1. Update the following Kruskal’s pseudocode with \texttt{union} and \texttt{find} operations, and do a runtime analysis of the updated code.

```pseudo
function Kruskal(Graph G)
    initialize disjoint set; call maketSet() on each vertex
    sort all edges by weight
    for each edge (u, v) in sorted order do
        if findSet(u) \neq \text{findSet}(v) then
            add edge (u,v) to the MST
            union(u,v)
        end if
    end for
end function
```

2. Consider the following disjoint set. Assume that (from left) the first tree has rank 3, the second has rank 0, the third has rank 1, and the last tree has rank 1.

```
  7   10
   3  12
  8  9   2
  11 1 11
     12
  5
```

Write the array representation of this disjoint set in the array below.

```
<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
</table>
```

3. (3 points) Suppose you are given a connected graph G. Describe how you would figure out if the graph has a cycle. (Answer in at most 3-4 sentences.)