Generate SVG images from Oracle Database

Zoran Tica, 18.10.2023

Agenda

- Brief History and Introduction to SVG
- SVG structure and organization
- Basic building blocks… or how to draw an image
- *“The path of the righteous man…” (Ezekiel 25:17)*
- Write “Hello world”… just like in 80-ties
- Transformers at work
- Link it up with URLs
- Grouping, Re-use
- SVG and CSS hand in hand
- Gradients, Patterns, Filters, Masks
- Integration with Javascript… if needed

Generate SVG images from Oracle Database with live demo

Zoran Tica…

- Slovenia
- Mid 80-ties - commodore 64
- Mid 90-ties - Business Analysis, Database Modeling, Software Development
- From 2000+ Oracle Technologies
- Principal Database Design & APEX Consultant at https://right-thing.solutions
- Speaker at various regional conferences
- OCP Advanced PL/SQL, Forms and Java SE developer
- Oracle ACE Associate
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- https://github.com/zorantica

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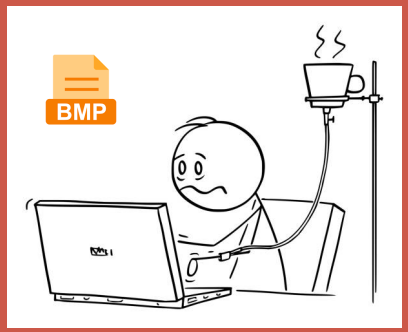
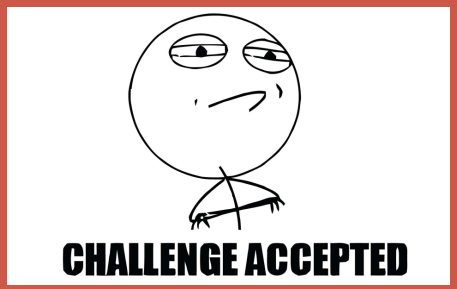
Before the beginning

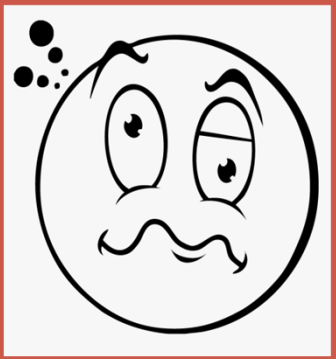


2018

2019



Before the beginning



2019-2023

```
CREATE OR REPLACE PACKAGE ZT_SVG AS
/*****************************************************************************
    Author:     Zoran Tica
                The Right Thing Solutions
                https://right-thing.solutions/

    PURPOSE:    A package for Scalable Vector Graphics (SVG) images generation

    REVISIONS:
    Ver        Date        Author           Description
    ---------  ----------  ---------------  ------------------------------------
    1.0        27/01/2023  Zoran Tica       First version of package.

    ---------------------------------------------------------------------------
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```

Introduction to SVG

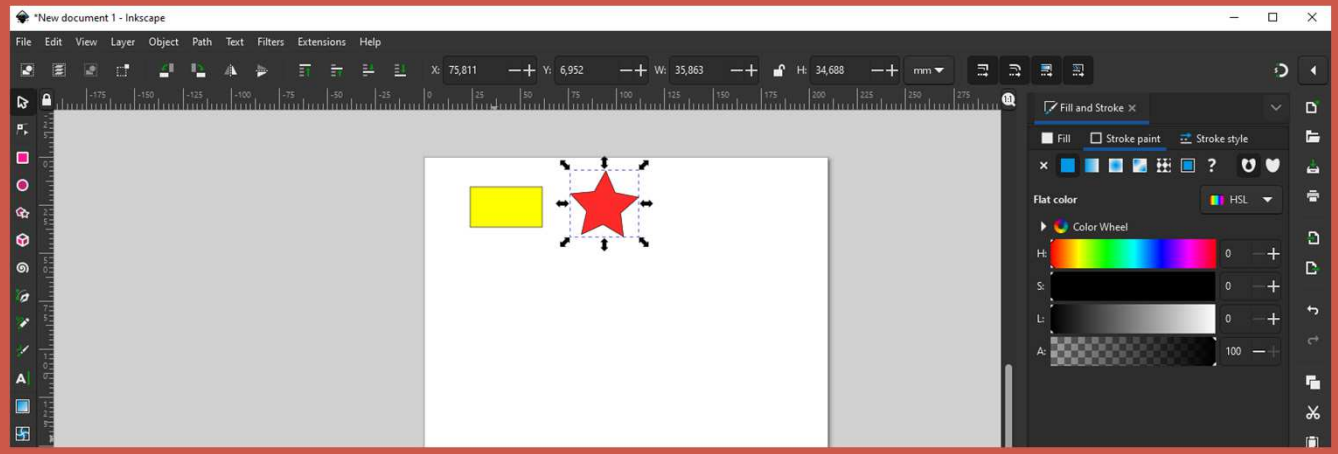
- Scalable Vector Graphics (SVG)
- Open standard developed by the World Wide Web Consortium (W3C) since 1999
- XML Markup language
- Selected among 6 competing vector graphics submissions
- Targeted for HTML and internet era

- Integration with HTML, CSS and Javascript

- Various browsers support and compatibility

Introduction to SVG

- A really popular image format
- Icons
- A LOT OF free images on internet
- Supported by various graphic editing software
- Inkscape
  https://inkscape.org/



Structure and Organization

- XML Markup language similar to HTML

- Main <svg> tag with attributes
- Image Height and Width
- Pixels and percentages
- Scalar values and lists
- ViewBox
- Other attributes like preserveAspectRatio, X, Y, Version…

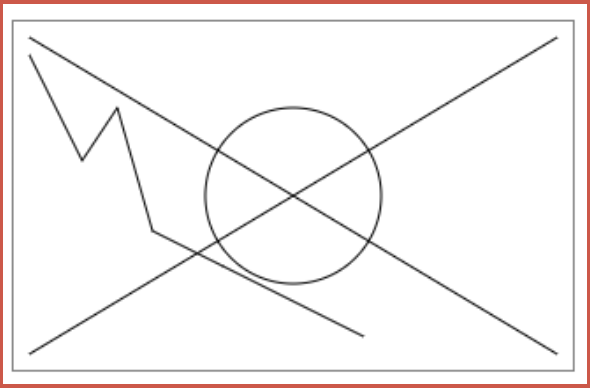
```
<svg xmlns="http://www.w3.org/2000/svg" viewBox="0 0 200 100" width="50%" height="200">

</svg>
```

- <defs> section, used for definitions like CSS classes
- Drawing elements section

Basic Drawing Elements

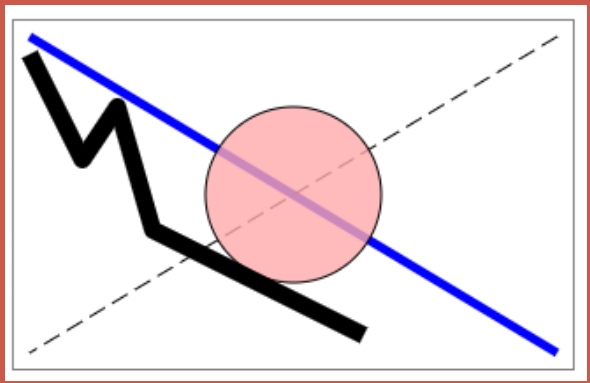
- Called “Shapes”
  - Line
  - Rectangle
  - Circle
  - Ellipse
  - Polyline
  - Polygon
- Attributes contain coordinates, colors…

```
<svg xmlns="http://www.w3.org/2000/svg" width="320" height="200" stroke="black" fill="none">
    <rect width="100%" height="100%"/>
    <line x1="10" y1="10" x2="310" y2="190"/>
    <line x1="310" y1="10" x2="10" y2="190"/>
    <circle cx="50%" cy="50%" r="50"/>
    <polyline points="10,20 40,80 60,50 80,120 120,140 200,180"/>
</svg>
```

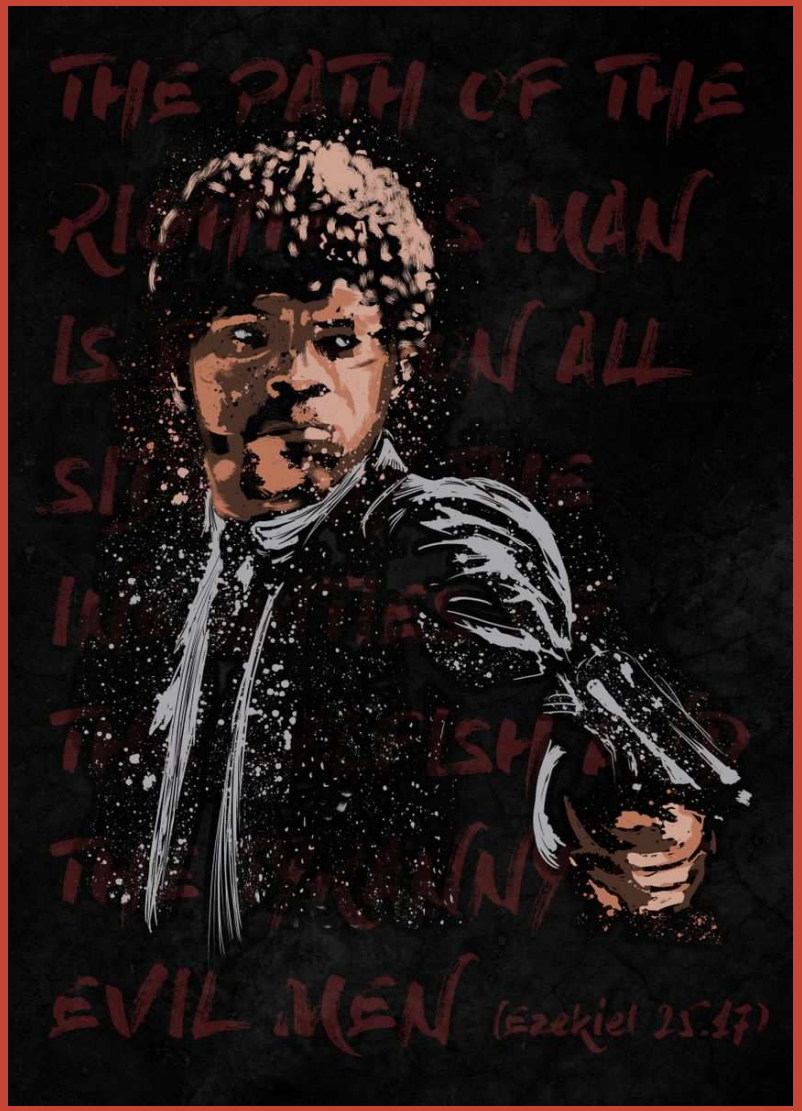


Drawing Elements –Stroke and Fill

- Color (named and RGB) and Transparency
- Stroke Width (thickness)
- Stroke Line Cap (line ending shape)
- Stroke Line Join (corner of 2 lines shape)
- Stroke Dash Array (dashed lines)
- Basic Fill



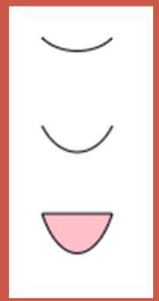
```
<svg xmlns="http://www.w3.org/2000/svg" width="320" height="200" stroke="black" fill="none">
    <rect width="100%" height="100%"/>
    <line x1="10" y1="10" x2="310" y2="190" stroke="blue" stroke-width="5"/>
    <line x1="310" y1="10" x2="10" y2="190" stroke-dasharray="10,5"/>
    <circle cx="50%" cy="50%" r="50" fill="#FFAAAA" fill-opacity="0.8"/>
    <polyline points="10,20 40,80 60,50 80,120 120,140 200,180" stroke-width="10" stroke-linejoin="round"/>
</svg>
```


THE PATH OF THE
MAN
ALL
EVIL MEN (Ezekiel 25:17)

Complex Shape - Path

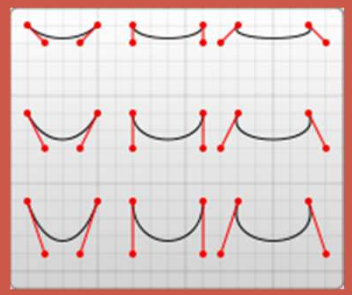
- Constructed from segments of type
  - Line
  - Bézier Curve
  - Arc
- Can draw practically anything
- Really complex to use
- Requires a list of commands, coordinates and segment parameters

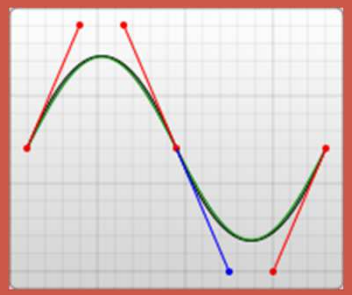
```
<svg width="190" height="160" xmlns="http://www.w3.org/2000/svg" stroke="black" fill="transparent">
    <path d="M 10 10 C 20 20, 40 20, 50 10" />
    <path d="M 10 60 C 20 80, 40 80, 50 60" />
    <path d="M 10 110 C 20 140, 40 140, 50 110 Z" fill="pink" />
</svg>
```

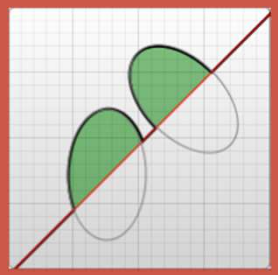


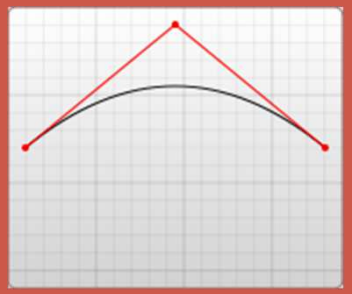
Complex Shape – Path Commands

- M - starting point of path (M x y)
- L – straight line segment (L x y)
- H – horizontal straight line (H x)
- V - vertical straight line (V x)
- Z – close the path at the end
- C – cubic Bézier Curve (C x1 y1, x2 y2, x y)
- S – continuous cubic Bézier Curve (S x2 y2, x y)
- Q – quadratic Bézier Curve (Q x1 y1, x y)
- T – continuous quadratic Bézier Curve (T x y)
- A – arc (rx ry x-axis-rotation large-arc-flag sweep-flag x y)
- X and Y vs DX and DY









Write a Text

- Basic <text> tag
- Subtext (<tspan> tag)
- Absolute text position with “x” and “y” attributes
- Relative subtext position with “dx” and “dy” attributes
- Fonts (style, size, spacing…)

Several lines: *First line.*

Second line.

```
<svg xmlns="http://www.w3.org/2000/svg" width="320" height="200" stroke="none" fill="red">
    <text x="10" y="50">Several lines:
    <tspan dx="0" dy="10" font-style="italic" font-family="Comic Sans MS" font-size="24">First line.</tspan>
        <tspan x="10" y="100" font-size="18" font-weight="bold">Second line.</tspan>
    </text>
</svg>
```

Transformations

- “transform” attribute
- Translation – translate(x,y)
- Rotation – rotate (angle centerx,centery)
- Skewing – skewX(angle) and skewY(angle)
- Scaling – scale(scalex, scaley)
- Possible to combine transformations

- Matrix

```
<svg viewBox="-5 -5 50 50" xmlns="http://www.w3.org/2000/svg">
    <rect x="-3" y="-3" width="6" height="6" />
    <rect x="-3" y="-3" width="6" height="6" fill="red" transform="skewX(-30) translate(10)" />
</svg>
```

URLs

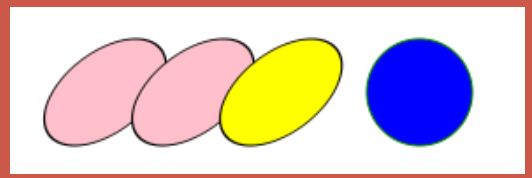
- Ordinary “a” tag
- Elements with URL are positioned within “a” tag

```
<svg viewBox="-5 -5 50 50" xmlns="http://www.w3.org/2000/svg">
    <a href="https://right-thing.solutions/">
        <rect x="-3" y="-3" width="6" height="6" />
        <rect x="-3" y="-3" width="6" height="6" fill="red" transform="skewX(-30) translate(10)" />
    </a>
</svg>
```

Grouping

- <g> … </g> tag
- Elements are located within tag
- Inherit attributes from group (stroke, fill, transformations…)

```svg
<svg width="100%" xmlns="http://www.w3.org/2000/svg" fill="blue" stroke="green">
    <g fill="pink" stroke="black" transform="skewX(-30)">
        <circle cx="150" cy="50" r="30"/>
        <circle cx="200" cy="50" r="30"/>
        <circle cx="250" cy="50" r="30" fill="yellow"/>
    </g>
    <circle cx="300" cy="50" r="30"/>
</svg>
```

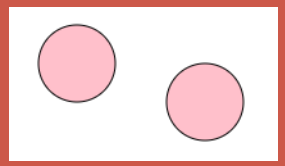


Re-use Elements and Objects

- “image” tag – inserts JPG, PNG or SVG image into current SVG image
- “use” tag – duplicates and displays a part of SVG image
- “object” tag – inserts object such as PDF document into image

```
<svg width="100%" xmlns="http://www.w3.org/2000/svg">
    <image
        href="https://right-thing.solutions/ords/r/app/170/files/static/v197/TRT_logo.svg"
        width="400"
    />
</svg>
```

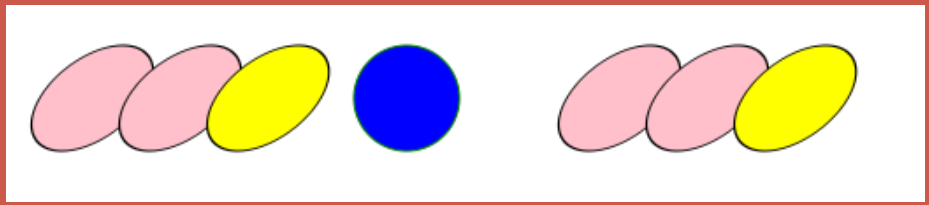

```
<svg width="100%" xmlns="http://www.w3.org/2000/svg">
    <circle cx="50" cy="50" r="30" fill="pink" stroke="black" id="myCircle" />
    <use href="#myCircle" x="100" y="30"/>
</svg>
```



Re-use Elements and Objects

- Re-use complete group by ID

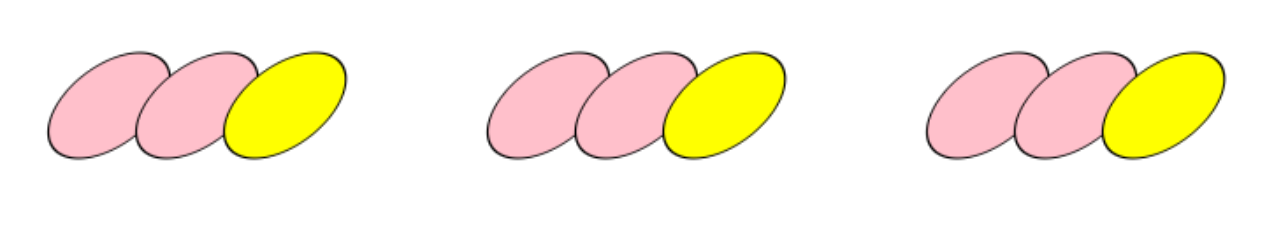
```svg
<svg width="100%" xmlns="http://www.w3.org/2000/svg" fill="blue" stroke="green">
    <g fill="pink" stroke="black" transform="skewX(-30)" id="myGroup">
        <circle cx="150" cy="50" r="30"/>
        <circle cx="200" cy="50" r="30"/>
        <circle cx="250" cy="50" r="30" fill="yellow"/>
    </g>
    <circle cx="300" cy="50" r="30"/>
    <use href="#myGroup" x="300" y="0">
</svg>
```



Re-use Elements and Objects

- Re-use elements or groups from <defs> section

```svg
<svg width="100%" xmlns="http://www.w3.org/2000/svg">
    <defs>
        <g fill="pink" stroke="black" transform="skewX(-30)" id="myGroup">
            <circle cx="150" cy="50" r="30"/>
            <circle cx="200" cy="50" r="30"/>
            <circle cx="250" cy="50" r="30" fill="yellow"/>
        </g>
    </defs>
    <use href="#myGroup" x="0" y="0"/>
    <use href="#myGroup" x="250" y="0"/>
    <use href="#myGroup" x="500" y="0"/>
</svg>
```



Style and CSS classes

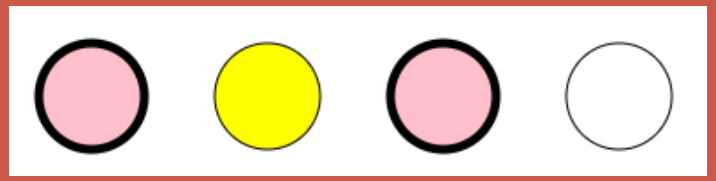
- SVG-specific styles are used
- “style” element attribute, similar to HTML

```
<svg width="100%" xmlns="http://www.w3.org/2000/svg">
    <circle
        cx="100"
        cy="50"
        r="30"
        style="fill:pink; stroke:black; stroke-width:5px;" />
    <text
        x="200"
        y="50"
        style="fill:red; font-size:24px; font-style:italic">Colored text</text>
</svg>
```

Style and CSS classes

- CSS classes are defined in <defs> section with “style” tag
- Used in elements with “class” attribute

```svg
<svg width="100%" xmlns="http://www.w3.org/2000/svg">
    <defs>
        <style>
            .pinkCircle { fill:pink; stroke:black; stroke-width:5px; }
            .yellowCircle { fill:yellow; stroke:black; }
        </style>
    </defs>
    <circle cx="100" cy="50" r="30" class="pinkCircle"/>
    <circle cx="200" cy="50" r="30" class="yellowCircle"/>
    <circle cx="300" cy="50" r="30" class="pinkCircle"/>
    <circle cx="400" cy="50" r="30" fill="none" stroke="black"/>
</svg>
```

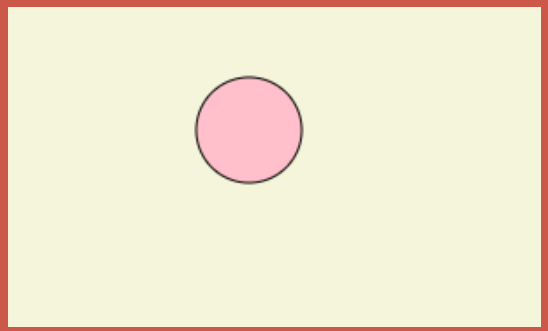


```svg
<svg
  width="600px"
  height="600px"
  viewBox="-300 -300 600 600"
  xmlns="http://www.w3.org/2000/svg"
  xmlns:xlink="http://www.w3.org/1999/xlink">
  <link rel="stylesheet" href="style8.css" type="text/css" />
```

- Can be also linked with external css file (“link” tag)

Style and CSS classes

- CSS classes outside of SVG

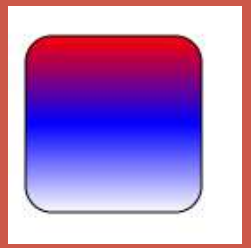


```html
<!DOCTYPE html>
<html>
    <head>
        <title>This is SVG example</title>
        <style>
            /*** SVG demonstration ***/

            /* page */
            svg {
                background-color: beige;
            }
            circle {
                fill: pink;
                stroke: black;
            }</style>
    </head>
    <body>
        <svg width="600px" height="600px" viewBox="-300 -300 600 600"
            xmlns="http://www.w3.org/2000/svg">
            <circle x="100" y="10" r="30"/>
        </svg>
    </body>
</html>
```

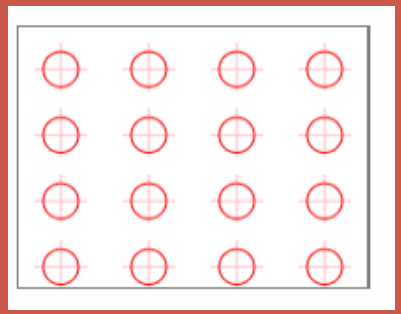
Gradients, Patterns

- Gradients – defined in <defs> section; fill color change; linear or circle
- Patterns – fill element by repeating another SVG elements

```svg
<svg width="100%" xmlns="http://www.w3.org/2000/svg">
    <defs>
    <linearGradient id="myGrad" x1="0" y1="0" x2="0" y2="100%">
        <stop offset="0%" style="stop-color:rgb(255,0,0); stop-opacity:1" />
        <stop offset="50%" style="stop-color:rgb(0,0,255); stop-opacity:1" />
        <stop offset="100%" style="stop-color:#FFFFFF; stop-opacity:1" />
    </linearGradient>
    </defs>
    <rect x="10" y="10" rx="15" ry="15" width="100" height="100" fill="url(#myGrad)" stroke="black"/>
</svg>
```



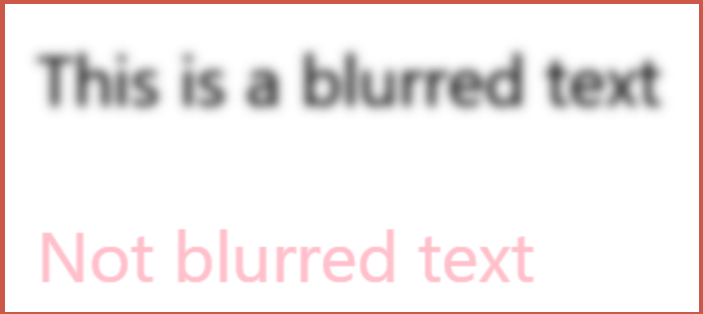
```svg
<svg width="100%" xmlns="http://www.w3.org/2000/svg">
    <defs>
        <pattern id="myPattern" x="0" y="0" width="25%" height="25%">
            <line x1="25" y1="10" x2="25" y2="40" stroke="pink"/>
            <line x1="10" y1="25" x2="40" y2="25" stroke="pink"/>
            <circle cx="25" cy="25" r="10" stroke="red" fill="none"/>
        </pattern>
    </defs>
    <rect fill="url(#myPattern)" stroke="black" width="200" height="150"/>
</svg>
```



Filters

- Filters – used for graphic effects like blur, lightning…
- Effects combining

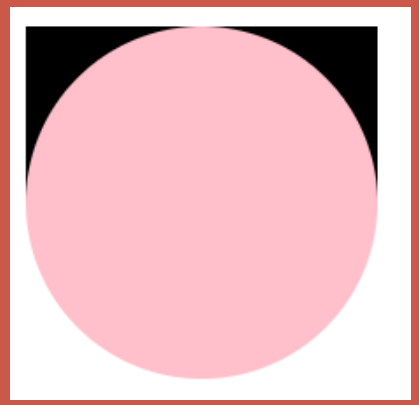
```svg
<svg width="100%" height="300" xmlns="http://www.w3.org/2000/svg" fill="pink">
    <defs>
        <filter id="myFilter" filterUnits="userSpaceOnUse" x="0" y="0" width="500" height="500">
            <feGaussianBlur in="SourceAlpha" stdDeviation="3" result="blur"/>
        </filter>
    </defs>
    <text filter="url(#myFilter)" x="10" y="50" font-size="40">This is a blurred text</text>
    <text x="10" y="150" font-size="40">Not blurred text</text>
</svg>
```



Clipping

- Clipping – removing element parts defined by other element

```svg
<svg width="100%" height="300">
    <rect x="0" y="0" width="200" height="100"/>
    <circle cx="100" cy="100" r="100" fill="pink"/>
</svg>
```



```svg
<svg width="100%" height="300">
    <defs>
        <clipPath id="myClip">
            <rect x="0" y="0" width="200" height="100"/>
        </clipPath>
    </defs>
    <circle cx="100" cy="100" r="100" fill="pink" clip-path="url(#myClip)"/>
</svg>
```

Masking

- Masking – complex clipping, can be combined with transparency

```svg
<svg viewBox="-10 -10 640 480">
    <rect x="0" y="0" width="100" height="100" fill="white" stroke="black"/>
    <path d="M10,35 A20,20,0,0,1,50,35 A20,20,0,0,1,90,35 Q90,65,50,95 Q10,65,10,35 Z" fill="black"/>
</svg>
```

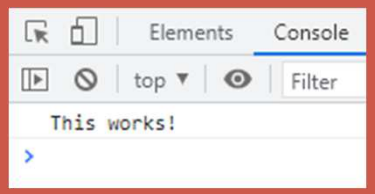
```svg
<svg viewBox="-10 -10 640 480">
    <mask id="myMask">
        <rect x="0" y="0" width="100" height="100" fill="white"/>
        <path d="M10,35 A20,20,0,0,1,50,35 A20,20,0,0,1,90,35 Q90,65,50,95 Q10,65,10,35 Z" fill="black"/>
    </mask>
    <polygon points="-10,110 110,110 110,-10" fill="orange"/>
    <circle cx="50" cy="50" r="50" fill="pink" mask="url(#myMask)"/>
</svg>
```

SVG and Javascript

- onClick and similar events

```svg
<svg xmlns="http://www.w3.org/2000/svg" width="700" height="600">
    <defs>
        <style type="text/css">
            <![CDATA[
                .oneCircle {
                    fill:pink;
                }
                .oneCircle:hover {
                    fill-opacity:0.5; cursor:pointer;
                }
            ]]></style>
    </defs>
    <circle cx="100" cy="100" r="50" class="oneCircle" onclick="myFunction()"/>
</svg>
```

```javascript
function myFunction() {
    console.log("This works!");
}
```



- Use jQuery to reference APEX dynamic actions

PL/SQL API – live demo

- ZT_SVG database package

```
--image handling
PROCEDURE p_new_image (
    p_image_reference varchar2 default zt_svg.gcDefaultIndex,
    p_viewbox_X number default null,
    p_viewbox_Y number default null,
    p_viewbox_width number default null,
    p_viewbox_height number default null,
    p_image_width varchar2 default null,  --number or percentage
    p_image_height varchar2 default null  --number or percentage
);
```

```
PROCEDURE p_draw_text (
    p_image_reference varchar2 default zt_svg.gcDefaultIndex,
    p_supertext_ref pls_integer default null,
    p_id varchar2 default null,
    p_x number default null,
    p_y number default null,
    p_dx number default null,
    p_dy number default null,
    p_text varchar2,
    p_font_ref varchar2 default null,
    p_font r_font default grDefaultFont,
    p_fill zt_svg.r_fill default zt_svg.grDefaultFill,
    p_stroke_ref varchar2 default null,
    p_stroke r_stroke default zt_svg.grDefaultStroke,
    p_style varchar2 default null,
    p_class_name varchar2 default null,
    p_url r_url default null,
    p_transform r_transform default null
);
```

```
FUNCTION f_draw_circle (
    p_image_reference varchar2 default zt_svg.gcDefaultIndex,
    p_id varchar2 default null,
    p_center_x number,
    p_center_y number,
    p_radius number,
    p_fill zt_svg.r_fill default zt_svg.grDefaultFill,
    p_stroke_ref varchar2 default null,
    p_stroke r_stroke default zt_svg.grDefaultStroke,
    p_style varchar2 default null,
    p_class_name varchar2 default null,
    p_url r_url default null,
    p_transform r_transform default null,
    p_custom_attributes varchar2 default null
) RETURN pls_integer;
```

```
--finish image and return HTML
FUNCTION f_finish_image (
    p_image_reference varchar2 default zt_svg.gcDefaultIndex
) RETURN clob;
```

LIVE DEMO

Conclusion

Conclusion

- What is SVG
- Brief history
- Organization and structure
- Basic and complex drawing elements
- Integration with CSS, HTML and Javascript

- PL/SQL API for generating images from Oracle Database
- Live demo

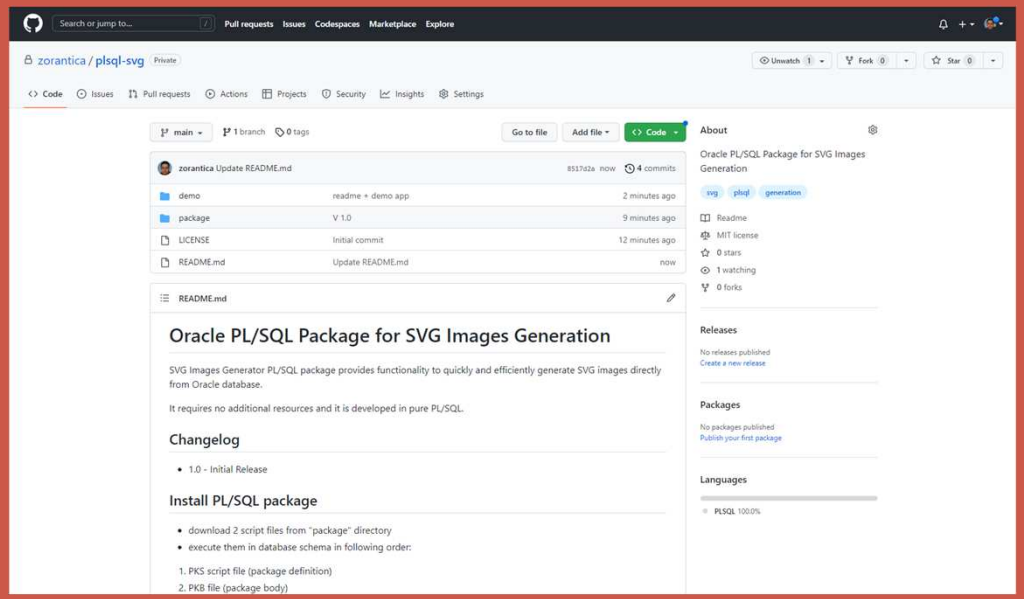
Conclusion

Useful scenarios:

- Different clients connect to same Oracle database
- Only PL/SQL developers in team
- Easy integration with APEX
- Customer doesn’t allow third party libraries on client side
- Restrictions on external services usage
- Generate SVG images during data processing

Easy to install and use on every project with Oracle database. Just install one PL/SQL package and You’re good to go.

A Gift for Community



https://github.com/zorantica/plsql-svg

Questions?


THE END
Thank you for listening!

References

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