Open Command-oriented Geometric Graphics Generator

OpenCG[3] Specification Version 0.3.6

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Command Tokens

Regular Expressions

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

$\mathbb{R} := \{ \ \alpha \mid \alpha \in \texttt{[+\textbackslash-]?([0-9]*[.])?[0-9]+} \ \}$ $\Rightarrow \mathbb{R} \supset \mathbb{N}$

$\mathbb{S} := \{ \ \alpha \mid \alpha \in \texttt{'(.*?)'|[.0-9A-Za-z+\textbackslash-]+} \ \}$ $\Rightarrow \mathbb{S} \supset \mathbb{R}$

$\mathbb{W} := \{ \ \alpha \mid \alpha \in \texttt{[\textbackslash t]} \ \}$ 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 (').

Command Grammars

Context-Free Expansions

$\mathbf{C} \to \mathbf{A}\,\mathbf{C} \mid \text{;} \mid \texttt{EOL}$

$\mathbf{A} \to \mathbf{T(A)} \mid \mathbf{V(A)} \mid \mathbf{S(A)} \mid \mathbf{L(A)} \mid \mathbf{L(A, A, \cdots, A)} \mid \mathbb{N} \mid \mathbb{R} \mid \mathbb{S}$

$\mathbf{T}(\Pi) \equiv \Pi : n\,) \to (\ \Sigma(\Pi, n)\ )$

$\mathbf{V}(\Pi) \equiv \Pi : n\,\rangle \to \texttt{<}\ \Sigma(\Pi, n)\ \texttt{>}$ $\Sigma(\Pi, n) \to \overbrace{\Pi\ \cdots\ \Pi}^{n \text{ items}}$ (identical)

$\mathbf{S}(\Pi) \equiv \Pi : n\,\} \to \texttt{\{}\ \Sigma(\Pi, n)\ \texttt{\}}$ $\mathbf{L}(\Pi) \equiv \mathbb{L}\,[\,\Pi : n\,] \to [\ \Sigma(\Pi, n)\ ]$

$\mathbf{L}(\Pi_1, \Pi_2, \cdots, \Pi_{n-1}, \Pi_n) \equiv \mathbb{L}\,[\,\Pi_1\,\Pi_2 \cdots \Pi_{n-1}\,\Pi_n\,] \to [\ \Pi_1 \cdots \Pi_n\ ]$

Descriptions

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

Command Parsing

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.

Fields, Classes, Objects and References

Definitions

- The whole system are divided into four fields and several classes:
  - ❶ field e-(nviron.):   includes class window and class camera.
  - ❷ field p-(rimitive):   includes class point, class circle, etc.
  - ❸ field c-(ompound): includes class line, class triangle, class polygon, etc.
  - ❹ 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 multitple 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.

Figure: Projection in Euclidean $\mathbb{R}^3$ Space
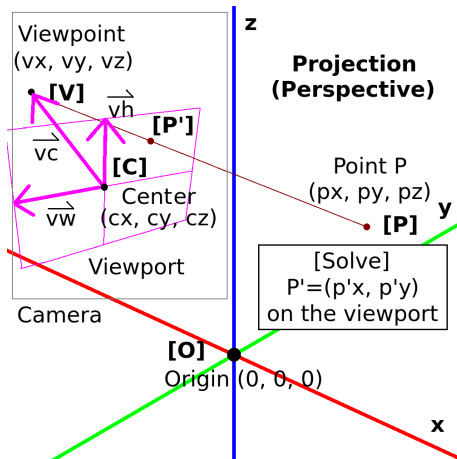
Create a Window

Command

```
create window  𝕊  + label^e                                            (1)
```

Parameters

- <u>label</u>^e : the name of the object from the class window

Examples

```
create window main
```

Delete a Window

Command

```
delete window  𝕊 – labeᶦᵉ  𝕊 string                                    (2)
```

Parameters

- labelᵉ : 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	$\underline{\mathbb{R} > 0}$	128
dots-per-unit	$\underline{\mathbb{R} > 0}$	256
background-color	$\underline{\mathbb{N} \in [0, 255] : 3}\,)$	(0 0 0)

Create a Camera

Command

```
create camera  S +label^e  R : 3) center  R : 3⟩ : 2) plane  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 vertors $(\vec{v_w}, \vec{v_h})$ 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.
```

Select a Camera

Command

`select camera` $\underline{\mathbb{S}}$ `&` $\underline{\text{label}_1^e}$ $\underline{\mathbb{S}}$ `&` $\underline{\text{label}_2^e}$ (4)

Parameters

- $\underline{\text{label}_1^e}$: the name of the object from the class camera
- $\underline{\text{label}_2^e}$: the name of the object from the class window

Examples

`select camera z-top main`

Remove a Camera

Command

`remove camera` $\underline{\mathbb{S} ~ \& \, label_1^e}$ $\underline{\mathbb{S} ~ \& \, label_2^e}$ (5)

Parameters

- $\underline{label_1^e}$: the name of the object from the class camera
- $\underline{label_2^e}$: the name of the object from the class window

Examples

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

Delete a Camera

Command

```
delete camera  S – labelᵉ                                                      (6)
```

Parameters

- labelᵉ : the name of the object from the class camera

Examples

```
delete camera z-top
```

Properties of a Camera

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

Create Points

Command

create point $\underline{\mathbb{S} \; + \underline{label^p} : \}^\star}$ $\underline{\mathbb{R} : 3) \; \underline{coord}}$ $\mathbb{S} \; \& label^a :)^\star$ (7)

create point $\underline{\mathbb{S} \; + \underline{label^p} : \geqslant n)^\star}$ $\underline{\mathbb{R} : 3) \; \underline{coord} : n)^\star}$ $\mathbb{S} \; \& label^a :)^\star$ (8)

Parameters

- $\underline{label^p}$: the name of the object from the class point
- $\underline{coord}$: the world coordinate (p_x, p_y, p_z) of the object named $\underline{label^p}$
- $\underline{label^a}$: 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)
```

Delete Points

Command

```
delete point    𝕊 – labelᵖ : }*                                    (9)
```

Parameters

- labelᵖ   : 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	$\underline{\mathbb{S}} \in \{\mathtt{none}, \mathtt{dot}, \mathtt{square}\}$	`dot`
radius	$\mathbb{L}\,[\,\underline{\mathbb{R} > 0}\;\;\underline{\mathbb{S}} \in \{\mathtt{px}, \mathtt{cm}\}\,]$	`[3 px]`
color	$\underline{\mathbb{N}} \in [0, 255] : 3\,)$	`(255 255 255)`
border-type	$\underline{\mathbb{S}} \in \{\mathtt{none}, \mathtt{inner}, \mathtt{middle}, \mathtt{outer}\}$	`outer`
border-width	$\mathbb{L}\,[\,\underline{\mathbb{R} > 0}\;\;\underline{\mathbb{S}} \in \{\mathtt{px}, \mathtt{cm}\}\,]$	`[2 px]`
border-color	$\underline{\mathbb{N}} \in [0, 255] : 3\,)$	`(127 127 127)`

Create Line Segments

Command

`create line`	$\mathbb{S} + \mathsf{label}^c : \}^\star$	$\mathbb{S} \ \& \mathsf{label}^p : 2\}$	$\mathbb{S} \ \& \mathsf{label}^a :)^\star$	(10)
`create line`	$\mathbb{S} + \mathsf{label}^c : \geqslant n)^\star$	$\mathbb{S} \ \& \mathsf{label}^p : 2\} : n)^\star$	$\mathbb{S} \ \& \mathsf{label}^a :)^\star$	(11)

Parameters

- $\underline{\mathsf{label}^c}$: the name of the object from the class line
- $\underline{\mathsf{label}^p}$: the name of the object from the class point
- $\underline{\mathsf{label}^a}$: 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    𝕊 − 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	$\underline{\mathbb{S} \in \{\mathrm{none}, \mathrm{solid}, \mathrm{dotted}, \mathrm{dashed}\}}$	solid
width	$\mathbb{L}\,[\,\underline{\mathbb{R} > 0}\ \ \underline{\mathbb{S} \in \{\mathrm{px}, \mathrm{cm}\}}\,]$	[2 px]
color	$\underline{\mathbb{N} \in [0, 255] : 3}\,)$	(191 191 191)
cap	$\mathbb{S} \in \{\mathrm{butt}, \mathrm{round}, \mathrm{square}\}$	butt
pattern	$\mathbb{L}\,[\,\underline{\mathbb{R} > 0} :\ )\ \underline{\mathbb{S} \in \{\mathrm{px}, \mathrm{cm}\}}\,]$	[(8 8) px]

Create Attributes

Command

```
create attrib  S + label^a : } ^*  L [ L [ S class^pc  L [ S prop  S value : ] ] : ] ^*   (13)
create attrib  S + label^a : ) ^*  L [ L [ S class^pc  L [ S prop  S value : ] ] : ] ^*   (14)
```

Parameters

- $\underline{label^a}$: the name of the object from the class attrib
- $\underline{class^{pc}}$: the name of a class in the field primitive or compound
- $\underline{prop}$: the property of the object from $\underline{class^{pc}}$
- $\underline{value}$: the value of $\underline{prop}$ 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]']]]
```

Attach Attributes

Command

$$\texttt{attach attrib } \underline{\mathbb{S} \ \& \ label_1^a :)^\star} \quad \underline{\mathbb{S} \ \& \ label^{pc}/ \ label_2^a : \ \}^\star} \tag{15}$$

$$\texttt{attach attrib } \underline{\mathbb{S} \ \& \ label_1^a :)^\star} \quad \underline{\mathbb{S} \ \& \ label^{pc}/ \ label_2^a :)^\star} \tag{16}$$

Parameters

- $\underline{label_1^a}$: the name of the object from the class attrib
- $\underline{label_2^a}$: the name of the object from the class group
- $\underline{label^{pc}}$: 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)
```

Detach Attributes

Command

$$\texttt{detach attrib } \underline{\mathbb{S} \text{ \& label}_1^a : \}}^\star \quad \underline{\mathbb{S} \text{ \& label}^{pc}/\text{label}_2^a : \}}^\star \qquad (17)$$

$$\texttt{detach attrib } \underline{\mathbb{S} \text{ \& label}_1^a :)}^\star \quad \underline{\mathbb{S} \text{ \& label}^{pc}/\text{label}_2^a :)}^\star \qquad (18)$$

Parameters

- $\underline{\text{label}_1^a}$: the name of the object from the class attrib
- $\underline{\text{label}_2^a}$: the name of the object from the class group
- $\underline{\text{label}^{pc}}$: 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)
```

Delete Attributes

Command

```
delete attrib  𝕊 – label^a : }*
```
(19)

Parameters

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

Examples

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

Command

```
create group   𝕊 + labelᵃ : }*
```
(20)

Parameters

- labelᵃ   : the name of the object from the class group

Examples

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

Delete Groups

Command

```
delete group    𝕊 – label^a : }*
```
(21)

Parameters

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

Examples

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

Assign Operations

Command

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

Parameters

- <u>action</u> : the name of the corresponding action of <u>class</u>
- <u>class</u>   : the name of a class
- <u>repeat</u> : 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
```