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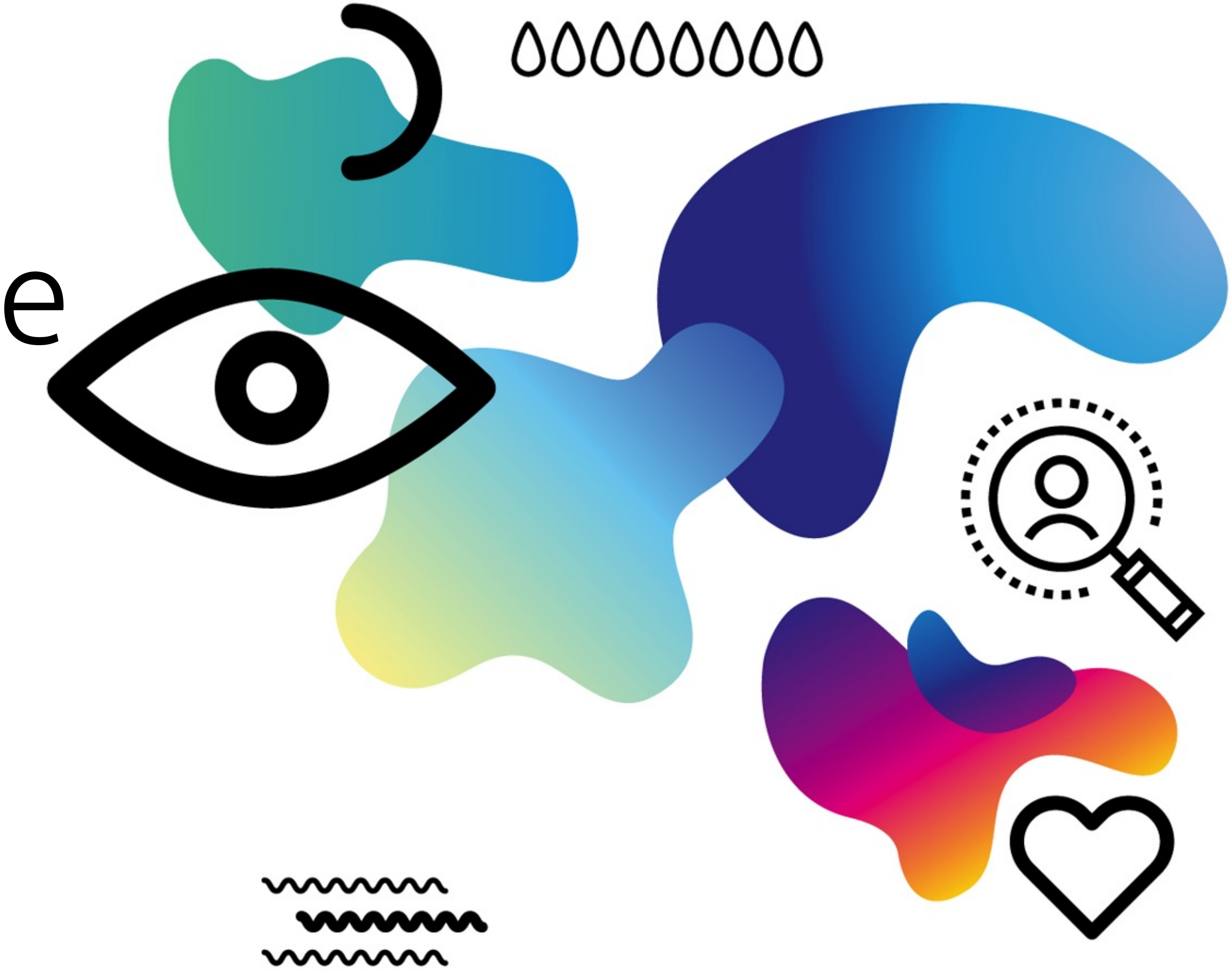
DOT Language for CONSORT Flow Diagram



Nicolas Guerro

PHUSE EU Connect 2022 - Paper SM03

Agenda

Introduction

CONSORT flow diagram

Implementation methods

DOT Language

DOT Language, R and SAS

Conclusion

Introduction

- CONSORT flow diagram is a growing need to describe the flow of a population through a trial analysis.
- Concepts and nomenclature related to flow diagrams.
- Drawing it by hand or drawing it programmatically : Evaluation of diagramming tools and SAS programming approaches.
- Graph Description Language (DOT Language) is thought to represent structured information.
- DOT language and R and SAS: A global programming approach to quickly produce, reproduce or update the right plot.

CONSORT flow diagram

Definition

- CONsolidated Standards Of Reporting Trials (CONSORT) group set up a list of recommendations for reporting randomized control trials, including a flow diagram.

  Consort - Welcome to the CONSORT Website (consort-statement.org)

- Fundamental when publishing posters or articles.
- Goes in the direction of data visualization; replaces disposition tables.
- Example:

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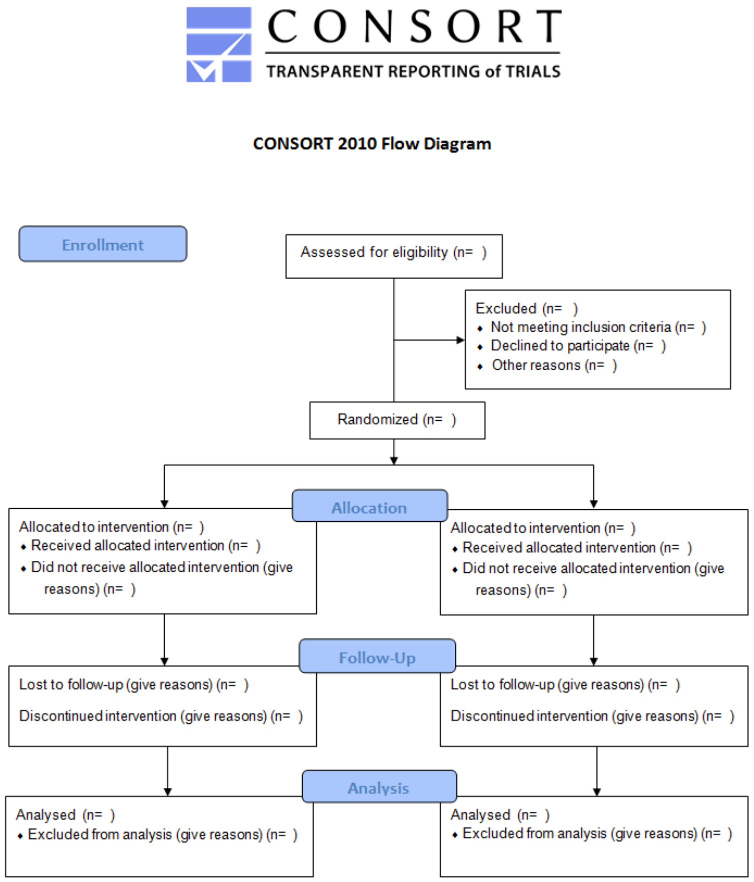

CONSORT
TRANSPARENT REPORTING of TRIALS

CONSORT 2010 Flow Diagram

Enrollment

Assessed for eligibility (n=)

Excluded (n=)
- Not meeting inclusion criteria (n=)
- Declined to participate (n=)
- Other reasons (n=)

Randomized (n=)

Allocation

Allocated to intervention (n=)
- Received allocated intervention (n=)
- Did not receive allocated intervention (give reasons) (n=)

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Follow-Up

Lost to follow-up (give reasons) (n=)

Discontinued intervention (give reasons) (n=)

Lost to follow-up (give reasons) (n=)

Discontinued intervention (give reasons) (n=)

Analysis

Analysed (n=)
- Excluded from analysis (give reasons) (n=)

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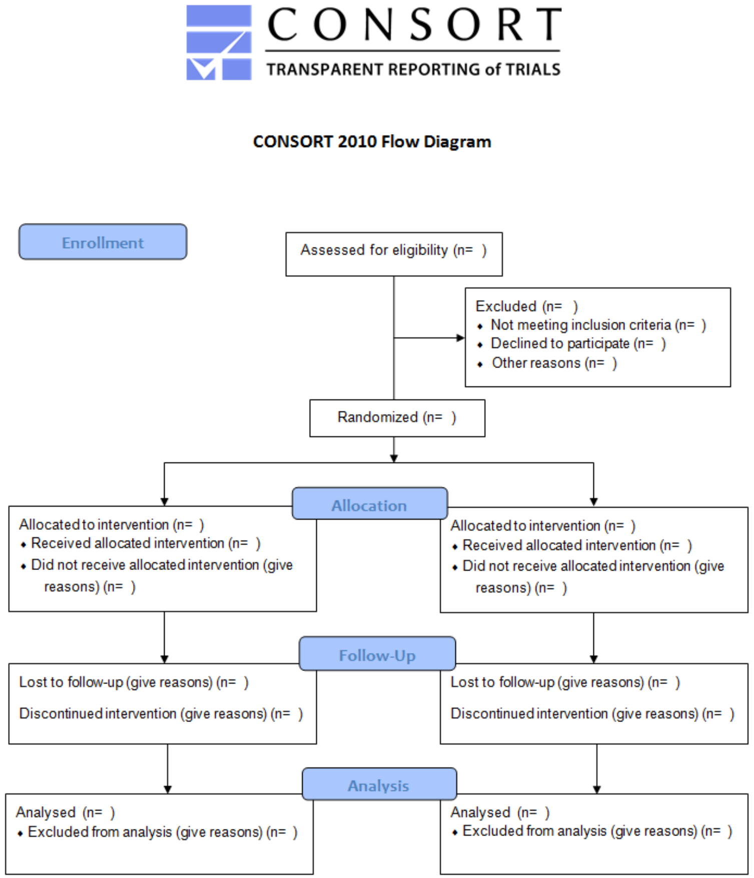
CONSORT flow diagram

Definition

- A flow diagram is a tree structure-like graph.
- A CONSORT plot is a flow diagram which provides a schematic view of the progress of patients through the phases of a trial :
  - Sequence of phases.
  - Discontinuations along the study.
  - Analysis sets.
  - Treatment allocation.
  - Number of patients in each category.



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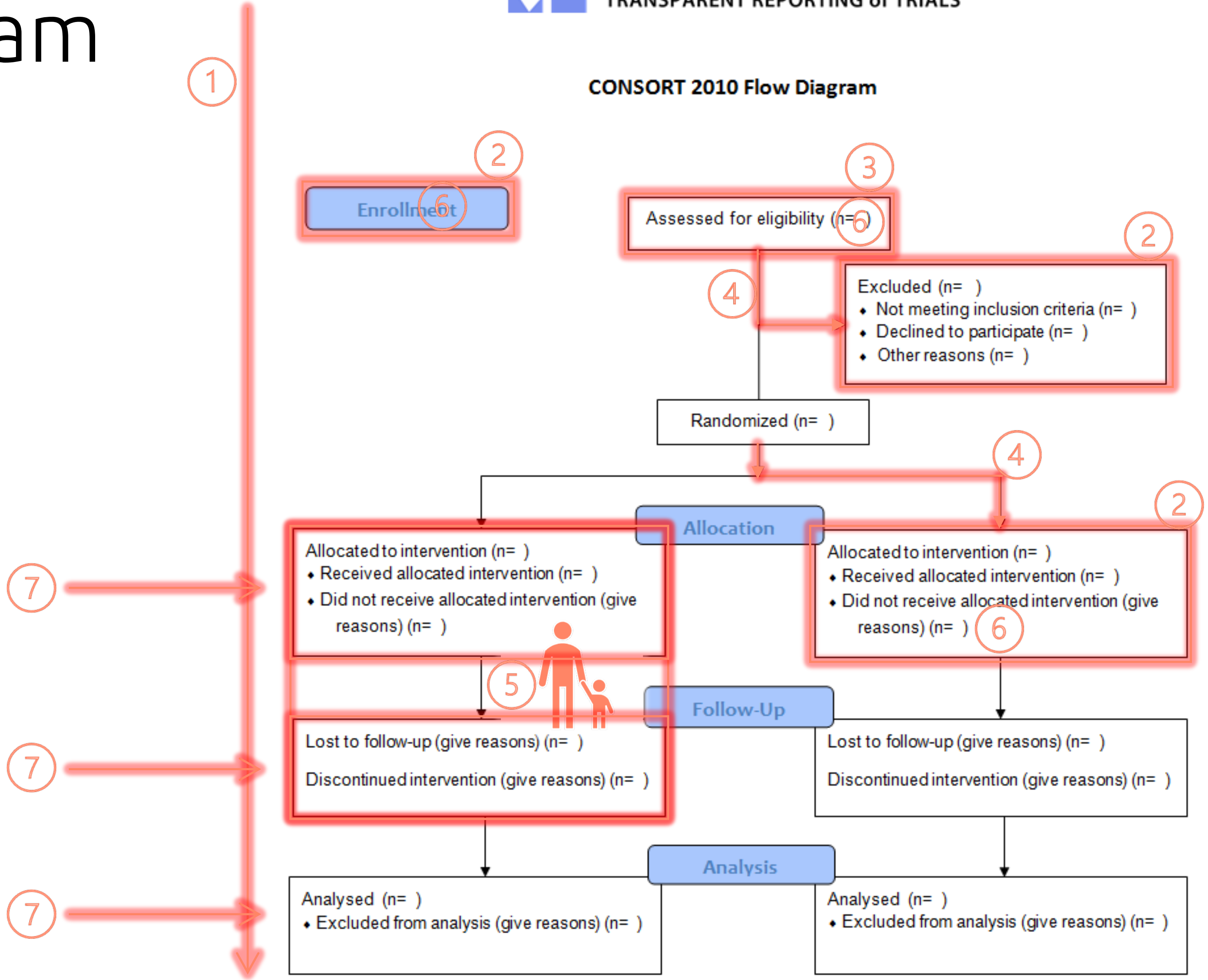

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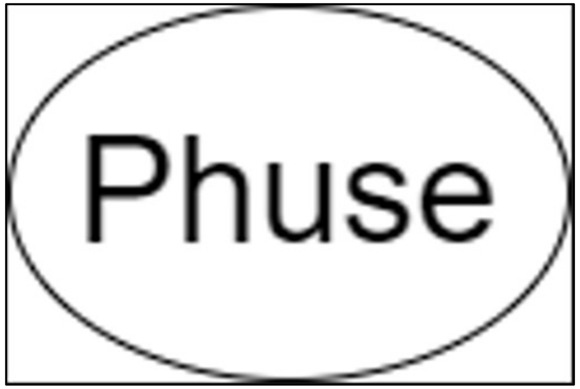
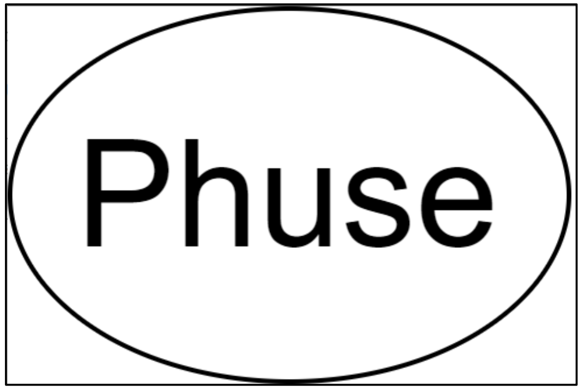
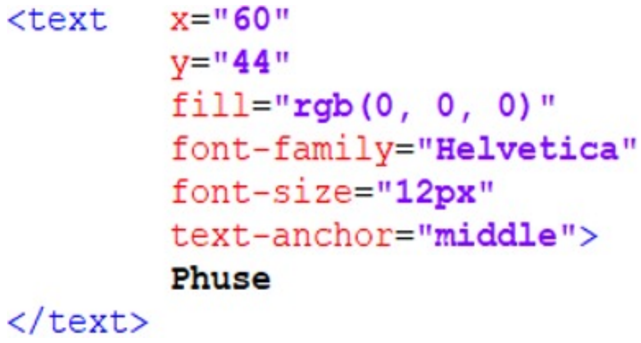
1 DIRECTION
2 NODES
3 ROOT NODE
4 EDGES
5 PARENT / CHILD
6 TEXT
7 RANK

CONSORT flow diagram

Image files

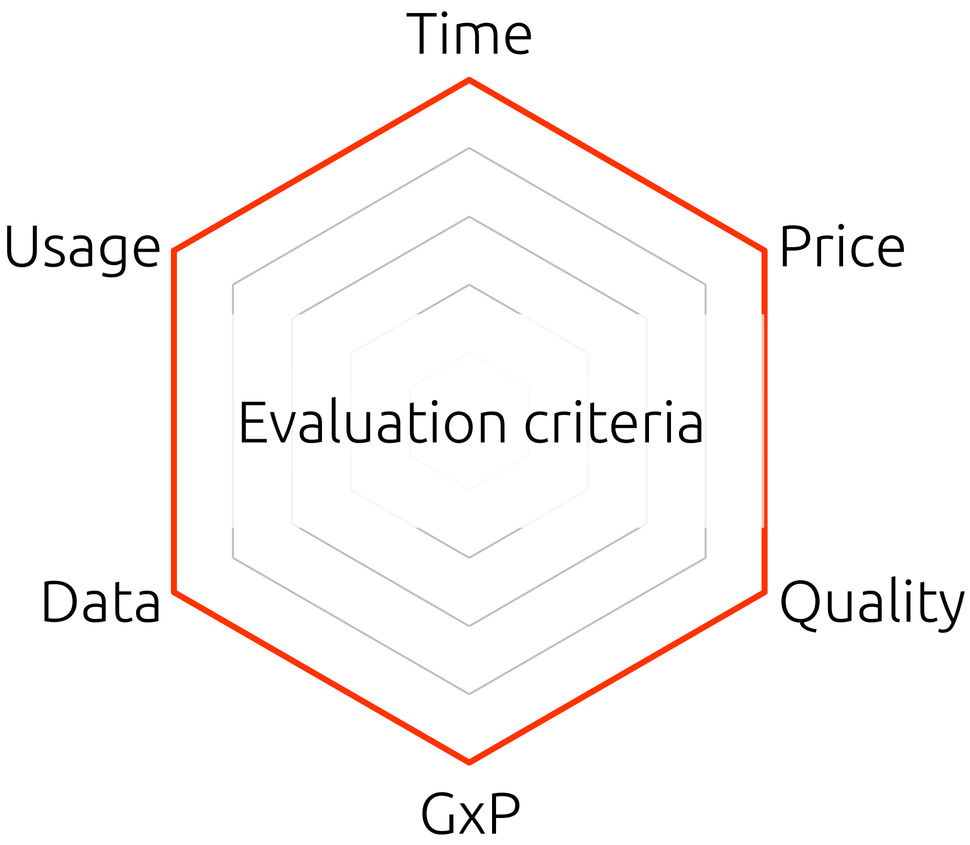
	RASTER	VECTOR
Characteristics	Pixels	Fixed points (paths) on a grid.
File type	JPEG, GIF, PNG…	SVG, EPS, EMF…
Resolution	Depends on DPI/PPI	Unlimited
Purpose	Photographs : image, photo and graphic	Illustration : graphics, logos
File size	Related to number of pixels	Mathematical formulas
Others	Supported by most of the printers and display devices.	Can be easily converted to raster. XML document
Example	 	



```
<text    x="60"
         y="44"
         fill="rgb(0, 0, 0)"
         font-family="Helvetica"
         font-size="12px"
         text-anchor="middle">
         Phuse
</text>
```

Implementation methods

Assessment



- Beginner friendly, quick production
- License cost minimal
- Visual quality of the deliverable
- Attributable, legible, accountable, traceable…
- Connected to source data – Accurate
- Flexible, resilient, maintenance, transfer to other people

Implementation methods

Manual drawing

→ Generic applications
Word, PowerPoint

→ Purpose-built applications
Visio, diagrams.net (draw.io)

Implementation methods

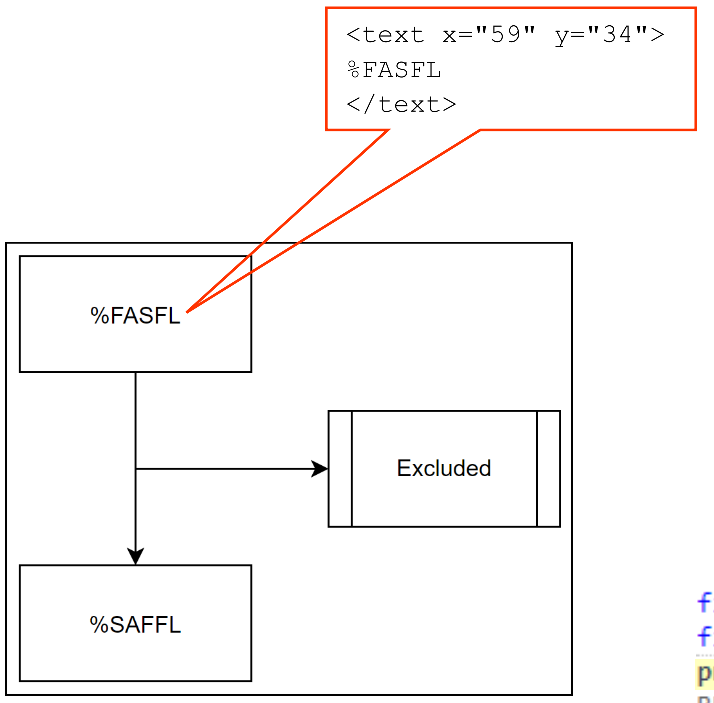
Manual drawing – SVG edition

- Mock shell
  - Build the diagram
  - Replace document-specific texts with placeholders (tokens)
  - Export diagram as SVG

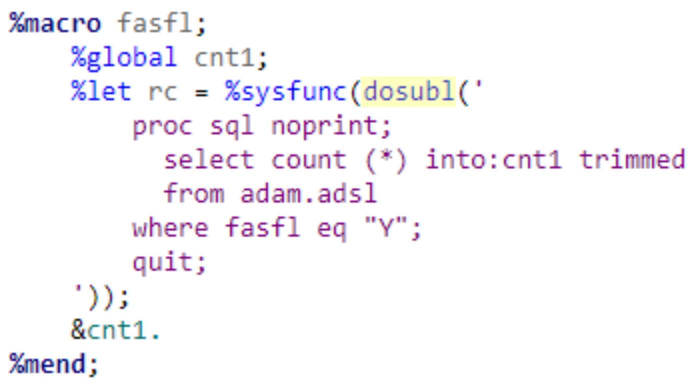
- Figure output
  - Read-in the SVG file
  - Perform text replacement
  - Output updated SVG file

Implementation methods

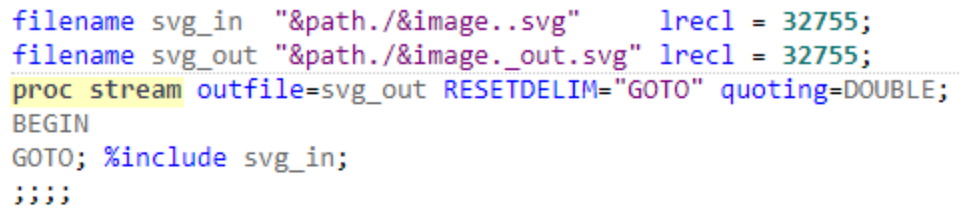
Manual drawing – SVG edition



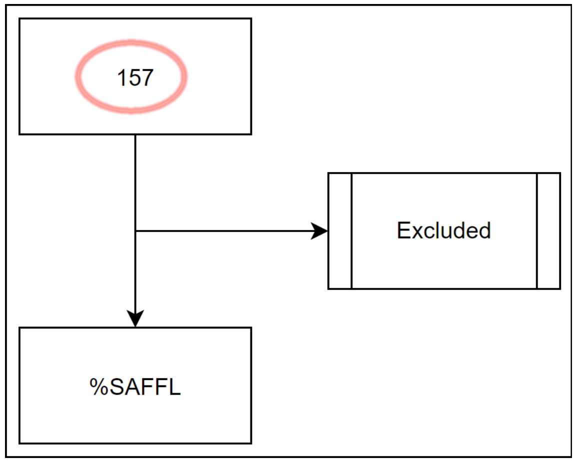
```
<text x="59" y="34">
%FASFL
</text>
```



```
%macro fasfl;
    %global cnt1;
    %let rc = %sysfunc(dosubl('
        proc sql noprint;
          select count (*) into:cnt1 trimmed
          from adam.adsl
        where fasfl eq "Y";
        quit;
    '));
    &cnt1.
%mend;
```



```
filename svg_in  "&path./&image..svg"     lrecl = 32755;
filename svg_out "&path./&image._out.svg" lrecl = 32755;
proc stream outfile=svg_out RESETDELIM="GOTO" quoting=DOUBLE;
BEGIN
GOTO; %include svg_in;
;;;;
```



Implementation methods

SAS programming

- Prepare CONSORT plot template in RTF and update tokens.
  - 👍 Has the merit of laying foundations for later approaches.
  - 👎 Chart built with Word. After text replacement, template may need to be redesigned.
- SAS ANNOTATE program to build the full plot.
  - 👍 Connected to data source. No extra tool. Process like any other figure creation.
  - 👎 Somehow need to input elements (nodes, edges) coordinates.
- SAS ANNOTATE program to build nodes. Link them together in a separate application.
  - 👍 Break free to position nodes relative to others.
  - 👎 Do not fit programming practices.
- Proc SGPLOT with series, polygon and text statements.
  - 👍 More modern than ANNOTATE facility
  - 👎 … but same limitations

Implementation methods

Summary

Creating CONSORT plots is possible with drawing applications or SAS programming.

- There is no suitable solution because each has its pros and cons.
  - VISIO and DIAGRAMS.NET best fit for quick production with high quality.
  - A SAS programming approach is more GCP compliant and connected to data.

- Manipulating SVG files might be considered to take advantage of all solutions.

DOT Language

Introduction

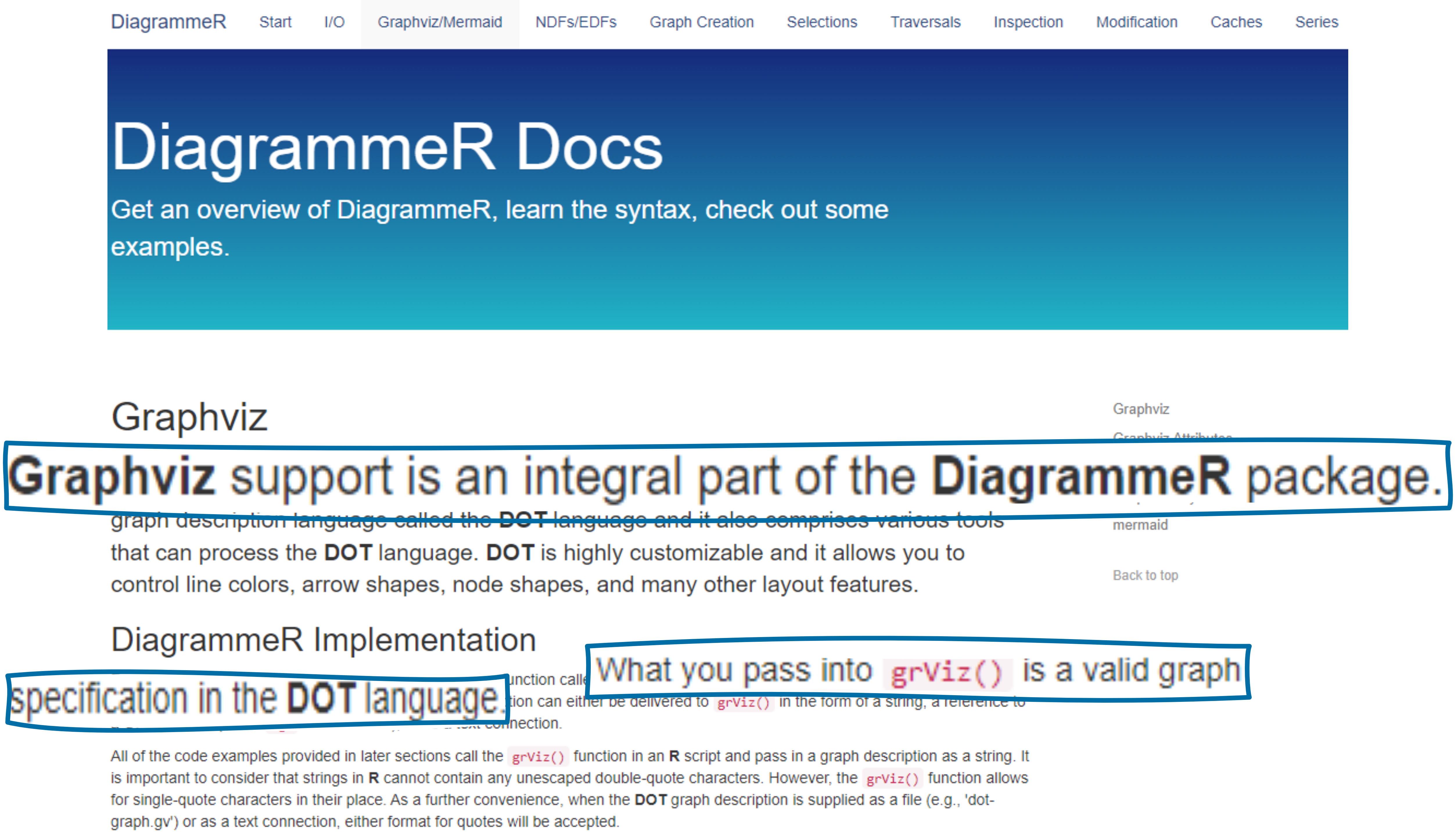
- The DOT Language is a syntax for describing graphs.
- In mathematics, graphs are the representation of a set of objects of which certain pairs are related, hierarchical and directional (but not always).
- This syntax is then parsed by a program to render the graph.
- Getting started with the language is simple, fast and learning the essential features can be covered in a very short time.
- Graphviz is such an open-source program which comes with all the documentation.
- DOT Language viewers allow to write and instantly visualize the graph.

DOT Language

Demo

Learn basics and make a CONSORT diagram

http://magjac.com/graphviz-visual-editor/



DiagrammeR Docs

Get an overview of DiagrammeR, learn the syntax, check out some examples.

Graphviz

Graphviz support is an integral part of the **DiagrammeR** package.

graph description language called the **DOT** language and it also comprises various tools that can process the **DOT** language. **DOT** is highly customizable and it allows you to control line colors, arrow shapes, node shapes, and many other layout features.

DiagrammeR Implementation

unction calle

What you pass into `grViz()` is a valid graph specification in the **DOT** language.

tion can either be delivered to `grViz()` in the form of a string, a reference to

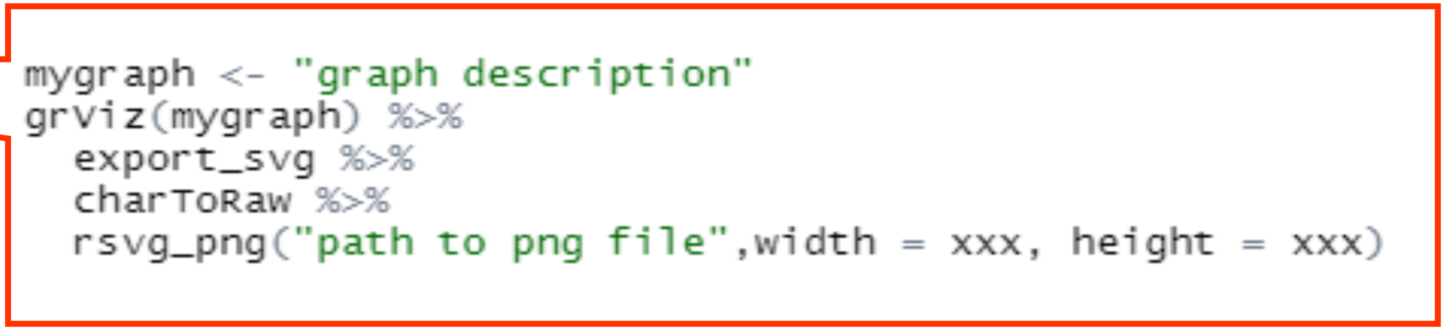
connection.

All of the code examples provided in later sections call the `grViz()` function in an **R** script and pass in a graph description as a string. It is important to consider that strings in **R** cannot contain any unescaped double-quote characters. However, the `grViz()` function allows for single-quote characters in their place. As a further convenience, when the **DOT** graph description is supplied as a file (e.g., 'dot-graph.gv') or as a text connection, either format for quotes will be accepted.

DOT Language, R and SAS

SAS: call R

```
proc options option=RLANG;
run;
options set=R_HOME "C:\Program Files\R\R-4.1.1"; /* name-of-R-home-directory */
proc iml;
  submit / R;
  # R code starts here
    <R code>
  # R code ends here
  endsubmit;
quit;
```



```
mygraph <- "graph description"
grViz(mygraph) %>%
  export_svg %>%
  charToRaw %>%
  rsvg_png("path to png file",width = xxx, height = xxx)
```

DOT Language, R and SAS

SAS: render image

```
ods escapechar = '^';
data get_r_image;
    length text $500; content=1;  text ='^S={preimage="path to png file"}';
run;
ods document name=work.dot (write);
    proc report data= get_r_image nowd missing spacing=1 split="@" contents=""
                      style(report)={rules=none frame=void cellspacing=0  };
        column content text ;
        define content / order order=internal noprint;
        define text    / style(column)={asis=on } " " width=20;
        break before content / page contents='';
    run;
ods document close;
ods pdf file ="path to pdf file";
    proc document name=work.dot(read);
        replay / dest=(pdf);
    run; quit;
ods pdf close;
```

DOT Language, R and SAS

Metadata driven diagram

Node	Cluster	Parent	Out	Rank	Text	Where	Codelist	Options
BOX_ENRL	PERIOD				Enrollment			Node:[style=filled fillcolor="light blue" width=2]
BOX_01	ENROLL			BOX_ENRL	Assessed for eligibility (n=%COUNT)	ADSL.ENRLFL eq ‘Y’		Edge:[style=invis]
BOX_02	ENROLL	BOX_01	Y		Excluded (n=%CNTPCT)	ADSL.ENRLFL eq ‘N’	ADSL.DCSREAS #CL.NCOMPLT	Edge:[minlen=6]

SHAPE + unique identifier for a node

BOX_ENRL is embedded in PERIOD cluster while the 2 others will be grouped together

An edge is drawn from BOX_01 to BOX_02

Node drawn to the right direction to indicate exclusions

Will appear on the same rank as the specified Node

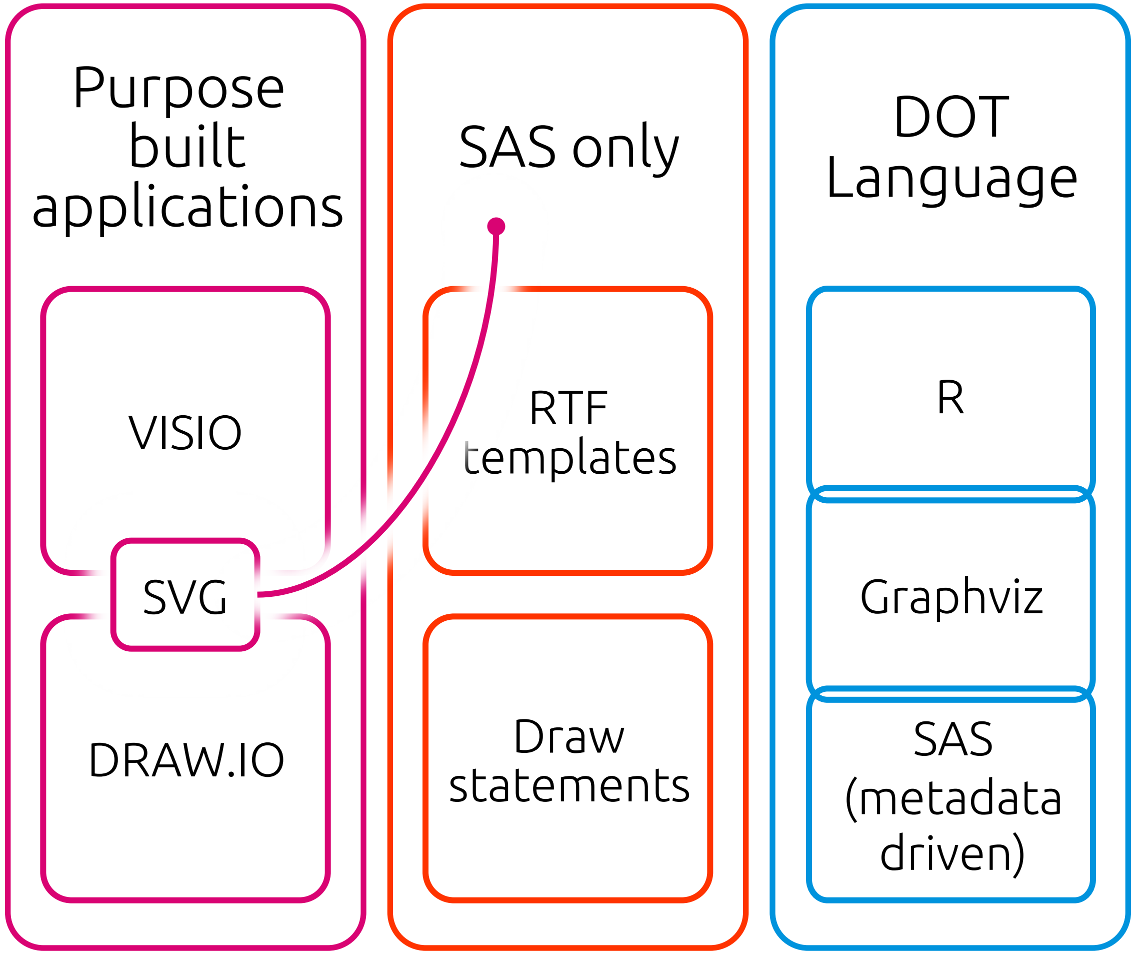
A free text and tokens

Records selection

A variable and its associated codelist to display all values + counts. If no codelist, then print only values in the datasets

Specify additional attributes for a node or the edge from the parent

Conclusion



Purpose built applications

VISIO

SVG

DRAW.IO

SAS only

RTF templates

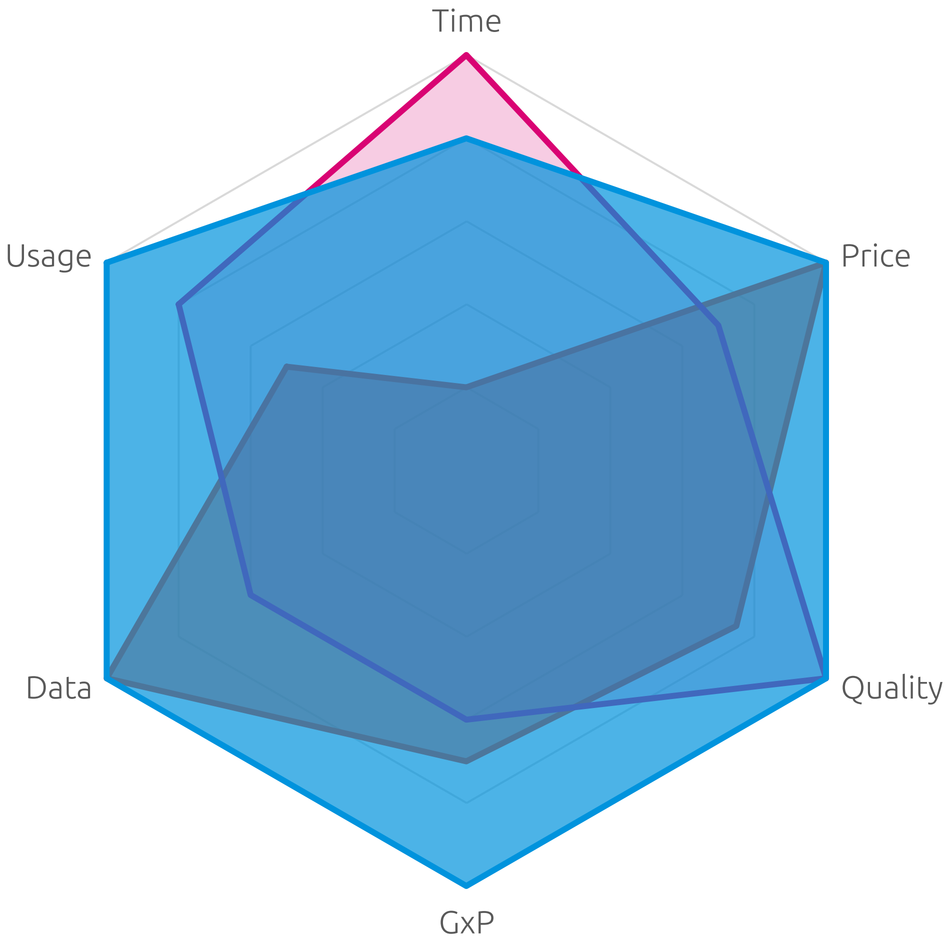
Draw statements

DOT Language

R

Graphviz

SAS (metadata driven)



Thanks

Questions ?

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