



High resolution display support in Gnome

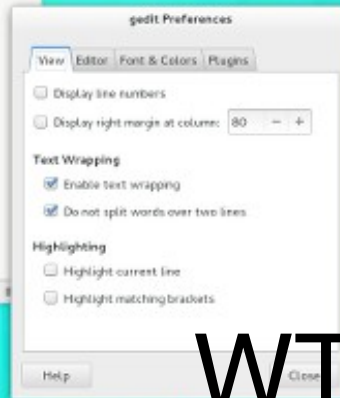
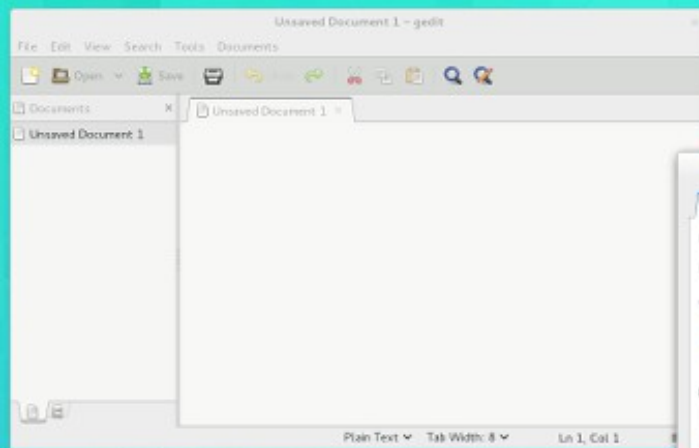
Alexander Larsson <alexl@redhat.com>

Who am I?

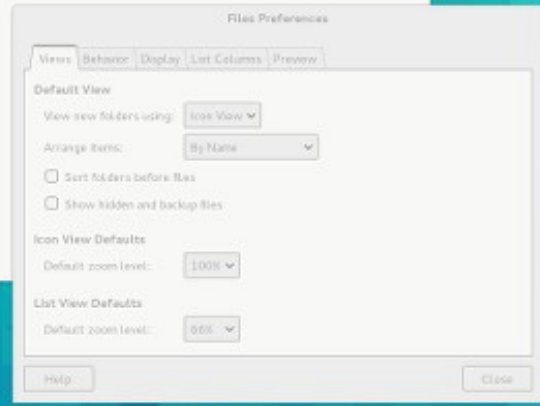
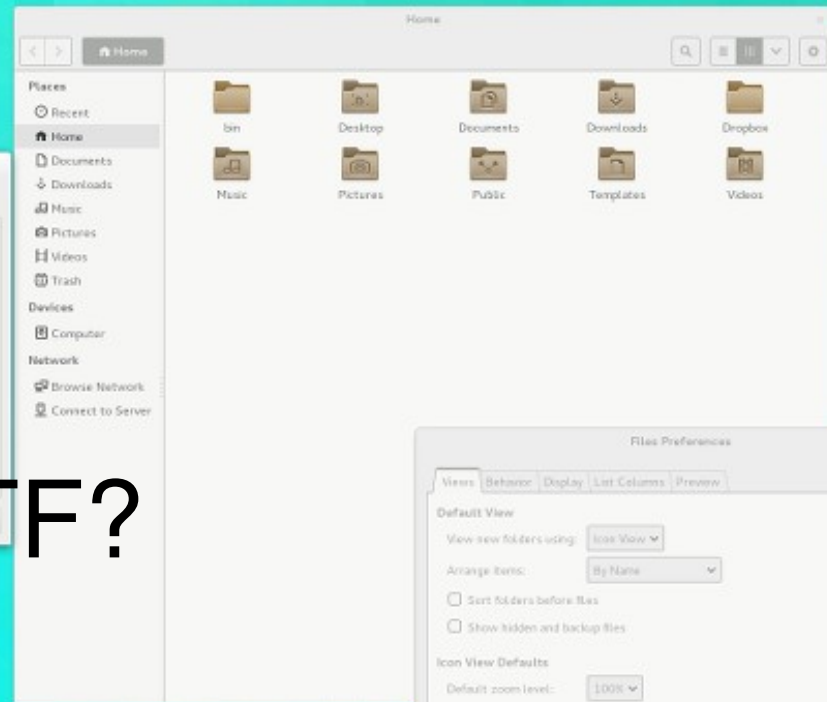


Problem definition

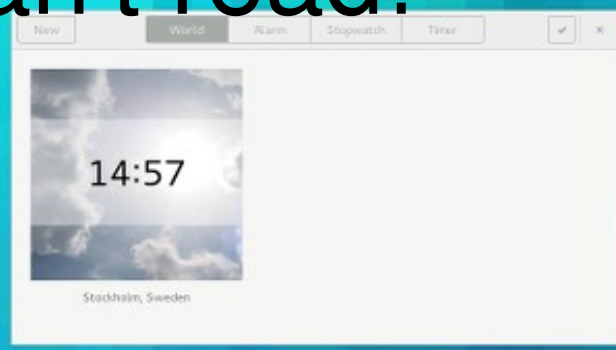
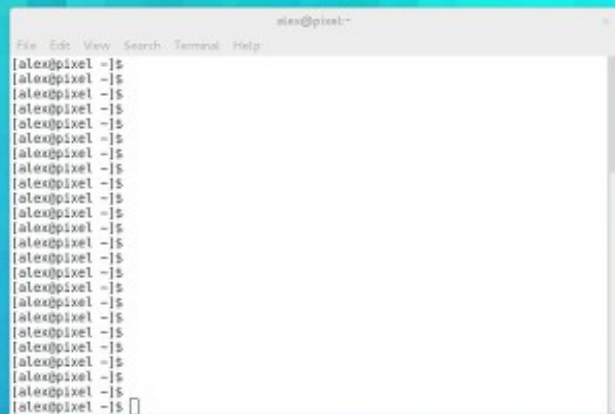




WTF?



I can't read!



Enter: DPI – Dots Per Inch

- Pixels per inch on the output screen
- Historically around 100 DPI for monitors
- Chromebook Pixel has 239 DPI

- Setting in X (Xft.DPI)
- Normally set to 96 by Gnome
- Tweakable via
`org.gnome.desktop.interface.text-scaling-factor`

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Views Behavior Display List Columns Preview

Default View

View new folders using: Icon View

Arrange items: By Name

Sort folders before files

Show hidden and backup files

Icon View Defaults

Default zoom level: 100%

List View Defaults

Default zoom level: 66%

Help Close

gedit Preferences

View Editor Font & Colors Plugins

Display line numbers

Display right margin at column: 80

Text Wrapping

Enable text wrapping

Do not split words over two lines

Highlighting

Highlight current line

Highlight matching brackets

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It only changed the text size!

Why?

Why not scale everything with DPI?

For monitors with “traditional” densities:

- One pixel is “visible”
- Rendering needs to match pixel grid to not look fuzzy
- **Even** when the rendering is “vector” based

Also:

- Lots of content is pixel based
 - Icons
 - Pictures
 - Cursors

Views

Behavior

Display

List Columns

Preview

Choose the order of information to appear in the list view.

Name

Size

Type

Modified

Group

Location

MIME Type

Move Up

Move Down

Use Default

Views

Behavior

Display

List Columns

Pr

Choose the order of information to appear in the view.



Name



Size



Type



Modified



Group

Fuzzy, variable width lines

Scaled pixel sources

Rendered at 120%

Mo

Mov

Use

Why not scale everything with DPI? (*cont*)

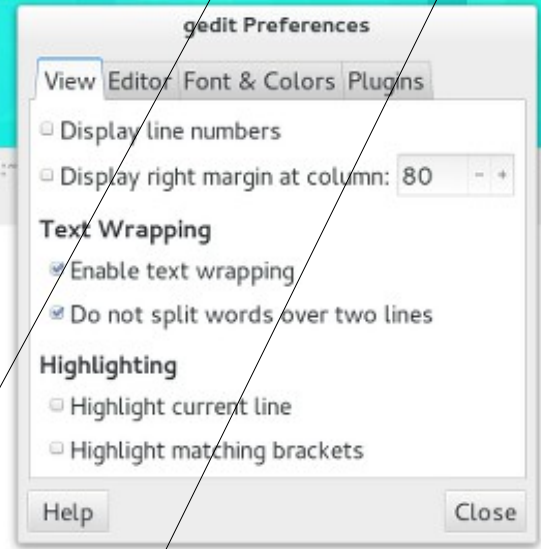
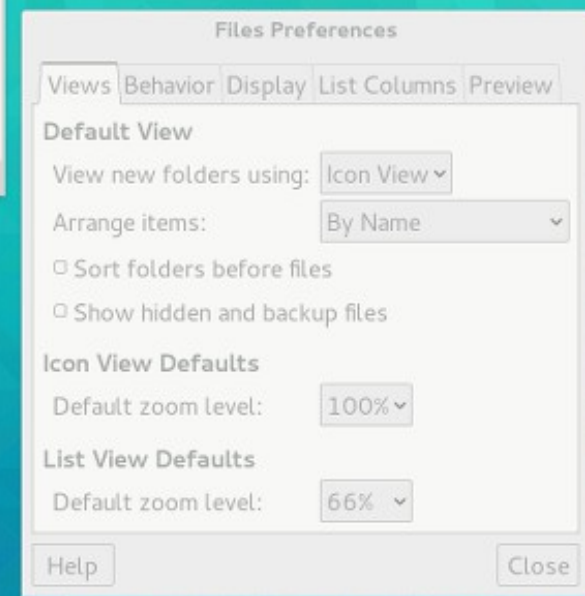
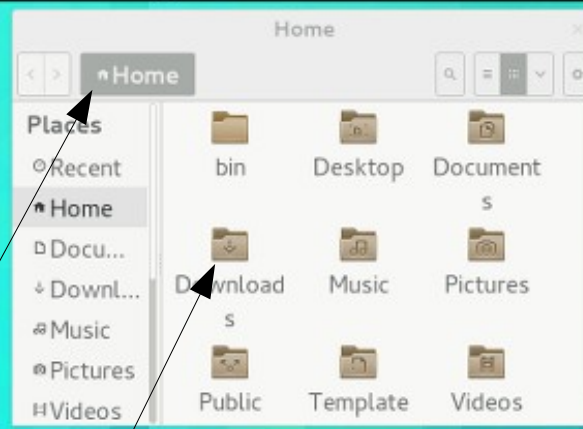
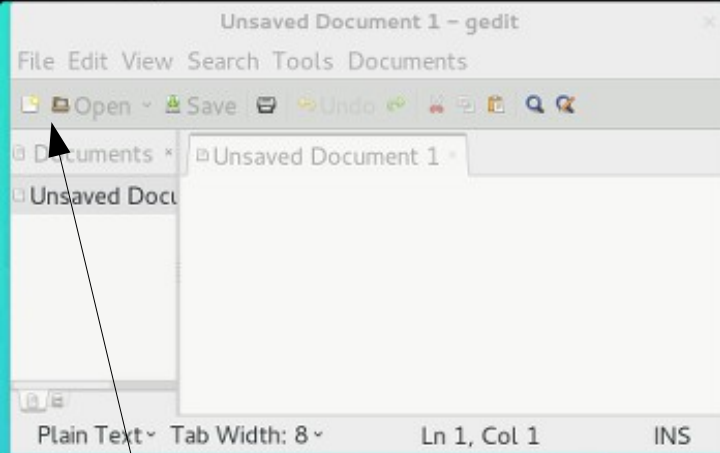
Also, it doesn't really matter in practice:

Height of buttons on screen:

- Laptop screen: 6mm
- 23" external monitor: 8mm

Both work fine.

However, on the Pixel it clearly **doesn't** work



Icons are too small
And don't match text height

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Fixed size widgets are hard to hit

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Images used are small



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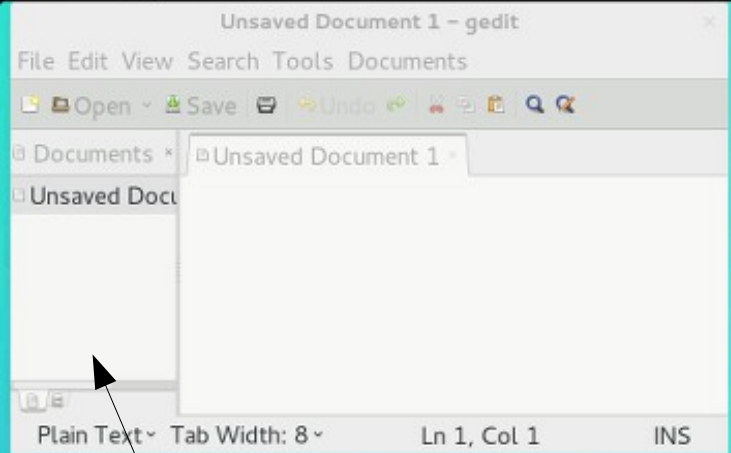
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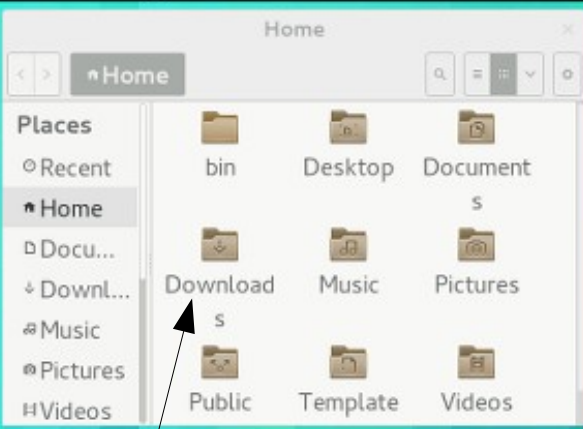
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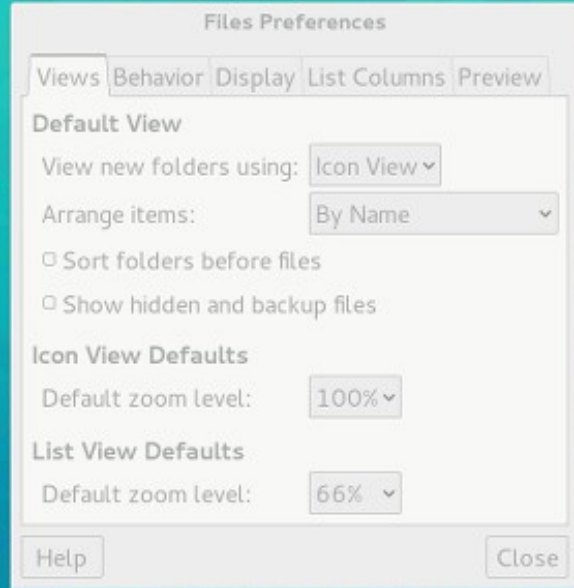
Default window sizes are too small



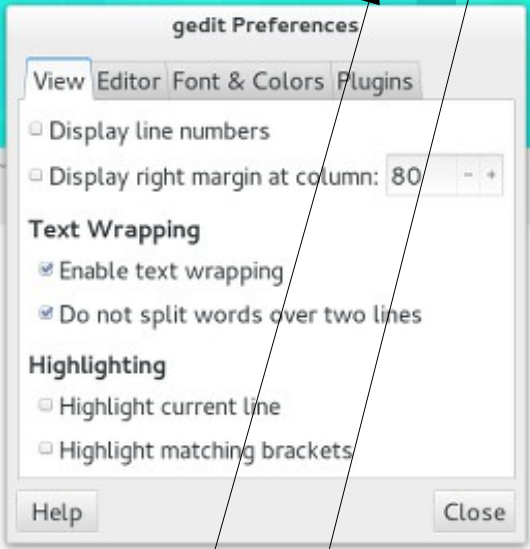
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Widget min/default sizes are wrong

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Mouse pointer is too small
And it moves too slowly

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Hard to resize windows

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Not enough padding
Borders too thin

Summing it up

- Lots of places specify sizes in pixels
- Implicit sizes based on images don't scale
- Don't want to change all existing code
- Don't want to make code more complex

Multiple monitors

- External monitors may have lower DPI
- A window can be visible on multiple monitors

Want a window to have *approximately* the same physical size on all monitors.

Solution:

- Specify sizes in an abstract “pixel” size
- On “traditional” monitors these are the same as monitor pixels
- On “HiDPI” monitors these are scaled to multiple monitor pixels
- Use integer scaling factor to keep pixel grid alignment
- Scaling is applied automatically
- Vector-based drawing renders in higher resolution
- Allow specifying high resolution alternatives for pixel data
 - Icons
 - CSS images

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How does this affect programmers - Cairo

- `cairo_surface_set_device_scale()`
- `cairo_surface_get_device_scale()`
- Automatically applies a scaling factor when rendering
 - Can't unset with e.g. `cairo_identity_matrix()`
- Applies scale factor when using the surface as source
- You don't really have to care, Gtk+ hides this

How does this affect programmers - Gdk

- Window, Screen, Monitor:
 - Sizes reported in abstract pixels
 - Position reported in abstract pixels
- `gdk_window_get_scale_factor()`
 - May change over time
- `gdk_screen_get_monitor_scale_factor()`
 - May change over time
- Mouse position reported in abstract pixels
 - Uses floating point, so has full resolution

How does this affect programmers – Gdk (*cont*)

- `gdk_window_create_similar_surface()`
 - Creates scaled offscreen surfaces if the window is scaled
 - Use this for all kinds of double buffering to avoid pixelized results
 - Recreate double buffers when scale changes
- `gdk_window_create_similar_image_surface()`
 - Allows creation of scaled image surfaces
 - Lets us specify pixel data which will automatically scale correctly when drawn
 - Allows you to specify the target `GdkWindow` ahead of time for more efficient rendering
- `gdk_cairo_surface_create_from_pixbuf()`

How does this affect programmers - Gtk

- Size allocation happens in abstract pixels
- GtkWidget::scale
 - Use property notification to detect changes
- cairo_surface_t is the primary way to specify pixel data
 - gtk_image_[new|set]_from_surface
 - GtkCellRendererPixbuf::surface
 - Automatic scaling wrt the target scale
 - More efficient to render
- GtkIconTheme supports choosing scaled icons
 - Icon theme spec extension for Scale
 - Otherwise picks larger icons
- CSS extension to specify alternative images:
 - -gtk-scaled(url('file.png'),url('file@2.png'))
 - Make sure they have the same size (sans scale)

Implementation – Wayland

- Protocol additions in Wayland 1.2
- Output/Surface positions in abstract pixels
- Compositor chooses the scale for each output
 - Exposed to client by an Output property
- Clients can chose to supply a buffer of a larger scale
- Compositor scales client buffers as needed
- Allows mixed-scale monitor
 - Including windows displaying on multiple monitors
- Gtk+ picks maximum scale of all monitors the window is on
 - Changes when the window moves between monitors
- Uses cairo surface device-scale to implement scaling
- This is the future!

Implementation – X11

- X screens/monitor size/positions are reported scaled down
- XWindows are larger than the corresponding GdkWindows
- Event coordinates are scaled when converting from X
- Only one scale can be used for all monitors
- GDK_SCALE environment variable
 - Useful for testing
- New Xsetting for scale
 - Will be set automatically in Gnome
- New Xsetting for the “unscaled dpi”
 - Normal dpi can be scaled for non-scale-aware apps
- Uses cairo surface device-scale to implement scaling
- Needs care when mixing with native X/GL operations

Implementation – OSX

Limitations

Thank brion

Future plans