Dednat6: an extensible (semi-)preprocessor for LuaLaTeX that understands diagrams in ASCII art

Eduardo Ochs - UFF

TUG 2018 - Rio de Janeiro, 20-22 jul 2018

http://angg.twu.net/dednat6.html

Prehistory: dednat.icn

My master's thesis was partly about Natural Deduction, and it had lots of tree diagrams like these:

$$\dfrac{\dfrac{\dfrac{[x]^1 \quad f}{f(x)} \qquad g}{g(f(x))}}{\lambda x.g(f(x))}\ 1 \qquad\qquad \dfrac{\dfrac{[a]^1 \quad a \to b}{b} \qquad b \to c}{c}\ 1$$

$$a \to c$$

I used `proof.sty` to typeset them, but the code for each diagram was so opaque that I had to keep a 2D ascii art version of each diagram in comments so that I wouldn't get lost...

Prehistory: dednat.icn (2)

...like this:

$$\dfrac{\dfrac{\dfrac{[x]^1 \quad f}{f(x)} \quad g}{g(f(x))}}{\lambda x.g(f(x))}\ 1$$

```
%:  [x]^1  f
%:  --------
%:     f(x)   g
%:     --------
%:     g(f(x))
%:   ----------1
%:   λx.g(f(x))
%:
$$\infer[{1}]{ \mathstrut λx.g(f(x)) }{
   \infer[{}]{ \mathstrut g(f(x)) }{
    \infer[{}]{ \mathstrut f(x) }{
     \mathstrut [x]^1 &
     \mathstrut f } &
    \mathstrut g } } }
$$
```

Prehistory: dednat.icn (3)

...then I realized that I could automate the boring part.
I made the syntax of the 2D ascii art trees more rigid
and wrote a parser (in Icon!) that understood it.
A tree with a name tag like `^foo` below it
would become a `\defded{foo}{...}` —
dednat.icn would only look for trees in '`%:`'-lines,

```
%:  [x]^1  f
%:  --------
%:     f(x)   g
%:     --------
%:     g(f(x))
%:   ----------1
%:   λx.g(f(x))
%:
%:   ^foo
```



```
\defded{foo}{
 \infer[{1}]{ \mathstrut λx.g(f(x)) }{
  \infer[{}]{ \mathstrut g(f(x)) }{
   \infer[{}]{ \mathstrut f(x) }{
    \mathstrut [x]^1 &
    \mathstrut f } &
   \mathstrut g } } }
```

and would put the '`\defded`'s in another file...

Prehistory: dednat.icn (4)

So that I could have this, in myfile.tex:

```
\input myfile.auto.dnt
%
%:  [x]^1  f
%:  --------
%:     f(x)   g
%:     --------
%:     g(f(x))
%:    ----------1
%:    λx.g(f(x))
%:
%:    ^foo
%
$$\ded{foo}$$
```

$$\longrightarrow \quad \dfrac{\dfrac{[x]^1 \quad f}{f(x)} \quad g}{\dfrac{g(f(x))}{\lambda x.g(f(x))}\ 1}$$

Running 'dednat.icn myfile.tex' would generate the file myfile.auto.dnt.

Prehistory: dednat4.lua

`dednat.icn` understood one kind of "head":
'`%:`'-lines would be scanned for trees.

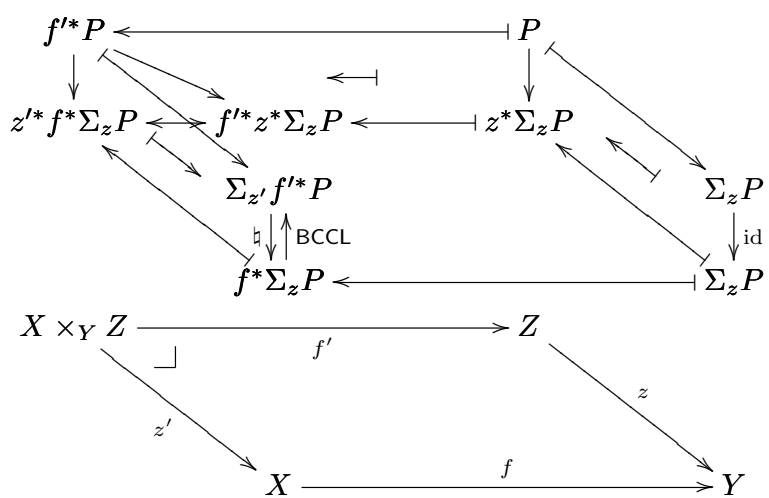
`dednat4.lua` understood three kinds of heads:
'`%:`'-lines would be scanned for trees,
'`%L`'-lines contained Lua code,
'`%D`'-lines contained diagrams in a Forth-based language.
New heads could be added dynamically.

(Actually I also had a head to define abbreviations like '`->`' → '`\to `')

Dednat4.lua's language for diagrams

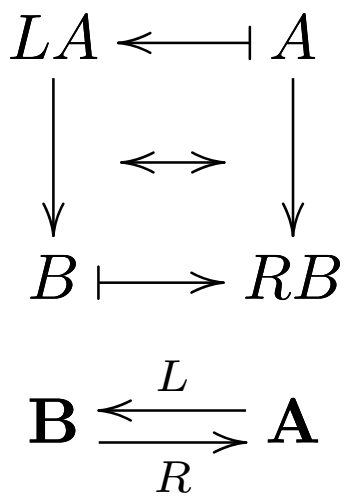
Based on Forth: stack-based, and we can define words that affect parsing — that eat the next word or all the rest of the line. Some words parse a 2D grid with coordinates for nodes; other words join nodes with arrows. Generates code for `diagxy.tex` (a front-end for `xypic`).

```
%D diagram BCCL-std
%D 2Dx    100      +45                  +55   +45
%D 2D 100 B0 <====================== B1
%D 2D      -\\                         -\\
%D 2D      | \\                        | \\
%D 2D      v  \\                       v  \\
%D 2D +20 B2 <\\> B2' ============== B3  \\
%D 2D       /\  \/                     /\  \/
%D 2D +15    \\   B4                     \\  B5
%D 2D          \\  -                      \\ -
%D 2D           \\ |                       \\|
%D 2D            \\v                        \v
%D 2D +20         B6 <==================== B7
%D 2D
%D 2D +10 b0 |--------------------> b1
%D 2D        |->                        |->
%D 2D +35        b2 |--------------------> b3
%D ((
%D    B0 .tex= f^{\prime*}P          B1 .tex= P
%D    B2 .tex= z^{\prime*}f^*Σ_zP    B3 .tex= z^*Σ_zP
%D    B4 .tex= Σ_{z'}f^{\prime*}P    B5 .tex= Σ_zP
%D    B6 .tex= f^*Σ_zP               B7 .tex= Σ_zP
%D     B2' .tex= f^{\prime*}z^*Σ_zP
%D    B0 B1 <-| B0 B2 -> B0 B2' -> B1 B3 -> B2 B2' <-> B2' B3 <-|
%D    B0 B4 |-> B1 B5 |->
%D    B2 B6 <-| B3 B7 <-|
%D    B6 B7 <-| B5 B7 -> .plabel= r \id
%D    B4 B6 -> sl_ .plabel= l ¦ B4 B6 <- sl^ .plabel= r \BCCL
%D    B0 B2' midpoint B1 B3 midpoint  harrownodes nil 20 nil <-|
%D    B0  B2 midpoint B4 B6 midpoint dharrownodes nil 20 nil |->
%D    B1  B3 midpoint B5 B7 midpoint dharrownodes nil 20 nil <-|
%D ))
%D (( b0 .tex= X×_{Y}Z b1 .tex= Z b2 .tex= X b3 .tex= Y
%D    b0 b1 -> .plabel= b f'
%D    b0 b2 -> .plabel= l z'
%D    b1 b3 -> .plabel= r z
%D    b2 b3 -> .plabel= a f
%D    b0 relplace 20 7 \pbsymbol{7}
%D ))
%D enddiagram
%
$$\diag{BCCL-std}$$
```



Dednat4.lua's language for diagrams (2)

```
%D diagram adj
%D 2Dx      100     +25
%D 2D   100 LA <-| A
%D 2D       |       |
%D 2D       | <--> |
%D 2D       v       v
%D 2D   +25 B |-> RB
%D 2D
%D 2D   +15 \catB \catA
%D 2D
%D (( LA A <-|
%D    LA B -> A RB ->
%D    B RB |->
%D    LA RB harrownodes nil 20 nil <->
%D    \catB \catA <- sl^ .plabel= a L
%D    \catB \catA -> sl_ .plabel= b R
%D ))
%D enddiagram
%D
$$\diag{adj}$$
```



Dednat4.lua's language for diagrams (3)

(See my "Bootstrapping a Forth in 40 lines of Lua code" in the Lua Gems book... section 'Modes")

```
%D diagram adj
%D 2Dx      100     +25
%D 2D   100 LA <-| A
%D 2D       |       |
%D 2D       | <--> |
%D 2D       v       v
%D 2D   +25 B |-> RB
%D 2D
%D 2D   +15 \catB \catA
%D 2D
%D (( LA A <-|
%D    LA B -> A RB ->
%D    B RB |->
%D    LA RB harrownodes nil 20 nil <->
%D    \catB \catA <- sl^ .plabel= a L
%D    \catB \catA -> sl_ .plabel= b R
%D ))
%D enddiagram
%D
$$\diag{adj}$$
```

The words in red "eat text".
2D and 2Dx eat the rest of the line as a grid, and define nodes with coordinates.
.plabel modifies the arrow at the top of the stack: 'placement' 'label'

Dednat4.lua's language for diagrams (4)

(See my "Bootstrapping a Forth in 40 lines of Lua code" in the Lua Gems book... section 'Modes")

```
%D diagram adj
%D 2Dx      100     +25
%D 2D   100 LA <-| A
%D 2D       |       |
%D 2D       | <--> |
%D 2D       v       v
%D 2D   +25 B |-> RB
%D 2D
%D 2D   +15 \catB \catA
%D 2D
%D (( LA A <-|
%D    LA B -> A RB ->
%D    B RB |->
%D    LA RB harrownodes nil 20 nil <->
%D    \catB \catA <- sl^ .plabel= a L
%D    \catB \catA -> sl_ .plabel= b R
%D ))
%D enddiagram
%D
$$\diag{adj}$$
```

`2D` and `2Dx` eat the rest of the line as a grid, and define nodes with coordinates. Arrow words connect the two topmost nodes in the stack. `harrownodes` creates two phantom nodes for a middle horizontal arrow.

Dednat4.lua's language for diagrams (5)

For the sake of completeness... `diagram` resets several tables, `enddiagram` outputs the table **arrows** as diagxy code, `sl^` and `sl_` slide the topmost arrow in the stack, The '`))`' in a `(( ... ))` block drops all top items from the stack until the depth becomes what it was at the '`((`', we can put Lua code in '`%L`' lines between '`%D`' lines, and...

```
require "diagforth"

storenode {TeX="a", tag="a", x=100, y=100}
storenode {TeX="b", tag="b", x=140, y=100}
= nodes

storearrow(DxyArrow {from="a", to="b", shape="|->",
                     slide="5pt", label="up",
                     placement="a"})
storearrow(DxyArrow {from="a", to="b", shape=".>"})
storearrow(DxyPlace {nodes["a"]})
storearrow(DxyLiteral {"literal foobar"})
= arrows

print(arrow_to_TeX(arrows[1]))
print(arrows[2]:TeX())
print(arrows[3]:TeX())
print(arrows[4]:TeX())
print(arrows_to_TeX())
```

← this Lua code shows how the low-level functions work...

Dednat6: a semi-preprocessor

Dednat4 is a real pre-processor —
it generates a `foo.auto.dnt` from `foo.tex`,
and it runs before LaTeX.

In Dednat6 the Lua code that processes the
lines with heads like '`%L`', '`%:`', '`%D`', etc,
pretends to run at the same time as TeX...
In fact there are synchronization points.
Each tree in a '`%:`' block generates a '`\defded`'
each diagram in a '`%D`' block generates a '`\defdiag`'...
'`\pu`' means "process all pending heads until the
current line", and send the defs to LaTeX—

Dednat6: a semi-preprocessor (2)

'\pu' means "process all pending heads until the current line", and send the defs to LaTeX—
This is implemented using "blocks" with `i` and `j` fields for their starting and ending lines.

```
%D diagram triangle
%D 2Dx     100   +20
%D 2D  100 A --> B
%D 2D        \   |
%D 2D         v  v
%D 2D  +20       C
%D 2D
%D (( A B -> B C -> A C ->
%D ))
%D enddiagram

$$\pu \diag{triangle}$$


%:  A  A->B
%:  -------
%:     B      C
%:     --------
%:       B/\C
%:
%:       ^a-tree
%:

$$\pu \ded{a-tree}$$
```

'%D' block: lines 1–10
First '\pu': line 12
'%:' block: lines 15–22
Second '\pu': line 24

Whole .tex file: lines 1–24

Dednat6: a semi-preprocessor (3)

'\pu' means "process all pending heads until the current line", and send the defs to LaTeX—
This is implemented using "blocks" with `i` and `j` fields for their starting and ending lines.

```
%D diagram triangle
%D 2Dx     100   +20
%D 2D  100 A --> B
%D 2D        \   |
%D 2D         v  v
%D 2D  +20       C
%D 2D
%D (( A B -> B C -> A C ->
%D ))
%D enddiagram

$$\pu \diag{triangle}$$


%:  A  A->B
%:  -------
%:     B      C
%:     --------
%:       B/\C
%:
%:       ^a-tree
%:

$$\pu \ded{a-tree}$$
```

```
tf = Block {i=1, j=24, nline=1, ...}
```

First '\pu': line 12

```
processuntil(12)
processlines(1, 11)
processblock {head="%D", i=1, j=10}
output("\\defdiag{triangle}{...}")
nline=13
```

`tf` becomes `{i=1, j=24, nline=13, ...}`

Second '\pu': line 24

```
processuntil(24)
processlines(13, 23)
processblock {head="%:", i=15, j=22}
output("\\defded{a-tree}{...}")
nline=25
```

Dednat6: a semi-preprocessor (4)

```
%D diagram triangle
%D 2Dx     100   +20
%D 2D  100 A --> B
%D 2D        \   |
%D 2D         v  v
%D 2D  +20       C
%D 2D
%D (( A B -> B C -> A C ->
%D ))
%D enddiagram

$$\pu \diag{triangle}$$


%:  A  A->B
%:  -------
%:     B      C
%:     --------
%:       B/\C
%:
%:       ^a-tree
%:

$$\pu \ded{a-tree}$$
```

```
tf = Block {i=1, j=24, nline=1, ...}
```

First '\pu': line 12

```
processuntil(12)
processlines(1, 11)
processblock {head="%D", i=1, j=10}
output("\\defdiag{triangle}{...}")
nline=13
```

```
tf becomes {i=1, j=24, nline=13, ...}
```

Second '\pu': line 24

```
processuntil(24)
processlines(13, 23)
processblock {head="%:", i=15, j=22}
output("\\defded{a-tree}{...}")
nline=25
```

Downloading and testing

I gave up (temporarily?) keeping a package or a git repo of Dednat6... but if you run something like this in a shell,

```
rm -rfv /tmp/edrx-latex/
mkdir   /tmp/edrx-latex/
cd      /tmp/edrx-latex/
# See: http://angg.twu.net/LATEX/2017planar-has-1.pdf
wget   http://angg.twu.net/LATEX/2017planar-has-1.tgz
tar -xvzf 2017planar-has-1.tgz
lualatex  2017planar-has-1.tex
```

you download and unpack a .tgz with the full source code for 2017planar-has-1.pdf, including a full version of Dednat6, and all the (non-standard) TEX files...
The home page of dednat6
http://angg.twu.net/dednat6.html
points to several such .tgzs, both simple and complex.

Extensions

It is easy to extend Dednat6 with new heads...
For example, for these slides I created a head '%V'
for a Dednat6-based verbatim mode...
the Lua code was initially just this:

```
registerhead "%V" {
  name   = "myverbatim",
  action = function ()
      local i,j,verbatimlinesorig = tf:getblock()
      verbatimlines = verbatimlinesorig
    end,
}
```

Dednat6 would take each block of '%V' lines and
store its contents in the global variable `verbatimlines`,
that I would process in Lua in '%L' lines to generate
the LaTeX code that I want...

Hacking

Hacking something usually consists of these stages:
1) “reading”: understanding docs, data structures, code
2) making tests, dumping data structures
3) “writing”: implementing new things

Here’s how to do (1):
Learn a tiny bit of Emacs and eev:
http://angg.twu.net/#eev
and run the “eepitch blocks” in the Lua source files...

Eepitch blocks in comments in Lua files

This is a comment block in `dednat6/diagforth.lua`:

```
--[==[
* (eepitch-lua51)
* (eepitch-kill)
* (eepitch-lua51)
require "diagforth"
storenode {TeX="a", tag="a", x=100, y=100}
storenode {TeX="b", tag="b", x=140, y=100}
= nodes

storearrow(DxyArrow {from="a", to="b", shape="|->",
                     slide="5pt", label="up",
                     placement="a"})
storearrow(DxyArrow {from="a", to="b", shape=".>"})
storearrow(DxyPlace {nodes["a"]})
storearrow(DxyLiteral {"literal foobar"})
= arrows

--]==]
```

It is an “e-script” — an *executable log* of an experiment that I was doing. It can be “played back” by typing ‘F8’s in Emacs+eev — an ‘F8’ on a red star line runs that line as Lisp code (→ set up a target buffer)...

Eepitch blocks in comments in Lua files (2)

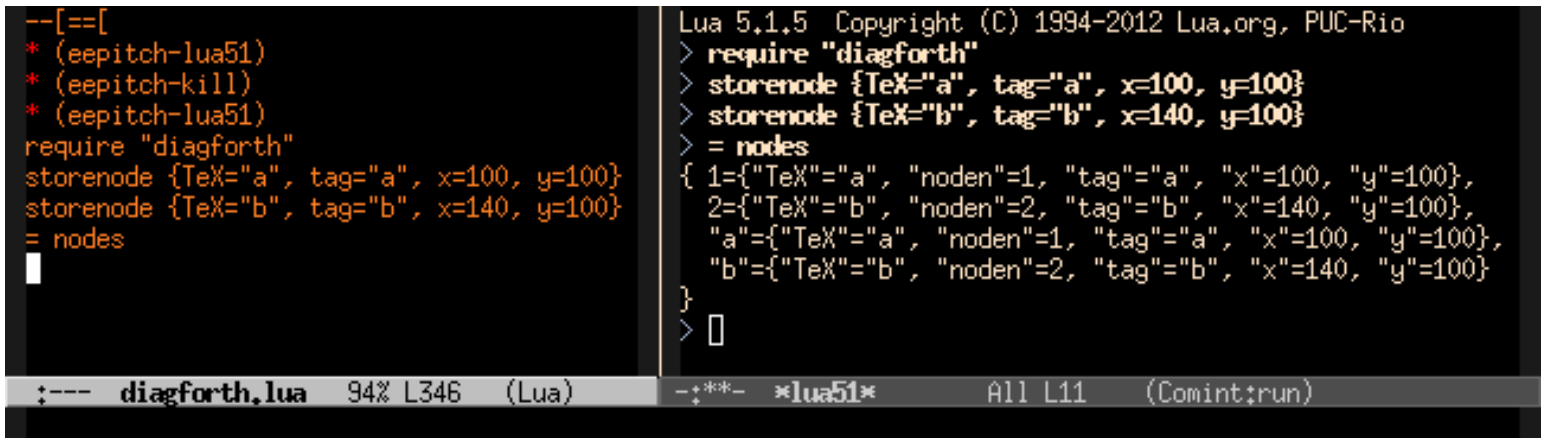
```
--[==[
* (eepitch-lua51)
* (eepitch-kill)
* (eepitch-lua51)
require "diagforth"
storenode {TeX="a", tag="a", x=100, y=100}
storenode {TeX="b", tag="b", x=140, y=100}
= nodes

(...)
--]==]
```

An ‘F8’ on a red star line runs that line as Lisp code (→ set up a target buffer with a Lua interpreter) and an ‘F8’ on a non-red star line sends that line to the target buffer as if the user had typed it...

REPLs

Here's a screenshot.



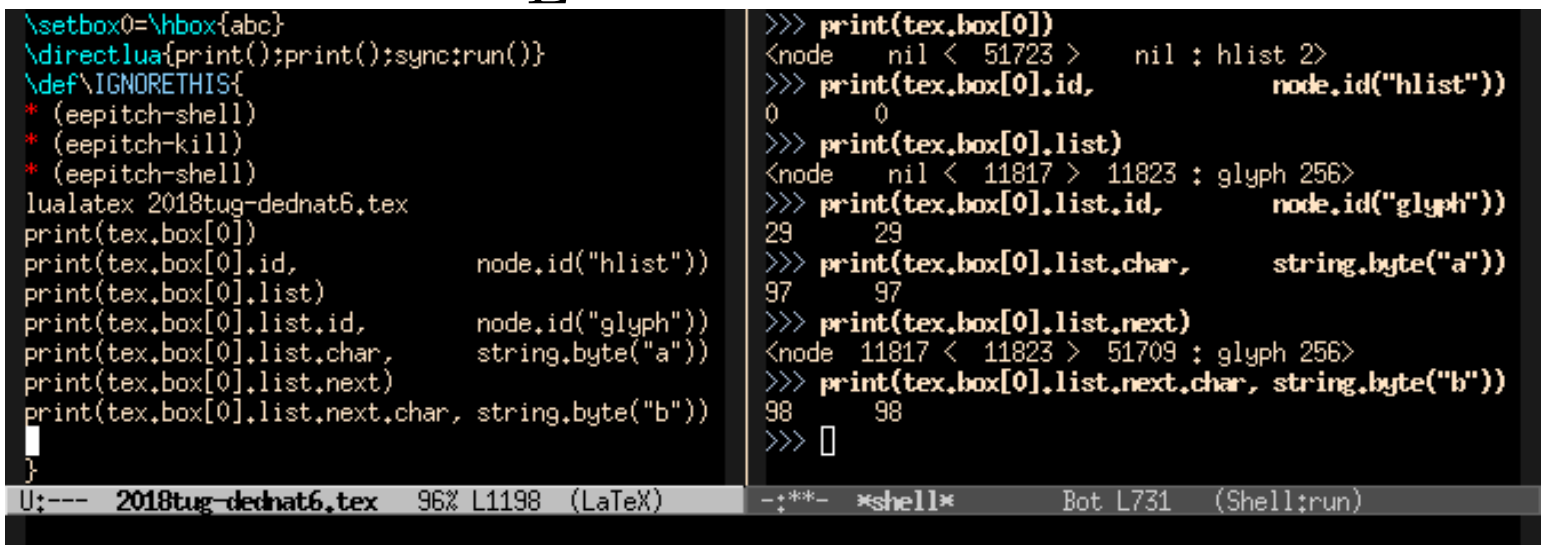
Left Emacs window: the e-script buffer. The cursor is there: ▮.
We have just executed an eepitch block with 'F8's.

Right Emacs window: the target buffer, with a terminal running Lua 5.1 in interactive (Read/Eval/Print/Loop) mode. Blue '>'s: Lua prompts. Bold white: user input (sent with 'F8's).

Here we used just Lua, not LuaLaTeX.

REPLs (2)

It is also possible to run Rob Hoelz's lua-repl from inside LuaLaTeX. Here's a screenshot.



When you are a Bear of Very Little Brain — like me — LuaTeX's interface to TeX boxes looks very hard... lua-repl may help.

HEY!!!

From http://angg.twu.net/dednat6.html:

I've stopped trying to document dednat6 because
1) I don't have a mental image of who I am writing for,
2) I get *far too little feedback*,
3) all of the feedback that I got came from people who felt that I was not writing for them — my approach, tone and choice of pre-requisites were all wrong.
If you would like to try dednat6, get in touch, let's chat — *please*!

Maybe I can typeset in 20 minutes a diagram that took you a day, maybe I can implement an extension that you need...