**bonus – theoretical:**

## We'll prove our Harassed Citizen Problem is NP hard.

## We'll show a reduction from Hamilton Path Problem to the Harassed Citizen Problem.

## Where Hamilton path problem is described as:

## Given a graph G and two vertexes s,t a Hamilton path is a path between s to t where each vertex is shown exactly once.

## Which is known to be NP-Hard.

## And the Harassed Citizen Problem is:

## Given graph G and two vertexes s,t we'd like to know if there's a cheap way to get from s to t (cheap is <= |V|-1).

## While vertexes in the graph may be locked and the keys for the looks may be found in other vertexs.

## The reduction function f:

## Given a <G,s,t> a Hamilton path input.

## We'll construct graph G' as: Vertex t will have |V| -1 locks (1,…|V|-1). each other Vertex other than t will have a different key from 1 to |V|-1. all edges are weighted with 1. The reduction is polynomial: We go through each vertex and each edge once to construct G' which can be done in linear time.

## The proof:

## if

Since G is in Hampath then we know there's a Hamilton path between s and t.

If we observe the same path in G' we'll go through all the vertexes in the graph and collect all the keys thus vertex t will be open and we get from vertex s to t with cost of |V|-1 which is cheap.

if <G,s,t> then we'll show that G' is not in

proof (by contradiction) assume G' is in Harassed Citizen Problem. Then there's a cheap path between s and t where the path weignt is <= |V|-1. But vertex t is locked by |V|-1 locks which means that to get from s to t we should have vistited all vertexes exactly once but that is in contradiction to the assumption that G doesn't have a Hamilton path from s to t.