Tutorial 3:

Q4.

```
VISITED[v] ← True;
HIGH-POINT[v] ← LEVEL[v];
foreach w ∈ N(v) do
    if (VISITED[w] = False) then
        Set PARENT[w] ← v  and  LEVEL[w] = 1 + LEVEL[v];
        Invoke DFS(w) ;
        HIGH-POINT[v] ← min{HIGH-POINT[w], HIGH-POINT[v]} ;
        if HIGH-POINT[w] ≥ LEVEL[v] then
            IS-CUT-VERTEX[v] ← True ;
        end
    else if (w ≠ PARENT[v]) then
        HIGH-POINT[v] ← min{LEVEL[w], HIGH-POINT[v]} ;
    end
end
```

Procedure DFS(v)

```
Let (v_1, ..., v_n) be any ordering of vertices of G;
for i = 1 to n do
    VISITED[v_i] ← False  and  IS-CUT-VERTEX[v_i] ← False ;
end
for i = 1 to n do
    if (VISITED[v_i] = False)  then
        LEVEL[v_i] ← 0;
        Invoke DFS(v_i);
        if (v_i has one child)  then  IS-CUT-VERTEX[v_i] ← False ;
    end
end
```

Procedure Compute-Cut-vertices(G)

Tutorial 4

Q5.

Solution: We first define the concept of *median*.

Definition: Given K real numbers $x_1, \ldots, x_L$, the *median* of $x_1, \ldots, x_L$ is a real number y satisfying $\sum_{i=1}^{L} |x_i - y|$ is minimized.

Fact (exercise, try on simple examples): If real numbers $x_1, \ldots, x_L$ are sorted in non-decreasing order then $y = x_{\lfloor L/2 \rfloor}$ and $y = x_{\lceil L/2 \rceil}$ are *medians* of $x_1, \ldots, x_L$.

Make a 2D table T of size $n \times k$, where for $i \in [1, n]$ and $j \in [1, k]$, the value $T[i, j]$ denotes the minimum sum total distance traveled for the sub-problem with first i residents if j testing centers are to be opened.

Note that ~~is~~ if the j center positions were already decided, then the residents can be partition into j intervals such that for the first interval first covid-test center is closest, for the second interval second covid-test center is closest, and so on. Based upon this observation, the recursive approach to build table T is as follows:

$$T(i, j) = \min_{\alpha \in [1, i]} \Big(T(\alpha - 1, j - 1) \; + \; \sum_{r=\alpha}^{i} \Big| A[r] - A\big[\lceil \tfrac{\alpha+i}{2} \rceil\big] \Big| \Big)$$

In the above formulation for having j centers for first i resident, we are trying all possibilities for the last interval, that is, corresponding to j^{th} test center. For the optimal choice of α, the median of resident locations $A[\alpha], \ldots, A[i]$, that is, $A\big[\lceil \frac{\alpha+i}{2} \rceil\big]$ is the optimal position for j^{th} test center.