TikZ/PGF shape library for constructing Single-World Intervention Graphs (SWIGs)

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Single World Intervention Graphs (SWIGs) are a graphical formalism for unifying two approaches to building (statistical) causal models (Richardson and Robins, 2013).

Key to the representation is an operation of ‘node splitting’, whereby a single node is divided into two pieces. It is important that the resulting halves can still be seen to have originated from a single node.

\[ A_1 \quad \rightarrow \quad A_2(a_1) \quad \rightarrow \quad a_2 \]

It has been hard to draw SWIGs using standard packages in TikZ/PGF. Two separate \texttt{semicircle} shapes can be used, but it is difficult to ensure that the two halves arise from the same node and/or without introducing a lot of whitespace. TikZ does contain a shape, called \texttt{split ellipse}, but this does not provide a way to add space between the two halves of the shape. (There does not appear to be a semi-ellipse shape.)

We address this by introducing two multipart shapes: \texttt{swig hsplit} that creates an ellipse that has been split horizontally, and and \texttt{swig vsplit} that is split vertically. The latter shape also adjusts the ratio of the two halves depending on the text that is contained.
Preliminaries

The examples included below use the following packages:

\documentclass[10pt]{article}
\usepackage{amsmath,amssymb,xcolor}
\usepackage{pgf,tikz}
\usetikzlibrary{arrows,shapes.arrows,shapes.geometric,shapes.multipart,decorations.pathmorphing,positioning,shapes.swigs,}
\begin{document}
...

The last library listed here uses the code in the file:
\texttt{pgflibraryshapes.swigs.code.tex}
(As this is not part of the TeX distribution, this file should be placed in the working directory.)

**SWIG with horizontal split**

Here is a very simple example:

\begin{tikzpicture}
  \node[shape=swig hsplit]{
    \nodepart{upper}\(A_1\)
    \nodepart{lower}\(a_1\)};
  \node[shape=swig hsplit, right=of a1]{
    \nodepart{upper}\(A_2(a_1)\)
    \nodepart{lower}\(a_2\)};
  \draw[->](a1) to[out=350,in=170] (a2);
\end{tikzpicture}

The parameter \texttt{gap} can be adjusted to change the size of the gap:

\begin{tikzpicture}
  \node[shape=swig hsplit, gap=5pt]{
    \nodepart{upper}\(A_1\)
    \nodepart{lower}\(a_1\)};
  \node[shape=swig hsplit, right=of a1]{
    \nodepart{upper}\(A_2(a_1)\)
    \nodepart{lower}\(a_2\)};
  \draw[->](a1) to[out=350,in=170] (a2);
\end{tikzpicture}

This can also be done globally for all split nodes; here we also make the line color red for lower halves.
For black and white publications color may not be sufficient to distinguish upper and lower halves. For this purpose a double line can be used. **inner line width** lower specifies the width of the inner gap.
The example below shows the full set of anchors and other options.
Here we describe the instructions for creating ellipses with vertical splits. These are often more efficient in terms of space. As before, first a very simple example:

\[
\begin{tikzpicture}
\node [name=a1, shape=swig vsplit] {
\nodepart{left} \(A_1\)
\nodepart{right} \(a_1\)};
\node [name=a2, right=5mm of a1, shape=swig vsplit] {
\nodepart{left} \(A_2(a_1)\)
\nodepart{right} \(a_2\)};
\draw [->] (a1) to (a2);
\end{tikzpicture}
\]

The parameter \texttt{gap} can be adjusted to change the size of the gap:

\[
\begin{tikzpicture}
\node [name=a1, shape=swig vsplit, swig vsplit={gap=3pt}] {
\nodepart{left} \(A_1\)
\nodepart{right} \(a_1\)};
\node [name=a2, right=5mm of a1, shape=swig vsplit] {
\nodepart{left} \(A_2(a_1)\)
\nodepart{right} \(a_2\)};
\draw [->] (a1) to (a2);
\end{tikzpicture}
\]

This can also be done globally for all split nodes; here we also make the line color red for right halves:

\[
\begin{tikzpicture}
\tikzset{swig vsplit={gap=3pt, line color right=red}}
\node [name=a1, shape=swig vsplit] {
\nodepart{left} \(A_1\)
\nodepart{right} \(a_1\)};
\node [name=a2, shape=swig vsplit, right=5mm of a1] {
\nodepart{left} \(A_2(a_1)\)
\nodepart{right} \(a_2\)};
\draw [->] (a1) to (a2);
\end{tikzpicture}
\]

The parameter \texttt{gap} can be adjusted to change the size of the gap.

SWIG with vertical split
As before, a version for black and white publications:

\begin{tikzpicture}
\tikzset{line width=1.5pt,
    swig vsplit={gap=3pt,
        inner line width right=0.5pt}}
\node[name=a1,shape=swig vsplit]
    {\nodepart{left}{$A_1$}
        \nodepart{right}{$a_1$}};
\node[name=a2,shape=swig vsplit,
    right=0 of a1]
    {\nodepart{left}{$A_2(a_1)$}
        \nodepart{right}{$a_2$}};
\draw[->,line width=1.5pt,>=stealth]
    (a1) to (a2);
\end{tikzpicture}

Here is an example with multiple stages:

\begin{tikzpicture}
\node[name=a1,shape=swig vsplit]
    {\nodepart{left}{$A_1$}
        \nodepart{right}{$a_1$}};
\node[name=a2,shape=swig vsplit,
    right=0 of a1]
    {\nodepart{left}{$A_2(a_1)$}
        \nodepart{right}{$a_2$}};
\node[name=a3,shape=swig vsplit,
    right=0 of a2]
    {\nodepart{left}{$A_3(a_1,a_2)$}
        \nodepart{right}{$a_3$}};
\draw[->,line width=1.5pt,>=stealth]
    (a1) to (a2);
\end{tikzpicture}
\begin{tikzpicture}
\tikzset{line width=1.5pt, outer sep=0pt,
  ell/.style={draw,fill=white, inner sep=2pt,
    line width=1.5pt},
  swig vsplit={gap=5pt,
    inner line width right=0.5pt}};
\node[name=l1, ell, shape=ellipse]{$L_1$};
\node[name=a1,right=5mm of l1, shape=swig vsplit]{
  \nodepart{left}{$A_1$}
  \nodepart{right}{$a_1$} }; 
\node[name=l2, right=5mm of a1, ell, shape=ellipse]{$L_2(a_1)$};
\node[name=a2, shape=swig vsplit,
  right=5mm of l2]{
  \nodepart{left}{$A_2(a_1)$}
  \nodepart{right}{$a_2$} };
\node[name=y, right=5mm of a2, ell, shape=ellipse]{$Y(a_1,a_2)$};
\draw[->,line width=1.5pt,>=stealth]
(11) edge (a1)
(11) edge[out=330,in=210] (a2)
(a1) edge (12)
(a1) edge[out=15,in=150] (a2)
(a1) edge[out=30,in=150] (y)
(12) edge (a2)
(a2) edge (y);
\end{tikzpicture}
Expanded nodes showing additional options and anchors.
References