

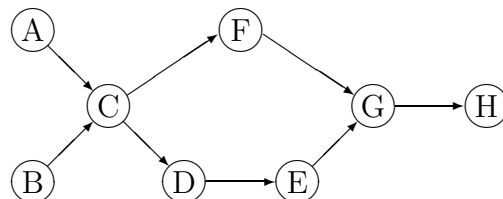
### Exercise Sheet 3

#### Exercise 9 Bayesian Theorem

- a) Color blindness affects 5 out of 100 men and 25 out of 10000 women. A color blind person is randomly picked. What is the probability of this person being male?
- b) In a given population, 2% of all persons suffer a certain disease. Let a test have the property that it correctly recognizes an ill person with 95% probability whereas the rate of correctly revealing a healthy person is 99%. What is the probability that a person does (not) suffer from the disease if the test does (not) reveal the disease?

#### Exercise 10 Separation Criteria: d-Separation

Consider the following directed graph:



Which of the following propositions hold true in the graph??

(„ $X \perp\!\!\!\perp Y \mid Z$ “ denotes „ $X$  and  $Y$  are d-separated (in  $G$ ) by  $Z$ .“)

- |   |   |
|---|---|
| i) $F \perp\!\!\!\perp H \mid G$          | v) $A \perp\!\!\!\perp B \mid D$              |
| ii) $C \perp\!\!\!\perp G \mid F$         | vi) $D \perp\!\!\!\perp F \mid \{C, G\}$      |
| iii) $F \perp\!\!\!\perp E \mid C$        | vii) $E \perp\!\!\!\perp F \mid \{A, B\}$     |
| iv) $A \perp\!\!\!\perp B \mid \emptyset$ | viii) $C \perp\!\!\!\perp E \mid \{D, F, H\}$ |

#### Exercise 11 Separation Criteria: u-Separation

Consider the undirected graph that is obtained if all arrow heads from the directed graph in exercise 10 are dropped. Check again the propositions i)–viii) of exercise 10, now with the u-separation criterion! Which differences can be observed?

**Exercise 12**      Separation Criteria: d/u-Separation

Remember the alternative way of checking for d-separation that was presented in the lecture (slides 56–58):  $X$  and  $Y$  are d-separated by  $Z$  if  $X$  and  $Y$  are u-separated by  $Z$  in the moralised minimal ancestral subgraph induced by  $X \cup Y \cup Z$ . With this approach, verify again the results from exercise 10!

**Additional Exercise**      The Unfair Subway

Marvin gets off work at random times between 3 and 5 p.m. His mother lives in uptown, his girl friend downtown. He takes the first subway that comes in either direction and eats dinner with the one he is first delivered to. His mother complains that he never comes to see her, but he says she has a 50-50 chance. He has had dinner with her twice in the last 20 working days. Explain.