

# Visualization Options for QCA

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# Outline

- I. Start-up reading of 10–12 minutes:
  - a) pages 28-31 of “Presenting QCA”
  - b) marked section of *The Comparative Method*
  - c) page 53 of *Visual Explanations*
  - d) page 183 of *The Visual Display of Quantitative Information*
- II. What we might visualize, and why
- III. Software for creating visualizations
- IV. Using visualization to introduce QCA
- V. Survey of visualizations

# Two Uses for Visualization

- Visual analysis seeks to *discover* relationships among/between observations and conditions.
  - Audience is yourself; what can visualization reveal to you that tabular output misses?
- Presentation graphics are used to convey our findings to others. They are fundamentally rhetorical:
  - What information do you wish to highlight?
  - What story do you want to tell?
  - Two different audiences: those who know QCA well and those who don't

## Objects in a QCA Analysis

- Calibrated data sets,
- Truth tables
- Consistency/coverage solutions

## Goals of QCA Visualization

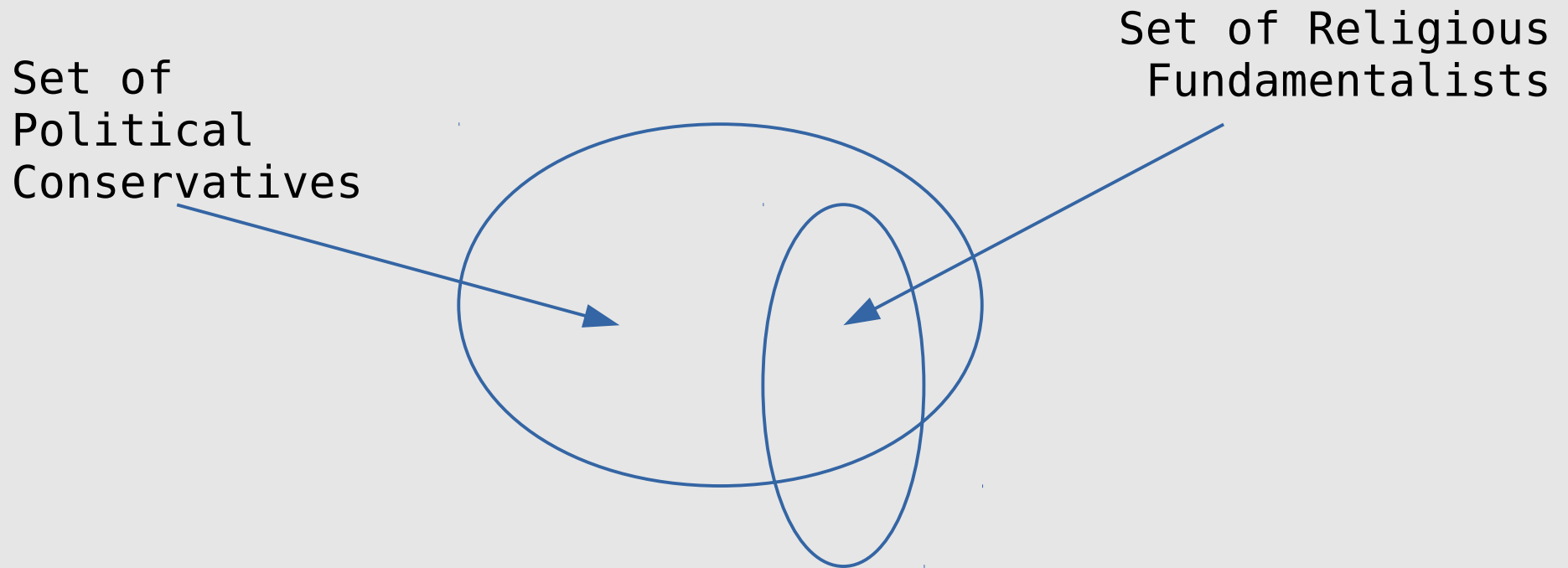
- Present superset/subset relationships
- Preserve case holism and diversity
- Clarify configurations
- Convey the range of solution complexity

# Introducing QCA to a New Audience

- Use Venn/Euler diagrams; people know and like them
- 2x2 tables are effective, especially when audience has a methodological background
- Be aware that XY plots can be confusing, especially when audience has a strong statistical background
- Boolean expressions are really helpful for highlighting QCA's distinctiveness
  - but consider alternatives to [ \*, + ] notation:
    - [ &, | ]
    - write out “and” and “or”

# QCA as the Study of Invariance

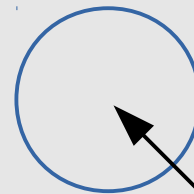
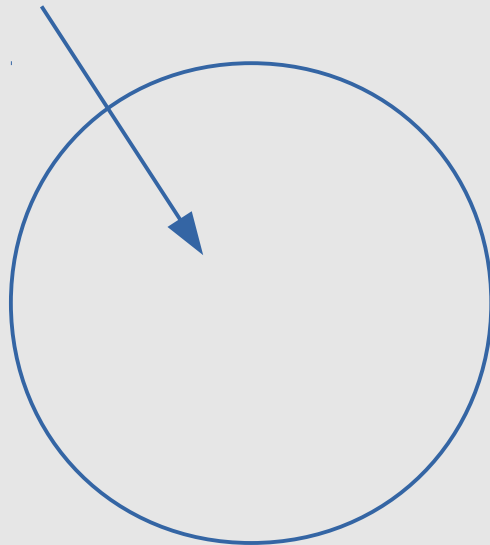
- Definition: Certain aspects of cases tend to co-occur.
  - Religious fundamentalists tend to be politically conservative.



# QCA as the Study of Invariance

- Definition: Certain aspects of cases tend to co-occur.
  - HIV causes AIDS

Set of people who are HIV-negative

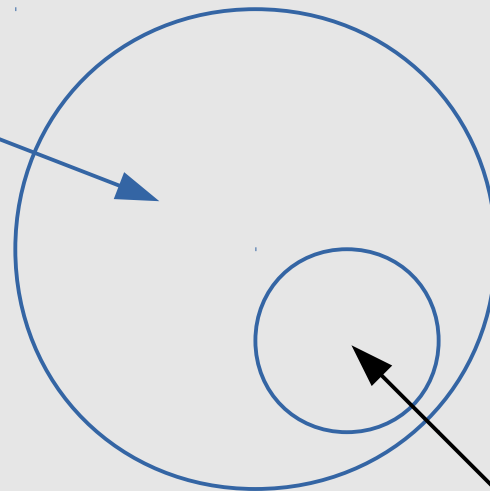


Set of people with AIDS

# QCA as the Study of Invariance

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Set of people who are HIV-positive

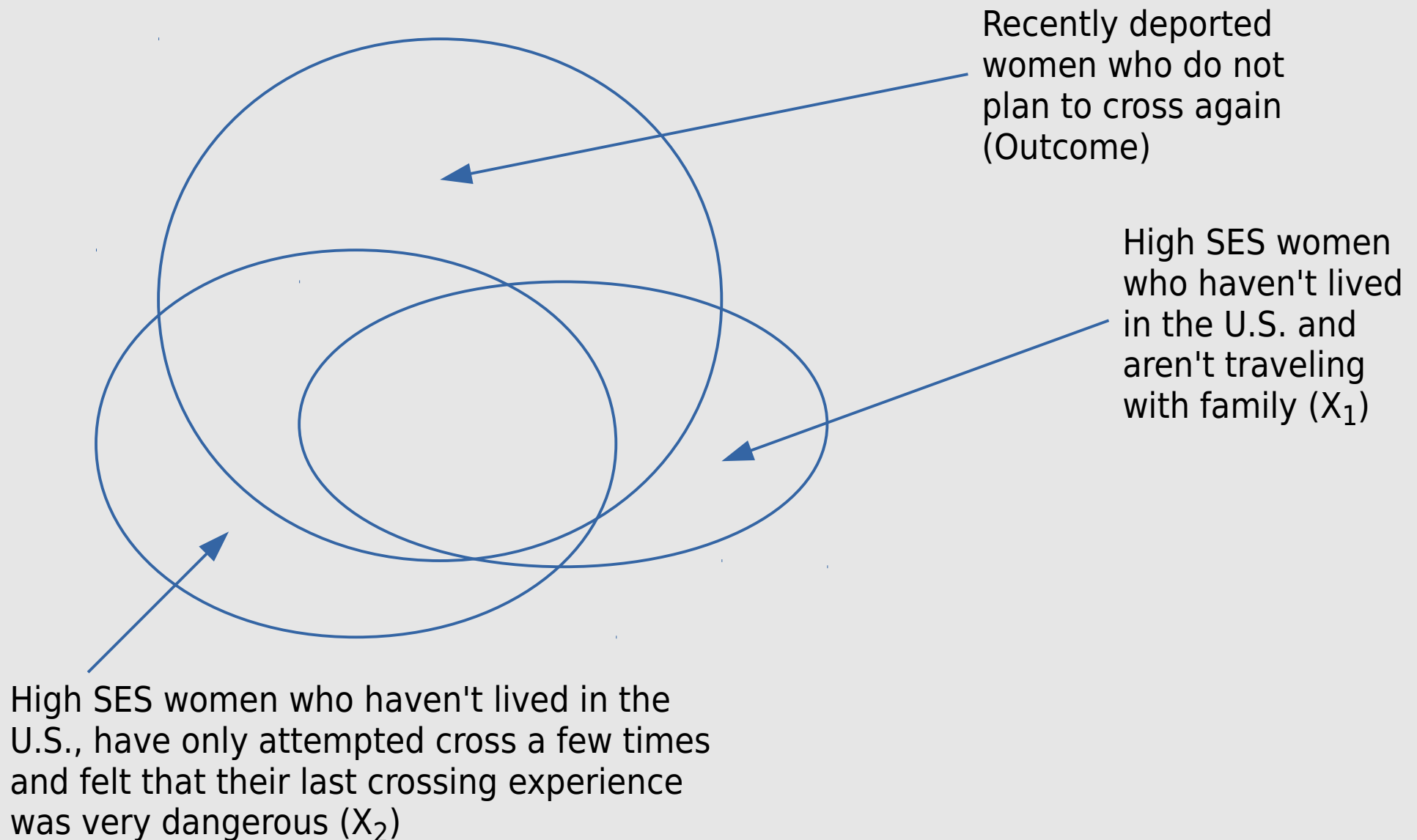


Set of people with AIDS



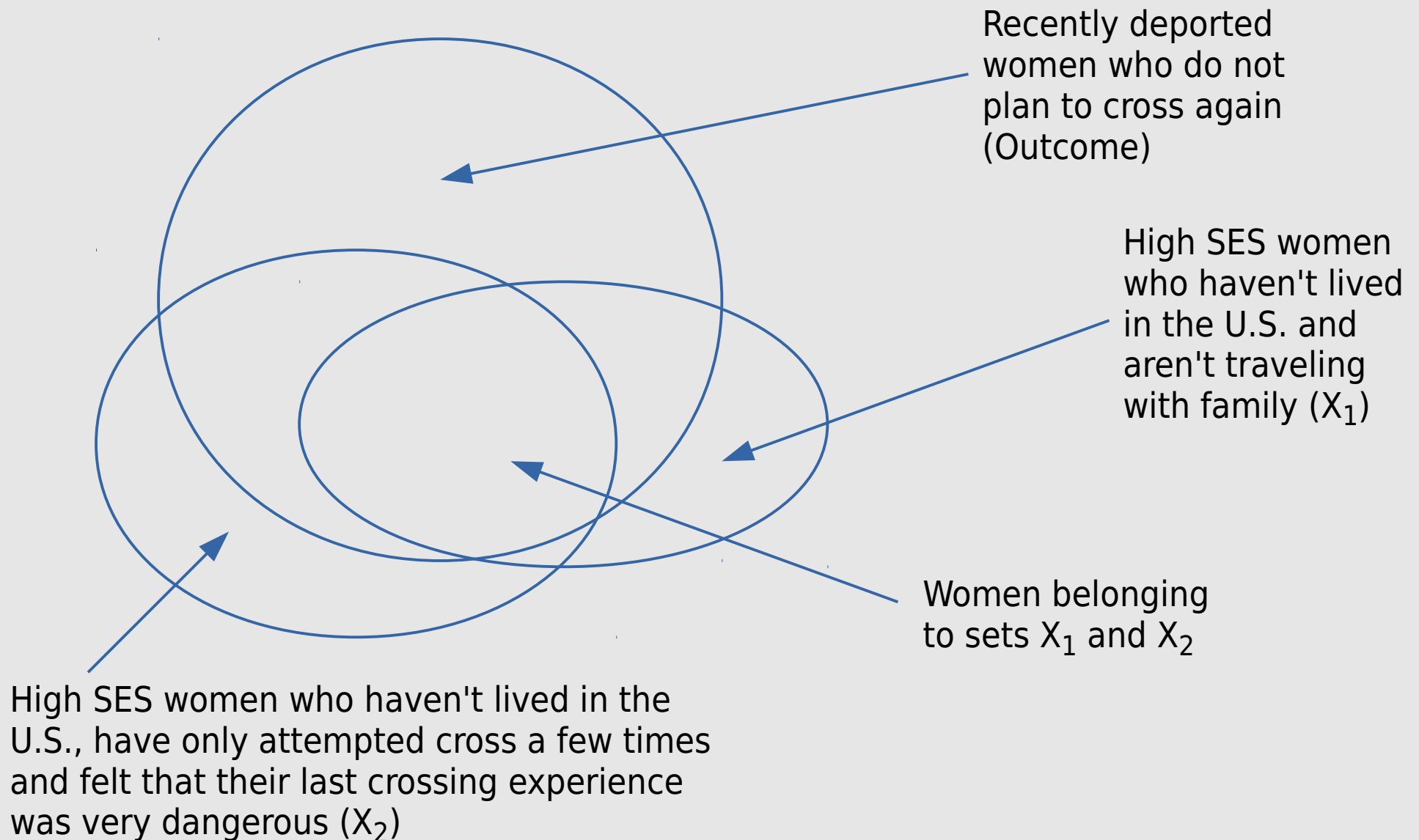
# Assessing Sufficient Conditions

- *Coverage* measures the relative “importance” of each solution



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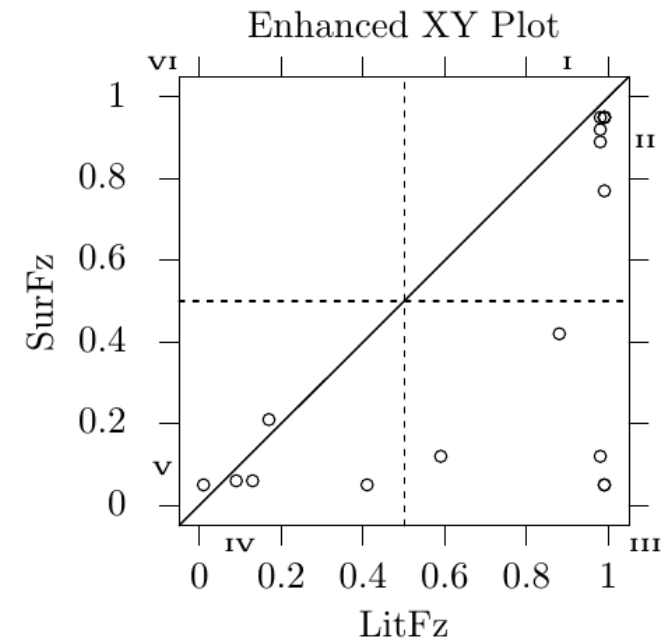
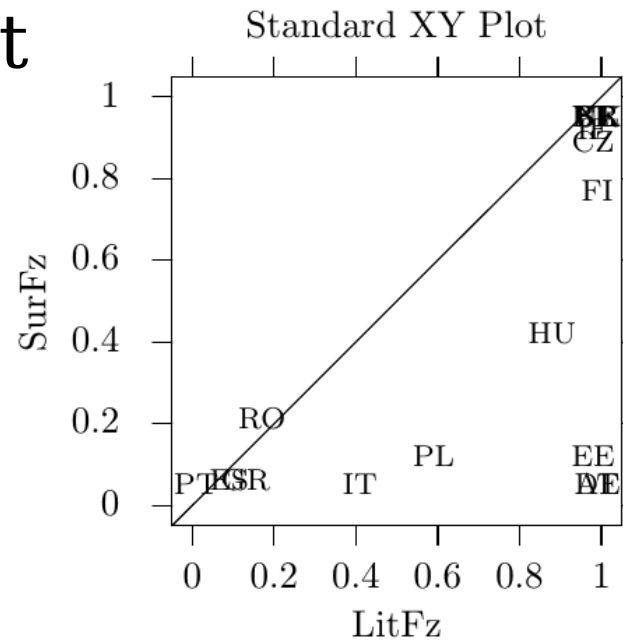
# (Too) Many Software Options

- Vector graphics (SVG, EPS, PS) permit arbitrary resizing and offer publication quality.
  - Avoid raster graphics (most formats, e.g., BMP, JPEG, PNG)
  - What about PDF?
- Vector graphics editors
  - **Inkscape**, Adobe Illustrator, LibreOffice, MS Office
- Diagram editors
  - **Dia**, **xfig**, MS Visio
- Languages
  - **TikZ**, **GraphViz**, **gnuplot**
  - R: SetMethods, Venn, ggplot2, lattice, etc.
  - programming language of your choice
- QCAViz suite under development
  - A good visualization usually requires manual intervention

# 2x2 Tables and XY Plots

	National Literacy Rate (LitCr)	
	Not High	High
Democracy Survival	— <i>n=0</i>	BE, CZ, FI, FR, IE, NL, SE, UK <i>n=8</i>
Democracy Breakdown	ES, GR, IT, PT, RO <i>n=5</i>	AT, DE, EE, HU, PL <i>n=5</i>

- Easy to construct
- Familiar and accessible
- Must explain interpretation of necessity and sufficiency



# Fiss Configuration Charts

- Displays all configurations and how they relate
- Simultaneously present multiple solutions
- Order of configurations is up to researcher; grouping by core conditions is just one option
- Can replace con/cov tables
- Web app:  
<http://grundrisse.org/qca/demo/>

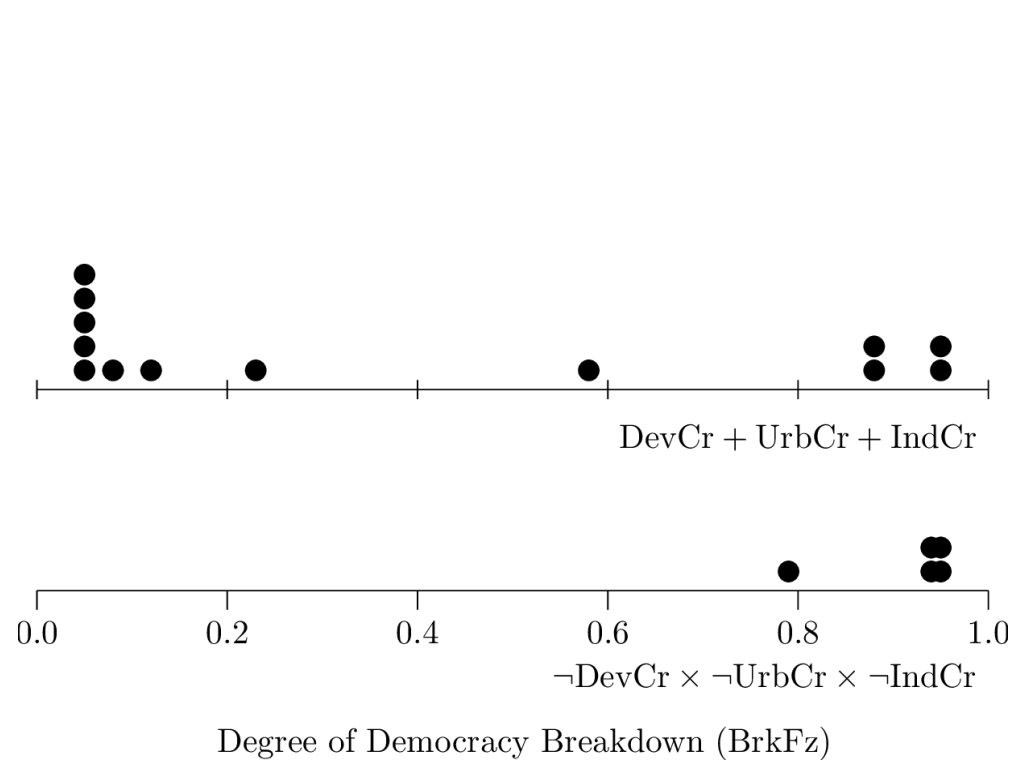
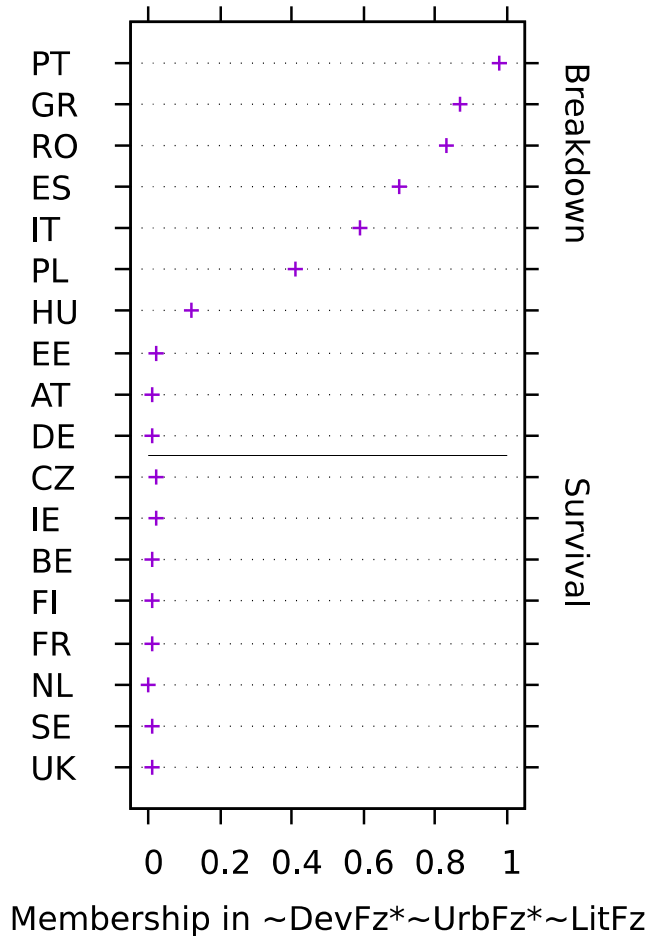
	Configurations				
	1	2	3	4	5
<b>Family Status</b>					
Married	●	⊖			●
Children	⊖		⊖	⊖	
<b>Education</b>					
High School	●	●	●		
College				●	●
<b>Test Scores</b>					
High AFQT					
Low AFQT		⊖	⊖	⊖	⊖
<b>Parental Income</b>					
High Income		●	●		
Low Income					⊖
Consistency	0.92	0.94	0.91	0.92	0.95
Raw coverage	0.13	0.10	0.14	0.16	0.11
Unique coverage	0.07	0.02	0.04	0.06	0.03

Solution consistency: 0.93

Solution coverage: 0.22

●/● Core/contributory condition present  
⊖/⊖ Core/contributory condition absent

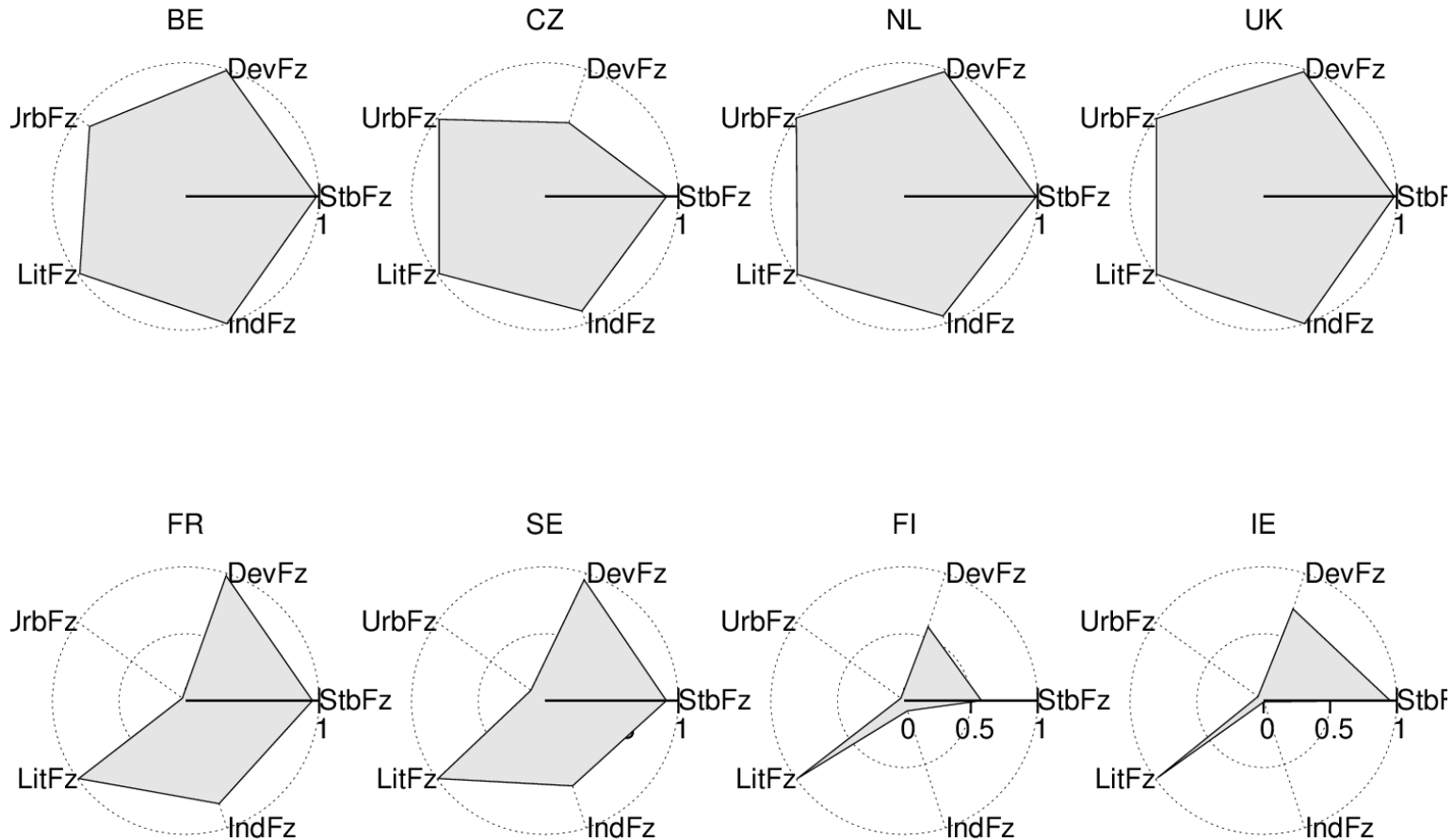
# Bivariate (biconditional) analysis: Crossing a fuzzy-set with a crisp-set



Rank-order plot

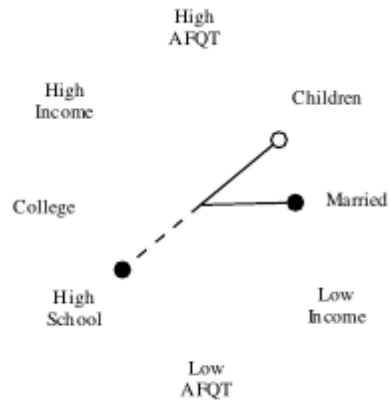
Dot plot

# Use radar charts to compare *shapes of observations*

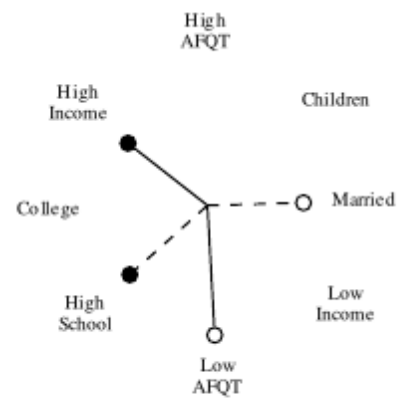


Also see Meuer, et. al. (2015) who use radar charts to compare configurations by aggregating (e.g., min, mean, max) across observations.

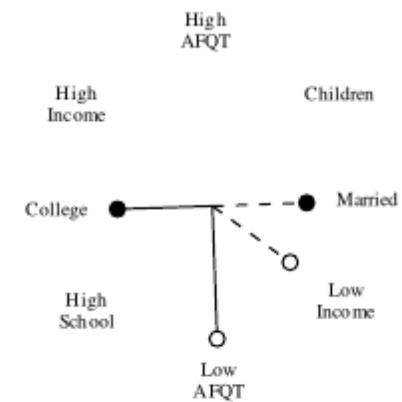
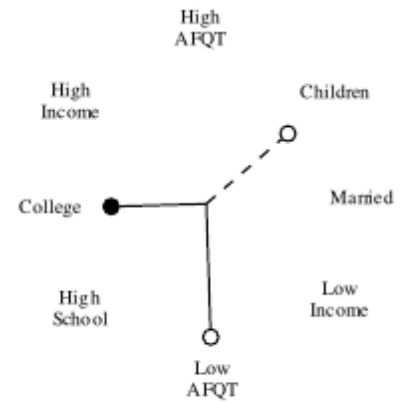
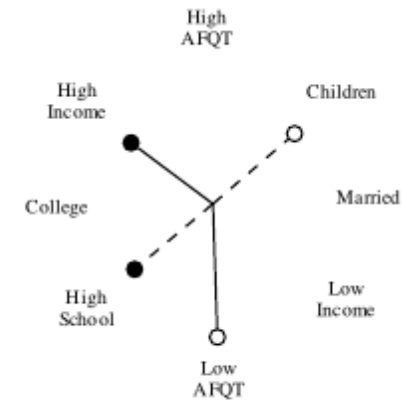
# Use star charts to compare *shapes of recipes*



(a) Favorable family situation  
(Configuration 1)



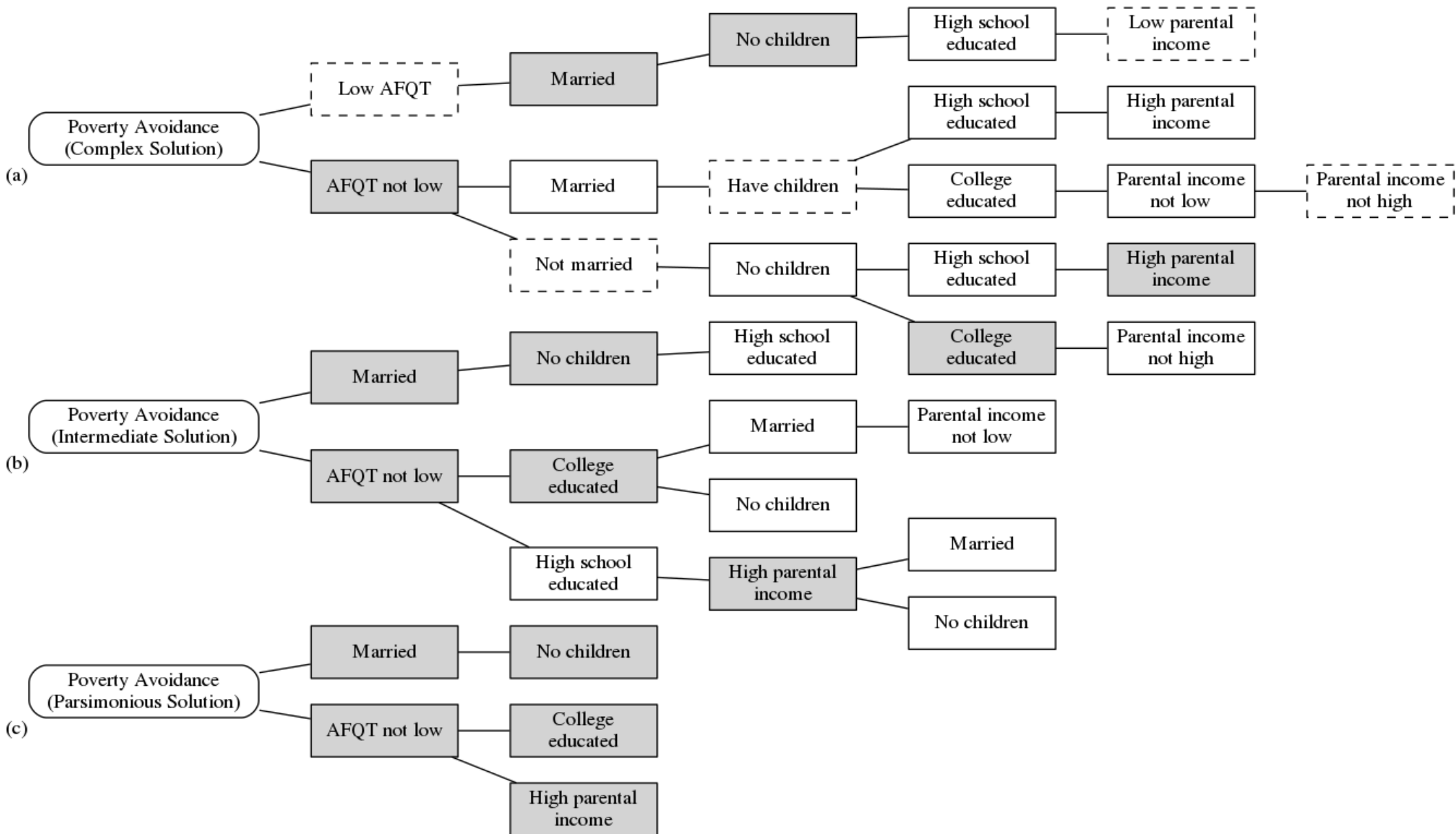
(b) Not-low AFQT score and high parental income  
(Configurations 2 & 3)



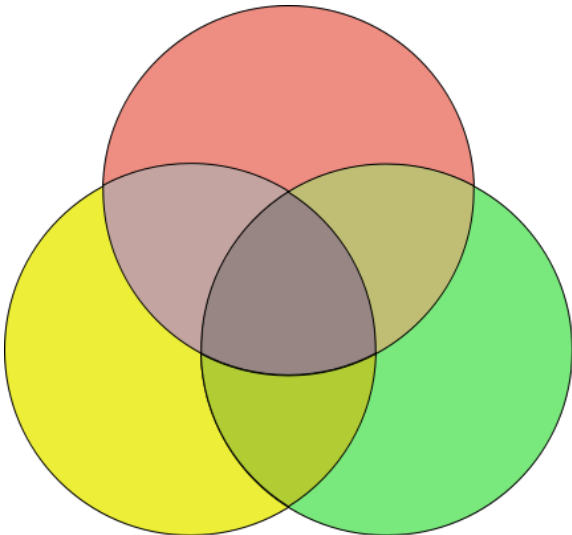
(c) Not-low AFQT score and college-educated  
(Configurations 4 & 5)



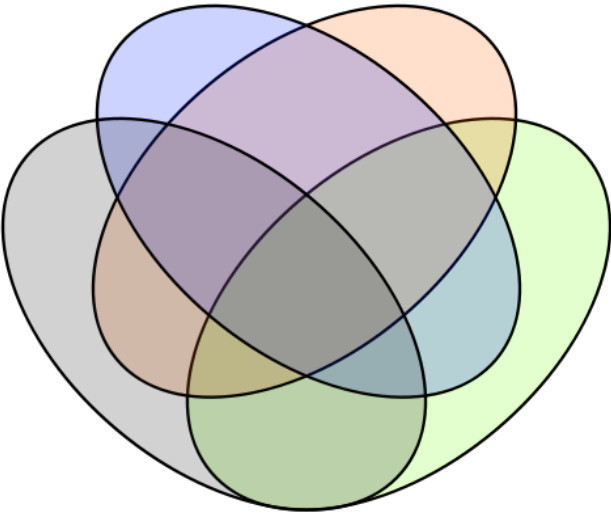
# Branching diagrams tell a story



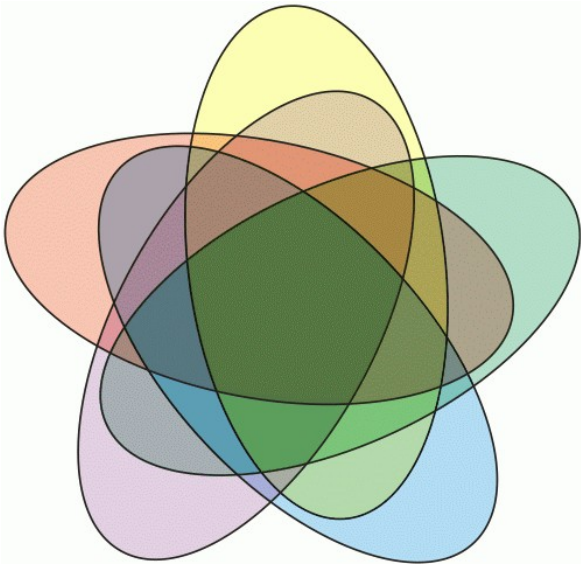
# Superset/subset Relationships



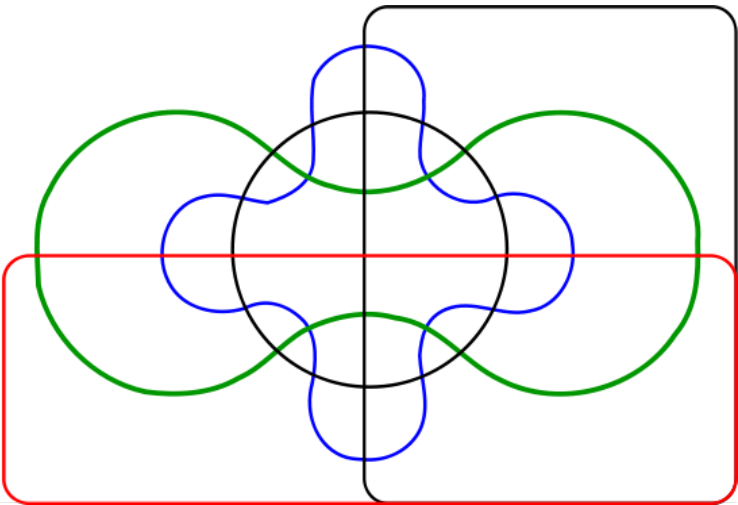
3-set Venn



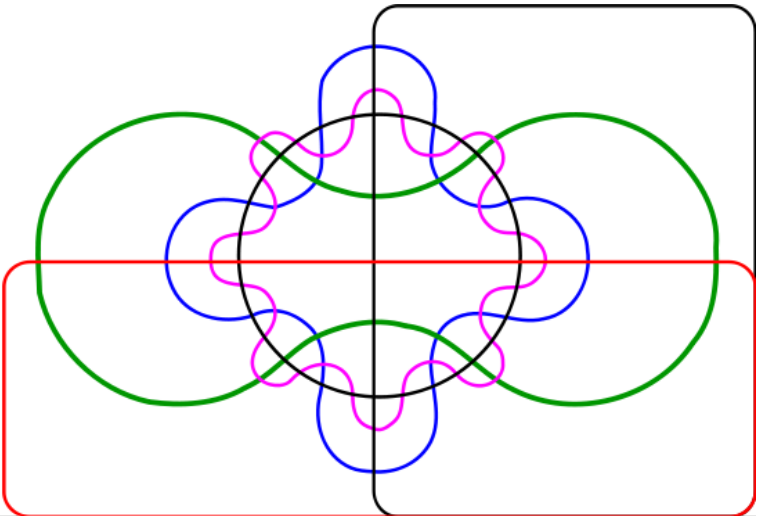
4-set Venn



5-set Venn



5 set Edwards-Venn

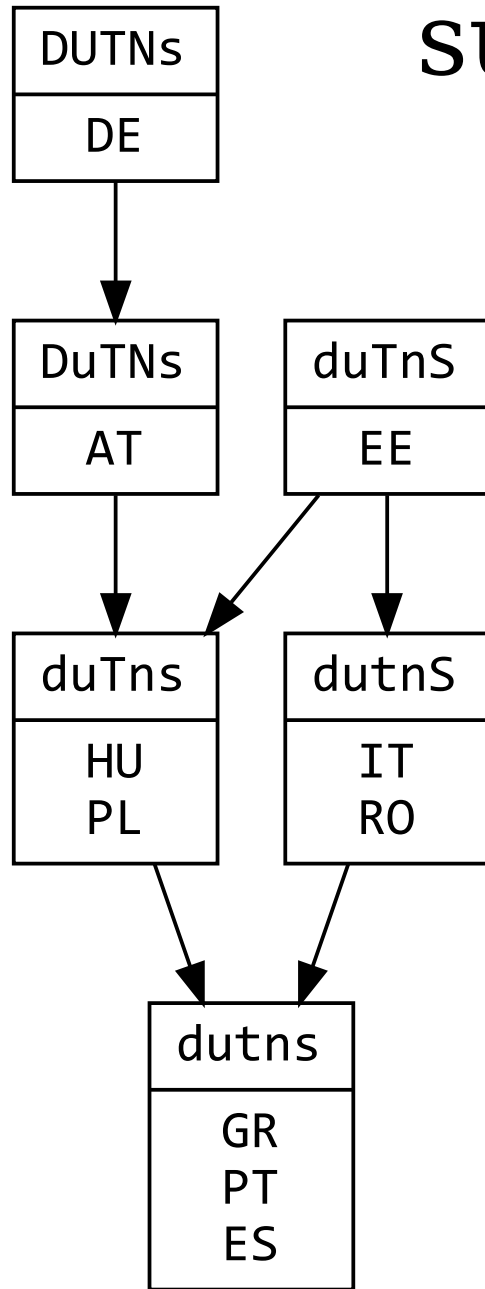


6 set Edwards-Venn

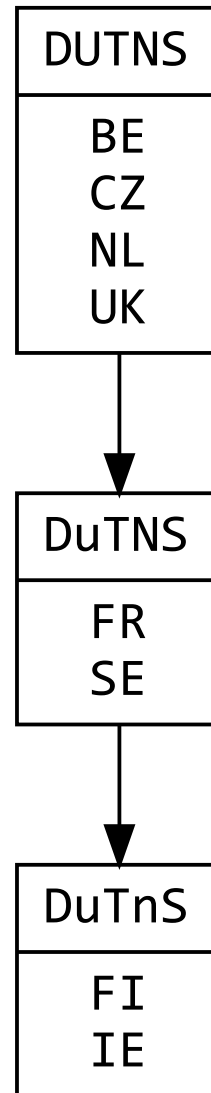
# Superset/subset Relationships

- Venn/Euler diagrams are familiar and easy to interpret, but:
  - Low information density
  - Interpretability decreases as intersections increase
  - Difficult to convey proportionality
  - Programmatically generating area-proportional Euler diagrams with more than 3 sets is an unsolved problem
- Alternatives:
  - Hierarchical graphs
  - Force-directed graphs
  - Galois lattices
  - Linear diagrams

# Hierarchical graphs reveal superset/subset relationships among configurations

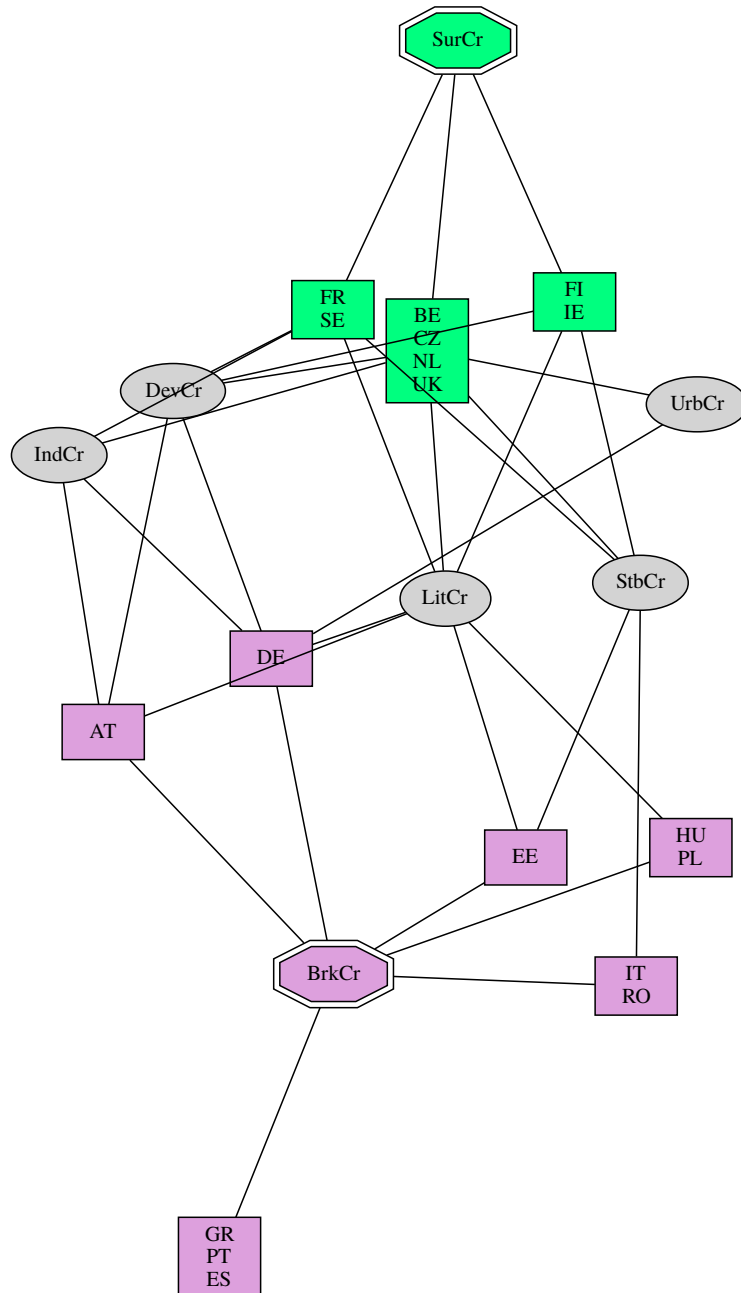
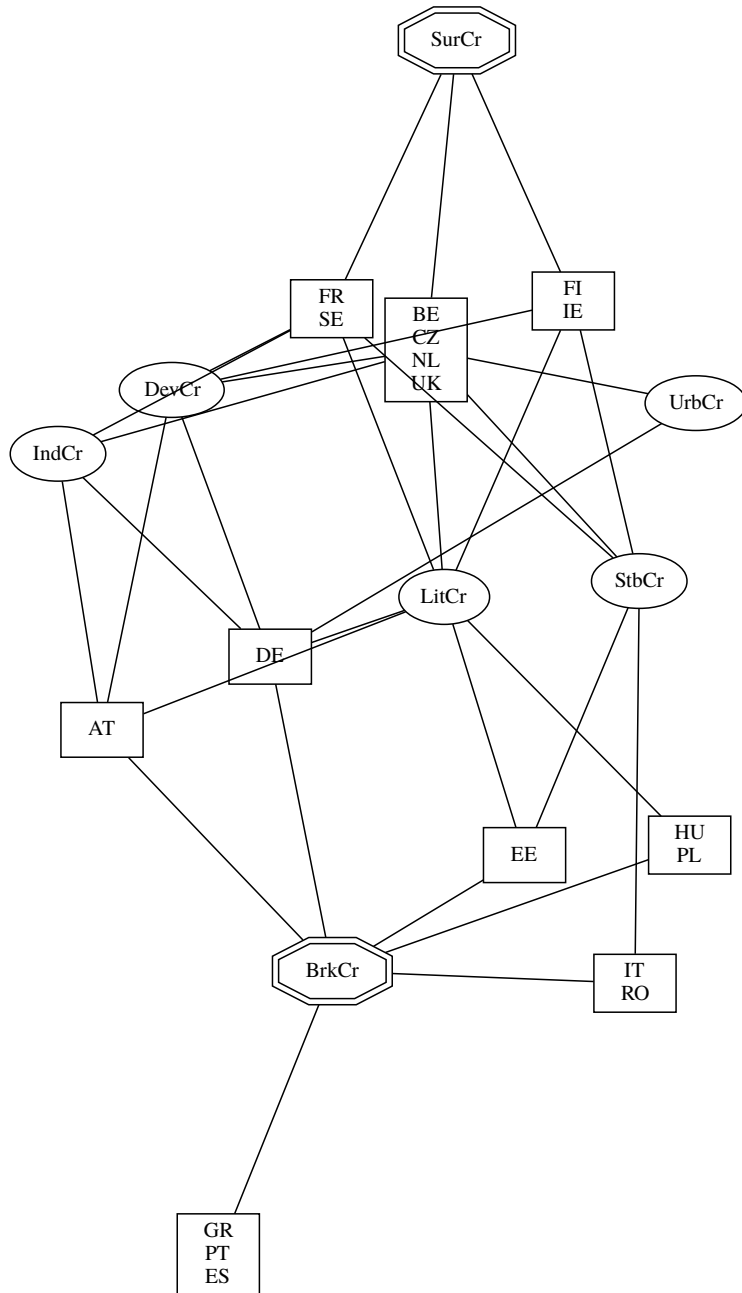


Democracy Breakdown

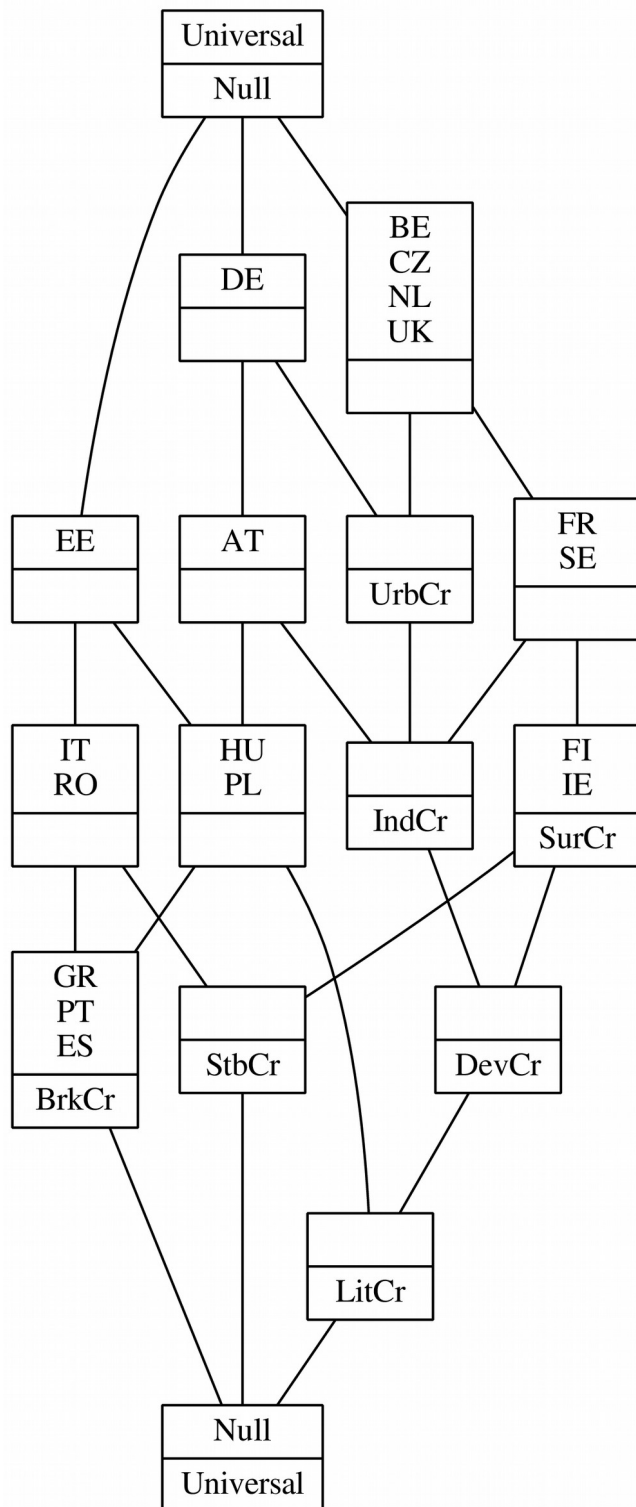


Democracy Survival

# Force-directed graphs map *logical distances* of conditions/observations



# Galois lattices reveal the *duality* of conditions and observations



- Easy to construct with software (but not by hand)
- Not intuitive; can be difficult to interpret. Will need to interpret for reader.
- Presents superset/subset relationships simultaneously
- Particularly well-suited for depicting truth tables (optionally including remainders)

# Linear diagrams are improved Venn/Euler diagrams

