

## Graphviz plugins

Plugins provide a means of flexibly extending the graphviz tools: **dot**, **neato**, etc.

The objectives for graphviz plugins are to:

- Support independent compilation so that features can be provided by third-parties.
- Support independent packaging so that features can be installed at the user's discretion, at a later time than the base package.
- Support optional platform-specific functionality without adding complexity or dependencies to the base package (e.g. renderers for a specific windowing system).
- Unbundle some lesser-used functionality from dot into plugins so that the core of dot can be smaller and faster.
- Unbundle some older functionality from dot into plugins so that the facilities are still available, but optionally and not in the core. For example the use of libgd.

Some constraints considered in there design were:

- To minimize any performance penalty from the use of plugins.
- To make the use of plugins transparent to the user and sys admin.
- To permit an option to link plugins statically at build time.
- To permit an option to always load plugins at run-time, not waiting for demand.
- To continue to support the old-style codegens, at least until completely replaced by plugins.

## Terminology

A **plugin** (or **plugin\_type**) provides a facility like a PNG renderer or an Xlib window driver, Each **plugin** implements a **plugin-api**.

A **plugin-api** is the exposed interface between the graphviz core and the **plugin**.

The set of apis is described in *lib/gvc/gvplugin.h* and each api is individually described in, e.g. *lib/gvc/gvplugin\_render.h*. The set of apis currently consists of:

|             |  |
|-------------|--|
| device:     | output devices and file formats, e.g png, svg, gtk                               |
| render:     | drawing engines, e.g. cairo  |
| layout:     | layout engines such as: dot, neato, circo, ...                                   |
| textlayout: | code that estimates the size of a block of text. Uses pango if available.        |
| loadimage:  | code that loads an image in one format and makes it available in another format. |

A **plugin-library** is an arbitrary collection of **plugins**, for one or more **plugin-apis**, that are loaded all together when any one of the contained **plugins** are demanded. The contents of a **plugin-library** are typically determined by other resources that are common to the set of **plugins**. For example, all the code that uses *libgd.so* is in the “gd” plugin.

A **demand-loaded plugin** is one that is not loaded until its need for use on the has been determined from the current usage.

A **builtin-plugin** is one that is available at program start, whether or not it will be needed for the current usage. **Builtin-plugins** can still be in the form of shared libraries, or they can be statically linked

A **statically-linked builtin-plugin** is one that is linked to the binary image at build time, rather than from a shared library at run-time.

## **Mechanism**

The contents of a **plugin-library** are self-describing. The **plugin-libraries** are named like: *libgvplugin\_core.so* where the “core” of the library name matches the name of the single exposed symbol: *gvplugin\_core\_LTX\_library*. This symbol is a pointer to a table of **plugin-apis** supported in this **plugin-library**, and for each **plugin-api** the list of **plugins** for that api. Each **plugin** provides a “quality” value which is used to control the default selection when there are multiple **plugins** of the same type loaded.

At installation time (with the file write privileges of the installer) “**dot -c**” is run to search for and verify loadability of all available **plugin-libraries**, and then to generate */usr/lib/graphviz/config* which records their capabilities. This is a human-readable text file. When **dot** is run by a regular user to process a graph, only this */usr/lib/graphviz/config* file is loaded at first so that the set of available **plugins** and their capabilities is known and the **plugin** can be loaded if needed.

When a **plugin** is demanded, the **plugin-library** containing that **plugin** is loaded in its entirety and all of the **plugins** it provides are recorded as loaded. One plugin may be dependent on another, if so the dependency is loaded as well whenever the dependent is loaded. In particular, device plugins are always dependent on a renderer.

## **Running dot with plugins**

**Dot** attempts to be transparent to the user about its use of **plugins**. By default it will always choose the highest “quality” **plugin** listed in */usr/lib/graphviz/config*.

Sometimes it may be necessary to override the default. This can be done for devices by indicating the specific renderer required: e.g.

-Tpng:cairo

-Tpng:gd

or further qualified by which plugin-library provides the device plugin: e.g.

-Tpng:cairo:cairo

-Tpng:cairo:gd

To allow the user to determine what renderers are available, the user can ask for any invalid plugin and dot will return the set available **plugins**:

```
$ dot -T?
```

```
Format: "?" not recognized. Use one of: bmp canon cmap cmapx cmapx_np dia dot fig gd gd2 gif gtk hpgl  
ico imap imap_np ismap jpe jpeg jpg mif mp pcl pdf pic plain plain-ext png ps ps2 svg svgz swf tga tif tiff  
vml vmlz vrml vtx wbmp xdot xlib
```

Or, if the **plugin-library** is not recognized then dot will return the set of alternatives:

```
$ dot -Tpng:?
```

```
Format: "png:?" not recognized. Use one of: png:cairo:cairo png:cairo:gd png:cairo:gdk_pixbuf png:gd:gd  
png:cairo:devil
```

The order of the alternatives corresponds to their quality ranking, so `-Tpng:cairo:cairo` is the default, i.e. the device and renderer combination used for: `dot -Tpng`

For additional information, **dot -v** will identify all available **plugins** for all **plugin-apis**:

```
$ dot -v
```

The plugin configuration file:

```
/home/ellson/FIX/Linux.x86_64/lib/graphviz/config  
was successfully loaded.
```

```
render      : cairo dot fig gd map ming ps svg vml vrml xdot  
layout      : circo dot fdp neato nop nop1 nop2 twopi  
textlayout  : textlayout  
device      : bmp canon cmap cmapx cmapx_np dia dot fig gd gd2 gif gtk hpgl ico imap  
imap_np ismap jpe jpeg jpg mif mp pcl pdf pic plain plain-ext png ps ps2 svg svgz swf tga tif  
tiff vml vmlz vrml vtx wbmp xdot xlib  
loadimage   : (lib) gd gd2 gif jpe jpeg jpg png ps xbm
```

and, **dot -v2** will identify all available plugin *type:dependency:library* for all **plugin-apis**:

```
$ dot -v2
```

The plugin configuration file:

```
/home/ellson/FIX/Linux.x86_64/lib/graphviz/config  
was successfully loaded.
```

```
render      : cairo:cairo dot:core fig:core gd:gd map:core ming:ming ps:core svg:core vml:core  
vrml:gd xdot:core  
layout      : circo:neato_layout dot:dot_layout fdp:neato_layout neato:neato_layout  
nop:neato_layout nop1:neato_layout nop2:neato_layout twopi:neato_layout  
textlayout  : textlayout:cairo textlayout:gd  
device      : bmp:cairo:gdk_pixbuf bmp:cairo:devil canon:dot:core cmap:map:core cmapx:map:core  
cmapx_np:map:core dia:cg dot:dot:core fig:fig:core gd:cairo:gd gd:gd gd2:cairo:gd gd2:gd:gd  
gif:cairo:gd gif:gd:gd gtk:cairo:gtk hpgl:cg ico:cairo:gdk_pixbuf imap:map:core imap_np:map:core  
ismap:map:core jpe:cairo:gdk_pixbuf jpe:cairo:gd jpe:gd:gd jpe:cairo:devil jpeg:cairo:gdk_pixbuf  
jpeg:cairo:gd jpeg:gd:gd jpeg:cairo:devil jpg:cairo:gdk_pixbuf jpg:cairo:gd jpg:gd:gd jpg:cairo:devil  
mif:cg mp:cg pcl:cg pdf:cairo:cairo pic:cg plain:dot:core plain-ext:dot:core png:cairo:cairo png:cairo:gd  
png:cairo:gdk_pixbuf png:gd:gd png:cairo:devil ps:ps:core ps:cairo:cairo ps2:ps:core svg:svg:core  
svg:cairo:cairo svgz:svg:core swf:ming:ming tga:cairo:devil tif:cairo:gdk_pixbuf tif:cairo:devil  
tiff:cairo:gdk_pixbuf tiff:cairo:devil vml:vml:core vmlz:vml:core vrml:vrml:gd vtx:cg wbmp:cairo:gd
```

wbmp:gd:gd xdot:xdot:core xlib:cairo:xlib

loadimage : (lib):ps:core gd:ps:gd gd:gd:gd gd2:ps:gd gd2:gd:gd gif:ps:gd gif:gd:gd gif:xdot:core  
gif:vrml:core gif:fig:core gif:svg:core jpe:ps:gd jpe:gd:gd jpe:xdot:core jpe:vrml:core jpe:fig:core  
jpe:svg:core jpeg:ps:gd jpeg:gd:gd jpeg:xdot:core jpeg:vrml:core jpeg:fig:core jpeg:svg:core jpg:ps:gd  
jpg:gd:gd jpg:xdot:core jpg:vrml:core jpg:fig:core jpg:svg:core png:ps:cairo png:ps:gd png:gd:gd  
png:xdot:core png:vrml:core png:fig:core png:svg:core png:cairo:cairo ps:ps:core xbm:ps:gd xbm:gd:gd

## Installing plugins

On package managed systems using .rpm or .deb or similar, the details of the installation process are handled automatically.

The key point about plugin-library installation or removal is that the */usr/lib/graphviz/config* file must be kept up to date by using “**dot -c**”.

## Builtins and static linking

A **plugin** is **builtin** if it is linked to the executable at startup.

Dot can be configured and built with an arbitrary combination of **builtin** and **demand loaded plugins**, however **plugins** that are to be **builtin** must be explicitly listed and linked at build time.

This is done by providing a source file like *lib/gvc/dot\_builtins.c* that is linked to the executable, and adding the matching *-lgvplugin\_xxx* to satisfy the symbol reference.

To control whether demand loading is available at all, link with *lib/gvc/demand\_loading.c* or *lib/gvc/no\_demand\_loading.c*

For the common case of maximal use of **demand-loaded plugins** the *libgvc.so* library is already linked with *lib/gvc/demand\_loading.c* and *lib/gvc/dot\_builtins.c*. To provide your own choice of **builtins**, and **demand-loading** use *libgvc\_builtins.so* and your own versions of *builtins.c* and *demand\_loading.c*.

Static linking will link all graphviz libraries, and any **plugins-libraries** that are **builtin**, into a single binary. Note that system libraries are not statically linked to the image.

See *cmd/dot/Makefile.am* for the technique used to build **dot\_static**.

## Writing a plugin

A **plugin\_library** is an implementation of one or more **plugin\_types** for one or more **plugin\_apis**.

Each library has a single public symbol of type: *gvplugin\_library\_t* provided in a file named like: *devil/gvplugin\_devil.c*.

```
gvplugin_library_t gvplugin_devil_LTX_library = { "devil", apis };
```

This symbol is the address of a struct which provides the name of the library and a pointer to the set of `plugin_apis` implemented in the library. The apis are defined in a: static `gvplugin_api_t apis[] = {...}` each element of this array provides an api identifier and a pointer to the set of types of that api implemented in this `plugin_library`.

```
static gvplugin_api_t apis[] = {
    {API_device, &gvdevice_devil_types},
    {(api_t)0, 0},
};
```

Each **plugin\_api** in the **plugin\_library** is typically provided by a separate file like: `devil/gvdevice_devil.c`. This file provides the set of types in an array of `gvplugin_installed_t`. Each element of the array provides: an id for the type, a string “name:dependency”, a quality value, a pointer to an engine implementing the api, and a pointer to a feature table.

```
gvplugin_installed_t gvdevice_devil_types[] = {
    {IL_BMP, "bmp:cairo", -1, &devil_engine, &device_features_devil},
    {IL_JPG, "jpg:cairo", -1, &devil_engine, &device_features_devil},
    {IL_JPG, "jpe:cairo", -1, &devil_engine, &device_features_devil},
    {IL_JPG, "jpeg:cairo", -1, &devil_engine, &device_features_devil},
    {IL_PNG, "png:cairo", -1, &devil_engine, &device_features_devil},
    {IL_TIF, "tif:cairo", -1, &devil_engine, &device_features_devil},
    {IL_TIF, "tiff:cairo", -1, &devil_engine, &device_features_devil},
    {IL_TGA, "tga:cairo", -1, &devil_engine, &device_features_devil},
    {0, NULL, 0, NULL, NULL}
};
```

The engine is a jump table into the functions for the api. Any entry can be NULL if not implemented by the plugin:

```
static gvdevice_engine_t devil_engine = {
    NULL,
    NULL,
    devil_format,
    NULL,
};
```

## **ToDo**

- “file” and “compressed file” output should be implemented as device plugins.
- Implement a mechanism for overriding **plugins** for other **plugin-apis** from the command line.
- Provide a new **plugin-api** and **plugins** for input-parsing – add support for e.g. GXL input.

## **Author**

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