

Virginia Lake Macros v1.28

<http://alessio.guglielmi.name/res/vl>

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You can use this package by doing `\usepackage{virginialake}`.

If you don't need any graphical elements (most of which have curved lines), you can save some time by doing `\usepackage[noxy]{virginialake}`. In this case, the package does not load `Xy-pic`.

If there are elements with curved lines, in order to see them you have two options:

- just use `\usepackage{virginialake}` and compile your `TeX` file with `tex + dvips`.
- use `\usepackage[pdftex]{virginialake}` and compile with `pdfTeX`; in this case, most graphical elements will have lower quality, but compilation is faster.

Calling the package with `\usepackage[goodsyntax]{virginialake}` produces formulae or structures in the deep-inference style.

Calling the package with `\usepackage[lutzsyntax]{virginialake}` produces formulae or structures in the traditional style, except that it uses square brackets for disjunctions.

The articles <http://arxiv.org/abs/0709.1201> and <http://arxiv.org/abs/0709.1205> provide further examples (note that the `LaTeX` source is available).

1 Formulae/Structures

Normal formulae, with special logical operators (smaller than usual):

$$((A \vee (B \wedge C) \rightarrow \neg D) \leftrightarrow E) \leftarrow F \qquad ((A \vlor (B \vlan C) \vlim \vlne D) \vldi E) \vlmi F$$

$$(A \supset (B \subset C)) \qquad (A \ \vljm \ (B \ \vlmj \ C))$$

$$(A \wp (B \otimes (C \lhd D))) \multimap E \qquad (A \ \vlpa \ (B \ \vlte \ (C \ \vlse \ D))) \vlli E$$

The command `\vllineartrue` triggers linear logic additive conjunction and disjunction. It is reversed by `\vllinearfalse`, which is the default:

$$((A \oplus (B \& C) \rightarrow \neg D) \leftrightarrow E) \leftarrow F \qquad \begin{array}{l} \vllineartrue \\ ((A \vlor (B \vlan C) \vlim \vlne D) \vldi E) \vlmi F \end{array}$$

The macro `\vlbin` creates a logical operator: *e.g.*, `\vlse` is `\vlbin\triangleleft`.

Note that the new macros `\lt` and `\gt` are defined, respectively, for $<$ and $>$ (whose corresponding ASCII characters have special meaning when dealing with formulae).

The following happens if the package is called without the option `[goodsyntax]`, or if the command `\vlnogoodsyntax` is issued:

$A \vee B$	<code>\vls[A.B]</code>
$A \vee B \vee \dots \vee D \vee E$	<code>\vls[A.B.\vldots.D.E]</code>
$A \vee (B \wedge (C \wp (D \lhd (E \otimes F)))) \vee G$	<code>\vls[A.(B.[C;<D;(E;F)>]).G]</code>
$(A \vee (B \wedge (C \wp (D \lhd (E \otimes F)))) \vee G$	<code>\vlsbr[A.(B.[C;<D;(E;F)>]).G]</code>
$\{A \vee (B \wedge (C \wp (D \lhd (E \otimes F)))) \vee G\}$	<code>\vlscn[A.(B.[C;<D;(E;F)>]).G]</code>
$A\{ \}$	<code>A\vlhole</code>

The following happens if the package is called with the option `[goodsyntax]`, or if the command `\vlgoodsyntax` is issued:

$[A B]$	<code>\vls[A.B]</code>
$[A B \dots D E]$	<code>\vls[A.B.\vldots.D.E]</code>
$[A (B [C \langle D (E F) \rangle]) G]$	<code>\vls[A.(B.[C;<D;(E;F)>]).G]</code>
$[A (B [C \langle D (E F) \rangle]) G]$	<code>\vlsbr[A.(B.[C;<D;(E;F)>]).G]</code>
$[A (B [C \langle D (E F) \rangle]) G]$	<code>\vlscn[A.(B.[C;<D;(E;F)>]).G]</code>
$A\{ \}$	<code>A\vlhole</code>

The following happens if the package is called with the option `[lutzsyntax]`, or if the command `\vllutzsyntax` is issued:

$$\begin{array}{ll}
A \vee B & \{\backslash\mathrm{vls}[A.B]\} \\
\\
A \vee B \vee \cdots \vee D \vee E & \{\backslash\mathrm{vls}[A.B.\backslash\mathrm{vldots}.D.E]\} \\
\\
A \vee (B \wedge [C \wp \langle D \lhd (E \otimes F) \rangle]) \vee G & \{\backslash\mathrm{vls}[A.(B.[C;<D;(E;F)>]).G]\} \\
\\
[A \vee (B \wedge [C \wp \langle D \lhd (E \otimes F) \rangle]) \vee G] & \{\backslash\mathrm{vlsbr}[A.(B.[C;<D;(E;F)>]).G]\} \\
\\
\{A \vee (B \wedge [C \wp \langle D \lhd (E \otimes F) \rangle]) \vee G\} & \{\backslash\mathrm{vlscn}[A.(B.[C;<D;(E;F)>]).G]\} \\
\\
A\{ \} & A\backslash\mathrm{vlhole}
\end{array}$$

The command `\vlsmallbrackets` corrects a possible problem with the size of brackets:

$$\begin{array}{ll}
(a \vee b) \wedge (\bar{a} \vee \bar{b}) & \{\backslash\mathrm{vls}([a.b].[\backslash\mathrm{bar} a.\backslash\mathrm{bar} b])\} \\
\\
(a \vee b) \wedge (\bar{a} \vee \bar{b}) & \{\backslash\mathrm{vlsmallbrackets} \\
& \backslash\mathrm{vls}([a.b].[\backslash\mathrm{bar} a.\backslash\mathrm{bar} b])\}
\end{array}$$

This also holds for the alternative syntax style:

$$\begin{array}{ll}
([a \ b] \ [\bar{a} \ \bar{b}]) & \{\backslash\mathrm{vls}([a.b].[\backslash\mathrm{bar} a.\backslash\mathrm{bar} b])\} \\
\\
([a \ b] \ [\bar{a} \ \bar{b}]) & \{\backslash\mathrm{vlsmallbrackets} \\
& \backslash\mathrm{vls}([a.b].[\backslash\mathrm{bar} a.\backslash\mathrm{bar} b])\}
\end{array}$$

The command `\vlnosmallbrackets` undoes `\vlsmallbrackets`.

Notice the difference between the following two displays; the second has better spacing:

$$\begin{array}{ll}
C(a \wedge b) & \{C\backslash\mathrm{vlsbr}(a.b)\} \\
\\
C(a \wedge b) & \{C\{\backslash\mathrm{vlsbr}(a.b)\}\}
\end{array}$$

The `\vls` macro works by redefining ‘.’, ‘[’, ‘]’, ‘(’ and ‘)’. This, of course, can cause several problems. In practice, they are rare, except when `\vls` is an argument of a macro. In this case, one needs to ‘update’ the macro by calling `\vlupdate`. Compare

$$[a.b] \quad \begin{array}{l} \text{\newcommand{\vltest}[1]{\#1}} \\ \text{\vltest{\vls[a.b]}} \end{array}$$

with

$$a \vee b \quad \begin{array}{l} \text{\newcommand{\vltest}[1]{\#1}} \\ \text{\vlupdate\vltest} \\ \text{\vltest{\vls[a.b]}} \end{array}$$

This mechanism, in principle, works with every macro. One can do `\vlupdate\frame` at the beginning of a document, for example, and then use as normal the macro `\frame` of the package **beamer**.

Sometimes it is not possible to use `\vlupdate`. For example, in the following situation (requiring the **amsmath** package):

$$\begin{array}{ll} \beta_k = \bigwedge_{k \leq i \leq n} [\bar{c}_i, \bar{d}_i] & \text{for } 1 < k \leq n \quad , \\ \gamma_i = (\beta_{i+1}, c_i) & \text{for } 1 \leq i < n \quad , \\ \delta_i = (\beta_{i+1}, d_i) & \text{for } 1 \leq i < n \quad , \\ \gamma_n = c_n \quad , & \\ \delta_n = d_n \quad . & \end{array}$$

```
\begin{align*}
\beta_k & \&= \bigwedge_{k \leq i \leq n} \text{\vls[\bar c_i.\bar d_i]} \&\text{\text{for } \$1 < k \leq n\$} \backslash\quad, \\
\gamma_i & \&= \text{\vls(\beta_{i+1}.c_i)} \&\text{\text{for } \$1 \leq i < n\$} \backslash\quad, \\
\delta_i & \&= \text{\vls(\beta_{i+1}.d_i)} \&\text{\text{for } \$1 \leq i < n\$} \backslash\quad, \\
\gamma_n & \&= c_n \backslash\quad, \\
\delta_n & \&= d_n \backslash\quad. \\
\end{align*}
```

The solution is to use the macros `\vlstore`, `\vlread` and `\lt` as follows:

$$\begin{array}{ll} \beta_k = \bigwedge_{k \leq i \leq n} \bar{c}_i \vee \bar{d}_i & \text{for } 1 < k \leq n \quad , \\ \gamma_i = \beta_{i+1} \wedge c_i & \text{for } 1 \leq i < n \quad , \\ \delta_i = \beta_{i+1} \wedge d_i & \text{for } 1 \leq i < n \quad , \\ \gamma_n = c_n \quad , & \\ \delta_n = d_n \quad . & \end{array}$$

```
\vlstore{\%
\beta_k &= \bigwedge_{k \leq i \leq n} \text{\vls[\bar c_i.\bar d_i]}
&\text{\text{for } \$1 \lt k \leq n\$} \backslash\quad, \\
\gamma_i &= \text{\vls(\beta_{i+1}.c_i)} \&\text{\text{for } \$1 \leq i \lt n\$} \backslash\quad, \\
\delta_i &= \text{\vls(\beta_{i+1}.d_i)} \&\text{\text{for } \$1 \leq i \lt n\$} \backslash\quad, \\
\gamma_n &= c_n \backslash\quad, \\
\delta_n &= d_n \backslash\quad \backslash\dot \quad \& \\
}
\begin{align*}
\vlread
\end{align*}
```

Notice the use of `\vldot` in the place of `.` in the last line of the display. The commands `\vldot` for `.` and `\vlsqbrl` for `[` and `\vlsqbrr` for `]` and `\vlrobrl` for `(` and `\vlrobr` for `)` are provided.

There's the command `\vlnos`, which sets `'.'`, `'['`, `']'`, `'('` and `')'` to their normal behaviour, for example:

$$a \wedge (. [b \wedge c] .) \qquad \{\vls(a.\{\vlnos (. [\vls(b.c)] .))\}}$$

2 Derivations

The following macros, by default, accept the commands for formulae/structures, as shown before. However, this might create problems in some circumstances, because the characters ‘.’, ‘[’, ‘]’, ‘(’ and ‘)’ are defined in a special way. To avoid such problems, in case the commands for formulae/structures are not wanted, you can use the command `\vlnostruressyntax`: every successive invocation of the commands for derivations does not redefine any character.

$$\begin{array}{l} \Pi \parallel s \\ T \vee U \end{array} \quad \begin{array}{l} \backslash\mathrm{vlderivation} \\ \backslash\mathrm{vlpr}\{\backslash\mathrm{Pi}\}\{\backslash\mathrm{cal}\ S\}\{\backslash\mathrm{vls}[T.U]\}\} \end{array}$$

$$\begin{array}{l} \Pi \parallel s \\ T \vee U \end{array} \quad \begin{array}{l} \backslash\mathrm{vlderivation} \\ \backslash\mathrm{vlpd}\{\backslash\mathrm{Pi}\}\{\backslash\mathrm{cal}\ S\}\{\backslash\mathrm{vls}[T.U]\}\} \end{array}$$

$$\begin{array}{l} \Pi \parallel s \\ T \vee U \end{array} \quad \begin{array}{l} \backslash\mathrm{toks0}=\{3.2\} \\ \backslash\mathrm{vlderivation} \\ \backslash\mathrm{vlpf}\{\backslash\mathrm{Pi}\}\{\backslash\mathrm{cal}\ S\}\{\backslash\mathrm{vls}[T.U]\}\{\backslash\mathrm{the}\backslash\mathrm{toks0}\} \end{array}$$

$$\begin{array}{l} \Pi \parallel s \\ T \vee U \end{array} \quad \backslash\mathrm{vlproof}\{\backslash\mathrm{Pi}\}\{\backslash\mathrm{cal}\ S\}\{\backslash\mathrm{vls}[T.U]\}$$

$$\begin{array}{l} \Pi \parallel s \\ T \vee U \end{array} \quad \backslash\mathrm{vlproofd}\{\backslash\mathrm{Pi}\}\{\backslash\mathrm{cal}\ S\}\{\backslash\mathrm{vls}[T.U]\}$$

$$\begin{array}{l} R \\ \Delta \parallel s \\ T \vee U \end{array} \quad \begin{array}{l} \backslash\mathrm{vlderivation} \\ \backslash\mathrm{vlde}\{\backslash\mathrm{Delta}\}\{\backslash\mathrm{cal}\ S\}\{\backslash\mathrm{vls}[T.U]\}\{ \\ \backslash\mathrm{vlhy} \end{array} \quad \begin{array}{l} \{ \\ \{R \\ \}\}\} \end{array}$$

$$\begin{array}{l} R \\ \Delta \parallel s \\ T \vee U \end{array} \quad \begin{array}{l} \backslash\mathrm{vlderivation} \\ \backslash\mathrm{vldd}\{\backslash\mathrm{Delta}\}\{\backslash\mathrm{cal}\ S\}\{\backslash\mathrm{vls}[T.U]\}\{ \\ \backslash\mathrm{vlhy} \end{array} \quad \begin{array}{l} \{ \\ \{R \\ \}\}\} \end{array}$$

$$\begin{array}{l} R \\ \Delta \parallel s \\ T \vee U \end{array} \quad \begin{array}{l} \backslash\mathrm{toks0}=\{2.5\} \\ \backslash\mathrm{vlderivation} \\ \backslash\mathrm{vldf}\{\backslash\mathrm{Delta}\}\{\backslash\mathrm{cal}\ S\}\{\backslash\mathrm{vls}[T.U]\}\{ \\ \backslash\mathrm{vlhy} \end{array} \quad \begin{array}{l} \{ \\ \}\}\{\backslash\mathrm{the}\backslash\mathrm{toks0}\} \\ \} \end{array}$$

$\frac{R}{\Delta \parallel S}{T \vee U}$	<code>\vlder{\Delta}{\cal S}{\vls[T.U]}{R}</code>
$\frac{R}{\Delta \parallel S}{T \vee U}$	<code>\vlderd{\Delta}{\cal S}{\vls[T.U]}{R}</code>
$\rho \frac{R}{T \vee U} \star$	<code>\vlderivation \vlin{\rho}{\star}{\vls[T.U]}{ \vlhy {R} }}</code>
$\rho \frac{R}{T \vee U} \star$	<code>\vlderivation \vliq{\rho}{\star}{\vls[T.U]}{ \vlhy {R} }}</code>
$\rho \frac{R}{T \vee U} \star$	<code>\vlinf{\rho}{\star}{\vls[T.U]}{R}</code>
$\rho \frac{R}{T \vee U} \star$	<code>\vliqf{\rho}{\star}{\vls[T.U]}{R}</code>
$\rho \frac{R}{T \vee U} \star$	<code>\vlidf{\rho}{\star}{\vls[T.U]}{R}</code>
$\frac{\Pi \parallel S}{\rho \frac{R}{T \vee U} \text{note}}$	<code>\vlderivation \vlin{\rho}{\rm note}{\vls[T.U]}{ \vlpr{\Pi }{\cal S }{R} }}</code>
$\frac{R}{\Delta \parallel S}{\frac{T}{U}}$	<code>\vlderivation \vlin{\rho }{ }{U} { \vlde{\Delta}{\cal S}{T}{ \vlhy {R}}}</code>

The commands `\vlsmlleftlabels` and `\vlnosmlleftlabels` control the size of labels at the left of — (the ρ s above); the default is small size.

$$\begin{array}{l}
R \\
\Delta \parallel S'' \\
T \\
\Delta' \parallel S' \\
U \\
\Delta'' \parallel S \\
V
\end{array}
\quad
\begin{array}{l}
\backslash\mathrm{vlderivation} \\
\backslash\mathrm{vlde}\{\backslash\mathrm{Delta}','\}\{\backslash\mathrm{cal}\ S\}\{V\}\{ \\
\backslash\mathrm{vlde}\{\backslash\mathrm{Delta}'\}\{\backslash\mathrm{cal}\ S'\}\{U\}\{ \\
\backslash\mathrm{vlde}\{\backslash\mathrm{Delta}\}\{\backslash\mathrm{cal}\ S'','\}\{T\}\{ \\
\backslash\mathrm{vlhy} \\
\{R\}\}\}\}
\end{array}$$

$$\begin{array}{l}
R \\
\rho \frac{R}{T} \\
\Delta \parallel \\
U \\
\Delta' \parallel \\
V
\end{array}
\quad
\begin{array}{l}
\backslash\mathrm{vlderivation} \\
\backslash\mathrm{vlde}\{\backslash\mathrm{Delta}','\}\{V\}\{ \\
\backslash\mathrm{vlde}\{\backslash\mathrm{Delta}\}\{U\}\{ \\
\backslash\mathrm{vlin}\{\backslash\mathrm{rho}\}\{T\}\{ \\
\backslash\mathrm{vlhy} \\
\{R\}\}\}\}
\end{array}$$

$$\begin{array}{l}
R \\
\rho \frac{\dots}{T} \\
\rho' \frac{\dots}{U} \\
\rho'' \frac{\dots}{V}
\end{array}
\quad
\begin{array}{l}
\backslash\mathrm{vlderivation} \\
\backslash\mathrm{vlin}\{\backslash\mathrm{rho}','\}\{\backslash\mathrm{quad.}\}\{V\}\{ \\
\backslash\mathrm{vliq}\{\backslash\mathrm{rho}'\}\{U\}\{ \\
\backslash\mathrm{vlid}\{\backslash\mathrm{rho}\}\{T\}\{ \\
\backslash\mathrm{vlhy} \\
\{R\}\}\}\}
\end{array}$$

Note `\vlvdots` in

$$\begin{array}{l}
\gamma \\
\parallel \\
\alpha_1 \\
\tau \frac{\alpha_1}{\alpha_1 \sigma_1} \\
\parallel \\
\vdots \\
\parallel \\
\alpha_n \\
\rho \frac{\alpha_n}{\alpha_n \sigma_n} \\
\parallel \\
\beta
\end{array}
\quad
\begin{array}{l}
\backslash\mathrm{vlderivation} \\
\backslash\mathrm{vlde}\{\}\{\backslash\mathrm{beta}\}\{ \\
\backslash\mathrm{vlin}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{alpha}_n\backslash\mathrm{sigma}_n\}\{ \\
\backslash\mathrm{vlde}\{\}\{\backslash\mathrm{alpha}_n\}\{ \\
\backslash\mathrm{vlde}\{\}\{\backslash\mathrm{vlvdots}\}\{ \\
\backslash\mathrm{vlin}\{\backslash\mathrm{tau}\}\{\backslash\mathrm{alpha}_1\backslash\mathrm{sigma}_1\}\{ \\
\backslash\mathrm{vlde}\{\}\{\backslash\mathrm{alpha}_1\}\{ \\
\backslash\mathrm{vlhy} \\
\{\backslash\mathrm{gamma}\}\}\}\}\}\}
\end{array}$$

The command `\vtx` provides for some extra space, as in

$$\xi \left\{ \left(\frac{\frac{t}{a \vee \bar{a}} \wedge (\bar{a} \vee \bar{a})}{\frac{a}{a \wedge a} \wedge (\bar{a} \vee \bar{a})} \vee \bar{a} \right) \right\}$$

$\rho \frac{R}{U} \star$	$\begin{array}{l} \backslash\mathrm{vlderivation} \quad \{ \\ \backslash\mathrm{vliin}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{star}\}\{\mathrm{U}\}\{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{R}\}\} \\ \quad \{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{T}\}\}\} \end{array}$
$\rho \frac{R}{U} \star$	$\begin{array}{l} \backslash\mathrm{vlderivation} \quad \{ \\ \backslash\mathrm{vliiq}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{star}\}\{\mathrm{U}\}\{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{R}\}\} \\ \quad \{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{T}\}\}\} \end{array}$
$\rho \frac{R}{U} \star$	$\backslash\mathrm{vliinf}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{star}\}\{\mathrm{U}\}\{\mathrm{R}\}\{\mathrm{T}\}$
$\rho \frac{R}{U} \star$	$\backslash\mathrm{vliiqf}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{star}\}\{\mathrm{U}\}\{\mathrm{R}\}\{\mathrm{T}\}$
$\rho \frac{R}{V} \star$	$\begin{array}{l} \backslash\mathrm{vlderivation} \quad \{ \\ \backslash\mathrm{vliiin}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{star}\}\{\mathrm{V}\}\{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{R}\}\} \\ \quad \{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{T}\}\} \\ \quad \{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{U}\}\}\} \end{array}$
$\rho \frac{R}{V} \star$	$\begin{array}{l} \backslash\mathrm{vlderivation} \quad \{ \\ \backslash\mathrm{vliiiq}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{star}\}\{\mathrm{V}\}\{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{R}\}\} \\ \quad \{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{T}\}\} \\ \quad \{ \\ \backslash\mathrm{vlhy} \quad \{\mathrm{U}\}\}\} \end{array}$
$\rho \frac{R}{V} \star$	$\backslash\mathrm{vliiinf}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{star}\}\{\mathrm{V}\}\{\mathrm{R}\}\{\mathrm{T}\}\{\mathrm{U}\}$
$\rho \frac{R}{V} \star$	$\backslash\mathrm{vliiiqf}\{\backslash\mathrm{rho}\}\{\backslash\mathrm{star}\}\{\mathrm{V}\}\{\mathrm{R}\}\{\mathrm{T}\}\{\mathrm{U}\}$

$$\begin{array}{c}
\frac{R \wedge R'}{\rho \frac{T \wedge T'}{\Delta \parallel}} \quad \frac{R \wedge R'}{\rho' \frac{T \wedge T'}{U \wedge U'}} \\
\frac{\Delta' \parallel}{V \wedge V'} \quad \frac{\rho'' \frac{U \wedge U'}{V \wedge V'}}{\rho \frac{W \wedge W'}{\star}} \star
\end{array}$$

```

\vllderivation
\vliliq{\rho }{\star}{\vls(W.W')}{
\vlde {\Delta'}{ }{\vls(V.V')}{
\vlde {\Delta }{ }{\vls(U.U')}{
\vlhy {\rho }{ }{\vls(T.T')}{
\vlhy {\vls(R.R')}}}}}{
\vlhy {\rho''}{\star}{\vls(V.V')}{
\vlhy {\rho'}{ }{\vls(U.U')}{
\vlhy {\rho }{ }{\vls(T.T')}{
\vlhy {\vls(R.R')}}}}}}

```

The following uses $\text{\texttt{Xy-pic}}$ (see at the beginning of this manual for instructions).

$$\begin{array}{c}
A_1 \quad \dots \quad A_h \\
\triangle \\
B
\end{array}$$

```

\vllderivation
\vltr{\Delta}{B}{
\vlhy {A_1 }}
{
\vlhy {\dots}}
{
\vlhy {A_h }}

```

$$\begin{array}{c}
A_1 \quad \dots \quad A_h \\
\triangle \\
B
\end{array}$$

```

\vltreeder{\Delta}{B}{A_1}{\dots}{A_h}

```

$$\begin{array}{c}
A_1 \quad \dots \quad A_h \\
a \quad \triangle \quad b \\
B
\end{array}$$

```

\vllderivation
\vltrl{\Delta}{a}{b}{B}{
\vlhy {A_1 }}
{
\vlhy {\dots}}
{
\vlhy {A_h }}

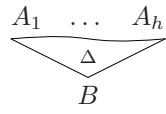
```

$$\begin{array}{c}
A_1 \quad \dots \quad A_h \\
a \quad \triangle \quad b \\
B
\end{array}$$

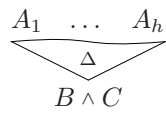
```

\vltreederl{\Delta}{a}{b}{B}{A_1}{\dots}{A_h}

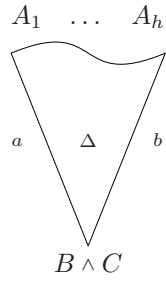
```



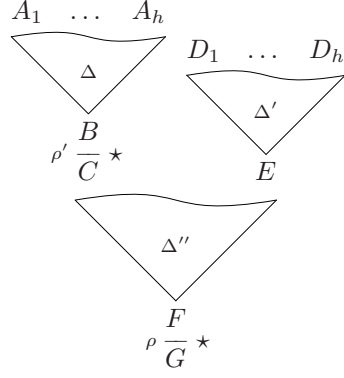
```
{\vlnostruressyntax
\vl derivation      {
\vltrf{\Delta}{B    }{
\vlhy      {A_1    }}
{
\vlhy      {\dots}}
{
\vlhy      {A_h    }}
{0.5}}}
```



```
\toks0={0.5}
\vl derivation      {
\vltrf{\Delta}{\vls(B.C)}{
\vlhy      {A_1      }}
{
\vlhy      {\dots    }}
{
\vlhy      {A_h      }}
{\the\toks0}}
```



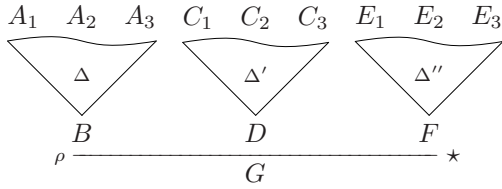
```
\toks0={2.5}
\vl derivation      {
\vltrlf{\Delta}{a}{b}{\vls(B.C)}{
\vlhy      {A_1      }}
{
\vlhy      {\dots    }}
{
\vlhy      {A_h      }}
{\the\toks0}}
```



```

\vllderivation
\vlilin{\rho }{\star}{G } {
\vltr{\Delta''} {F } {
\vlilin{\rho' }{\star}{C } {
\vltr{\Delta } {B } {
\vlhy {A_1 }}
{
\vlhy {\dots }}
{
\vlhy {A_h }}} }
{
\vlhy {\kern-1pc} }
{
\vltr{\Delta' } {E } {
\vlhy {D_1 }}
{
\vlhy {\dots }}
{
\vlhy {D_h }} } } }

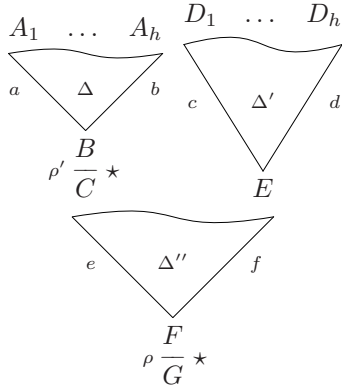
```



```

\vllderivation
\vlilin{\rho }{\star}{G } {
\vltr {\Delta } {B } {
\vlhy {A_1}}
{
\vlhy {A_2}}
{
\vlhy {A_3}}} }
\vltr {\Delta' } {D } {
\vlhy {C_1}}
{
\vlhy {C_2}}
{
\vlhy {C_3}}} }
\vltr {\Delta''} {F } {
\vlhy {E_1}}
{
\vlhy {E_2}}
{
\vlhy {E_3}} } } }

```



```
{\vlnostruressyntax
\lderivation
\lin {\rho }{\star}{G } {
\ltrl {\Delta''}{e}{f} {F } {
\lin {\rho' }{\star}{C } {
\ltrl {\Delta }{a}{b} {B }{
\lhy {A_1 }
{
\lhy {\dots }
{
\lhy {A_h }}}}
{
\lhy {\kern-1pc} }
{
\ltrlf{\Delta' }{c}{d} {E }{
\lhy {D_1 }
{
\lhy {\dots }
{
\lhy {D_h }
{1.6}}}}}
```

3 Atomic Flows

The following uses Xy-pic (see at the beginning of this manual for instructions).

$$\begin{array}{c} e \quad f \\ \hline a \mid b \quad c \mid d \end{array}$$

`\afaid abcdef`

$$\begin{array}{c} e \quad f \\ \hline a \mid b \quad c \mid d \end{array}$$

`\afaidcol abcdef{Red}{Green}`

$$\begin{array}{c} e \quad f \\ \hline a \mid b \quad c \mid d \end{array}$$

`\afaide x abcdef45`

$$\begin{array}{c} e \quad f \\ \hline a \mid b \quad c \mid d \end{array}$$

`\afaide xcol abcdef45{Red}{Green}`

$$\begin{array}{c} a \mid b \quad c \mid d \\ \hline e \quad f \end{array}$$

`\afaiu abcdef`

$$\begin{array}{c} a \mid b \quad c \mid d \\ \hline e \quad f \end{array}$$

`\afaiucol abcdef{Red}{Green}`

$$\begin{array}{c} a \mid b \quad c \mid d \\ \hline e \quad f \end{array}$$

`\afaiuex abcdef32`

$$\begin{array}{c} a \mid b \quad c \mid d \\ \hline e \quad f \end{array}$$

`\afaiuexcol abcdef32{Red}{Green}`

$$\overline{a \quad b}$$

`\afaidnw ab`

$$\overline{a \quad b}$$

`\afaiunw ab`

Use the macro `\afnegspace` to compensate for excess white space below some diagrams including `\afaiu` and similar macros. The macro is a negative `\vskip` of the right amount (this is necessary to go around some bugs in Xy-pic, or perhaps some poor programming on my side).

$$\begin{array}{c} e \quad f \\ \hline a \parallel b \quad c \parallel d \end{array}$$

`\afaidm abcdef`

$$\begin{array}{c} e \quad f \\ \hline a \parallel b \quad c \parallel d \end{array}$$

`\afaidmcol abcdef{Red}{Green}`

$$\begin{array}{c} e \quad f \\ \hline a \parallel b \quad c \parallel d \end{array}$$

`\afaidmex abcdef45`

$$\begin{array}{c} e \quad f \\ \hline a \parallel b \quad c \parallel d \end{array}$$

`\afaidmexcol abcdef45{Red}{Green}`

$$\begin{array}{c} a \parallel b \quad c \parallel d \\ \hline e \quad f \end{array}$$

`\afaium abcdef`

$$\begin{array}{c} a \parallel b \quad c \parallel d \\ \hline e \quad f \end{array}$$

`\afaiumcol abcdef{Red}{Green}`

$$\begin{array}{c} a \parallel b \quad c \parallel d \\ \hline e \quad f \end{array}$$

`\afaiumex abcdef32`

$$\begin{array}{c} a \parallel b \quad c \parallel d \\ \hline e \quad f \end{array}$$

`\afaiumexcol abcdef32{Red}{Green}`

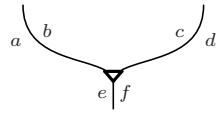
Use the macros `\afraise` and `\aflower`, typically with one atomic flow as argument, to raise or lower a bit the atomic flow (see examples).



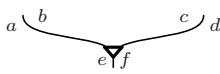
`\afacd abcdef`



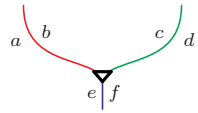
`\afacdcol abcdef{Red}{Green}{Blue}`



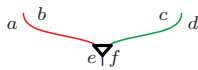
`\afacdexsq abcdef41`



`\afacdexsn abcdef41`



`\afacdexsqcol abcdef72{Red}{Green}{Blue}`



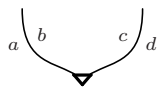
`\afacdexsncol abcdef72{Red}{Green}{Blue}`



`\afacdncw abcd`



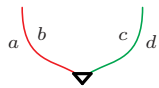
`\afacdncwcol abcd{Red}{Green}`



`\afacdncwexsq abcdsq83`



`\afacdncwexsn abcdsq83`



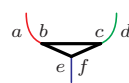
`\afacdncwexsqcol abcd83{Red}{Green}`




`\afacdncwexsncol abcd83{Red}{Green}`



```
\afacdex abcdef21
```



```
\afacdexcol abcdef21{Red}{Green}{Blue}
```



```
\afacdnwex abcd23
```



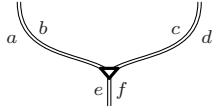
```
\afacdnwexcol abcd23{Red}{Green}
```



`\afacdm abcdef`



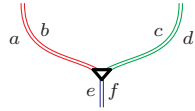
`\afacdmcol abcdef{Red}{Green}{Blue}`



`\afacdmexsq abcdef41`



`\afacdmexsn abcdef41`



`\afacdmexsqcol abcdef72{Red}{Green}{Blue}`



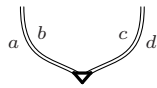
`\afacdmexsncol abcdef72{Red}{Green}{Blue}`



`\afacdmnw abcd`



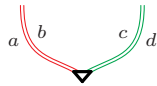
`\afacdmnwcol abcd{Red}{Green}`



`\afacdmnwexsq abcdsq83`



`\afacdmnwexsn abcdsq83`



`\afacdmnwexsqcol abcd83{Red}{Green}`



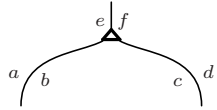
`\afacdmnwexsncol abcd83{Red}{Green}`



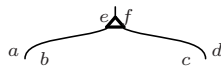
`\afacu abcdef`



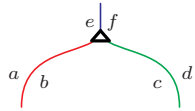
`\afacucol abcdef{Red}{Green}{Blue}`



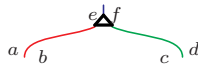
`\afacuexsq abcdef41`



`\afacuexsn abcdef41`



`\afacuexsqcol abcdef72{Red}{Green}{Blue}`



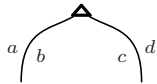
`\afacuexsncol abcdef72{Red}{Green}{Blue}`



`\afacunw abcd`



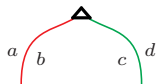
`\afacunwcol abcd{Red}{Green}`



`\afacunwexsq abcdsq83`



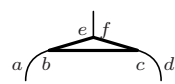
`\afacunwexsn abcdsq83`



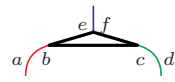
`\afacunwexsqcol abcd83{Red}{Green}`



`\afacunwexsncol abcd83{Red}{Green}`



`\afacuex abcdef31`



`\afacuexcol abcdef31{Red}{Green}{Blue}`



`\afacunwex abcd23`



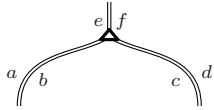
`\afacunwexcol abcd23{Red}{Green}`



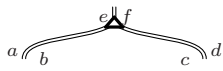
\afacum abcdef



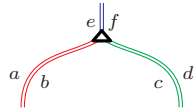
\afacumcol abcdef{Red}{Green}{Blue}



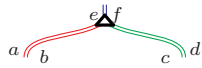
\afacumexsq abcdef41



\afacumexsn abcdef41



\afacumexsqcol abcdef72{Red}{Green}{Blue}



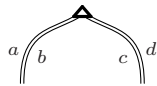
\afacumexsncol abcdef72{Red}{Green}{Blue}



\afacumnw abcd



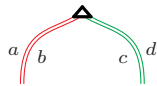
\afacumnwcol abcd{Red}{Green}



\afacumnwexsq abcdsq83



\afacumnwexsn abcdsq83



\afacumnwexsqcol abcd83{Red}{Green}



\afacumnwexsncol abcd83{Red}{Green}

$\begin{array}{c} a \ b \\ \blacktriangledown \\ c \ d \\ \end{array}$	<code>\afawd abcd</code>
$\begin{array}{c} a \ b \\ \blacktriangledown \\ c \ d \\ \end{array}$	<code>\afawdcol abcd{Red}{Green}</code>
$\begin{array}{c} a \ b \\ \blacktriangledown \end{array}$	<code>\afawdnw ab</code>
$\begin{array}{c} c \ d \\ \blacktriangle \\ a \ b \end{array}$	<code>\afawu abcd</code>
$\begin{array}{c} c \ d \\ \blacktriangle \\ a \ b \end{array}$	<code>\afawucol abcd{Red}{Green}</code>
$\begin{array}{c} \blacktriangle \\ a \ b \end{array}$	<code>\afawunw ab</code>
$\begin{array}{c} \\ a \ b \\ \blacktriangledown \end{array}$	<code>\aff 6ab</code>
$\begin{array}{c} \\ a \ b \\ \blacktriangledown \end{array}$	<code>\affcol 6ab{Red}</code>
$\begin{array}{c} \blacktriangle \\ a \ b \\ \end{array}$	<code>\aft 6ab</code>
$\begin{array}{c} \blacktriangle \\ a \ b \\ \end{array}$	<code>\aftcol 6ab{Red}</code>
$\begin{array}{c} a \ b \\ \blacktriangledown \\ c \parallel d \end{array}$	<code>\afawdm abcd</code>
$\begin{array}{c} a \ b \\ \blacktriangledown \\ c \parallel d \end{array}$	<code>\afawdmcol abcd{Red}{Green}</code>
$\begin{array}{c} c \parallel d \\ \blacktriangle \\ a \ b \end{array}$	<code>\afawum abcd</code>
$\begin{array}{c} c \parallel d \\ \blacktriangle \\ a \ b \end{array}$	<code>\afawumcol abcd{Red}{Green}</code>

$\left \right.$	<code>\afvj 6</code>
------------------	----------------------

$\left \right.$	<code>\afvjcol 6{Red}</code>
------------------	------------------------------

$a \left \right. b$	<code>\afvjd 6ab</code>
----------------------	-------------------------

$a \left \right. b$	<code>\afvjdcol 6ab{Red}</code>
----------------------	---------------------------------

$a \left \right. b$	<code>\afvju 6ab</code>
----------------------	-------------------------

$a \left \right. b$	<code>\afvjucol 6ab{Red}</code>
----------------------	---------------------------------

\parallel	<code>\afvjm 6</code>
-------------	-----------------------

\parallel	<code>\afvjmc col 6{Red}</code>
-------------	---------------------------------

$a \parallel b$	<code>\afvjdm 6ab</code>
-----------------	--------------------------

$a \parallel b$	<code>\afvjdmcol 6ab{Red}</code>
-----------------	----------------------------------

$a \parallel b$	<code>\afvjum 6ab</code>
-----------------	--------------------------

$a \parallel b$	<code>\afvjumcol 6ab{Red}</code>
-----------------	----------------------------------

$ $	<code>\aftvj 6</code>
-----	-----------------------

$ $	<code>\aftvjcol 6{Red}</code>
-----	-------------------------------

$a b$	<code>\aftvjd 6ab</code>
-------	--------------------------

$a b$	<code>\aftvjdcol 6ab{Red}</code>
-------	----------------------------------

$a b$	<code>\aftvju 6ab</code>
-------	--------------------------

$a b$	<code>\aftvjucol 6ab{Red}</code>
-------	----------------------------------

$:$	<code>\afvdj</code>
-----	---------------------


 \afcjl 44

 \afcjlcol 44{Red}

 \afcjr 44

 \afcjrcol 44{Red}

 \afcjlm 44

 \afcjlmcol 44{Red}


 \afcjrm 44


 \afcjrmlcol 44{Red}


 \afex 44

 \afexcol 44{Red}{Green}


 \aftcjl 44

 \aftcjlcol 44{Red}

 \aftcjr 44

 \aftcjrcol 44{Red}

 \afexpu 542

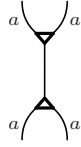
 \afexpd 825

The following `dimen` registers are defined:

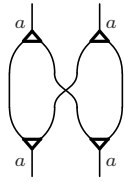
```
\atflowunit          =0.01pt
\atflowelwidth        =425\atflowunit
\atflowelwidthtriangle=250\atflowunit
\atflowelheight       =325\atflowunit
\atflowthickone       = 60\atflowunit
\atflowthicktwo       = 40\atflowunit
\atflowthickthree     =160\atflowunit
\atflowthickfour      =120\atflowunit
\atflowthickfive      = 40\atflowunit
\atflowlabeldistance  =220\atflowunit
```

They govern various parameters in the atomic flow elements (experiment to see which ones). You might be interested especially in changing the last one.

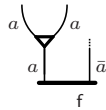
Each line starting with a coordinate pair (x,y) is an element of the picture; just experiment turning them on and off by commenting them. The coordinates are relative, so, for example, you can add or subtract the same vector to all of them and still get the same picture.



```
\atomicflow{
(0,8)*{\afacd a{}{}a{}{}};
(0,0)*{\afacu a{}{}a{}{}}
```



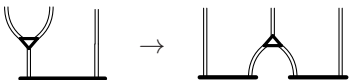
```
\atomicflow{
( 2,12)*{\afacu{}{}{}{}a{}{}};
( 8,12)*{\afacu{}{}{}{}a{}{}};
( 0, 6)*{\afvj4};
( 5, 6)*{\afex24};
(10, 6)*{\afvj4};
( 2, 0)*{\afacd{}{}{}{}a{}{}};
( 8, 0)*{\afacd{}{}{}{}a{}{}}
```



```
\atomicflow{
(4,4.5)*{\afvdj};
(0,5 )*{\afacd a{}{}a{}{}};
(2,0 )*{\afaiu a{}{}{\bar a}{}{\mathsf f}}}
```

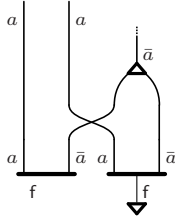


```
\aflower{\atomicflow{
( 6, 6)*{\afvjd4{}{}{}{}};
( 3, 0)*{\afaiuex{}{}{}{}{}{}32};
( 0, 4)*{\afacdwn{}{}{}{}}}
\quad\to\quad
\aflower{\atomicflow{
( 6,6)*{\afacu{}{}{}{}{}{}};
( 0,6)*{\afvjd8{}{}{}};
( 12,6)*{\afvjd8{}{}{}};
( 10,0)*{\afaiunw{}{}{}};
( 2,0)*{\afaiunw{}{}{}}}}
```

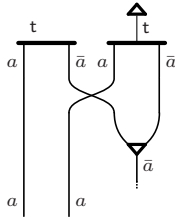


```
\aflower{\atomicflow{
( 6, 6)*{\afvjd4{}{}{}{}};
( 3, 0)*{\afaiumex{}{}{}{}{}{}32};
( 0, 4)*{\afacdmnw{}{}{}{}}}
\quad\to\quad
\aflower{\atomicflow{
( 6,6)*{\afacum{}{}{}{}{}{}};
( 0,6)*{\afvjd8{}{}{}};
( 12,6)*{\afvjd8{}{}{}};
( 10,0)*{\afaiunw{}{}{}};
( 2,0)*{\afaiunw{}{}{}}}}
```

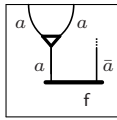
In the next two pictures, notice how vertical symmetry is achieved.



```
\atomicflow{
(10,20.5)*{\afvdj};
( 4,18 )*{\afvjd{12}{a}};
( 0,16 )*{\afvjd{16}{a{}}};
(10,16 )*{\afacu{}{}{}{}{\bar a}};
( 6,10 )*{\afex44};
(12,10 )*{\afvj4};
( 2, 4 )*{\afaiu a{}{}{\bar a}{\mathsf f}{}};
(10, 4 )*{\aftrianglefalse\afaiu a{}{}{\bar a}{}};
(10, 2 )*{\aff4{}{\mathsf f}}
```



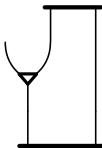
```
\atomicflowinv{
(10,20.5)*{\afvdj};
( 4,18 )*{\afvju{12}{a}};
( 0,16 )*{\afvju{16}{a{}}};
(10,16 )*{\afacd{}{}{}{}{\bar a}};
( 6,10 )*{\afex44};
(12,10 )*{\afvj4};
( 2, 4 )*{\afaid a{}{}{\bar a}{\mathsf t}{}};
(10, 4 )*{\aftrianglefalse\afaid a{}{}{\bar a}{}};
(10, 2 )*{\aft4{}{\mathsf t}}
```



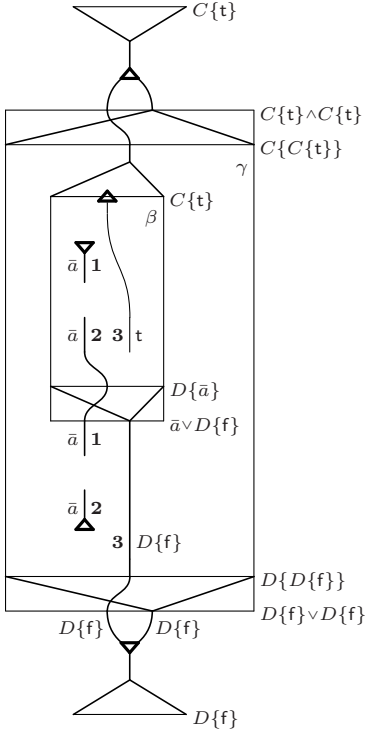
```
\atomicflow{
(4,4.5)*{\afvdj};
(0,5 )*{\afacd a{}{}{a{}}};
(1,2.5)*{\affr{10}{13}};
(2,0 )*{\afaiu a{}{}{\bar a}{\mathsf f}}
```



```
\atomicflow{
(4,16)*{\afaid{}{}{}{}{}};
(0,8 )*{\afacd{}{}{}{}{}};
(5,8 )*{\afcjr28};
(2,0 )*{\afaiu{}{}{}{}{}}
```



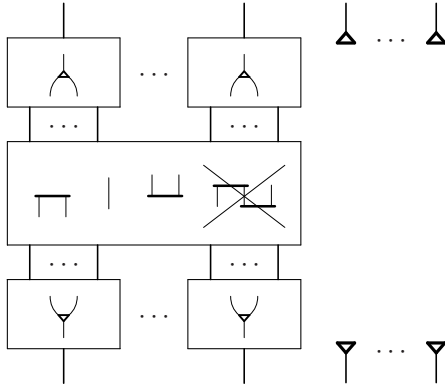
```
{\aftrianglefalse
\atomicflow{
(4,16)*{\afaid{}{}{}{}{}};
(0,8 )*{\afacd{}{}{}{}{}};
(6,8 )*{\afvj8};
(3,0 )*{\afaiuex{}{}{}{}{}{32}}}
```



```

\newbox\boxone
\setbox\boxone=\hbox{$\scriptstyle\mathrm{vls}(C\{\ttt\}.C\{\ttt\})$}
\newbox\boxtwo
\setbox\boxtwo=\hbox{$\scriptstyle\mathrm{vls}[\bar{a}.D\{\fff\}]$}
\newbox\boxthree
\setbox\boxthree=\hbox{$\scriptstyle\mathrm{vls}[D\{\fff\}.D\{\fff\}]$}
\atomicflow{
( 9,82 )*{\aflabelright{C\{\ttt\}}};
( 4,80 )*{\afexpu540};
( 4,74 )*{\afacu\{\}\{\}\{\}\{\}};
(15,70 )*{\aflabelright{\copy\boxone}};
( 3,68 )*{\afcjl24};
( 4,68 )*{\afexpd{11}42};
(15,66 )*{\aflabelright{C\{C\{\ttt\}\}}};
( 4,65 )*{\afvj2};
(15,64 )*{\aflabelleft\gamma};
( 2,62 )*{\afexpd542};
( 7,60 )*{\aflabelright{C\{\ttt\}}};
( 2,58.5)*{\aft2\{\}\{\}};
( 7,58 )*{\aflabelleft\beta};
( 0,54 )*{\afawd\{\}\{\}\bar{a}\one};
( 3,52 )*{\aftcjl2{12}};
( 2,47 )*{\affr{10}{26}};
( 0,44 )*{\afvju4{\bar{a}}\two};
( 4,44 )*{\aftvju4\three\ttt};
( 4,41 )*{\affr{22}{58}};
( 1,40 )*{\afcjl24};
( 7,38 )*{\aflabelright{D\{\bar{a}\}}};
( 1,36 )*{\afcjr24};
( 2,36 )*{\afexpu542};
( 7,34 )*{\aflabelright{\copy\boxtwo}};
( 0,32 )*{\afvju4{\bar{a}}\one};
( 4,26 )*{\afvju{16}\three{D\{\fff\}}};
( 0,22 )*{\afawu\{\}\{\}\bar{a}\two};
( 4,17 )*{\afvj2};
(15,16 )*{\aflabelright{D\{D\{\fff\}\}}};
( 3,14 )*{\afcjr24};
( 4,14 )*{\afexpu{11}42};
(15,12 )*{\aflabelright{\copy\boxthree}};
(25,12 )*{\invisiblemark};
( 4, 8 )*{\afacd{D\{\fff\}\}\{\}\{D\{\fff\}\}\{\}};
( 4, 2 )*{\afexpd540};
( 9, 0 )*{\aflabelright{D\{\fff\}}}

```



```

{\aftrianglefalse
\newbox\boxone\setbox\boxone=\hbox{$
\divide\atflowunit by5
\multiply\atflowunit by3\afsetunits
\atomicflow{(0,0)*{\afacd{}{}{}{}{}}}$}
\newbox\boxtwo\setbox\boxtwo=\hbox{$
\divide\atflowunit by5
\multiply\atflowunit by3\afsetunits
\atomicflow{(0,0)*{\afaid{}{}{}{}{}}}$}
\newbox\boxthree\setbox\boxthree=\hbox{$
\divide\atflowunit by5
\multiply\atflowunit by3\afsetunits
\atomicflow{(0,0)*{\afaiu{}{}{}{}{}}}$}
\newbox\boxfour\setbox\boxfour=\hbox{$
\divide\atflowunit by5
\multiply\atflowunit by3\afsetunits
\atomicflow{(0,0)*{\afvj6}}$}
\newbox\boxfive\setbox\boxfive=\hbox{$
\divide\atflowunit by5
\multiply\atflowunit by3\afsetunits
\atomicflow{(0,0)*{\afacu{}{}{}{}{}}}$}
\newbox\boxsix\setbox\boxsix=\hbox{$
\divide\atflowunit by5
\multiply\atflowunit by3\afsetunits
\atomicflow{(4,8)*{\afaidnw{}};
(2,6)*{\afvjd4{}};
(8,4)*{\afaiu{}{}{}{}{}};
(0,0);(12,12)**[|<\atflowthickone>]@{-};
(0,12);(12,0)**[|<\atflowthickone>]@{-}]$}
\atomicflow{
(3,40)*{\afvj4}; (19,40)*{\afvj4};
(28,38)*{\afawu{}{}{}{}}; (32,38)*{\cdots};
(36,38)*{\afawu{}{}{}{}}; (11,34)*{\cdots};
(19,34)*{\affr{10}8}; (19,34)*{\copy\boxfive};
(3,34)*{\affr{10}8}; (3,34)*{\copy\boxfive};
(0,28)*{\afvj4}; (3,28)*{\cdots};
(6,28)*{\afvj4}; (16,28)*{\afvj4};
(19,28)*{\cdots}; (22,28)*{\afvj4};
(2,20)*{\copy\boxtwo}; (7,20)*{\copy\boxfour};
(11,20)*{\affr{26}{12}}; (12,20)*{\copy\boxthree};
(19,20)*{\copy\boxsix}; (0,12)*{\afvj4};
(3,12)*{\cdots}; (6,12)*{\afvj4};
(16,12)*{\afvj4}; (19,12)*{\cdots};
(22,12)*{\afvj4}; (3,6)*{\affr{10}8};
(3,6)*{\copy\boxone}; (11,6)*{\cdots};
(19,6)*{\affr{10}8}; (19,6)*{\copy\boxone};
(28,2)*{\afawd{}{}{}{}}; (32,2)*{\cdots};
(36,2)*{\afawd{}{}{}{}}; (3,0)*{\afvj4};
(19,0)*{\afvj4}}

```

4 Smash macros

Compare

$$\begin{array}{c}
 \alpha \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \rho \parallel S \\
 \beta \\
 \alpha \\
 \rho \parallel S \text{ aaa aaa aaa aaa aaa aaa aaa aaa aaa } \alpha \\
 \beta \\
 \alpha \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \rho \parallel S \\
 \beta
 \end{array}$$

$$\begin{array}{c}
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \$\vlder{\rho}{\cal S}{\beta}{\alpha}$ \\
 \$\vlder{\rho}{\cal S}{\beta}{\alpha}$ \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \$\vlder{\rho}{\cal S}{\beta}{\alpha}$
 \end{array}$$

with

$$\begin{array}{c}
 \alpha \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \rho \parallel S \\
 \beta \\
 \alpha \\
 \rho \parallel S \text{ aaa aaa aaa aaa aaa aaa aaa aaa aaa } \alpha \\
 \beta \\
 \alpha \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \rho \parallel S \\
 \beta
 \end{array}$$

$$\begin{array}{c}
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \$\vldownsmash{\vlder{\rho}{\cal S}{\beta}{\alpha}}$ \\
 \$\vlder{\rho}{\cal S}{\beta}{\alpha}$ \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \$\vlpusmash{\vlder{\rho}{\cal S}{\beta}{\alpha}}$
 \end{array}$$

and

$$\begin{array}{c}
 \alpha \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \rho \parallel S \\
 \beta \\
 \alpha \\
 \rho \parallel S \text{ aaa aaa aaa aaa aaa aaa aaa aaa aaa } \alpha \\
 \beta \\
 \alpha \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \rho \parallel S \\
 \beta
 \end{array}$$

$$\begin{array}{c}
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \$\vlder{\rho}{\cal S}{\beta}{\alpha}$ \\
 \$\vlsdash{\vlder{\rho}{\cal S}{\beta}{\alpha}}$ \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \text{aaa aaa aaa aaa aaa aaa aaa aaa aaa } \\
 \$\vlder{\rho}{\cal S}{\beta}{\alpha}$
 \end{array}$$

5 Colours

Peach	Fuchsia	Turquoise
Melon	Lavender	TealBlue
YellowOrange	Thistle	Aquamarine
Orange	Orchid	BlueGreen
BurntOrange	DarkOrchid	Emerald
Bittersweet	Purple	JungleGreen
RedOrange	Plum	SeaGreen
Mahogany	Violet	Green
Maroon	RoyalPurple	ForestGreen
BrickRed	BlueViolet	PineGreen
Red	Periwinkle	LimeGreen
OrangeRed	CadetBlue	YellowGreen
RubineRed	CornflowerBlue	SpringGreen
WildStrawberry	MidnightBlue	OliveGreen
Salmon	NavyBlue	RawSienna
CarnationPink	RoyalBlue	Sepia
Magenta	Blue	Brown
VioletRed	Cerulean	Tan
Rhodamine	Cyan	Gray
Mulberry	ProcessBlue	Black
RedViolet	SkyBlue	

6 Acknowledgements

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