The luamplib package

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Abstract

Package to have metapost code typeset directly in a document with LuaTeX.

1 Documentation

This packages aims at providing a simple way to typeset directly metapost code in a document with LuaTeX. LuaTeX is built with the lua `mplib` library, that runs metapost code. This package is basically a wrapper (in Lua) for the Lua `mplib` functions and some TeX functions to have the output of the `mplib` functions in the pdf.

The package needs to be in PDF mode in order to output something, as PDF specials are not supported by the DVI format and tools.

The metapost figures are put in a TeX `hbox` with dimensions adjusted to the metapost code.

Using this package is easy: in Plain, type your metapost code between the macros `\mplibcode` and `\endmplibcode`, and in LaTeX in the `mplibcode` environment.

The code is from the `luatex-mplib.lua` and `luatex-mplib.tex` files from ConTeXt, they have been adapted to LaTeX and Plain by Elie Roux and Philipp Gesang, new functionalities have been added by Kim Dohyun. The changes are:

- a LaTeX environment
- all TeX macros start by `mplib`
- use of luatexbase for errors, warnings and declaration
- possibility to use `btex ... etex` to typeset TeX code. `textext()` is a more versatile macro equivalent to `TEX()` from TEX.mp. `TEX()` is also allowed unless TEX.mp is loaded, which should be always avoided.
- `verbatimtex ... etex` that comes just before `beginfig()` is not ignored, but the TeX code inbetween will be inserted before the following mplib hbox. Using this command, each mplib box can be freely moved horizontally and/or vertically. All other `verbatimtex ... etex`'s are ignored. *E.G.*

```
\mplibcode
```

```
verbatimtex \moveright 3cm etex; beginfig(0); ... endfig;
verbatimtex \leavevmode etex; beginfig(1); ... endfig;
verbatimtex \leavevmode\lower 1ex etex; beginfig(2); ... endfig;
verbatimtex \endgraf\moveright 1cm etex; beginfig(3); ... endfig;
\endmplibcode
```

N.B. `\endgraf` should be used instead of `\par` inside `verbatimtex ... etex`.

- Notice that, after each figure is processed, macro `\MPwidth` stores the width value of latest figure; `\MPheight`, the height value.

- Since v2.3, new macros `\everymplib` and `\everyendmplib` redefine token lists `\everymplibtoks` and `\everyendmplibtoks` respectively, which will be automatically inserted at the beginning and ending of each mplib code. *E.G.*

```
\everymplib{ verbatimtex \leavevmode etex; beginfig(0); }
\everyendmplib{ endfig; }
\mplibcode % beginfig/endfig not needed; always in horizontal mode
  draw fullcircle scaled 1cm;
\endmplibcode
```

- Since v2.3, `\mpdim` and other raw TEX commands are allowed inside mplib code. This feature is inpired by gmp.sty authored by Enrico Gregorio. Please refer the manual of gmp package for details. *E.G.*

```
\begin{mplibcode}
  draw origin--(\mpdim{\linewidth},0) withpen pencircle scaled 4
  dashed evenly scaled 4 withcolor \myrulecolor;
\end{mplibcode}
```

N.B. Users should not use the protected variant of `btex ... etex` as provided by gmp package. As luamplib automatically protects TEX code inbetween, `\btex` is not supported here.

- Users can choose `numbersystem` option since v2.4. The default value `scaled` can be changed to `double` by declaring `\mplibnumbersystem{double}`. For details see `http://github.com/lualatex/luamplib/issues/21`.

There are (basically) two formats for metapost: *plain* and *metafun*. By default, the *plain* format is used, but you can set the format to be used by future figures at any time using `\mplibsetformat{`⟨*format name*⟩`}`.

2 Implementation

2.1 Lua module

Use the `luamplib` namespace, since `mplib` is for the metapost library itself. ConTEXt uses `metapost`.

```

luamplib          = luamplib or { }

```

Identification.

```

local luamplib    = luamplib
luamplib.showlog  = luamplib.showlog or false
luamplib.lastlog  = ""

local err, warn, info, log = luatexbase.provides_module({
    name          = "luamplib",
    version       =  2.4,
    date          = "2014/02/02",
    description   = "Lua package to typeset Metapost with LuaTeX's MPLib.",
})


```

This module is a stripped down version of libraries that are used by ConTEXt. Provide a few "shortcuts" expected by the imported code.

```

local format, abs = string.format, math.abs

local stringgsub    = string.gsub
local stringfind    = string.find
local stringmatch   = string.match
local stringgmatch  = string.gmatch
local tableconcat   = table.concat
local texsprint     = tex.sprint

local mplib = require ('mplib')
local kpse  = require ('kpse')

local file = file
if not file then

```

This is a small trick for LATEX. In LATEX we read the metapost code line by line, but it needs to be passed entirely to `process()`, so we simply add the lines in `data` and at the end we call `process(data)`.

A few helpers, taken from `l-file.lua`.

```

```

```
  file = { }

  function file.replacesuffix(filename, suffix)
      return (stringgsub(filename,”%.[%a%d]+$”,””)) .. ”.” .. suffix
  end

  function file.stripsuffix(filename)
      return (stringgsub(filename,”%.[%a%d]+$”,””))
  end
end
```

As the finder function for `mplib`, use the `kpse` library and make it behave like as if MetaPost was used (or almost, since the engine name is not set this way—not sure if this is a problem).

```

local mpkpse = kpse.new(”luatex”, ”mpost”)

local function finder(name, mode, ftype)
    if mode == ”w” then
        return name
    else
        return mpkpse:find_file(name,ftype)
    end
end
luamplib.finder = finder

```

The rest of this module is not documented. More info can be found in the LuaTEX manual, articles in user group journals and the files that ship with ConTEXt.

```

function luamplib.resetlastlog()
    luamplib.lastlog = ””
end

```

Below included is section that defines fallbacks for older versions of mplib.

```
local mplibone = tonumber(mplib.version()) <= 1.50

if mplibone then

    luamplib.make = luamplib.make or function(name,mem_name,dump)
        local t = os.clock()
        local mpx = mplib.new {
            ini_version = true,
            find_file = luamplib.finder,
            job_name = file.stripsuffix(name)
        }
        mpx:execute(format(”input %s ;”,name))
        if dump then
            mpx:execute(”dump ;”)
            info(”format %s made and dumped for %s in %0.3f seconds”,mem_name,name,os.clock()-t)
        else
            info(”%s read in %0.3f seconds”,name,os.clock()-t)
        end
        return mpx
    end

    function luamplib.load(name)
        local mem_name = file.replacesuffix(name,”mem”)
        local mpx = mplib.new {
            ini_version = false,
            mem_name = mem_name,
            find_file = luamplib.finder
        }
        if not mpx and type(luamplib.make) == ”function” then
            -- when i have time i’ll locate the format and dump
            mpx = luamplib.make(name,mem_name)
        end
        if mpx then
            info(”using format %s”,mem_name,false)
            return mpx, nil
        else
            return nil, { status = 99, error = ”out of memory or invalid format” }
        end
    end

else

```

These are the versions called with sufficiently recent mplib.

```

    local preamble = [[
        boolean mplib ; mplib := true ;
        let dump = endinput ;
        let normalfontsize = fontsize;
        input %s ;
    ]]

    luamplib.make = luamplib.make or function()
    end

    function luamplib.load(name)
        local mpx = mplib.new {
            ini_version = true,
            find_file = luamplib.finder,
```

Provides `numbersystem` option since v2.4. Default value `”scaled”` can be changed by declaring `\mplibnumbersystem{double}`. See `https://github.com/lualatex/luamplib/issues/21`.

```
            math_mode = luamplib.numbersystem,
        }
        local result
        if not mpx then
            result = { status = 99, error = ”out of memory”}
        else
            result = mpx:execute(format(preamble, file.replacesuffix(name,”mp”)))
        end
        luamplib.reporterror(result)
        return mpx, result
    end

end

local currentformat = ”plain”

local function setformat (name) --- used in .sty
    currentformat = name
end
luamplib.setformat = setformat


luamplib.reporterror = function (result)
    if not result then
        err(”no result object returned”)
    elseif result.status > 0 then
        local t, e, l = result.term, result.error, result.log
        if t then
            info(t)
        end
        if e then
            err(e)
        end
        if not t and not e and l then
            luamplib.lastlog = luamplib.lastlog .. ”\n ” .. l
            log(l)
        else
            err(”unknown, no error, terminal or log messages”)
        end
    else
        return false
    end
    return true
end

local function process_indeed (mpx, data)
    local converted, result = false, {}
    local mpx = luamplib.load(mpx)
    if mpx and data then
        local result = mpx:execute(data)
        if not result then
```

```
            err(”no result object returned”)
        elseif result.status > 0 then
            err(”%s”,(result.term or ”no-term”) .. ”\n” .. (result.error or ”no-error”))
        elseif luamplib.showlog then
            luamplib.lastlog = luamplib.lastlog .. ”\n” .. result.term
            info(”%s”,result.term or ”no-term”)
        elseif result.fig then
            converted = luamplib.convert(result)
        else
            err(”unknown error, maybe no beginfig/endfig”)
        end
    else
        err(”Mem file unloadable. Maybe generated with a different version of mplib?”)
    end
    return converted, result
end
local process = function (data)
    return process_indeed(currentformat, data)
end
luamplib.process = process

local function getobjects(result,figure,f)
    return figure:objects()
end

local function convert(result, flusher)
    luamplib.flush(result, flusher)
    return true -- done
end
luamplib.convert = convert

local function pdf_startfigure(n,llx,lly,urx,ury)
```

The following line has been slightly modified by Kim.

```
    texsprint(format(”\\mplibstarttoPDF{%f}{%f}{%f}{%f}”,llx,lly,urx,ury))
end

local function pdf_stopfigure()
    texsprint(”\\mplibstoptoPDF”)
end

local function pdf_literalcode(fmt,...) -- table
    texsprint(format(”\\mplibtoPDF{%s}”,format(fmt,...)))
end
luamplib.pdf_literalcode = pdf_literalcode

local function pdf_textfigure(font,size,text,width,height,depth)
```

The following three lines have been modified by Kim.

```
    -- if text == ”” then text = ”\0” end -- char(0) has gone
    text = text:gsub(”.”,function(c)
        return format("\\hbox{\\char%i}",string.byte(c)) -- kerning happens in meta-
post
    end)
    texsprint(format("\\mplibtextext{%s}{%f}{%s}{%s}{%f}",font,size,text,0,-( 7200/ 7227)/65536*depth))
end
luamplib.pdf_textfigure = pdf_textfigure

local bend_tolerance = 131/65536

local rx, sx, sy, ry, tx, ty, divider = 1, 0, 0, 1, 0, 0, 1

local function pen_characteristics(object)
    local t = mplib.pen_info(object)
    rx, ry, sx, sy, tx, ty = t.rx, t.ry, t.sx, t.sy, t.tx, t.ty
    divider = sx*sy - rx*ry
    return not (sx==1 and rx==0 and ry==0 and sy==1 and tx==0 and ty==0), t.width
end

local function concat(px, py) -- no tx, ty here
    return (sy*px-ry*py)/divider,(sx*py-rx*px)/divider
end

local function curved(ith,pth)
    local d = pth.left_x - ith.right_x
    if abs(ith.right_x - ith.x_coord - d) <= bend_tolerance and abs(pth.x_coord - pth.left_x - d) <= be
erance then
        d = pth.left_y - ith.right_y
        if abs(ith.right_y - ith.y_coord - d) <= bend_tolerance and abs(pth.y_co-
ord - pth.left_y - d) <= bend_tolerance then
            return false
        end
    end
    return true
end

local function flushnormalpath(path,open)
    local pth, ith
    for i=1,#path do
        pth = path[i]
        if not ith then
            pdf_literalcode("%f %f m",pth.x_coord,pth.y_coord)
        elseif curved(ith,pth) then
            pdf_literalcode("%f %f %f %f %f %f c",ith.right_x,ith.right_y,pth.left_x,pth.left_y,pth.x_c
        else
            pdf_literalcode("%f %f l",pth.x_coord,pth.y_coord)
        end
        ith = pth
    end
    if not open then
        local one = path[1]
        if curved(pth,one) then
            pdf_literalcode("%f %f %f %f %f %f c",pth.right_x,pth.right_y,one.left_x,one.left_y,one.x_c
        else
            pdf_literalcode("%f %f l",one.x_coord,one.y_coord)
        end
    elseif #path == 1 then
        -- special case .. draw point
        local one = path[1]
        pdf_literalcode("%f %f l",one.x_coord,one.y_coord)
    end
    return t
end

local function flushconcatpath(path,open)
    pdf_literalcode("%f %f %f %f %f %f cm", sx, rx, ry, sy, tx ,ty)
    local pth, ith
    for i=1,#path do
        pth = path[i]
        if not ith then
           pdf_literalcode("%f %f m",concat(pth.x_coord,pth.y_coord))
        elseif curved(ith,pth) then
            local a, b = concat(ith.right_x,ith.right_y)
            local c, d = concat(pth.left_x,pth.left_y)
            pdf_literalcode("%f %f %f %f %f %f c",a,b,c,d,concat(pth.x_coord, pth.y_co-
ord))
        else
           pdf_literalcode("%f %f l",concat(pth.x_coord, pth.y_coord))
        end
        ith = pth
    end
    if not open then
        local one = path[1]
        if curved(pth,one) then
            local a, b = concat(pth.right_x,pth.right_y)
            local c, d = concat(one.left_x,one.left_y)
            pdf_literalcode("%f %f %f %f %f %f c",a,b,c,d,concat(one.x_coord, one.y_co-
ord))
        else
            pdf_literalcode("%f %f l",concat(one.x_coord,one.y_coord))
        end
    elseif #path == 1 then
        -- special case .. draw point
        local one = path[1]
        pdf_literalcode("%f %f l",concat(one.x_coord,one.y_coord))
    end
    return t
end

```

Below code has been contributed by Dohyun Kim. It implements `btex` / `etex` functions.

v2.1: `textext()` is now available, which is equivalent to `TEX()` macro from TEX.mp. `TEX()` is synonym of `textext()` unless TEX.mp is loaded.

v2.2: Transparency and Shading

v2.2: `\everymplib`, `\everyendmplib`, and allows naked TeX commands.

```
local further_split_keys = {
    ["MPlibTEXboxID"] = true,
    ["sh_color_a"]    = true,
    ["sh_color_b"]    = true,
}

local function script2table(s)
    local t = {}
    for i in stringgmatch(s,"[^\13]+") do
        local k,v = stringmatch(i,"(.-)=(.+)") -- v may contain =.
        if k and v then
            local vv = {}
            if further_split_keys[k] then
                for j in stringgmatch(v,"[^:]+") do
                    vv[#vv+1] = j
                end
            end
            if #vv > 0 then
                t[k] = vv
            else
                t[k] = v
            end
        end
    end
    return t
end

local mplibcodepreamble = [[
vardef rawtextext (expr t) =
    if unknown TEXBOX_:
        image( special "MPlibmkTEXbox="&t; )
    else:
        TEXBOX_ := TEXBOX_ + 1;
        image (
            addto currentpicture doublepath unitsquare
            xscaled TEXBOX_wd[TEXBOX_]
            yscaled (TEXBOX_ht[TEXBOX_] + TEXBOX_dp[TEXBOX_])
            shifted (0, -TEXBOX_dp[TEXBOX_])
            withprescript "MPlibTEXboxID=" &
                          decimal TEXBOX_ & ":" &
                          decimal TEXBOX_wd[TEXBOX_] & ":" &
                          decimal(TEXBOX_ht[TEXBOX_]+TEXBOX_dp[TEXBOX_]);
        )
    fi
enddef;
if known context_mlib:
    defaultfont := "cmtt10";
    let infont = normalinfont;
    let fontsize = normalfontsize;
    vardef thelabel@#(expr p,z) =
        if string p :
            thelabel@#(p infont defaultfont scaled defaultscale,z)
        else :
            p shifted (z + labeloffset*mfun_laboff@# -
                (mfun_labxf@#*lrcorner p + mfun_labyf@#*ulcorner p +
                (1-mfun_labxf@#-mfun_labyf@#)*llcorner p))
        fi
    enddef;
else:
    vardef textext@# (text t) = rawtextext (t) enddef;
fi
def externalfigure primary filename =
    draw rawtextext("\includegraphics{"& filename &"}")
enddef;
def TEX = textext enddef;
def fontmapfile primary filename = enddef;
def specialVerbatimTeX (text t) = special "MPlibVerbTeX="&t; enddef;
def ignoreVerbatimTeX  (text t) = enddef;
let VerbatimTeX = specialVerbatimTeX;
extra_beginfig := extra_beginfig & " let VerbatimTeX = ignoreVerbatimTeX;" ;
extra_endfig   := extra_endfig   & " let VerbatimTeX = specialVerbatimTeX;" ;
]]

local function protecttextext(data)
    local everymplib    = tex.toks['everymplibtoks']    or ''
    local everyendmplib = tex.toks['everyendmplibtoks'] or ''
    data = " " .. everymplib .. data .. everyendmplib
    data = stringgsub(data,
        "%f[A-Za-z]btex%f[^A-Za-z]%s*(.-)%s*%f[A-Za-z]etex%f[^A-Za-z]",
        function(str)
            str = stringgsub(str,'"','"&ditto&"')
            return format("rawtextext(\\unexpanded{\"%s\"})",str)
        end)
    data = stringgsub(data,
        "%f[A-Za-z]verbatimtex%f[^A-Za-z]%s*(.-)%s*%f[A-Za-z]etex%f[^A-Za-z]",
        function(str)
            str = stringgsub(str,'"','"&ditto&"')
            return format("VerbatimTeX(\\unexpanded{\"%s\"})",str)
        end)
    data = stringgsub(data, "\".-\"", -- hack for parentheses inside quotes
        function(str)
            str = stringgsub(str,"%(","%%%%LEFTPAREN%%%%")
            str = stringgsub(str,"%)","%%%%RGHTPAREN%%%%")
            return str
        end)
    data = stringgsub(data, "%f[A-Za-z]TEX%s*%b()", "\\unexpanded{%1}")
    data = stringgsub(data, "%f[A-Za-z]textext%s*%b()", "\\unexpanded{%1}")
    data = stringgsub(data, "%f[A-Za-z]textext%.[_a-z]+%s*%b()", "\\unexpanded{%1}")
    data = stringgsub(data, "%%%%LEFTPAREN%%%%", "(") -- restore
    data = stringgsub(data, "%%%%RGHTPAREN%%%%", ")") -- restore
    texsprint(data)
end

luamplib.protecttextext = protecttextext

local factor = 65536*(7227/7200)

local function putTEXboxes (object,prescript)
    local box = prescript.MPlibTEXboxID
    local n,tw,th = box[1],box[2],box[3]
    if n and tw and th then
        local op = object.path
        local first, second, fourth = op[1], op[2], op[4]
        local tx, ty = first.x_coord, first.y_coord
        local sx, sy = (second.x_coord - tx)/tw, (fourth.y_coord - ty)/th
        local rx, ry = (second.y_coord - ty)/tw, (fourth.x_coord - tx)/th
        if sx == 0 then sx = 0.00001 end
        if sy == 0 then sy = 0.00001 end
        pdf_literalcode("q %f %f %f %f %f %f cm",sx,rx,ry,sy,tx,ty)
        texsprint(format("\\mplibputtextbox{%i}",n))
        pdf_literalcode("Q")
    end
end

local TeX_code_t = {}

local function domakeTEXboxes (data)
    local num = tex.count[14] -- newbox register
    if data and data.fig then
        local figures = data.fig
        for f=1, #figures do
            TeX_code_t[f] = nil
            local figure = figures[f]
            local objects = getobjects(data,figure,f)
            if objects then
                for o=1,#objects do
                    local object    = objects[o]
                    local prescript = object.prescript
                    prescript = prescript and script2table(prescript)
                    local str = prescript and prescript.MPlibmkTEXbox
                    if str then
                        num = num + 1
                        texsprint(format("\\setbox%i\\hbox{%s}",num,str))
                    end
```

`verbatimtex ... etex` before `beginfig()` is not ignored, but the TEX code inbetween is inserted before the mplib box.

```
                    local texcode = prescript and prescript.MPlibVerbTeX
                    if texcode and texcode ~= "" then
                        TeX_code_t[f] = texcode
                    end
                end
            end
        end
    end
end

local function makeTEXboxes (data)
    data = stringgsub(data, "##", "#") -- restore # doubled in input string
    local mpx = luamplib.load(currentformat)
    if mpx and data then
        local result = mpx:execute(mplibcodepreamble .. data)
        domakeTEXboxes(result)
    end
    return data
end

luamplib.makeTEXboxes = makeTEXboxes

local function processwithTEXboxes (data)
    local num = tex.count[14] -- the same newbox register
    local prepreamble = "TEXBOX_ := "..num..";\n"
    while true do
        num = num + 1
        local box = tex.box[num]
        if not box then break end
        prepreamble = prepreamble ..
        "TEXBOX_wd["..num.."] := "..box.width /factor..";\n"..
        "TEXBOX_ht["..num.."] := "..box.height/factor..";\n"..
        "TEXBOX_dp["..num.."] := "..box.depth /factor..";\n"
    end
    process(prepreamble .. mplibcodepreamble .. data)
end

luamplib.processwithTEXboxes = processwithTEXboxes

```

Transparency and Shading

```
local pdf_objs = {}

-- objstr <string> => obj <number>, new <boolean>
local function update_pdfobjs (os)
    local on = pdf_objs[os]
    if on then
        return on,false
    end
    on = pdf.immediateobj(os)
    pdf_objs[os] = on
    return on,true
end

local transparancy_modes = { [0] =  ”Normal”,
    ”Normal”,       ”Multiply”,     ”Screen”,       ”Overlay”,
    ”SoftLight”,    ”HardLight”,    ”ColorDodge”,   ”ColorBurn”,
    ”Darken”,       ”Lighten”,      ”Difference”,   ”Exclusion”,
    ”Hue”,          ”Saturation”,   ”Color”,        ”Luminosity”,
    ”Compatible”,
}

local function update_tr_res(res,mode,opaq)
    local os = format(”<</BM /%s/ca %g/CA %g/AIS false>>”,mode,opaq,opaq)
    local on, new = update_pdfobjs(os)
    if new then
        res = res .. format(”/MPlibTr%s%g %i 0 R”,mode,opaq,on)
    end
    return res
end

local function tr_pdf_pageresources(mode,opaq)
    local res = ””
    res = update_tr_res(res, ”Normal”, 1)
    res = update_tr_res(res, mode, opaq)
    if res ~= ”” then
        local tpr = tex.pdfpageresources -- respect luaotfload-colors
        if not stringfind(tpr,”/ExtGState<<.*>>”) then
            tpr = tpr..”/ExtGState<<>>”
        end
        tpr = stringgsub(tpr,”/ExtGState<<”,”%1”..res)
        tex.set(”global”,”pdfpageresources”,tpr)
    end
end

-- luatexbase.mcb is not yet updated: ”finish_pdffile” callback is missing

local function sh_pdfpageresources(shtype,domain,colorspace,colora,colorb,coordinates)
    local os, on, new
    os = format(”<</FunctionType 2/Domain [ %s ]/C0 [ %s ]/C1 [ %s ]/N 1>>”,
                domain, colora, colorb)
    on = update_pdfobjs(os)
    os = format(”<</ShadingType %i/ColorSpace /%s/Function %i 0 R/Coords [ %s ]/Ex-
tend [ true true ]/AntiAlias true>>”,
                shtype, colorspace, on, coordinates)
    on, new = update_pdfobjs(os)
    if not new then
        return on
    end
    local res = format("/MPlibSh%i %i 0 R", on, on)
    local ppr = pdf.pageresources or ""
    if not stringfind(ppr,"/Shading<<.*>>") then
        ppr = ppr.."/Shading<<>>"
    end
    pdf.pageresources = stringgsub(ppr,"/Shading<<","%1"..res)
    return on
end

local function color_normalize(ca,cb)
    if #cb == 1 then
        if #ca == 4 then
            cb[1], cb[2], cb[3], cb[4] = 0, 0, 0, 1-cb[1]
        else -- #ca = 3
            cb[1], cb[2], cb[3] = cb[1], cb[1], cb[1]
        end
    elseif #cb == 3 then -- #ca == 4
        cb[1], cb[2], cb[3], cb[4] = 1-cb[1], 1-cb[2], 1-cb[3], 0
    end
end

local function do_preobj_color(object,prescript)
    -- transparency
    local opaq = prescript and prescript.tr_transparency
    if opaq then
        local mode = prescript.tr_alternative or 1
        mode = transparancy_modes[tonumber(mode)]
        tr_pdf_pageresources(mode,opaq)
        pdf_literalcode("/MPlibTr%s%g gs",mode,opaq)
    end
    -- color
    local cs = object.color
    if cs and #cs > 0 then
        pdf_literalcode(luamplib.colorconverter(cs))
    end
    -- shading
    local sh_type = prescript and prescript.sh_type
    if sh_type then
        local domain  = prescript.sh_domain
        local centera = prescript.sh_center_a
        local centerb = prescript.sh_center_b
        local colora  = prescript.sh_color_a or {0};
        local colorb  = prescript.sh_color_b or {1};
        if #colora > #colorb then
            color_normalize(colora,colorb)
        elseif #colorb > #colora then
            color_normalize(colorb,colora)
        end
        local colorspace
        if     #colorb == 1 then colorspace = ”DeviceGray”
        elseif #colorb == 3 then colorspace = ”DeviceRGB”
        elseif #colorb == 4 then colorspace = ”DeviceCMYK”
        else   return opaq
        end
        colora = tableconcat(colora, ” ”)
        colorb = tableconcat(colorb, ” ”)
        local shade_no
        if sh_type == ”linear” then
            local coordinates = format(”%s %s”,centera,centerb)
            shade_no = sh_pdfpageresources(2,domain,colorspace,colora,colorb,coordinates)
        elseif sh_type == ”circular” then
            local radiusa = prescript.sh_radius_a
            local radiusb = prescript.sh_radius_b
            local coordinates = format(”%s %s %s %s”,centera,radiusa,centerb,radiusb)
            shade_no = sh_pdfpageresources(3,domain,colorspace,colora,colorb,coordinates)
        end
        pdf_literalcode(”q /Pattern cs”)
        return opaq,shade_no
    end
    return opaq
end

local function do_postobj_color(tr,sh)
    if sh then
        pdf_literalcode(”W n /MPlibSh%s sh Q”,sh)
    end
    if tr then
        pdf_literalcode(”/MPlibTrNormal1 gs”)
    end
end

```

End of `btex` – `etex` and Transparency/Shading patch.

```

local function flush(result,flusher)
    if result then
        local figures = result.fig
        if figures then
            for f=1, #figures do
                info(”flushing figure %s”,f)
                local figure = figures[f]
                local objects = getobjects(result,figure,f)
                local fignum = tonumber(stringmatch(figure:filename(),”([%d]+)$”) or fig-
ure:charcode() or 0)
                local miterlimit, linecap, linejoin, dashed = -1, -1, -1, false
                local bbox = figure:boundingbox()
                local llx, lly, urx, ury = bbox[1], bbox[2], bbox[3], bbox[4] -- faster than un-
pack
                if urx < llx then
                    -- invalid
                    pdf_startfigure(fignum,0,0,0,0)
                    pdf_stopfigure()
                else
```

Insert `verbatimtex` code before mplib box.

```
                if TeX_code_t[f] then
                    texsprint(TeX_code_t[f])
                end
                pdf_startfigure(fignum,llx,lly,urx,ury)
                pdf_literalcode(”q”)
                if objects then
                    for o=1,#objects do
                        local object        = objects[o]
                        local objecttype    = object.type
```

Change from ConTEXt code: the following 5 lines are part of the `btex...etex` patch. Again, colors are processed at this stage.

```
                        local prescript     = object.prescript
                        prescript = prescript and script2table(prescript) -- prescript is now a table
                        local tr_opaq,shade_no = do_preobj_color(object,prescript)
                        if prescript and prescript.MPlibTEXboxID then
                            putTEXboxes(object,prescript)
                        elseif objecttype == ”start_bounds” or objecttype == ”stop_bounds” then
                            -- skip
                        elseif objecttype == ”start_clip” then
                            pdf_literalcode(”q”)
                            flushnormalpath(object.path,t,false)
                            pdf_literalcode(”W n”)
                        elseif objecttype == ”stop_clip” then
                            pdf_literalcode(”Q”)
                            miterlimit, linecap, linejoin, dashed = -1, -1, -1, false
                        elseif objecttype == ”special” then
                            -- not supported
                        elseif objecttype == ”text” then
                            local ot = object.transform -- 3,4,5,6,1,2
                            pdf_literalcode(”q %f %f %f %f %f %f cm”,ot[3],ot[4],ot[5],ot[6],ot[1],
                            pdf_textfigure(object.font,object.dsize,object.text,object.width,object
                            pdf_literalcode(”Q”)
                        else
```

Color stuffs are modified and moved to several lines above.

```
                            local ml = object.miterlimit
                            if ml and ml ~= miterlimit then
                                miterlimit = ml
                                pdf_literalcode(”%f M”,ml)
                            end
                            local lj = object.linejoin
                            if lj and lj ~= linejoin then
```

```
                linejoin = lj
                pdf_literalcode("%i j",lj)
            end
            local lc = object.linecap
            if lc and lc ~= linecap then
                linecap = lc
                pdf_literalcode("%i J",lc)
            end
            local dl = object.dash
            if dl then
                local d = format("[%s] %i d",tableconcat(dl.dashes or {}," "),dl.of
                if d ~= dashed then
                    dashed = d
                    pdf_literalcode(dashed)
                end
            elseif dashed then
               pdf_literalcode("[] 0 d")
               dashed = false
            end
            local path = object.path
            local transformed, penwidth = false, 1
            local open = path and path[1].left_type and path[#path].right_type
            local pen = object.pen
            if pen then
               if pen.type == 'elliptical' then
                    transformed, penwidth = pen_characteristics(object) -- boolean, value
                    pdf_literalcode("%f w",penwidth)
                    if objecttype == 'fill' then
                        objecttype = 'both'
                    end
               else -- calculated by mplib itself
                    objecttype = 'fill'
               end
            end
            if transformed then
                pdf_literalcode("q")
            end
            if path then
                if transformed then
                    flushconcatpath(path,open)
                else
                    flushnormalpath(path,open)
                end
```

Change from ConTEXt code: color stuff

```
                if not shade_no then ----- conflict with shading
                    if objecttype == "fill" then
                        pdf_literalcode("h f")
```

```
                                        elseif objecttype == ”outline” then
                                            pdf_literalcode((open and ”S”) or ”h S”)
                                        elseif objecttype == ”both” then
                                            pdf_literalcode(”h B”)
                                        end
                                    end
                                end
                                if transformed then
                                    pdf_literalcode(”Q”)
                                end
                                local path = object.htap
                                if path then
                                    if transformed then
                                        pdf_literalcode(”q”)
                                    end
                                    if transformed then
                                        flushconcatpath(path,open)
                                    else
                                        flushnormalpath(path,open)
                                    end
                                    if objecttype == ”fill” then
                                        pdf_literalcode(”h f”)
                                    elseif objecttype == ”outline” then
                                        pdf_literalcode((open and ”S”) or ”h S”)
                                    elseif objecttype == ”both” then
                                        pdf_literalcode(”h B”)
                                    end
                                    if transformed then
                                        pdf_literalcode(”Q”)
                                    end
                                end
--                              if cr then
--                                  pdf_literalcode(cr)
--                              end
                            end
```

Added to ConTEXt code: color stuff

```
                            do_postobj_color(tr_opaq,shade_no)
                       end
                    end
                    pdf_literalcode(”Q”)
                    pdf_stopfigure()
                end
            end
        end
    end
end
luamplib.flush = flush

local function colorconverter(cr)
```

```
    local n = #cr
    if n == 4 then
        local c, m, y, k = cr[1], cr[2], cr[3], cr[4]
        return format("%.3g %.3g %.3g %.3g k %.3g %.3g %.3g %.3g K",c,m,y,k,c,m,y,k), "0 g 0 G"
    elseif n == 3 then
        local r, g, b = cr[1], cr[2], cr[3]
        return format("%.3g %.3g %.3g rg %.3g %.3g %.3g RG",r,g,b,r,g,b), "0 g 0 G"
    else
        local s = cr[1]
        return format("%.3g g %.3g G",s,s), "0 g 0 G"
    end
end
luamplib.colorconverter = colorconverter
```

2.2 TEX package

```
⟨*package⟩
```

First we need to load some packages.

```
\bgroup\expandafter\expandafter\expandafter\egroup
\expandafter\ifx\csname ProvidesPackage\endcsname\relax
  \input luatexbase-modutils.sty
\else
  \NeedsTeXFormat{LaTeX2e}
  \ProvidesPackage{luamplib}
    [2014/02/02 v2.4 mplib package for LuaTeX]
  \RequirePackage{luatexbase-modutils}
  \RequirePackage{pdftexcmds}
\fi
```

Loading of lua code.

```
\RequireLuaModule{luamplib}
```

Set the format for metapost.

```
\def\mplibsetformat#1{%
  \directlua{luamplib.setformat("\luatexluaescapestring{#1}")}}
```

MPLib only works in PDF mode, we don't do anything if we are in DVI mode, and we output a warning.

```
\ifnum\pdfoutput>0
    \let\mplibtoPDF\pdfliteral
\else
    %\def\MPLIBtoPDF#1{\special{pdf:literal direct #1}} % not ok yet
    \def\mplibtoPDF#1{}
    \expandafter\ifx\csname PackageWarning\endcsname\relax
      \write16{}
      \write16{Warning: MPLib only works in PDF mode, no figure will be output.}
      \write16{}
    \else
      \PackageWarning{mplib}{MPLib only works in PDF mode, no figure will be out-
  put.}
```

```
    \fi
\fi
\def\mplibsetupcatcodes{%
  %catcode‘\{=12 %catcode‘\}=12
  \catcode‘\#=12
  \catcode‘\^=12 \catcode‘\~=12 \catcode‘\_=12
  %catcode‘\%=12 %% don’t in Plain!
  \catcode‘\&=12 \catcode‘\$=12
}
```

Make `btex...etex` box zero-metric.

```
\def\mplibputtextbox#1{\vbox to 0pt{\vss\hbox to 0pt{\raise\dp#1\copy#1\hss}}}
```

The Plain-specific stuff.

```
\bgroup\expandafter\expandafter\expandafter\egroup
\expandafter\ifx\csname ProvidesPackage\endcsname\relax
\def\mplibcode{%
  \begingroup
  \bgroup
  \mplibsetupcatcodes
  \mplibdocode %
}
\long\def\mplibdocode#1\endmplibcode{%
  \egroup
  \def\mplibtemp{\directlua{luamplib.protecttextext([===[\unexpanded{#1}]===])}}%
  \directlua{luamplib.tempdata = luamplib.makeTEXboxes([===[\mplibtemp]===])}%
  \directlua{luamplib.processwithTEXboxes(luamplib.tempdata)}%
  \endgroup
}
\else
```

The LaTeX-specific parts: a new environment.

```
\newenvironment{mplibcode}{\toks@{}\ltxdomplibcode}{}
\def\ltxdomplibcode{%
  \begingroup
  \mplibsetupcatcodes
  \ltxdomplibcodeindeed %
}
%
\long\def\ltxdomplibcodeindeed#1\end#2{%
  \endgroup
  \toks@\expandafter{\the\toks@#1}%
  \ifnum\pdf@strcmp{#2}{mplibcode}=\z@
    \def\reserved@a{\directlua{luamplib.protecttextext([===[\the\toks@]===])}}%
    \directlua{luamplib.tempdata=luamplib.makeTEXboxes([===[\reserved@a]===])}%
    \directlua{luamplib.processwithTEXboxes(luamplib.tempdata)}%
    \end{mplibcode}%
  \else
    \toks@\expandafter{\the\toks@\end{#2}}\expandafter\ltxdomplibcode
  \fi
}
```

```
\fi
```

`\everymplib` & `\everyendmplib`: macros redefining `\everymplibtoks` & `\everyendmplibtoks` respectively

```
\newtoks\everymplibtoks
\newtoks\everyendmplibtoks
\protected\def\everymplib{%
  \begingroup
  \mplibsetupcatcodes
  \mplibdoeverymplib
}
\def\mplibdoeverymplib#1{%
  \endgroup
  \everymplibtoks{#1}%
}
\protected\def\everyendmplib{%
  \begingroup
  \mplibsetupcatcodes
  \mplibdoeveryendmplib
}
\def\mplibdoeveryendmplib#1{%
  \endgroup
  \everyendmplibtoks{#1}%
}
\def\mpdim#1{ begingroup \the\dimexpr #1\relax\space endgroup } % gmp.sty
\def\mplibnumbersystem#1{\directlua{luamplib.numbersystem = "#1"}}
```

We use a dedicated scratchbox.

```
\ifx\mplibscratchbox\undefined \newbox\mplibscratchbox \fi
```

We encapsulate the litterals.

```
\def\mplibstarttoPDF#1#2#3#4{%
  \hbox\bgroup
  \xdef\MPllx{#1}\xdef\MPlly{#2}%
  \xdef\MPurx{#3}\xdef\MPury{#4}%
  \xdef\MPwidth{\the\dimexpr#3bp-#1bp\relax}%
  \xdef\MPheight{\the\dimexpr#4bp-#2bp\relax}%
  \parskip0pt%
  \leftskip0pt%
  \parindent0pt%
  \everypar{}%
  \setbox\mplibscratchbox\vbox\bgroup
  \noindent
}

\def\mplibstoptoPDF{%
  \egroup %
  \setbox\mplibscratchbox\hbox %
    {\hskip-\MPllx bp%
     \raise-\MPlly bp%
     \box\mplibscratchbox}%
  \setbox\mplibscratchbox\vbox to \MPheight
```

```
    {\vfill
     \hsize\MPwidth
     \wd\mplibscratchbox0pt%
     \ht\mplibscratchbox0pt%
     \dp\mplibscratchbox0pt%
     \box\mplibscratchbox}%
  \wd\mplibscratchbox\MPwidth
  \ht\mplibscratchbox\MPheight
  \box\mplibscratchbox
  \egroup
}
```

Text items have a special handler.

```
\def\mplibtextext#1#2#3#4#5{%
  \begingroup
  \setbox\mplibscratchbox\hbox
    {\font\temp=#1 at #2bp%
     \temp
     #3}%
  \setbox\mplibscratchbox\hbox
    {\hskip#4 bp%
     \raise#5 bp%
     \box\mplibscratchbox}%
  \wd\mplibscratchbox0pt%
  \ht\mplibscratchbox0pt%
  \dp\mplibscratchbox0pt%
  \box\mplibscratchbox
  \endgroup
}
```

That's all folks!

⟨/package⟩

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13. *In no event unless required by applicable law or agreed to in writing will any copyright holder, or any other party who may modify and/or redistribute the program as permitted above, be liable to you for damages, including any general, special, incidental or consequential damages arising out of the use or inability to use the program (including but not limited to loss of data or data being rendered inaccurate or losses sustained by you or third parties or a failure of the program to operate with any other programs), even if such holder or other party has been advised of the possibility of such damages.*

End of Terms and Conditions

Appendix: How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

> one line to give the program's name and a brief idea of what it does.
> Copyright (C) yyyy name of author
>
> This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.
>
> This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.
>
> You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA.

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

> Gnomovision version 69, Copyright (C) yyyy name of author
> Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type 'show w'.
> This is free software, and you are welcome to redistribute it under certain conditions; type 'show c' for details.

The hypothetical commands `show w` and `show c` should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than `show w` and `show c`; they could even be mouse-clicks or menu items—whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

> Yoyodyne, Inc., hereby disclaims all copyright interest in the program 'Gnomovision' (which makes passes at compilers) written by James Hacker.
>
> signature of Ty Coon, 1 April 1989
> Ty Coon, President of Vice

This General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Library General Public License instead of this License.