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**Task 1: SAT Encoding**

1. Each guest should be seated at one and only one table

This can be decomposed to:

1. A guest should be seated on at least one table
2. A guest should not be seated on more than one table

That way, for (i) for M people and N tables

X(1,1) V X(1,2) V….V X(1,N)

X(2,1) V X(2,2) V….V X(2,N)

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X(M,1) V X(M,2) V….V X(M,N)

These become total M clauses

**X(Y,Z)** indicates that person Y is seated on table Z

**- X(Y,Z)** indicates that person Y is NOT seated on table Z

Now for not more than one clause:

X(1,1) -> -X(1,2) ^ X(1,3) ^…^- X(1,N) {N-1 clauses} => (-X(1,1) V -X(1,2)) ^ (-X(1,1) , -X(1,3)) ^ … (-X(1,1) , -X(1,N))

X(1,2) -> -X(1,1) ^ X(1,3) ^…^ -X(1,N) {N-1 clauses} => (-X(1,2) V -X(1,1)) ^ (-X(1,2) , -X(1,3)) ^… (-X(1,2) , -X(1,N))

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X(1,N) -> -X(1,1) ^ X(1,2) ^…^ X(1,M-1) {N-1 clauses} => => (-X(1,N) V -X(1,1)) ^ (-X(1,N) , -X(1,2)) ^ (-X(1,1) , -X(1,3)… (-X(1,1) , -X(1,N-1))

So, for person 1, there are N\*(N-1) clauses.

Similarly for M persons, it would be total of: M\* N\*(N-1) clauses.

So for condition (a) the total number of clauses are: **M + M\* N\*(N-1)**

**The CNF:**

1. For friend or enemy relation matrix, the number of relation pairs possible are:

**(M \* (M-1))/2**

If a relation for pair of persons (Y,Z) is friend then:

X(Y,1) -> X(Z, 1) => - X(Y,1) V X(Z, 1)

X(Y,2) -> X(Z, 2) => - X(Y,2) V X(Z, 2)

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X(Y,N) -> X(Z, N) => -X(Y,N) V X(Z, N)

So total of N clauses

Similarly if enemy:

X(Y,1) -> -X(Z, 1) => - X(Y,1) V -X(Z, 1)

X(Y,2) ->- X(Z, 2) => - X(Y,2) V -X(Z, 2)

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X(Y,N) -> -X(Z, N) => -X(Y,N) V -X(Z, N)

So again total of N clauses.

Now a relation can be either a friend or enemy, in both the cases, the number of clauses is N.

So total of clauses in this step is: **N \* (M \* (M-1))/2**

So (a) + (b) = **M + M\* N\*(N-1)** + (**N \* (M \* (M-1))/2)** is the total number of clauses.

**Task 2: Instance Generator**

This is done in the code.

**Task 3: SAT Solver**

This is done in the code.

**Task 4: Experiment 1**

Y-axis: P(satisfiability)

X-aixs: values for <e>

**Question 2:**

**Task 5: Experiment 2**

Question 3:

Question 4:

**Task 6: Experiment 3**

Question 5:

Question 6: