# The okicmd and okithm Packages

Taihei Oki

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## 1 The okicmd Package

### 1.1 Alphabets

| Input | Output |
|---|---|
| `l` | $\ell$ |
| `\ell` | $l$ |
| `\epsilon` | $\varepsilon$ |
| `\varepsilon` | $\epsilon$ |
| `\phi` | $\varphi$ |
| `\varphi` | $\phi$ |

### 1.2 Parentheses

| Input | Output |
|---|---|
| `\prn{\cdot}` | $(\cdot)$ |
| `\prn[\big]{\cdot}` | $\big(\cdot\big)$ |
| `\prn[\Big]{\cdot}` | $\Big(\cdot\Big)$ |
| `\prn[\bigg]{\cdot}` | $\bigg(\cdot\bigg)$ |
| `\prn[\Bigg]{\cdot}` | $\Bigg(\cdot\Bigg)$ |
| `\curl{\cdot}` | $\{\cdot\}$ |
| `\sqbr{\cdot}` | $[\cdot]$ |
| `\agbr{\cdot}` | $\langle\cdot\rangle$ |
| `\dbbr{\cdot}` | $[\![\cdot]\!]$ |
| `\abs{\cdot}` | $\lvert\cdot\rvert$ |
| `\norm{\cdot}` | $\lVert\cdot\rVert$ |
| `\floor{\cdot}` | $\lfloor\cdot\rfloor$ |
| `\ceil{\cdot}` | $\lceil\cdot\rceil$ |

### 1.3 Logic

| Input | Output |
|---|---|
| `\bigland` | $\bigwedge$ |
| `\biglor` | $\bigvee$ |
| `a \defeq b` | $a \coloneqq b$ |
| `a \eqdef b` | $b \eqqcolon a$ |
| `P \defiff Q` | $P \overset{\text{def}}{\iff} Q$ |

## 1.4 Sets

| Input | Output |
|---|---|
| `\set{a \in S}` | $\{a \in S\}$ |
| `\set{a \in S}[a^2 = 1]` | $\{a \in S \mid a^2 = 1\}$ |
| `\intset{n}` | $[n]$ |
| `\card{X}` | $\lvert X\rvert$ |
| `X \symdif Y` | $X \triangle Y$ |
| `\setN` | $\mathbb{N}$ |
| `\setZ` | $\mathbb{Z}$ |
| `\setQ` | $\mathbb{Q}$ |
| `\setR` | $\mathbb{R}$ |
| `\setC` | $\mathbb{C}$ |
| `\setH` | $\mathbb{H}$ |
| `\setF` | $\mathbb{F}$ |
| `\setK` | $\mathbb{K}$ |
| `\setZp` | $\mathbb{Z}_{\geq 0}$ |
| `\setQp` | $\mathbb{Q}_{\geq 0}$ |
| `\setRp` | $\mathbb{R}_{\geq 0}$ |

## 1.5 Maps

| Input | Output |
|---|---|
| `\doms{X}{Y}` | $X \to Y$ |
| `\funcdoms{f}{X}{Y}` | $f\colon X \to Y$ |
| `\restr{f}{S}` | $f\rvert_S$ |
| `\id_K` | $\mathrm{id}_K$ |
| `\dom f` | $\operatorname{dom} f$ |
| `\cod f` | $\operatorname{cod} f$ |
| `\supp f` | $\operatorname{supp} f$ |

## 1.6 Lattices

| Input | Output |
|---|---|
| `x \meet y` | $x \wedge y$ |
| `x \join y` | $x \vee y$ |
| `\bigmeet` | $\bigwedge$ |
| `\bigjoin` | $\bigvee$ |

### 1.7 Algebra

| Input | Output |
|---|---|
| `\Hom(G)` | $\operatorname{Hom}(G)$ |
| `\End R` | $\operatorname{End} R$ |
| `\Aut_k K` | $\operatorname{Aut}_k K$ |
| `\gen{a, b}` | $\langle a, b \rangle$ |
| `\gen{a, b}[ab = e]` | $\langle a, b \mid ab = e \rangle$ |
| `\abel{G}` | $G_{\mathrm{ab}}$ |
| `\comm{G}` | $[G, G]$ |
| `\sym_n` | $\mathfrak{S}_n$ |
| `\sgn(\sigma)` | $\operatorname{sgn}(\sigma)$ |
| `\mult{R}` | $R^\times$ |
| `\M_{m,n}(R)` | $\mathrm{M}_{m,n}(R)$ |
| `\GL_n(R)` | $\mathrm{GL}_n(R)$ |
| `\SL_n(R)` | $\mathrm{SL}_n(R)$ |
| `\O(n)` | $\mathrm{O}(n)$ |
| `\SO(n)` | $\mathrm{SO}(n)$ |
| `\U(n)` | $\mathrm{U}(n)$ |
| `\SU(n)` | $\mathrm{SU}(n)$ |

### 1.8 Number Theory

| Input | Output |
|---|---|
| `a \coprime b` | $a \perp b$ |
| `a \divides b` | $a \mid b$ |
| `a \ndivides b` | $a \nmid b$ |

### 1.9 Linear Algebra

| Input | Output |
|---|---|
| `\tr A` | $\operatorname{tr} A$ |
| `\rank A` | $\operatorname{rank} A$ |
| `\trank A` | $\operatorname{t-rank} A$ |
| `\diag(a_1, \ldots, a_n)` | $\operatorname{diag}(a_1, \ldots, a_n)$ |
| `\blockdiag(A_1, \ldots, A_n)` | $\operatorname{block-diag}(A_1, \ldots, A_n)$ |
| `\vec(A)` | $\operatorname{vec}(A)$ |
| `\Row(A)` | $\operatorname{Row}(A)$ |
| `\Col(A)` | $\operatorname{Col}(A)$ |
| `\onevec` | $\mathbb{1}$ |
| `\trsp{A}` | $A^\top$ |
| `\adjo{A}` | $A^*$ |
| `\inpr{x}{y}` | $\langle x, y \rangle$ |

### 1.10 Analysis

| Input | Output |
|---|---|
| `\e` | $\mathrm{e}$ |
| `\d` | $\mathrm{d}$ |
| `\dif{f}{x}` | $\tfrac{\mathrm{d}f}{\mathrm{d}x}$ |
| `\pdif{f}{x}` | $\tfrac{\partial f}{\partial x}$ |
| `\ddif{f}{x}` | $\dfrac{\mathrm{d}f}{\mathrm{d}x}$ |
| `\dpdif{f}{x}` | $\dfrac{\partial f}{\partial x}$ |

### 1.11 Complex Analysis

| Input | Output |
|---|---|
| `\i` | $\mathrm{i}$ |
| `\Re z` | $\operatorname{Re} z$ |
| `\Im z` | $\operatorname{Im} z$ |
| `\Arg z` | $\operatorname{Arg} z$ |
| `\Loc z` | $\operatorname{Log} z$ |
| `\Sin z` | $\operatorname{Sin} z$ |
| `\Cos z` | $\operatorname{Cos} z$ |
| `\Tan z` | $\operatorname{Tan} z$ |
| `\Res_{z=0} f(z)` | $\operatorname{Res}_{z=0} f(z)$ |

### 1.12 Optimization

| Input | Output |
|---|---|
| `\argmin_{x \in S} f(x)` | $\operatorname{arg\,min}_{x \in S} f(x)$ |
| `\argmax_{x \in S} f(x)` | $\operatorname{arg\,max}_{x \in S} f(x)$ |
| `\Order(n)` | $\mathrm{O}(n)$ |
| `\order(n)` | $\mathrm{o}(n)$ |

## 2 The okithm Package

### 2.1 Theorems

If the language is set to Japanese like by `\usepackage[main = japanese]{babel}`, okithm will translate all the environment titles (Theorem, Definition, etc.) into Japanese. You can disable theorems by giving the option `notheorem` to okicmd.

```
\begin{theorem}[Awesome theorem]
  The square root $\sqrt{2}$ of two is irrational.
\end{theorem}

\begin{definition}[Coprime]
  Integers $a$ and $b$ are said to be \emph{coprime} if their greatest common
  divisor is one.
\end{definition}

```

```latex
\begin{lemma}
  If $a$ and $b$ are coprime, so are $a^2$ and $b^2$.
\end{lemma}

\begin{proposition}
  If $\sqrt{2} = a/b$, then $a^2 = 2b^2$.
\end{proposition}

\begin{corollary}
  If $\sqrt{2} = a/b$ with $a$ and $b$ being coprime, then $a$ is even.
\end{corollary}

\begin{example}
  If $a = 2$ and $b = 1$, then $a$ is even but $\sqrt{2} \ne a/b$.
\end{example}

\begin{remark}
  Note that $a$ and $b$ must be integers.
\end{remark}

\begin{proof}[of Awesome theorem]
  Suppose to the contrary that $\sqrt{2} = a/b$ with coprime $a$ and $b$.
  Then both $a$ and $b$ are even, which contradicts the assumption.
\end{proof}
```

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**Theorem 2.1** (Awesome theorem). *The square root $\sqrt{2}$ of two is irrational.*

**Definition 2.2** (Coprime)**.** Integers $a$ and $b$ are said to be *coprime* if their greatest common divisor is one.

**Lemma 2.3.** *If $a$ and $b$ are coprime, so are $a^2$ and $b^2$.*

**Proposition 2.4.** *If $\sqrt{2} = a/b$, then $a^2 = 2b^2$.*

**Corollary 2.5.** *If $\sqrt{2} = a/b$ with $a$ and $b$ being coprime, then $a$ is even.*

**Example 2.6.** If $a = 2$ and $b = 1$, then $a$ is even but $\sqrt{2} \neq a/b$. $\square$

**Remark 2.7.** Note that $a$ and $b$ must be integers.

*Proof* (of Awesome theorem). Suppose to the contrary that $\sqrt{2} = a/b$ with coprime $a$ and $b$. Then both $a$ and $b$ are even, which contradicts the assumption. $\square$

## 2.2 Algorithms

You can disable algorithms by setting the option `noalgorithm`.

```latex
\begin{algorithmic}[1]
  \Input{$n \in \setN$}
  \Output{$n(n+1)/2$}
  \State{$s \gets 0$}
  \ForTo{$i = 1$}{$n$}
  \State{$s \gets s + i$}
  \EndFor
  \State{\Return $s$}
\end{algorithmic}
```

**Input** : $n \in \mathbb{N}$
**Output:** $n(n+1)/2$

1: $s \leftarrow 0$
2: **for** $i = 1$ **to** $n$ **do**
3: $\quad s \leftarrow s + i$
4: **return** $s$

## 2.3 Optimization Problems

You can change `minimize`, `maximize` and `subject to` into `min`, `max` and `s.t.`, respectively, by setting the option `optstyle = short`.

```
\Minimize[name={(P)}]{
  \sum_{\condit{x \in S}[x^2 = 1]} w (x) + \sum_{i=1}^n (p_i + q_i)
}{
  S \subseteq V, \\
  p_i \ge 0 & (i = 1, \ldots, n), \\
  q_i \ge 0 & (i = 1, \ldots, n)
}
```

$$\text{(P)} \quad \left| \begin{array}{ll} \text{minimize} & \displaystyle\sum_{x \in S : x^2 = 1} w(x) + \sum_{i=1}^{n} (p_i + q_i) \\ \text{subject to} & S \subseteq V, \\ & p_i \geq 0 \quad (i = 1, \ldots, n), \\ & q_i \geq 0 \quad (i = 1, \ldots, n) \end{array} \right.$$