Inkscape Interface
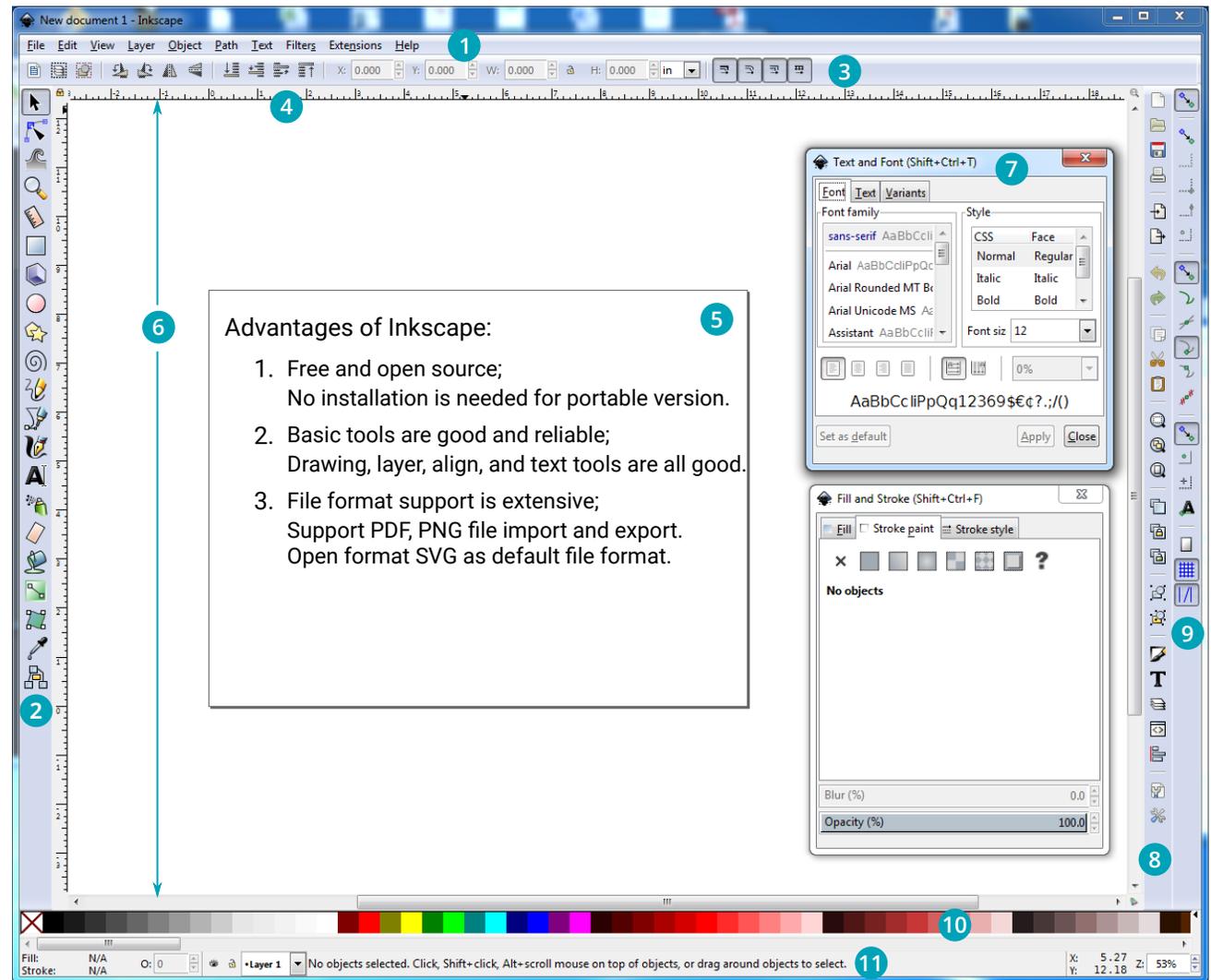
The Windows Inkscape interface looks different from other software tools. Here is a brief discussion of interface items:

1. Menu: 10 top level menu items.

2. Tool Bar: Total 21 tools in version 0.92.2; we only discuss a few of them.

3. Tool Setting: Change with tool selection.

4. Ruler: Drag from ruler to create guides.

5. Page: Where drawings are shown. Only objects or paths inside page will print.

6. Canvas: Put temporary objects outside page.

7. Setting Window: Float (pop-up) style is easy to access (Ctrl + Shift + key).

8. Command Bar: Not very useful.

9. Snap Bar: Shift + % to turn on and off snapping.

10. Color Pallet: You can drag and drop color boxes.

11. Status Bar: Easy access to fill and stroke.

Advantages of Inkscape:

1. Free and open source;
   No installation is needed for portable version.

2. Basic tools are good and reliable;
   Drawing, layer, align, and text tools are all good.

3. File format support is extensive;
   Support PDF, PNG file import and export.
   Open format SVG as default file format.

Inkscape Default Settings

Inkscape has lots of settings that you can customize. However, a few default settings do not work very well in Windows, and it is suggested to change them.

You can access Preferences dialog by menu *Edit > Preferences* (Ctrl + Shift + P).

In the Preference window, make those changes:

- Tools (select) > Bounding box to use
  Geometric bounding box

- Interface > Windows (select) > Dialog behavior (requires restart)
  Floating

- Interface > Windows (select) > Dialog Transparency
 *Opacity when unfocused: 1.0000*

Inkscape Books
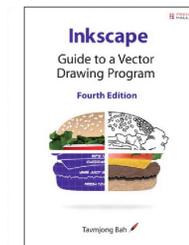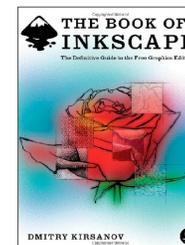
Book of Inkscape
Dmitry Kirsanov
1999 published
472 Pages

Inkscape Guide
Tavmjong Bah
2011 published
504 Pages

Inkscape Navigation

We introduce basic Computer Graphic (CG) drawing concepts such as page size, unit, and dimension and discuss Inkscape navigation on this page.

Menu: File > Document Properties (Ctrl + Shift + D)
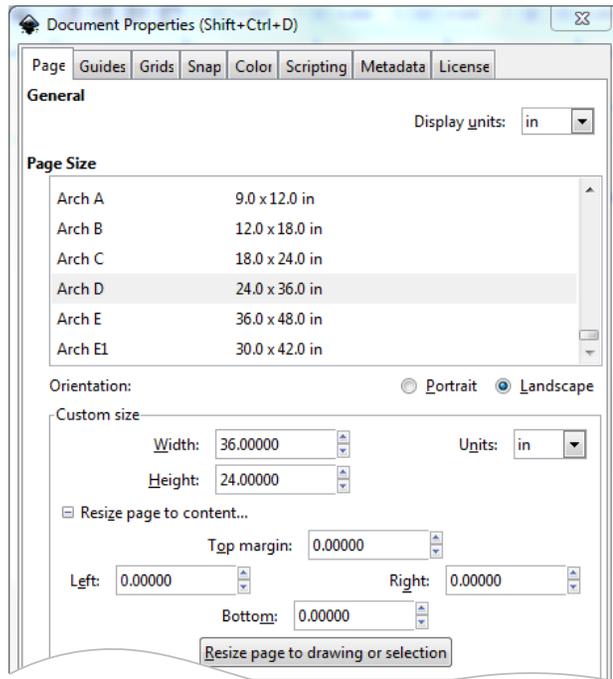
Units

We normally have unit inch for page size, pixel for line width, and point for text size in the US.

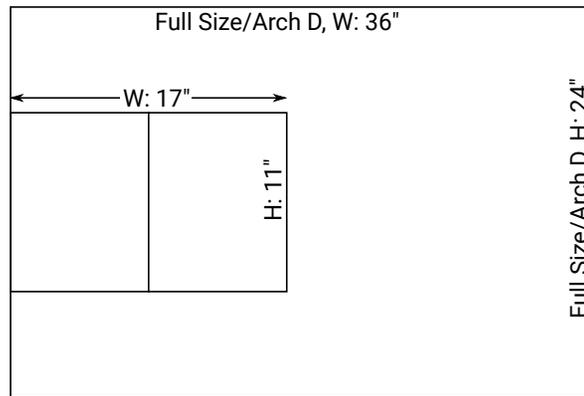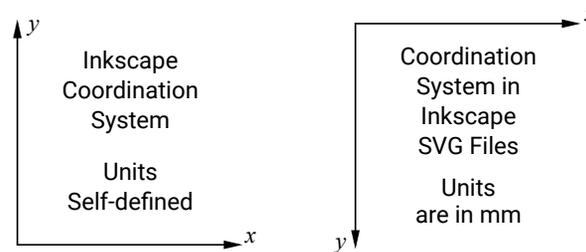|	
inch (in)	⊢——— 1 inch ———⊣
pixel (px)	1/96 inch, the width of above line is 1px, page border is 1.5px. DPI is Dots Per Inch, which means number of pixels in an inch.
point (pt)	1/72 inch, typographic concept, MS Word default font is 11 pt Calibri.
mm, cm	1mm = 1/25.4 inch. 1 millimeter = 1/10 centimeter. ⊢— 1 cm = 10 mm

Common US engineering drawing paper sizes:

- Letter Size: 8.5" x 11"
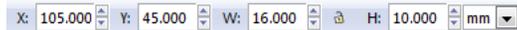- Ledger/Tabloid Size: 17" x 11"
- Full Size/Arch D: 36" x 24"

Note the ledger size area is twice as large as letter size.

Full Size/Arch D, W: 36"

W: 17" H: 11"

Full Size/Arch D, H: 24"

Coordination

Inkscape Coordination System

Units Self-defined

Coordination System in Inkscape SVG Files

Units are in mm

```
<rect id="rect1407"
style="opacity:1;...l"
width="16" height="10"
x="105" y="160.9" />
```

X: 105.000 Y: 45.000 W: 16.000 H: 10.000 mm

Page size is 11 x 8.5 in, or 279.4 x 215.9 mm.
SVG code shows x=105, y=160.9 (top left corner).
Tool setting bar shows X: 105, Y:45 (bottom left).

Those navigation shortcuts should be memorized:

Those 3 shortcuts are indispensible for daily work.

- (+) : Enlarge, actually it is key '=' on keyboard
- (-) : Zoom out, make objects smaller.
- (5) : Number 5 is the shortcut for fitting the page

Mouse scroll is very important in Inkscape.

- Middle Mouse Button (Scroll):
  - Drag (click and hold to move) to pan the page
  - Single click to enlarge the page
  - Shift + click to reduce page size
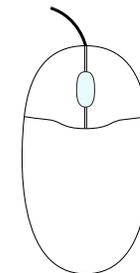
Arrow keys are for moving selection by a nudge factor, which is 2 SVG pixels by default.

- Shift + Arrow: Move selection by ten times of the nudge factor
- Alt + Arrow: Move selection by one screen pixel.

Other shortcuts to be aware of:

- Ctrl + Arrow: Scroll canvas.
- (1) : Zoom to 1:1
- (2) : Zoom to 1: 2
- (3) : Zoom to selection
- (4) : Zoom to drawing
- (`) : Previous zoom
- Shift + (`): Next zoom

Inkscape Tools

Inkscape version 0.92.2 has 21 tools. We discuss 10 most useful tools for engineers.

Selector (S, F1, Spacebar)

Node (N, F2)

Zoom (Z)

Measurement (M)

5

Rectangle (R)

Ellipse/Arc (E)

Polygon/Star (*)

10

Bezier (B)

Type or Text (T)

15

Single click an icon chooses a tool.
Double click an icon brings up Preference setting window for the tool.

The letters (lower case) in the parentheses are shortcuts. For example, press the lower-case letter 'z' key to choose Zoom tool.

20

Dropper (D)

Selector (S, F1, Spacebar)

This tool is very different from other drawing software.
- Single click: Select object or path; Resize object.
- Second click: Rotate and skew selection.
- Double click: Adjust other object properties.

Single Click   Second Click

Double Click
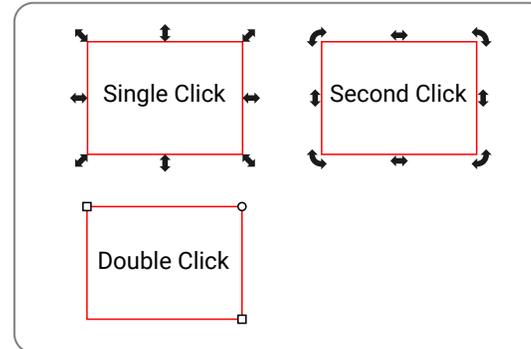
Node (N, F2)

The Inkscape does not include some common CAD tools. The Node tool and Guideline work together to achieve some CAD functions.
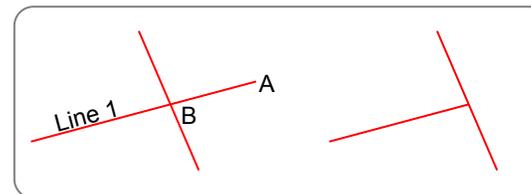
Line 1   A
B

The steps to trim line 1 in the above figure:
1. Select two lines, Ctrl + D to duplicate them.
2. Shift + G (or Object > Objects to Guides) to create two Guidelines.
3. Select Line 1; F2 Select Point A; Move A to B. (Shift + % to turn on Snap); Delete Guidelines.

When you move one end of a line, press two keys Ctrl + Alt to preserve the line direction.

Zoom (Z)

You can navigate via shortcuts on the previous page instead of Zoom tools.

Measurement (M)

Because object and path dimensions are shown on the tool setting bar, the Measurement tool is not used very often.

Rectangle (R)

The tool is also for squares and rectangles with radius.
- Ctrl key: Draw a Square.
- Shift key: Drawing starts from center.
- Double click an rectangle to change corner radius.

Ellipse/Arc (E)

This tool is used for both Ellipse (including circle) and Arc. Sometimes, we use Bezier tool to draw curves instead of Arc tool.

Ctrl and Shift keys are the same as Rectangle tool.

Polygon/Star (*)

The Star tool is rarely used for engineering drawings. However, sometimes we need the Polygon tool.

Bezier (B)

The Bezier tool is the backbone of the Inkscape software. You draw both lines and curves with this tool.

Type or Text (T)

The Text tool in Inkscape is good, but not perfect.

Dropper (D)

The Dropper tool is very simple. If you want to fill the color of an object on the page with another color, you select the object, choose the tool, and click on another object (even on an image). Press Shift key to change stroke color.

Guidelines

You can drag from ruler to create guides, or use menu Object > Objects to Guides (Shift + G) to create guides. Double clicking a guide brings up a dialog, and you can delete the guide. Access menu Extension > Render > Guides Creator to delete all guides.

SVG File Format

The default Inkscape file format is Scalable Vector Graphics (SVG). The SVG specification is an open standard developed by the World Wide Web Consortium (W3C).

SVG files are XML text documents. All major modern web browsers support SVG rendering.

SVG Document

The format of an SVG file is,

```
<svg version="1.1"
     xmlns="http://www.w3.org/2000/svg"
     ... >
   <line x1="40" y1="30" x2="240" y2="100" stroke="black" />

</svg>
```

You can add width, height, and viewBox attributes to the SVG tag. The code below sets the document unit to millimeter.

```
<svg ...width="11in" height="8.5in" viewBox="0 0 279.4 215.9">
```

Defs, View, and Metadata

The Inkscape SVG has Defs, View, and Metadata elements at the top of svg document.

- Defs elements are for gradient, pattern, marker, clipping path, mask, filter definitions.
- namedview is for document specific options.
- Metadata stores information about the document.
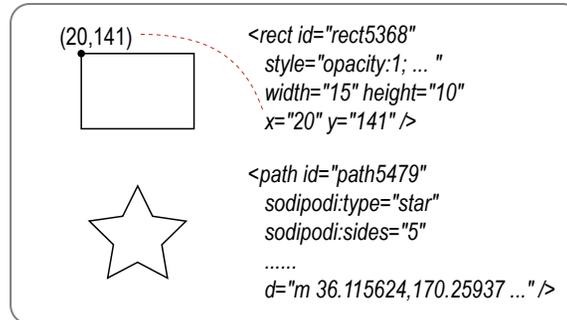


```
<path id="path6130"
    style="fill:none;stroke:#000000; ...
                  marker-end:url(#marker6317)"
    d="m 107,61 h 13" />

<defs id="defs858">
 <marker id="marker6317"
    inkscape:isstock="true" style="overflow:visible;"
    refX="0.0" refY="0.0"
    orient="auto" inkscape:stockid="Arrow2Lend">
   <path id="path6315"
     transform="scale(0.8) rotate(180) translate(9.0,0)"
     style="fill-rule:evenodd;stroke:#000000; ..."
     d="M 0.0,0.0 L 0.0,-2.5 L -11.0,0.0 L 0.0,2.5 L 0.0,0.0 z " />
 </marker> ... </defs>
```

Shape Elements

The six SVG shape elements are line, rect, circle, ellipse, polyline, and polygon.

- rect: x y width height
- circle: cx cy r
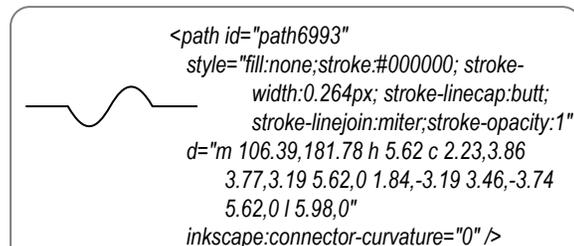- ellipse: cx cy rx ry
- polyline and polygon: points


```
(20,141)
<rect id="rect5368"
   style="opacity:1; ... "
   width="15" height="10"
   x="20" y="141" />

<path id="path5479"
   sodipodi:type="star"
   sodipodi:sides="5"
   ......
   d="m 36.115624,170.25937 ..." />
```

Star object does not have a corresponding shape element in SVG specification. Inkscape saves paths with special attributes in an SVG file.

Paths

A path element has a *d* attribute which contains a sequence of drawing commands. Uppercase commands indicate that parameters are absolute values, and lowercase are relative values.

- M/m: move to
- L/l: line to
- H/h, V/v: horizontal (vertical) line to
- Q/q, C/c: quadratic (cubic) curve to
- T/t, S/s: smooth quadratic (cubic) curve to
- A/a: elliptical arc to
- Z/z: close the path


```
<path id="path6993"
   style="fill:none;stroke:#000000; stroke-
            width:0.264px; stroke-linecap:butt;
            stroke-linejoin:miter;stroke-opacity:1"
   d="m 106.39,181.78 h 5.62 c 2.23,3.86
            3.77,3.19 5.62,0 1.84,-3.19 3.46,-3.74
            5.62,0 l 5.98,0"
   inkscape:connector-curvature="0" />
```

Texts

Texts in SVG 1.1 have two element tags <text> and <tspan>.

- Element <text> requires two attributes, x and y.
- Many properties are the same as in CSS.
- Element <tspan> can change text styles.

Bold *Text* Example

```
<text id="text4262" xml:space="preserve"
    style="font-style:normal;font-variant:..."
    x="189.79" y="145.95" >
  <tspan id="tspan4260" sodipodi:role="line"
    x="189.79" y="145.95"
    style="font-style:normal;font-variant:...">
    <tspan id="tspan4266" style="font-weight:bold">Bold</tspan>
    <tspan id="tspan4268" style="font-style:italic" >Text</tspan>
    Example
  </tspan>
</text>
```

XML Editor

You can change the attribute value in the lower-right textbox of XML editor (Ctrl + Shift + X), and press Ctrl + Enter to commit the change. XML editor is one of the most powerful tools in Inkscape.
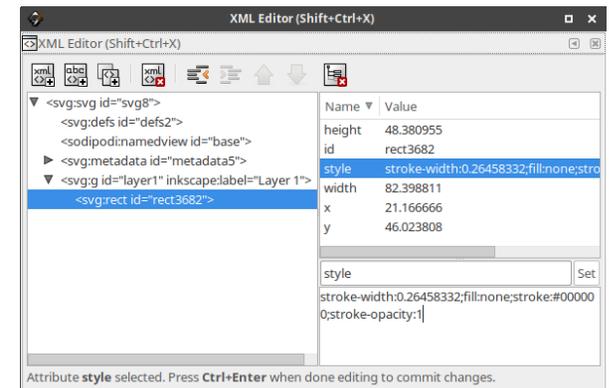
SVG Study Materials

The web site by Peter Collingridge has good tutorial.

http://archive.petercollingridge.co.uk/svg-tutorial

A book titled *SVG Essentials* is also good.

Bézier Curves

Traditional engineering drawing CAD software does not have Bézier tool, but the tool is the backbone of drawing programs like Inkscape.
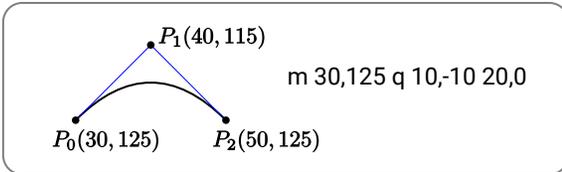
Equations

The curves are named after Pierre Bézier, who used them to design automobile bodies at Renault and published them in 1962.

We have two points P_0 (x_0, y_0) and P_1 (x_1, y_1) in a coordinate system, the line between two points is

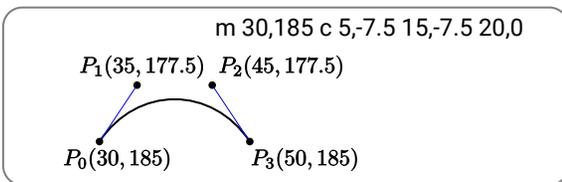$$B(t) = P_0 + t(P_1 - P_0)$$
$$= (1-t)P_0 + tP_1 \qquad 0 \le t \le 1$$

Quadratic Bézier curve has three control points P_0, P_1, and P_2. The curve equation is

$$B(t) = (1-t)[(1-t)P_0 + tP_1] + t[(1-t)P_1 + tP_2]$$
$$= (1-t)^2 P_0 + 2(1-t)tP_1 + t^2 P_2 \qquad 0 \le t \le 1$$
$$B'(t) = 2(1-t)(P_1 - P_0) + 2t(P_2 - P1)$$

$P_1(40, 115)$

m 30,125 q 10,-10 20,0

$P_0(30, 125)$ $P_2(50, 125)$

Cubic Bézier curve has four control points P_0, P_1, P_2, and P_3.

$$B(t) = (1-t)B_{P_0 P_1 P_2}(t) + tB_{P_1 P_2 P_3}(t)$$
$$= (1-t)^3 P_0 + 3(1-t)^2 tP_1 + 3(1-t)t^2 P_2 + t^3 P_3$$
$$0 \le t \le 1$$

m 30,185 c 5,-7.5 15,-7.5 20,0

$P_1(35, 177.5)$ $P_2(45, 177.5)$

$P_0(30, 185)$ $P_3(50, 185)$

Inkscape Pen tool only generates cubic curves. You have to edit SVG to get quadratic curves.

Pen Tool - Mode

When you click the Pen (B) tool, the Tool Setting bar shows 5 modes you can choose.

Mode: | Shape: None
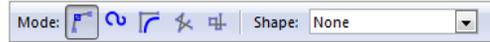
The first mode is regular Bézier line, and the fourth and fifth modes are straight and paraxial lines.
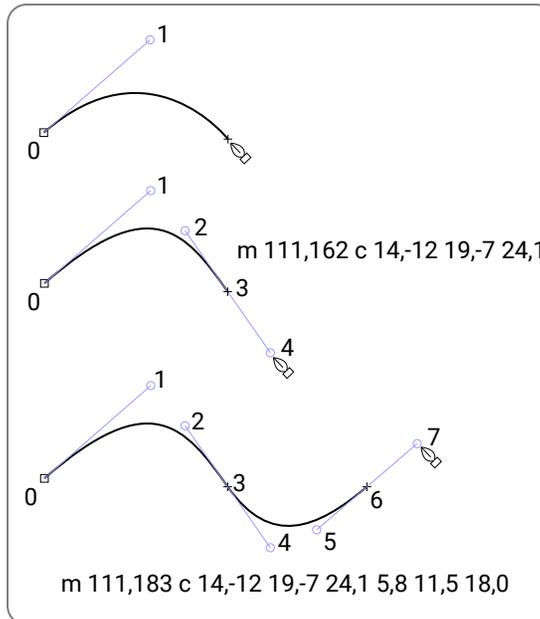
Create Dots

You need to choose the straight or paraxial line mode to create dots.

- Choose the Pen (B) tool; select fourth or fifth mode.
- Double click the Pen tool to choose dot diameter, and the unit is in (millimeter x stroke width).
- Ctrl + Click to place the dot.

Bézier Curves

Here are the steps to create Bézier curves.

- Click at 0; drag and release at 1
- Click at 3; drag to 4. Point 2 shows up.
- Click at 6; drag to 7.

1
0

1
2
3
0
4

m 111,162 c 14,-12 19,-7 24,1

1
2
0
3
4   5
6
7

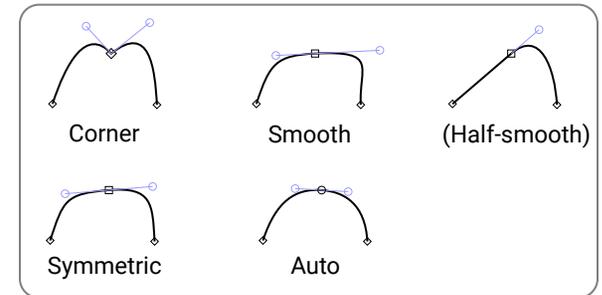m 111,183 c 14,-12 19,-7 24,1 5,8 11,5 18,0
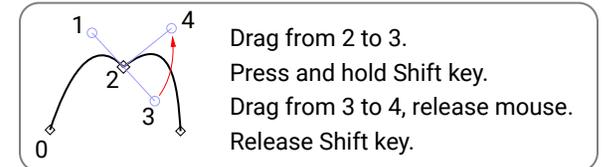
Pen Tool

Pen tool is very versatile.

- Click mouse to create lines; Click and drag to create Bézier curves.
- Backspace key to delete a node.
- Press Enter key or double click to end a path.
- If a path is selected, you can start drawing from end nodes to continue the current path.
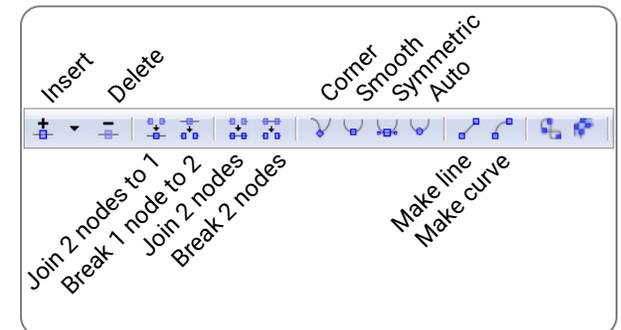
Node Types

There are four types of node: Corner (cusp), Smooth, Symmetric, and Auto.

Corner   Smooth   (Half-smooth)

Symmetric   Auto

Here are the steps to create a corner node.

1   4
2
3
0

Drag from 2 to 3.
Press and hold Shift key.
Drag from 3 to 4, release mouse.
Release Shift key.

Node Tools

Insert Delete   Corner Smooth Symmetric Auto

Join 2 nodes to 1
Break 1 node to 2
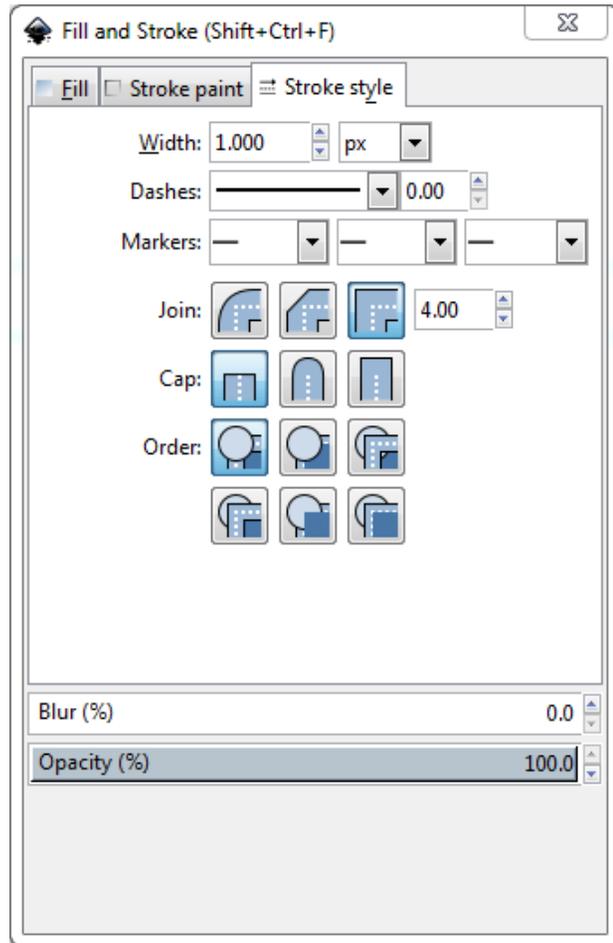Join 2 nodes
Break 2 nodes   Make line
Make curve

Fill and Stroke

In Inkscape or other vector drawing programs, you style objects or paths with fill and stroke.

You can set the fill or stroke paint to flat (or solid), gradient, or patterns.

Fill and Stroke (Shift+Ctrl+F)

Fill | Stroke paint | Stroke style

Width: 1.000 px

Dashes: ———————— 0.00

Markers: —— | —— | ——

Join: 4.00

Cap:

Order:

Blur (%) 0.0

Opacity (%) 100.0

Status Bar - Fill, Stroke, and Opacity

You can change fill/stroke, stroke width, and opacity on the status bar (right mouse click).

Fill: None   O: 0   ⊙ ⓐ ▾ -Text ▾ **Path** 2 nodes in layer
Stroke: ▮ 1

Stroke Style

When you select an object, the dialog shows the style of the object.

If you want to set the default stroke style of a tool such as Bezier tool, double click the tool icon on the toolbar.

Stroke Width

The stroke width is a unit. When stroke width is 1px, the miter limit of 4 is 4px. Customized dashes and markers are represented in unit of stroke width. You need to set the stroke width to a large value such as 10px to see the effects of Join, Cap, and Order.

Join

Three join types: round, bevel, and miter. Miter-limit value is for miter join type only.

Round   Bevel   Miter

d

d=52.5px   d=81.6px
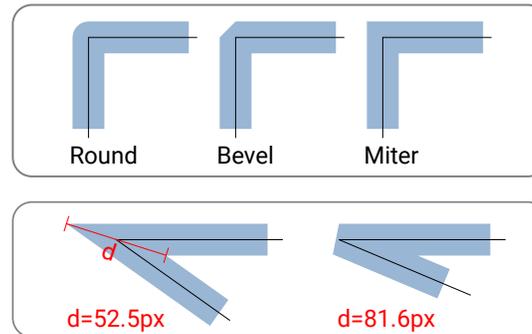
Stroke width is 16 px. The miter limit is set to 4, which means 4 times of stroke width. When d > 64 px, the miter setting becomes bevel.

Order

The default order type puts fill on top of stroke. It will cover half stroke width. Change the order if you want stroke on top of fill.

stroke, fill, markers   fill, stroke, markers
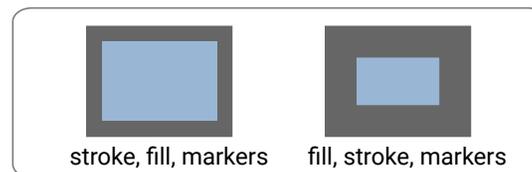
Cap

Three cap types are butt, round, and square. Round and square extent 1/2 stroke width on each end.

Dashes

Dashes are defined in the preferences.xml file, which is saved in InkscapePortable\Data\settings folder.

You can add a dash style to dashes group.

    <dash id="dash-5-15"
        style="stroke-dasharray: 5, 15" />

This dash will have 5px dash length and 15px dash interval if the stroke width is 1px.

The object or path with this dash style will have a style attribute (stroke-dasharry) in the SVG file.

    style="... stroke-dasharray:5, 15; ..."

You can change the values on XML editor.

Markers (Arrowheads)

Markers are defined in the markers.svg file, which is saved in \App\Inkscape\share\markers folder. Here is an example of a marker in the SVG file.

<marker style="overflow:visible;" id="Arrow2Lend"
    refX="0.0" refY="0.0" orient="auto"
    inkscape:stockid="Arrow2Lend">
  <path transform="scale(0.8) rotate(180) translate(9.0,0)"
    style="fill-rule:evenodd;stroke:#000000;stroke-width:1.0pt;
    stroke-linejoin:miter;stroke-miterlimit:10;"
    d="M 0.0,0.0 L 0.0,-2.5 L -11.0,0.0 L 0.0,2.5 L 0.0,0.0 z "/>
</marker>

The refX and refY is the anchor point of the marker, which is also rotation center of the object.

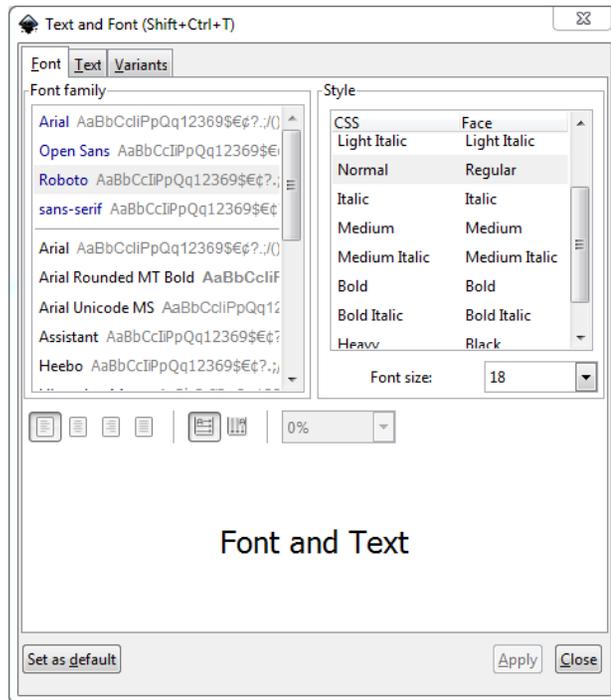-11.0,0.0   0.0,-2.5
             0.0,0.0
             0.0,2.5
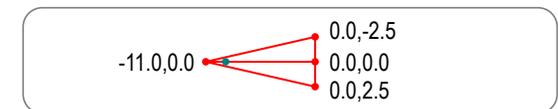
It is easier to create an object, convert it to a marker (Object > Objects to Maker menu), save the svg file, edit the marker, then save it to markes.svg.

When you set marker style of a path, Inkscape places a copy of the marker in the SVG defs section, and the path refers to the definition.

Font and Text

The easy way to edit text objects in Inkscape is to select the text, and press Ctrl + Shift + T to open the Text and Font dialog to make changes.

Font Examples	Names
ABCDEFGHabcdefgh12345	*Arial Narrow*
ABCDEFGHabcdefgh12345	*Open Sans*
ABCDEFGHabcdefgh12345	*Roboto*
ABCDEFGHabcdefgh12345	*Assistant*
ABCDEFGHabcdefgh12345	*Times New Roman*

```
<flowRoot id="flowRoot17"
   xml:space="preserve"
   style="font-style:normal;..."
   transform="matrix
   (0.264,0,0,0.264,0,81.1)">
   <flowRegion id="flowRegion19">
     <rect id="rect21"
        width="85.86" height="69.19"
        x="24.24" y="67.98" />
   </flowRegion>
   <flowPara id="flowPara23">
     This is an example of flowed text
   </flowPara>
</flowRoot>
```

This is an example of flowed text

Fonts

The Font tab of the Text and Font dialog shows the font families that are in the document and installed in the computer. You can customize the fonts.

- Comment out a line (line # 26) in the file \Inkscape Portable\App\Inkscape\etc\fonts\fonts.conf.
  <!-- <dir>WINDOWSFONTDIR</dir> -->
- Add a line to the Inkscape\etc\fonts\conf.d\51-local.conf file before </fontconfig>.
  <dir>./fonts</dir>
- Create an Inkscape\fonts folder and copy font files (*.ttf and *.otf) to this folder.

Google Fonts service provides a library of libre licensed fonts. Popular fonts include Open Sans, Roboto, Assistant etc.

Regular Text

Regular text does not have automatic line wrapping, and you need to press Enter key to insert a line break.

- Double click a text object to start selecting text. You can also choose the Text tool, and click a text object to select.
- You can drag the I mouse cursor, or use Shift + arrow keys, or Ctrl+A to select texts.
- Press Ctrl+I to apply italic sytle.
- Ctrl+ B to apply bold style.
- You can use Alt+arrow keys to move each character or adjust spacing between charcters (kerning).
- Shortcuts Alt + [and Alt +] rotate characters.
- Change text fill color to change color.
- The font size is in the unit of point (pt). A 10pt text on paper is the minimum considered readable.

Flowed Text

You click and drag the Text tool to start flowed text. It automatically wraps the text to fill the width.

The flowed text was in a draft SVG 1.2 specification. Other programs can not render it properly (e.g. IE 10).

You can convert it to regular text via menu Text > Convert to Text, however the converted text is wrapped inside two <tspan> elements. It is likely a bug of Inkscape.

It is recommended to have flowed text in Inkscape file, and save a copy of PDF file to be transmitted. If you have to transmit the SVG file, convert text to paths via menu Path > Object to Path.

Text on a Path

A single line text object in Inkscape can link to a path and use it as a guide to bend the text's baseline.

Select both text and path, and choose menu Text > Put on Path.

Evergreen Mills Road

```
<text id="text1829"
   style="font-style:normal;..."
   xml:space="preserve">
<textPath id="textPath1833"
   xlink:href="#path1831" >
   <tspan id="tspan1827"
      style="font-style:normal;..."
      dx="7.347435">Evergreen Mills Road</tspan>
</textPath></text>

<path id="path1831"
   inkscape:connector-curvature="0"
   d="m 196.7,143.8 c 6.0,-4.6 ..."
      style="fill:none;stroke:#000000;stroke-width:..."/>
```

You can set the Fill and Stroke of the path to none or opacity to 0 to hide the path.

Select and Edit

Like in other software packages, objects must be selected before manipulation. The first tool on toolbar is Select and Transform (S, F1, Spacebar).

Mouse Selection

You combine left mouse click with keyboard keys to make selections.

- Shift: Add an object to a selection. If it is already selected, remove from selection.
- Alt: Select object underneath current selected one.
- Ctrl: Select an object in a group.
- Drag: Select objects within the rectangle.
- Alt + Drag: Select objects that touch mouse path.
- Shift + Drag: Same as drag, but do not select the object when start dragging.
- Click an empty space or press Esc key to deselect.

Locked or hidden objects are not selected. Sometimes you do not want to select an object, you can put it on a separate layer and lock the layer.

Select with Keyboard Shortcuts

Sometimes it is convenient to use keyboard shortcuts to select objects.

- Tab: Select next object in z-order.
- Shift + Tab: Select previous object in z-order.
- Ctrl + A: Select all objects on current layer.
- Ctrl + Shift + A: Select all objects on all layers.
- !: Invert selection on current layer.

Basic Editing

Here is a list of some very basic editing shortcuts. You need to get familiar with these operations.

- Ctrl + D: Duplicate a copy of the object, it is easier to use than Ctrl + C and Ctrl + V.
- Group: Ctrl + G to group; Ctrl + Shift + G to ungroup.
- Z-Order: Pageup and Pagedown to change z-order.
- Paste Style: Ctrl + Shift + V to paste style. It is the "format painter" of Inkscape.

Transform

When an object is selected, you can start basic editing like move (translate), scale, and rotate.

- Move: Drag an object to move.
- Scale: Drag the corner arrow to scale an object.
- Rotate: Click the selected object again to rotate.

Pressing the Ctrl key will restrict the move to horizontal or vertical, lock the scale aspect ratio, and constrain the rotation angle to a multiple of 15 degrees.

When scaling an object, sometimes you want stroke width and corner radius scale with the object. You can set the options on the tool setting bar.

Transform Equations

When you move an object in a coordinate system, you can view it as moving the coordinate system, but the object stays at the same location.
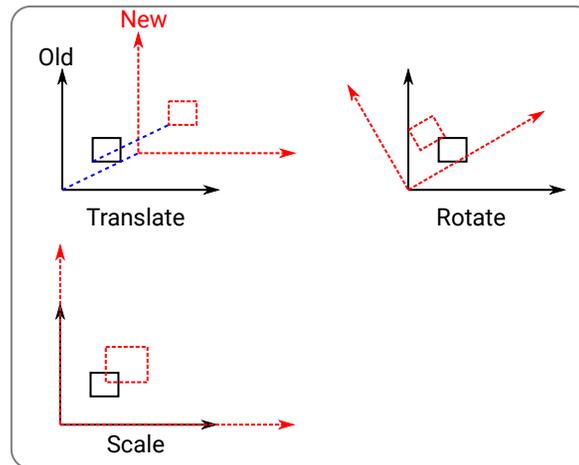
Suppose you have a point in the new coordinate system (x', y'), the point in the old coordinate system is (x, y).

$$x = x' + a$$
$$y = y' + b$$

You can write the point as [x' y' 1] and [x y 1], so you can use matrix calculations.

$$\begin{bmatrix} x & y & 1 \end{bmatrix} = \begin{bmatrix} x' & y' & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ a & b & 1 \end{bmatrix}$$

The equations for rotation and scale are,

$$\begin{bmatrix} x & y & 1 \end{bmatrix} = \begin{bmatrix} x' & y' & 1 \end{bmatrix} \cdot \begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

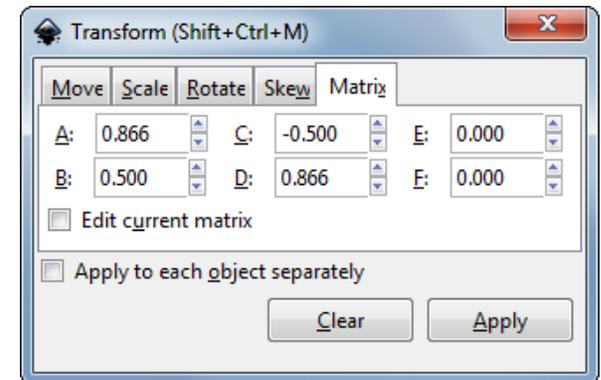$$\begin{bmatrix} x & y & 1 \end{bmatrix} = \begin{bmatrix} x' & y' & 1 \end{bmatrix} \cdot \begin{bmatrix} a & 0 & 0 \\ 0 & b & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

The transform matrix is,

$$\begin{bmatrix} a & b & 0 \\ c & d & 0 \\ e & f & 1 \end{bmatrix}$$

Transform Dialog

You can also move, scale, or rotate objects in the Transform dialog box. The Matrix tab is the place to enter transform matrix.

The values in the above dialog box rotate the object 30 degrees counterclockwise around lower left corner.

Color and Pattern

Inkscape objects can have different types of paint: none, flat color, gradient or pattern, and unset.

Color Palette

The Color Palette bar and Swatches dialog box show color squares. You drag and drop a color square to fill and stroke strips on status bar or a selected object.

- You can create customized color palettes and save them in Inkscape\share\palettes folder.
- The palette files have same format as in GIMP.

GIMP Palette
Name: Traffic Control Devices
 # generated by goTrafficSign.com
 35 31 32 Sign Black
  0 86 150 Blue
121 69 00 Brown
241 94 124 Fluorescent Pink
193 215 46 Fluorescent Yellow ...
  0 111 81 Green
244 145 30 Orange
108 39 124 Purple
191 46 26 Red
255 255 255 White
255 210 79 Yellow
255 127 80 Coral (Reserved)
 90 147 193 Light Blue (Reserved)

Gradient

Gradient is rarely used in engineering drawings, but you need to know the basics. It is one of the most important features of vector graphics.

- Select an object first, then choose the gradient tool.
- If you transform an object with gradient or pattern, toggle on two buttons on selector setting toolbar.

Gradients Patterns

- Gradient in SVG has two levels of elements.

```
<rect id="rect1285"
  style="fill:url(#linearGradient1293); ..."
  width="17.86" height="11.03"
  x="158.39" y="25.92" />

<linearGradient id="linearGradient1293"
  inkscape:collect="always"
  xlink:href="#linearGradient1291"
  x1="158.26" y1="31.44"
  x2="176.38" y2="31.44"
  gradientUnits="userSpaceOnUse" />

<linearGradient id="linearGradient1291"
  inkscape:collect="always" >
  <stop id="stop1287" offset="0"
    style="stop-color:#006f51;stop-opacity:1" />
  <stop id="stop1289" offset="1"
    style="stop-color:#ffffff;stop-opacity:1"  />
</linearGradient>
```

Linear

Radial

Pattern

Pattern in Inkscape is somewhat difficult to control. It is easy to create the pattern by drawing a grid of the pattern, make duplicates, and align them.

Here are the steps to create a pattern fill,

- Create a diamond shape and fill yellow.
- Apply menu Object>Pattern>Object to Pattern (Alt+I).
- Fill a new object with the pattern.

Pattern Fill   Align Duplicates
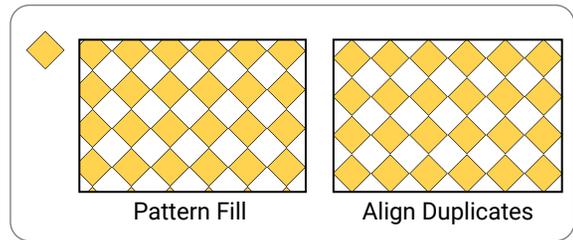
Clone

A clone is a linked copy of an object that updates itself when the original changes. The Create Tiled Clones dialog is a very powerful tool.
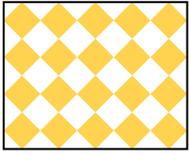
```
<rect id="rect1304"
  transform="rotate(45)"
  x="160.31" y="-122.01"
  height="3.45" width="3.45"
  style="fill:#ffd24f;..." />

<use id="use1310"
  x="0" y="0"
  xlink:href="#rect1304"
  transform="translate(9.36,5.40)"
  width="100%" height="100%" />
```

Original

Clone

Unlink Clone

Sometimes you want to edit a clone independent of the original. You can unlink the clone (menu Edit > Clone > Unlink Clone, Shift+Alt+D). The clone becomes a full copy of the original.

When you import a PDF file with embedded fonts into Inkscape, the text becomes a group of glyph symbols. You need to ungroup them, then unlink glyphs from symbols to get paths of embedded font glyphs.

Clipping and Masking

When engineers work on CAD drawings, we often start the drawing on one sheet, then use reference and clipping tools to separate it into multiple plan sheets.

The clipping tool in Inkscape has similar function, you can show part of drawing inside a path or an object.

Enlarge A Map Area 5 Times
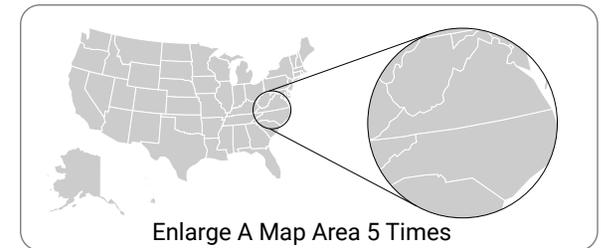
Masking tool is similar to clipping, however color black makes masked area transparent (invisible) and white makes the area opaque (visible).
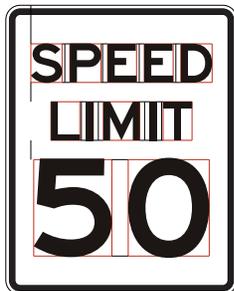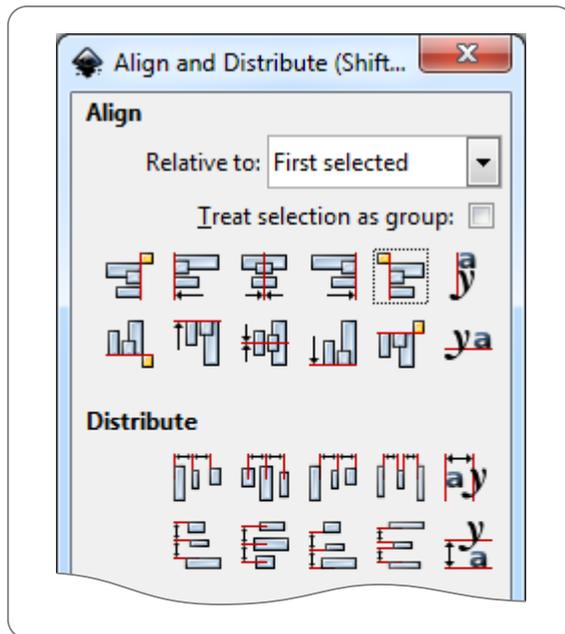
Align and Layer

Align, snapping, layer, and guide are important tools in Inkscape.

Align and Distribute

The align and distribute (Ctrl + Shift + A) dialog is a very powerful tool. The tool is better designed than other graphic drawing software.

- Choose Page in the "Relative to" drop down list box; align objects to center of a page.
- Draw auxiliary lines to help align objects.

You can create a sign drawing using auxiliary lines and alignment tool.

The dimensions, spaces, and letter paths are from FHWA Standard Highway Signs and Markings Book.

Snapping

Snapping may not be important for artistic drawings, but it is essential for engineering drawings. You can not do serious engineering drawings without the tool.

- Snapping happens when you drag something.
- The global snap toggle is % (Shift + 5).
- Guide and grid toggle is | and #.
- Toggle on Rotation Center button when move it.
- Shift + Click rotation center to move it back.

Snap Centers of Objects

Snap an Item's Rotation Center
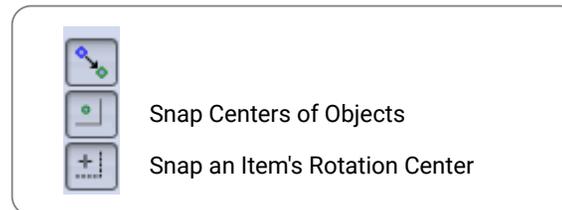
Layer

Layers tool in Inkscape is good and simple. Layers can be easily hidden, locked, or reordered. You can drawing everything on one layer if the drawing is very simple.

- If you want to trace objects on a bitmap, put the image on a layer and lock it.
- Objects on a hidden layer are not visible nor select-able. You can hide a layer with all auxiliary lines.
- Both layer and group are element g in XML.
- You can change the current layer on status bar or layers dialog (Ctrl + Shift + L).
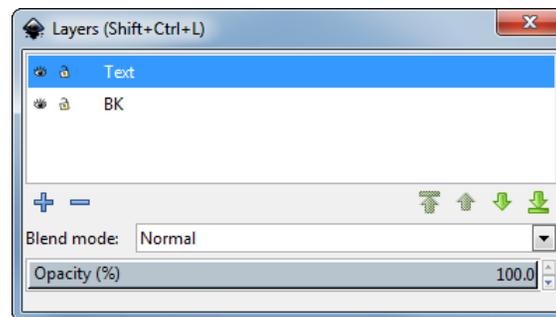
Guides

Inkscape guides are infinitely long straight lines. They are saved in the SVG documents.

- Turn on the ruler (Ctrl + R), and drag from ruler to create guides.
- Double click a guide to set properties or delete it.
- Choose menu Object > Objects to Guides (Shift + G) to convert objects to guides.
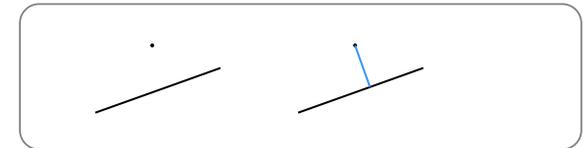
The steps to draw a perpendicular line from a point:

1. Select the line; Ctrl + D, Shift + G create a guide.
2. Double click the guide; enter "+90" to Angle textbox, press key Enter.
3. Press B; draw a line from center of the dot to the intersection.

Breakup Object

In CAD programs, you can breakup a shape into lines and curves. In Inkscape it takes a few steps to do so.

Breakup Object

1. Draw a rect with 0.1in radius
2. Select; Path > Object to Path
3. F2, select nodes
   Break path at selected nodes
4. Re-select the path
   Path > Breakapart

Combine Paths

1. Draw 4 separate paths
2. Select; Path > Combine
3. F2, select nodes
   Join selected nodes

Extensions

Inkscape has a programming interface to expand its functionality. An extension consists of an INX file and a python script file. Most extensions are saved in this directory \inkscape\share\extensions.

Extension Execution Steps

Those are the steps how a python script is executed as an Inkscape extension.

- Inkscape reads INX file and collects arguments on the extension dialog, then calls the python script with arguments.
- Python reads the temporary SVG and arguments.
- The script modifies the temporary SVG file.
- Inkscape reloads the modified SVG file.

Inkscape passes additional arguments to the extension such as ids of selected elements.

(interpreter) your_script (--param=value)* /path/SVGfile | inkscape

Description (INX) File

The INX file describes which parameters the extension needs. Inkscape will prompt a dialog for the user to fill. The arguments will be passed to the python file.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<inkscape-extension xmlns="http://www.inkscape.org/...">
  <_name>Draw Tangent</_name>
  <id>com.gotrafficsign.drawtangent</id>
  <dependency type="executable" location="extensions">
                    draw_tangent.py</dependency>
  <param name="point_to_circle"    type="boolean"
                    _gui-text="Point To Circle"></param>
  <effect>
    <object-type>all</object-type>
    <effects-menu>
      <submenu _name="Render"/>
    </effects-menu>
  </effect>
  <script>
    <command reldir="extensions" interpreter="python">
                    draw_tangent.py</command>
  </script>
</inkscape-extension>
```

Python Script File

Here is the skeleton code of a Python extension script.

```python
import sys
from math import *
import inkex
import simplestyle

class Draw_Tangent(inkex.Effect):
    def __init__(self):
        inkex.Effect.__init__(self)
        self.OptionParser.add_option("--point_to_circle",
                action="store", type="inkbool",
                dest="point_to_circle", default=False)
        ......
    def effect(self):
        so = self.options #shorthand
        ......
if __name__ == '__main__':
    e = Draw_Tangent()
    e.affect()
```

Most interfacing code between Inkscape and Python has already been written by others.

- The inkex.py file uses optparse and lxml modules, and defines Effect class.
- The optparse module parses arguments.
- The lxml is for processing XML files.
- Derive a class from inkex.Effect and write code in the effect(self) method.

Extension Debug

The inkex module has a debug function which displays object or variable values. The result of below code is Python 2.7.13 for Inkscape 0.92.2.

```python
debug = True
if debug:
    cur_version=sys.version_info
    message = 'Python version: ' + str(cur_version) +'\n'
    inkex.debug(message)
```

The file extensionerrors.log records error messages. It is saved in this folder \InkscapePortable\Data\settings.

Draw Tangent Extension

You can create an extension to draw tangent lines from a point to a circle or between two circles.

- Snap smooth nodes
- Snap centers of objects
- ----- Auxiliary path
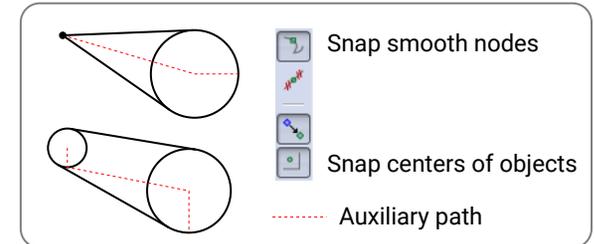
Python Code

The code below creates a line path and add it to the parent node (a layer or a group). SubElement method constructs a node and adds it to its parent.

```python
def draw_SVG_line( (x1, y1), (x2, y2), name, parent):
    line_style   = { 'stroke':'#000000', 'stroke-width':
            str(Draw_Tangent.unittouu(e, '1px')), 'fill':'none' }
    line_attribs = {'style':simplestyle.formatStyle(line_style),
            inkex.addNS('label','inkscape'):name,
            'd':'M '+str(x1)+','+str(y1)+' L '+str(x2)+','+str(y2)}
    inkex.etree.SubElement(parent, inkex.addNS('path','svg'),
                                                line_attribs )
```

The code below loops through selected nodes and saves points from selected path.

```python
for id, node in self.selected.iteritems():
    if node.tag == inkex.addNS('path','svg'):
        pts = get_n_points_from_path( node, 3 )
```

References

Python Book:
Automate The Boring Stuff With Python

Tangent Line Equations:
http://ambrsoft.com/TrigoCalc/Circles2/Circles2Tangent_.htm

Online Tutorial:
http://www.hoboes.com/Mimsy/hacks/write-inkscape-.../
http://lxml.de/tutorial.html

Inkscape Wiki (8 articles):
http://wiki.inkscape.org/wiki/index.php/Script_extensions

Other Topics

We discuss some practical Inkscape tips on this last tutorial page.

Image Markup

We often markup an image to convey ideas. It is easy to import an image into Inkscape, add markups, and save it as an PDF file.

- You can use Snipping tool (or others) to capture and copy a region of the screen and paste it in Inkscape.
- Keep the image ratio and resize it. Add texts and other objects and paths.
- Save the SVG and PDF files.
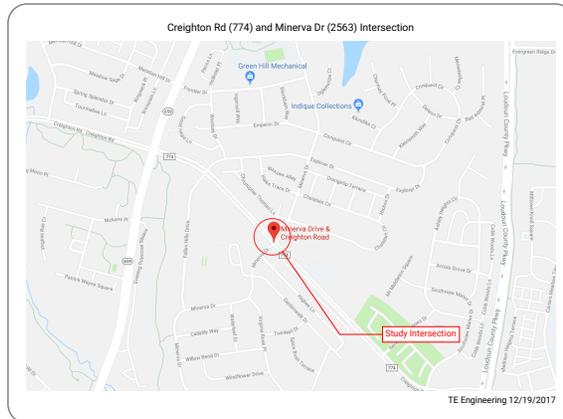
Tracing

It is easier to create a drawing by tracing an image than drawing it from scratch. The Bezier tool is essential when you are tracing an image.

- Import an image onto a background layer. Adjust layer opacity and lock the layer.
- Create a tracing layer on top of background layer. Tracing the object with Bezier tool.
- Turn off or delete the background layer when you save the final PDF file.

Inkscape has an auto-tracing tool, but it is not as good as manual tracing.

Background Map Traced From Aerial Photo
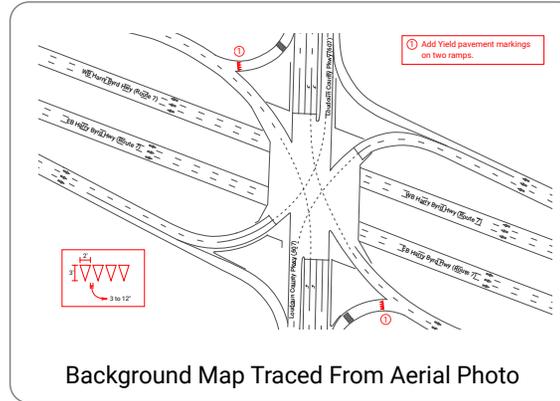
Inkscape Version

I would recommend Portable Inkscape version 0.92.2 in Windows. Google search "Portable Inkscape" and go to portableapps.com to download it.

The advantage of this version is that all the customized settings can be easily moved to a new computer.

The preferences.xml file is saved in this folder,

InkscapePortable\Data\settings

The extensions are saved here,

InkscapePortable\App\Inkscape\share\extensions

Command Line

Inkscape can be executed as a command in a CMD console window.

If you have hundreds of files that you want to convert file format, you can write a Python script and call the Inkscape as a command. Here are a few examples,

inkscape --export-pdf=filename.pdf filename.svg

inkscape --export-png=f1.png --export-dpi=600 f1.svg

inkscape --export-png=f1.png --export-width=400 f1.svg

inkscape --export-png=f1.png --export-background=#000000
    --export-background-opacity=1.0 f1.svg

inkscape --help

Import/Export

You can import or export files in various formats in Inkscape.

- Choose "Poppler/Cairo import" for PDF files. It will preserve text paths.
- Text consists of groups containing cloned glyphs.
- You can ungroup and unlink the glyphs.
- When exporting page, drawing, or selection to PNG files, it doesn't have a white background. Change Background color RGBA to #ffffffff on Document Properties dialog to get white background.
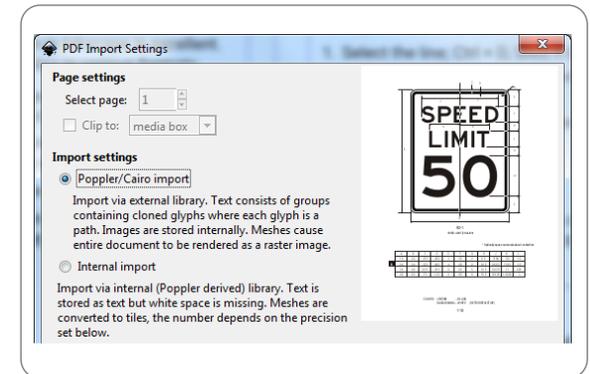
LaTeX Equations

The Inkscape 0.92.2 does not come with a LaTeX extension. You can download WriteTeX extension and insert equations into SVG file.

- WriteTeX calls pdf2svg to convert LaTeX result PDF to SVG file. You need a copy of pdf2svg (github).
- Add LaTeX and pdf2svg directories to system path.
- Enter equations in "LaTeX Source" textbox,

    \[\begin{bmatrix} x_o & y_o & 1\\ \end{bmatrix} = \begin{bmatrix} x & y & 1 \\ \end{bmatrix} \cdot T_{\ast}   \]

Drawing Library

If engineers put common drawing blocks on an SVG file and share it among fellow engineers, Inkscape will gain popularity faster.