Q1

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Answer:

Let us say there are n symbols and n-1 operations between them. We can solve the two subproblems which are how many ways are there to make the expression between l^{th} and r^{th} evaluate to true (T), and the base cases are:

$T(i,i)$ is 1 if symbol i is true, and 0 if symbol i is false.

$F(i,i)$ is 0 if symbol i is true, and 1 if symbol i is false.

For each subproblem, we separate the expression by an operator m and put both sides of the operator in its own bracket. Then we evaluate each subproblem of the two sides and combine the results together by the type of operator we separated.

We solve both subproblems:

$$T(l,r) = \sum_{m=1}^{r-1} T_{separate(l,m,r)}$$

$$F(l,r) = \sum_{m=1}^{r-1} F_{separate(l,m,r)}$$

$$T_{separate(l,m,r)} \begin{cases} T(l,m) \times T(m+1,r) & if\ operator\ m\ is\ AND \\ F(l,m) \times F(m+1,r) & if\ operator\ m\ is\ NOR \\ T(l,m) \times T(m+1,r) + T(l,m) \times F(m+1,r) + F(l,m) \times T(m+1,r) & \\ \qquad if\ operator\ m\ is\ OR & \\ T(l,m) \times F(m+1,r) + F(l,m) \times F(m+1,r) + F(l,m) \times T(m+1,r) & \\ \qquad if\ operator\ m\ is\ NAND & \end{cases}$$

$$F_{separate(l,m,r)} \begin{cases} T(l,m) \times T(m+1,r) & if\ operator\ m\ is\ NAND \\ F(l,m) \times F(m+1,r) & if\ operator\ m\ is\ OR \\ T(l,m) \times T(m+1,r) + T(l,m) \times F(m+1,r) + F(l,m) \times T(m+1,r) & \\ \qquad if\ operator\ m\ is\ NOR & \\ T(l,m) \times F(m+1,r) + F(l,m) \times F(m+1,r) + F(l,m) \times T(m+1,r) & \\ \qquad if\ operator\ m\ is\ AND & \end{cases}$$