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.

In the past, the package required PDF mode in order to output something. Starting with version 2.7 it works in DVI mode as well, though DVIPDFMx is the only DVI tool currently supported.

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 our own function for errors, warnings and informations
- 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 and is a synomym of `textext()`.

  N.B. Since v2.5, `btex ... etex` input from external `mp` files will also be processed by luamplib.

  N.B. Since v2.20, `verbatimtex ... etex` from external `mp` files will be also processed by luamplib. Warning: This is a change from previous version.

Some more changes and cautions are:

`\mplibforcehmode` When this macro is declared, every mplibcode figure box will be typeset in horizontal mode, so `\centering`, `\raggedleft` etc will have effects. `\mplibnoforcehmode`, being default, reverts this setting. (Actually these commands redefine `\prependtomplibbox`. You can define this command with anything suitable before a box.)

`\mpliblegacybehavior{enable}` By default, `\mpliblegacybehavior{enable}` is already declared, in which case a `verbatimtex ... etex` that comes just before `beginfig()` is not ignored, but the TeX code will be inserted before the following mplib hbox. Using this command, each mplib box can be freely moved horizontally and/or vertically. Also, a box number might be assigned to mplib box, allowing it to be reused later (see test files).

```
\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`.

By contrast, TeX code in `VerbatimTeX(...)` or `verbatimtex ... etex` between `beginfig()` and `endfig` will be inserted after flushing out the mplib figure.

```
\mplibcode
  D := sqrt(2)**7;
  beginfig(0);
  draw fullcircle scaled D;
  VerbatimTeX("\gdef\Dia{" & decimal D & "}");
  endfig;
\endmplibcode
diameter: \Dia bp.
```

`\mpliblegacybehavior{disable}` If `\mpliblegacybehavior{disabled}` is declared by user, any `verbatimtex ... etex` will be executed, along with `btex ... etex`, sequentially one by one. So, some TeX code in `verbatimtex ... etex` will have effects on `btex ... etex` codes that follows.

```
\begin{mplibcode}
  beginfig(0);
  draw btex ABC etex;
  verbatimtex \bfseries etex;
  draw btex DEF etex shifted (1cm,0); % bold face
  draw btex GHI etex shifted (2cm,0); % bold face
  endfig;
\end{mplibcode}
```

`\everymplib`, `\everyendmplib` Since v2.3, new macros `\everymplib` and `\everyendmplib` redefine the lua table containing MetaPost code which will be automatically inserted at the beginning and ending of each `mplibcode`.

```
\everymplib{ beginfig(0); }
```

```
\everyendmplib{ endfig; }
\mplibcode % beginfig/endfig not needed
  draw fullcircle scaled 1cm;
\endmplibcode
```

\mpdim 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.

```
\begin{mplibcode}
  draw origin--(.6\mpdim{\linewidth},0) withpen pencircle scaled 4
  dashed evenly scaled 4 withcolor \mpcolor{orange};
\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.

\mpcolor With \mpcolor command, color names or expressions of color/xcolor packages can be used inside mplibcode enviroment (after withcolor operator), though luamplib does not automatically load these packages. See the example code above. For spot colors, colorspace, spotcolor (in PDF mode) and xespotcolor (in DVI mode) packages are supported as well.

From v2.26.1, l3color is also supported by the command \mpcolor{color expression}, including spot colors.

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

\mplibtextextlabel Starting with v2.6, \mplibtextextlabel{enable} enables string labels typeset via textext() instead of infont operator. So, label("my text",origin) thereafter is exactly the same as label(textext("my text"),origin). N.B. In the background, luamplib redefines infont operator so that the right side argument (the font part) is totally ignored. Every string label therefore will be typeset with current TEX font. Also take care of char operator in the left side argument, as this might bring unpermitted characters into TEX.

\mplibcodeinherit Starting with v2.9, \mplibcodeinherit{enable} enables the inheritance of variables, constants, and macros defined by previous mplibcode chunks. On the contrary, the default value \mplibcodeinherit{disable} will make each code chunks being treated as an independent instance, and never affected by previous code chunks.

Separate instances for LATEX environment v2.22 has added the support for several named MetaPost instances in LATEX mplibcode environment. Syntax is like so:

```
\begin{mplibcode}[instanceName]
  % some mp code
\end{mplibcode}
```

Behaviour is as follows.

- All the variables and functions are shared only among all the environments belonging to the same instance.
- \mplibcodeinherit only affects environments with no instance name set (since if a name is set, the code is intended to be reused at some point).
- From v2.27, btex ... etex boxes are also shared and do not require \mplibglobaltextext.
- When an instance names is set, respective \currentmpinstancename is set.

In parellel with this functionality, v2.23 and after supports optional argument of instance name for \everymplib and \everyendmplib, affecting only those mplibcode environments of the same name. Unnamed \everymplib affects not only those instances with no name, but also those with name but with no corresponding \everymplib. Syntax is:

```
\everymplib[instanceName]{...}
\everyendmplib[instanceName]{...}
```

\mplibglobaltextext Formerly, to inherit btex ... etex boxes as well as metapost variables, it was necessary to declare \mplibglobaltextext{enable} in advance. But from v2.27, this is implicitly enabled when \mplibcodeinherit is true.

```
\mplibcodeinherit{enable}
%\mplibglobaltextext{enable}
\everymplib{ beginfig(0);} \everyendmplib{ endfig;}
\mplibcode
  label(btex $\sqrt{2}$ etex, origin);
  draw fullcircle scaled 20;
  picture pic; pic := currentpicture;
\endmplibcode
\mplibcode
  currentpicture := pic scaled 2;
\endmplibcode
```

Generally speaking, it is recommended to turn mplibglobaltextext always on, because it has the advantage of more efficient processing. But everything has its downside: it will waste more memory resources.

\mplibverbatim Starting with v2.11, users can issue \mplibverbatim{enable}, after which the contents of mplibcode environment will be read verbatim. As a result, except for \mpdim and \mpcolor, all other TeX commands outside btex ... etex or verbatimtex ... etex are not expanded and will be fed literally into the mplib process.

\mplibshowlog When \mplibshowlog{enable} is declared, log messages returned by mplib instance will be printed into the .log file. \mplibshowlog{disable} will revert this functionality. This is a TeX side interface for luamplib.showlog. (v2.20.8)

Settings regarding cache files To support `btex ... etex` in external `.mp` files, `luamplib` inspects the content of each and every `.mp` input files and makes caches if nececcsary, before returning their paths to LuaTEX's mplib library. This would make the compilation time longer wastefully, as most `.mp` files do not contain `btex ... etex` command. So `luamplib` provides macros as follows, so that users can give instruction about files that do not require this functionality.

- `\mplibmakenocache{<filename>[,<filename>,...]}`
- `\mplibcancelnocache{<filename>[,<filename>,...]}`

where `<filename>` is a file name excluding `.mp` extension. Note that `.mp` files under `$TEXMFMAIN/metapost/base` and `$TEXMFMAIN/metapost/context/base` are already registered by default.

By default, cache files will be stored in `$TEXMFVAR/luamplib_cache` or, if it's not available (mostly not writable), in the directory where output files are saved: to be specific, `$TEXMF_OUTPUT_DIRECTORY/luamplib_cache`, `./luamplib_cache`, `$TEXMFOUTPUT/luamplib_cache`, and `.` in this order. (`$TEXMF_OUTPUT_DIRECTORY` is normally the value of `--output-directory` command-line option.) This behavior however can be changed by the command `\mplibcachedir{<directory path>}`, where tilde (`~`) is interpreted as the user's home directory (on a windows machine as well). As backslashes (`\`) should be escaped by users, it would be easier to use slashes (`/`) instead.

`mplibgraphictext` For some amusement, luamplib provides its own metapost operator `mplibgraphictext`, the effect of which is similar to that of ConTEXt's `graphictext`. However syntax is somewhat different.

```
mplibgraphictext "Funny"
  fakebold 2.3 scale 3              % fontspec options
  drawcolor .7blue fillcolor "red!50" % color expressions
```

`fakebold`, `scale`, `drawcolor` and `fillcolor` are optional; default values are `2`, `1`, `"black"` and `"white"` respectively. When color expressions are given as string, they are regarded as xcolor's or l3color's expressions (this is the same with shading colors). All from `mplibgraphictext` to the end of sentence will compose an anonymous `picture`, which can be drawn or assigned to a variable. Incidentally, `withdrawcolor` and `withfillcolor` are synonyms of `drawcolor` and `fillcolor`, hopefully to be compatible with `graphictext`. N.B. Because luamplib's current implementation is quite different from the ConTEXt's, there are some limitations such that you can't apply shading (gradient colors) to the text.

About figure box metrics Notice that, after each figure is processed, macro `\MPwidth` stores the width value of latest figure; `\MPheight`, the height value. Incidentally, also note that `\MPllx`, `\MPlly`, `\MPurx`, and `\MPury` store the bounding box information of latest figure without the unit `bp`.

luamplib.cfg At the end of package loading, `luamplib` searches `luamplib.cfg` and, if found, reads the file in automatically. Frequently used settings such as `\everymplib`, `\mplibforcehmode` or `\mplibcodeinherit` are suitable for going into this file.

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

```

luatexbase.provides_module {
  name          = "luamplib",
  version       = "2.28.2",
  date          = "2024/04/25",
  description   = "Lua package to typeset Metapost with LuaTeX's MPLib.",
}

```

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

```
luamplib         = luamplib or { }
local luamplib    = luamplib

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

```

Use our own function for warn/info/err.

```
local function termorlog (target, text, kind)
  if text then
    local mod, write, append = "luamplib", texio.write_nl, texio.write
    kind = kind
        or target == "term" and "Warning (more info in the log)"
        or target == "log" and "Info"
        or target == "term and log" and "Warning"
        or "Error"
    target = kind == "Error" and "term and log" or target
    local t = text:explode"\n+"
    write(target, format("Module %s %s:", mod, kind))
    if #t == 1 then
      append(target, format(" %s", t[1]))
    else
      for _,line in ipairs(t) do
        write(target, line)
      end
      write(target, format("(%s)     ", mod))
    end
    append(target, format(" on input line %s", tex.inputlineno))
    write(target, "")
    if kind == "Error" then error() end
  end
end

local function warn (...) -- beware '%' symbol
  termorlog("term and log", select("#",...) > 1 and format(...) or ...)
end
local function info (...)
  termorlog("log", select("#",...) > 1 and format(...) or ...)
end
local function err (...)
  termorlog("error", select("#",...) > 1 and format(...) or ...)
```

```
end

luamplib.showlog  = luamplib.showlog or false

```

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

```
local tableconcat = table.concat
local texsprint   = tex.sprint
local texgettoks  = tex.gettoks
local texgetbox   = tex.getbox
local texruntoks  = tex.runtoks
```

We don’t use tex.scantoks anymore. See below reagrding tex.runtoks.

```
  local texscantoks = tex.scantoks
```

```

if not texruntoks then
  err("Your LuaTeX version is too old. Please upgrade it to the latest")
end

local is_defined  = token.is_defined
local get_macro   = token.get_macro

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

local lfsattributes = lfs.attributes
local lfsisdir      = lfs.isdir
local lfsmkdir      = lfs.mkdir
local lfstouch      = lfs.touch
local ioopen        = io.open

```

Some helper functions, prepared for the case when l-file etc is not loaded.

```
local file = file or { }
local replacesuffix = file.replacesuffix or function(filename, suffix)
  return (filename:gsub("%.[%a%d]+$","")) .. "." .. suffix
end

local is_writable = file.is_writable or function(name)
  if lfsisdir(name) then
    name = name .. "/_luam_plib_temp_file_"
    local fh = ioopen(name,"w")
    if fh then
      fh:close(); os.remove(name)
      return true
    end
  end
end
local mk_full_path = lfs.mkdirp or lfs.mkdirs or function(path)
  local full = ""
  for sub in path:gmatch("(/*[^\\/]+)") do
    full = full .. sub
    lfsmkdir(full)
  end
end

```

btex ... etex in input .mp files will be replaced in finder. Because of the limitation of MPLib regarding make_text, we might have to make cache files modified from input files.

```
local luamplibtime = kpse.find_file("luamplib.lua")
luamplibtime = luamplibtime and lfsattributes(luamplibtime,"modification")

local currenttime = os.time()

local outputdir
if lfstouch then
  for i,v in ipairs{'TEXMFVAR','TEXMF_OUTPUT_DIRECTORY','.','TEXMFOUTPUT'} do
    local var = i == 3 and v or kpse.var_value(v)
    if var and var ~= "" then
      for _,vv in next, var:explode(os.type == "unix" and ":" or ";") do
        local dir = format("%s/%s",vv,"luamplib_cache")
        if not lfsisdir(dir) then
          mk_full_path(dir)
        end
        if is_writable(dir) then
          outputdir = dir
          break
        end
      end
      if outputdir then break end
    end
  end
end
outputdir = outputdir or '.'

function luamplib.getcachedir(dir)
  dir = dir:gsub("##","#")
  dir = dir:gsub("^~",
    os.type == "windows" and os.getenv("UserProfile") or os.getenv("HOME"))
  if lfstouch and dir then
    if lfsisdir(dir) then
      if is_writable(dir) then
        luamplib.cachedir = dir
      else
        warn("Directory '%s' is not writable!", dir)
      end
    else
      warn("Directory '%s' does not exist!", dir)
    end
  end
end

```

Some basic MetaPost files not necessary to make cache files.

```
local noneedtoreplace = {
  ["boxes.mp"] = true, --  ["format.mp"] = true,
  ["graph.mp"] = true, ["marith.mp"] = true, ["mfplain.mp"] = true,
  ["mpost.mp"] = true, ["plain.mp"] = true, ["rboxes.mp"] = true,
  ["sarith.mp"] = true, ["string.mp"] = true, -- ["TEX.mp"] = true,
  ["metafun.mp"] = true, ["metafun.mpiv"] = true, ["mp-abck.mpiv"] = true,
  ["mp-apos.mpiv"] = true, ["mp-asnc.mpiv"] = true, ["mp-bare.mpiv"] = true,
  ["mp-base.mpiv"] = true, ["mp-blob.mpiv"] = true, ["mp-butt.mpiv"] = true,
  ["mp-char.mpiv"] = true, ["mp-chem.mpiv"] = true, ["mp-core.mpiv"] = true,
  ["mp-crop.mpiv"] = true, ["mp-figs.mpiv"] = true, ["mp-form.mpiv"] = true,
  ["mp-func.mpiv"] = true, ["mp-grap.mpiv"] = true, ["mp-grid.mpiv"] = true,
  ["mp-grph.mpiv"] = true, ["mp-idea.mpiv"] = true, ["mp-luas.mpiv"] = true,
  ["mp-mlib.mpiv"] = true, ["mp-node.mpiv"] = true, ["mp-page.mpiv"] = true,
  ["mp-shap.mpiv"] = true, ["mp-step.mpiv"] = true, ["mp-text.mpiv"] = true,
  ["mp-tool.mpiv"] = true, ["mp-cont.mpiv"] = true,
}
luamplib.noneedtoreplace = noneedtoreplace

```

format.mp is much complicated, so specially treated.

```
local function replaceformatmp(file,newfile,ofmodify)
  local fh = ioopen(file,"r")
  if not fh then return file end
  local data = fh:read("*all"); fh:close()
  fh = ioopen(newfile,"w")
  if not fh then return file end
  fh:write(
    "let normalinfont = infont;\n",
    "primarydef str infont name = rawtextext(str) enddef;\n",
    data,
    "vardef Fmant_(expr x) = rawtextext(decimal abs x) enddef;\n",
    "vardef Fexp_(expr x) = rawtextext(\"$^{\"&decimal x&\"}$\") enddef;\n",
    "let infont = normalinfont;\n"
  ); fh:close()
  lfstouch(newfile,currenttime,ofmodify)
  return newfile
end

```

Replace btex ... etex and verbatimtex ... etex in input files, if needed.

```
local name_b = "%f[%a_]"
local name_e = "%f[^%a_]"
local btex_etex = name_b.."btex"..name_e.."%s*(.-)%s*"..name_b.."etex"..name_e
local verbatimtex_etex = name_b.."verbatimtex"..name_e.."%s*(.-)%s*"..name_b.."etex"..name_e

local function replaceinputmpfile (name,file)
  local ofmodify = lfsattributes(file,"modification")
  if not ofmodify then return file end
  local cachedir = luamplib.cachedir or outputdir
  local newfile = name:gsub("%W","_")
  newfile = cachedir .."/luamplib_input_"..newfile
  if newfile and luamplibtime then
    local nf = lfsattributes(newfile)
    if nf and nf.mode == "file" and
      ofmodify == nf.modification and luamplibtime < nf.access then
      return nf.size == 0 and file or newfile
    end
  end

  if name == "format.mp" then return replaceformatmp(file,newfile,ofmodify) end

  local fh = ioopen(file,"r")
  if not fh then return file end
  local data = fh:read("*all"); fh:close()

```

"etex" must be followed by a space or semicolon as specified in LuaTEX manual, which is not the case of standalone MetaPost though.

```
  local count,cnt = 0,0
  data, cnt = data:gsub(btex_etex, "btex %1 etex ") -- space
  count = count + cnt
  data, cnt = data:gsub(verbatimtex_etex, "verbatimtex %1 etex;") -- semicolon
  count = count + cnt

  if count == 0 then
    noneedtoreplace[name] = true
    fh = ioopen(newfile,"w");
    if fh then
      fh:close()
      lfstouch(newfile,currenttime,ofmodify)
    end
    return file
  end

  fh = ioopen(newfile,"w")
  if not fh then return file end
  fh:write(data); fh:close()
  lfstouch(newfile,currenttime,ofmodify)
  return newfile
end

```

As the finder function for MPLib, use the kpse library and make it behave like as if MetaPost was used. And replace it with cache files if needed. See also #74, #97.

```
local mpkpse
do
  local exe = 0
  while arg[exe-1] do
    exe = exe-1
  end
  mpkpse = kpse.new(arg[exe], "mpost")
end

local special_ftype = {
  pfb = "type1 fonts",
  enc = "enc files",
}

local function finder(name, mode, ftype)
  if mode == "w" then
    if name and name ~= "mpout.log" then
      kpse.record_output_file(name) -- recorder
    end
    return name
  else
    ftype = special_ftype[ftype] or ftype
    local file = mpkpse:find_file(name,ftype)
    if file then
      if lfstouch and ftype == "mp" and not noneedtoreplace[name] then
        file = replaceinputmpfile(name,file)
      end
    else
      file = mpkpse:find_file(name, name:match("%a+$"))
    end
    if file then
      kpse.record_input_file(file) -- recorder
    end
    return file
  end
end
luamplib.finder = finder

```

Create and load MPLib instances. We do not support ancient version of MPLib any more. (Don't know which version of MPLib started to support make_text and run_script; let the users find it.)

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

```

plain or metafun, though we cannot support metafun format fully.

```
local currentformat = "plain"
local function setformat (name)
  currentformat = name
end
luamplib.setformat = setformat

```

v2.9 has introduced the concept of "code inherit"

```
luamplib.codeinherit = false

local mplibinstances = {}
local instancename

local function reporterror (result, prevlog)
  if not result then
    err("no result object returned")
  else
    local t, e, l = result.term, result.error, result.log
```

log has more information than term, so log first (2021/08/02)

```
    local log = l or t or "no-term"
    log = log:gsub("%(Please type a command or say 'end'%)",""):gsub("\n+","\n")
    if result.status > 0 then
```

```
      local first = log:match"(.-\n! .-)\n! "
      if first then
        termorlog("term", first)
        termorlog("log", log, "Warning")
      else
        warn(log)
      end
      if result.status > 1 then
        err(e or "see above messages")
      end
    elseif prevlog then
      log = prevlog..log
```

v2.6.1: now luamplib does not disregard `show` command, even when `luamplib.showlog` is false. Incidentally, it does not raise error but just prints an info, even if output has no figure.

```
      local show = log:match"\n>>? .+"
      if show then
        termorlog("term", show, "Info (more info in the log)")
        info(log)
      elseif luamplib.showlog and log:find"%g" then
        info(log)
      end
    end
    return log
  end
end

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

Make use of `make_text` and `run_script`, which will co-operate with LuaTEX's `tex.runtoks`. And we provide `numbersystem` option since v2.4. Default value "scaled" can be changed by declaring `\mplibnumbersystem{double}` or `\mplibnumbersystem{decimal}`. See `https://github.com/lualatex/luamplib/issues/21`.

```
    make_text   = luamplib.maketext,
    run_script  = luamplib.runscript,
    math_mode   = luamplib.numbersystem,
    job_name    = tex.jobname,
    random_seed = math.random(4095),
    extensions  = 1,
  }
```

Append our own MetaPost preamble to the preamble above.

```
  local preamble = tableconcat{
    format(preamble, replacesuffix(name,"mp")),
    luamplib.mplibcodepreamble,
    luamplib.legacy_verbatimtex and luamplib.legacyverbatimtexpreamble or "",
    luamplib.textextlabel and luamplib.textextlabelpreamble or "",
  }
  local result, log
  if not mpx then
    result = { status = 99, error = "out of memory"}
  else
    result = mpx:execute(preamble)
  end
  log = reporterror(result)
  return mpx, result, log
end

```

Here, excute each mplibcode data, ie \begin{mplibcode} ... \end{mplibcode}.

```
local function process (data)
```

The workaround of issue #70 seems to be unnecessary, as we use make_text now.

```
if not data:find(name_b..”beginfig%s*%([%+%-%s]*%d[%.%d%s]*%)”) then
  data = data .. ”beginfig(-1);endfig;”
end
```

```
  local currfmt
  if instancename and instancename ~= ”” then
    currfmt = instancename
  else
    currfmt = tableconcat{
      currentformat,
      luamplib.numbersystem or ”scaled”,
      tostring(luamplib.textextlabel),
      tostring(luamplib.legacy_verbatimtex),
    }
  end
  local mpx = mplibinstances[currfmt]
  local standalone = false
  if currfmt ~= instancename then
    standalone = not luamplib.codeinherit
  end
  if mpx and standalone then
    mpx:finish()
  end
  local log = ””
  if standalone or not mpx then
    mpx, _, log = luamplibload(currentformat)
    mplibinstances[currfmt] = mpx
  end
  local converted, result = false, {}
  if mpx and data then
    result = mpx:execute(data)
    local log = reporterror(result, log)
    if log then
      if result.fig then
        converted = luamplib.convert(result)
      else
        info”No figure output. Maybe no beginfig/endfig”
      end
    end
  else
    err”Mem file unloadable. Maybe generated with a different version of mplib?”
  end
  return converted, result
end

```

dvipdfmx is supported, though nobody seems to use it.

```
local pdfmode = tex.outputmode > 0
```

make_text and some run_script uses LuaTeX's tex.runtoks, which made possible running TeX code snippets inside \directlua.

```
local catlatex = luatexbase.registernumber("catcodetable@latex")
local catat11  = luatexbase.registernumber("catcodetable@atletter")

```

tex.scantoks sometimes fail to read catcode properly, especially \#, \&, or \%. After some experiment, we dropped using it. Instead, a function containing tex.script seems to work nicely.

```
local function run_tex_code_no_use (str, cat)
  cat = cat or catlatex
  texscantoks("mplibtmptoks", cat, str)
  texruntoks("mplibtmptoks")
end
```

```
local function run_tex_code (str, cat)
  texruntoks(function() texsprint(cat or catlatex, str) end)
end

```

Prepare textext box number containers, locals, globals and possibly instances. localid can be any number. They are local anyway. The number will be reset at the start of a new code chunk. Global boxes will use \newbox command in tex.runtoks process. This is the same when codeinherit is declared as true. Boxes of an instance will also be global, so that their tex boxes can be shared among instances of the same name.

```
local texboxes = {
  locals  = {}, localid  = 4096,
  globals = {}, globalid = 0,
}
```

For conversion of sp to bp.

```
local factor = 65536*(7227/7200)

local textext_fmt = 'image(addto currentpicture doublepath unitsquare \z
xscaled %f yscaled %f shifted (0,-%f) \z
withprescript "mplibtexboxid=%i:%f:%f")'

local function process_tex_text (str)
  if str then
    local boxtable, global
    if instancename and instancename ~= ""
      or luamplib.globaltextext or luamplib.codeinherit then
      boxtable, global = texboxes.globals, "\\global"
    else
      boxtable, global = texboxes.locals, ""
    end
    local tex_box_id = boxtable[str]
    local box = tex_box_id and texgetbox(tex_box_id)
    if not box then
      if global == ”” then
        tex_box_id = texboxes.localid + 1
        texboxes.localid = tex_box_id
      else
        local boxid = texboxes.globalid + 1
        texboxes.globalid = boxid
        run_tex_code(format(
          [[\expandafter\newbox\csname luamplib.box.%s\endcsname]], boxid))
        tex_box_id = tex.getcount'allocationnumber'
      end
      if str:find”^[%s%w%{%}%$%^%_]*$” then -- the same cs may expand differently
        boxtable[str] = tex_box_id
      end
      run_tex_code(format(”%s\\setbox%i\\hbox{%s}”, global, tex_box_id, str))
      box = texgetbox(tex_box_id)
    end
    local wd  = box.width  / factor
    local ht  = box.height / factor
    local dp  = box.depth  / factor
    return textext_fmt:format(wd, ht+dp, dp, tex_box_id, wd, ht+dp)
  end
  return ””
end

```

Make color or xcolor's color expressions usable, with \mpcolor or mplibcolor. These commands should be used with graphical objects.

Attempt to support l3color as well.

```
local mplibcolorfmt = {
  xcolor = tableconcat{
    [[\begingroup\let\XC@mcolor\relax]],
    [[\def\set@color{\global\mplibtmptoks\expandafter{\current@color}}]],
    [[\color%s\endgroup]],
  },
  l3color = tableconcat{
    [[\begingroup\def\__color_select:N#1{\expandafter\__color_select:nn#1}]],
    [[\def\__color_backend_select:nn#1#2{\global\mplibtmptoks{#1 #2}}]],
    [[\def\__kernel_backend_literal:e#1{\global\mplibtmptoks\expandafter{\expanded{#1}}}]],
    [[\color_select:n%s\endgroup]],
  },
}

local colfmt = is_defined'color_select:n' and ”l3color” or ”xcolor”
if colfmt == ”l3color” then
  run_tex_code{
    ”\\newcatcodetable\\luamplibcctabexplat”,
    ”\\begingroup”,
    ”\\catcode`@=11 ”,
    ”\\catcode`_=11 ”,
    ”\\catcode`:=11 ”,
    ”\\savecatcodetable\\luamplibcctabexplat”,
    ”\\endgroup”,
  }
end
local ccexplat = luatexbase.registernumber"luamplibcctabexplat"

local function process_color (str, kind)
  if str then
    if not str:find("%b{}") then
      str = format("{%s}",str)
    end
    local myfmt = mplibcolorfmt[colfmt]
    if colfmt == "l3color" and is_defined"color" then
      if str:find("%b[]") then
        myfmt = mplibcolorfmt.xcolor
      else
        for _,v in ipairs(str:match"{(.+)}":explode"!") do
          if not v:find("^%s*%d+%s*$") then
            local pp = get_macro(format("l__color_named_%s_prop",v))
            if not pp or pp == "" then
              myfmt = mplibcolorfmt.xcolor
              break
            end
          end
        end
      end
    end
    if myfmt == mplibcolorfmt.l3color and (kind == "fill" or kind == "draw") then return str end
    run_tex_code(myfmt:format(str), ccexplat or catat11)
    local t = texgettoks"mplibtmptoks"
    if not pdfmode and not t:find"^pdf" then
      t = t:gsub("%a+ (.+)","pdf:bc [%1]")
    end
    if kind then return t end
    return format('1 withprescript "MPlibOverrideColor=%s"', t)
  end
  return ""
end

local function colorsplit (res)
  local t, tt = { }, res:gsub("[%[%]]",""):explode()
  local be = tt[1]:find"^%d" and 1 or 2
  for i=be, #tt do
    if tt[i]:find"^%a" then break end
    t[#t+1] = tt[i]
  end
  return t
end

luamplib.outlinecolor = function (str, filldraw)
  local nn = filldraw == "fill" and 'fn:=' or 'dn:='
  local cc = filldraw == "fill" and 'fc:=' or 'dc:='
  local res = process_color(str, filldraw)
  if res:match"{(.+)}" == str then
    return format('%s"n"; %s"%s";', nn,cc,str)
  end
  local t = colorsplit(res)
  local md = #t == 1 and 'gray' or #t == 3 and 'rgb' or #t == 4 and 'cmyk'
  return format('%s"nn"; %s"%s}{%s";', nn, cc, md, tableconcat(t,','))
end

luamplib.shadecolor = function (str)
  local res = process_color(str, "shade")
  if res:find" cs " or res:find"@pdf.obj" then -- spot color shade: l3 only
```

An example of spot color shading:

```
\documentclass{article}
\usepackage{luamplib}
\mplibsetformat{metafun}
\ExplSyntaxOn
\color_model_new:nnn { pantone3005 }
  { Separation }
  { name = PANTONE~3005~U ,
    alternative-model = cmyk ,
    alternative-values = {1, 0.56, 0, 0}
  }
  \color_set:nnn{spotA}{pantone3005}{1}
  \color_set:nnn{spotB}{pantone3005}{0.6}
\color_model_new:nnn { pantone1215 }
  { Separation }
  { name = PANTONE~1215~U ,
    alternative-model = cmyk ,
    alternative-values = {0, 0.15, 0.51, 0}
  }
  \color_set:nnn{spotC}{pantone1215}{1}
\color_model_new:nnn { pantone2040 }
  { Separation }
  { name = PANTONE~2040~U ,
    alternative-model = cmyk ,
    alternative-values = {0, 0.28, 0.21, 0.04}
  }
  \color_set:nnn{spotD}{pantone2040}{1}
\ExplSyntaxOff
\begin{document}
\begin{mplibcode}
beginfig(1)
  fill unitsquare xyscaled (\mpdim\textwidth,1cm)
       withshademethod "linear"
       withshadevector (0,1)
       withshadestep (
           withshadefraction .5
           withshadecolors ("spotB","spotC")
       )
       withshadestep (
           withshadefraction 1
           withshadecolors ("spotC","spotD")
       )
  ;
endfig;
\end{mplibcode}
```

```
\end{document}
```

```
    run_tex_code({
      [[\color_export:nnN{]], str, [[}{backend}\mplib_@tempa]],
    },ccexplat)
    local name = get_macro'mplib_@tempa':match'{(.-)}{.+}'
    local t, obj = res:explode()
    if pdfmode then
      obj = t[1]:match"^/(.+)"
      if ltx.pdf and ltx.pdf.object_id then
        obj = format("%s 0 R", ltx.pdf.object_id(obj))
      else
        run_tex_code({
          [[\edef\mplib_@tempa{\pdf_object_ref:n{]], obj, "}}",
        },ccexplat)
        obj = get_macro'mplib_@tempa'
      end
    else
      obj = t[2]
    end
    local value = t[3]:match"%[(.-)%]" or t[3]
    return format('(%s) withprescript"mplib_spotcolor=%s:%s"', value,obj,name)
  end
  return colorsplit(res)
end

```

for \mpdim or mplibdimen

```
local function process_dimen (str)
  if str then
    str = str:gsub("{(.+)}","%1")
    run_tex_code(format([[\mplibtmptoks\expandafter{\the\dimexpr %s\relax}]], str))
    return format("begingroup %s endgroup", texgettoks"mplibtmptoks")
  end
  return ""
end

```

Newly introduced method of processing verbatimtex ... etex. This function is used when \mpliblegacybehavior{false} is declared.

```
local function process_verbatimtex_text (str)
  if str then
    run_tex_code(str)
  end
  return ""
end

```

For legacy verbatimtex process. verbatimtex ... etex before beginfig() is not ignored, but the TEX code is inserted just before the mplib box. And TEX code inside beginfig() ... endfig is inserted after the mplib box.

```
local tex_code_pre_mplib = {}
luamplib.figid = 1
luamplib.in_the_fig = false
```

```

local function legacy_mplibcode_reset ()
  tex_code_pre_mplib = {}
  luamplib.figid = 1
end

local function process_verbatimtex_prefig (str)
  if str then
    tex_code_pre_mplib[luamplib.figid] = str
  end
  return ""
end

local function process_verbatimtex_infig (str)
  if str then
    return format('special "postmplibverbtex=%s";', str)
  end
  return ""
end

local runscript_funcs = {
  luamplibtext    = process_tex_text,
  luamplibcolor   = process_color,
  luamplibdimen   = process_dimen,
  luamplibprefig  = process_verbatimtex_prefig,
  luamplibinfig   = process_verbatimtex_infig,
  luamplibverbtex = process_verbatimtex_text,
}

```

For metafun format. see issue #79.

```
mp = mp or {}
local mp = mp
mp.mf_path_reset = mp.mf_path_reset or function() end
mp.mf_finish_saving_data = mp.mf_finish_saving_data or function() end
mp.report = mp.report or info


```

metafun 2021-03-09 changes crashes luamplib.

```
catcodes = catcodes or {}
local catcodes = catcodes
catcodes.numbers = catcodes.numbers or {}
catcodes.numbers.ctxcatcodes = catcodes.numbers.ctxcatcodes or catlatex
catcodes.numbers.texcatcodes = catcodes.numbers.texcatcodes or catlatex
catcodes.numbers.luacatcodes = catcodes.numbers.luacatcodes or catlatex
catcodes.numbers.notcatcodes = catcodes.numbers.notcatcodes or catlatex
catcodes.numbers.vrbcatcodes = catcodes.numbers.vrbcatcodes or catlatex
catcodes.numbers.prtcatcodes = catcodes.numbers.prtcatcodes or catlatex
catcodes.numbers.txtcatcodes = catcodes.numbers.txtcatcodes or catlatex

```

A function from ConTEXt general.

```
local function mpprint(buffer,...)
  for i=1,select("#",...) do
```

```
    local value = select(i,...)
    if value ~= nil then
      local t = type(value)
      if t == "number" then
        buffer[#buffer+1] = format("%.16f",value)
      elseif t == "string" then
        buffer[#buffer+1] = value
      elseif t == "table" then
        buffer[#buffer+1] = "(" .. tableconcat(value,",") .. ")"
      else -- boolean or whatever
        buffer[#buffer+1] = tostring(value)
      end
    end
  end
end

function luamplib.runscript (code)
  local id, str = code:match("(.-){(.*)}")
  if id and str then
    local f = runscript_funcs[id]
    if f then
      local t = f(str)
      if t then return t end
    end
  end
  local f = loadstring(code)
  if type(f) == "function" then
    local buffer = {}
    function mp.print(...)
      mpprint(buffer,...)
    end
    local res = {f()}
    buffer = tableconcat(buffer)
    if buffer and buffer ~= "" then
      return buffer
    end
    buffer = {}
    mpprint(buffer, table.unpack(res))
    return tableconcat(buffer)
  end
  return ""
end

```

make_text must be one liner, so comment sign is not allowed.

```
local function protecttexcontents (str)
  return str:gsub("\\%%", "\0PerCent\0")
            :gsub("%%.-\n", "")
            :gsub("%%.-$",  "")
            :gsub("%zPerCent%z", "\\%%")
            :gsub("%s+", " ")
end

luamplib.legacy_verbatimtex = true

```

```
function luamplib.maketext (str, what)
  if str and str ~= ”” then
    str = protecttexcontents(str)
    if what == 1 then
      if not str:find(”\\documentclass”..name_e) and
         not str:find(”\\begin%s*{document}”) and
         not str:find(”\\documentstyle”..name_e) and
         not str:find(”\\usepackage”..name_e) then
        if luamplib.legacy_verbatimtex then
          if luamplib.in_the_fig then
            return process_verbatimtex_infig(str)
          else
            return process_verbatimtex_prefig(str)
          end
        else
          return process_verbatimtex_text(str)
        end
      end
    else
      return process_tex_text(str)
    end
  end
  return ””
end

```

Our MetaPost preambles

```
local mplibcodepreamble = [[
texscriptmode := 2;
def rawtextext (expr t) = runscript(”luamplibtext{”&t&”}”) enddef;
def mplibcolor (expr t) = runscript(”luamplibcolor{”&t&”}”) enddef;
def mplibdimen (expr t) = runscript(”luamplibdimen{”&t&”}”) enddef;
def VerbatimTeX (expr t) = runscript(”luamplibverbtex{”&t&”}”) 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;
  def colordecimals primary c =
    if cmykcolor c:
      decimal cyanpart c & ”:” & decimal magentapart c & ”:” & decimal yellowpart c & ”:” & decimal blackpart c
    elseif rgbcolor c:
      decimal redpart c & ”:” & decimal greenpart c & ”:” & decimal bluepart c
    elseif string c:
      colordecimals resolvedcolor(c)
    else:
      decimal c
    fi
  enddef;
  def resolvedcolor(expr s) =
    runscript("return luamplib.shadecolor('"& s &"')")
  enddef;
else:
  vardef textext@# (text t) = rawtextext (t) enddef;
fi
def externalfigure primary filename =
  draw rawtextext("\includegraphics{"& filename &"}")
enddef;
def TEX = textext enddef;
def mplibgraphictext primary t =
  begingroup;
  mplibgraphictext_ (t)
enddef;
def mplibgraphictext_ (expr t) text rest =
  save fakebold, scale, fillcolor, drawcolor, withfillcolor, withdrawcolor,
    fb, sc, fc, dc, fn, dn, tpic;
  picture tpic; tpic := nullpicture;
  numeric fb, sc; string fc, dc, fn, dn;
  fb:=2; sc:=1; fc:="white"; dc:="black"; fn:=dn:="n";
  def fakebold  primary c = hide(fb:=c;) enddef;
  def scale     primary c = hide(sc:=c;) enddef;
  def fillcolor primary c = hide(
    if string c:
      runscript("return luamplib.outlinecolor('"& c &"','fill')")
    else:
      fn:="nn"; fc:=mpliboutlinecolor_(c);
    fi
    ) enddef;
  def drawcolor primary c = hide(
    if string c:
      runscript("return luamplib.outlinecolor('"& c &"','draw')")
    else:
      dn:="nn"; dc:=mpliboutlinecolor_(c);
    fi
  ) enddef;
  let withfillcolor = fillcolor; let withdrawcolor = drawcolor;
  addto tpic doublepath origin rest; tpic:=nullpicture;
  def fakebold  primary c = enddef;
  def scale     primary c = enddef;
  def fillcolor primary c = enddef;
  def drawcolor primary c = enddef;
  let withfillcolor = fillcolor; let withdrawcolor = drawcolor;
  image(draw rawtextext(
  "{\addfontfeature{FakeBold="& decimal fb &",Scale="& decimal sc &
  "}\csname color_fill:"& fn &"\endcsname{"& fc &
  "}\csname color_stroke:"& dn &"\endcsname{"& dc &
  "}"& t &"}") rest;)
  endgroup;
enddef;
def mpliboutlinecolor_ (expr c) =
  if color c:
    "rgb}{" & decimal redpart c & "," & decimal greenpart c
      & "," & decimal bluepart c
  elseif cmykcolor c:
    "cmyk}{" & decimal cyanpart c & "," & decimal magentapart c
      & "," & decimal yellowpart c & "," & decimal blackpart c
  else:
    "gray}{" & decimal c
  fi
enddef;
]]
luamplib.mplibcodepreamble = mplibcodepreamble

local legacyverbatimtexpreamble = [[
def specialVerbatimTeX (text t) = runscript("luamplibprefig{"&t&"}") enddef;
def normalVerbatimTeX  (text t) = runscript("luamplibinfig{"&t&"}") enddef;
let VerbatimTeX = specialVerbatimTeX;
extra_beginfig := extra_beginfig & " let VerbatimTeX = normalVerbatimTeX;"&
  "runscript(" &ditto& "luamplib.in_the_fig=true" &ditto& ");";
extra_endfig := extra_endfig & " let VerbatimTeX = specialVerbatimTeX;"&
  "runscript(" &ditto&
  "if luamplib.in_the_fig then luamplib.figid=luamplib.figid+1 end "&
  "luamplib.in_the_fig=false" &ditto& ");";
]]
luamplib.legacyverbatimtexpreamble = legacyverbatimtexpreamble

local textextlabelpreamble = [[
primarydef s infont f = rawtextext(s) enddef;
def fontsize expr f =
  begingroup
  save size; numeric size;
  size := mplibdimen("1em");
  if size = 0: 10pt else: size fi
  endgroup
enddef;
]]
luamplib.textextlabelpreamble = textextlabelpreamble

```

When `\mplibverbatim` is enabled, do not expand `mplibcode` data.

```
luamplib.verbatiminput = false

```

Do not expand `btex ... etex`, `verbatimtex ... etex`, and string expressions.

```
local function protect_expansion (str)
  if str then
    str = str:gsub("\\","!!!Control!!!")
             :gsub("%%","!!!Comment!!!")
             :gsub("#", "!!!HashSign!!!")
             :gsub("{", "!!!LBrace!!!")
             :gsub("}", "!!!RBrace!!!")
    return format("\\unexpanded{%s}",str)
  end
end

local function unprotect_expansion (str)
```

```
  if str then
    return str:gsub("!!!Control!!!", "\\")
              :gsub("!!!Comment!!!", "%%")
              :gsub("!!!HashSign!!!","#")
              :gsub("!!!LBrace!!!",  "{")
              :gsub("!!!RBrace!!!",  "}")
  end
end

luamplib.everymplib    = { [""] = "" }
luamplib.everyendmplib = { [""] = "" }

local function process_mplibcode (data, instance)
  instancename = instance
  texboxes.locals, texboxes.localid = {}, 4096

```

This is needed for legacy behavior regarding verbatimtex

```
  legacy_mplibcode_reset()

  local everymplib    = luamplib.everymplib[instancename] or
                        luamplib.everymplib[""]
  local everyendmplib = luamplib.everyendmplib[instancename] or
                        luamplib.everyendmplib[""]
  data = format("\n%s\n%s\n%s\n",everymplib, data, everyendmplib)
  :gsub("\r","\n")

```

These five lines are needed for mplibverbatim mode.

```
  if luamplib.verbatiminput then
    data = data:gsub("\\mpcolor%s+(.-%b{})","mplibcolor(\"%1\")")
    :gsub("\\mpdim%s+(%b{})", "mplibdimen(\"%1\")")
    :gsub("\\mpdim%s+(\\%a+)","mplibdimen(\"%1\")")
    :gsub(btex_etex, "btex %1 etex ")
    :gsub(verbatimtex_etex, "verbatimtex %1 etex;")
```

If not mplibverbatim, expand mplibcode data, so that users can use TEX codes in it. It has turned out that no comment sign is allowed.

```
  else
    data = data:gsub(btex_etex, function(str)
      return format("btex %s etex ", protect_expansion(str)) -- space
    end)
    :gsub(verbatimtex_etex, function(str)
      return format("verbatimtex %s etex;", protect_expansion(str)) -- semicolon
    end)
    :gsub("\".-\"", protect_expansion)
    :gsub("\\%%", "\0PerCent\0")
    :gsub("%%.-\n","\n")
    :gsub("%zPerCent%z", "\\%%")
    run_tex_code(format("\\mplibtmptoks\\expandafter{\\expanded{%s}}",data))
    data = texgettoks"mplibtmptoks"
```

Next line to address issue #55

```
    :gsub("##", "#")
    :gsub("\".-\"", unprotect_expansion)
    :gsub(btex_etex, function(str)
      return format("btex %s etex", unprotect_expansion(str))
    end)
    :gsub(verbatimtex_etex, function(str)
      return format("verbatimtex %s etex", unprotect_expansion(str))
    end)
   end

  process(data)
 end
luamplib.process_mplibcode = process_mplibcode

```

For parsing prescript materials.

```
local further_split_keys = {
 mplibtexboxid = true,
 sh_color_a    = true,
 sh_color_b    = true,
}
local function script2table(s)
 local t = {}
 for _,i in ipairs(s:explode("\13+")) do
  local k,v = i:match("(.-)=(.*)") -- v may contain = or empty.
  if k and v and k ~= "" and not t[k] then
   if further_split_keys[k] or further_split_keys[k:sub(1,10)] then
    t[k] = v:explode(":")
   else
    t[k] = v
   end
  end
 end
 return t
end

```

Codes below for inserting PDF lieterals are mostly from ConTeXt general, with small changes when needed.

```
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 figcontents = { post = { } }
local function put2output(a,...)
 figcontents[#figcontents+1] = type(a) == "string" and format(a,...) or a
end

local function pdf_startfigure(n,llx,lly,urx,ury)
 put2output("\\mplibstarttoPDF{%f}{%f}{%f}{%f}",llx,lly,urx,ury)
end

```

```
local function pdf_stopfigure()
  put2output(”\\mplibstoptoPDF”)
end

```

tex.sprint with catcode regime -2, as sometimes # gets doubled in the argument of pdfliteral.

```
local function pdf_literalcode (fmt,...)
  put2output{-2, format(fmt,...)}
end

local function pdf_textfigure(font,size,text,width,height,depth)
  text = text:gsub(”.”,function(c)
    return format(”\\hbox{\\char%i}”,string.byte(c)) -- kerning happens in metapost : false
  end)
  put2output(”\\mplibtextext{%s}{%f}{%s}{%s}{%s}”,font,size,text,0,0)
end

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) <= bend_tolerance t
    d = pth.left_y - ith.right_y
    if abs(ith.right_y - ith.y_coord - d) <= bend_tolerance and abs(pth.y_coord - pth.left_y - d) <= bend_tolerance
      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_coord,pth.y_coord)
    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_coord,one.y_coord )
    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
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_coord))
    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_coord))
    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
end

local function start_pdf_code()
  if pdfmode then
    pdf_literalcode("q")
  else
    put2output"\\special{pdf:bcontent}"
  end
end
```

```
local function stop_pdf_code()
  if pdfmode then
    pdf_literalcode("Q")
  else
    put2output"\\special{pdf:econtent}"
  end
end

```

Now we process hboxes created from btex ... etex or textext(...) or TEX(...), all being the same internally.

```
local function put_tex_boxes (object,prescript)
  local box = prescript.mplibtexboxid
  local n,tw,th = box[1],tonumber(box[2]),tonumber(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, rx, ry, sy = 1, 0, 0, 1
    if tw ~= 0 then
      sx = (second.x_coord - tx)/tw
      rx = (second.y_coord - ty)/tw
      if sx == 0 then sx = 0.00001 end
    end
    if th ~= 0 then
      sy = (fourth.y_coord - ty)/th
      ry = (fourth.x_coord - tx)/th
      if sy == 0 then sy = 0.00001 end
    end
    start_pdf_code()
    pdf_literalcode("%f %f %f %f %f %f cm",sx,rx,ry,sy,tx,ty)
    put2output("\\mplibputtextbox{%i}",n)
    stop_pdf_code()
  end
end

```

Colors and Transparency

```
local pdfmanagement = is_defined'pdfmanagement_add:nnn'
local pdfobjs, pdfetcs = {}, {}
pdfetcs.pgfextgs = "pgf@sys@addpdfresource@extgs@plain"

if pdfmode then
  pdfetcs.getpageres = pdf.getpageresources or function() return pdf.pageresources end
  pdfetcs.setpageres = pdf.setpageresources or function(s) pdf.pageresources = s end
else
  texsprint("\\special{pdf:obj @MPlibTr<<>>}","\\special{pdf:obj @MPlibSh<<>>}")
end

local function update_pdfobjs (os)
  local on = pdfobjs[os]
  if on then
    return on,false
  end
  if pdfmode then
```

```
    on = pdf.immediateobj(os)
  else
    on = pdfetcs.cnt or 1
    texsprint(format("\\special{pdf:obj @mplibpdfobj%s %s}",on,os))
    pdfetcs.cnt = on + 1
  end
  pdfobjs[os] = on
  return on,true
end

```

transparency

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

local function opacity_initialize ()
  pdfetcs.opacity_res = {}
  if pdfmode and luatexbase.callbacktypes.finish_pdffile then -- ltluatex
    local extgstate_obj = pdf.reserveobj()
    pdfetcs.setpageres(format("%s/ExtGState %i 0 R",pdfetcs.getpageres() or "",extgstate_obj))
    luatexbase.add_to_callback("finish_pdffile", function()
      pdf.immediateobj(extgstate_obj, format("<<%s>>",tableconcat(pdfetcs.opacity_res)))
    end, "luamplib.opacity.finish_pdffile")
  end
end

local function update_tr_res(mode,opaq)
  if pdfetcs.pgfloaded == nil then
    pdfetcs.pgfloaded = is_defined(pdfetcs.pgfextgs)
    if not pdfmanagement and not pdfetcs.pgfloaded and not is_defined"TRP@list" then
      opacity_initialize()
    end
  end
  local os = format("<</BM /%s/ca %.3f/CA %.3f/AIS false>>",mode,opaq,opaq)
  local on, new = update_pdfobjs(os)
  if new then
    if pdfmode then
      if pdfmanagement then
        texsprint(ccexplat,{
          [[\pdfmanagement_add:nnn{Page/Resources/ExtGState}]],
          format("{MPlibTr%s}{%s 0 R}", on, on),
        })
      else
        local tr = format("/MPlibTr%s %s 0 R",on,on)
        if pdfetcs.pgfloaded then
          texsprint(format("\\csname %s\\endcsname{%s}", pdfetcs.pgfextgs,tr))
        elseif is_defined"TRP@list" then
          texsprint(catat11,{
            [[\if@filesw\immediate\write\@auxout{]],
            [[\string\g@addto@macro\string\TRP@list{]],
            tr,
            [[}}\fi]],
          })
          if not get_macro"TRP@list":find(tr) then
            texsprint(catat11,[[\global\TRP@reruntrue]])
          end
        else
          if luatexbase.callbacktypes.finish_pdffile then
            pdfetcs.opacity_res[#pdfetcs.opacity_res+1] = tr
          else
            local tpr, n = pdfetcs.getpageres() or "", 0
            tpr, n = tpr:gsub("/ExtGState<<", "%1"..tr)
            if n == 0 then
              tpr = format("%s/ExtGState<<%s>>", tpr, tr)
            end
            pdfetcs.setpageres(tpr)
          end
        end
      end
    else
      if pdfmanagement then
        texsprint(ccexplat,{
          [[\pdfmanagement_add:nnn{Page/Resources/ExtGState}]],
          format("{MPlibTr%s}{@mplibpdfobj%s}", on, on),
        })
      else
        local tr = format("/MPlibTr%s @mplibpdfobj%s",on,on)
        if pdfetcs.pgfloaded then
          texsprint(format("\\csname %s\\endcsname{%s}", pdfetcs.pgfextgs,tr))
        else
          texsprint(format("\\special{pdf:put @MPlibTr<<%s>>}",tr))
          texsprint"\\special{pdf:put @resources<</ExtGState @MPlibTr>>}"
        end
      end
    end
   end
   return on
  end

local function do_preobj_TR(prescript)
  local opaq = prescript and prescript.tr_transparency
  local tron_no, troff_no
  if opaq then
    local mode = prescript.tr_alternative or 1
    mode = transparancy_modes[tonumber(mode)]
    troff_no = update_tr_res("Normal", 1)
    tron_no  = update_tr_res(mode, opaq)
    pdf_literalcode("/MPlibTr%i gs",tron_no)
  end
  return troff_no
end

```

color

```
local prev_override_color
local function do_preobj_CR(object,prescript)
  local override = prescript and prescript.MPlibOverrideColor
  if override then
    if pdfmode then
      pdf_literalcode(override)
      override = nil
    else
      put2output("\\special{%s}",override)
      prev_override_color = override
    end
  else
    local cs = object.color
    if cs and #cs > 0 then
      pdf_literalcode(luamplib.colorconverter(cs))
      prev_override_color = nil
    elseif not pdfmode then
      override = prev_override_color
      if override then
        put2output("\\special{%s}",override)
      end
    end
  end
  return override
end

```

Shading with metafun format.

```
local function shading_initialize ()
  pdfetcs.shading_res = {}
  if pdfmode and luatexbase.callbacktypes.finish_pdffile then -- ltluatex
    local shading_obj = pdf.reserveobj()
    pdfetcs.setpageres(format("%s/Shading %i 0 R",pdfetcs.getpageres() or "",shading_obj))
    luatexbase.add_to_callback("finish_pdffile", function()
      pdf.immediateobj(shading_obj,format("<<%s>>",tableconcat(pdfetcs.shading_res)))
    end, "luamplib.shading.finish_pdffile")
  end
end

local function sh_pdfpageresources(shtype,domain,colorspace,ca,cb,coordinates,steps,fractions)
  if not pdfmanagement and not pdfetcs.shading_res then
    shading_initialize()
  end
  local fun2fmt,os = "<</FunctionType 2/Domain [%s]/C0 [%s]/C1 [%s]/N 1>>"
  if steps > 1 then
    local list,bounds,encode = { },{ },{ }
    for i=1,steps do
      if i < steps then
        bounds[i] = fractions[i] or 1
      end
      encode[2*i-1] = 0
      encode[2*i]   = 1
      os = fun2fmt:format(domain,tableconcat(ca[i],' '),tableconcat(cb[i],' '))
      list[i] = format(pdfmode and "%s 0 R" or "@mplibpdfobj%s",update_pdfobjs(os))
    end
    os = tableconcat {
```

```
    "<</FunctionType 3",
    format("/Bounds [%s]",    tableconcat(bounds,' ')),
    format("/Encode [%s]",    tableconcat(encode,' ')),
    format("/Functions [%s]", tableconcat(list,  ' ')),
    format("/Domain [%s]>>",  domain),
  }
else
  os = fun2fmt:format(domain,tableconcat(ca[1],' '),tableconcat(cb[1],' '))
end
local objref = format(pdfmode and "%s 0 R" or "@mplibpdfobj%s",update_pdfobjs(os))
os = tableconcat {
  format("<</ShadingType %i", shtype),
  format("/ColorSpace %s",    colorspace),
  format("/Function %s",      objref),
  format("/Coords [%s]",      coordinates),
  "/Extend [true true]/AntiAlias true>>",
}
local on, new = update_pdfobjs(os)
if pdfmode then
  if new then
    if pdfmanagement then
      texsprint(ccexplat,{
        [[\pdfmanagement_add:nnn{Page/Resources/Shading}]],
        format("{MPlibSh%s}{%s 0 R}", on, on),
      })
    else
      local res = format("/MPlibSh%s %s 0 R", on, on)
      if luatexbase.callbacktypes.finish_pdffile then
        pdfetcs.shading_res[#pdfetcs.shading_res+1] = res
      else
        local pageres = pdfetcs.getpageres() or ""
        if not pageres:find("/Shading<<.*>>") then
          pageres = pageres.."/Shading<<>>"
        end
        pageres = pageres:gsub("/Shading<<","%1"..res)
        pdfetcs.setpageres(pageres)
      end
    end
  end
else
  if pdfmanagement then
    if new then
      texsprint(ccexplat,{
        [[\pdfmanagement_add:nnn{Page/Resources/Shading}]],
        format("{MPlibSh%s}{@mplibpdfobj%s}", on, on),
      })
    end
  else
    if new then
      texsprint{
        "\\special{pdf:put @MPlibSh",
        format("<</MPlibSh%s @mplibpdfobj%s>>}",on, on),
      }
    end
```

```
      texsprint"\\special{pdf:put @resources<</Shading @MPlibSh>>}"
    end
  end
  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

pdfetcs.clrspcs = { }
local function do_preobj_SH(object,prescript)
  local shade_no
  local sh_type = prescript and prescript.sh_type
  if sh_type then
    local domain  = prescript.sh_domain or "0 1"
    local centera = prescript.sh_center_a or "0 0"; centera = centera:explode()
    local centerb = prescript.sh_center_b or "0 0"; centerb = centerb:explode()
    local transform = prescript.sh_transform == "yes"
    local sx,sy,sr,dx,dy = 1,1,1,0,0
    if transform then
      local first = prescript.sh_first or "0 0"; first = first:explode()
      local setx = prescript.sh_set_x or "0 0";  setx = setx:explode()
      local sety = prescript.sh_set_y or "0 0";  sety = sety:explode()
      local x,y = tonumber(setx[1]) or 0, tonumber(sety[1]) or 0
      if x ~= 0 and y ~= 0 then
        local path = object.path
        local path1x = path[1].x_coord
        local path1y = path[1].y_coord
        local path2x = path[x].x_coord
        local path2y = path[y].y_coord
        local dxa = path2x - path1x
        local dya = path2y - path1y
        local dxb = setx[2] - first[1]
        local dyb = sety[2] - first[2]
        if dxa ~= 0 and dya ~= 0 and dxb ~= 0 and dyb ~= 0 then
          sx = dxa / dxb ; if sx < 0 then sx = - sx end
          sy = dya / dyb ; if sy < 0 then sy = - sy end
          sr = math.sqrt(sx^2 + sy^2)
          dx = path1x - sx*first[1]
          dy = path1y - sy*first[2]
        end
      end
    end
    local ca, cb, colorspace, steps, fractions
    ca = { prescript.sh_color_a_1 or prescript.sh_color_a or {0} }
```

```
cb = { prescript.sh_color_b_1 or prescript.sh_color_b or {1} }
steps = tonumber(prescript.sh_step) or 1
if steps > 1 then
  fractions = { prescript.sh_fraction_1 or 0 }
  for i=2,steps do
    fractions[i] = prescript[format("sh_fraction_%i",i)] or (i/steps)
    ca[i] = prescript[format("sh_color_a_%i",i)] or {0}
    cb[i] = prescript[format("sh_color_b_%i",i)] or {1}
  end
end
if prescript.mplib_spotcolor then
  ca, cb = { }, { }
  local names, pos, objref = { }, -1, ""
  local script = object.prescript:explode"\13+"
  for i=#script,1,-1 do
    if script[i]:find"mplib_spotcolor" then
      local name, value
      objref, name = script[i]:match"=(.-):(.+)"
      value = script[i+1]:match"=(.+)"
      if not names[name] then
        pos = pos+1
        names[name] = pos
        names[#names+1] = name
      end
      local t = { }
      for j=1,names[name] do t[#t+1] = 0 end
      t[#t+1] = value
      table.insert(#ca == #cb and ca or cb, t)
    end
  end
  for _,t in ipairs{ca,cb} do
    for _,tt in ipairs(t) do
      for i=1,#names-#tt do tt[#tt+1] = 0 end
    end
  end
  if #names == 1 then
    colorspace = objref
  else
    local name = tableconcat(names,"-")
    local obj = pdfetcs.clrspcs[name]
    if obj then
      colorspace = obj
    else
      run_tex_code({
        [[\color_model_new:nnn]],
        format("{mplibcolorspace_%s}", name),
        format("{DeviceN}{names={%s}}", tableconcat(names,",")),
        [[\edef\mplib_@tempa{\pdf_object_ref_last:}]],
      }, ccexplat)
      colorspace = get_macro'mplib_@tempa'
      pdfetcs.clrspcs[name] = colorspace
    end
  end
else
```

```
      local model = 0
      for _,t in ipairs{ca,cb} do
        for _,tt in ipairs(t) do
          model = model > #tt and model or #tt
        end
      end
      for _,t in ipairs{ca,cb} do
        for _,tt in ipairs(t) do
          if #tt < model then
            color_normalize(model == 4 and {1,1,1,1} or {1,1,1},tt)
          end
        end
      end
      colorspace = model == 4 and "/DeviceCMYK"
                or model == 3 and "/DeviceRGB"
                or model == 1 and "/DeviceGray"
                or err"unknown color model"
    end
    if sh_type == "linear" then
      local coordinates = format("%f %f %f %f",
        dx + sx*centera[1], dy + sy*centera[2],
        dx + sx*centerb[1], dy + sy*centerb[2])
      shade_no = sh_pdfpageresources(2,domain,colorspace,ca,cb,coordinates,steps,fractions)
    elseif sh_type == "circular" then
      local factor = prescript.sh_factor or 1
      local radiusa = factor * prescript.sh_radius_a
      local radiusb = factor * prescript.sh_radius_b
      local coordinates = format("%f %f %f %f %f %f",
        dx + sx*centera[1], dy + sy*centera[2], sr*radiusa,
        dx + sx*centerb[1], dy + sy*centerb[2], sr*radiusb)
      shade_no = sh_pdfpageresources(3,domain,colorspace,ca,cb,coordinates,steps,fractions)
    else
      err"unknown shading type"
    end
    pdf_literalcode("q /Pattern cs")
  end
  return shade_no
end

```

color stuffs at the end of object

```
local function do_postobj_color(tr,over,sh)
  if sh then
    pdf_literalcode("W n /MPlibSh%s sh Q",sh)
  end
  if over then
    put2output"\\special{pdf:ec}"
  end
  if tr then
    pdf_literalcode("/MPlibTr%i gs",tr)
  end
end

```

Finally, flush figures by inserting PDF literals.

```
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(figure:filename():match("([%d]+)$") or figure: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 unpack
        if urx < llx then
```

luamplib silently ignores this invalid figure for those that do not contain beginfig ... endfig. (issue #70) Original code of ConTeXt general was:

```
-- invalid
pdf_startfigure(fignum,0,0,0,0)
pdf_stopfigure()
```

```
        else
```

For collecting pdf materials and for legacy behavior. Insert 'pre-fig' TEX code here, and prepare a table for 'in-fig' codes.

```
          if tex_code_pre_mplib[f] then
            put2output(tex_code_pre_mplib[f])
          end
          pdf_startfigure(fignum,llx,lly,urx,ury)
          start_pdf_code()
          if objects then
            local savedpath = nil
            local savedhtap = nil
            for o=1,#objects do
              local object        = objects[o]
              local objecttype    = object.type
```

The following 7 lines are part of 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 = do_preobj_TR(prescript)
              local cr_over = do_preobj_CR(object,prescript)
              local shade_no = do_preobj_SH(object,prescript)
              if prescript and prescript.mplibtexboxid then
                put_tex_boxes(object,prescript)
              elseif objecttype == "start_bounds" or objecttype == "stop_bounds" then --skip
              elseif objecttype == "start_clip" then
                local evenodd = not object.istext and object.postscript == "evenodd"
                start_pdf_code()
                flushnormalpath(object.path,false)
                pdf_literalcode(evenodd and "W* n" or "W n")
              elseif objecttype == "stop_clip" then
                stop_pdf_code()
                miterlimit, linecap, linejoin, dashed = -1, -1, -1, false
```

```
        elseif objecttype == "special" then
```

Collect TEX codes that will be executed after flushing. Legacy behavior.

```
          if prescript and prescript.postmplibverbtex then
            figcontents.post[#figcontents.post+1] = prescript.postmplibverbtex
          end
        elseif objecttype == "text" then
          local ot = object.transform -- 3,4,5,6,1,2
          start_pdf_code()
          pdf_literalcode("%f %f %f %f %f %f cm",ot[3],ot[4],ot[5],ot[6],ot[1],ot[2])
          pdf_textfigure(object.font,object.dsize,object.text,object.width,object.height,object.depth)
          stop_pdf_code()
        else
          local evenodd, collect, both = false, false, false
          local postscript = object.postscript
          if not object.istext then
            if postscript == "evenodd" then
              evenodd = true
            elseif postscript == "collect" then
              collect = true
            elseif postscript == "both" then
              both = true
            elseif postscript == "eoboth" then
              evenodd = true
              both    = true
            end
          end
          if collect then
            if not savedpath then
              savedpath = { object.path or false }
              savedhtap = { object.htap or false }
            else
              savedpath[#savedpath+1] = object.path or false
              savedhtap[#savedhtap+1] = object.htap or false
            end
          else
            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] %f d",tableconcat(dl.dashes or {}," "),dl.offset)
              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
              start_pdf_code()
            end
            if path then
              if savedpath then
                for i=1,#savedpath do
                  local path = savedpath[i]
                  if transformed then
                    flushconcatpath(path,open)
                  else
                    flushnormalpath(path,open)
                  end
                end
                savedpath = nil
              end
              if transformed then
                flushconcatpath(path,open)
              else
                flushnormalpath(path,open)
              end
```

Change from ConTeXt general: there was color stuffs.

```
          if not shade_no then -- conflict with shading
            if objecttype == "fill" then
              pdf_literalcode(evenodd and "h f*" or "h f")
            elseif objecttype == "outline" then
              if both then
                pdf_literalcode(evenodd and "h B*" or "h B")
              else
                pdf_literalcode(open and "S" or "h S")
              end
            elseif objecttype == "both" then
              pdf_literalcode(evenodd and "h B*" or "h B")
```

```
                end
              end
            end
            if transformed then
              stop_pdf_code()
            end
            local path = object.htap
            if path then
              if transformed then
                start_pdf_code()
              end
              if savedhtap then
                for i=1,#savedhtap do
                  local path = savedhtap[i]
                  if transformed then
                    flushconcatpath(path,open)
                  else
                    flushnormalpath(path,open)
                  end
                end
                savedhtap = nil
                evenodd   = true
              end
              if transformed then
                flushconcatpath(path,open)
              else
                flushnormalpath(path,open)
              end
              if objecttype == ”fill” then
                pdf_literalcode(evenodd and ”h f*” or ”h f”)
              elseif objecttype == ”outline” then
                pdf_literalcode(open and ”S” or ”h S”)
              elseif objecttype == ”both” then
                pdf_literalcode(evenodd and ”h B*” or ”h B”)
              end
              if transformed then
                stop_pdf_code()
              end
            end
          end
        end
```

Added to ConTeXt general: color stuff. And execute legacy verbatimtex code.

```
        do_postobj_color(tr_opaq,cr_over,shade_no)
      end
    end
    stop_pdf_code()
    pdf_stopfigure()
    for _,v in ipairs(figcontents) do
      if type(v) == ”table” then
        texsprint”\\mplibtoPDF{”; texsprint(v[1], v[2]); texsprint”}”
      else
        texsprint(v)
      end
    end
```

```
        if #figcontents.post > 0 then texsprint(figcontents.post) end
        figcontents = { post = { } }
      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("%.3f %.3f %.3f %.3f k %.3f %.3f %.3f %.3f 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("%.3f %.3f %.3f rg %.3f %.3f %.3f RG",r,g,b,r,g,b), "0 g 0 G"
 else
   local s = cr[1]
   return format("%.3f g %.3f G",s,s), "0 g 0 G"
 end
end
luamplib.colorconverter = colorconverter
```

2.2 TEX package

First we need to load some packages.

```
\bgroup\expandafter\expandafter\expandafter\egroup
\expandafter\ifx\csname selectfont\endcsname\relax
 \input ltluatex
\else
 \NeedsTeXFormat{LaTeX2e}
 \ProvidesPackage{luamplib}
   [2024/04/25 v2.28.2 mplib package for LuaTeX]
 \ifx\newluafunction\@undefined
 \input ltluatex
 \fi
\fi
```

Loading of lua code.

```
\directlua{require("luamplib")}
```

legacy commands. Seems we don't need it, but no harm.

```
\ifx\pdfoutput\undefined
 \let\pdfoutput\outputmode
\fi
\ifx\pdfliteral\undefined
 \protected\def\pdfliteral{\pdfextension literal}
\fi
```

Set the format for metapost.

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

luamplib works in both PDF and DVI mode, but only DVIPDFMx is supported currently among a number of DVI tools. So we output a info.

```
\ifnum\pdfoutput>0
  \let\mplibtoPDF\pdfliteral
\else
  \def\mplibtoPDF#1{\special{pdf:literal direct #1}}
  \ifcsname PackageInfo\endcsname
    \PackageInfo{luamplib}{only dvipdfmx is supported currently}
  \else
    \write128{luamplib Info: only dvipdfmx is supported currently}
  \fi
\fi
```

Make mplibcode typesetted always in horizontal mode.

```
\def\mplibforcehmode{\let\prependtomplibbox\leavevmode}
\def\mplibnoforcehmode{\let\prependtomplibbox\relax}
\mplibnoforcehmode
```

Catcode. We want to allow comment sign in mplibcode.

```
\def\mplibsetupcatcodes{%
  %catcode`\{=12 %catcode`\}=12
  \catcode`\#=12 \catcode`\^=12 \catcode`\~=12 \catcode`\_=12
  \catcode`\&=12 \catcode`\$=12 \catcode`\%=12 \catcode`\^^M=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.

```
\unless\ifcsname ver@luamplib.sty\endcsname
\def\mplibcode{%
  \begingroup
  \begingroup
  \mplibsetupcatcodes
  \mplibdocode
}
\long\def\mplibdocode#1\endmplibcode{%
  \endgroup
  \directlua{luamplib.process_mplibcode([===[\unexpanded{#1}]===],"")}%
  \endgroup
}
\else
```

The LaTeX-specific part: a new environment.

```
\newenvironment{mplibcode}[1][]{%
  \global\def\currentmpinstancename{#1}%
  \mplibtmptoks{}\ltxdomplibcode
}{}
\def\ltxdomplibcode{%
  \begingroup
  \mplibsetupcatcodes
  \ltxdomplibcodeindeed
}
\def\mplib@mplibcode{mplibcode}
\long\def\ltxdomplibcodeindeed#1\end#2{%
  \endgroup
  \mplibtmptoks\expandafter{\the\mplibtmptoks#1}%
  \def\mplibtemp@a{#2}%
  \ifx\mplib@mplibcode\mplibtemp@a
    \directlua{luamplib.process_mplibcode([===[\the\mplibtmptoks]===],"\currentmpinstancename")}%
    \end{mplibcode}%
  \else
    \mplibtmptoks\expandafter{\the\mplibtmptoks\end{#2}}%
    \expandafter\ltxdomplibcode
  \fi
}
\fi
```

User settings.

```
\def\mplibshowlog#1{\directlua{
    local s = string.lower("#1")
    if s == "enable" or s == "true" or s == "yes" then
      luamplib.showlog = true
    else
      luamplib.showlog = false
    end
}}
\def\mpliblegacybehavior#1{\directlua{
    local s = string.lower("#1")
    if s == "enable" or s == "true" or s == "yes" then
      luamplib.legacy_verbatimtex = true
    else
      luamplib.legacy_verbatimtex = false
    end
}}
\def\mplibverbatim#1{\directlua{
    local s = string.lower("#1")
    if s == "enable" or s == "true" or s == "yes" then
      luamplib.verbatiminput = true
    else
      luamplib.verbatiminput = false
    end
}}
\newtoks\mplibtmptoks
```

`\everymplib` & `\everyendmplib`: macros resetting `luamplib.every(end)mplib` tables

```
\protected\def\everymplib{%
  \begingroup
  \mplibsetupcatcodes
  \mplibdoeverymplib
}
\protected\def\everyendmplib{%
  \begingroup
  \mplibsetupcatcodes
  \mplibdoeveryendmplib
}
\ifcsname ver@luamplib.sty\endcsname
  \newcommand\mplibdoeverymplib[2][]{%
    \endgroup
    \directlua{
      luamplib.everymplib["#1"] = [===[\unexpanded{#2}]===]
    }%
  }
  \newcommand\mplibdoeveryendmplib[2][]{%
    \endgroup
    \directlua{
      luamplib.everyendmplib["#1"] = [===[\unexpanded{#2}]===]
    }%
  }
\else
  \long\def\mplibdoeverymplib#1{%
    \endgroup
    \directlua{
      luamplib.everymplib[""] = [===[\unexpanded{#1}]===]
    }%
  }
  \long\def\mplibdoeveryendmplib#1{%
    \endgroup
    \directlua{
      luamplib.everyendmplib[""] = [===[\unexpanded{#1}]===]
    }%
  }
\fi
```

Allow TEX dimen/color macros. Now `runscript` does the job, so the following lines are not needed for most cases. But the macros will be expanded when they are used in another macro.

```
\def\mpdim#1{ runscript("luamplibdimen{#1}") }
\def\mpcolor#1#{\domplibcolor{#1}}
\def\domplibcolor#1#2{ runscript("luamplibcolor{#1{#2}}") }
```

MPLib's number system. Now `binary` has gone away.

```
\def\mplibnumbersystem#1{\directlua{
  local t = "#1"
  if t == "binary" then t = "decimal" end
  luamplib.numbersystem = t
}}
```

Settings for `.mp` cache files.

```
\def\mplibmakenocache#1{\mplibdomakenocache #1,*,}
\def\mplibdomakenocache#1,{%
  \ifx\empty#1\empty
    \expandafter\mplibdomakenocache
  \else
    \ifx*#1\else
      \directlua{luamplib.noneedtoreplace["#1.mp"]=true}%
      \expandafter\expandafter\expandafter\mplibdomakenocache
    \fi
  \fi
}
\def\mplibcancelnocache#1{\mplibdocancelnocache #1,*,}
\def\mplibdocancelnocache#1,{%
  \ifx\empty#1\empty
    \expandafter\mplibdocancelnocache
  \else
    \ifx*#1\else
      \directlua{luamplib.noneedtoreplace["#1.mp"]=false}%
      \expandafter\expandafter\expandafter\mplibdocancelnocache
    \fi
  \fi
}
\def\mplibcachedir#1{\directlua{luamplib.getcachedir("\unexpanded{#1}")}}
```

More user settings.

```
\def\mplibtextextlabel#1{\directlua{
    local s = string.lower("#1")
    if s == "enable" or s == "true" or s == "yes" then
      luamplib.textextlabel = true
    else
      luamplib.textextlabel = false
    end
}}
\def\mplibcodeinherit#1{\directlua{
    local s = string.lower("#1")
    if s == "enable" or s == "true" or s == "yes" then
      luamplib.codeinherit = true
    else
      luamplib.codeinherit = false
    end
}}
\def\mplibglobaltextext#1{\directlua{
    local s = string.lower("#1")
    if s == "enable" or s == "true" or s == "yes" then
      luamplib.globaltextext = true
    else
      luamplib.globaltextext = false
    end
}}
```

The followings are from ConTeXt general, mostly. We use a dedicated scratchbox.

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

We encapsulate the litterals.

```
\def\mplibstarttoPDF#1#2#3#4{%
  \prependtomplibbox
  \hbox dir TLT\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{%
  \par
  \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
}
```

Input `luamplib.cfg` when it exists.

```
\openin0=luamplib.cfg
\ifeof0 \else
  \closein0
  \input luamplib.cfg
\fi
```

That's all folks!

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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.