

Diagrams using tikz

Diogo Ferrari
Department of Political Science
University of California, Riverside

June 1, 2020

Contents

1	Instructions and Information	2
2	Nodes	2
2.1	Basic shapes	2
2.2	Template	2
2.3	Examples	3
3	Plate and Parametric Models	4
3.1	Basic shapes	4
3.2	Examples	4
4	DAG	7
4.1	Nodes as Text and box	7
4.2	Nodes as text	7
4.3	Nodes as variables (relative position)	7
4.4	Nodes as variables and circles	8
4.5	Nodes as variables and circles (closer)	8
4.6	Nodes as variables and circles (closer, no edge labels)	9
4.7	Nodes as variables and circles (closer, no edge labels, and subfigures)	9
4.8	Large DAG	10
4.9	Large DAG (using latent var notation)	11
4.10	Large DAG (using latent var notation alternative)	11
5	Undirected Graphs	11
6	Tree	12
A	Settings to draw diagrams	13

1. Instructions and Information

To draw this diagrams, you need to use the following latex packages:

- `\usepackage{tikz}`
- `\usetikzlibrary{decorations.pathreplacing}`
- `\usepackage{forest}`
- **Note:** you may need additional packages. The file `./sty/basic-article.sty` contains all the packages you need and some extra ones.
- You also need to create `./sty/`, save the file `math-commands.sty` on that folder, and include `\usepackage{./sty/math-commands}` in your main file.


You can check the `.tex` file used to create this `.pdf` for details.


The diagrams created here uses the package `tikz`. See documentation [here](#). It extends that package using commands whose deetails you can find [here](#). The full code is in the appendix [A](#) below, which is also in the file `math-commands.sty`.


2. Nodes

2.1. Basic shapes


Some predefined nodes on `basic-math-commands.sty`


 `c` const (constant node) (Snippet: `dagnc`)


 `Zi` latent (latent node) (Snippet: `dagnl`)

 `Xi` obs (observed node) (Snippet: `dagno`)

 factor (factor node) (Snippet: `dagnf`)

 dist (distribution node) (Snippet: `dagndist`)

 `a` det (deterministic node) (Snippet: `dagnd`)

 `||·||` operation (operation node) (Snippet: `dagno`)

2.2. Template

```
\node at (<x>, <y>) [<properties>] (<node-id>) {<label>} ; %
```

`<x>` and `<y>` position of the nodes

<properties> circle, rectangle, diamond shape (e.g., circle)

draw color of the border (default draw=black)

minimum size minimum size of the node

inner sep separation between label and node

font font size

colorfont font color (default=black)

fill color to fill the node (default color=white)

node distance distance between nodes

label={ [<color>]<position>:<text> } label next to node (e.g., label=right:"this node is about X"; <position> can be right, left, top, bottom, top right, etc.)

<node-id> label to identify the node

<label> text that appear inside the node

2.3. Examples

```
\begin{figure}[ht]\centering
\begin{tikzpicture}
\node at (0, 0) [
  circle,                % rectangle/diamond
  draw                    = black,      % border
  line width              = .5pt,       % border width
  minimum size            = 20pt,       % minimum size of node
  inner sep                = 1pt,       % sep b/w border and inner text
  font                    = \normalsize,%
  text                    = black,      % inner label color
  fill                    = white,
  node distance           = 1pt,
]
(beta1)
{\( \beta_{1} \) } ;
\end{tikzpicture}
\end{figure}
```

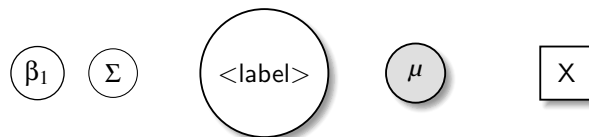


```
\begin{figure}[ht]\centering
\begin{tikzpicture}
\node at (0, 0) [
  circle,                % rectangle/diamond
  draw                    = black,      % border
  line width              = .5pt,       % border width
  minimum size            = 20pt,       % minimum size of node
  inner sep                = 1pt,       % sep b/w border and inner text
  font                    = \normalsize,%
  text                    = black,      % inner label color
```

```

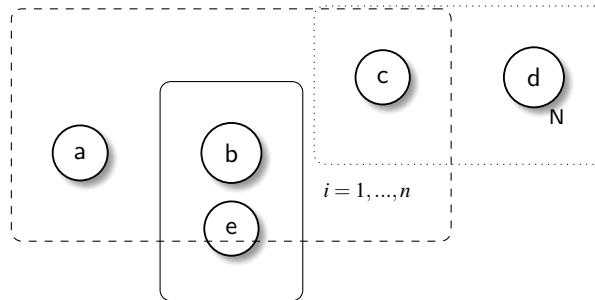
fill          = white,
node distance = 1pt,
]
(beta1)
{\( \beta_{1} \)} ; %
\node at (1, 0) [
  circle,          % rectangle/diamond
  draw             = black, % border
]
()
{\( \Sigma \)} ;
\node at (3, 0) [latent ] (id) {<label>} ; %
\node at (5, 0) [obs    ] (mu) {\( \mu \)} ; %
\node at (7, 0) [const  ] (id-x) {X} ; %
\end{tikzpicture}
\end{figure}

```



3. Plate and Parametric Models

3.1. Basic shapes



3.2. Examples

```

\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}]
%% Nodes
\node at (2, 0) [obs    ] (yi)      {\( y_i \)} ; %
\node at (0, 0) [latent ] (fi)      {\( f_i \)} ; %
\node at (-2, 0) [latent ] (betai)   {\( \beta_{i} \)} ; %
\node at (-2, 2) [const ] (Sigmabeta) {\( \Sigma_{\beta} \)} ; %
\node at (-4, 0) [const ] (mubeta)   {\( \mu_{\beta} \)} ; %
\node at (0, 2) [latent ] (theta)    {\( \theta \)} ; %
\node at (-1, 4) [const ] (mutheta)  {\( \mu_{\theta} = 0 \)} ; %

```

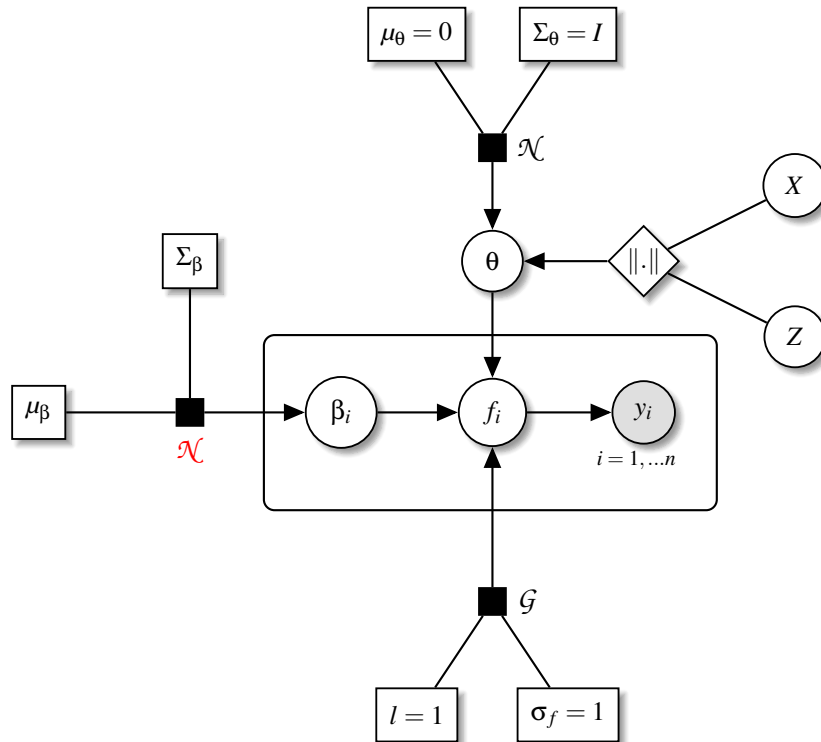


```

\node at (2, 2) [operation          ] (dot) {\(\ \norm{.} \)} ; %
\node at (4, 3) [latent            ] (x) {\(\ X \)} ; %
\node at (4, 1) [latent            ] (z) {\(\ Z \)} ; %
\node at (0, 3.5) [dist, label={\[\textcolor{black}{right:\normalsize\(\ \No \)} \]} (normaltheta) {}
; %
%% arrows
\edge [-] {mubeta} {normal}
\edge [-] {Sigmabeta} {normal}
\edge {normal} {betai} ;
\edge {fi} {yi}
\edge {betai} {fi}
\edge [-] {l} {g}
\edge [-] {sigmaf} {g}
\edge {g} {fi} ;
\edge [-] {mutheta} {normaltheta}
\edge [-] {Sigmatheta} {normaltheta}
\edge {normaltheta} {theta} ;
\edge {theta} {fi}
\edge [-] {x} {dot} ;
\edge [-] {z} {dot} ;
\edge {dot} {theta} ;

%% plate
\plate {plate1} {(betai) (fi) (yi)} {\(\ i=1,\dots n \)};
\end{tikzpicture}
\end{figure}

```

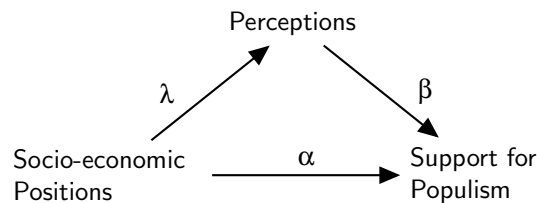


4. DAG

4.1. Nodes as Text and box

```
\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0) [textnode, text width=2.5cm ] (ind) {Socio-economic Positions} ; %
\node at (2.5, 2) [textnode, text width=1.8cm ] (med) {Perceptions} ; %
\node at (5, 0) [textnode, text width=2cm ] (out) {Support for Populism} ; %

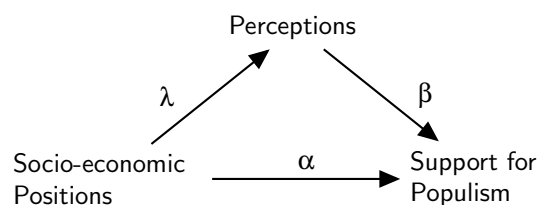
%% edges
\path[->] (ind) edge node[el,left,rotate=0] {\(\ \lambda\ \quad \)} (med);
\path[->] (med) edge node[el,right,rotate=0] {\(\ \quad \beta\ \)} (out);
\path[->] (ind) edge node[el,above,rotate=0] {\(\ \alpha\ \)} (out);
\end{tikzpicture}
\end{figure}
```



4.2. Nodes as text

```
\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0) [text width=2.5cm ] (ind) {Socio-economic Positions} ; %
\node at (2.5, 2) [text width=1.8cm ] (med) {Perceptions} ; %
\node at (5, 0) [text width=2cm ] (out) {Support for Populism} ; %

%% edges
\path[->] (ind) edge node[el,left,rotate=0] {\(\ \lambda\ \quad \)} (med);
\path[->] (med) edge node[el,right,rotate=0] {\(\ \quad \beta\ \)} (out);
\path[->] (ind) edge node[el,above,rotate=0] {\(\ \alpha\ \)} (out);
\end{tikzpicture}
\end{figure}
```



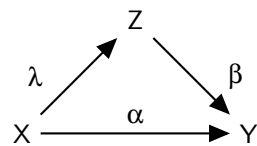
4.3. Nodes as variables (relative position)

```

\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0) [ ] (ind) {X} ; %
\node (med) [above right = 1.5cm and 1.5cm of ind] {Z};
\node (out) [right = 3cm and 3cm of ind] {Y} ; %

%% edges
\path[->] (ind) edge node[el,left,rotate=0] {\(\lambda\quad\)} (med);
\path[->] (med) edge node[el,right,rotate=0] {\(\quad\beta\quad\)} (out);
\path[->] (ind) edge node[el,above,rotate=0] {\(\alpha\quad\)} (out);
\end{tikzpicture}
\end{figure}

```



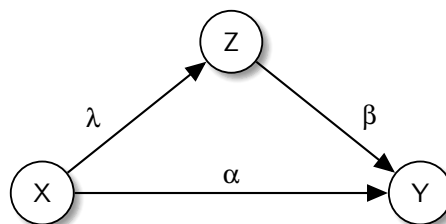
4.4. Nodes as variables and circles

```

\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0) [latent ] (ind) {X} ; %
\node at (2.5, 2) [latent, ] (med) {Z} ; %
\node at (5, 0) [latent, ] (out) {Y} ; %

%% edges
\path[->] (ind) edge node[el,left,rotate=0] {\(\lambda\quad\)} (med);
\path[->] (med) edge node[el,right,rotate=0] {\(\quad\beta\quad\)} (out);
\path[->] (ind) edge node[el,above,rotate=0] {\(\alpha\quad\)} (out);
\end{tikzpicture}
\end{figure}

```



4.5. Nodes as variables and circles (closer)

```

\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0) [latent ] (ind) {X} ; %
\node at (2, 1.5) [latent, ] (med) {Z} ; %
\node at (4, 0) [latent, ] (out) {Y} ; %

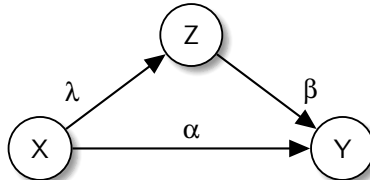
```



```

%% edges
\path[->] (ind) edge node[el,left,rotate=0] {\(\ \lambda \quad \)} (med);
\path[->] (med) edge node[el,right,rotate=0] {\(\quad \beta \quad \)} (out);
\path[->] (ind) edge node[el,above,rotate=0] {\(\ \alpha \quad \)} (out);
\end{tikzpicture}
\end{figure}

```



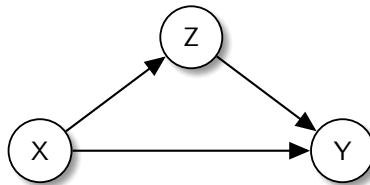
4.6. Nodes as variables and circles (closer, no edge labels)

```

\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0) [latent ] (ind) {X} ; %
\node at (2, 1.5) [latent, ] (med) {Z} ; %
\node at (4, 0) [latent, ] (out) {Y} ; %

%% edges
\path[->] (ind) edge node[el,left,rotate=0] {} (med);
\path[->] (med) edge node[el,right,rotate=0] {} (out);
\path[->] (ind) edge node[el,above,rotate=0] {} (out);
\end{tikzpicture}
\end{figure}

```



4.7. Nodes as variables and circles (closer, no edge labels, and subfigures)

```

\begin{figure}[ht]
\begin{subfigure}{.5\textwidth}
% -----
\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0) [latent ] (ind) {X} ; %
\node at (2, 1.5) [latent, ] (med) {Z} ; %
\node at (4, 0) [latent, ] (out) {Y} ; %

%% edges
\path[->] (ind) edge node[el,left,rotate=0] {} (med);

```

```

\path[->] (med) edge node[e1,right,rotate=0] {} (out);
\path[->] (ind) edge node[e1,above,rotate=0] {} (out);
\end{tikzpicture}
\caption{Put your sub-caption here}
\label{fig:sub-first}
% -----
\end{subfigure}
\begin{subfigure}{.5\textwidth}
% -----
\centering
\begin{tikzpicture}[thick,scale=.7, every node/.style={transform shape}, on grid,
auto]
\node at (0, 0) [latent ] (ind) {X} ; %
\node at (2, 1.5) [latent, ] (med) {Z} ; %
\node at (4, 0) [latent, ] (out) {Y} ; %

%% edges
\path[->] (ind) edge node[e1,left,rotate=0] {} (med);
\path[->] (med) edge node[e1,right,rotate=0] {} (out);
\path[->] (ind) edge node[e1,above,rotate=0] {} (out);
\end{tikzpicture}
\caption{Put your sub-caption here}
\label{fig:sub-second}
% -----
\end{subfigure}
\caption{Put your caption here}
\label{fig:fig}
\end{figure}

```

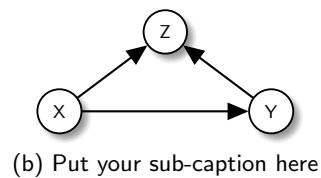
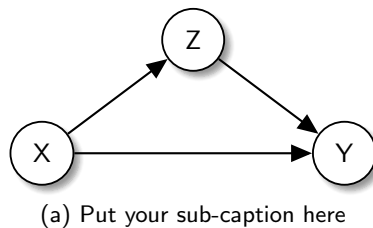
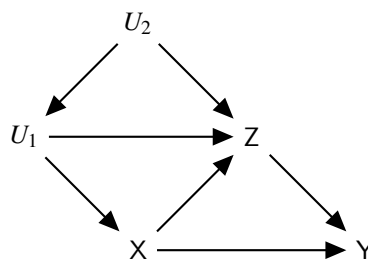
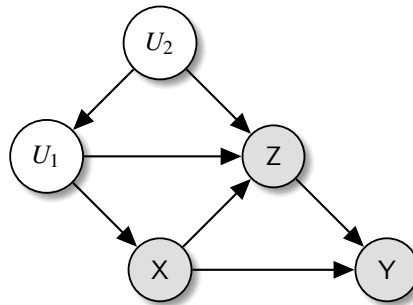


Figure 1: Put your caption here

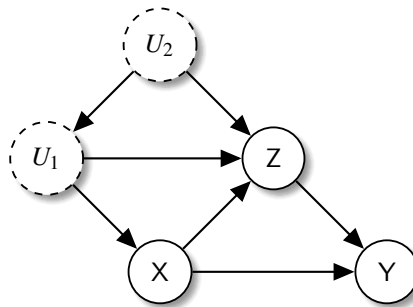
4.8. Large DAG



4.9. Large DAG (using latent var notation)



4.10. Large DAG (using latent var notation alternative)



5. Undirected Graphs

```

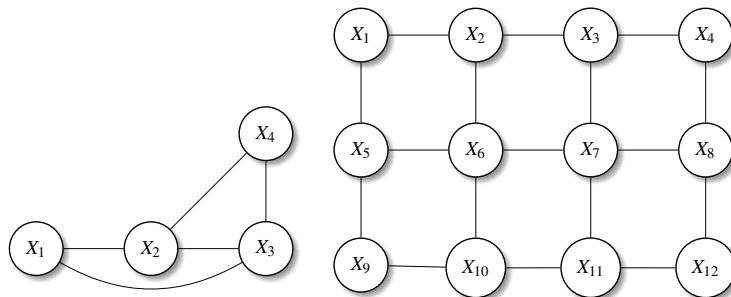
\begin{figure}[ht]
\scalebox{.75}{ % to reduce the size of the figure (package graphix)
% nodes: latent, obs, det, const, factor, plate, gate
\centering
\tikz{ %
\node[latent] (x1) {\( X_1 \)} ; %
\node[latent, right=of x1] (x2) {\( X_2 \)} ; %
\node[latent, right=of x2] (x3) {\( X_3 \)} ; %
\node[latent, above=of x3] (x4) {\( X_4 \)} ; %
\edge [-] {x1} {x2} ; %
\edge [-] {x2} {x3} ; %
\edge [-] {x3} {x4} ; %
\edge [-] {x2} {x4} ; %
\edge[bend right, -] {x1} {x3} ; %
}
~~~~~
\tikz{ %
\node[latent] (x1) {\( X_1 \)} ; %
\node[latent, right=of x1] (x2) {\( X_2 \)} ; %
\node[latent, right=of x2] (x3) {\( X_3 \)} ; %
\node[latent, right=of x3] (x4) {\( X_4 \)} ; %
% second row

```

```

\node[latent, below=of x1] (x5) {\( X_5 \)} ; %
\node[latent, below=of x2] (x6) {\( X_6 \)} ; %
\node[latent, below=of x3] (x7) {\( X_7 \)} ; %
\node[latent, below=of x4] (x8) {\( X_8 \)} ; %
% third row
\node[latent, below=of x5] (x9) {\( X_9 \)} ; %
\node[latent, below=of x6] (x10) {\( X_{10} \)} ; %
\node[latent, below=of x7] (x11) {\( X_{11} \)} ; %
\node[latent, below=of x8] (x12) {\( X_{12} \)} ; %
\edge [-] {x1} {x2} ; %
\edge [-] {x2} {x3} ; %
\edge [-] {x3} {x4} ; %
\edge [-] {x1} {x5} ; %
\edge [-] {x2} {x6} ; %
\edge [-] {x3} {x7} ; %
\edge [-] {x4} {x8} ; %
\edge [-] {x5} {x6} ; %
\edge [-] {x6} {x7} ; %
\edge [-] {x7} {x8} ; %
\edge [-] {x5} {x9} ; %
\edge [-] {x6} {x10} ; %
\edge [-] {x7} {x11} ; %
\edge [-] {x8} {x12} ; %
\edge [-] {x9} {x10} ; %
\edge [-] {x10} {x11} ; %
\edge [-] {x11} {x12} ; %
}
}
\end{figure}

```



6. Tree

It uses the package `forest`, so you need to include `\usepackage{forest}` in the latex header.
 Snippet: `dagtree`

```

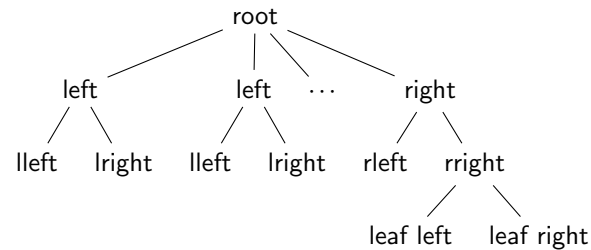
\begin{figure}[ht]\centering
\begin{forest}
  % for tree={l+=1cm} % increase level distance
  [root
    [left[lleft][lright]]
    [left[lleft][lright]]
  ]
\end{forest}

```

```

    [\\( \cdots \)]
    [right[rleft][rright[leaf left][leaf right]]]
  ]
\end{forest}
\end{figure}

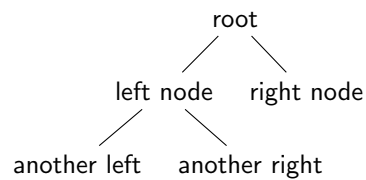
```



```

\begin{figure}[ht]\centering
\begin{forest}
  % for tree={l+=1cm} % increase level distance
  [root
    [left node[ another left][ another right]]
    [right node]
  ]
\end{forest}
\end{figure}

```



A. Settings to draw diagrams

```

%% =====
%% For graphs
%% =====
% tikzlibrary.code.tex
% Modified from https://github.com/jluttine/tikz-bayesnet
%
% Copyright 2010–2011 by Laura Dietz
% Copyright 2012 by Jaakko Luttinen
%
% This file may be distributed and/or modified
%
% 1. under the LaTeX Project Public License and/or
% 2. under the GNU General Public License.
%
% See the files LICENSE_LPPL and LICENSE_GPL for more details.

```

```

% Load other libraries
\usetikzlibrary{shapes}
\usetikzlibrary{fit}
\usetikzlibrary{chains}
\usetikzlibrary{arrows}

% Nodes
% -----
\usetikzlibrary{shadows.blur}
\usetikzlibrary{shapes.symbols}
\newcommand{\DAGnodedistance}{30pt}
\newcommand{\DAGinnersep}{5pt}
\newcommand{\DAGminsize}{20pt}
\newcommand{\DAGfont}{\fontsize{10}{10}\selectfont}
\newcommand{\DAGcolorfont}{black}
\newcommand{\DAGcolorborder}{black}
\newcommand{\DAGcolorfill}{white}
\newcommand{\DAGlinewidth}{.7pt}
\tikzstyle{basic} = [
  shape          = circle,
  draw           = \DAGcolorborder,
  line width     = \DAGlinewidth,
  minimum size   = \DAGminsize,
  inner sep      = \DAGinnersep,
  font           = \DAGfont,
  text           = \DAGcolorfont,
  fill           = \DAGcolorfill,
  node distance = \DAGnodedistance,           % for relative positions
  blur shadow={shadow blur steps=5}
]
\tikzstyle{latent}      = [basic]                % Latent node
\tikzstyle{obs}         = [basic, fill=gray!25]   % Observed node
%% \tikzstyle{factor}    = [basic, fill=black, text=white] % Factor node
\tikzstyle{factor}     = [rectangle, fill=black, minimum size=5pt, inner sep=0pt,
  node distance=0.4]
\tikzstyle{factor caption} = [caption] %
\tikzstyle{const}      = [basic, rectangle,]      % Constant node
\tikzstyle{det}        = [basic, inner sep =1pt, diamond] %
  Deterministic node
\tikzstyle{dist}       = [rectangle, draw, fill=black, minimum size=10pt, inner
  sep=0pt, node distance=0.4]
\tikzstyle{operation}  = [basic, inner sep =1pt, diamond] %
  Deterministic node
\tikzstyle{textnode}   = [basic, rectangle, inner sep=5pt] %
  Deterministic node

% Plate node
% -----
\tikzset{
  plate/.style={
    draw = black,
    shape=rectangle,
    rounded corners=0.5ex,

```

```

    thick,
    minimum width=3.1cm,
    text width=3.1cm,
    align=right,
    inner sep=10pt,
    inner ysep=10pt,
  }
}
\newcommand{\DAGplateinnersep}{15pt}
\newcommand{\DAGplatecolorborder}{black}
\tikzstyle{plate caption} = [
  caption,
  node distance=0,
  inner sep=0pt,
  below left=0pt and 0pt of #1.south east] %
\tikzstyle{plate} = [
  draw=black,
  text width=3.1cm,
  shape=rectangle,
  solid,          % dashed, dotted
  rounded corners,
  fit=#1,
  color           = \DAGplatecolorborder,
  inner sep       = \DAGplateinnersep,
  xshift=0cm,     % displacement to x direcation
  yshift=0cm,     % displacement to y direcation
  node distance=5pt,
]
\tikzstyle{wrap} = [inner sep=0pt, fit=#1] % Invisible wrapper node
\tikzstyle{gate} = [draw, rectangle, dashed, fit=#1] % Gate

% Caption node
% -----
\tikzstyle{caption} = [font=\footnotesize, node distance=0] %
\tikzstyle{every label} += [caption] %

\tikzset{>={triangle 45}}

%\pgfdeclarelayer{b}
%\pgfdeclarelayer{f}
%\pgfsetlayers{b,main,f}

% \factoredge [options] {inputs} {factors} {outputs}
\newcommand{\factoredge}[4][[]]{ %
  % Connect all nodes #2 to all nodes #4 via all factors #3.
  \foreach \f in {#3} { %
    \foreach \x in {#2} { %
      \path (\x) edge[-,#1] (\f) ; %
      %\draw[-,#1] (\x) edge[-] (\f) ; %
    } ;
    \foreach \y in {#4} { %
      \path (\f) edge[->,#1] (\y) ; %
      %\draw[->,#1] (\f) -- (\y) ; %
    } ;
  } ;
}

```

```

    } ;
}

% \edge [options] {inputs} {outputs}
\newcommand{\edge}[3][[]]{ %
    % Connect all nodes #2 to all nodes #3.
    \foreach \x in {#2} { %
        \foreach \y in {#3} { %
            \path (\x) edge [->, #1 ] (\y) ;%
            %\draw[->, #1] (\x) -- (\y) ;%
        } ;
    } ;
}

% \factor [options] {name} {caption} {inputs} {outputs}
\newcommand{\factor}[5][[]]{ %
    % Draw the factor node. Use alias to allow empty names.
    \node[factor, label={[name=#2-caption]#3}, name=#2, #1,
    alias=#2-alias] {} ; %
    % Connect all inputs to outputs via this factor
    \factoredge {#4} {#2-alias} {#5} ; %
}

% \plate [options] {name} {fitlist} {caption}
\newcommand{\plate}[4][[]]{ %
    \node[wrap=#3] (#2-wrap) {} ; %
    \node[plate caption=#2-wrap] (#2-caption) {#4} ; %
    \node[plate=(#2-wrap)(#2-caption), #1] (#2) {} ; %
}

% \gate [options] {name} {fitlist} {inputs}
\newcommand{\gate}[4][[]]{ %
    \node[gate=#3, name=#2, #1, alias=#2-alias] {} ; %
    \foreach \x in {#4} { %
        \draw [-*, thick] (\x) -- (#2-alias) ; %
    } ; %
}

% \vgate {name} {fitlist-left} {caption-left} {fitlist-right}
% {caption-right} {inputs}
\newcommand{\vgate}[6]{ %
    % Wrap the left and right parts
    \node[wrap=#2] (#1-left) {} ; %
    \node[wrap=#4] (#1-right) {} ; %
    % Draw the gate
    \node[gate=(#1-left)(#1-right)] (#1) {} ; %
    % Add captions
    \node[caption, below left=of #1.north ] (#1-left-caption)
    {#3} ; %
    \node[caption, below right=of #1.north ] (#1-right-caption)
    {#5} ; %
    % Draw middle separation
    \draw [-, dashed] (#1.north) -- (#1.south) ; %
    % Draw inputs

```



```

\foreach \x in {#6} { %
  \draw [-*,thick] (\x) -- (#1); %
} ;%
}

% \hgate {name} {fitlist-top} {caption-top} {fitlist-bottom}
% {caption-bottom} {inputs}
\newcommand{\hgate}[6]{ %
  % Wrap the left and right parts
  \node[wrap=#2] (#1-top) {}; %
  \node[wrap=#4] (#1-bottom) {}; %
  % Draw the gate
  \node[gate=(#1-top)(#1-bottom)] (#1) {}; %
  % Add captions
  \node[caption, above right=of #1.west ] (#1-top-caption)
  {#3}; %
  \node[caption, below right=of #1.west ] (#1-bottom-caption)
  {#5}; %
  % Draw middle separation
  \draw [-, dashed] (#1.west) -- (#1.east); %
  % Draw inputs
  \foreach \x in {#6} { %
    \draw [-*,thick] (\x) -- (#1); %
  } ;%
}

% End graphs
%=====

```