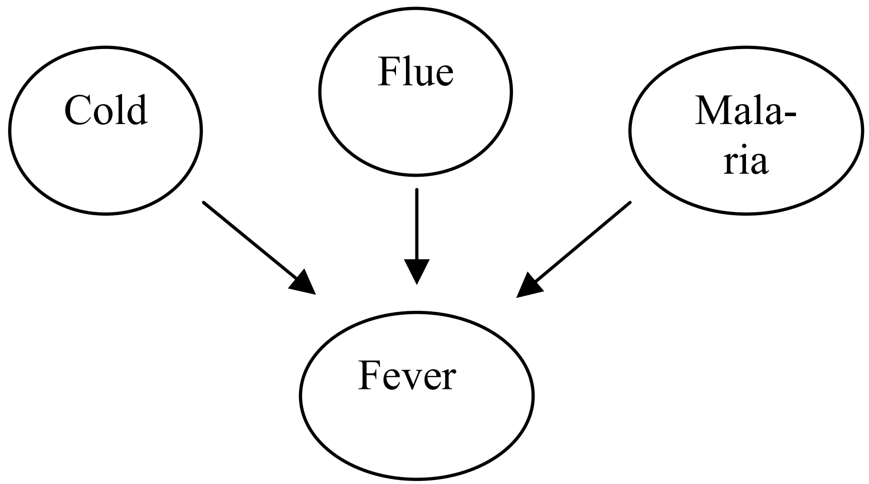
Noisy OR

- The number N of independent entries in the CPT (conditional probability table) grows exponentially with the number of parents (with binary units: $N \sim 2^n-1$)

- Two ways of overcoming this worst-case scenario:

  - The relation between parents and children is restricted in the sense that there are conditional independencies between the nodes. For instance, if each node has not more than three parents, then $N < 8\,n$

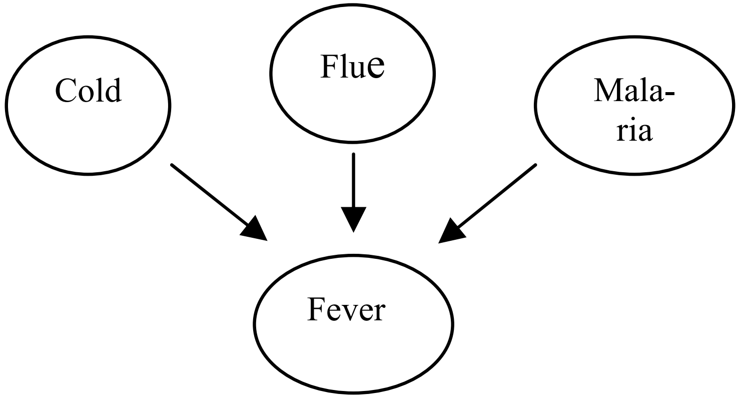
  - Instead of free distributions, often canonical (parameterized) distributions are suggested. The noisy OR is the most popular distribution in the discrete case.



The noisy OR is a generalization of the logical OR. Three assumptions:

1. All possible causes U_i for a event X are listed (you can add a *leak* node)
2. Negated causes $\neg U_i$ do not have any influence on X
3. Independent failure probability q_i for each cause alone.

$$\mu(X|U_1 \ldots U_j, \neg U_{j+1} \ldots \neg U_k) = 1 - \Pi^{j}_{i=1} q_i$$



$\mu(X|U_1 \ldots U_j, \neg U_{j+1} \ldots \neg U_k) = 1 - \Pi^{j}_{i=1}\, q_i$

Cold	Flu	Malaria	μ(Fever)	$\mu(\neg$Fever)
F	F	F	0	1
F	F	**T**	0.9	**0.1**
F	**T**	F	0.8	**0.2**
F	T	T	0.98	0.02 = 0.2 x 0.1
T	F	F	0.4	**0.6**
T	F	T	0.94	0.06 = 0.6 x 0.1
T	T	F	0.88	0.12 = 0.6 x 0.2
T	T	T	0.988	0.012 = 0.6 x 0.2 x 0.1

e.g. $\mu(\neg$Fever|Flue&Malaria&$\neg$Cold) = $\mu(\neg$Fever|Flue) $\mu(\neg$Fever|Malaria) = 0.2 x 0.1

Assume a noisy OR-gate model for $\mu(A|\, E, B)$. Calculate the probability table assuming $\mu(A|\, E, \neg B) = 0.2$ and $\mu(A|\, \neg E, B) = 0.9$