Bayesian Networks and Influence Diagrams: A Guide to Construction and Analysis

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Answers to Exercises

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Answer to Exercise 2.1:

(a) $\|(\mathsf{X},\mathsf{Y},\mathsf{Z})\| = |\mathrm{dom}(\mathsf{X})| \cdot |\mathrm{dom}(\mathsf{Y})| \cdot |\mathrm{dom}(\mathsf{Z})| = 12$.

(b) $\mathrm{dom}(\mathsf{X},\mathsf{Y} = \mathsf{good},\mathsf{Z}) = \{(0,\mathsf{good},\mathsf{low}),(0,\mathsf{good},\mathsf{average}),(0,\mathsf{good},\mathsf{high}),$ $(1,\mathsf{good},\mathsf{low}),(1,\mathsf{good},\mathsf{average}),(1,\mathsf{good},\mathsf{high})\}$.

(c) $w_{\{\mathsf{X},\mathsf{Z}\}} = (1,\mathsf{high})$, $w_{\mathsf{Y}} = \mathsf{good}$.

(d)

(i) $\mathcal{E}_{\mathsf{Z}} = (1,0,0)$.

(ii) $\mathcal{E}_{\mathsf{Z}} = (0,1,3)$.

Answer to Exercise 2.2:

(a) $\mathsf{Flu} \rightarrow \mathsf{Fever}$

(b) $\mathsf{State\_of\_battery} \leftarrow \mathsf{Age\_of\_battery}$

(c) $\mathsf{Living\_standard} \leftarrow \mathsf{Education}$

(d) $\mathsf{Age} \rightarrow \mathsf{Number\_of\_children}$

(e) $\mathsf{Occupation} \leftarrow \mathsf{Education}$

(f) $\mathsf{Fake\_die} \rightarrow \mathsf{Number\_of\_6s}$

Answer to Exercise 2.3:

(a) $\mathsf{A} \perp \mathsf{B}$ is true

(b) $\mathsf{A} \perp \mathsf{B}|\mathsf{C}$ is true

(c) $\mathsf{A} \perp \mathsf{B}|\{\mathsf{C},\mathsf{D}\}$ is false

(d) $\mathsf{B} \not\perp \mathsf{F}$ is true

(e) $\mathsf{B} \perp \mathsf{F}|\mathsf{E}$ is true

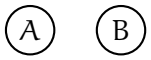
(f) $\mathsf{B} \perp \mathsf{F}|\{\mathsf{D},\mathsf{E}\}$ is false

(g) $\mathsf{F} \perp \mathsf{G}$ is false

(h) $\mathsf{F} \perp \mathsf{G}|\mathsf{E}$ is false

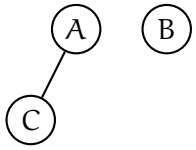
(i) $\mathsf{F} \perp \mathsf{G}|\{\mathsf{A},\mathsf{E}\}$ is true

Answer to Exercise 2.4:

(a) 

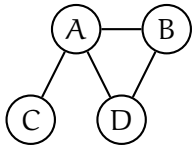
The lack of a path from A to B verifies that $\mathsf{A} \perp \mathsf{B}$.

(b)



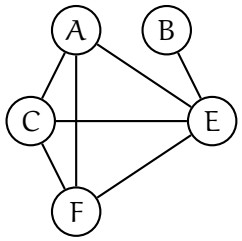
The lack of a path from A to B verifies that $\mathsf{A} \perp \mathsf{B} | \mathsf{C}$.

(c)



The link between A and B verifies that $\mathsf{A} \perp \mathsf{B} | \{\mathsf{C}, \mathsf{D}\}$ is false.

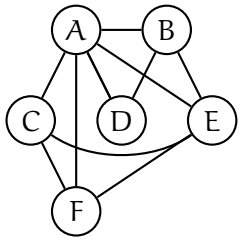
(d)



There are paths from B to F, verifying that $\mathsf{B} \not\perp \mathsf{F}$ is true (i.e., $\mathsf{B} \perp \mathsf{F}$ is false).

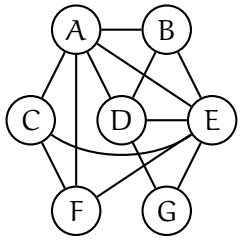
(e) Same graph as in (d). All paths between B and F pass through E, verifying that $\mathsf{B} \perp \mathsf{F} | \mathsf{E}$ is true.

(f)



There are paths between B and F not passing through D or E, verifying that $\mathsf{B} \perp \mathsf{F} | \{\mathsf{D}, \mathsf{E}\}$ is false.

(g)



There are paths between F and G, verifying that $\mathsf{F} \perp \mathsf{G}$ is false.

(h) Same graph as in (g). There are paths between F and G not passing through E, verifying that $\mathsf{F} \perp \mathsf{G} | \mathsf{E}$ is false.

(i) Same graph as in (g). All paths between F and G pass through A or E, verifying that $\mathsf{F} \perp \mathsf{G} | \{\mathsf{A}, \mathsf{E}\}$ is true.