Joint, marginal, conditional probabilities

- Joint: $P(x, y) \quad where \quad P(\cdot) \in \mathbb{R}^{|X| \times |Y|}$

- Marginal: $P(x) = \sum_{y} P(\mathsf{x} = x, \mathsf{y} = y)$

- Conditional: $P(y \mid x) = \frac{P(\mathsf{y} = y, \mathsf{x} = x)}{P(\mathsf{x} = x)}$

Product rule, independence, conditional independence

- Product rule: $P(x^{(1)}, \ldots, x^{(n)}) = P(x^{(1)}) \prod_{i=2}^{n} P(x^{(i)} \mid x^{(1)}, \ldots, x^{(i-1)})$

- Independence condition: $P(x, y) = P(x)P(y)$

- Conditional independence condition: $P(x, y \mid z) = P(x \mid z)\ P(y \mid z)$