Sample Solutions to Homework #1

1. (a) See Figure 1.
(b) See Figure 2.
(c) $G = w \cdot z + x \cdot y \cdot z + x \cdot y \cdot \pi$. The schematic diagram for NMOS network is shown in Figure 3.

![Figure 1: Schematic diagram for Problem 1(a).]

2. (a) Incorrect. It is correct when $c > 1$, but incorrect when $c = 1$ and $k > 1$.
(b) Correct.
(c) Correct.

3. See Table 1. The shortest distance is 4.
4. See Table 2. The total tree cost is 9.
5. See Figure 4. The branch and bound tree contains 24 nodes.
6. (a) See Table 3. The DFS order is $\{v_4, v_3, v_1, v_2, v_5\}$.
(b) See Table 4. The BFS order is $\{v_4, v_3, v_1, v_2, v_5\}$. 
Table 1: Iteration info for Problem 3.

<table>
<thead>
<tr>
<th>Iteration</th>
<th>Key</th>
<th>(\pi)</th>
<th>Vertex in MST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>key[V1]=0</td>
<td>(\pi[V1]=\text{NIL})</td>
<td>V1</td>
</tr>
<tr>
<td></td>
<td>key[V2]=\infty</td>
<td>key[V3]=\infty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V4]=\infty</td>
<td>key[V5]=\infty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V6]=\infty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>key[V1]=0</td>
<td>(\pi[V2, V5, V6]=V1)</td>
<td>V1 V2</td>
</tr>
<tr>
<td></td>
<td>key[V2]=1</td>
<td>key[V3]=\infty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V4]=\infty</td>
<td>key[V5]=4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V6]=2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>key[V1]=0</td>
<td>(\pi[V4]=V2)</td>
<td>V1 V2</td>
</tr>
<tr>
<td></td>
<td>key[V2]=2</td>
<td>key[V3]=\infty</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V4]=8</td>
<td>key[V5]=4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V6]=2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
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<td>(\pi[V3, V4, V5]=V6)</td>
<td>V1 V2</td>
</tr>
<tr>
<td></td>
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<td>key[V3]=6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V4]=2</td>
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</tr>
<tr>
<td></td>
<td>key[V6]=2</td>
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<td></td>
</tr>
<tr>
<td>5</td>
<td>key[V1]=0</td>
<td>(\pi[V3]=V4)</td>
<td>V1 V2 V3</td>
</tr>
<tr>
<td></td>
<td>key[V2]=1</td>
<td>key[V3]=1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V4]=2</td>
<td>key[V5]=3</td>
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<td></td>
<td>key[V6]=2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
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<td>key[V2]=1</td>
<td>V1 V2 V3</td>
</tr>
<tr>
<td></td>
<td>key[V4]=2</td>
<td>key[V5]=3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>key[V6]=2</td>
<td></td>
<td>V4 V5 V6</td>
</tr>
</tbody>
</table>

Table 2: Iteration info for Problem 4.

<table>
<thead>
<tr>
<th>DFS(v4)</th>
<th>DFS(v3)</th>
<th>DFS(v2)</th>
<th>DFS(v5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(e_4 = (v_4, v_3))</td>
<td>(e_3)</td>
<td>(e_2 = (v_1, v_2)), (e_2 = (v_1, v_3))</td>
<td>(e_5 = (v_2, v_5))</td>
</tr>
</tbody>
</table>

Table 3: Step info for Problem 6(a).

<table>
<thead>
<tr>
<th>Q</th>
<th>W</th>
<th>Edges processed</th>
</tr>
</thead>
<tbody>
<tr>
<td>(v_4)</td>
<td>(v_4)</td>
<td>(v_4 = (v_4, v_3))</td>
</tr>
<tr>
<td>(v_3)</td>
<td>(v_3)</td>
<td></td>
</tr>
<tr>
<td>(v_1)</td>
<td>(v_1)</td>
<td>(e_1 = (v_1, v_2)), (e_2 = (v_1, v_3))</td>
</tr>
<tr>
<td>(v_2)</td>
<td>(v_2)</td>
<td>(e_3 = (v_2, v_4)), (e_5 = (v_2, v_5))</td>
</tr>
<tr>
<td>(v_5)</td>
<td>(v_5)</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Step info for Problem 6(b).
Figure 4: Branch and bound tree for Problem 5.