Artificial Intelligence II

(a) A given probabilistic inference problem involves a query random variable (RV) \( Q \), evidence RVs \( E = (E_1, \ldots, E_n) \) and unobserved RVs \( U = (U_1, \ldots, U_m) \). Assuming that RVs are discrete, state the equation allowing the inference \( \Pr(Q \mid E = (e_1, \ldots, e_n)) \) to be computed using the full joint distribution of the RVs and explain why in practice such a method might fail. [5 marks]

(b) Give a general definition of a Bayesian network (BN), and explain how a BN represents a joint probability distribution. [4 marks]

(c) Define conditional independence and explain how BNs make use of this concept to reduce the effect of the difficulties mentioned in your answer to part (a). Describe the way in which conditional independence is employed by the naïve Bayes algorithm. [6 marks]

(d) Describe two further issues relevant to the application of BNs in a practical context and describe briefly how these issues can be addressed. [5 marks]