1 EAs and SAT

In the Boolean Satisfiability Problem (SAT), one has a Boolean expression composed of conjunctions and disjunctions of literals. A literal is a Boolean variable or the negation of a variable. The variables $v_i$ can be true or false. An example (in prefix notation) is $(\land (\lor v_1 \neg v_2 v_3 ) (\lor \neg v_1 \neg v_4 \neg v_5 ))$. One class of these problems is called “3-SAT”, which has the form given in the previous sentence. Expressions have the form $(\land \text{clause}_1 \text{clause}_2 \ldots \text{clause}_M )$. Each clause has the form $(\lor \ldots )$ where each “dot” is a literal. The goal is to find any assignment to the variables such that the expression evaluates to true. There are $N$ variables and $M$ clauses.

1(a) EAs for 3-SAT
Assume the problems are 3-SAT in nature.

If we solve this with a genetic algorithm, an individual can simply be a bit string of length $N$. Bit $i$ is 1 if $v_i$ is true, or bit $i$ is 0 if $v_i$ is false. Note that mutation and crossover will work fine. Define a fitness function that evaluates better individuals as having higher fitness, with the maximum fitness being equal to 1.0 (this would be a solution that satisfies the whole expression). Give me a function that will work with general 3-SAT problems of $N$ variables and $M$ clauses.

1(b) EAs for SAT
Now assume that the Boolean expressions have arbitrary form. For example, we could have $(\land \neg((\lor v_1 v_2 ) v_4 ) (\lor \neg((\land v_2 v_3 ) v_5 ) (\land v_5 \neg v_6 )))$. In other words, the expression is an arbitrary combination of ANDs, ORs, NOTs and variables. Note that this time whole expressions can be negated.
Again assume an individual is a bit string of length $N$, with 1 = true and 0 = false.

Define a fitness function that evaluates better individuals as having higher fitness, with the maximum fitness being equal to 1.0 (this would be a solution that satisfies the whole expression). Give me a function that will work with general SAT problems, not just the trivial example above.