

Open Command-oriented Geometric Graphics Generator

OpenCG³ Specification Version 0.3.5

Dong Nai-Jia ¹ Lin Yong-Hsiang ²

¹National Chiao Tung University
Department of Computer Science

²National Taiwan University
Department of Agricultural Chemistry

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Regular Expressions

$\mathbb{N} := \{ \alpha \mid \alpha \in [0-9]^+ \}$

$\mathbb{R} := \{ \alpha \mid \alpha \in [+ \backslash -]^? ([0-9]^* [.])^? [0-9]^+ \}$

$\Rightarrow \mathbb{R} \supset \mathbb{N}$

$\mathbb{S} := \{ \alpha \mid \alpha \in '(. * ?)' \mid [. 0-9 A-Z a-z + \backslash -]^+ \}$

$\Rightarrow \mathbb{S} \supset \mathbb{R}$

$\mathbb{W} := \{ \alpha \mid \alpha \in [\backslash t]^* \}$

whitespace

Descriptions

- The matching mechanism abides by the maximal munch rule.
- Each command is whitespace-insensitive except being quoted by a pair of single quotation marks (').

Context-Free Expansions

$$\mathbf{C} \rightarrow \mathbf{AC} \mid ; \mid \text{EOL}$$

$$\mathbf{A} \rightarrow \mathbf{T(A)} \mid \mathbf{V(A)} \mid \mathbf{S(A)} \mid \mathbf{L(A)} \mid \mathbf{L(A, A, \dots, A)} \mid \mathbf{N} \mid \mathbf{R} \mid \mathbf{S}$$

$$\begin{array}{l} \mathbf{T(\Pi)} \equiv \Pi : n \rangle \rightarrow (\Sigma(\Pi, n)) \\ \mathbf{V(\Pi)} \equiv \Pi : n \rangle \rightarrow < \Sigma(\Pi, n) > \\ \mathbf{S(\Pi)} \equiv \Pi : n \} \rightarrow \{ \Sigma(\Pi, n) \} \\ \mathbf{L(\Pi_1, \Pi_2, \dots, \Pi_{n-1}, \Pi_n)} \equiv \mathbb{L} [\Pi_1 \Pi_2 \dots \Pi_{n-1} \Pi_n] \rightarrow [\Pi_1 \dots \Pi_n] \end{array} \quad \left\| \quad \begin{array}{l} \Sigma(\Pi, n) \rightarrow \overbrace{\Pi \dots \Pi}^{n \text{ items}} \quad (\text{identical}) \\ \mathbf{L(\Pi)} \equiv \mathbb{L} [\Pi : n] \rightarrow [\Sigma(\Pi, n)] \end{array} \right.$$

Descriptions

- Each command starts from \mathbf{C} and ends with a $;$ or an EOL.
- Non-terminal symbol expansions are prior than function expansions.

Escape Sequence

- `\x` is an escape sequence.
- If `x` is `\`, then it is treated as a single backslash.
- If `x` is EOL which may vary from platforms, then the sequence is omitted.
- Otherwise, the sequence is ignored and triggers a warning by default.

Error Handling

- Physical lines are separated by an EOL.
- Logical lines are separated by either a semicolon or an unescaped EOL.
- If the command cannot be parsed by the grammar, then all the characters on the same logical line will be discarded.

Definitions

- The whole system are divided into four fields and several classes:
 - ① field e-(nviron.): includes class window and class camera.
 - ② field p-(rimitive): includes class point, class circle, etc.
 - ③ field c-(ompound): includes class line, class triangle, class polygon, etc.
 - ④ field a-(uxiliary): includes class attrib and class group.

Notations

- class^x denotes the name of a class in the field x .
- label^x denotes the unique name of the object from a class in the field x .

Prototypes

- Argument prototypes are written in a mixture of types and names with underlines.
- Each type with an asterisk indicates that the brackets are used for cross-referencing.
- Cross-reference is a feature for manipulating multiple objects in a single command.
- Each name with a plus/minus/ampersand implies that the given name is used for creating new objects/deleting existed objects/cross-referencing among objects, etc.

Perspective Projection

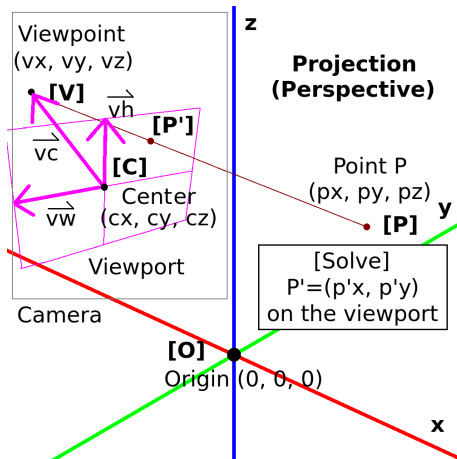


Figure: Projection in Euclidean \mathbb{R}^3 Space

Command

`create window § +labele` (1)

Parameters

- label^e : the name of the object from the class window

Examples

`create window main`

Command

```
delete window $ -labele $ string (2)
```

Parameters

- label^e : the name of the object from the class window
- string : the text printed right after exiting the current session

Examples

```
delete window main  
delete window main 'Have a nice day.'
```


Properties of a Window

Property	Value Format	Default
dots-per-cm	$\mathbb{R} > 0$	128
dots-per-unit	$\mathbb{R} > 0$	256
background-color	$\mathbb{N} \in [0, 255] : 3$	(0 0 0)

Command

```
create camera S +labele  $\mathbb{R} : 3$ ) center  $\mathbb{R} : 3$  : 2) plane  $\mathbb{R} : 3$  > sight (3)
```

Parameters

- label^e : the name of the object from the class camera
- center : the world coordinate (c_x, c_y, c_z) of the center of the viewport
- plane : the horizontal and the vertical vectors (\vec{v}_w, \vec{v}_h) of the viewport
- sight : the reverse line of sight \vec{v}_c from center to the camera

Examples

```
create camera z-top (0 0 1) (<2 0 0> <0 1.5 0>) <0 0 1>  
// The size of the viewport is 512px * 384px when dots-per-unit is 256.
```

Command

```
select camera S &label1 S &label2 (4)
```

Parameters

- label₁ : the name of the object from the class camera
- label₂ : the name of the object from the class window

Examples

```
select camera z-top main
```

Command

```
remove camera S &label1 S &label2 (5)
```

Parameters

- label₁ : the name of the object from the class camera
- label₂ : the name of the object from the class window

Examples

```
remove camera z-top main
```

Command

`delete camera § -labele` (6)

Parameters

- label^e : the name of the object from the class camera

Examples

`delete camera z-top`

Properties of a Camera

Property	Value Format	Default
axis-enable	$\mathbb{S} \in \{\text{true}, \text{false}\}$	true
axis-show	$\mathbb{S} \in \{\text{x}, \text{y}, \text{z}, \text{xy}, \text{xz}, \text{yz}, \text{xyz}\}$	xyz
axis-color	$\mathbb{N} \in [0, 255] : 3) : 3)$	((255 0 0)(0 255 0)(0 0 255))
axis-width	$\mathbb{L} [\mathbb{R} > 0 \ \mathbb{S} \in \{\text{px}, \text{cm}\}]$	[2 px]
grid-enable	$\mathbb{S} \in \{\text{true}, \text{false}\}$	true
grid-show	$\mathbb{S} \in \{\text{x}, \text{y}, \text{z}, \text{xy}, \text{xz}, \text{yz}, \text{xyz}\}$	xy
grid-color	$\mathbb{N} \in [0, 255] : 3) : 3)$	((127 0 0)(0 127 0)(0 0 127))
grid-width	$\mathbb{L} [\mathbb{R} > 0 \ \mathbb{S} \in \{\text{px}, \text{cm}\}]$	[1 px]
grid-interval	$\mathbb{R} > 0$	10

Command

`create point` $\frac{\mathbb{S} \text{ +label}^p : \}^*}{\mathbb{R} : 3} \frac{\text{coord}}{\text{coord}}$ (7)

`create point` $\frac{\mathbb{S} \text{ +label}^p : \geq n)^*}{\mathbb{R} : 3} \frac{\text{coord} : n)^*}{\mathbb{S} :)^* \& \text{label}^a}$ (8)

Parameters

- label^p : the name of the object from the class point
- coord : the world coordinate (p_x, p_y, p_z) of the object named label^p
- label^a : the name of the object from the class group

Examples

```
create point 'origin'    (0 0 0)
```

```
create point {X-1 X-2}    (1 0 0)
```

```
create point (Y-1 Y-2) ((0 1 0))
```

```
create point (Z D1 D2) ((0 1 0) (1 1 1)) (square red)
```

Command

`delete point` \S $-\text{label}^P$: $\}$ ^{*} (9)

Parameters

- label^P : the name of the object from the class point

Examples

```
delete point 'origin'  
delete point {Z D1 D2}
```


Properties of a Point

Property	Value Format	Default
shape	$\mathbb{S} \in \{\text{none}, \text{dot}, \text{square}\}$	dot
radius	$\mathbb{L} [\mathbb{R} > 0 \ \mathbb{S} \in \{\text{px}, \text{cm}\}]$	[3 px]
color	$\mathbb{N} \in [0, 255] : 3)$	(255 255 255)
border-type	$\mathbb{S} \in \{\text{none}, \text{inner}, \text{middle}, \text{outer}\}$	outer
border-width	$\mathbb{L} [\mathbb{R} > 0 \ \mathbb{S} \in \{\text{px}, \text{cm}\}]$	[2 px]
border-color	$\mathbb{N} \in [0, 255] : 3)$	(127 127 127)

Command

`create line` $\frac{\$ \text{+label}^c : \}^*}{\$ \text{&label}^p : 2\}$ (10)

`create line` $\frac{\$ \text{+label}^c : \geq n)^*}{\$ \text{&label}^p : 2\} : n)^* \ \$:)^* \ \underline{\text{&label}^a}$ (11)

Parameters

- label^c : the name of the object from the class line
- label^p : the name of the object from the class point
- label^a : the name of the object from the class group

Examples

`create line` `seg-1` `{X-1 Y-1}`

`create line` `{seg-2 seg-3}` `{X-2 Y-2}`

Delete Line Segments

Command

`delete line` § -label^c : }^{*} (12)

Parameters

- label^c : the name of the object from the class line

Examples

```
delete line seg-1  
delete line {seg-2 seg-3}
```

Properties of a Line

Property	Value Format	Default
style	$\mathbb{S} \in \{\text{none, solid, dotted, dashed}\}$	solid
width	$\mathbb{L} [\mathbb{R} > 0 \mid \mathbb{S} \in \{\text{px, cm}\}]$	[2 px]
color	$\mathbb{N} \in [0, 255] : 3$	(191 191 191)
cap	$\mathbb{S} \in \{\text{butt, round, square}\}$	butt
pattern	$\mathbb{L} [\mathbb{R} > 0 :) \mid \mathbb{S} \in \{\text{px, cm}\}]$	[(8 8) px]

Command

`create attrib $ +labela : }* L [L [$ classpc L [$ prop $ value :]] :]*` (13)

`create attrib $ +labela : }* L [L [$ classpc L [$ prop $ value :]] :]*` (14)

Parameters

- label^a : the name of the object from the class `attrib`
- class^{pc} : the name of a class in the field primitive or compound
- prop : the property of the object from class^{pc}
- value : the value of prop in the designated format

Examples

```
create attrib (purple dashed-and-translucent-line) \  
[[point color '(128 0 128)'] \  
 [line [style dashed] [color '(0 255 0)'] [pattern '[(16 8) px]']]]
```

Command

`attach attrib` $\frac{\$ \& \text{label}_1^a :)^*}{\$ \& \text{label}^{pc} / \text{label}_2^a : \}^*}$ (15)

`attach attrib` $\frac{\$ \& \text{label}_1^a :)^*}{\$ \& \text{label}^{pc} / \text{label}_2^a :)^*}$ (16)

Parameters

- label_1^a : the name of the object from the class `attrib`
- label_2^a : the name of the object from the class `group`
- label^{pc} : the name of the object from a class in the field `primitive` or `compound`

Examples

```
attach attrib red point-0
attach attrib (red large) point-1
attach attrib blue {point-2 rect-0}
attach attrib (5px black) {point-3 circ-0}
attach attrib (red thick) (point-4 line-0 triangle-0)
```

Command

`detach attrib` $\frac{\$ \&\text{label}^a : \}^*}{\$ \&\text{label}^{\text{pc}} : \}^*}$ (17)

`detach attrib` $\frac{\$ \&\text{label}^a :)^*}{\$ \&\text{label}^{\text{pc}} :)^*}$ (18)

Parameters

- label^a : the name of the object from the class `attrib`
- label^{pc} : the name of the object from a class in the field primitive or compound

Examples

```
detach attrib red point-0
detach attrib {red large} point-1
detach attrib blue {point-2 rect-0}
detach attrib {5px black} {point-3 circ-0}
detach attrib (red thick) (point-4 line-0 triangle-0)
```

Command

`delete attrib § -labela : }*` (19)

Parameters

- label^a : the name of the object from the class attrib

Examples

```
delete attrib red
delete attrib {5px large}
```


Command

`create group § +labela : }*` (20)

Parameters

- label^a : the name of the object from the class group

Examples

```
create group  points
create group {planes circles}
```

Command

`delete group` \S $-\text{label}^a$: }^{*} (21)

Parameters

- label^a : the name of the object from the class group

Examples

```
delete group points
delete group {planes circles}
```

Command

`assign operat S action S class N repeat [= ∞]` (22)

Parameters

- action : the name of the corresponding action of class
- class : the name of a class
- repeat : the amount of the commands emitting operation names

Examples

```
assign operat create point 2
x-axis (1 0 0)
y-axis (0 1 0)
// Back To Normal
```