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Question 1)

Mention 3 applications to the Minimum Vertex Cover (MVC) problem.

1- fire hydrant location.

2- Ambulance centers.

3- Police stations.

4 - network security

5- parallel machine scheduling

6- financial networks and economics.

Question 2)

Mention 3 applications to the Traveling Salesman Problem (TSP).

Answer from this website:

1- Drilling of printed circuit boards

2- Overhauling gas turbine engines

3- X-Ray crystallography

Question 3)

Model the Minimum Vertex Cover problem using JuMP and solve it for the following.

Answer = 3 vertices, (vertex 3, 4 and 5)

Code:

```
using JuMP, GLPK
number_of_vertex = 6
arr = [
    0 0 1 0 0 0;
    0 0 0 1 0 0;
    1 0 0 0 1 0;
    0 1 0 0 1 0;
    0 0 1 1 0 1;
    0 0 0 0 1 0
]
model = Model(optimizer_with_attributes(GLPK.Optimizer, "tm_lim" => 60000,
"msg_lev" => GLPK.OFF))

@variable(model, v[1:number_of_vertex], Bin)
@objective(model, Min, sum(v))
@constraint(model, [j=1:number_of_vertex], sum(arr[i, j]*v[i] for i in
1:number_of_vertex) >= 1)
optimize!(model)
println("Model:")
println(model)
println("Objective value = ", objective_value(model))
for i in 1:6
    println("v[$i] = ", value(v[i]))
End
```

Result:

```
Model:
Min v[1] + v[2] + v[3] + v[4] + v[5] + v[6]
Subject to
 v[3] ≥ 1.0
 v[4] ≥ 1.0
 v[1] + v[5] ≥ 1.0
 v[2] + v[5] ≥ 1.0
 v[3] + v[4] + v[6] ≥ 1.0
 v[5] ≥ 1.0
 v[1] binary
 v[2] binary
 v[3] binary
 v[4] binary
 v[5] binary
 v[6] binary

Objective value = 3.0
v[1] = 0.0
v[2] = 0.0
v[3] = 1.0
v[4] = 1.0
v[5] = 1.0
v[6] = 0.0
```