Diagrams using tikz

Diogo Ferrari
Department of Political Science
University of California, Riverside

Contents

1. Instructions and Information

This document uses a few packages and configurations:

- `\usepackage{tikz}`
- `\usetikzlibrary{decorations.pathreplacing}`
- `\usepackage{forest}`

The files `./sty/basic-article.sty` and `./sty/math-commands` contain all the packages and commands required to create this document. If you are trying to compile this file locally in your computer, you need to create a subfolder `./sty/` in the folder of the `.tex` file you are trying to compile, save both the file `math-commands.sty` and `basic-article.sty` on that subfolder, and include `\usepackage{./sty/math-commands}` in your main `.tex` file.

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

See documentation of `TikZ` here.

2. Nodes and Edges

2.1. Basic shapes

Some predefined nodes on `math-commands.sty`

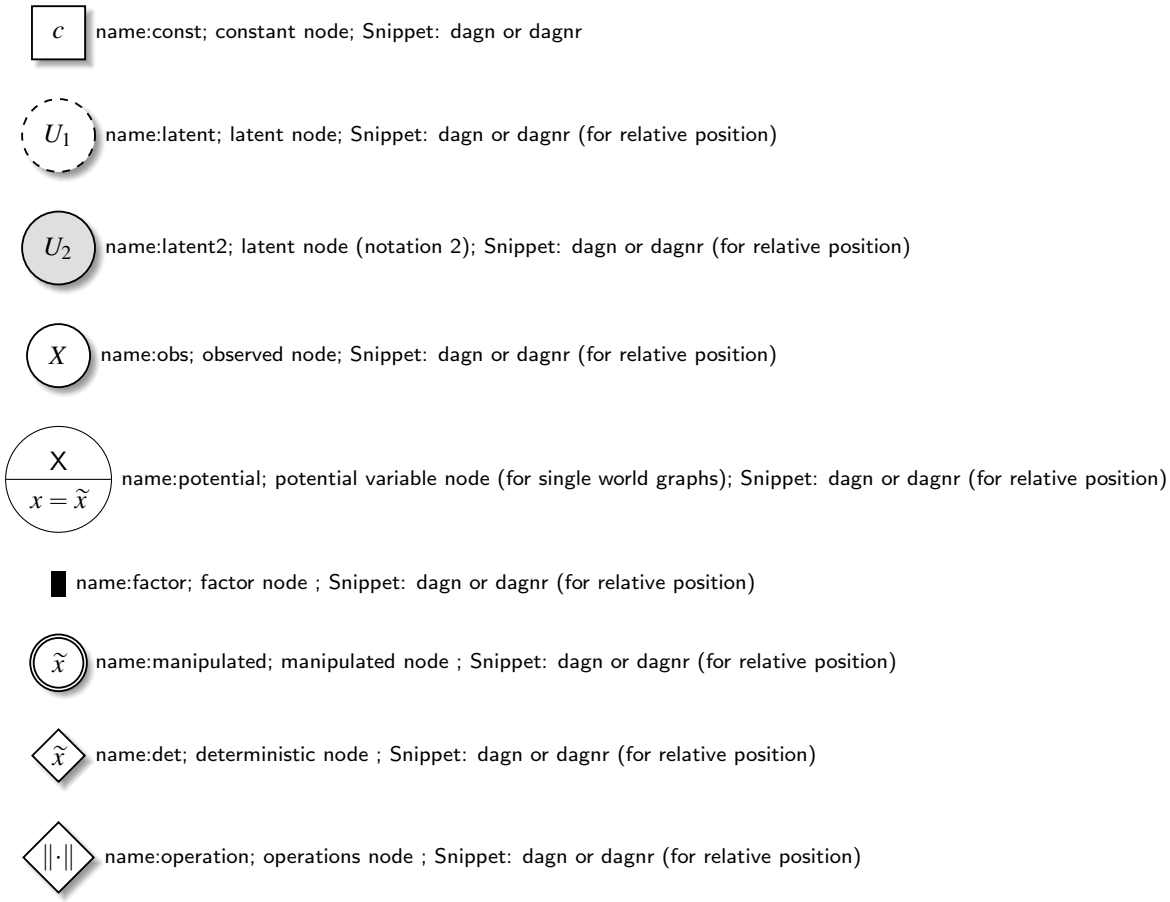


Figure 1: Some possible notation for types of nodes

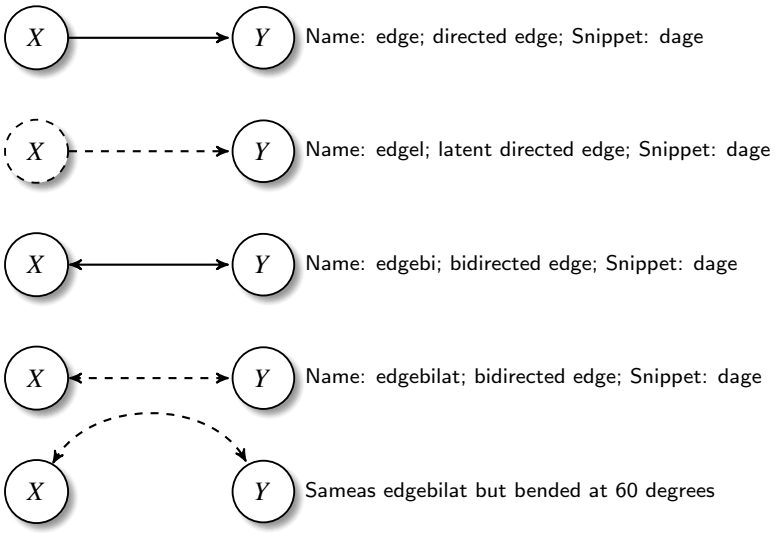


Figure 2: Some edge types

2.2. Template

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

<x> and <y> position of the nodes

<properties> **circle, retangle, 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 distange betweeen 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

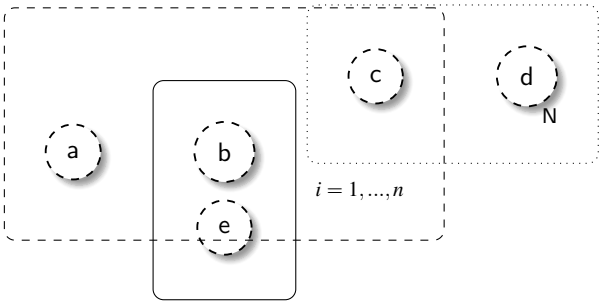
```
\begin{figure}[ht]\centering
\begin{tikzpicture}
\node at (0, 0) [
  circle,                       % rectangle/diamond
  draw          = black,        % border
  line width    = .5pt,         % border width
  minimum size  = 20pt,         % minimum size of node
  inner sep     = 1pt,          % sep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

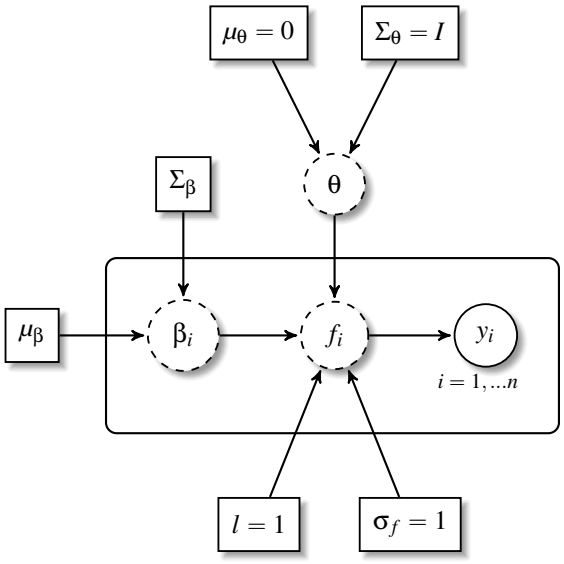
3.1. Basic shapes



3.2. Examples

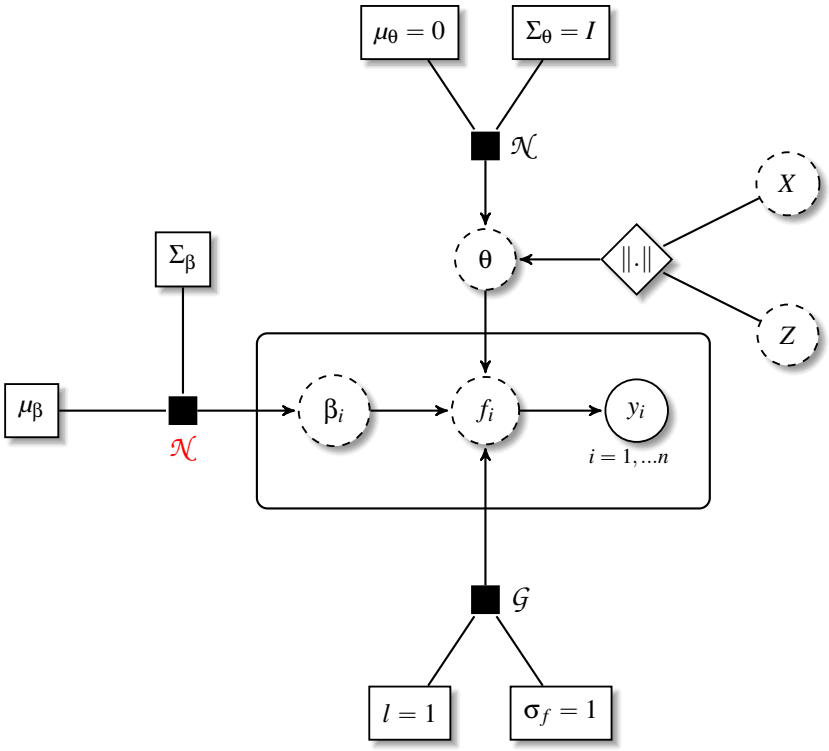
```
\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}]
%% Nodes
\node at (2, 0) [obs        ] (yi)          {\( y_i \)} ; %
\node at (0, 0) [latent     ] (fi)          {\( f_i \)} ; %
\node at (-2, 0) [latent    ] (betai)       {\( \beta_ {i}  \)} ; %
\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 ( 1, 4) [const     ] (Sigmatheta) {\( \Sigma_{\theta }=I   \)} ; %
\node at (-1, -2.5) [const  ] (l)           {\( l=1 \)} ; %
\node at ( 1, -2.5) [const  ] (sigmaf)      {\( \sigma_{f} =1 \)} ; %

%% plate
\plate {plate1} {(betai) (fi) (yi)} {\( i=1,...n \)};

%% arrows
\edgesimple {fi} {yi}
\edgesimple {betai} {fi}
\edgesimple {mubeta} {betai}
\edgesimple {l} {fi}
\edgesimple {sigmaf} {fi}
\edgesimple {Sigmabeta} {betai}
\edgesimple {mutheta} {theta}
\edgesimple {Sigmatheta} {theta}
\edgesimple {theta} {fi}
\end{tikzpicture}
\end{figure}
```

```
\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
%% Nodes
\node at (-6, 0) [const                ] (mubeta)      {\( \mu_   {\beta }  \)} ; %
\node at (-4, 2) [const                ] (Sigmabeta)   {\( \Sigma_{\beta }  \)} ; %
```




```
\node at (-4, 0) [dist, label={[red    ]below:\normalsize\( \No \)}  ] (normal)  {} ; %
\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 (0, 2) [latent                 ] (theta)       {\( \theta  \)} ; %
\node at (-1, 5) [const                 ] (mutheta)     {\( \mu_   {\theta } =0 \)} ; %
\node at ( 1, 5) [const                 ] (Sigmatheta) {\( \Sigma_{\theta }  =I   \)} ; %
\node at (-1, -4) [const              ] (l)           {\( l                =1 \)} ; %
\node at ( 1, -4) [const              ] (sigmaf)      {\( \sigma_{f}       =1 \)} ; %
\node at (0, -2.5) [dist, label={[black]right:\normalsize \( \G \)}  ] (g)  {} ; %
\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={[black]right:\normalsize\( \No \)}  ] (normaltheta)  {}
    ; %
%% arrows
\edgesimple [-] {mubeta} {normal}
\edgesimple [-] {Sigmabeta} {normal}
\edgesimple {normal} {betai} ;
\edgesimple {fi} {yi}
\edgesimple {betai} {fi}
\edgesimple [-] {l} {g}
\edgesimple [-] {sigmaf} {g}
\edgesimple {g} {fi} ;
\edgesimple [-] {mutheta} {normaltheta}
\edgesimple [-] {Sigmatheta} {normaltheta}
\edgesimple {normaltheta} {theta} ;
\edgesimple {theta} {fi}
\edgesimple [-] {x} {dot} ;
\edgesimple [-] {z} {dot} ;
\edgesimple {dot} {theta} ;

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

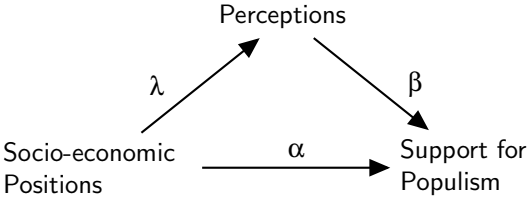
```
\end{figure}
```



4. DAG

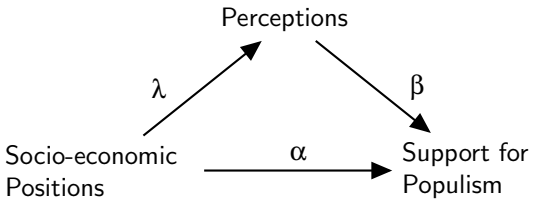
4.1. Nodes as Text and box

```
\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}
```



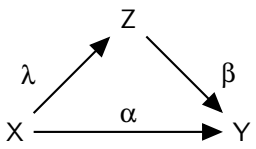
4.2. Nodes as text

```
\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)

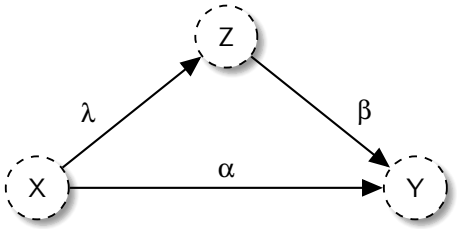
```
\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0)    [    ] (ind) {X} ; %
\node (med) [above right =  1.5cm and 1.5cm of ind] {Z};
\node (out) [right = 3cm and 3cm of ind] {Y} ; %

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



4.4. Nodes as variables and circles

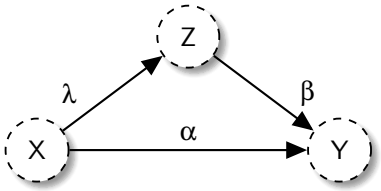
```
\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0)    [latent      ] (ind) {X} ; %
\node at (2.5, 2) [latent,     ] (med) {Z} ; %
```

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



4.5. Nodes as variables and circles (closer)

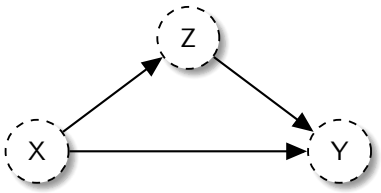
```
\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0)    [latent      ] (ind) {X} ; %
\node at (2, 1.5)  [latent,     ] (med) {Z} ; %
\node at (4, 0)    [latent,     ] (out) {Y} ; %

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



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

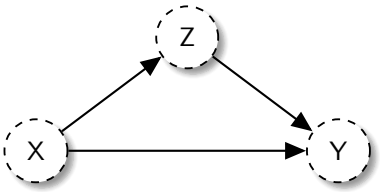
```
\begin{figure}[ht]\centering
\begin{tikzpicture}[thick,scale=1, every node/.style={transform shape}, on grid, auto]
\node at (0, 0)    [latent      ] (ind) {X} ; %
\node at (2, 1.5)  [latent,     ] (med) {Z} ; %
\node at (4, 0)    [latent,     ] (out) {Y} ; %

%% 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}
```

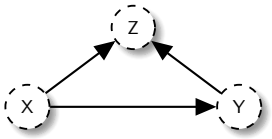


4.7. Nodes as variables and circles (closer, no edge labels, and subfigures)

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



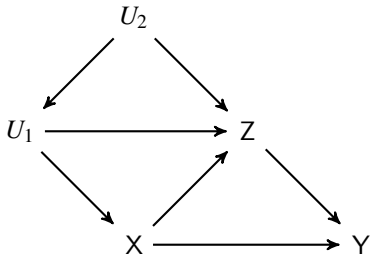
(a) Put your sub-caption here



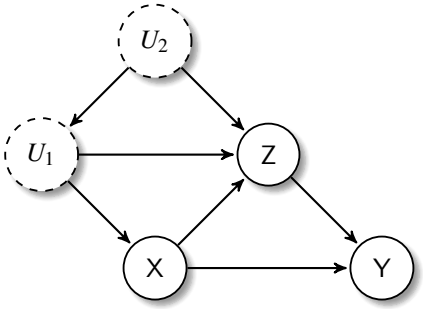
(b) Put your sub-caption here

Figure 3: Put your caption here

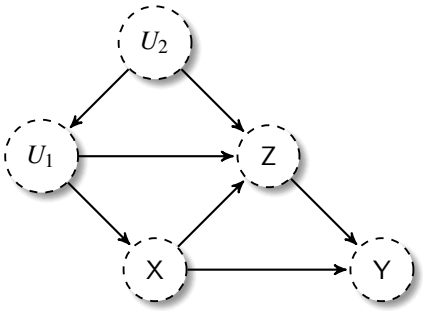
4.8. Large DAG



4.9. Large DAG (using latent var notation)



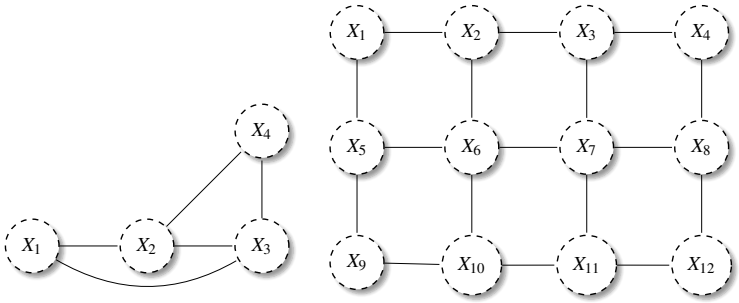
4.10. Large DAG (using latent var notation alternative)



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) {\( X_4 \)} ; %
\edgesimple [-] {x1} {x2} ; %
\edgesimple [-] {x2} {x3} ; %
\edgesimple [-] {x3} {x4} ; %
\edgesimple [-] {x2} {x4} ; %
\edgesimple[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) {\( X_{12} \)} ; %
\edgesimple [-] {x1} {x2} ; %
\edgesimple [-] {x2} {x3} ; %
\edgesimple [-] {x3} {x4} ; %
\edgesimple [-] {x1} {x5} ; %
\edgesimple [-] {x2} {x6} ; %
\edgesimple [-] {x3} {x7} ; %
\edgesimple [-] {x4} {x8} ; %
\edgesimple [-] {x5} {x6} ; %
\edgesimple [-] {x6} {x7} ; %
\edgesimple [-] {x7} {x8} ; %
```

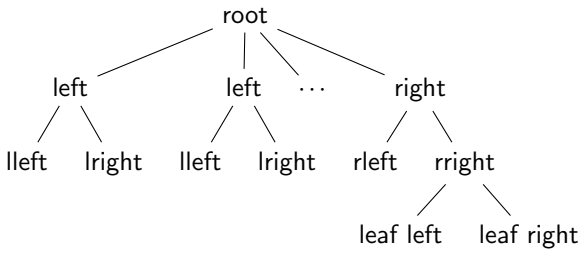
```
\edgesimple [-] {x5} {x9} ; %
\edgesimple [-] {x6} {x10} ; %
\edgesimple [-] {x7} {x11} ; %
\edgesimple [-] {x8} {x12} ; %
\edgesimple [-] {x9} {x10} ; %
\edgesimple [-] {x10} {x11} ; %
\edgesimple [-] {x11} {x12} ; %
}
}
\end{figure}
```



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]]
    [\( \cdots  \)]
    [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}
```