$

$intervals\_angle\_unioned = \text{array\_splice} \begin{pmatrix} intervals\_angle\_unioned \\ key\_unioned \\ 0 \\ [interval\_angle\_unioned] \end{pmatrix}$

2 complement: complement of *this*

complement

$= \begin{bmatrix} this\_complement \\ \textbf{Union\_interval\_angle} \end{bmatrix}$

IF $|this| \neq 0$

$interval\_angle = \textbf{Interval\_angle} \begin{pmatrix} 0 \\ 2\pi \\ \text{TR} \end{pmatrix}$

$\overset{\cup}{=} \begin{bmatrix} this\_complement \\ interval\_angle \end{bmatrix}$

RE $this\_complement$

FO $0 \leq i < |this|$

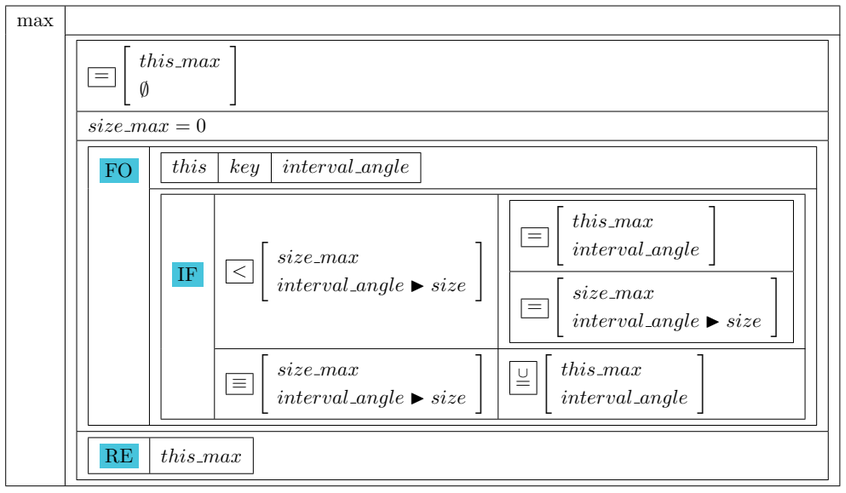
$= \begin{bmatrix} angle\_end\_i \\ this[i] \blacktriangleright \text{end}() \end{bmatrix}$

$interval\_angle = \textbf{Interval\_angle} \begin{pmatrix} angle\_end\_i \\ - \begin{bmatrix} this \blacktriangleright \begin{bmatrix} \text{interval\_angle}(i+1) \\ start \end{bmatrix} \\ angle\_end\_i \end{bmatrix} \end{pmatrix}$

$\overset{\cup}{=} \begin{bmatrix} this\_complement \\ interval\_angle \end{bmatrix}$

RE $this\_complement$

3 max: max size interval_angle in *this*


max
$= \begin{bmatrix} this\_max \\ \emptyset \end{bmatrix}$
$size\_max = 0$
FO
this
key
interval_angle
IF
$< \begin{bmatrix} size\_max \\ interval\_angle \blacktriangleright size \end{bmatrix}$
$= \begin{bmatrix} this\_max \\ interval\_angle \end{bmatrix}$
$= \begin{bmatrix} size\_max \\ interval\_angle \blacktriangleright size \end{bmatrix}$
$\equiv \begin{bmatrix} size\_max \\ interval\_angle \blacktriangleright size \end{bmatrix}$
$\cup= \begin{bmatrix} this\_max \\ interval\_angle \end{bmatrix}$
RE
this_max

1 Figure

1.1 Angle2D

1. **Definition**

Angle2D
type = Angle2D
center
start
end
height
right
key
key_object
key_label
method

2. **Method**

1 construct

CO | *center* | *start* | *end* | *height* | *right* |

= [*this* ▶ *center* ; *center*]

= [*this* ▶ *start* ; *start*]

= [*this* ▶ *end* ; *end*]

= [*this* ▶ *right* ; right]

SW | *this* ▶ *right*

- arc: = [*this* ▶ *height* ; *height*]
- right: = [*this* ▶ *height* ; $\frac{1}{\sqrt{2}} \times$ *height*]

2 angle: center angle of *this*

angle

angle_start = *this* ▶ [*center* ; vector_angle(*this* ▶ *start*)]

angle_end = *this* ▶ [*center* ; vector_angle(*this* ▶ *end*)]

RE | − [*angle_end* ; *angle_start*]

3 height_contact: compute height when an object contacts

height_contact | *object* | *type* = min

SW | *object* ▶ *type*

▽ [Label2D / Rectangle2D]

Rectangle2D = *object*

heights = ∅

FE | *Rectangle2D* ▶ *vertices* | *vertex*

heights ± [−] [*this* ▶ *center* / *vertex*]

SW | *type*

min | RE | min(*heights*)

max | RE | max(*heights*)

RE | max(*distances*)

4 interval_angle: interval_angle formed by two edges of *this*

interval_angle

angle_start = *this* ▶ [*center* / vector_angle(*this* ▶ *start*)]

RE | **Interval_angle** (*angle_start* / *this* ▶ angle)

5 rotation: rotated *this* arround *center* with *angle*

rotation | *center* | *angle*

this_rotated = *this*

this_rotated ▶ *start* = *this* ▶ [*start* / rotation (*center* / *angle*)]

this_rotated ▶ *end* = *this* ▶ [*end* / rotation (*center* / *angle*)]

RE | *this_rotated*

6 translation: translate *this* whit *vector*

translation | *vector*

this_translated = *this*

this_translated ▶ *center* = + [*this* ▶ *center* / *vector*]

this_translated ▶ *start* = + [*this* ▶ *start* / *vector*]

this_translated ▶ *end* = + [*this* ▶ *end* / *vector*]

RE | *this_translated*

1.2 Arc2D

1. **Definition**

Arc2D

type = Arc2D

center

start

angle

measure = ∅

key

key_object

key_label

method

2. **Method**

1 construct

CO | *center* | *start* | *angle* | *measure*

- $\left[\begin{array}{l} this \blacktriangleright center \\ center \end{array}\right]$
- $\left[\begin{array}{l} this \blacktriangleright start \\ start \end{array}\right]$
- $\left[\begin{array}{l} this \blacktriangleright angle \\ angle \end{array}\right]$
- $\left[\begin{array}{l} this \blacktriangleright measure \\ measure \end{array}\right]$

2 center: center of *this*

center

RE $this \blacktriangleright \left[\begin{array}{l} start \\ \text{rotation}\left(\begin{array}{l} this \blacktriangleright center \\ \frac{1}{2} \times this \blacktriangleright angle \end{array}\right) \end{array}\right]$

3 end: end of *this*

end

RE $this \blacktriangleright \left[\begin{array}{l} start \\ \text{rotation}\left(\begin{array}{l} this \blacktriangleright center \\ this \blacktriangleright angle \end{array}\right) \end{array}\right]$

4 interval_angle: interval_angle formed by start angle and end angle of *this*

interval_angle

RE **Interval_angle** $\left(\begin{array}{l} this \blacktriangleright \left[\begin{array}{l} center \\ \text{vector\_angle}(this \blacktriangleright start) \end{array}\right] \\ this \blacktriangleright angle \end{array}\right)$

5

is_tangent | *object*

SW | *object* ▶ *type*

Segment2D

Segment2D = *object*

$\boxed{=}\begin{bmatrix} raduis\_this \\ this \blacktriangleright \text{radius} \end{bmatrix}$

$\boxed{=}\begin{bmatrix} angle\_Segment2D \\ Segment2D \blacktriangleright \text{vector\_angle} \end{bmatrix}$

$angle\_Segment2D\_start = this \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Segment2D \blacktriangleright start) \end{bmatrix}$

$angle\_Segment2D\_end = this \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Segment2D \blacktriangleright end) \end{bmatrix}$

$sign\_Segment2D = \text{sign}\left(\begin{matrix} \pi - \text{polar}\left(\boxed{-} \begin{bmatrix} angle\_Segment2D\_end \\ angle\_segment2D\_start \end{bmatrix} \right) \\ 1 \end{matrix} \right)$

$angle\_perpendicular = \boxed{\times}\begin{bmatrix} sign\_Segment2D \\ angle\_Segment2D \end{bmatrix} - \frac{\pi}{2}$

$\boxed{=}\begin{bmatrix} interval\_angle\_this \\ this \blacktriangleright \text{interval\_angle} \end{bmatrix}$

IF | $\notin \begin{bmatrix} angle\_perpendicular \\ interval\_angle\_this \end{bmatrix}$ | RE | FA

$angle\_start = \min\left(\begin{matrix} \boxed{\times}\begin{bmatrix} -sign\_Segment2D \\ angle\_segment2D\_start \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} sign\_Segment2D \\ angle\_Segment2D\_start \end{bmatrix} \end{matrix} \right)$

$angle\_end = \max\left(\begin{matrix} \boxed{\times}\begin{bmatrix} sign\_Segment2D \\ angle\_segment2D\_start \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} -sign\_Segment2D \\ angle\_Segment2D\_start \end{bmatrix} \end{matrix} \right)$

$interval\_angle\_Segment2D = \textbf{Interval\_angle}\left(\begin{matrix} angle\_start \\ \boxed{-}\begin{bmatrix} angle\_end \\ angle\_start \end{bmatrix} \end{matrix} \right)$

IF | $\notin \begin{bmatrix} angle\_perpendicular \\ interval\_angle\_Segment2D \end{bmatrix}$ | RE | FA

$angle\_start = \boxed{-}\begin{bmatrix} angle\_perpendicular \\ interval\_angle\_Segment2D \blacktriangleright start \end{bmatrix}$

$angle\_end = \boxed{-}\begin{bmatrix} interval\_angle\_Segment2D \blacktriangleright end \\ angle\_perendicular \end{bmatrix}$

$distance = \boxed{\div}\begin{bmatrix} |Segment2D| \\ \boxed{+}\begin{bmatrix} \tan(angle\_start) \\ \tan(angle\_end) \end{bmatrix} \end{bmatrix}$

RE | $distance \equiv radius\_this$

6

radius

RE | $\boxed{-}\begin{bmatrix} this \blacktriangleright start \\ this \blacktriangleright center \end{bmatrix}$

7

rotation | *center* | *angle*

this_rotated = *this*

$this\_rotated \blacktriangleright center = this \blacktriangleright \begin{bmatrix} center \\ \text{rotation}\left(\begin{matrix} center \\ angle \end{matrix} \right) \end{bmatrix}$

$this\_rotated \blacktriangleright start = this \blacktriangleright \begin{bmatrix} start \\ \text{rotation}\left(\begin{matrix} center \\ angle \end{matrix} \right) \end{bmatrix}$

RE | *this_rotated*

8

translation	*vector*
	this_translated = *this*
	$\overset{+}{=}$ [*this_rotated* ▶ *center* ; *vector*]
	$\overset{+}{=}$ [*this_rotated* ▶ *start* ; *vector*]
	RE: *this_translated*

1.3 Curve2D

1. **Definition**

Curve2D	*type* = Curve2D
	equation
	bounds
	key
	key_object
	key_label
	method

2. **Method**

1

CO	*equation* | *bounds*
	= [*this* ▶ *equation* ; javascript_to_php(*equation*)]
	= [*this* ▶ *bounds* ; *bounds*]

2

centroid	
	= [*region* ; *this* ▶ region]
	$x = 0$
	$y = 0$
	FE: *region* | *rectalgle* → $x \overset{+}{=} rectangle$ ▶ [*center* ; *x*] ; $y \overset{+}{=} rectangle$ ▶ [*center* ; *y*]
	$x \overset{+}{=} \lvert region \rvert$
	$y \overset{+}{=} \lvert region \rvert$
	RE: **xy** $\begin{pmatrix} x \\ y \end{pmatrix}$

region

$unit = 0.1$

$size = \mathbf{xy}\begin{pmatrix} unit \\ unit \end{pmatrix}$

$x\_size = \left\lceil \left[\div \right] \left[\left| this \blacktriangleright \left[\begin{matrix} bounds \\ x \end{matrix} \right] \right| \right] \right\rceil$

$y\_size = \left\lceil \left[\div \right] \left[\left| this \blacktriangleright \left[\begin{matrix} bounds \\ y \end{matrix} \right] \right| \right] \right\rceil$

$parts = \text{strok}\begin{pmatrix} this \blacktriangleright equation \\ = \end{pmatrix}$

$expression = \left[- \right] \left[\begin{matrix} parts[0] \\ parts[1] \end{matrix} \right]$

$region = \emptyset$

$centroid = \mathbf{xy}\begin{pmatrix} 0 \\ 0 \end{pmatrix}$

next level

$centroid = \left[\div \right] \left[\begin{matrix} centroid \\ |region| \end{matrix} \right]$

3

$densities = \emptyset$

$region\_sorted = \emptyset$

FO $0 \leq i < |region|$

FO $i + 1 \leq j < |region|$

$density = \left[\div \right] \left[\begin{matrix} 1 \\ \left| \left[- \right] \left[\begin{matrix} region[i] \blacktriangleright center \\ region[j] \blacktriangleright center \end{matrix} \right] \right| \end{matrix} \right]$

$densities[i][j] = density$

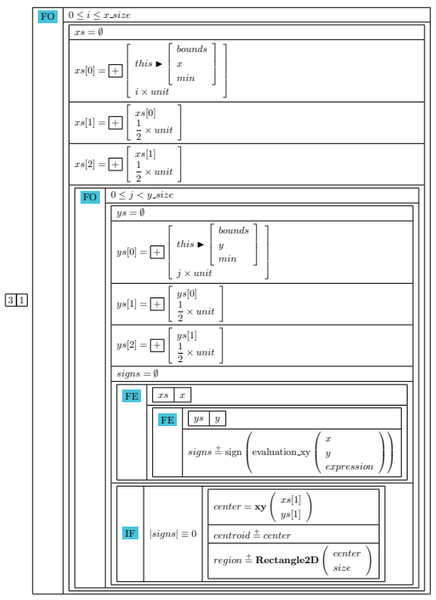
$densities[j][i] = density$

$key = \left[\times \right] \left[\begin{matrix} |densities[i]| \\ \left| \left[- \right] \left[\begin{matrix} centroid \\ region[i] \blacktriangleright center \end{matrix} \right] \right| \end{matrix} \right]$

$\left[= \right] \left[\begin{matrix} region\_sorted[key] \\ region[i] \end{matrix} \right]$

$region\_sorted \blacktriangleright \text{krsort}$

RE $region\_sorted$



1.4 Face2D

1. **Definition**

Face2D
type = Face2D
vertices
key
key_object
key_label
method

2. **Method**

centroid | *type*

SW | *type*

polygon

$\boxed{=}$ $\begin{bmatrix} centroid\_vertices \\ this \blacktriangleright \text{centroid}(\text{vertices}) \end{bmatrix}$

$\boxed{=}$ $\begin{bmatrix} vertices\_anticlockwise \\ \emptyset \end{bmatrix}$

FE | $this \blacktriangleright vertices$ | $vertex$

$\boxed{=}$ $\begin{bmatrix} key \\ centroid\_vertices \blacktriangleright \text{vector\_angle}(vertex) \end{bmatrix}$

$vertices\_anticlockwise[key] = vertex$

$vertices\_anticlockwise \blacktriangleright \text{ksort}$

$area \equiv 0$

$centroid = \mathbf{xy} \begin{pmatrix} 0 \\ 0 \end{pmatrix}$

FO | $0 \leq i < |vertices\_anticlockwise|$

$matrix = \begin{bmatrix} vertices\_anticlockwise[i] \blacktriangleright x & vertices\_anticlockwise[i] \blacktriangleright y \\ vertices\_anticlockwise[i+1] \blacktriangleright x & vertices\_anticlockwise[i+1] \blacktriangleright y \end{bmatrix}$

$\boxed{=}$ $\begin{bmatrix} area\_i \\ matrix \blacktriangleright \text{determinant} \end{bmatrix}$

$area \stackrel{+}{=} area\_i$

$centroid \stackrel{+}{=} \boxed{\times} \begin{bmatrix} area\_i \\ \boxed{+} \begin{bmatrix} vertices\_anticlockwise[i] \\ vertices\_anticlockwise[i+1] \end{bmatrix} \end{bmatrix}$

$centroid = \boxed{\div} \begin{bmatrix} centroid \\ 3 \times area \end{bmatrix}$

RE | centroid

vertices

$centroid\_vertices = \mathbf{xy} \begin{pmatrix} 0 \\ 0 \end{pmatrix}$

FE | $this \blacktriangleright vertices$ | $vertex$

$centroid\_vertices \stackrel{+}{=} vertex$

RE | $\boxed{\div} \begin{bmatrix} centroid\_vertices \\ |this \blacktriangleright vertices| \end{bmatrix}$

2

edge

$edges = \emptyset$

FE | $this \blacktriangleright vertices$ | key | vertex

$edges \stackrel{+}{=} \mathbf{Segment2D} \begin{pmatrix} this \blacktriangleright vertices[key] \\ this \blacktriangleright vertices[key+1] \end{pmatrix}$

RE | $edges$

3

rotation | $center$ | $angle$

$this\_rotated = this$

$\boxed{=}$ $\begin{bmatrix} this\_rotated \blacktriangleright vertices \\ \emptyset \end{bmatrix}$

FE | $this \blacktriangleright vertices$ | $vertex$

$this\_rotated \stackrel{+}{=} vertex \blacktriangleright \text{rotation} \begin{pmatrix} center \\ angle \end{pmatrix}$

RE | $this\_rotated$

4

translation | *vector*

this_translated = *this*

= [*this_translated* ▶ *vertices* ; ∅]

5 FE [*this* ▶ *vertices* | *vertex*]

this_translated ▶ *vertices* ≔ + [*vertex* ; *vector*]

RE [*this_translated*]

1.5 Label2D

1. **Definition**

Label2D

- *type* = Label2D
- *type_labeled*
- *center*
- *size*
- *rotation*
- *target*
- *key*
- *key_object*
- *key_labeled*
- *key_labeled_object*

method

2. **Method**

center | *inputs*

object = *inputs*[0]

SW [*object* ▶ *type* | case | excution]

1 1 Angle2D

Angle2D = *object*

center_arc = *inputs*[1]

IF [*interval_angle* ≡ ∅ | = [*interval_angle* ; *Angle2D* ▶ interval_angle]]

distance_min = 0.25

= [*radius_arc* ; *Angle2D* ▶ *height*]

RE [*this* ▶ center_arc (*center_arc* ; *interval_angle* ; *radius_arc* ; *distance_min*)]

1 2 Arc2D

Arc2D = *object*

= [*center_arc* ; *Arc2D* ▶ *center*]

= [*interval_angle_arc2D* ; *Arc2D* ▶ interval_angle]

interval_angle = **Interval_angle** (− [*interval_angle_Arc2D* ▶ mid ; $\frac{\pi}{2}$] ; π)

= [*radius_arc* ; *Arc2D* ▶ radius]

distance_min = 0.25

RE [*this* ▶ center_arc (*center_arc* ; *interval_angle* ; *radius_arc* ; *distance_min*)]

1 3 Curve2D

Curve2D = *object*

centers = ∅

next level

centers_sorted = ∅

next level

RE *centers_sorted*

1 3 1

FE *Curve2D* ▶ coordinates | *coordinates*

FO $0 \leq i \leq 1$

FO $0 \leq j \leq 1$

this_moved = *this*

$$this\_moved \blacktriangleright center = \boxed{+} \begin{bmatrix} coordinates \\ \boxed{\times} \begin{bmatrix} \left[-\frac{1}{2} + i \;\middle|\; -\frac{1}{2} + j \right] \\ this\_moved \blacktriangleright size \end{bmatrix} \end{bmatrix}$$

IF $\boxed{\cap} \begin{bmatrix} this \\ this\_moved \end{bmatrix} \equiv \emptyset$ | $\boxed{\pm} \begin{bmatrix} centers \\ this\_moved \blacktriangleright center \end{bmatrix}$

1 3 2

FO $0 \leq i < |centers|$

FO $j = i - 1$ | $j \geq 0$ | $j\bar{-}$

IF $\boxed{\vee} \begin{bmatrix} \boxed{>} \begin{bmatrix} center \blacktriangleright x \\ centers[j] \blacktriangleright x \end{bmatrix} \\ \boxed{\wedge} \begin{bmatrix} \boxed{\equiv} \begin{bmatrix} centers \blacktriangleright x \\ centers[j] \blacktriangleright x \end{bmatrix} \\ \begin{bmatrix} center \blacktriangleright y \\ centers[j] \blacktriangleright y \end{bmatrix} \end{bmatrix} \end{bmatrix}$

key_center = *j*

$\boxed{=} \begin{bmatrix} centers\_sorted[j+1] \\ centers\_sorted[j] \end{bmatrix}$

$\boxed{=} \begin{bmatrix} centers\_sorted[key\_center] \\ center \end{bmatrix}$

1 4 Face2D

Fac2D = *object*

RE *Face2D* ▶ centroid(vertices)

1 5 Measure2D | next level

Measure2D = *object*

sign_height = *inputs*[1]

1 5 1

$\boxed{=} \begin{bmatrix} Segment2D \\ Measure2D \blacktriangleright segment \end{bmatrix}$

$\boxed{=} \begin{bmatrix} center\_object \\ Segment2D \blacktriangleright center \end{bmatrix}$

distance_min = 0.25

angle_Segment2D = $\boxed{-} \begin{bmatrix} Segment2D \blacktriangleright vector\_angle \\ this \blacktriangleright rotation \end{bmatrix}$

IF *sign_height* ≡ 0 | *sign_height* = $\boxed{-} \begin{bmatrix} \lceil 1 + \text{sign}(Measure2D \blacktriangleright height) \rceil \\ 1 \end{bmatrix}$

angle_rotation = $\boxed{+} \begin{bmatrix} angle\_Segment2D \\ \pi \times sign\_height \end{bmatrix}$

1 5 2

angle_label = $\boxed{+} \begin{bmatrix} this \blacktriangleright rotation \\ angle\_rotation \end{bmatrix}$

angles_label = **index**(direction)

$angles\_label \blacktriangleright right = \text{mod}\left(\frac{angle\_lagel}{\frac{\pi}{2}} \right)$

$\boxed{=} \begin{bmatrix} angles\_label \blacktriangleright left \\ \frac{\pi}{2} - angles\_label \blacktriangleright right \end{bmatrix}$

	$parity = \mathrm{mod}\left(\begin{matrix} \left\lfloor \frac{\pi}{2} \times angle\_label \right\rfloor \\ 2 \end{matrix} \right)$
	$lengths\_label = \mathbf{index}(\text{direction})$
	$lengths\_label \blacktriangleright left = \boxed{\times} \left[\begin{matrix} \left[\, parity \mid 1 - parity \, \right] \\ this \blacktriangleright size \end{matrix} \right]$
	$lengths\_label \blacktriangleright right = \boxed{\times} \left[\begin{matrix} \left[\, 1 - parity \mid parity \, \right] \\ this \blacktriangleright size \end{matrix} \right]$
	$widths\_label = \mathbf{index}(\text{direction})$
	$widths\_label \blacktriangleright left = \boxed{\times} \left[\begin{matrix} lengths\_label \blacktriangleright left \\ \cos(angles\_label \blacktriangleright left) \end{matrix} \right]$
	$widths\_label \blacktriangleright right = \boxed{\times} \left[\begin{matrix} lengths\_label \blacktriangleright right \\ \cos(angles\_label \blacktriangleright right) \end{matrix} \right]$
	$heights\_label = \mathbf{index}(\text{direction})$
153	$heights\_label \blacktriangleright left = \boxed{\times} \left[\begin{matrix} lengths\_label \blacktriangleright left \\ \sin(angles\_label \blacktriangleright left) \end{matrix} \right]$
	$heights\_label \blacktriangleright right = \boxed{\times} \left[\begin{matrix} lengths\_label \blacktriangleright right \\ \sin(angles\_label \blacktriangleright right) \end{matrix} \right]$
	$angle = \min \left(\begin{matrix} angles\_label \blacktriangleright left \\ angles\_label \blacktriangleright right \end{matrix} \right)$
	$sign = \mathrm{sign} \left(\begin{matrix} \boxed{-} \left[\begin{matrix} angles\_label \blacktriangleright left \\ angles\_label \blacktriangleright right \end{matrix} \right] \\ 1 \end{matrix} \right)$
	$length = \boxed{+} \left[\begin{matrix} \boxed{\times} \left[\begin{matrix} \max \left(\begin{matrix} sign \\ 0 \end{matrix} \right) \\ lengths\_label \blacktriangleright left \end{matrix} \right] \\ \boxed{\times} \left[\begin{matrix} \min \left(\begin{matrix} sign \\ 0 \end{matrix} \right) \\ lengths\_label \blacktriangleright right \end{matrix} \right] \end{matrix} \right]$

	$x\_label\_min = \boxed{\div} \left[\begin{matrix} \frac{1}{2} \times length \\ \cos\left(angle + \frac{\pi}{4}\right) \end{matrix} \right]$
	$a = \boxed{+} \left[\begin{matrix} \frac{1}{2} \times \lvert Segment2D \rvert \\ distance\_min \end{matrix} \right]$
	$\boxed{=} \left[\begin{matrix} b \\ \frac{1}{2} \times Measure2D \blacktriangleright height \end{matrix} \right]$
	$\boxed{=} \left[\begin{matrix} y\_label\_min \\ -\frac{b}{a^2} \times (x\_label\_min)^2 + b \end{matrix} \right]$
	$length\_diagonal\_half = \frac{1}{2} \times \sqrt{\boxed{-} \left[\begin{matrix} (lengths\_label \blacktriangleright left)^2 \\ (lengths\_label \blacktriangleright right)^2 \end{matrix} \right]}$
154	$angle\_diagonal = \mathrm{vector\_angle} \left(\begin{matrix} lengths\_label \blacktriangleright right \\ lengths\_label \blacktriangleright left \end{matrix} \right)$
	$label\_min = \mathbf{xy} \left(\begin{matrix} x\_label\_min \\ y\_label\_min \end{matrix} \right)$
	$translation = \mathbf{xy} \left(\begin{matrix} length\_diagonal\_half \\ \boxed{+} \left[\begin{matrix} angles\_label \blacktriangleright right \\ angle\_diagonal \end{matrix} \right] \\ \text{polar} \end{matrix} \right)$
	$translation\_center = \boxed{+} \left[\begin{matrix} label\_min \\ translation \end{matrix} \right] \blacktriangleright \mathrm{rotation} \left(\begin{matrix} center\_rotation \\ -angle\_rotation \end{matrix} \right)$
	RE $\boxed{+} \left[\begin{matrix} this \blacktriangleright center \\ translation\_center \\ center\_object \end{matrix} \right]$

1 6 MeasureArc2D

$MeasureArc2D = object$
$\boxed{=} \begin{bmatrix} Arc2D \\ MeasureArc2D \blacktriangleright \text{arc} \end{bmatrix}$
$\boxed{=} \begin{bmatrix} center\_arc \\ Arc2D \blacktriangleright center \end{bmatrix}$
$\boxed{=} \begin{bmatrix} radius\_arc \\ Arc2D \blacktriangleright \text{radius} \end{bmatrix}$
$distance\_min = 0.25$
$angle\_mid = Arc2D \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(center\_arc) \end{bmatrix}$
$interval\_angle = \textbf{Interval\_angle} \begin{pmatrix} angle\_mid - \frac{\pi}{2} \\ \pi \end{pmatrix}$
RE $this \blacktriangleright \text{center\_arc} \begin{pmatrix} center\_arc \\ interval\_angle \\ radius\_arc \\ distance\_min \end{pmatrix}$

1 7 Point2D

$Point2D = object$		
$center\_arc = Poin2D$		
$interval\_angle = inputs[1]$		
$radius\_arc = 0$		
$distance\_min = inputs[2]$		
IF	$distance\_min \equiv \emptyset$	$distance\_min = 0.35$
RE	$this \blacktriangleright \text{center\_arc} \begin{pmatrix} center\_arc \\ interval\_angle \\ radius\_rac \\ distance\_min \end{pmatrix}$	

1 8 Segment2D

$Segment2D = object$
$distance\_min = 0.35$
$center = \mathbf{xy}\begin{pmatrix} 0 \\ 0 \end{pmatrix}$
$Segment2D\_rotated = Segment2D \blacktriangleright \text{rotation}\begin{pmatrix} center \\ this \blacktriangleright rotation \end{pmatrix}$
$angle\_this\_rotated = \text{mod}\begin{pmatrix} Segment2D\_rotated \blacktriangleright \text{vetor\_angle} \\ \pi \end{pmatrix}$
$\boxed{=}\begin{bmatrix} center\_Segment2D\_rotated \\ Segment2D\_rotated \blacktriangleright \text{center} \end{bmatrix}$
$vector\_Segment2D\_rotated\_half = \mathbf{xy}\begin{pmatrix} \frac{1}{2} \times \lvert Segment2D\_rotated \rvert \\ angle\_Segment2D\_rotated \\ \text{polar} \end{pmatrix}$
$start\_Segment2D\_rotated = \boxed{+}\begin{bmatrix} center\_Segment2D\_rotated \\ vector\_Segment2D\_rotated\_half \end{bmatrix}$
$angles = \mathbf{index}(\text{polar})$
$angles \blacktriangleright right = \text{mod}\begin{pmatrix} angle\_this\_rotated \\ \frac{\pi}{2} \end{pmatrix}$
$\boxed{=}\begin{bmatrix} angles \blacktriangleright left \\ \frac{\pi}{2} - angles \blacktriangleright right \end{bmatrix}$
$lengths = \mathbf{index}(\text{direction})$
$lengths \blacktriangleright left = \boxed{\times}\begin{bmatrix} \begin{bmatrix} \cos(angles \blacktriangleright right) \mid \cos(angles \blacktriangleright left) \end{bmatrix} \\ this \blacktriangleright size \end{bmatrix}$
$lengths \blacktriangleright right = \boxed{\times}\begin{bmatrix} \begin{bmatrix} \cos(angles \blacktriangleright left) \mid \cos(angles \blacktriangleright right) \end{bmatrix} \\ this \blacktriangleright size \end{bmatrix}$
$radius = \sqrt{\begin{bmatrix} \boxed{-}\begin{bmatrix} \left(\boxed{+}\begin{bmatrix} \frac{1}{2} \times lengths \blacktriangleright left \\ distance\_min \end{bmatrix}\right)^2 \\ \left(\boxed{+}\begin{bmatrix} \frac{1}{2} \times lengths \blacktriangleright right \\ distance\_min \end{bmatrix}\right)^2 \end{bmatrix} \end{bmatrix}}$
$sign\_angle = \text{sign}\begin{pmatrix} \cos(angle\_this) \\ 1 \end{pmatrix}$
$angle\_diagonal = \text{vector\_angle}\begin{pmatrix} \boxed{+}\begin{bmatrix} \frac{1}{2} \times lengths \blacktriangleright left \\ distance\_min \end{bmatrix} \\ \boxed{+}\begin{bmatrix} \frac{1}{2} \times lengths \blacktriangleright right \\ distance\_min \end{bmatrix} \end{pmatrix}$
$angle = sign\_angle \times \left(\boxed{+}\begin{bmatrix} -angle\_Segment2D\_rotated \\ -angle\_diagonal \end{bmatrix}\right)$
$vector\_addition = \mathbf{xy}\begin{pmatrix} radius \\ angle \\ \text{polar} \end{pmatrix}$
RE $\boxed{+}\begin{bmatrix} start\_Segment2D\_rotated \\ vector\_addition \end{bmatrix}$

2 center_arc

center_arc	interval_angle	radius_arc	distance_min
next level			
next level			
next level			
next level			
next level			
RE $\boxed{+}\begin{bmatrix} label\_min \\ translation\_center \\ center\_arc \end{bmatrix}$			

$$\mathit{distance\_min\_center} = \boxed{+}\begin{bmatrix} \mathit{distance\_min} \\ \mathit{radius\_arc} \end{bmatrix}$$

$$\boxed{=}\begin{bmatrix} \mathit{angle\_rotation} \\ \frac{\pi}{2} - \mathit{interval\_angle} \blacktriangleright \mathrm{mid} \end{bmatrix}$$

2 1

$$\mathit{angle\_arc} = \max\left(\begin{matrix} 0 \\ \mathrm{polar}\left(\begin{matrix} \boxed{+}\begin{bmatrix} \mathit{interval\_angle} \blacktriangleright \mathit{start} \\ \mathit{angle\_rotation} \end{bmatrix} \\ -\pi \end{matrix} \right) \end{matrix} \right)$$

$$\mathit{angle\_label} = \boxed{+}\begin{bmatrix} \mathit{this} \blacktriangleright \mathit{rotation} \\ \mathit{angle\_rotation} \end{bmatrix}$$

$$\mathit{angles\_label} \blacktriangleright \mathit{right} = \mathrm{mod}\left(\begin{matrix} \mathit{angle\_label} \\ \frac{\pi}{2} \end{matrix} \right)$$

$$\boxed{=}\begin{bmatrix} \mathit{angles\_label} \blacktriangleright \mathit{left} \\ \frac{\pi}{2} - \mathit{angles\_label} \blacktriangleright \mathit{right} \end{bmatrix}$$

$$\mathit{parity\_label} = \mathrm{mod}\left(\begin{matrix} \left\lfloor \frac{2}{\pi} \times \mathit{angle\_label} \right\rfloor \\ 2 \end{matrix} \right)$$

$$\mathit{lengths\_label} = \mathbf{index}(\mathsf{direction})$$

$$\mathit{lengths\_label} \blacktriangleright \mathit{left} = \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} 1 - \mathit{parity\_label} \\ \mathit{this} \blacktriangleright \begin{bmatrix} \mathit{size} \\ x \end{bmatrix} \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} \mathit{parity\_label} \\ \mathit{this} \blacktriangleright \begin{bmatrix} \mathit{size} \\ y \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

$$\mathit{lengths\_label} \blacktriangleright \mathit{right} = \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} \mathit{parity\_label} \\ \mathit{this} \blacktriangleright \begin{bmatrix} \mathit{size} \\ x \end{bmatrix} \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} 1 - \mathit{parity\_label} \\ \mathit{this} \blacktriangleright \begin{bmatrix} \mathit{size} \\ y \end{bmatrix} \end{bmatrix} \end{bmatrix}$$

$$\mathit{widths\_label} = \mathbf{index}(\mathsf{direction})$$

2 2

$$\mathit{widths\_label} \blacktriangleright \mathit{left} = \boxed{\times}\begin{bmatrix} \mathit{lengths\_label} \blacktriangleright \mathit{left} \\ \cos(\mathit{angles\_label} \blacktriangleright \mathit{left}) \end{bmatrix}$$

$$\mathit{widths\_label} \blacktriangleright \mathit{right} = \boxed{\times}\begin{bmatrix} \mathit{lengths\_label} \blacktriangleright \mathit{right} \\ \cos(\mathit{angles\_label} \blacktriangleright \mathit{right}) \end{bmatrix}$$

$$\mathit{heights\_label} = \mathbf{index}(\mathsf{direction})$$

$$\mathit{heights\_label} \blacktriangleright \mathit{left} = \boxed{\times}\begin{bmatrix} \mathit{lengths\_label} \blacktriangleright \mathit{left} \\ \sin(\mathit{angles\_label} \blacktriangleright \mathit{left}) \end{bmatrix}$$

$$\mathit{heights\_label} \blacktriangleright \mathit{left} = \boxed{\times}\begin{bmatrix} \mathit{lengths\_label} \blacktriangleright \mathit{right} \\ \sin(\mathit{angles\_label} \blacktriangleright \mathit{right}) \end{bmatrix}$$

$$\mathit{widths\_label\_min} = \mathbf{index}(\mathsf{direction})$$

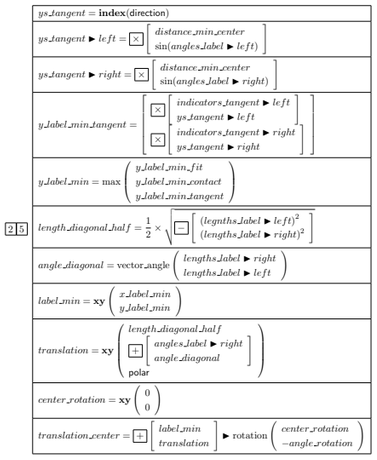
$$\mathit{angle\_label\_min} = \max\left(\begin{matrix} \mathit{angle\_arc} \\ \mathit{angles\_label} \blacktriangleright \mathit{left} \\ \mathit{angles\_label} \blacktriangleright \mathit{right} \end{matrix} \right)$$

$$\mathit{widths\_label\_min} \blacktriangleright \mathit{left} = \boxed{-}\begin{bmatrix} \mathit{widths\_label} \blacktriangleright \mathit{left} \\ \boxed{\div}\begin{bmatrix} \mathit{heights\_label} \blacktriangleright \mathit{left} \\ \sin(\mathit{angle\_label\_min}) \end{bmatrix} \end{bmatrix}$$

$$\mathit{widths\_label\_min} \blacktriangleright \mathit{right} = \boxed{-}\begin{bmatrix} \mathit{widths\_label} \blacktriangleright \mathit{right} \\ \boxed{\div}\begin{bmatrix} \mathit{heights\_label} \blacktriangleright \mathit{right} \\ \sin(\mathit{angle\_label\_min}) \end{bmatrix} \end{bmatrix}$$

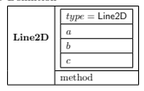
$$
\begin{array}{l}
\textit{interval\_x\_min\_contact} = \textbf{Interval}\left(\begin{bmatrix} -\textit{distance\_min\_center} \\ \cos(\textit{angle\_label} \blacktriangleright \textit{left}) \end{bmatrix}^{\times}, \begin{bmatrix} \textit{distance\_min\_center} \\ \cos(\textit{angle\_label} \blacktriangleright \textit{right}) \end{bmatrix}^{\times}\right) \\
\hline
\left[\textit{interval\_x\_min\_tangent}\right]^{=} \\
\textbf{Index}(\textsf{direction}) \\
\hline
\textit{interval\_x\_min\_tangent} \blacktriangleright \textit{left} = \textbf{Interval}\left(\left[\textit{interval\_x\_min\_contact} \blacktriangleright \textit{min}\right]^{=}, \left[\textit{interval\_x\_min\_contact} \blacktriangleright \textit{min}\right]\right) \\
\textit{interval\_x\_min\_tangent} \blacktriangleright \textit{right} = \textbf{Interval}\left(\left[\textit{interval\_x\_min} \blacktriangleright \textit{max}\right]^{+}, \left[\textit{interval\_x\_min\_contact} \blacktriangleright \textit{max}\right]\right) \\
\hline
\textit{indicators\_tangent} = \textbf{Index}(\textsf{direction}) \\
\hline
\textit{indicators\_tangent} \blacktriangleright \textit{left} = \textit{intervals\_x\_min\_tangent} \blacktriangleright \left[\begin{matrix} \textit{left} \\ \text{indicator}(x\_\textit{label\_min}) \end{matrix}\right] \\
\hline
\textit{indicators\_tangent} \blacktriangleright \textit{right} = \textit{intervals\_x\_min\_tangent} \blacktriangleright \left[\begin{matrix} \textit{right} \\ \text{indicator}(x\_\textit{label\_min}) \end{matrix}\right]
\end{array}
$$

$$
\begin{array}{l}
x\_\textit{label\_min} = \left[-\right]\left[\begin{matrix} \textit{width\_label\_min} \blacktriangleright \textit{left} \\ \textit{width\_label\_min} \blacktriangleright \textit{right} \end{matrix}\right]^{\times \frac{1}{2}} \\
\hline
y\_\textit{label\_min\_fit} = \left[+\right]\left[\begin{matrix} \left[\times\right]\left[\begin{matrix} z\_\textit{label\_min} \\ \tan(\textit{angle\_arc}) \end{matrix}\right] \\ \textit{distance\_min} \end{matrix}\right] \\
\hline
\textit{xs\_label} = \textbf{Index}(\textsf{direction}) \\
\hline
\textit{xs\_label} \blacktriangleright \textit{left} = \left[-\right]\left[\begin{matrix} x\_\textit{label\_min} \\ \textit{width\_label} \blacktriangleright \textit{left} \end{matrix}\right] \\
\hline
\textit{xs\_label} \blacktriangleright \textit{right} = \left[+\right]\left[\begin{matrix} x\_\textit{label\_min} \\ \textit{width\_label} \blacktriangleright \textit{right} \end{matrix}\right] \\
\hline
\textit{y\_label\_contact\_min} = \sqrt{\max\left(\begin{matrix} 0 \\ \left[-\right]\left[\begin{matrix} (\textit{distance\_min\_center})^2 \\ (x\_\textit{label\_min})^2 \end{matrix}\right] \end{matrix}\right)} \\
\hline
\textit{ys\_label\_contact} = \textbf{Index}(\textsf{direction}) \\
\hline
\textit{ys\_label\_contact} \blacktriangleright \textit{left} = \sqrt{\max\left(\begin{matrix} 0 \\ \left[-\right]\left[\begin{matrix} (\textit{distance\_min\_center})^2 \\ (x\_\textit{label} \blacktriangleright \textit{left})^2 \end{matrix}\right] \end{matrix}\right)} \\
\hline
\textit{ys\_label\_contact} \blacktriangleright \textit{left} = \sqrt{\max\left(\begin{matrix} 0 \\ \left[-\right]\left[\begin{matrix} (\textit{distance\_min\_center})^2 \\ (x\_\textit{label} \blacktriangleright \textit{right})^2 \end{matrix}\right] \end{matrix}\right)} \\
\hline
\textit{y\_label\_min\_contact} = \max\left(\begin{matrix} y\_\textit{label\_contact\_min} \\ \left[-\right]\left[\begin{matrix} \textit{ys\_label\_contact} \blacktriangleright \textit{left} \\ \textit{heights\_label} \blacktriangleright \textit{left} \end{matrix}\right] \\ \left[-\right]\left[\begin{matrix} \textit{ys\_label\_contact} \blacktriangleright \textit{right} \\ \textit{heights\_label} \blacktriangleright \textit{right} \end{matrix}\right] \end{matrix}\right)
\end{array}
$$

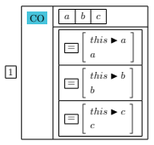


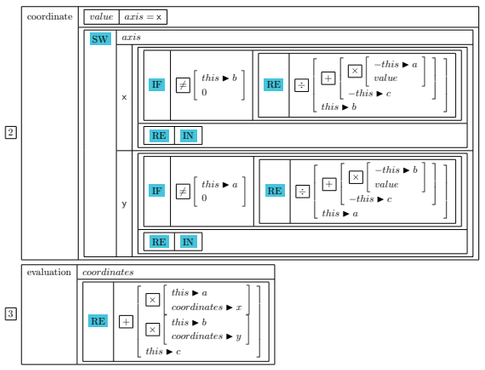
1.6 Line2D

1. **Definition**



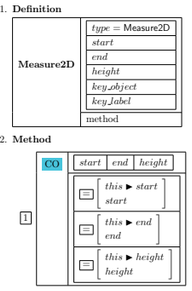
2. **Method**





1.7 Measure2D

1. **Definition**



2. **Method**

2

angles_height

$angles = \mathbf{index}(\text{position})$

$\boxed{=}\begin{bmatrix} angles \blacktriangleright start \\ \mathbf{index}(\text{sign}) \end{bmatrix}$

$\boxed{=}\begin{bmatrix} angles \blacktriangleright end \\ \mathbf{index}(\text{sign}) \end{bmatrix}$

$angle = \text{vector\_angle}\begin{pmatrix} \frac{1}{2} \times |this| \\ this \blacktriangleright height \end{pmatrix}$

$angles \blacktriangleright \begin{bmatrix} start \\ positive \end{bmatrix} = \max \begin{bmatrix} 0 \\ angle \end{bmatrix}$

$angles \blacktriangleright \begin{bmatrix} start \\ negative \end{bmatrix} = \min \begin{pmatrix} 0 \\ angle \end{pmatrix}$

$angles \blacktriangleright \begin{bmatrix} end \\ positve \end{bmatrix} = angles \blacktriangleright \begin{bmatrix} start \\ positive \end{bmatrix}$

$angles \blacktriangleright \begin{bmatrix} end \\ negative \end{bmatrix} = angles \blacktriangleright \begin{bmatrix} start \\ negative \end{bmatrix}$

RE | $angles$

3

Bezier

RE | $\mathbf{Bezier}\begin{pmatrix} this \blacktriangleright start \\ this \blacktriangleright \text{center} \\ this \blacktriangleright end \end{pmatrix}$

4

center

$angle = this \blacktriangleright \begin{bmatrix} start \\ \text{vector\_angle}(this \blacktriangleright end) \end{bmatrix}$

$angle\_height = \boxed{+}\begin{bmatrix} angle \\ \frac{\pi}{2} \times \text{sign}(this \blacktriangleright height) \end{bmatrix}$

$translation = \mathbf{xy}\begin{pmatrix} this \blacktriangleright height \\ angle\_height \\ \text{polar} \end{pmatrix}$

RE | $\boxed{+}\begin{bmatrix} \boxed{+}\begin{bmatrix} this \blacktriangleright start \\ this \blacktriangleright end \end{bmatrix} \times \frac{1}{2} \\ translation \end{bmatrix}$

5

height | $angle$

$angle = \min \begin{pmatrix} angle \\ \frac{\pi}{2} \end{pmatrix}$

RE | $\boxed{\times}\begin{bmatrix} \frac{1}{2} \times \left|\boxed{-}\begin{bmatrix} this \blacktriangleright start \\ this \blacktriangleright end \end{bmatrix}\right| \\ \tan(angle) \end{bmatrix}$

height_contact | *object* | *label_this* | *type* = max

heights = **index**(sign)

[=] [*Segment2D_this* / *this* ▶ segment]

[=] [*translation* / *Segment2D_this* ▶ center]

center_rotation = **xy** (0 / 0)

[=] [*angle_rotation* / −*Segment2D_this* ▶ vector_angle]

Segment2D_this_moved = *Segment2D_this* ▶ [translation(*translation*) / rotation (*center_rotation* / *angle_rotation*)]

[=] [*interval_x_this* / *Segment2D_this_moved* ▶ interval(x)]

interval_x_label_this = **Interval** (−*label_this* ▶ [*size* / *x*] × 1/2 / *label_this* ▶ [*size* / *x*] × 1/2)

distance = 0

SW | *object* ▶ *type*

[V]	[Label2D / Rectangle2D]	next level
	Measure2D	next level
	Segment2D	next level
	xy	next level

6

6 1 [V] [Label2D / Rectangle2D]

Rectangle2D = *object*

Rectangle2D = *Rectangle2D* ▶ [translation(*translation*) / rotation (*center* / *angle*)]

SW | *type*

min	next level
max	next level

6 1 1 min

- $\boxed{=}\begin{bmatrix} heights \blacktriangleright positive \\ 0 \end{bmatrix}$
- $\boxed{=}\begin{bmatrix} heights \blacktriangleright negative \\ 0 \end{bmatrix}$
- $Rectangle2D = Rectangle2D \blacktriangleright \begin{bmatrix} \text{translation}(translation) \\ \text{rotation}\begin{pmatrix} center \\ -angle \end{pmatrix} \end{bmatrix}$
- **IF** $\boxed{\leq}\begin{bmatrix} |Sement2D\_this| \\ \left| Rectangle2D \blacktriangleright \begin{bmatrix} center \\ x \end{bmatrix} \right| \end{bmatrix}$ — **RE** $heights$
- **IF** $\boxed{\cap}\begin{bmatrix} Rectangle2D \blacktriangleright \text{interval(x)} \\ interval\_x\_label\_this \end{bmatrix} \neq \emptyset$
  - $sign\_height = \text{sign}\begin{pmatrix} Rectangle2D \blacktriangleright \begin{bmatrix} center \\ y \end{bmatrix} \\ 1 \end{pmatrix}$
  - $height\_abs = \max\begin{pmatrix} 0 \\ \boxed{+}\begin{bmatrix} \left| Rectangle2D \blacktriangleright \begin{bmatrix} center \\ y \end{bmatrix} \right| \\ \frac{1}{2} \times Rectangle2D \blacktriangleright \begin{bmatrix} size \\ y \end{bmatrix} \\ label\_this \blacktriangleright \begin{bmatrix} size \\ y \end{bmatrix} \\ -distance \end{bmatrix} \end{pmatrix}$
  - $heights\_positive = \max\begin{pmatrix} 0 \\ \boxed{\times}\begin{bmatrix} sign\_height \\ height\_abs \end{bmatrix} \end{pmatrix}$
  - $heights\_negative = \max\begin{pmatrix} 0 \\ \boxed{\times}\begin{bmatrix} -sign\_height \\ height\_abs \end{bmatrix} \end{pmatrix}$
- **FO** $Rectangle2D \blacktriangleright \text{vertices}$ | $vertex$
  - $height = \boxed{\div}\begin{bmatrix} \boxed{\times}\begin{bmatrix} vertex \blacktriangleright y \\ (2 \times vertex \blacktriangleright x)^2 \end{bmatrix} \\ \boxed{-}\begin{bmatrix} |Segment2D\_this|^2 \\ (2 \times vertex \blacktriangleright x)^2 \end{bmatrix} \end{bmatrix}$
  - $sign\_height = \text{sign}\begin{pmatrix} height \\ 1 \end{pmatrix}$
  - $heights \blacktriangleright positive = \max\begin{pmatrix} heights \blacktriangleright positive \\ \boxed{\times}\begin{bmatrix} sign\_height \\ |height| \end{bmatrix} \end{pmatrix}$
  - $heights \blacktriangleright negative = \max\begin{pmatrix} heights \blacktriangleright negative \\ \boxed{\times}\begin{bmatrix} -sign\_height \\ |height| \end{bmatrix} \end{pmatrix}$
- **RE** $heights$

6 1 2 max | next level

6 1 2 1

- $height\_Segment2D =$ **IN**
- $height\_Rectangle2D = \text{sign}\left(Rectangle2D \blacktriangleright \begin{bmatrix} center \\ y \end{bmatrix}\right)$
- $\boxed{=}\begin{bmatrix} vertices \\ Rectangle2D \blacktriangleright \text{vertices} \end{bmatrix}$

FO $0 \leq i < 4$

6 1 2 2 IF $\left[\begin{array}{l} vertices[i] \\ (interval\_x\_this)^\circ \end{array}\right]$

IF $\left[\begin{array}{l} vertices[i] \blacktriangleright x \\ interval\_x\_label\_this \end{array}\right]$ $height\_Rectangle2D = \min\left(\begin{array}{l} height\_Rectangle2D \\ \max\left(\begin{array}{l} 0 \\ \left[\begin{array}{l} |vertices[i] \blacktriangleright y| \\ \frac{1}{2} \times label\_this \blacktriangleright \left[\begin{array}{l} size \\ y \end{array}\right] \end{array}\right] \\ distance \end{array}\right) \end{array}\right)$

$height = \left|\left[\begin{array}{l} vertices[i] \blacktriangleright y \\ |interval\_x\_this|^2 \end{array}\right] \middle/ \left[\begin{array}{l} |interval\_x\_this|^2 \\ 4 \times (vertices[i] \blacktriangleright x)^2 \end{array}\right]\right|$

$height\_Segment2D = \min\left(\begin{array}{l} height\_Segment2D \\ height \end{array}\right)$

$edge = \textbf{Segment2D}\left(\begin{array}{l} vertices[i] \\ vertices[i+1] \end{array}\right)$

$\left[\begin{array}{l} line\_edge \\ edge \blacktriangleright \text{line} \end{array}\right]$

next level

6 1 2 2 1 IF $\left[\begin{array}{l} line\_edge \blacktriangleright b \\ 0 \end{array}\right]$

$A = \left[\begin{array}{l} -line\_edge \blacktriangleright a \\ line\_edge \blacktriangleright b \end{array}\right]$

$C = \left[\begin{array}{l} -line\_edge \blacktriangleright c \\ line\_edge \blacktriangleright b \end{array}\right]$

$D\_height = \left[\begin{array}{l} C^2 \\ (A \times interval\_x\_this \blacktriangleright max)^2 \end{array}\right]$

IF $D\_height \geq 0$

$sign\_C = \text{sign}\left(\begin{array}{l} C \\ 1 \end{array}\right)$

$x = \left[\begin{array}{l} A \times (interval\_x\_this \blacktriangleright max)^2 \\ \left[\begin{array}{l} sign\_C \\ \sqrt{D\_height} \end{array}\right] + C \end{array}\right]$

IF $\left[\begin{array}{l} x \\ edge \blacktriangleright \text{interval(x)} \end{array}\right]$

$height = \frac{1}{2} \times \left|\left[\begin{array}{l} sign\_C \\ \sqrt{D\_height} \end{array}\right] + C\right|$

$height\_Segment2D = \min\left(\begin{array}{l} height\_Segment2D \\ height \end{array}\right)$

6 1 2 3

$height\_abs = \min\left(\begin{array}{l} height\_Rectangle2D \\ height\_Segment2D \end{array}\right)$

$heights \blacktriangleright positive = \max\left(\begin{array}{l} 0 \\ \left[\begin{array}{l} sign\_height \\ height\_abs \end{array}\right] \end{array}\right)$

$heights \blacktriangleright negative = \max\left(\begin{array}{l} 0 \\ \left[\begin{array}{l} -sign\_height \\ height\_abs \end{array}\right] \end{array}\right)$

RE $heights$

7 Measure2D

$Measure2D = object$

SW $type$

min	next level
max	next level

7 1 min next level

$\boxed{=}\begin{bmatrix} Segment2D\_Measure2D \\ Measure2D \blacktriangleright \text{segment} \end{bmatrix}$

7 1 1

IF	$\boxed{\subseteq}\begin{bmatrix} Segment2D\_Measure2D \\ Segment2D\_this \end{bmatrix}$	$\boxed{=}\begin{bmatrix} heights \blacktriangleright positive \\ 0 \end{bmatrix}$ $\boxed{=}\begin{bmatrix} heights \blacktriangleright negative \\ 0 \end{bmatrix}$ RE $heights$

7 1 2

$distance\_start\_start = \left|\boxed{-}\begin{bmatrix} Segment2D\_this \blacktriangleright start \\ Segment2D\_Measure2D \blacktriangleright start \end{bmatrix}\right|$

$distance\_start\_end = \left|\boxed{-}\begin{bmatrix} Segment2D\_this \blacktriangleright start \\ Segment2D\_Measure2D \blacktriangleright end \end{bmatrix}\right|$

$sign\_height = \text{sign}\begin{pmatrix} \boxed{-}\begin{bmatrix} distance\_start\_end \\ distance\_start\_start \end{bmatrix} \\ 1 \end{pmatrix}$

$min = \boxed{+}\begin{bmatrix} interval\_x\_this \blacktriangleright min \\ \min\begin{pmatrix} distance\_start\_start \\ distance\_start\_end \end{pmatrix} \end{bmatrix}$

$max = \boxed{+}\begin{bmatrix} interval\_x\_this \blacktriangleright min \\ \max\begin{pmatrix} distance\_start\_start \\ distance\_start\_end \end{pmatrix} \end{bmatrix}$

$interval\_x\_Measure2D = \textbf{Interval}\begin{pmatrix} min \\ max \end{pmatrix}$

$x\_center\_Measure2D = \boxed{+}\begin{bmatrix} interval\_x\_Measure2D \blacktriangleright min \\ interval\_x\_Measure2D \blacktriangleright max \end{bmatrix} \times \frac{1}{2}$

$\boxed{=}\begin{bmatrix} height\_Measure2D \\ |Measure2D \blacktriangleright height| \end{bmatrix}$

7 1 3

$\boxed{=}\begin{bmatrix} A\_height \\ |Segment2D\_Measure2D|^2 \end{bmatrix}$

$B\_height = \times\begin{bmatrix} -height\_Measure2D \\ \boxed{+}\begin{bmatrix} |Segment2D\_Measure2D|^2 \\ |Segment2D\_this|^2 \\ -(2 \times x\_center\_Measure2D)^2 \end{bmatrix} \end{bmatrix}$

$C\_height = \boxed{\times}\begin{bmatrix} |Segment2D\_this|^2 \\ (height\_Measure2D)^2 \end{bmatrix}$

$height\_abs = \boxed{\div}\begin{bmatrix} \boxed{+}\begin{bmatrix} -B\_height \\ -\sqrt{\boxed{-}\begin{bmatrix} (B\_height)^2 \\ \boxed{\times}\begin{bmatrix} 4 \times A\_height \\ C\_height \end{bmatrix} \end{bmatrix}} \end{bmatrix} \\ 2 \times A\_height \end{bmatrix}$

$heights \blacktriangleright positive = \max\begin{pmatrix} 0 \\ \boxed{\times}\begin{bmatrix} sign\_height \\ height\_abs \end{bmatrix} \end{pmatrix}$

$heights \blacktriangleright negative = \max\begin{pmatrix} 0 \\ \boxed{\times}\begin{bmatrix} -sign\_height \\ height\_abs \end{bmatrix} \end{pmatrix}$

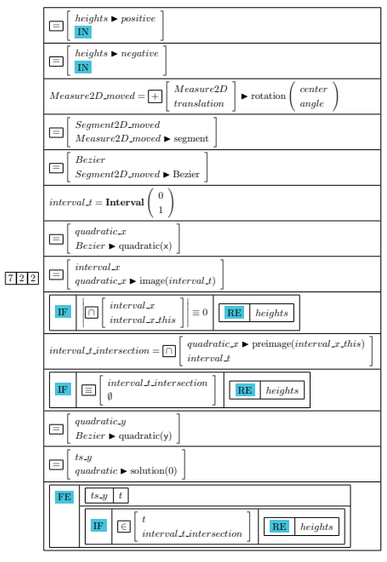
RE $heights$

7 2 max next level

$Measure2D = object$

7 2 1

IF	$\boxed{\equiv}\begin{bmatrix} Measure2D \blacktriangleright height \\ 0 \end{bmatrix}$	RE $this \blacktriangleright \text{height\_contact}\begin{pmatrix} Measure2D \blacktriangleright \text{segment} \\ label\_this \\ \text{max} \end{pmatrix}$


heights ▶ positive
IN
heights ▶ negative
IN
Measure2D_moved = + Measure2D translation ▶ rotation center angle
Segment2D_moved Measure2D_moved ▶ segment
Bezier Segment2D_moved ▶ Bezier
interval_t = Interval 0 1
quadratic_x Bezier ▶ quadratic(x)
7 2 2
interval_x quadratic_x ▶ image(interval_t)
IF ∩ interval_x interval_x_this ≡ 0
RE heights
interval_t_intersection = ∩ quadratic_x ▶ preimage(interval_x_this) interval_t
IF ≡ interval_t_intersection ∅
RE heights
quadratic_y Bezier ▶ quadratic(y)
ts_y quadratic ▶ solution(0)
FE ts_y t
IF ∈ t interval_t_intersection
RE heights

$ts\_bound = \emptyset$

$\overset{+}{=}\left[\begin{array}{l} ts\_bound \\ interval\_f\_intersection \blacktriangleright min \end{array}\right]$

$\overset{+}{=}\left[\begin{array}{l} ts\_bound \\ interval\_f\_intersection \blacktriangleright max \end{array}\right]$

$\overline{\in}\left[\begin{array}{l} ts\_x \\ quadratic\_x \blacktriangleright \text{solution}(0) \end{array}\right]$

FE ts_x t

IF $\in\left[\begin{array}{l} t \\ interval\_f\_intersection \end{array}\right]$ | $ts\_bound \overset{+}{=} t$

$t\_apex\_y = \dot{\div}\left[\begin{array}{l} -quadratic\_y \blacktriangleright b \\ 2 \times quadratic\_y \blacktriangleright a \end{array}\right]$

7 2 3

IF $\in\left[\begin{array}{l} t\_apex\_y \\ interval\_f\_intersection \end{array}\right]$ | $\overset{+}{=}\left[\begin{array}{l} ts\_bound \\ t\_apex\_y \end{array}\right]$

FE ts_bound t

$height = \dot{\div}\left[\begin{array}{l} \times\left[\begin{array}{l} (interval\_x\_this \blacktriangleright max)^2 \\ quadratic\_y \blacktriangleright \text{evaluation}(t) \end{array}\right] \\ -\left[\begin{array}{l} (interval\_x\_this \blacktriangleright max)^2 \\ (quadratic\_x \blacktriangleright \text{evaluation}(5))^2 \end{array}\right] \end{array}\right]$

$height \blacktriangleright positive = \min\left(\begin{array}{l} heights \blacktriangleright positive \\ \max\left(\begin{array}{l} 1 \\ e^{height} \end{array}\right) \end{array}\right)$

$height \blacktriangleright negative = \min\left(\begin{array}{l} heights \blacktriangleright positive \\ \max\left(\begin{array}{l} 1 \\ e^{-height} \end{array}\right) \end{array}\right)$

RE $heights$

8 Segment2D next level

$Segment2D = object$

$Segment2D\_moved = +\left[\begin{array}{l} Segment2D \\ translation \end{array}\right] \blacktriangleright \text{rotation}\left(\begin{array}{l} center \\ angle \end{array}\right)$

IF $\vee\left[\begin{array}{l} =\left[\begin{array}{l} Segment2D\_intersection \\ \emptyset \end{array}\right] \\ \subsetneq\left[\begin{array}{l} Segment2D\_intersection \blacktriangleright \text{interval(x)} \\ interval\_x\_this \end{array}\right] \end{array}\right]$

$=\left[\begin{array}{l} heights \blacktriangleright positive \\ \text{IN} \end{array}\right]$

$=\left[\begin{array}{l} heights \blacktriangleright negative \\ \text{IN} \end{array}\right]$

RE $heights$

$=\left[\begin{array}{l} interval\_y\_Segment2D \\ Segment2D\_intersection \blacktriangleright \text{interval(y)} \end{array}\right]$

8 1

$sign\_y = \text{sign}\left(\times\left[\begin{array}{l} interval\_y\_segment2D \blacktriangleright min \\ interval\_y\_Segment2D \blacktriangleright max \end{array}\right]\right)$

IF $sign\_y \leq 0$

$heights \blacktriangleright positive = \max\left(\begin{array}{l} 0 \\ -\text{sign}\left(\begin{array}{l} interval\_y\_Segment2D \blacktriangleright max \\ -1 \end{array}\right) \\ \text{IN} \end{array}\right)$

$heights \blacktriangleright negative = \max\left(\begin{array}{l} 0 \\ -\text{sign}\left(\begin{array}{l} interval\_y\_Segment2D \blacktriangleright min \\ -1 \end{array}\right) \\ \text{IN} \end{array}\right)$

RE $heights$

$$\left[\begin{array}{l} line\_Segment2D \\ Segment2D\_moved \blacktriangleright \text{line} \end{array}\right]$$

$$\left[\begin{array}{l} sign\_height \\ \text{sign}(interval\_y\_Segment2D \blacktriangleright max) \end{array}\right]$$

$$Segment2D\_intersection\_label\_this = \left[\begin{array}{l} Segment2D\_intersection \\ interval\_x\_label\_this \end{array}\right]$$

IF $\left[\begin{array}{l} \neq \left[\begin{array}{l} Segment2D\_intersection\_label\_this \\ \emptyset \end{array}\right] \\ \neq \left[\begin{array}{l} |Segment2D\_intersection\_label\_this \blacktriangleright \text{interval(y)}| \\ 0 \end{array}\right] \end{array}\right]$

$$height\_label\_this = \max\left(\begin{array}{l} 0 \\ -\left[\begin{array}{l} |Segment2D\_intersection\_label\_this \blacktriangleright \text{interval(y)}| \\ distance \end{array}\right] \end{array}\right)$$

$$height\_Segment2D\_start = \left|\left[\begin{array}{l} \times \left[\begin{array}{l} Segment2D\_intersection \blacktriangleright start \\ (interval\_x\_this \blacktriangleright max)^2 \end{array}\right] \\ -\left[\begin{array}{l} (interval\_x\_this \blacktriangleright max)^2 \\ \left(Segment2D\_intersection \blacktriangleright \left[\begin{array}{l} start \\ x \end{array}\right]\right)^2 \end{array}\right] \end{array}\right]\right|$$

$$height\_Segment2D\_end = \left|\left[\begin{array}{l} \times \left[\begin{array}{l} Segment2D\_intersection \blacktriangleright end \\ (interval\_x\_this \blacktriangleright max)^2 \end{array}\right] \\ -\left[\begin{array}{l} (interval\_x\_this \blacktriangleright max)^2 \\ \left(Segment2D\_intersection \blacktriangleright \left[\begin{array}{l} end \\ x \end{array}\right]\right)^2 \end{array}\right] \end{array}\right]\right|$$

$$\left[\begin{array}{l} height\_Segment2D\_tangent \\ \text{IN} \end{array}\right]$$

8 2

IF $\left[\begin{array}{l} line\_Segment2D \blacktriangleright b \\ 0 \end{array}\right]$

$$A = \left[\begin{array}{l} -line\_Segment2D \blacktriangleright a \\ line\_Segment2D \blacktriangleright b \end{array}\right]$$

$$C = \left[\begin{array}{l} -line\_Segment2D \blacktriangleright c \\ line\_Segment2D \blacktriangleright b \end{array}\right]$$

$$D\_height = \left[\begin{array}{l} C^2 \\ A \times (interval\_x\_this \blacktriangleright max)^2 \end{array}\right]$$

IF $D\_height \geq 0$

$$sign\_C = \text{sign}\left(\begin{array}{l} C \\ 1 \end{array}\right)$$

$$x = \left[\begin{array}{l} A \times (interval\_x\_this \blacktriangleright max)^2 \\ \times \left[\begin{array}{l} sign\_C \\ \sqrt{D\_height} \end{array}\right] + C \end{array}\right]$$

IF $\left[\begin{array}{l} \in \left[\begin{array}{l} x \\ Segment2D\_intersection \blacktriangleright \text{interval(x)} \end{array}\right] \end{array}\right]$

$$height\_Segment2D\_tangent = \frac{1}{2} \times \left|\left[\begin{array}{l} \times \left[\begin{array}{l} sign\_C \\ \sqrt{D\_height} \end{array}\right] + C \end{array}\right]\right|$$

$$height\_Segment2D = \min\left(\begin{array}{l} height\_Segment2D\_start \\ height\_Segment2D\_end \\ height\_Segment2D\_tangent \end{array}\right)$$

$$height\_abs = \min\left(\begin{array}{l} height\_label\_this \\ height\_Segment2D \end{array}\right)$$

$$heights \blacktriangleright positive = \max\left(\begin{array}{l} 0 \\ \times \left[\begin{array}{l} sign\_height \\ height\_abs \end{array}\right] \end{array}\right)$$

$$heights \blacktriangleright negative = \max\left(\begin{array}{l} 0 \\ \times \left[\begin{array}{l} -sign\_height \\ height\_abs \end{array}\right] \end{array}\right)$$

RE $heights$

9 xy

$xy = object$

$xy\_moved = [+] \begin{bmatrix} xy \\ translation \end{bmatrix} \blacktriangleright \text{rotation} \begin{pmatrix} center\_rotation \\ angle\_rotation \end{pmatrix}$

IF $[\notin] \begin{bmatrix} xy\_moved \blacktriangleright x \\ (interval\_x\_this)^\circ \end{bmatrix}$

- $[=] \begin{bmatrix} heights \blacktriangleright positive \\ \mathbb{N} \end{bmatrix}$
- $[=] \begin{bmatrix} heights \blacktriangleright negative \\ \mathbb{N} \end{bmatrix}$
- RE | $heights$

IF $[\in] \begin{bmatrix} xy \blacktriangleright x \\ interval\_x\_label\_this \end{bmatrix}$

$height = [\times] \begin{bmatrix} \text{sign}(xy\_moved \blacktriangleright y) \\ \max \left(\begin{bmatrix} 0 \\ [+] \begin{bmatrix} |xy\_moved \blacktriangleright y| \\ -\frac{1}{2} \times label\_this \blacktriangleright \begin{bmatrix} size \\ y \end{bmatrix} \\ -distance \end{bmatrix} \end{pmatrix} \end{bmatrix}$

$height = [\div] \begin{bmatrix} [\times] \begin{bmatrix} xy\_moved \blacktriangleright y \\ (interval\_x\_this \blacktriangleright max)^2 \end{bmatrix} \\ [-] \begin{bmatrix} (interval\_x\_this \blacktriangleright max)^2 \\ (xy\_moved \blacktriangleright x)^2 \end{bmatrix} \end{bmatrix}$

$sign\_height = \text{sign} \begin{pmatrix} height \\ 1 \end{pmatrix}$

$heights \blacktriangleright positive = \max \left(\begin{bmatrix} 0 \\ [\times] \begin{bmatrix} sign\_height \\ |height| \end{bmatrix} \end{pmatrix}$

$heights \blacktriangleright negative = \max \left(\begin{bmatrix} 0 \\ [\times] \begin{bmatrix} -sign\_height \\ |height| \end{bmatrix} \end{pmatrix}$

RE | $heights$

10 segment

RE **Segment2D** $\begin{pmatrix} this \blacktriangleright start \\ this \blacktriangleright end \end{pmatrix}$

1.8 MeasureArc2D

1. **Definition**

$MeasureArc2D \blacktriangleleft Arc2D$

- $type$ = MeasureArc2D
- $center$
- $start$
- $angle$
- $height$
- key_object
- key_label

method

2. **Method**

1 CO | $center$ | $start$ | $angle$ | $height$ |

- $[=] \begin{bmatrix} this \blacktriangleright center \\ center \end{bmatrix}$
- $[=] \begin{bmatrix} this \blacktriangleright start \\ start \end{bmatrix}$
- $[=] \begin{bmatrix} this \blacktriangleright angle \\ angle \end{bmatrix}$
- $[=] \begin{bmatrix} this \blacktriangleright height \\ height \end{bmatrix}$

arc

2 RE **Arc2D** (*this* ▶ *center* ; *this* ▶ *start* ; *this* ▶ *angle*)

center

3 *radius* = + [| − [*this* ▶ *center* ; *this* ▶ *start*] | ; *height*]

angle = + [*this* ▶ [*center* ; vector_angle(*this* ▶ *start*)] ; $\frac{1}{2}$ × *this* ▶ *angle*]

RE **xy** (*radius* ; *angle* ; polar)

height_contact | *object* | *type* = max

4 *radius_this* = | − [*this* ▶ *center* ; *this* ▶ *start*] |

SW *object* ▶ *type*

V [Label2D ; Rectangle2D] next_level

4 1 V [Label2D ; Rectangle2D]

Rectangle = *object*

SW *type*

max

heights = ∅

= [*Rectangle2D_vertices* ; *Label2D* ▶ vertices]

FE *Rectangle2D_vertices* | *vertex*

heights ≜ + [| − [*this* ▶ *center* ; *vertex*] | ; *radius_this*]

RE max(*heights*)

1.9 Path2D

1. **Definition**

Path2D

type = Path2D
vertices
key
key_object
key_label
method

2. **Method**

1 CO *vertices*

= [*this* ▶ *vertices* ; *vertices*]

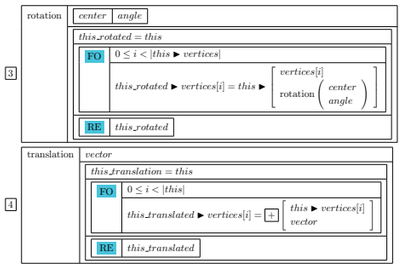
2 edges

edges = ∅

FO $0 \leq i \leq |this \blacktriangleright vertices| - 2$

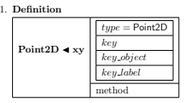
edges ≜ + **Segment2D** (*this* ▶ *vertices*[*i*] ; *this* ▶ *vertices*[*i* + 1])

RE *edges*

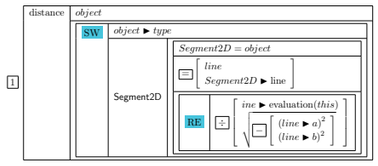


1.10 Point2D

1. **Definition**



2. **Method**



2

interval_angle_forbidden | *object*

SW *object* ▶ *type*

V [Label2D / Rectangle2D]

Rectangle2D = *object*

IF *this* ⊆ (*Rectangle2D*)° | RE **Interval_anlge** (0 / 2π / 1 / TR)

= [*angles_vertices* / ∅]

FE *Rectangle2D* ▶ vertices | *vertex*

IF ≠ [*this* ▶ *center* / *vertex*] | *angles_vertices* ≜ *this* ▶ [*center* / vector_angle(*vertex*)]

= [*angle_difference_min* / 0]

= [*angle_difference_max* / 0]

FE *angle_vertices* | *angle*

angle_difference = polar (− [*angle* / *angles_vertices*[0]] / $-\pi$)

angle_difference_max = max (*angle_difference_max* / *angle_difference*)

angle_difference_min = min (*angle_difference_min* / *angle_difference*)

size = − [*angle_difference_max* / *angle_difference_min*]

RE **Interval_angle** (+ [*angles_vertices*[0] / *angle_difference_min*] / *size*)

3

number_directions_measure | *Measure2Ds*

= [*Measure2Ds_contained* / ∅]

FE *Measure2Ds* | *Measure2D*

IF ≠ [*Measure2D* ▶ *height* / 0]

= [*Segment2D* / *Measure2D* ▶ segment]

IF *this* ⊆ *Segment2D* | ± [*Measure2Ds_contained* / *Measure2D*]

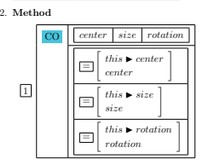
number_directions = 0

next level

RE *number_directions*

1.11 Rectangle2D

1. **Definition**



2. **Method**

2

interval | *coordinate*

SW | *coordinate*

x | RE | **Interval** $\left(\boxed{-} \begin{bmatrix} this \blacktriangleright \begin{bmatrix} center \\ x \end{bmatrix} \\ \frac{1}{2} \times this \blacktriangleright \begin{bmatrix} size \\ x \end{bmatrix} \end{bmatrix} \; \boxed{+} \begin{bmatrix} this \blacktriangleright \begin{bmatrix} center \\ x \end{bmatrix} \\ \frac{1}{2} \times this \blacktriangleright \begin{bmatrix} size \\ x \end{bmatrix} \end{bmatrix} \right)$

y | RE | **Interval** $\left(\boxed{-} \begin{bmatrix} this \blacktriangleright \begin{bmatrix} center \\ y \end{bmatrix} \\ \frac{1}{2} \times this \blacktriangleright \begin{bmatrix} size \\ y \end{bmatrix} \end{bmatrix} \; \boxed{+} \begin{bmatrix} this \blacktriangleright \begin{bmatrix} center \\ y \end{bmatrix} \\ \frac{1}{2} \times this \blacktriangleright \begin{bmatrix} size \\ y \end{bmatrix} \end{bmatrix} \right)$

3

rotation | angle

this_rotated = *this*

center_rotation = **xy** $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$

this_rotated ▶ *center* = *this* ▶ $\begin{bmatrix} center \\ \text{rotation} \begin{pmatrix} center\_rotation \\ -this \blacktriangleright rotation \end{pmatrix} \end{bmatrix}$

this_rotated ▶ *target* = *this* ▶ $\begin{bmatrix} target \\ \text{rotation} \begin{pmatrix} center\_rotation \\ -this \blacktriangleright rotation \end{pmatrix} \end{bmatrix}$

this_rotated $\stackrel{+}{=}$ *angle*

RE | *this_rotated*

4

translation | *translation*

this_translation = *this*

this_translated ▶ *center* = $\boxed{+} \begin{bmatrix} this \blacktriangleright center \\ translation \end{bmatrix}$

this_translated ▶ *target* = $\boxed{+} \begin{bmatrix} this \blacktriangleright target \\ translation \end{bmatrix}$

RE | *this_translated*

vertices

$vertices\_0 = \emptyset$

$$vertices\_0 \overset{+}{=} \boxed{+} \begin{bmatrix} this \blacktriangleright center \\ \boxed{\times} \begin{bmatrix} \begin{bmatrix} -\frac{1}{2} \mid -\frac{1}{2} \end{bmatrix} \\ this \blacktriangleright size \end{bmatrix} \end{bmatrix}$$

$$vertices\_0 \overset{+}{=} \boxed{+} \begin{bmatrix} this \blacktriangleright center \\ \boxed{\times} \begin{bmatrix} \begin{bmatrix} -\frac{1}{2} \mid \frac{1}{2} \end{bmatrix} \\ this \blacktriangleright size \end{bmatrix} \end{bmatrix}$$

$$vertices\_0 \overset{+}{=} \boxed{+} \begin{bmatrix} this \blacktriangleright center \\ \boxed{\times} \begin{bmatrix} \begin{bmatrix} \frac{1}{2} \mid \frac{1}{2} \end{bmatrix} \\ this \blacktriangleright size \end{bmatrix} \end{bmatrix}$$

$$vertices\_0 \overset{+}{=} \boxed{+} \begin{bmatrix} this \blacktriangleright center \\ \boxed{\times} \begin{bmatrix} \begin{bmatrix} \frac{1}{2} \mid -\frac{1}{2} \end{bmatrix} \\ this \blacktriangleright size \end{bmatrix} \end{bmatrix}$$

$vertices = \emptyset$

FE | $vertices\_0$ | $vertex$

$$vertices \overset{+}{=} vertex \blacktriangleright \text{rotation} \begin{pmatrix} this \blacktriangleright center \\ this \blacktriangleright rotation \end{pmatrix}$$

RE | $vertices$

1.12 Sector2D

1. **Definition**

Sector2D

Sector2D
center
start
angle

method

2. **Method**

CO | *center* | *start* | *angle*

1

$$\boxed{=} \begin{bmatrix} this \blacktriangleright center \\ center \end{bmatrix}$$

$$\boxed{=} \begin{bmatrix} this \blacktriangleright start \\ start \end{bmatrix}$$

$$\boxed{=} \begin{bmatrix} this \blacktriangleright angle \\ angle \end{bmatrix}$$

end

2

RE $this \blacktriangleright \begin{bmatrix} start \\ \text{rotation} \begin{pmatrix} this \blacktriangleright center \\ this \blacktriangleright angle \end{pmatrix} \end{bmatrix}$

radius

3

RE $\boxed{-} \begin{bmatrix} this \blacktriangleright center \\ this \blacktriangleright start \end{bmatrix}$

rotation | *center* | *angle*

4

$this\_rotated =$ RE | *this*

$$this\_rotated \blacktriangleright center = this \blacktriangleright \begin{bmatrix} center \\ \text{rotation} \begin{pmatrix} this \blacktriangleright center \\ angle \end{pmatrix} \end{bmatrix}$$

$$this\_rotated \blacktriangleright start = this \blacktriangleright \begin{bmatrix} start \\ \text{rotation} \begin{pmatrix} this \blacktriangleright center \\ angle \end{pmatrix} \end{bmatrix}$$

RE | $this\_translated$

translation	*vector*
	this_translated = *this*
	this_translated ▶ *center* = + [*this* ▶ *center*, *vector*]
	this_translated ▶ *start* = + [*this* ▶ *start*, *vector*]
	RE *this_translated*

5

1.13 Segment2D

1. **Definition**

Segment2D	*type* = Segment2D
	start
	end
	measure = ∅
	key
	key_object
	key_label
	method

2. **Method**

1

CO	*start*	*end*	*measure*
	= [*this* ▶ *start*, *start*]		
	= [*this* ▶ *end*, *end*]		
	= [*this* ▶ *measure*, *measure*]		

2

center			
	RE	+ [*this* ▶ *start*, *this* ▶ *end*]	× $\frac{1}{2}$

3

coordinate | *value* | *axis* = x

[=] [*line* / *this* ▶ line]

coordinate = *line* ▶ coordinate (*value* / *axis*)

IF | *coordinate* ≡ ∅ | RE | *coordinate*

SW | *axis*

x

$x\_min = \min \begin{pmatrix} this \blacktriangleright \begin{bmatrix} start \\ x \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ x \end{bmatrix} \end{pmatrix}$

$x\_max = \max \begin{pmatrix} this \blacktriangleright \begin{bmatrix} start \\ x \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ x \end{bmatrix} \end{pmatrix}$

IF | [∉] [*coordinate* / *this* ▶ interval(x)] | RE | *emptyset*

RE | *coordinate*

y

$x\_min = \min \begin{pmatrix} this \blacktriangleright \begin{bmatrix} start \\ y \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ y \end{bmatrix} \end{pmatrix}$

$x\_max = \max \begin{pmatrix} this \blacktriangleright \begin{bmatrix} start \\ y \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ y \end{bmatrix} \end{pmatrix}$

IF | [∉] [*coordinate* / *this* ▶ interval(y)] | RE | *emptyset*

RE | *coordinate*

4

interval | *coordinate* = x

SW | *coordinate*

x | RE | **Interval** $\left(\min \begin{pmatrix} this \blacktriangleright \begin{bmatrix} start \\ x \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ x \end{bmatrix} \end{pmatrix} \; \max \begin{pmatrix} this \blacktriangleright \begin{bmatrix} start \\ x \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ x \end{bmatrix} \end{pmatrix} \right)$

y | RE | **Interval** $\left(\min \begin{pmatrix} this \blacktriangleright \begin{bmatrix} start \\ y \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ y \end{bmatrix} \end{pmatrix} \; \max \begin{pmatrix} this \blacktriangleright \begin{bmatrix} start \\ y \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ y \end{bmatrix} \end{pmatrix} \right)$

5

is_chord | *Arc2D*

distance_this_start = [−] [*Segment2D* ▶ center ; *this* ▶ *start*]

IF [≠] [*Arc2D* ▶ radius ; *distance_this_start*] | RE FA

distance_this_end = [−] [*Arc2D* ▶ *center* ; *this* ▶ *end*]

IF [≠] [*Arc2D* ▶ radius ; *distance_this_end*] | RE FA

angle_Arc2D_start = *Arc2D* ▶ [*center* ; vector_angle(*Arc2D* ▶ *start*)]

angle_Arc2D_end = [+] [*angle_Arc2D_start* ; *Arc2D* ▶ *angle*]

IF [≡] [*angle_Arc2D_start* ; *angle_Arc2D_end*] | RE TR

angle_this_start = *Arc2D* ▶ [*center* ; vector_angle(*this* ▶ *start*)]

[=] [*interval_angle_Arc2D* ; *Arc2D* ▶ interval_angle]

IF [∉] [*angle_this_start* ; *interval_angle_Arc2D*] | RE FA

angle_this_end = *Arc2D* ▶ [*center* ; vector_angle(*this* ▶ *end*)]

RE [∈] [*angle_this_end* ; *inteval_angle_Arc2D*]

6

is_equal_direction | *Segment2D*

RE [≡] [*this* ▶ vector_angle ; *Segment2D* ▶ vector_angle]

7

is_opposite_direction | *Segment2D*

RE [≡] [*this* ▶ vector_angle ; −*Segment2D* ▶ vector_angle]

8

is_tangent | *object*

SW *object* ▶ *type*

Arc2D | *Arc2 = object*

RE *Arc2D* ▶ is_tangent(*this*)

9

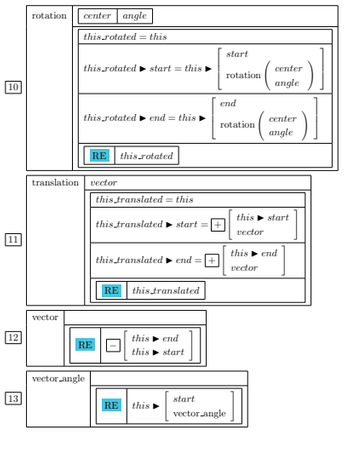
line

$$a = [-]\begin{bmatrix} this \blacktriangleright \begin{bmatrix} end \\ y \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} start \\ y \end{bmatrix} \end{bmatrix}$$

$$b = [-]\begin{bmatrix} this \blacktriangleright \begin{bmatrix} start \\ x \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} end \\ x \end{bmatrix} \end{bmatrix}$$

$$c = [\times]\begin{bmatrix} -a & b \\ this \blacktriangleright start & \end{bmatrix}$$

RE **line** $\begin{pmatrix} a \\ b \\ c \end{pmatrix}$


rotation
center
angle
this_rotated = this
this_rotated ▶ start = this ▶ [start, rotation (center, angle)]
this_rotated ▶ end = this ▶ [end, rotation (center, angle)]
RE
this_rotated
10
translation
vector
this_translated = this
this_translated ▶ start = + [this ▶ start, vector]
this_translated ▶ end = + [this ▶ end, vector]
RE
this_translated
11
vector
RE
− [this ▶ end, this ▶ start]
12
vector_angle
RE
this ▶ [start, vector_angle]
13

New Sinod - Cartesian2D

1 Defnition

Cartesian2D	*type* = Cartesian2D
	structure
	rotation
	size
	zoom
	sizes
	method

2 Method

1. construct

CO | *structure*

- $\left[\begin{array}{l} this \blacktriangleright structure \\ structure \end{array}\right]$
- $\left[\begin{array}{l} this \blacktriangleright rotation \\ this \blacktriangleright structure[\text{rotation}] \end{array}\right]$
- $\left[\begin{array}{l} this \blacktriangleright size \\ this \blacktriangleright structure[\text{size}] \end{array}\right]$
- $\left[\begin{array}{l} this \blacktriangleright zoom \\ this \blacktriangleright structure[\text{zoom}] \end{array}\right]$
- $\left[\begin{array}{l} types\_object \\ \left[\begin{array}{l|l|l|l|l|l} \text{Angle2D} & \text{Curve2D} & \text{Face2D} & \text{Label2D} & \text{Point2D} & \text{Segment2D} \end{array}\right] \end{array}\right]$
- $\left[\begin{array}{l} this \blacktriangleright objects \\ \textbf{index}(types\_object) \end{array}\right]$
- $\left[\begin{array}{l} this \blacktriangleright sizes \\ \textbf{index}(types\_object) \end{array}\right]$
- next level
- next level
- $\left[\begin{array}{l} types\_object\_nonLabel2D \\ \left[\begin{array}{l|l|l|l|l} \text{Angle2D} & \text{Curve2D} & \text{Face2D} & \text{Point2D} & \text{Segment2D} \end{array}\right] \end{array}\right]$
- next level

1 FO | *types_object* | *type_object*

$this \blacktriangleright \left[\begin{array}{l} objects \\ type\_object \end{array}\right] = \emptyset$

2 FO | $this \blacktriangleright structure[\text{elements}]$ | *key* | *object_structure*

- $\left[\begin{array}{l} object \\ this \blacktriangleright \textbf{object}(object\_structure) \end{array}\right]$
- $object \blacktriangleright key\_object = \left| this \blacktriangleright \left[\begin{array}{l} objects \\ (object \blacktriangleright type) \end{array}\right] \right|$
- $\left[\begin{array}{l} object \blacktriangleright key \\ key \end{array}\right]$
- $this \blacktriangleright \left[\begin{array}{l} objects \\ (object \blacktriangleright type) \end{array}\right] \stackrel{+}{=} object$

3

FO | *types_object_nonLabel2D* | *type*

FO $0 \leq i < \left| this \blacktriangleright \begin{bmatrix} objects \\ type \end{bmatrix} \right|$

FO $0 \leq j < \left| this \blacktriangleright \begin{bmatrix} objects \\ Label2D \end{bmatrix} \right|$

IF $\left[\begin{matrix} this \blacktriangleright \begin{bmatrix} objects \\ types[i] \blacktriangleright key \end{bmatrix} \\ this \blacktriangleright \begin{bmatrix} objects \\ Label2D[j] \\ key\_labeled \end{bmatrix} \end{matrix} \right]$

$this \blacktriangleright \begin{bmatrix} objects \\ types[i] \\ key\_label \end{bmatrix} = this \blacktriangleright \begin{bmatrix} objects \\ Label2D[j] \\ key \end{bmatrix}$

$this \blacktriangleright \begin{bmatrix} objects \\ Label2D[j] \\ key\_labeled\_object \end{bmatrix} = this \blacktriangleright \begin{bmatrix} objects \\ type[i] \\ object \end{bmatrix}$

$this \blacktriangleright \begin{bmatrix} objects \\ Label2D[j] \\ type\_labeled \end{bmatrix} = type$

BR

2. algorithm: algorithm to apply

algorithm | *version*

$\left[\begin{matrix} index\_height \\ \left[\text{Angle2D} \mid \text{Measure2D} \mid \text{MeasureArc2D} \right] \end{matrix} \right]$

$heights = \textbf{index}(index\_height)$

SW | *version*

KR

$\left[\begin{matrix} heights \blacktriangleright Angle2D \\ 1 \end{matrix} \right]$

$\left[\begin{matrix} heights \blacktriangleright Measuer2D \\ 1 \end{matrix} \right]$

$\left[\begin{matrix} heights \blacktriangleright MeasureArc2D \\ 1 \end{matrix} \right]$

US

$\left[\begin{matrix} heights \blacktriangleright Angle2D \\ 0 \end{matrix} \right]$

$\left[\begin{matrix} heights \blacktriangleright Measuer2D \\ 0 \end{matrix} \right]$

$\left[\begin{matrix} heights \blacktriangleright MeasureArc2D \\ 1 \end{matrix} \right]$

$this\_updated = this$

$this\_updated = this\_updated \blacktriangleright \text{update} \left(\begin{matrix} \text{Angle2D} \\ heights \blacktriangleright Angle2D \end{matrix} \right)$

$this\_updated = this\_updated \blacktriangleright \text{update} \left(\begin{matrix} \text{Arc2D} \\ heights \blacktriangleright MeasureArc2D \end{matrix} \right)$

$\left[\begin{matrix} this\_updated \\ this\_updated \blacktriangleright \text{update}(\text{Face2D}) \end{matrix} \right]$

$this\_updated = this\_updated \blacktriangleright \text{update} \left(\begin{matrix} \text{Segment2D} \\ heights \blacktriangleright Measure2D \end{matrix} \right)$

$\left[\begin{matrix} this\_updated \\ this\_updated \blacktriangleright \text{update}(\text{Point2D}) \end{matrix} \right]$

$\left[\begin{matrix} this\_updated \\ this\_updated \blacktriangleright \text{update}(\text{structure}) \end{matrix} \right]$

RE | *this_updated*

3. object: convert structure to object

object	*object_structure*

SW	*object_structure*[type]
angle-free	next level
arc-free	next level
curve-free	next level
face-free	next level
label-free	next level
point-free	next level
region-free	next level
segment-free	next level

1 angle-free

$$\boxed{=}\begin{bmatrix} angle\_structure \\ object\_structure \end{bmatrix}$$

$$Angle2D = \mathbf{Angle2D}$$

$$Angle2D \blacktriangleright center = \mathbf{xy}\left(\begin{bmatrix} angle\_structure \\ \text{struct} \\ \text{coords} \\ \text{center} \\ \text{x} \end{bmatrix}, \begin{bmatrix} angle\_structure \\ \text{struct} \\ \text{coords} \\ \text{center} \\ \text{y} \end{bmatrix}\right)$$

$$Angle2D \blacktriangleright start = \mathbf{xy}\left(\begin{bmatrix} angle\_structure \\ \text{struct} \\ \text{coords} \\ \text{start} \\ \text{x} \end{bmatrix}, \begin{bmatrix} angle\_structure \\ \text{struct} \\ \text{coords} \\ \text{start} \\ \text{y} \end{bmatrix}\right)$$

$$Angle2D \blacktriangleright end = \mathbf{xy}\left(\begin{bmatrix} angle\_structure \\ \text{struct} \\ \text{coords} \\ \text{end} \\ \text{x} \end{bmatrix}, \begin{bmatrix} angle\_structure \\ \text{struct} \\ \text{coords} \\ \text{end} \\ \text{y} \end{bmatrix}\right)$$

$$Angle2D \blacktriangleright height = angle\_structure\begin{bmatrix} \text{struct} \\ \text{style} \\ \text{height} \end{bmatrix}$$

$$Angle2D \blacktriangleright right = angle\_structure\begin{bmatrix} \text{struct} \\ \text{style} \\ \text{rightAngle} \end{bmatrix}$$

RE	*Angle2D*

2 arc-free

[=] [arc_structure ; object_structure]

Arc2D = **Arc2D**

Arc2D ▶ center = **xy** (arc_structure [struct ; coords ; center ; x] ; arc_structure [struct ; coords ; center ; y])

Arc2D ▶ start = **xy** (arc_structure [struct ; coords ; start ; x] ; arc_structure [struct ; coords ; start ; y])

angle_sign = sign (arc_structure [struct ; angle])

angle_abs = | arc_structure [struct ; angle] |

Arc2D ▶ angle = [×] [angle_sign ; angle_abs ; $\frac{\pi}{180}$]

IF arc_structure [struct ; measure ; type] ≡ Blank | [=] [Arc2D ▶ measure ; ∅]

Arc2D ▶ measure = **MeasureArc2D** (Arc2D ▶ center ; Arc2D ▶ start ; Arc2D ▶ angle ; arc_structure [struct ; height])

RE Arc2D

3 curve-free

[=] [curve_structure ; object_structure]

Curve2D = **Curve2D**

RE Curve2D

4 face-free

[=] [face_structure ; object_structure]

Face2D = **Face2D**

FO face_structure [struct ; coords] | coords

Face2D ▶ vertices ≜ **xy** (coords[x] ; coords[y])

RE Face2D

5 label-free

[=] [label_structure / object_structure]

Label2D = **Label2D**

Label2D ▶ center = **xy** (label_structure [struct / coords / x] , label_structure [struct / coords / y])

Label2D ▶ target = **xy** (label_structure [struct / target / x] , label_structure [struct / target / y])

SW label_structure [struct / label / type]

Latex	Label2D_size = latex_size (label_structure [struct / label / content])
Text	Label2D_size = text_size (label_structure [struct / label / content])

Label2D ▶ size = [÷] [Label2D_size / [×] [this ▶ size / this ▶ zoom]]

[=] [Label2D ▶ rotation / this ▶ rotation]

FO | this ▶ struct[elements] | key_object_structure | object_structure

IF [∧] [[≠] [object_structure[type] / label-free] / [≡] [label_structure [struct / dependency[0]] / object_structure[_id]]] [=] [Label2D ▶ key_labeled / key_object_structure]

RE | Label2D

6 point-free

[=] [point_structure / object_structure]

Point2D = **Point2D** (point_structure [struct / coord / x] , point_structure [struct / coord / y])

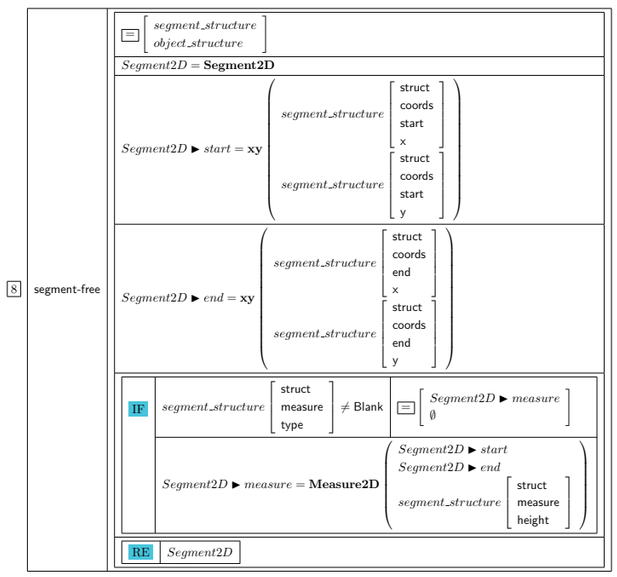
RE | Point2D

7 region-free

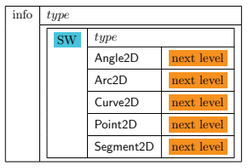
[=] [region_structure / object_structure]

Region2D = **Region2D**

RE | Region2D



4. info: compute imformation of object



1 Angle2D

$index\_info = \left[\begin{array}{c|c} \text{objects} & \text{poset} \end{array}\right]$

$info = \textbf{index}(index\_info)$

$\left[\begin{array}{l} info \blacktriangleright objects \\ \emptyset \end{array}\right]$

$index\_object = \left[\begin{array}{c|c} \text{label} & \text{key\_object} \end{array}\right]$

$index\_object\_label = [\text{intervals\_angle}]$

$relations = \emptyset$

FO

$this \blacktriangleright \left[\begin{array}{l} objects \\ Angle2D \end{array}\right] \;\Big|\; Angle2D$

$object = \textbf{index}(index\_object)$

$\left[\begin{array}{l} object \blacktriangleright key\_object \\ Angle2D \blacktriangleright key\_object \end{array}\right]$

$\left[\begin{array}{l} object \blacktriangleright label \\ \textbf{index}(index\_object\_label) \end{array}\right]$

$object \blacktriangleright \left[\begin{array}{l} label \\ interval\_angle \end{array}\right] = \emptyset$

$\left[\begin{array}{l} Angle2D\_size \\ Angle2D \blacktriangleright \text{size} \end{array}\right]$

$\left[\begin{array}{l} relation \\ \textbf{Relation}(Angle2D \blacktriangleright key\_object) \end{array}\right]$

next level

$\left[\begin{array}{l} interval\_angle \\ Angle2D \blacktriangleright \text{interval\_angle} \end{array}\right]$

$angles\_forbidden = \emptyset$

$angle\_Angle2D\_start = Angle2D \blacktriangleright \left[\begin{array}{l} center \\ \text{vector\_angle}(Angle2D \blacktriangleright start) \end{array}\right]$

$\left[\begin{array}{l} angles\_forbidden[0] \\ angle\_Angle2D\_start \end{array}\right]$

$angles\_forbidden = \emptyset$

$angles\_forbidden\,[Angle2D \blacktriangleright \text{angle}] = Angle \blacktriangleright \left[\begin{array}{l} center \\ \text{vector\_angle}(Angle2D \blacktriangleright end) \end{array}\right]$

next level

$angles\_forbidden = angles\_forbidden \blacktriangleright \text{ksort}$

next level

$object \blacktriangleright \left[\begin{array}{l} label \\ intervals\_angle \end{array}\right] = \textbf{Union\_interval\_angle}(intervals\_angle\_allowed)$

$\left[\begin{array}{l} info \blacktriangleright [Angle2D \blacktriangleright key\_object] \\ object \end{array}\right]$

$\left[\begin{array}{l} info \blacktriangleright poset \\ \textbf{Poset}(relations) \end{array}\right]$

RE $info$

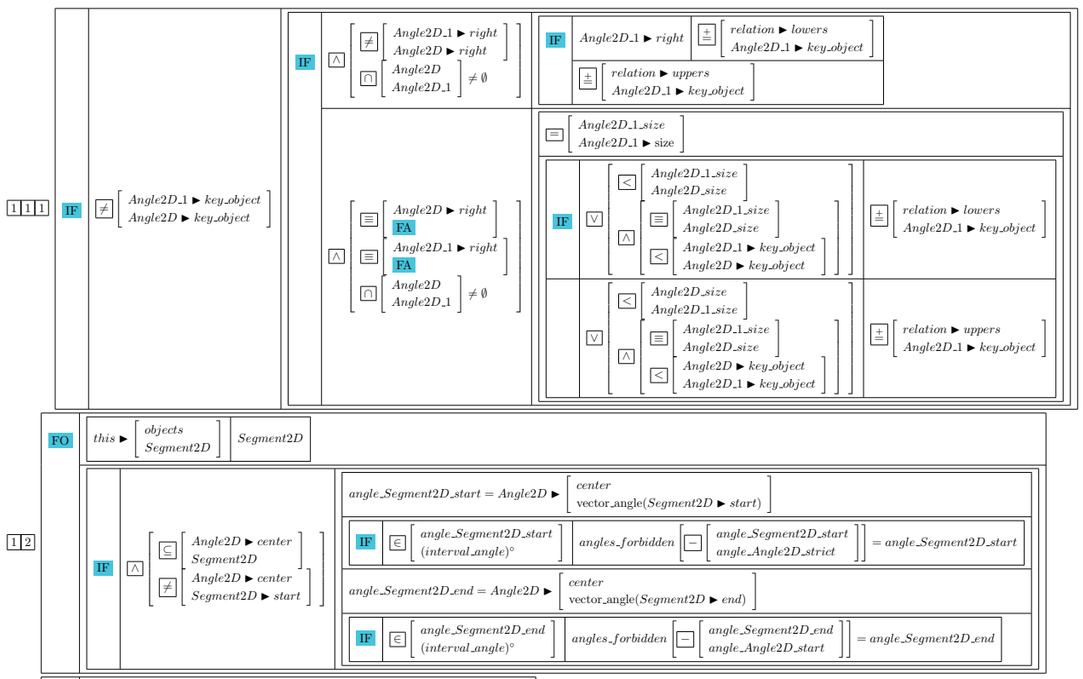
1 1

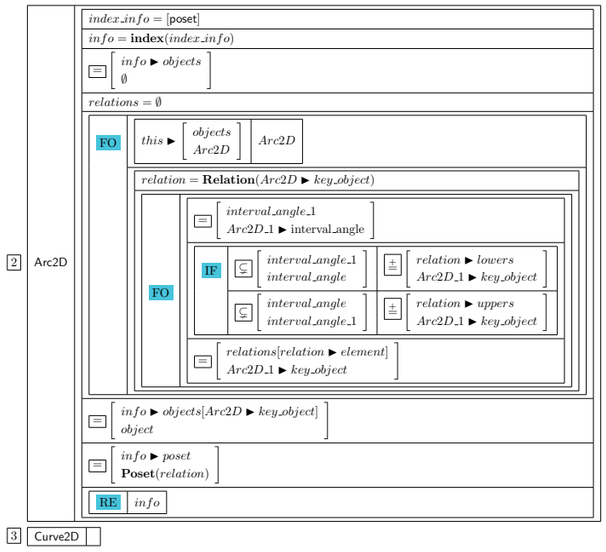
FO

$this \blacktriangleright \left[\begin{array}{l} objects \\ Angle2D \end{array}\right] \;\Big|\; Angle2D\_1$

next level

$\left[\begin{array}{l} relations[relation \blacktriangleright element] \\ relation \end{array}\right]$


1 1 1
IF
$\neq$ [Angle2D_1 ▶ key_object ; Angle2D ▶ key_object]
IF
$\wedge$ [$\neq$ [Angle2D_1 ▶ right ; Angle2D ▶ right] ; $\cap$ [Angle2D ; Angle2D_1] $\neq \emptyset$]
IF
Angle2D_1 ▶ right
$\pm=$ [relation ▶ lowers ; Angle2D_1 ▶ key_object]
$\pm=$ [relation ▶ uppers ; Angle2D_1 ▶ key_object]
$\wedge$ [$\equiv$ [Angle2D ▶ right] FA ; $\equiv$ [Angle2D_1 ▶ right] FA ; $\cap$ [Angle2D ; Angle2D_1] $\neq \emptyset$]
$=$ [Angle2D_1_size ; Angle2D_1 ▶ size]
IF
$\vee$ [$<$ [Angle2D_1_size ; Angle2D_size] ; $\wedge$ [$\equiv$ [Angle2D_1_size ; Angle2D_size] ; $<$ [Angle2D_1 ▶ key_object ; Angle2D ▶ key_object]]]
$\pm=$ [relation ▶ lowers ; Angle2D_1 ▶ key_object]
$\vee$ [$<$ [Angle2D_size ; Angle2D_1_size] ; $\wedge$ [$\equiv$ [Angle2D_1_size ; Angle2D_size] ; $<$ [Angle2D ▶ key_object ; Angle2D_1 ▶ key_object]]]
$\pm=$ [relation ▶ uppers ; Angle2D_1 ▶ key_object]
1 2
FO
this ▶ [objects ; Segment2D]
Segment2D
IF
$\wedge$ [$\subseteq$ [Angle2D ▶ center ; Segment2D] ; $\neq$ [Angle2D ▶ center ; Segment2D ▶ start]]
angle_Segment2D_start = Angle2D ▶ [center ; vector_angle(Segment2D ▶ start)]
IF
$\in$ [angle_Segment2D_start ; (interval_angle)°]
angles_forbidden [$-$ [angle_Segment2D_start ; angle_Angle2D_strict]] = angle_Segment2D_start
angle_Segment2D_end = Angle2D ▶ [center ; vector_angle(Segment2D ▶ end)]
IF
$\in$ [angle_Segment2D_end ; (interval_angle)°]
angles_forbidden [$-$ [angle_Segment2D_end ; angle_Angle2D_start]] = angle_Segment2D_end
1 3
FO
$0 \leq i < |angles\_forbidden|$
intervals_angle_allowed $\triangleq$ **Interval_angle** ($\square-$ [angles_forbidden[i+1] ; angles_forbidden[i]])


2
Arc2D
index_info = [poset]
info = index(index_info)
info ▶ objects
∅
relations = ∅
FO
this ▶ objects
Arc2D
Arc2D
relation = Relation(Arc2D ▶ key_object)
FO
interval_angle_1
Arc2D_1 ▶ interval_angle
IF
interval_angle_1
interval_angle
relation ▶ lowers
Arc2D_1 ▶ key_object
interval_angle
interval_angle_1
relation ▶ uppers
Arc2D_1 ▶ key_object
relations[relation ▶ element]
Arc2D_1 ▶ key_object
info ▶ objects[Arc2D ▶ key_object]
object
info ▶ poset
Poset(relation)
RE
info
3
Curve2D

4 Point2D

$index\_info =$ [objects]

$info =$ **index**$(index\_info)$

$\left[\begin{array}{l} info \blacktriangleright objects \\ \emptyset \end{array}\right]$

$index\_object = \left[\begin{array}{l|l|l} \text{Angle2Ds} & \text{label} & \text{key\_object} \end{array}\right]$

$\left[\begin{array}{l} index\_object\_Angle2Ds \\ [\text{is\_surrounded}] \end{array}\right]$

$\left[\begin{array}{l} index\_object\_Angle2Ds\_contained \\ \left[\begin{array}{l|l} \text{start} & \text{end} \end{array}\right] \end{array}\right]$

$\left[\begin{array}{l} index\_object\_label \\ [\text{intervals\_angle}] \end{array}\right]$

FO | $this \blacktriangleright \left[\begin{array}{l} objects \\ Point2D \end{array}\right]$ | $Point2D$

IF | $\left[\begin{array}{l} Point2D \blacktriangleright key\_label \\ \emptyset \end{array}\right]$ | CO

$object =$ **index**$(index\_object)$

$\left[\begin{array}{l} object \blacktriangleright key\_object \\ Point2D \blacktriangleright key\_object \end{array}\right]$

$\left[\begin{array}{l} object \blacktriangleright Angle2Ds \\ \textbf{index}(index\_object\_Angle2Ds) \end{array}\right]$

$object \blacktriangleright \left[\begin{array}{l} Angle2Ds \\ contained \end{array}\right] =$ **index**$(index\_object\_Angle2Ds\_contained)$

$\left[\begin{array}{l} object \blacktriangleright label \\ \textbf{index}(index\_object\_label) \end{array}\right]$

$\left[\begin{array}{l} intervals\_angle\_forbidden\_label \\ \emptyset \end{array}\right]$

$\left[\begin{array}{l} intervals\_angle\_forbidden\_Angle2Ds \\ \emptyset \end{array}\right]$

next level

$\left[\begin{array}{l} union\_forbidden\_Angle2Ds \\ \textbf{Union\_interval\_angle}(intervals\_angle\_forbidden\_Angle2Ds) \end{array}\right]$

IF | $|union\_forbidden\_Angle2Ds| \equiv 2\pi$ | $object \blacktriangleright \left[\begin{array}{l} Angle2Ds \\ is\_surrounded \end{array}\right] =$ TR

$object \blacktriangleright \left[\begin{array}{l} Angle2Ds \\ is\_surrounded \end{array}\right] =$ FA

next level

next level

next level

next level

next level

next level

$\left[\begin{array}{l} union\_forbidden\_label \\ \textbf{Union\_interval\_angle}(intervals\_angle\_forbidden\_label) \end{array}\right]$

$object \blacktriangleright \left[\begin{array}{l} label \\ intervals\_angle \end{array}\right] = union\_forbidden\_label \blacktriangleright \left[\begin{array}{l} \text{complement} \\ \text{max} \end{array}\right]$

$\left[\begin{array}{l} info \blacktriangleright objects\,[Point2D \blacktriangleright key\_object] \\ object \end{array}\right]$

RE | $info$

4 1

FO

$Point2D \blacktriangleright \begin{bmatrix} objects \\ Angle2D \end{bmatrix}$	$Angle2D$

IF $\boxed{\equiv} \begin{bmatrix} Point2D \\ Angle2D \blacktriangleright center \end{bmatrix}$

$angle\_start = Angle2D \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Angle2D \blacktriangleright center) \end{bmatrix}$

$size = \boxed{-} \begin{bmatrix} Angle2D \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Angle2D \blacktriangleright end) \end{bmatrix} \\ angle\_start \end{bmatrix}$

$interval\_angle = \textbf{Interval\_angle} \begin{pmatrix} angle\_start \\ size \end{pmatrix}$

$\boxed{\pm_{=}} \begin{bmatrix} intervals\_angle\_forbidden\_label \\ interval\_angle \end{bmatrix}$

$\boxed{\pm_{=}} \begin{bmatrix} intervals\_angle\_forbidden\_Angle2Ds \\ interval\_angle \end{bmatrix}$

$Segment2D\_start = \textbf{Segment2D} \begin{pmatrix} Angle2D \blacktriangleright center \\ Angle2D \blacktriangleright start \end{pmatrix}$

IF $\boxed{\subseteq} \begin{bmatrix} Point2D \\ (Segment2D\_start)^{\circ} \end{bmatrix}$

$intervals\_angle\_forbidden\_label \overset{\pm}{=} \textbf{Interval\_angle} \begin{pmatrix} Segment2D\_start \blacktriangleright \text{vector\_angle} \\ \pi \end{pmatrix}$

$object \blacktriangleright \begin{bmatrix} Angle2Ds \\ contained \\ start \end{bmatrix} \overset{\pm}{=} Angle2D \blacktriangleright key\_object$

$Segment2D\_end = \textbf{Segment2D} \begin{pmatrix} Angle2D \blacktriangleright center \\ Angle2D \blacktriangleright end \end{pmatrix}$

IF $\boxed{\subseteq} \begin{bmatrix} Point2D \\ (Segment2D\_end)^{\circ} \end{bmatrix}$

$intervals\_angle\_forbidden\_label \overset{\pm}{=} \textbf{Interval\_angle} \begin{pmatrix} Segment2D\_end \blacktriangleright \text{vector\_angle} \\ \pi \end{pmatrix}$

$object \blacktriangleright \begin{bmatrix} Angle2Ds \\ contained \\ end \end{bmatrix} \overset{\pm}{=} Angle2D \blacktriangleright key\_object$

4 2

FO

$this \blacktriangleright \begin{bmatrix} objects \\ Arc2D \end{bmatrix}$	$Arc2D$

IF $Point2D \subseteq Arc2D$

$angle\_Point2D = Arc2D \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Point2D) \end{bmatrix}$

$is\_measure =$ FA

IF $Arc2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix} \neq 0$ $is\_measure =$ TR

$\boxed{=} \begin{bmatrix} interval\_angle\_Arc2D \\ Arc2D \blacktriangleright \text{interval\_angle} \end{bmatrix}$

next level

IF $\boxed{\wedge}\begin{bmatrix}\boxed{\neq}\begin{bmatrix}Point2D\\Arc2D \blacktriangleright start\end{bmatrix}\\ \boxed{\neq}\begin{bmatrix}Point2D\\Arc2D \blacktriangleright end\end{bmatrix}\end{bmatrix}$

IF $is\_measure \equiv$ FA

$\boxed{=}\begin{bmatrix}angle\_start\\angle\_Point2D + \frac{\pi}{2}\end{bmatrix}$

$size = \boxed{-}\begin{bmatrix}angle\_Point2D\\interval\_angle\_Arc2D \blacktriangleright start\end{bmatrix} \times \frac{1}{2}$

$intervals\_angle\_forbidden\_label \triangleq$ **Interval_angle** $\begin{pmatrix}angle\_start\\size\end{pmatrix}$

$\boxed{=}\begin{bmatrix}angle\_start\\angle\_Point2D - \frac{\pi}{2}\end{bmatrix}$

$size = \boxed{-}\begin{bmatrix}angle\_Point2D\\interval\_angle\_Arc2D \blacktriangleright start\end{bmatrix} \times \frac{1}{2}$

$intervals\_angle\_forbidden\_label \triangleq$ **Interval_angle** $\begin{pmatrix}angle\_start\\size\end{pmatrix}$

$angle\_difference\_start = \boxed{-}\begin{bmatrix}angle\_Point2D\\interval\_angle\_Arc2D \blacktriangleright start\end{bmatrix}$

$angle\_difference\_end = \boxed{-}\begin{bmatrix}interval\_angle\_Arc2D \blacktriangleright \text{end}\\angle\_Point2D\end{bmatrix}$

$angle\_start = \boxed{+}\begin{bmatrix}angle\_Point2D\\-\frac{\pi}{2}\\\frac{1}{2} \times angle\_difference\_start\end{bmatrix}$

$size = \boxed{+}\begin{bmatrix}\boxed{+}\begin{bmatrix}angle\_difference\_start\\angle\_difference\_end\end{bmatrix} \times \frac{1}{2}\\ \pi\end{bmatrix}$

$intervals\_angle\_forbidden\_label \triangleq$ **Interval_angle** $\begin{pmatrix}angle\_start\\size\end{pmatrix}$

$sign = \text{sign}(Arc2D \blacktriangleright angle)$

4 2 1

IF $\boxed{\equiv}\begin{bmatrix}Point2D\\Arc2D \blacktriangleright start\end{bmatrix}$

IF $is\_measure \equiv$ FA

$angle\_start = \boxed{+}\begin{bmatrix}angle\_Point2D\\sign \times \frac{\pi}{2}\end{bmatrix}$

$\boxed{=}\begin{bmatrix}size\\\frac{1}{2} \times Arc2D \blacktriangleright angle\end{bmatrix}$

$\boxed{=}\begin{bmatrix}angle\_start\\angle\_Point2D\end{bmatrix}$

$size = \boxed{+}\begin{bmatrix}sign \times \frac{\pi}{2}\\\frac{1}{2} \times Arc2D \blacktriangleright angle\end{bmatrix}$

$intervals\_angle\_forbidden\_label \triangleq$ **Interval_angle** $\begin{pmatrix}angle\_start\\size\\sign\end{pmatrix}$

$\boxed{\equiv}\begin{bmatrix}Point2D\\Arc2D \blacktriangleright end\end{bmatrix}$

IF $is\_measure \equiv$ FA

$angle\_end = \boxed{-}\begin{bmatrix}angle\_Point2D\\sign \times \frac{\pi}{2}\end{bmatrix}$

$angle\_start = \boxed{-}\begin{bmatrix}angle\_end\\\frac{1}{2} \times Arc2D \blacktriangleright angle\end{bmatrix}$

$\boxed{=}\begin{bmatrix}angle\_end\\angle\_Point2D\end{bmatrix}$

$angle\_start = \boxed{+}\begin{bmatrix}angle\_end\\-sign \times \frac{\pi}{2}\\-\frac{1}{2} \times Arc2D \blacktriangleright angle\end{bmatrix}$

$size = \boxed{-}\begin{bmatrix}angle\_end\\angle\_start\end{bmatrix}$

$intervals\_angle\_forbidden\_label \triangleq$ **Interval_angle** $\begin{pmatrix}angle\_start\\size\\sign\end{pmatrix}$

4 3 FO

$this \blacktriangleright \begin{bmatrix} objects \\ Curve2D \end{bmatrix}$ | $Curve2D$

4 4 FO

$this \blacktriangleright \begin{bmatrix} objects \\ Face2D \end{bmatrix}$ | $Face2D$

$\boxed{=} \begin{bmatrix} interior\_point \\ Face2D \blacktriangleright \text{centroid}(\textsf{vertices}) \end{bmatrix}$

FO $1 \leq i < |Face2D\_vertices|$

IF $Point2D \equiv vertices[i]$

$\boxed{=} \begin{bmatrix} angle\_start \\ Point2D \blacktriangleright \text{vector\_angle}\,(Face2D \blacktriangleright vertices[i+1]) \end{bmatrix}$

$\boxed{=} \begin{bmatrix} size \\ Point2D \blacktriangleright \text{vector\_angle}\,(Face2D \blacktriangleright vertices[i+1]) \end{bmatrix}$

$intervals\_angle\_forbidden\_label \triangleq \textbf{Interval\_angle} \begin{pmatrix} angle\_start \\ size \end{pmatrix}$

BR

$edge = \textbf{Segment2D} \begin{pmatrix} Face2D \blacktriangleright vertices[i] \\ Face2D \blacktriangleright vertices[i+1] \end{pmatrix}$

IF $Point2D \subseteq (edge)^{\circ}$

$\boxed{=} \begin{bmatrix} angle\_start \\ Point2D \blacktriangleright \text{vector\_angle}\,(Face2D \blacktriangleright vertices[i+1]) \end{bmatrix}$

$size = \boxed{-} \begin{bmatrix} Point2D \blacktriangleright \text{vector\_angle}\,(Face2D \blacktriangleright vertices[i]) \\ angle\_start \end{bmatrix}$

$intervals\_angle\_forbidden\_label \triangleq \textbf{Interval\_angle} \begin{pmatrix} angle\_start \\ size \end{pmatrix}$

RE

4 5 FO

$this \blacktriangleright \begin{bmatrix} objects \\ Path2D \end{bmatrix}$ | $Path2D$

$\boxed{=} \begin{bmatrix} vertices\_Path2D \\ Path2D \blacktriangleright \text{vertices} \end{bmatrix}$

FO $0 \leq i \leq |vertices\_Path2D| - 2$

$Segment2D = \textbf{Segment2D} \begin{pmatrix} vertices\_Path2D[i] \\ vertices\_Path2D[i+1] \end{pmatrix}$

$\boxed{=} \begin{bmatrix} angle\_Segment2D \\ Segment2D \blacktriangleright \text{vector\_angle} \end{bmatrix}$

IF $\boxed{\equiv} \begin{bmatrix} Point2D \\ Segment2D \blacktriangleright start \end{bmatrix}$

$intervals\_angle\_forbidden\_label \triangleq \textbf{Interval\_angle} \begin{pmatrix} angle\_Segment2D \\ 0 \end{pmatrix}$

BR

$\boxed{\subseteq} \begin{bmatrix} Point2D \\ (Segment2D)^{\circ} \end{bmatrix}$

$intervals\_angle\_forbidden\_label \triangleq \textbf{Interval\_angle} \begin{pmatrix} angle\_Segment2D \\ \pi \end{pmatrix}$

BR

$\boxed{\equiv} \begin{bmatrix} Point2D \\ Segment2D \blacktriangleright end \end{bmatrix}$

$intervals\_angle\_forbidden\_label \triangleq \textbf{Interval\_angle} \begin{pmatrix} angle\_Segment2D + \pi \\ 0 \end{pmatrix}$

BR

4 6 FO

$this \blacktriangleright \begin{bmatrix} objects \\ Segment2D \end{bmatrix}$ | $Segment2D$

next level

4 6 1 IF $Point2D \subseteq Segment2D$

$$\begin{bmatrix} angle\_Segment2D \\ Segment2D \blacktriangleright \text{vector\_angle} \end{bmatrix}$$

IF $\begin{bmatrix} Point2D \\ Segment2D \blacktriangleright start \end{bmatrix}$ next level

IF $\begin{bmatrix} Point2D \\ Segment2D \blacktriangleright end \end{bmatrix}$ next level

next level

4 6 1 1 IF $\begin{bmatrix} Segment2D \blacktriangleright measure \neq \emptyset \\ Segment2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix} \neq 0 \end{bmatrix}$

$$\begin{bmatrix} angle\_start \\ angle\_Segment2D \end{bmatrix}$$

$$\begin{bmatrix} angle\_end \\ angle\_start \end{bmatrix}$$

$$angle\_Segment2D\_measure = \text{vector\_angle}\left(\begin{matrix} \frac{1}{2} \times |Segment2D| \\ 2 \times Segment2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix} \end{matrix}\right)$$

IF $\text{sign}\left(Segment2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix}\right) \geq 0$

$$\begin{bmatrix} angle\_start \\ angle\_Segment2D \end{bmatrix}$$

$$angle\_end = \begin{bmatrix} angle\_Segment2D \\ angle\_Segment2D\_measure \end{bmatrix}$$

$$angle\_start = \begin{bmatrix} angle\_Segment2D \\ angle\_Segment2D\_measure \end{bmatrix}$$

$$\begin{bmatrix} angle\_end \\ angle\_Segment2D \end{bmatrix}$$

$$intervals\_angle\_forbidden\_label \triangleq \textbf{Interval\_angle}\left(\begin{matrix} angle\_start \\ \begin{bmatrix} angle\_end \\ angle\_start \end{bmatrix} \end{matrix}\right)$$

$$\begin{bmatrix} angle\_start \\ angle\_Segment2D + \pi \end{bmatrix}$$

$$\begin{bmatrix} angle\_end \\ angle\_start \end{bmatrix}$$

IF $\begin{bmatrix} Segment2D \blacktriangleright measure \neq \emptyset \\ Segment2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix} \neq 0 \end{bmatrix}$

$$angle\_Segment2D\_measure = \text{atan2}\left(\begin{matrix} \frac{1}{2} \times |Segment2D| \\ 2 \times Segment2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix} \end{matrix}\right)$$

IF $\text{sign}\left(Segment2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix}\right) \geq 0$

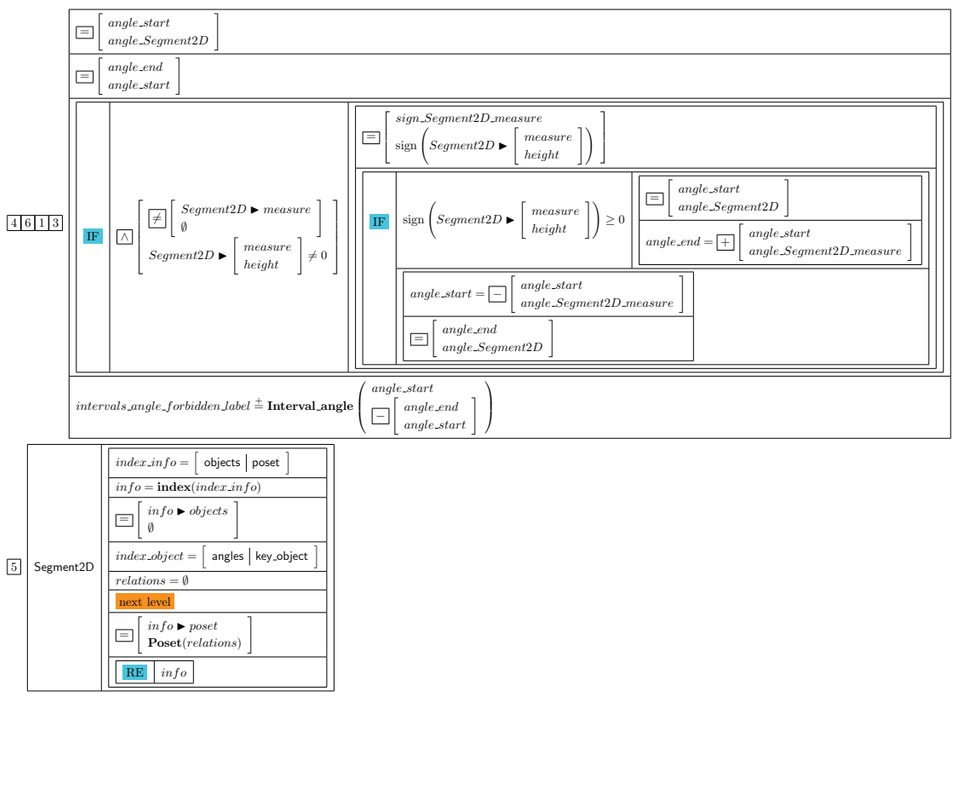
$$angle\_start = \begin{bmatrix} angle\_start \\ angle\_Segment2D\_measure \end{bmatrix}$$

$$\begin{bmatrix} angle\_end \\ angle\_Segment2D \end{bmatrix}$$

$$\begin{bmatrix} angle\_start \\ angle\_Segment2D \end{bmatrix}$$

$$angle\_end = \begin{bmatrix} angle\_start \\ angle\_Segment2D\_measure \end{bmatrix}$$

$$intervals\_angle\_forbidden\_label \triangleq \textbf{Interval\_angle}\left(\begin{matrix} angle\_start \\ \begin{bmatrix} angle\_end \\ angle\_start \end{bmatrix} \end{matrix}\right)$$


[=] [angle_start / angle_Segment2D]
[=] [angle_end / angle_start]
4 6 1 3
IF
[∧] [[≠] [Segment2D ▶ measure / ∅] / Segment2D ▶ [measure / height] ≠ 0]
[=] [sign_Segment2D_measure / sign (Segment2D ▶ [measure / height])]
IF
sign (Segment2D ▶ [measure / height]) ≥ 0
[=] [angle_start / angle_Segment2D]
angle_end = [+] [angle_start / angle_Segment2D_measure]
angle_start = [−] [angle_start / angle_Segment2D_measure]
[=] [angle_end / angle_Segment2D]
intervals_angle_forbidden_label ≜ Interval_angle (angle_start / [−] [angle_end / angle_start])
5
Segment2D
index_info = [objects | poset]
info = index(index_info)
[=] [info ▶ objects / ∅]
index_object = [angles | key_object]
relations = ∅
next level
[=] [info ▶ poset / Poset(relations)]
RE | info

FO

$this \blacktriangleright \begin{bmatrix} objects \\ Segment2D \end{bmatrix}$	$Segment2D$

IF	$Segment2D \blacktriangleright \begin{bmatrix} measure \\ key\_label \end{bmatrix} \neq \emptyset$	$this \blacktriangleright \begin{bmatrix} objects \\ Label2D \left[Segment2D \blacktriangleright \begin{bmatrix} measure \\ key\_label \end{bmatrix} \right] \\ center \end{bmatrix} = this \blacktriangleright \begin{bmatrix} objects \\ Label2D \left[Segment2D \blacktriangleright \begin{bmatrix} measure \\ key\_label \end{bmatrix} \right] \\ \text{center}(Segment2D \blacktriangleright measure) \end{bmatrix}$

$object = \textbf{index}(index\_objct)$

$\begin{bmatrix} object \blacktriangleright key\_object \\ Segment2D \blacktriangleright key\_object \end{bmatrix}$

$\begin{bmatrix} objects \blacktriangleright angles \\ \textbf{index}(\text{position}) \end{bmatrix}$

$object \blacktriangleright \begin{bmatrix} angles \\ start \end{bmatrix} = \textbf{index}(\text{sign})$

$object \blacktriangleright \begin{bmatrix} angles \\ end \end{bmatrix} = \textbf{index}(\text{sign})$

$\begin{bmatrix} relation \\ \textbf{Relation}(Segment2D \blacktriangleright key\_object) \end{bmatrix}$

$angles = \textbf{index}(\text{poisition})$

$\begin{bmatrix} angles \blacktriangleright start \\ \left[-\frac{\pi}{2} \middle| \frac{\pi}{2} \right] \end{bmatrix}$

$\begin{bmatrix} angles \blacktriangleright end \\ \left[-\frac{\pi}{2} \middle| \frac{\pi}{2} \right] \end{bmatrix}$

$signs = \textbf{index}(\text{position})$

$\begin{bmatrix} signs \blacktriangleright start \\ -1 \end{bmatrix}$

$\begin{bmatrix} signs \blacktriangleright end \\ 1 \end{bmatrix}$

$angle\_Segment2D = \textbf{index}(\text{poisition})$

$\begin{bmatrix} angle\_Segment2D \blacktriangleright end \\ Segment2D \blacktriangleright \text{vector\_angle} \end{bmatrix}$

$\begin{bmatrix} angle\_Segment2D \blacktriangleright start \\ -angle\_Segment2D \blacktriangleright end \end{bmatrix}$

next level

next level

next level

next level

next level

$object \blacktriangleright \begin{bmatrix} angles \\ start \\ positive \end{bmatrix} = \pi - \max(angles \blacktriangleright start)$

$object \blacktriangleright \begin{bmatrix} angles \\ start \\ negative \end{bmatrix} = \pi - |\min(angles \blacktriangleright start)|$

$object \blacktriangleright \begin{bmatrix} angles \\ end \\ positive \end{bmatrix} = \pi - \max(angles \blacktriangleright end)$

$object \blacktriangleright \begin{bmatrix} angles \\ end \\ negative \end{bmatrix} = \pi - |\min(angles \blacktriangleright end)|$

$\begin{bmatrix} info \blacktriangleright objects[Segment2D \blacktriangleright key\_object] \\ object \end{bmatrix}$

5 1

5 1 1

FO

$this \blacktriangleright \begin{bmatrix} objects \\ Angle2D \end{bmatrix}$ | $Angle2D$

IF

$\boxed{\subseteq} \begin{bmatrix} Angle2D \blacktriangleright center \\ Segment2D \end{bmatrix}$

$angles\_Angle2D = \textbf{index}(\text{position})$

$angles\_Angle2D \blacktriangleright start = Angle2D \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Angle2D \blacktriangleright start) \end{bmatrix}$

$angles\_Angle2D \blacktriangleright end = Angle2D \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Angle2D \blacktriangleright end) \end{bmatrix}$

$parities = \textbf{index}(\text{position})$

$parities \blacktriangleright start = \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Angle2D \blacktriangleright center \\ Segment2D \blacktriangleright start \end{bmatrix}\right|\right)$

$parities \blacktriangleright end = \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Angle2D \blacktriangleright center \\ Segment2D \blacktriangleright end \end{bmatrix}\right|\right)$

$angles\_start = \textbf{index}(\text{position})$

$angles\_start \blacktriangleright start = \boxed{\times}\begin{bmatrix} signs \blacktriangleright start \\ \boxed{+}\begin{bmatrix} angles\_Angle2D \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles\_start \blacktriangleright end = \boxed{\times}\begin{bmatrix} signs \blacktriangleright start \\ \boxed{+}\begin{bmatrix} angles\_Angle2D \blacktriangleright end \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles\_end = \textbf{index}(\text{position})$

$angles\_end \blacktriangleright start = \boxed{\times}\begin{bmatrix} signs \blacktriangleright end \\ \boxed{+}\begin{bmatrix} angles\_Angle2D \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles\_end \blacktriangleright end = \boxed{\times}\begin{bmatrix} signs \blacktriangleright end \\ \boxed{+}\begin{bmatrix} angles\_Angle2D \blacktriangleright end \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright start \stackrel{\pm}{=} \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} parities \blacktriangleright start \\ angles\_start \blacktriangleright start \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} 1 - parities \blacktriangleright start \\ \pi \times \text{sign}(angles\_start \blacktriangleright start) \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright start \stackrel{\pm}{=} \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} parities \blacktriangleright start \\ angles\_start \blacktriangleright end \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} 1 - parities \blacktriangleright start \\ \pi \times \text{sign}(angles\_start \blacktriangleright end) \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright end \stackrel{\pm}{=} \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} parities \blacktriangleright end \\ angles\_start \blacktriangleright start \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} 1 - parities \blacktriangleright end \\ \pi \times \text{sign}(angles\_start \blacktriangleright start) \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright end \stackrel{\pm}{=} \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} parities \blacktriangleright end \\ angles\_start \blacktriangleright end \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} 1 - parities \blacktriangleright end \\ \pi \times \text{sign}(angles\_start \blacktriangleright end) \end{bmatrix} \end{bmatrix}$

FO

$this \blacktriangleright \begin{bmatrix} objects \\ Arc2D \end{bmatrix}$ | $Arc2D$

$\boxed{=} \begin{bmatrix} interval\_angle\_Arc2D \\ Arc2D \blacktriangleright \text{interval\_angle} \end{bmatrix}$

$angles\_Arc2D = \textbf{index}(\text{position})$

$\boxed{=} \begin{bmatrix} angles\_Arc2D \blacktriangleright start \\ \frac{\pi}{2} + interval\_angle\_Arc2D \blacktriangleright start \end{bmatrix}$

$\boxed{=} \begin{bmatrix} angles\_Arc2D \blacktriangleright end \\ -\frac{\pi}{2} + interval\_angle\_Arc2D \blacktriangleright \text{end} \end{bmatrix}$

5 1 2

IF $\boxed{\vee} \begin{bmatrix} \boxed{\subseteq} \begin{bmatrix} Segment2D \blacktriangleright start \\ Arc2D \end{bmatrix} \\ \boxed{\subseteq} \begin{bmatrix} Segment2D \blacktriangleright end \\ Arc2D \end{bmatrix} \end{bmatrix}$

IF $\boxed{\subseteq} \begin{bmatrix} Segment2D \blacktriangleright start \\ Arc2D \end{bmatrix}$

$angle\_contact = Arc2D \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Segment2D \blacktriangleright start) \end{bmatrix}$

$angles\_contact = \textbf{index}(\text{sign})$

$\boxed{=} \begin{bmatrix} angles\_contact \blacktriangleright negative \\ angle\_contact - \frac{\pi}{2} \end{bmatrix}$

$\boxed{=} \begin{bmatrix} angles\_contact \blacktriangleright positive \\ angle\_contact + \frac{\pi}{2} \end{bmatrix}$

$sign\_start = \left| \text{sign} \left(\boxed{-} \begin{bmatrix} interval\_angle\_Arc2D \blacktriangleright \text{end} \\ angle\_contact \end{bmatrix} \right) \right|$

$angles \blacktriangleright start \overset{+}{=} \boxed{\times} \begin{bmatrix} sign\_start \\ signs \blacktriangleright start \\ \boxed{+} \begin{bmatrix} angles\_contact \blacktriangleright negative \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright start \overset{+}{=} \boxed{\times} \begin{bmatrix} sign\_start \\ signs \blacktriangleright start \\ \boxed{+} \begin{bmatrix} angles\_contact \blacktriangleright positive \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

IF $\boxed{\subseteq} \begin{bmatrix} Segment2D \blacktriangleright end \\ Arc2D \end{bmatrix}$

$angle\_contact = Arc2D \blacktriangleright \begin{bmatrix} center \\ \text{vector\_angle}(Segment2D \blacktriangleright end) \end{bmatrix}$

$angles\_contact = \textbf{index}(\text{sign})$

$\boxed{=} \begin{bmatrix} angles\_contact \blacktriangleright negative \\ angle\_contact - \frac{\pi}{2} \end{bmatrix}$

$\boxed{=} \begin{bmatrix} angles\_contact \blacktriangleright positive \\ angle\_contact + \frac{\pi}{2} \end{bmatrix}$

$sign\_end = \left| \text{sign} \left(\boxed{-} \begin{bmatrix} interval\_angle\_Arc2D \blacktriangleright start \\ angle\_contact \end{bmatrix} \right) \right|$

$angles \blacktriangleright end \overset{+}{=} \boxed{\times} \begin{bmatrix} sign\_end \\ signs \blacktriangleright end \\ \boxed{+} \begin{bmatrix} angles\_contact \blacktriangleright negative \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright end \overset{+}{=} \boxed{\times} \begin{bmatrix} sign\_end \\ signs \blacktriangleright end \\ \boxed{+} \begin{bmatrix} angles\_contact \blacktriangleright positive \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$

next level

5 1 2 1

IF $\boxed{\vee}\left[\begin{array}{l}\boxed{\subseteq}\left[\begin{array}{l}Arc2D \blacktriangleright start\\ Segment2D\end{array}\right]\\ \boxed{\subseteq}\left[\begin{array}{l}Arc2D \blacktriangleright end\\ Segment2D\end{array}\right]\end{array}\right]$

IF $\boxed{\subseteq}\left[\begin{array}{l}Arc2D \blacktriangleright start\\ Segment2D\end{array}\right]$

$angles \blacktriangleright start \stackrel{+}{=} \pi \times \text{sign}\left(\begin{array}{l}\boxed{\times}\left[\begin{array}{l}signs \blacktriangleright start\\ \boxed{+}\left[\begin{array}{l}angles\_Arc2D \blacktriangleright start\\ -angles\_Segment2D \blacktriangleright start\\ -\pi\end{array}\right]\end{array}\right]\\ 1\end{array}\right)$

$angles \blacktriangleright end \stackrel{+}{=} \pi \times \text{sign}\left(\begin{array}{l}\boxed{\times}\left[\begin{array}{l}signs \blacktriangleright end\\ \boxed{+}\left[\begin{array}{l}angles\_Arc2D \blacktriangleright start\\ -angles\_Segment2D \blacktriangleright end\\ -\pi\end{array}\right]\end{array}\right]\\ 1\end{array}\right)$

IF $\boxed{\subseteq}\left[\begin{array}{l}Arc2D \blacktriangleright end\\ Segment2D\end{array}\right]$

$angles \blacktriangleright start \stackrel{+}{=} \pi \times \text{sign}\left(\boxed{\times}\left[\begin{array}{l}signs \blacktriangleright start\\ \boxed{+}\left[\begin{array}{l}angles\_Arc2D \blacktriangleright end\\ -angles\_Segment2D \blacktriangleright start\\ -\pi\end{array}\right]\end{array}\right]\right)$

$angles \blacktriangleright end \stackrel{+}{=} \pi \times \text{sign}\left(\boxed{\times}\left[\begin{array}{l}signs \blacktriangleright end\\ \boxed{+}\left[\begin{array}{l}angles\_Arc2D \blacktriangleright end\\ -angles\_Segment2D \blacktriangleright end\\ -\pi\end{array}\right]\end{array}\right]\right)$

$Arc2D \blacktriangleright \text{is\_tangent}(Segment2D)$

$\boxed{=}\left[\begin{array}{l}angles\_Arc2D\_Segment2D\\ \textbf{index}(\text{position})\end{array}\right]$

$angles\_Arc2D\_Segment2D \blacktriangleright start = Arc2D \blacktriangleright \left[\begin{array}{l}center\\ \text{vector\_angle}(Segment2D \blacktriangleright start)\end{array}\right]$

$angles\_Arc2D\_Segment2D \blacktriangleright end = Arc2D \blacktriangleright \left[\begin{array}{l}center\\ \text{vector\_angle}(Segment2D \blacktriangleright end)\end{array}\right]$

$sign = \text{sign}\left(\begin{array}{l}\pi - \text{polar}\left(\boxed{-}\left[\begin{array}{l}angles\_Arc2D\_Segment2D \blacktriangleright end\\ angles\_Arc2D\_Segment2D \blacktriangleright start\end{array}\right]\right)\\ 1\end{array}\right)$

$angles \blacktriangleright start \stackrel{+}{=} \boxed{\times}\left[\begin{array}{l}sign\\ angles\_Arc2D\_Segment2D \blacktriangleright start\end{array}\right]$

$angles \blacktriangleright end \stackrel{+}{=} \boxed{\times}\left[\begin{array}{l}sign\\ angles\_Arc2D\_Segment2D \blacktriangleright end\end{array}\right]$

FO | $this \blacktriangleright \begin{bmatrix} objects \\ Face2D \end{bmatrix}$ | $Face2D$

FO | $0 \leq i < |Face2D \blacktriangleright vertices|$

$edge\_i = \textbf{Segment2D}\begin{pmatrix} Face2D \blacktriangleright vertices[i] \\ Face2D \blacktriangleright vertices[i+1] \end{pmatrix}$

IF | $\boxed{\subseteq}\begin{bmatrix} Segment2D \blacktriangleright start \\ edge\_i \end{bmatrix}$

$signs\_start = \textbf{index}(\text{position})$

$signs\_start \blacktriangleright start = 1 - \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Segment2D \blacktriangleright start \\ edge\_i \blacktriangleright start \end{bmatrix}\right|\right)$

$signs\_start \blacktriangleright start = 1 - \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Segment2D \blacktriangleright start \\ edge\_i \blacktriangleright end \end{bmatrix}\right|\right)$

$angles\_edge\_i = \textbf{index}(\text{position})$

$\boxed{=}\begin{bmatrix} angles\_edge\_i \blacktriangleright end \\ edge\_i \blacktriangleright \text{vector\_angle} \end{bmatrix}$

$\boxed{=}\begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ 2\pi - angles\_edge\_i \blacktriangleright end \end{bmatrix}$

$angles \blacktriangleright start \overset{\pm}{=} \boxed{\times}\begin{bmatrix} signs\_start \blacktriangleright start \\ signs \blacktriangleright start \\ \boxed{+}\begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright start \overset{\pm}{=} \boxed{\times}\begin{bmatrix} signs\_start \blacktriangleright end \\ signs \blacktriangleright start \\ \boxed{+}\begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

$\boxed{\subseteq}\begin{bmatrix} Segment2D \blacktriangleright end \\ edge\_i \end{bmatrix}$

$signs\_end = \textbf{index}(\text{position})$

$signs\_end \blacktriangleright start = 1 - \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Segment2D \blacktriangleright end \\ edge\_ \blacktriangleright start \end{bmatrix}\right|\right)$

$signs\_end \blacktriangleright end = 1 - \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Segment2D \blacktriangleright end \\ edge\_ \blacktriangleright end \end{bmatrix}\right|\right)$

$angles\_edge\_i = \textbf{index}(\text{position})$

$\boxed{=}\begin{bmatrix} angles\_edge\_i \blacktriangleright end \\ edge\_i \blacktriangleright \text{vector\_angle} \end{bmatrix}$

$\boxed{=}\begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ 2\pi - angles\_edge\_i \blacktriangleright end \end{bmatrix}$

$angles \blacktriangleright end \overset{\pm}{=} \boxed{\times}\begin{bmatrix} signs\_end \blacktriangleright start \\ signs \blacktriangleright end \\ \boxed{+}\begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright end \overset{\pm}{=} \boxed{\times}\begin{bmatrix} signs\_end \blacktriangleright end \\ signs \blacktriangleright end \\ \boxed{+}\begin{bmatrix} angles\_edge\_i \blacktriangleright end \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$

5 1 3

FO

$this \blacktriangleright \begin{bmatrix} objects \\ Path2D \end{bmatrix}$ | $Path2D$

$\boxed{=} \begin{bmatrix} vertices \\ Path2D \blacktriangleright vertices \end{bmatrix}$

FO $0 \leq i \leq |vertices| - 2$

$edge\_i = \mathbf{Segment2D} \begin{pmatrix} vertices[i] \\ vertices[i+1] \end{pmatrix}$

IF $\boxed{\subseteq} \begin{bmatrix} Segment2D \blacktriangleright start \\ edge\_i \end{bmatrix}$

$signs\_start = \mathbf{index}(\text{position})$

$signs\_start \blacktriangleright start = 1 - \text{sign}\left(\left|\boxed{-} \begin{bmatrix} Segment2D \blacktriangleright start \\ edge\_i \blacktriangleright start \end{bmatrix}\right|\right)$

$signs\_start \blacktriangleright end = 1 - \text{sign}\left(\left|\boxed{-} \begin{bmatrix} Segment2D \blacktriangleright start \\ edge\_i \blacktriangleright end \end{bmatrix}\right|\right)$

$signs\_start\_i = \mathbf{index}(\text{position})$

$\boxed{=} \begin{bmatrix} angles\_edge\_i \blacktriangleright end \\ edge\_i \blacktriangleright \text{vector\_angle} \end{bmatrix}$

$\boxed{=} \begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ 2\pi - angles\_edge\_i \blacktriangleright end \end{bmatrix}$

$angles \blacktriangleright start \stackrel{+}{=} \boxed{\times} \begin{bmatrix} signs\_start \blacktriangleright start \\ signs \blacktriangleright start \\ \boxed{+} \begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright start \stackrel{+}{=} \boxed{\times} \begin{bmatrix} signs\_start \blacktriangleright end \\ signs \blacktriangleright start \\ \boxed{+} \begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

$signs\_end = \mathbf{index}(\text{position})$

$signs\_end \blacktriangleright start = 1 - \text{sign}\left(\left|\boxed{-} \begin{bmatrix} Segment2D \blacktriangleright end \\ edge\_i \blacktriangleright start \end{bmatrix}\right|\right)$

$signs\_end \blacktriangleright end = 1 - \text{sign}\left(\left|\boxed{-} \begin{bmatrix} egment2D \blacktriangleright end \\ edge\_i \blacktriangleright end \end{bmatrix}\right|\right)$

$angles\_edge\_i = \mathbf{index}(\text{postion})$

$\boxed{=} \begin{bmatrix} angles\_edge\_i \blacktriangleright end \\ edge\_i \blacktriangleright \text{vector\_angle} \end{bmatrix}$

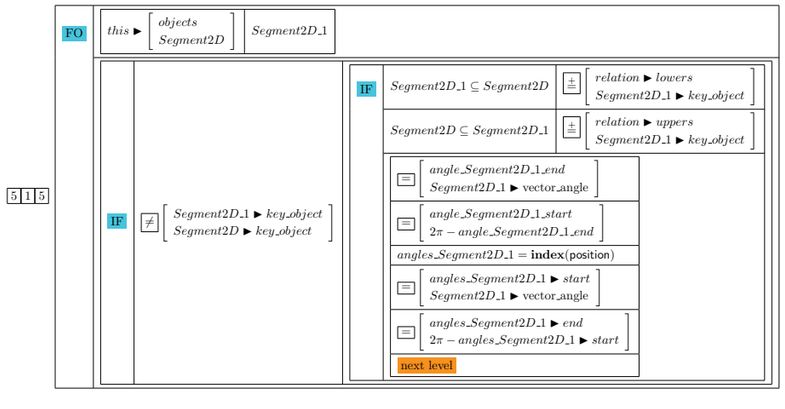
$\boxed{=} \begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ 2\pi - angles\_edge\_i \blacktriangleright end \end{bmatrix}$

$angles \blacktriangleright end \stackrel{+}{=} \boxed{\times} \begin{bmatrix} signs\_end \blacktriangleright start \\ signs \blacktriangleright end \\ \boxed{+} \begin{bmatrix} angles\_edge\_i \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$

$angles \blacktriangleright end \stackrel{+}{=} \boxed{\times} \begin{bmatrix} signs\_end \blacktriangleright end \\ signs \blacktriangleright end \\ \boxed{+} \begin{pmatrix} angles\_edge\_i \blacktriangleright end \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{pmatrix} \end{bmatrix}$

$\boxed{\subseteq} \begin{bmatrix} Segment2D \blacktriangleright end \\ edge\_i \end{bmatrix}$

$\boxed{5}\boxed{1}\boxed{4}$


5 1 5
FO
this ▶ objects Segment2D
Segment2D_1
IF
≠ Segment2D_1 ▶ key_object Segment2D ▶ key_object
IF
Segment2D_1 ⊆ Segment2D
± relation ▶ lowers Segment2D_1 ▶ key_object
Segment2D ⊆ Segment2D_1
± relation ▶ uppers Segment2D_1 ▶ key_object
= angle_Segment2D_1_end Segment2D_1 ▶ vector_angle
= angle_Segment2D_1_start 2π − angle_Segment2D_1_end
angles_Segment2D_1 = index(position)
= angles_Segment2D_1 ▶ start Segment2D_1 ▶ vector_angle
= angles_Segment2D_1 ▶ end 2π − angles_Segment2D_1 ▶ start
next level

5 1 5 1

IF $\boxed{\in}\begin{bmatrix} Segment2D \blacktriangleright start \\ Segment2D\_1 \end{bmatrix}$

- $signs\_start = \textbf{index}(\text{position})$
- $signs\_start \blacktriangleright start = 1 - \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Segment2D \blacktriangleright start \\ Segment2D\_1 \blacktriangleright end \end{bmatrix}\right|\right)$
- $signs\_start \blacktriangleright end = 1 - \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Segment2D \blacktriangleright start \\ Segment2D\_1 \blacktriangleright start \end{bmatrix}\right|\right)$
- $angles \blacktriangleright start \overset{\pm}{=} \boxed{\times}\begin{bmatrix} signs\_start \blacktriangleright start \\ signs \blacktriangleright start \\ \boxed{+}\begin{bmatrix} angles\_Segment2D\_1 \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$
- $angles \blacktriangleright start \overset{\pm}{=} \boxed{\times}\begin{bmatrix} signs\_start \blacktriangleright end \\ signs \blacktriangleright start \\ \boxed{+}\begin{bmatrix} angles\_Segment2D\_1 \blacktriangleright end \\ -angles\_Segment2D \blacktriangleright start \\ -\pi \end{bmatrix} \end{bmatrix}$

$\boxed{\subseteq}\begin{bmatrix} Segment2D \blacktriangleright end \\ Segment2D\_1 \end{bmatrix}$

- $signs\_end = \textbf{index}(\text{position})$
- $signs\_end \blacktriangleright start = 1 - \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Segment2D \blacktriangleright end \\ Segment2D\_ \blacktriangleright end \end{bmatrix}\right|\right)$
- $signs\_end \blacktriangleright end = 1 - \text{sign}\left(\left|\boxed{-}\begin{bmatrix} Segment2D \blacktriangleright end \\ Segment2D\_ \blacktriangleright start \end{bmatrix}\right|\right)$
- $angles \blacktriangleright end \overset{\pm}{=} \boxed{\times}\begin{bmatrix} sign\_end \blacktriangleright start \\ signs \blacktriangleright end \\ \boxed{+}\begin{bmatrix} angles\_Segment2D_1 \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$
- $angles \blacktriangleright end \overset{\pm}{=} \boxed{\times}\begin{bmatrix} sign\_end \blacktriangleright end \\ signs \blacktriangleright end \\ \boxed{+}\begin{bmatrix} angles\_Segment2D_1 \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \end{bmatrix}$

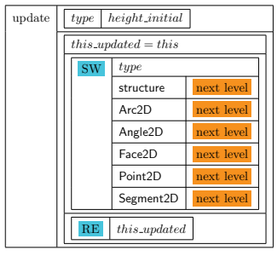
$\boxed{\subseteq}\begin{bmatrix} Segment2D\_1 \blacktriangleright start \\ Segment2D \end{bmatrix}$

- $signs\_end = \textbf{index}(\text{position})$
- $signs\_end \blacktriangleright start = \text{sign}\left(\begin{matrix}\boxed{+}\begin{bmatrix} angles\_Segment2D\_1 \blacktriangleright end \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \\ 1\end{matrix}\right)$
- $signs\_end \blacktriangleright end = \text{sign}\left(\begin{matrix}\boxed{+}\begin{bmatrix} -angles\_Segment2D\_1 \blacktriangleright end \\ +angles\_Segment2D \blacktriangleright start \\ +\pi \end{bmatrix} \\ 1\end{matrix}\right)$
- $\boxed{\overset{\pm}{=}}\begin{bmatrix} angles \blacktriangleright start \\ \pi \times sign\_end \blacktriangleright start \end{bmatrix}$
- $\boxed{\overset{\pm}{=}}\begin{bmatrix} angles \blacktriangleright end \\ \pi \times sign\_end \blacktriangleright end \end{bmatrix}$

$\boxed{\subseteq}\begin{bmatrix} Segment2D\_1 \blacktriangleright end \\ Segment2D \end{bmatrix}$

- $signs\_start = \textbf{index}(\text{position})$
- $signs\_start \blacktriangleright start = \text{sign}\left(\begin{matrix}\boxed{+}\begin{bmatrix} angles\_Segment2D\_1 \blacktriangleright start \\ -angles\_Segment2D \blacktriangleright end \\ -\pi \end{bmatrix} \\ 1\end{matrix}\right)$
- $signs\_start \blacktriangleright end = \text{sign}\left(\begin{matrix}\boxed{+}\begin{bmatrix} -angles\_Segment2D\_1 \blacktriangleright start \\ +angles\_Segment2D \blacktriangleright start \\ +\pi \end{bmatrix} \\ 1\end{matrix}\right)$
- $\boxed{\overset{\pm}{=}}\begin{bmatrix} angles \blacktriangleright end \\ \pi \times signs\_start \blacktriangleright start \end{bmatrix}$
- $\boxed{\overset{\pm}{=}}\begin{bmatrix} angles \blacktriangleright end \\ \pi \times signs\_start \blacktriangleright end \end{bmatrix}$

5. update: update status


update
type
height_initial
this_updated = this
SW
type
structure
next level
Arc2D
next level
Angle2D
next level
Face2D
next level
Point2D
next level
Segment2D
next level
RE
this_updated

1 structure

FO

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Angle2D \end{bmatrix}$ | $Angle2D$

$this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Angle2D \blacktriangleright key \\ \text{struct} \\ \text{styleheight} \end{bmatrix} = Angle2D \blacktriangleright height$

FO

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Arc2D \end{bmatrix}$ | $Arc2D$

IF $this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Arc2D \blacktriangleright key \\ \text{struct} \\ \text{measure} \\ \text{type} \end{bmatrix} \neq \text{Blank}$ | $this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Arc2D \blacktriangleright key \\ \text{struct} \\ \text{measure} \\ \text{style} \\ \text{height} \end{bmatrix} = Arc2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix}$

FO

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D \end{bmatrix}$ | $Label2D$

$this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Label2D \blacktriangleright key \\ \text{struct} \\ \text{coords} \\ \text{center} \\ \text{x} \end{bmatrix} = Label2D \blacktriangleright \begin{bmatrix} center \\ x \end{bmatrix}$

$this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Label2D \blacktriangleright key \\ \text{struct} \\ \text{coords} \\ \text{center} \\ \text{y} \end{bmatrix} = Label2D \blacktriangleright \begin{bmatrix} center \\ y \end{bmatrix}$

$this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Label2D \blacktriangleright key \\ \text{struct} \\ \text{coords} \\ \text{target} \\ \text{x} \end{bmatrix} = Label2D \blacktriangleright \begin{bmatrix} target \\ x \end{bmatrix}$

$this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Label2D \blacktriangleright key \\ \text{struct} \\ \text{coords} \\ \text{target} \\ \text{y} \end{bmatrix} = Label2D \blacktriangleright \begin{bmatrix} center \\ y \end{bmatrix}$

FO

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Segment2D \end{bmatrix}$ | $Segment2D$

IF $this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Segment2D \blacktriangleright key \\ \text{struct} \\ \text{measure} \\ \text{type} \end{bmatrix} \neq \text{Blank}$ | $this\_updated \blacktriangleright structure \begin{bmatrix} \text{elements} \\ Segment2D \blacktriangleright key \\ \text{struct} \\ \text{meausure} \\ \text{style} \\ \text{height} \end{bmatrix} = Segment2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix}$

2 Arc2D

$[=] \begin{bmatrix} info \\ this\_updated \blacktriangleright \text{info}(type) \end{bmatrix}$

$height\_increment = \frac{1}{2}$

next level

FO $0 \leq i \leq info \blacktriangleright \begin{bmatrix} poset \\ rank\_max \end{bmatrix}$

FO $info \blacktriangleright poset[i]$ | $relation$

$Arc2D = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Arc2D[relation \blacktriangleright element] \end{bmatrix}$

$height\_max = height\_initial$

FO $relation \blacktriangleright lowers$ | $lower$

$Arc2D\_lower = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Arc2D[lower] \end{bmatrix}$

IF $this\_updated \blacktriangleright \begin{bmatrix} objects \\ Arc2D[lower] \\ measure \\ key\_label \end{bmatrix} \neq \emptyset$

$this\_measure\_lower = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D[Arc2D\_lower] \\ measure \\ key\_label \end{bmatrix}$

$height\_max = \max \left(\begin{bmatrix} height\_max \\ Arc2D \blacktriangleright \begin{bmatrix} measure \\ \text{height\_contact} \left(\begin{matrix} label\_measure\_lower \\ \mathsf{max} \end{matrix} \right) \end{bmatrix} \end{bmatrix} \right)$

$height\_max = \max \left(\begin{bmatrix} height\_max \\ \boxplus \begin{bmatrix} Arc2D \blacktriangleright \begin{bmatrix} meausure \\ height \end{bmatrix} \\ height\_increment \end{bmatrix} \end{bmatrix} \right)$

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Arc2D[relation \blacktriangleright element] \\ measure \\ height \end{bmatrix} = height\_max$

IF $\boxminus \begin{bmatrix} Arc2D \blacktriangleright key\_label \\ \emptyset \end{bmatrix}$ | CO

$label\_measure = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D[Arc2D \blacktriangleright key\_label] \end{bmatrix}$

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D \left[Arc2D \blacktriangleright \begin{bmatrix} measure \\ key\_label \end{bmatrix} \right] \\ center \end{bmatrix} = label\_measure \blacktriangleright \text{center} \left(\begin{matrix} Arc2D \\ Arc2D \blacktriangleright \text{interval\_angle} \end{matrix} \right)$

2 1

3 Angle2D

$$\boxed{=}\begin{bmatrix} info \\ this\_updated \blacktriangleright \text{info}(type) \end{bmatrix}$$

$$ration\_right = \frac{1}{\sqrt{2}}$$

$$height\_increment = \frac{1}{2}$$

$$\boxed{=}\begin{bmatrix} intervals\_angle\_forbidden \\ \emptyset \end{bmatrix}$$

FO $0 \leq i \leq info \blacktriangleright \begin{bmatrix} poset \\ rank\_max \end{bmatrix}$

FO $\boxed{info \blacktriangleright poset[i]}\ \boxed{relation}$

$$Angle2D = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Angle2D[relation \blacktriangleright element] \end{bmatrix}$$

$$parity = \text{intval}\left(Angle2D \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix}\right)$$

$$height\_max = \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} parity \\ ratio\_right \\ height\_initial \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} 1 - parity \\ height\_initial \end{bmatrix} \end{bmatrix}$$

$$\boxed{=}\begin{bmatrix} intervals\_angle\_forbidden[relation \blacktriangleright element] \\ \boxed{\pm}\begin{bmatrix} Intervals\_angle\_forbidden \\ Angle2D\_lower \blacktriangleright \text{interval\_angle} \end{bmatrix} \end{bmatrix}$$

IF $\boxed{\neq}\begin{bmatrix} Angle2D\_lower \blacktriangleright key\_label \\ \emptyset \end{bmatrix}$

$$height\_max = \max\left(\begin{matrix} height\_max \\ Angle2D\_lower \blacktriangleright \text{height\_contact}\left(\begin{matrix} this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D[Angle2D\_lower \blacktriangleright key\_label] \end{bmatrix} \\ \text{min} \end{matrix}\right) \end{matrix}\right)$$

$$\boxed{\bigcup}\begin{bmatrix} union\_forbidden \\ \boxed{\pm}\begin{bmatrix} intervals\_angle\_forbidden[lower] \\ \left(Angle2D \blacktriangleright \begin{bmatrix} center \\ \text{interval\_angle\_forbidden}\left(this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D[Angle2D\_lower \blacktriangleright key\_label] \end{bmatrix}\right) \end{bmatrix}\right) \end{bmatrix} \end{bmatrix}$$

$$height\_max = \max\left(\begin{matrix} height\_max \\ \boxed{+}\begin{bmatrix} Angle2D\_lower \blacktriangleright height \\ height\_increment \end{bmatrix} \end{matrix}\right)$$

$$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Angle2D[relation \blacktriangleright element] \\ height \end{bmatrix} = height\_max$$

IF $\boxed{\equiv}\begin{bmatrix} Angle2D \blacktriangleright key\_label \\ \emptyset \end{bmatrix}$ **CO**

$$info \blacktriangleright \begin{bmatrix} objects[relatino \blacktriangleright element] \\ label \\ intervals\_angle \end{bmatrix} = info \blacktriangleright \begin{bmatrix} objects[relation \blacktriangleright element] \\ label \\ intervals\_angle \\ \text{difference}(union\_forbidden) \end{bmatrix}$$

$$interval\_angle = info \blacktriangleright \begin{bmatrix} objects[relation \blacktriangleright element] \\ label \\ intervals\_angle[0] \end{bmatrix}$$

$$this\_update \blacktriangleright \begin{bmatrix} objects \\ Label2D[Angle2D \blacktriangleright key\_label] \\ center \end{bmatrix} = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D[Angle2D \blacktriangleright key\_label] \\ \text{center}\left(\begin{matrix} Angle2D \\ interval\_angle \end{matrix}\right) \end{bmatrix}$$

4 Face2D

FO $this\_updated \blacktriangleright \begin{bmatrix} objects \\ Face2D \end{bmatrix}$ | $Face2D$

IF $\boxed{\neq} \begin{bmatrix} Face2D \blacktriangleright key\_label \\ \emptyset \end{bmatrix}$ | $this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D[Face2D \blacktriangleright key\_label] \\ center \end{bmatrix} = this \blacktriangleright \begin{bmatrix} objects \\ Label2D[Face2D \blacktriangleright key\_label] \\ \text{center}(Face2D) \end{bmatrix}$

5 Point2D

$\boxed{=} \begin{bmatrix} info \\ this\_updated \blacktriangleright \text{info}(type) \end{bmatrix}$

FO $info \blacktriangleright \begin{bmatrix} objects \\ Point2D \end{bmatrix}$ | $Point2D$

IF $Point2D \blacktriangleright \begin{bmatrix} Angle2Ds \\ is\_surrounded \end{bmatrix} \equiv$ TR | $distance\_initial = 0$

$interval\_angle = info \blacktriangleright \begin{bmatrix} objects[Point2D \blacktriangleright key\_object] \\ label \\ intervals\_angle[0] \end{bmatrix}$

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D[Point2D \blacktriangleright key\_label] \\ center \end{bmatrix} = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D[Point2D \blacktriangleright key\_laebl] \\ \text{center} \begin{pmatrix} Point2D \\ interval\_angle \\ distance\_initial \end{pmatrix} \end{bmatrix}$

6 Segment2D

$\boxed{=} \begin{bmatrix} info \\ this\_updated \blacktriangleright \text{info}(type) \end{bmatrix}$

$height\_increment = \frac{1}{2}$

next level

6 1

FO $0 \leq i \leq info \blacktriangleright \begin{bmatrix} poset \\ rank\_max \end{bmatrix}$

next level

6 1 1

FO

$info \blacktriangleright poset[i]$	$relation$

$heights = \textbf{index}(\text{sign})$

$angles = \textbf{index}(\text{sign})$

$$Segment2D = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Segment2D[relation \blacktriangleright element] \end{bmatrix}$$

$$label\_measure = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D \left[Segment2D \blacktriangleright \begin{bmatrix} measure \\ key\_label \end{bmatrix} \right] \end{bmatrix}$$

$$angles \blacktriangleright positive = \min \left(\begin{matrix} Segment2D \blacktriangleright \begin{bmatrix} angles \\ start \\ positive \end{bmatrix} \\ Segment2D \blacktriangleright \begin{bmatrix} angles \\ end \\ positive \end{bmatrix} \end{matrix} \right)$$

$$angles \blacktriangleright negative = \min \left(\left| \begin{matrix} Segment2D \blacktriangleright \begin{bmatrix} angles \\ start \\ negative \end{bmatrix} \\ Segment2D \blacktriangleright \begin{bmatrix} angles \\ end \\ negative \end{bmatrix} \end{matrix} \right| \right)$$

$$\boxed{=} \begin{bmatrix} heights \blacktriangleright positive \\ height\_initial \end{bmatrix}$$

$$\boxed{=} \begin{bmatrix} heights \blacktriangleright negative \\ height\_initial \end{bmatrix}$$

next level

$$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Label2D \left[Segment2D \blacktriangleright \begin{bmatrix} measure \\ key\_label \end{bmatrix} \right] \ center \end{bmatrix} = label\_measure \blacktriangleright \text{center}(Segment2D \blacktriangleright measure)$$

6 1 1 1 IF $\max\begin{pmatrix} angles \blacktriangleright positive \\ angles \blacktriangleright negative \end{pmatrix} \equiv \frac{\pi}{2}$

$\boxed{=}\begin{bmatrix} angle\_element \\ Segment2D \blacktriangleright \text{vector\_angle} \end{bmatrix}$

IF $\boxed{\equiv}\begin{bmatrix} relation \blacktriangleright lowers \\ \emptyset \end{bmatrix}$

$sign = \text{sign}\begin{pmatrix} \pi - \text{polar}\left(angle\_element - \frac{3\pi}{2}\right) \\ 1 \end{pmatrix}$

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Segment2D[relation \blacktriangleright element] \\ measure \blacktriangleright height \end{bmatrix} = \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} \max\begin{pmatrix} sign \\ 0 \end{pmatrix} \\ heights \blacktriangleright positive \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} \min\begin{pmatrix} sign \\ 0 \end{pmatrix} \\ heights \blacktriangleright negative \end{bmatrix} \end{bmatrix}$

FO $info \blacktriangleright \begin{bmatrix} relations[relation \blacktriangleright element] \\ lowers \end{bmatrix} \mid lower$

$Segment2D\_lower = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Segment2D[lower] \end{bmatrix}$

$height\_label\_max = Segment2D \blacktriangleright \begin{bmatrix} measure \\ \text{height\_contact}\begin{pmatrix} Segment2D\_lower \blacktriangleright measure \\ label\_measure \\ \max \end{pmatrix} \end{bmatrix}$

$\boxed{=}\begin{bmatrix} angle\_lower \\ measure\_lower \blacktriangleright \text{vector\_angle} \end{bmatrix}$

$sign\_direction\_lower = \text{sign}\begin{pmatrix} \frac{\pi}{2} - \text{polar}\left(\boxed{-}\begin{bmatrix} angle\_lower \\ angle\_element \end{bmatrix}\right) \\ 1 \end{pmatrix}$

$sign\_height\_lower = \text{sign}\begin{pmatrix} Segment2D\_lower \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix} \\ 1 \end{pmatrix}$

$sign\_lower = \boxed{\times}\begin{bmatrix} sign\_direction\_lower \\ sign\_height \\ height\_lower \end{bmatrix}$

$heights \blacktriangleright positive = \max\begin{pmatrix} heights \blacktriangleright positive \\ \boxed{\times}\begin{bmatrix} \max\begin{pmatrix} sign\_lower \\ 0 \end{pmatrix} \\ height\_label\_max \end{bmatrix} \end{pmatrix}$

$heights \blacktriangleright negative = \max\begin{pmatrix} heights \blacktriangleright positive \\ \boxed{\times}\begin{bmatrix} -\min\begin{pmatrix} sign\_lower \\ 0 \end{pmatrix} \\ height\_label\_max \end{bmatrix} \end{pmatrix}$

$sign = \text{sign}\begin{pmatrix} \boxed{-}\begin{bmatrix} heights \blacktriangleright positive \\ heights \blacktriangleright negative \end{bmatrix} \\ 1 \end{pmatrix}$

$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Segment2D[relation \blacktriangleright element] \\ measure \blacktriangleright height \end{bmatrix} = \boxed{+}\begin{bmatrix} \boxed{\times}\begin{bmatrix} \max\begin{pmatrix} sign \\ 0 \end{pmatrix} \\ heights \blacktriangleright positive \end{bmatrix} \\ \boxed{\times}\begin{bmatrix} \min\begin{pmatrix} sign \\ 0 \end{pmatrix} \\ heights \blacktriangleright negative \end{bmatrix} \end{bmatrix}$

next level

6 1 1 1 1

FO

$relation \blacktriangleright lowers$ | $lower$

$$Segment2D\_lower = this\_updated \blacktriangleright \begin{bmatrix} objects \\ Segment2D[lower] \end{bmatrix}$$

$$height\_label\_max = Segment2D \blacktriangleright \begin{bmatrix} measure \\ \text{height\_contact} \left(\begin{array}{l} Segment2D\_lower \blacktriangleright measure \\ label\_measure \\ \mathsf{max} \end{array} \right) \end{bmatrix}$$

$$sign\_lower = \text{sign} \left(\begin{array}{l} Segment2D\_lower \blacktriangleright \begin{bmatrix} measure \\ height \end{bmatrix} \\ 1 \end{array} \right)$$

$$heights \blacktriangleright positive = \max \left(\begin{array}{l} heights \blacktriangleright positive \\ \boxed{\times} \begin{bmatrix} \max \left(\begin{array}{l} sign\_lower \\ 0 \end{array} \right) \\ height\_label\_max \end{bmatrix} \end{array} \right)$$

$$heights \blacktriangleright negative = \max \left(\begin{array}{l} heights \blacktriangleright positive \\ \boxed{\times} \begin{bmatrix} -\min \left(\begin{array}{l} sign\_lower \\ 0 \end{array} \right) \\ height\_label\_max \end{bmatrix} \end{array} \right)$$

$$heights \blacktriangleright positive = \min \left(\begin{array}{l} heights \blacktriangleright positive \\ Segment2D \blacktriangleright \begin{bmatrix} measure \\ \text{height}(angles \blacktriangleright positive) \end{bmatrix} \end{array} \right)$$

$$heights \blacktriangleright negative = \min \left(\begin{array}{l} heights \blacktriangleright positive \\ Segment2D \blacktriangleright \begin{bmatrix} measure \\ \text{height}(angles \blacktriangleright negative) \end{bmatrix} \end{array} \right)$$

$$sign = \text{sign} \left(\begin{array}{l} \boxed{-} \begin{bmatrix} angles \blacktriangleright positive \\ angles \blacktriangleright negative \end{bmatrix} \\ 1 \end{array} \right)$$

$$this\_updated \blacktriangleright \begin{bmatrix} objects \\ Segment2D[relation \blacktriangleright element] \\ measure \\ height \end{bmatrix} = \boxed{+} \begin{bmatrix} \boxed{\times} \begin{bmatrix} \max \left(\begin{array}{l} sign \\ 0 \end{array} \right) \\ heights \blacktriangleright positive \end{bmatrix} \\ \boxed{\times} \begin{bmatrix} \min \left(\begin{array}{l} sign \\ 0 \end{array} \right) \\ heights \blacktriangleright negative \end{bmatrix} \end{bmatrix}$$

1 Definition

string	
	method

2 Method

1.

javascript_to_php	*javscript*
	patterns = [Math.E | Math.LN2 | Math.LN10 | Math.LOG2E | Math.LOG10E | Math.PI | Math.SQRT1_2 | Math.SQRT2 | NaN | POSITIVE_INFINITY | NEGATIVE_INFINITY]
	replacements = [M_E | M_LN2 | M_LN2 | M_LN10 | M_LOG2E | M_LOG10E | M_PI | M_SQRT1_2 | M_SQRT2 | NAN | INF | -INF]
	RE: str_replace(Math. ∅ preg_replace(*patterns* *replacements* *javascript*))

2.

evaluation_xy	*x* | *y* | *expression*
	str_replace(× *x* str_replace(y *y* *expression*))

latex_separation	*string*

$parts = \emptyset$

IF	$string \equiv \emptyset$	RE	*parts*

$$funcitons\_length = \begin{bmatrix} \backslash\mathsf{frac} & \backslash\mathsf{nthroot} & \backslash\mathsf{sqrt} & \backslash\mathsf{text} \\ |\backslash\mathsf{frac}| & |\backslash\mathsf{nthroot}| & |\backslash\mathsf{sqrt}| & |\backslash\mathsf{text}| \end{bmatrix}$$

$$pairs = \begin{bmatrix} \backslash\mathsf{left}\{ & \backslash\mathsf{left}[& \backslash\mathsf{left}(& \backslash\mathsf{left}| \\ \backslash\mathsf{right}\} & \backslash\mathsf{right}] & \backslash\mathsf{right}) & \backslash\mathsf{right}| \end{bmatrix}$$

$$pairs\_left\_length = \begin{bmatrix} \backslash\mathsf{left}\backslash\{ & \backslash\mathsf{left}[& \backslash\mathsf{left}(& \backslash\mathsf{left}| \\ |\backslash\mathsf{left}\backslash\{| & |\backslash\mathsf{left}[| & |\backslash\mathsf{left}(| & |\backslash\mathsf{left}|| \end{bmatrix}$$

$$pairs\_right\_length = \begin{bmatrix} \backslash\mathsf{right}\backslash\} & \backslash\mathsf{right}] & \backslash\mathsf{right}) & \backslash\mathsf{right}| \\ |\backslash\mathsf{right}\backslash\}| & |\backslash\mathsf{right}]| & |\backslash\mathsf{right})| & |\backslash\mathsf{right}|| \end{bmatrix}$$

$$functions\_open\_length = \begin{bmatrix} \backslash & [& \{ & (& | \\ |\backslash| & |[| & |\{| & |(| & ||| \end{bmatrix}$$

$$alphabets\_lower = \begin{bmatrix} \mathsf{a} & \mathsf{b} & \mathsf{c} & \mathsf{d} & \mathsf{e} & \mathsf{f} & \mathsf{g} & \mathsf{h} & \mathsf{i} & \mathsf{j} & \mathsf{k} & \mathsf{l} & \mathsf{m} & \mathsf{n} & \mathsf{o} & \mathsf{p} & \mathsf{q} & \mathsf{r} & \mathsf{s} & \mathsf{t} & \mathsf{u} & \mathsf{v} & \mathsf{w} & \mathsf{x} & \mathsf{y} & \mathsf{z} \end{bmatrix}$$

$$alphabets\_upper = \begin{bmatrix} \mathsf{A} & \mathsf{B} & \mathsf{C} & \mathsf{D} & \mathsf{E} & \mathsf{F} & \mathsf{G} & \mathsf{H} & \mathsf{I} & \mathsf{J} & \mathsf{K} & \mathsf{L} & \mathsf{M} & \mathsf{N} & \mathsf{O} & \mathsf{P} & \mathsf{Q} & \mathsf{R} & \mathsf{S} & \mathsf{T} & \mathsf{U} & \mathsf{V} & \mathsf{W} & \mathsf{X} & \mathsf{Y} & \mathsf{Z} \end{bmatrix}$$

3. $$alphabets = \boxed{\cup} \begin{bmatrix} alphabets\_lower \\ alphabets\_upper \end{bmatrix}$$

WH	$string \neq \emptyset$

next level

next level

next level

next level

next level

next level

next level

$parts = \emptyset$

$part[\mathsf{type}] = \mathsf{character}$

$$parts[\mathsf{value}] = \mathrm{substr}\begin{pmatrix} string \\ 0 \\ 1 \end{pmatrix}$$

$$parts \overset{+}{=} part$$

$$string = \mathrm{substr}\begin{pmatrix} string \\ 1 \end{pmatrix}$$

WH substr $\begin{pmatrix} string \\ 0 \\ functions\_length[\backslash\mathsf{frac}] \end{pmatrix} \equiv \backslash\mathsf{frac}$

$\boxed{=}\begin{bmatrix} key\_numerator\_start \\ functions\_length[\backslash\mathsf{frac}] \end{bmatrix}$

FO $key\_numerator\_start \leq i < |string|$

$character = \text{substr}\begin{pmatrix} string \\ i \\ 1 \end{pmatrix}$

IF		
	$character \equiv \{$	$\overset{+}{+}parenthesis\_sign$
	$character \equiv \}$	$\overset{-}{-}parenthesis\_sign$

IF		
	$\boxed{\equiv}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$	$part = \emptyset$
		$part[\mathsf{type}] = \backslash\mathsf{frac}$
		$part[\mathsf{value}] = \emptyset$
		$part\begin{bmatrix} \mathsf{value} \\ \mathsf{numerator} \end{bmatrix} = \text{substr}\begin{pmatrix} string \\ key\_numerator\_start \\ i - key\_numerator\_start \end{pmatrix}$
		$\boxed{=}\begin{bmatrix} key\_denominator\_start \\ i+2 \end{bmatrix}$
		BR

$parenthesis\_sign = 0$

FO $key\_denominator\_start \leq i < |string|$

$character = \text{substr}\begin{pmatrix} string \\ i \\ 1 \end{pmatrix}$

IF		
	$character \equiv \{$	$\overset{+}{+}parenthesis\_sign$
	$character \equiv \}$	$\overset{-}{-}parenthesis\_sign$

IF		
	$\boxed{\equiv}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$	$part\begin{bmatrix} \mathsf{value} \\ \mathsf{denominator} \end{bmatrix} = \text{substr}\begin{pmatrix} string \\ key\_denominator\_start \\ i - key\_denominator\_start \end{pmatrix}$
		$parts \overset{+}{=} part$
		$string = substr\begin{pmatrix} string \\ i+1 \end{pmatrix}$
		BR

2

FO | $pairs\_left\_length$ | $pair\_left$ | $pair\_left\_length$

WH | substr $\begin{pmatrix} string \\ 0 \\ pair\_left\_length \end{pmatrix} \equiv pair\_left$

$\boxed{=} \begin{bmatrix} key\_pair\_start \\ pair\_left\_length \end{bmatrix}$

$\boxed{=} \begin{bmatrix} pair\_right\_length \\ pairs\_right\_length\,[pairs[pair\_left]] \end{bmatrix}$

$parenthesis\_sign = 0$

FO | $key\_parenthesis\_start \leq i < |string|$

IF | substr $\begin{pmatrix} string \\ 0 \\ pair\_left\_length \end{pmatrix} \equiv pair\_left$ | $\overset{+}{+} parenthesis\_sign$

| substr $\begin{pmatrix} string \\ 0 \\ pair\_right\_length \end{pmatrix} \equiv \emptyset$ | $\overset{-}{-} parenthesis\_sign$

IF | $\boxed{\equiv} \begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

$part = \emptyset$

$part[\text{type}] = pair\_left$

$part[\text{value}] = \text{substr} \begin{pmatrix} string \\ i - key\_parenthesis\_start \end{pmatrix}$

$parts \overset{+}{=} part$

$string = \text{substr} \begin{pmatrix} string \\ i + pair\_right\_length \end{pmatrix}$

BR

WH $\text{substr}\begin{pmatrix} string \\ 0 \\ functions\_length[\backslash\text{nthroot}] \end{pmatrix} \equiv \backslash\text{nthroot}$

$\boxed{=}\begin{bmatrix} key\_index\_start \\ functions\_length[\backslash\text{nthroot}] \end{bmatrix}$

$\boxed{=}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

FO $key\_index\_start \leq i < |string|$

$character = \text{substr}\begin{pmatrix} string \\ i \\ 1 \end{pmatrix}$

IF		
	$character \equiv [$	$\overset{+}{+}parenthesis\_sign$
	$character \equiv]$	$\overset{-}{-}parenthesis\_sign$

IF $\boxed{\equiv}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

$part = \emptyset$

$part[\text{type}] = \backslash\text{nthroot}$

$part[\text{value}] = \emptyset$

$part\begin{bmatrix} \text{value} \\ \text{index} \end{bmatrix} = \text{substr}\begin{pmatrix} string \\ key\_index\_start \\ i - key\_index\_start \end{pmatrix}$

$\boxed{=}\begin{bmatrix} key\_radicand\_start \\ i+1 \end{bmatrix}$

BR

$\boxed{=}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

FO $key\_radicand\_start \leq i < |string|$

$character = \text{substr}\begin{pmatrix} string \\ i \\ 1 \end{pmatrix}$

IF		
	$character \equiv \{$	$\overset{+}{+}parenthesis\_sign$
	$character \equiv \}$	$\overset{-}{-}parenthesis\_sign$

IF $\boxed{\equiv}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

$part\begin{bmatrix} \text{value} \\ \text{radicand} \end{bmatrix} = \text{substr}\begin{pmatrix} string \\ key\_radicand\_start \\ i - key\_radicand\_start \end{pmatrix}$

$parts \overset{+}{=} part$

$string = \text{substr}\begin{pmatrix} string \\ i+1 \end{pmatrix}$

BR

3

4

WH substr $\begin{pmatrix} string \\ 0 \\ functions\_length[\backslash\mathsf{sqrt}] \end{pmatrix} \equiv \backslash\mathsf{sqrt}$

$\boxed{=}\begin{bmatrix} key\_sqrt\_start \\ i + functions\_length[\backslash\mathsf{sqrt}] \end{bmatrix}$

$\boxed{=}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

FO $key\_sqrt\_start \leq i < |string|$

$character = \text{substr}\begin{pmatrix} string \\ i \\ 1 \end{pmatrix}$

IF

$character \equiv \{$	$\overset{+}{+} parenthesis\_sign$
$character \equiv \}$	$\overset{-}{-} parenthesis\_sign$

IF $\boxed{\equiv}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

$part = \emptyset$

$part[\mathsf{type}] = \backslash\mathsf{sqrt}$

$part[\mathsf{value}] = \text{substr}\begin{pmatrix} string \\ i - key\_sqrt\_start \end{pmatrix}$

$parts \overset{+}{=} part$

$string = \text{substr}\begin{pmatrix} string \\ i + 1 \end{pmatrix}$

BR

5

WH substr $\begin{pmatrix} string \\ 0 \\ functions\_length[\backslash\mathsf{text}] \end{pmatrix} \equiv \backslash\mathsf{text}$

$\boxed{=}\begin{bmatrix} key\_text\_start \\ functions\_length[\backslash\mathsf{text}] \end{bmatrix}$

$\boxed{=}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

FO $key\_text\_start \leq i < |string|$

$character = \text{substr}\begin{pmatrix} string \\ i \\ 1 \end{pmatrix}$

IF

$character \equiv \{$	$\overset{+}{+} parenthesis\_sign$
$character \equiv \}$	$\overset{-}{-} parenthesis\_sign$

IF $\boxed{\equiv}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

$part = \emptyset$

$part[\mathsf{type}] = \backslash\mathsf{text}$

$part[\mathsf{value}] = \text{substr}\begin{pmatrix} string \\ i - key\_text\_start \end{pmatrix}$

$parts \overset{+}{=} part$

$string = \text{substr}\begin{pmatrix} string \\ i + 1 \end{pmatrix}$

BR

6

SW

∨ substr(string, 1, 1) ≡ ∧

substr(string, 0, 1) ≡ {

IF substr(string, 1, 1) ≡ ∧

part = ∅

part[type] = ∧

part[value] = ∅

part[value, base] = substr(string, 0, 1)

next level

substr(string, 0, 1) ≡ {

is_power = TR

[=] key_base_start, 1

[=] parenthesis_sign, 0

next level

next level

IF substr(string, 2, 1) ≠ {

part[value, power] = substr(string, 1, 1)

parts ≐ part

[=] key_power_start, 2

[=] parenthesis_sign, 0

6 1

FO key_power_start ≤ i < |string|

character = substr(string, i, 1)

IF character ≡ { | +parenthesis_sign

character ≡ } | −parentehsis_sign

IF [≡] parenthesis_sign, 0

part[value, power] = substr(string, i − key_power_start)

parts ≐ part

string = substr(string, i + 1)

BR

6 2

FO $1 \leq i < |string|$

$character = \text{substr}\begin{pmatrix} string \\ i \\ 1 \end{pmatrix}$

IF		
	$character \equiv \{$	$\overset{+}{+}parenthesis\_sign$
	$character \equiv \}$	$\overset{-}{-}parenthesis\_sign$

IF $\boxed{\equiv}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

IF $\text{substr}\begin{pmatrix} string \\ i+1 \\ 1 \end{pmatrix} \equiv \wedge$

$part = \emptyset$

$part[\mathsf{type}] = \wedge$

$part[\mathsf{value}] = \emptyset$

$part\begin{bmatrix} \mathsf{value} \\ \mathsf{base} \end{bmatrix} = \text{substr}\begin{pmatrix} string \\ key\_base\_start \\ i - key\_base\_start \end{pmatrix}$

$\boxed{=}\begin{bmatrix} key\_power\_symbol \\ i+1 \end{bmatrix}$

BR

$part = \emptyset$

$part[\mathsf{type}] = \{$

$part[\mathsf{value}] = \text{substr}\begin{pmatrix} string \\ key\_base\_start \\ i - key\_base\_start \end{pmatrix}$

$parts \overset{+}{=} part$

$is\_power =$ FA

$string = \text{substr}\begin{pmatrix} string \\ i+1 \end{pmatrix}$

BR

6 3 IF is_power

IF $\text{substr}\begin{pmatrix} string \\ key\_power\_symbol + 1 \\ 1 \end{pmatrix} \neq \{$ | $part\begin{bmatrix} \mathsf{value} \\ \mathsf{power} \end{bmatrix} = \text{substr}\begin{pmatrix} string \\ key\_power\_symbol + 1 \\ 1 \end{pmatrix}$

$\boxed{=}\begin{bmatrix} key\_power\_start \\ key\_power\_symbol + 2 \end{bmatrix}$

$\boxed{=}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

FO $\boxed{=}\begin{bmatrix} i \\ key\_power\_start \end{bmatrix}$ | $i < |string|$ | $\overset{-}{i-}$

$character = \text{substr}\begin{pmatrix} string \\ i \\ 1 \end{pmatrix}$

IF		
	$character \equiv \{$	$\overset{+}{+}parenthesis$
	$character \equiv \}$	$\overset{-}{-}parenthesis$

IF $\boxed{\equiv}\begin{bmatrix} parenthesis\_sign \\ 0 \end{bmatrix}$

$part\begin{bmatrix} \mathsf{value} \\ \mathsf{power} \end{bmatrix} = \text{substr}\begin{pmatrix} string \\ key\_power\_start \\ i - key\_power\_start \end{pmatrix}$

$parts \overset{+}{=} part$

$string = \text{substr}\begin{pmatrix} string \\ i+1 \end{pmatrix}$

BR

WH substr $\begin{pmatrix} string \\ 0 \\ functions\_open\_length[\backslash] \end{pmatrix} \equiv \backslash$

FO | *functions_length* | *function* | *function_length*

IF substr $\begin{pmatrix} string \\ 0 \\ functiohn\_length \end{pmatrix} \equiv function$ | BR | 3

$[=]$ $\begin{bmatrix} key\_backslash\_start \\ functions\_open\_length[\backslash] \end{bmatrix}$

7 FO *key_backslash_start* $\leq i <$ |*string*|

IF substr $\begin{pmatrix} string \\ i \\ 1 \end{pmatrix} \notin alphabets$

part $= \emptyset$

part[type] $= \backslash$

part[value] $=$ substr $\begin{pmatrix} string \\ 0 \\ i-1 \end{pmatrix}$

parts $\stackrel{+}{=}$ *part*

string $=$ substr $\begin{pmatrix} string \\ i \end{pmatrix}$

BR

latex_size | *latex*

latex_size $=$ xy $\begin{pmatrix} 0 \\ 0 \end{pmatrix}$

IF *latex* $\equiv \emptyset$ | RE | *latex_size*

$[=]$ $\begin{bmatrix} parts \\ this \blacktriangleright \text{latex\_separation}(latex) \end{bmatrix}$

FO | *parts* | *part*

4. SW *part*[type]

\	next level
\frac	next level
\nthroot	next level
\sqrt	next level
\text	next level
^	next level
{	next level
character	next level

RE | *latex_size*

$[=]$ $\begin{bmatrix} part\_size \\ this \blacktriangleright \text{latex\_size\_backslash}\ (part[\text{value}]) \end{bmatrix}$

1 \ $[\stackrel{+}{=}]$ $\begin{bmatrix} latex\_size \blacktriangleright x \\ part\_size \blacktriangleright x \end{bmatrix}$

$[\stackrel{+}{=}]$ $\begin{bmatrix} latex\_size \blacktriangleright y \\ part\_size \blacktriangleright y \end{bmatrix}$

2 \frac

$$numerator\_size = this \blacktriangleright \text{latex\_size}\left(part\left[\begin{array}{l}\text{value}\\ \text{numerator}\end{array}\right]\right)$$

$$denominator\_size = this \blacktriangleright \text{latex\_size}\left(part\left[\begin{array}{l}\text{value}\\ \text{denominator}\end{array}\right]\right)$$

$$latex\_size \blacktriangleright x \stackrel{+}{=} \max\left(\begin{array}{l} numerator\_size \blacktriangleright x \\ denominator\_size \blacktriangleright x \end{array}\right) + \frac{1}{3.5}$$

$$latex\_size \blacktriangleright y \stackrel{+}{=} \boxed{+}\left[\begin{array}{l} numerator\_size \blacktriangleright y \\ denominator\_size \blacktriangleright y \\ \frac{1}{10} \end{array}\right]$$

3 \nthroot

$$index\_size = this \blacktriangleright \text{latex\_size}\left(part\left[\begin{array}{l}\text{value}\\ \text{index}\end{array}\right]\right)$$

$$\boxed{\stackrel{\times}{=}}\left[\begin{array}{l} index\_size \blacktriangleright x \\ \frac{7}{8} \end{array}\right]$$

$$\boxed{\stackrel{\times}{=}}\left[\begin{array}{l} index\_size \blacktriangleright y \\ \frac{7}{8} \end{array}\right]$$

$$index\_size \blacktriangleright x = \max\left(\begin{array}{l} index\_size \blacktriangleright x \\ \frac{3}{14} \end{array}\right)$$

$$radicand\_size = this \blacktriangleright \text{latex\_size}\left(part\left[\begin{array}{l}\text{value}\\ \text{radicand}\end{array}\right]\right)$$

$$radicand\_size \blacktriangleright x = \max\left(\begin{array}{l} radicand\_size \blacktriangleright x \\ \frac{3}{7} \end{array}\right)$$

$$width\_space = \frac{1}{11} + \frac{1}{5.5} + \frac{1}{7} + \frac{1}{12} + \frac{1}{17.5}$$

$$height\_space = \frac{1}{16}$$

$$latex\_size \blacktriangleright x \stackrel{\pm}{=} \max\left(\begin{array}{l} \frac{5}{5.4} \times ratio \\ \boxed{+}\left[\begin{array}{l} index\_size \blacktriangleright x \\ radicand\_size \blacktriangleright x \\ width\_space \end{array}\right] \end{array}\right)$$

$$latex\_size \blacktriangleright y \stackrel{\pm}{=} \max\left(\begin{array}{l} \frac{4}{5} \times ratio \\ index\_size \blacktriangleright y \\ \boxed{+}\left[\begin{array}{l} radicand\_size \blacktriangleright x \\ width\_space \end{array}\right] \end{array}\right)$$

4 \sqrt

$$\boxed{=}\left[\begin{array}{l} part\_size \\ this \blacktriangleright \text{latex\_size}\,(part[\text{value}]) \end{array}\right]$$

$$latex\_size \blacktriangleright x \stackrel{\pm}{=} \boxed{+}\left[\begin{array}{l} part\_size \blacktriangleright x \\ \frac{2}{2} - \frac{1}{3.2} \end{array}\right]$$

$$latex\_size \blacktriangleright y \stackrel{\pm}{=} \boxed{+}\left[\begin{array}{l} part\_size \blacktriangleright y \\ \frac{2}{3.2} - \frac{2}{3.7} \end{array}\right]$$

5 \text

$$\boxed{=}\left[\begin{array}{l} part\_size \\ this \blacktriangleright \text{text\_size}\,(part[\text{value}]) \end{array}\right]$$

$$\boxed{\stackrel{\pm}{=}}\left[\begin{array}{l} latex\_size \blacktriangleright x \\ part\_size \blacktriangleright x \end{array}\right]$$

$$\boxed{\stackrel{\pm}{=}}\left[\begin{array}{l} latex\_size \blacktriangleright y \\ part\_size \blacktriangleright y \end{array}\right]$$

6 ∧

$base\_size = this \blacktriangleright \text{latex\_size}\left(part\left[\begin{array}{l}\text{value}\\ \text{base}\end{array}\right]\right)$
$power\_size = this \blacktriangleright \text{latex\_size}\left(part\left[\begin{array}{l}\text{value}\\ \text{power}\end{array}\right]\right)$
$latex\_size \blacktriangleright \overset{\pm}{=} \boxed{+}\left[\begin{array}{l}base\_size \blacktriangleright x\\ power\_size \blacktriangleright x\end{array}\right]$
$latex\_size \blacktriangleright y \overset{\pm}{=} \boxed{+}\left[\begin{array}{l}\frac{1}{2} \times base\_size \blacktriangleright y\\ \max\left(\begin{array}{l}\frac{1}{2} \times base\_size \blacktriangleright y\\ power\_size \blacktriangleright y\end{array}\right)\end{array}\right]$

7 {

$\boxed{=}\left[\begin{array}{l}part\_size\\ this \blacktriangleright \text{latex\_size}\,(part[\text{value}])\end{array}\right]$
$\boxed{\overset{\pm}{=}}\left[\begin{array}{l}latex\_size \blacktriangleright x\\ part\_size \blacktriangleright x\end{array}\right]$
$\boxed{\overset{\pm}{=}}\left[\begin{array}{l}latex\_size \blacktriangleright y\\ part\_size \blacktriangleright y\end{array}\right]$

8 character

$\boxed{=}\left[\begin{array}{l}part\_size\\ this \blacktriangleright \text{latex\_size\_character}\,(part[\text{value}])\end{array}\right]$
$\boxed{\overset{\pm}{=}}\left[\begin{array}{l}latex\_size \blacktriangleright x\\ part\_size \blacktriangleright x\end{array}\right]$
$\boxed{\overset{\pm}{=}}\left[\begin{array}{l}latex\_size \blacktriangleright y\\ part\_size \blacktriangleright y\end{array}\right]$

5.

latex_size_character | *character*

$widths = \emptyset$
next level
next level
next level
next level
$height\_standard = \frac{2}{3.5}$
$width\_standard = \frac{2}{3.5}$

IF arry_key_exists $\left(\begin{array}{l}character\\ widths\end{array}\right)$ — RE $\mathbf{xy}\left(\begin{array}{l}widths[character]\\ height\_standard\end{array}\right)$

RE $\mathbf{xy}\left(\begin{array}{l}width\_standard\\ height\_standard\end{array}\right)$

1 $widths \overset{\sqcup\subset}{=}$

1	2	3	4	5	6	7	8	9	0
$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$

$widths \overset{\sqcup\subset}{=}$

a	b	c	d	e	f	g	h	k	n	o	p	q	r	s	u	x	y	z
$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$

2 $widths \overset{\sqcup\subset}{=}$

i	j	l	t
$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$

$widths \overset{\sqcup\subset}{=}$

m	w
$\frac{1}{2.5}$	$\frac{1}{2.5}$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c|c} \mathsf{A} & \mathsf{B} & \mathsf{C} & \mathsf{D} & \mathsf{E} & \mathsf{F} & \mathsf{K} & \mathsf{L} & \mathsf{N} & \mathsf{P} & \mathsf{R} & \mathsf{S} & \mathsf{T} & \mathsf{V} & \mathsf{X} & \mathsf{Y} & \mathsf{Z} \\ \hline \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} & \frac{1}{2.7} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c|c|c} \mathsf{D} & \mathsf{G} & \mathsf{H} & \mathsf{O} & \mathsf{Q} & \mathsf{U} & \mathsf{W} \\ \hline \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} \end{array}\right]$$

3

$$widths \overset{\cup}{=} \left[\begin{array}{c} \mathsf{I} \\ \hline \frac{1}{5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \mathsf{J} \\ \hline \frac{1}{4} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c} \mathsf{M} & \mathsf{W} \\ \hline \frac{1}{2} & \frac{1}{2} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c} \tilde{} & \# & * & ? \\ \hline \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c} ! & (&) & [&] \\ \hline \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} @ \\ \hline \frac{1}{1.7} \end{array}\right]$$

4

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c} \% & \& & - & + \\ \hline \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c} = & \text{¡} & \text{¿} \\ \hline \frac{1}{1.5} & \frac{1}{1.5} & \frac{1}{1.5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c|c|c} \text{‘} & ; & : & \text{’} & , & . & / \\ \hline \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} | \\ \hline \frac{1}{8} \end{array}\right]$$

6.

latex_size_backslash	*latex*
	$widths = \emptyset$
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	next level
	$height\_standard = \frac{2}{3.5}$
	$width\_standard = \frac{2}{3.5}$
	IF array_key_exists $\begin{pmatrix} latex \\ widths \end{pmatrix}$ RE xy $\begin{pmatrix} widths[latex] \\ height\_standard \end{pmatrix}$
	RE xy $\begin{pmatrix} width\_standard \\ height\_standard \end{pmatrix}$

1

$widths \coloneqq$	\hookleftarrow	\hookrightarrow	\leftarrow	\Leftarrow	\leftrightarrow	\longleftarrow	\Longleftarrow	\longleftrightarrow	\longrightarrow	\Longrightarrow	\nearrow	\nwarrow	\rightarrow	\Rightarrow	\searrow	\swarrow
	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$	$\frac{1}{1.7}$

1

$widths \coloneqq$	\Downarrow	\Uparrow
	$\frac{1}{2.7}$	$\frac{1}{2.7}$

$widths \coloneqq$	\downarrow	\uparrow	\updownarrow	\Updownarrow
	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$	$\frac{1}{3.2}$

$\boxed{2}$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c|c} \text{\textbackslash cup} & \text{\textbackslash div} & \text{\textbackslash oplus} & \text{\textbackslash oslash} & \text{\textbackslash otimes} & \text{\textbackslash times} \\ \hline \frac{1}{1.5} & \frac{1}{1.5} & \frac{1}{1.5} & \frac{1}{1.5} & \frac{1}{1.5} & \frac{1}{1.5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c} \text{\textbackslash bigcirc} & \text{\textbackslash square} \\ \hline \frac{1}{1.7} & \frac{1}{1.7} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c|c} \text{\textbackslash amalg} & \text{\textbackslash ast} & \text{\textbackslash lg} & \text{\textbackslash ln} & \text{\textbackslash star} & \text{\textbackslash \%} \\ \hline \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} & \frac{1}{2} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash +} \\ \hline \frac{1}{2.2} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c|c|c} \text{\textbackslash and} & \text{\textbackslash or} & \text{\textbackslash sqcap} & \text{\textbackslash sqcup\textbackslash uplus} & \text{\textbackslash vee} & \text{\textbackslash wedge} & \\ \hline \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash cdot} \\ \hline \frac{1}{3} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c} \text{\textbackslash setminus} & \text{\textbackslash wr} \\ \hline \frac{1}{3.2} & \frac{1}{3.2} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c} \text{\textbackslash dagger} & \text{\textbackslash ddagger} \\ \hline \frac{1}{4} & \frac{1}{4} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash bullet} \\ \hline \frac{1}{5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash circ} \\ \hline \frac{1}{6} \end{array}\right]$$

$\boxed{3}$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c} \text{\textbackslash approx} & \text{\textbackslash asymp} & \text{\textbackslash cong} & \text{\textbackslash equiv} & \text{\textbackslash propto} \\ \hline \frac{1}{1.5} & \frac{1}{1.5} & \frac{1}{1.5} & \frac{1}{1.5} & \frac{1}{1.5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash sim} \\ \hline \frac{1}{1.8} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c|c|c} \text{\textbackslash doteq} & \text{\textbackslash perp} & \text{\textbackslash prec} & \text{\textbackslash preceq} & \text{\textbackslash simeq} & \text{\textbackslash succ} & \text{\textbackslash succeq} \\ \hline \frac{1}{2.2} & \frac{1}{2.2} & \frac{1}{2.2} & \frac{1}{2.2} & \frac{1}{2.2} & \frac{1}{2.2} & \frac{1}{2.2} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c} \text{\textbackslash frown} & \text{\textbackslash smile} \\ \hline \frac{1}{2.5} & \frac{1}{2.5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c} \text{\textbackslash dashv} & \text{\textbackslash models} \\ \hline \frac{1}{2.7} & \frac{1}{2.7} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash paralle} \\ \hline \frac{1}{3.2} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash vdash} \\ \hline \frac{1}{4.5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash mid} \\ \hline \frac{1}{6} \end{array}\right]$$

$\boxed{4}$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c} \text{\textbackslash lceil} & \text{\textbackslash lfloor} & \text{\textbackslash rceil} & \text{\textbackslash rfloor} \\ \hline \frac{1}{3.6} & \frac{1}{3.6} & \frac{1}{3.6} & \frac{1}{3.6} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c|c} \text{\textbackslash lbrack} & \text{\textbackslash rbrack} \\ \hline \frac{1}{5} & \frac{1}{5} \end{array}\right]$$

$$widths \overset{\cup}{=} \left[\begin{array}{c} \text{\textbackslash backslash} \\ \hline \frac{1}{6} \end{array}\right]$$

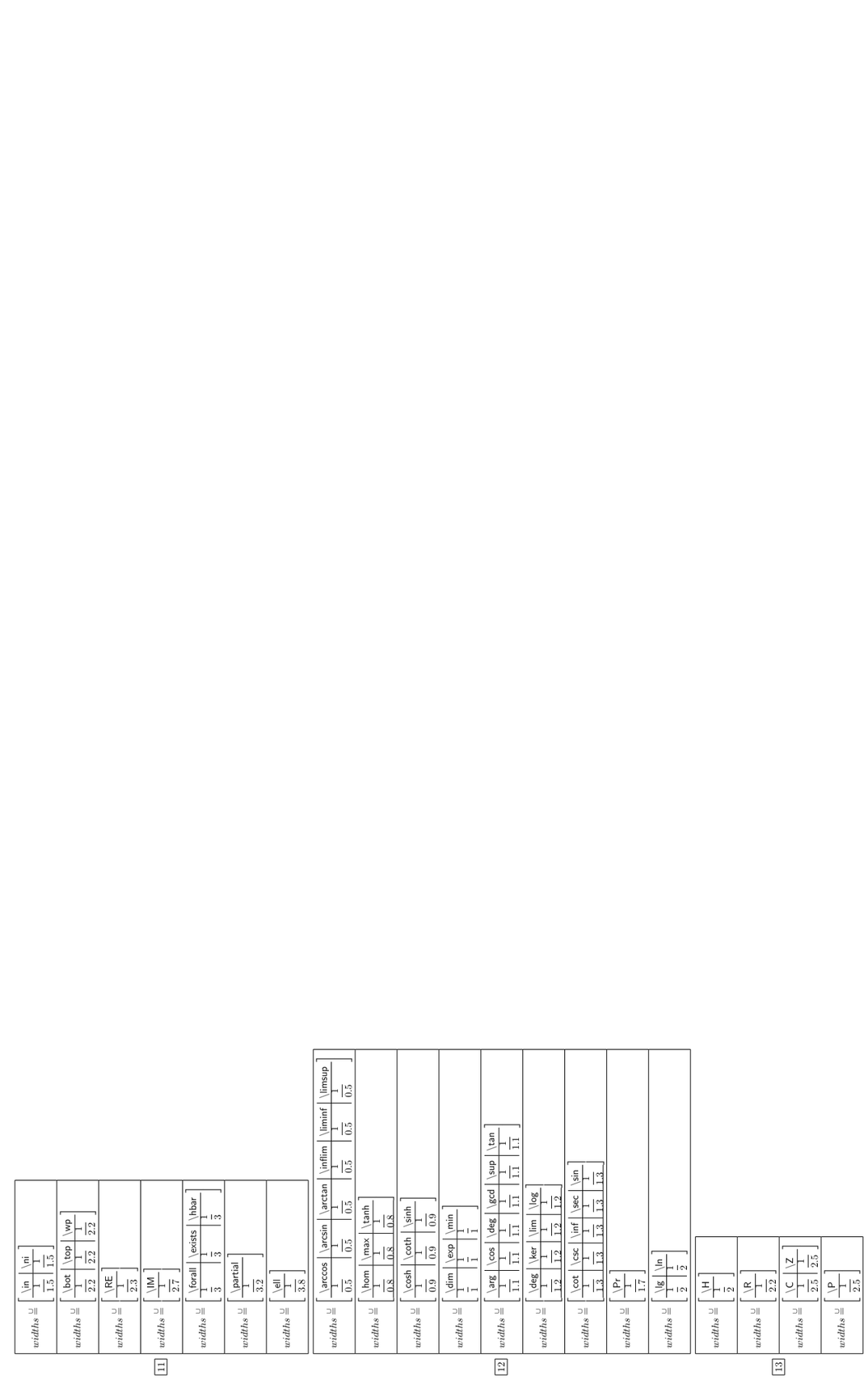
$\boxed{5}$ $$widths \overset{\cup}{=} \left[\begin{array}{c|c|c} \text{\textbackslash cdots} & \text{\textbackslash dots} & \text{\textbackslash ldots} \\ \hline \frac{1}{1.7} & \frac{1}{1.7} & \frac{1}{1.7} \end{array}\right]$$

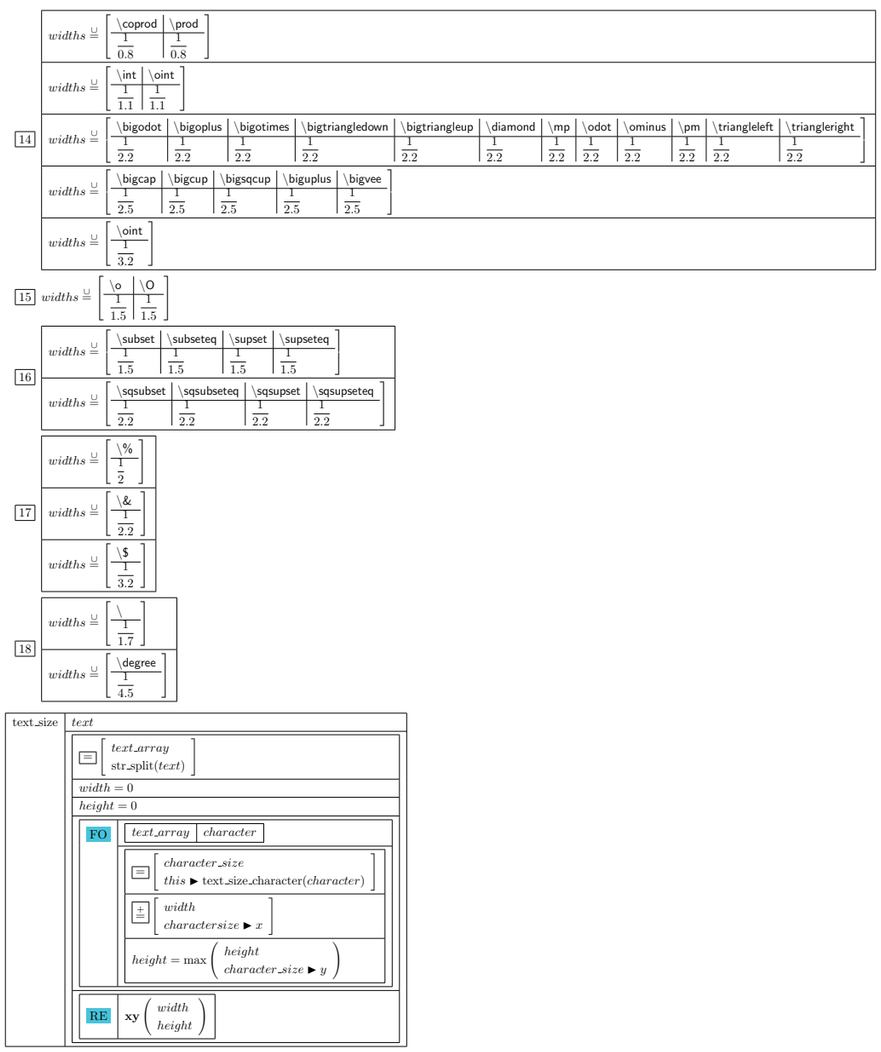
$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash Pi} \\ \hline 1 \\ \hline 2.3 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c\|c\|c} \text{\textbackslash Phi} & \text{\textbackslash Psi} & \text{\textbackslash Omega} \\ \hline 1 & 1 & 1 \\ \hline 2.4 & 2.4 & 2.4 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c\|c} \text{\textbackslash Lambda} & \text{\textbackslash Sigma} \\ \hline 1 & 1 \\ \hline 2.5 & 2.5 \end{array}\right]$
8 $width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash Upsilon} \\ \hline 1 \\ \hline 2.6 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c\|c} \text{\textbackslash Gamma} & \text{\textbackslash Xi} \\ \hline 1 & 1 \\ \hline 2.7 & 2.7 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash Delta} \\ \hline 1 \\ \hline 2.9 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash Theta} \\ \hline 1 \\ \hline 2.3 \end{array}\right]$

9 $width_{\mathbb{C}}$ $\left[\begin{array}{c\|c\|c\|c} \text{\textbackslash leftharpoondown} & \text{\textbackslash leftharpoonup} & \text{\textbackslash rightharpoondown} & \text{\textbackslash rightharpoonup} \\ \hline 1 & 1 & 1 & 1 \\ \hline 1.7 & 1.7 & 1.7 & 1.7 \end{array}\right]$
10 $width_{\mathbb{C}}$ $\left[\begin{array}{c\|c\|c\|c\|c\|c\|c\|c\|c\|c} \text{\textbackslash ge} & \text{\textbackslash geq} & \text{\textbackslash ll} & \text{\textbackslash le} & \text{\textbackslash ll} & \text{\textbackslash ne} & \text{\textbackslash neq} & \text{\textbackslash <} & \text{\textbackslash >} \\ \hline 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ \hline 1.5 & 1.5 & 1.5 & 1.5 & 1.5 & 1.5 & 1.5 & 1.5 & 1.5 \end{array}\right]$

$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash triangle} \\ \hline 1 \\ \hline 2.2 \end{array}\right]$
6 $width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash circle} \\ \hline 1 \\ \hline 6 \end{array}\right]$

$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash omega} \\ \hline 1 \\ \hline 2.3 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash psi} \\ \hline 1 \\ \hline 2.7 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash varpsi} \\ \hline 1 \\ \hline 3 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c} \text{\textbackslash alpha} & \text{\textbackslash beta} & \text{\textbackslash eta} & \text{\textbackslash mu} & \text{\textbackslash pi} & \text{\textbackslash theta} & \text{\textbackslash varrho} & \text{\textbackslash vartheta} & \text{\textbackslash phi} \\ \hline 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ \hline 3.2 & 3.2 & 3.2 & 3.2 & 3.2 & 3.2 & 3.2 & 3.2 & 3.2 \end{array}\right]$
7 $width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash sigma} \\ \hline 1 \\ \hline 3.3 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c\|c\|c\|c\|c\|c\|c} \text{\textbackslash delta} & \text{\textbackslash kappa} & \text{\textbackslash lambda} & \text{\textbackslash rho} & \text{\textbackslash upsilon} \\ \hline 1 & 1 & 1 & 1 & 1 \\ \hline 3.5 & 3.5 & 3.5 & 3.5 & 3.5 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c\|c\|c} \text{\textbackslash nu} & \text{\textbackslash xi} & \text{\textbackslash chi} \\ \hline 1 & 1 & 1 \\ \hline 3.7 & 3.7 & 3.7 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c\|c\|c\|c} \text{\textbackslash gamma} & \text{\textbackslash epsilon} & \text{\textbackslash varepsilon} & \text{\textbackslash zeta} \\ \hline 1 & 1 & 1 & 1 \\ \hline 4.2 & 4.2 & 4.2 & 4.2 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash tau} \\ \hline 1 \\ \hline 4.5 \end{array}\right]$
$width_{\mathbb{C}}$ $\left[\begin{array}{c} \text{\textbackslash iota} \\ \hline 1 \\ \hline 6 \end{array}\right]$


11
widths ⊒ \in \ni
1 1
1.5 1.5
widths ⊒ \bot \top \wp
1 1 1
2.2 2.2 2.2
widths ⊒ \RE
1
2.3
widths ⊒ \IM
1
2.7
widths ⊒ \forall \exists \hbar
1 1 1
3 3 3
widths ⊒ \partial
1
3.2
widths ⊒ \ell
1
3.8
12
widths ⊒ \arccos \arcsin \arctan \injlim \liminf \limsup
1 1 1 1 1 1
0.5 0.5 0.5 0.5 0.5 0.5
widths ⊒ \hom \max \tanh
1 1 1
0.8 0.8 0.8
widths ⊒ \cosh \coth \sinh
1 1 1
0.9 0.9 0.9
widths ⊒ \dim \exp \min
1 1 1
1 1 1
widths ⊒ \arg \cos \deg \gcd \sup \tan
1 1 1 1 1 1
1.1 1.1 1.1 1.1 1.1 1.1
widths ⊒ \deg \ker \lim \log
1 1 1 1
1.2 1.2 1.2 1.2
widths ⊒ \cot \csc \inf \sec \sin
1 1 1 1 1
1.3 1.3 1.3 1.3 1.3
widths ⊒ \Pr
1
1.7
widths ⊒ \lg \ln
1 1
2 2
13
widths ⊒ \H
1
2
widths ⊒ \R
1
2.2
widths ⊒ \C \Z
1 1
2.5 2.5
widths ⊒ \P
1
2.5



7.

text_size | *text*

= [*text_array* ; str_split(*text*)]

width = 0

height = 0

FO | *text_array* | *character*

= [*character_size* ; *this* ▶ text_size_character(*character*)]

+= [*width* ; *charactersize* ▶ *x*]

height = max (*height* ; *character_size* ▶ *y*)

RE | **xy** (*width* ; *height*)

8.

text_size_character	*character*
	widths = ∅
	next level
	next level
	next level
	next level
	$height\_standard = \frac{2}{3.5}$
	$width\_standard = \frac{2}{3.5}$
	IF: array_key_exists $\begin{pmatrix} character \\ widths \end{pmatrix}$ — RE: xy $\begin{pmatrix} widths[character] \\ height\_standard \end{pmatrix}$
	RE: xy $\begin{pmatrix} width\_standard \\ height\_standard \end{pmatrix}$

1 $widths \overset{\cup}{=} \left[\begin{array}{c|c|c|c|c|c|c|c|c|c} \backslash 1 & \backslash 2 & \backslash 3 & \backslash 4 & \backslash 5 & \backslash 6 & \backslash 7 & \backslash 8 & \backslash 9 & \backslash 0 \\ \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} \end{array}\right]$

$widths \overset{\cup}{=} \left[\begin{array}{c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c} \backslash a & \backslash b & \backslash c & \backslash d & \backslash e & \backslash g & \backslash h & \backslash k & \backslash n & \backslash o & \backslash p & \backslash q & \backslash u & \backslash x & \backslash y & \backslash z \\ \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} \end{array}\right]$
$widths \overset{\cup}{=} \left[\begin{array}{c\|c} \backslash f & \backslash r \\ \frac{1}{5} & \frac{1}{5} \end{array}\right]$
2 $widths \overset{\cup}{=} \left[\begin{array}{c\|c\|c\|c} \backslash i & \backslash j & \backslash l & \backslash t \\ \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \end{array}\right]$
$widths \overset{\cup}{=} \left[\begin{array}{c} \backslash s \\ \frac{1}{4.5} \end{array}\right]$
$widths \overset{\cup}{=} \left[\begin{array}{c\|c} \backslash m & \backslash w \\ \frac{1}{2.2} & \frac{1}{2.2} \end{array}\right]$

$widths \overset{\cup}{=} \left[\begin{array}{c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c\|c} \backslash A & \backslash B & \backslash C & \backslash D & \backslash E & \backslash G & \backslash H & \backslash K & \backslash L & \backslash N & \backslash O & \backslash P & \backslash Q & \backslash R & \backslash T & \backslash U & \backslash V & \backslash X & \backslash Y & \backslash Z \\ \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} & \frac{1}{2.5} \end{array}\right]$
$widths \overset{\cup}{=} \left[\begin{array}{c\|c\|c} \backslash F & \backslash P & \backslash S \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \end{array}\right]$
$widths \overset{\cup}{=} \left[\begin{array}{c} \backslash I \\ \frac{1}{5} \end{array}\right]$
3 $widths \overset{\cup}{=} \left[\begin{array}{c} \backslash J \\ \frac{1}{4} \end{array}\right]$
$widths \overset{\cup}{=} \left[\begin{array}{c} \backslash M \\ \frac{1}{2} \end{array}\right]$
$widths \overset{\cup}{=} \left[\begin{array}{c} \backslash W \\ \frac{1}{1.8} \end{array}\right]$

$$widths \stackrel{\cup}{=} \left[\begin{array}{c|c|c|c|c|c} \backslash\tilde{} & \backslash\# & \backslash * & \backslash ? & \backslash\{ & \backslash\} \\ \hline \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} & \frac{1}{3.5} \end{array}\right]$$

$$widths \stackrel{\cup}{=} \left[\begin{array}{c|c|c|c|c|c|c} \backslash ! & \backslash (& \backslash) & \backslash [& \backslash] & \backslash - & \backslash ` \\ \hline \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} & \frac{1}{5} \end{array}\right]$$

$$widths \stackrel{\cup}{=} \left[\begin{array}{c} \backslash\ \\ \hline \frac{1}{1.7} \end{array}\right]$$

4 $$widths \stackrel{\cup}{=} \left[\begin{array}{c|c} \backslash\% & \backslash\& \\ \hline \frac{1}{2} & \frac{1}{2} \end{array}\right]$$

$$widths \stackrel{\cup}{=} \left[\begin{array}{c|c|c|c|c} \backslash ; & \backslash : & \backslash , & \backslash . & \backslash / \\ \hline \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} & \frac{1}{6} \end{array}\right]$$

$$widths \stackrel{\cup}{=} \left[\begin{array}{c|c} \backslash ` & \backslash | \\ \hline \frac{1}{9} & \frac{1}{9} \end{array}\right]$$

$$widths \stackrel{\cup}{=} \left[\begin{array}{c} \backslash\text{``''} \\ \hline \frac{1}{1.4} - \frac{1}{1.7} \end{array}\right]$$