1. Any language in $SPACE(f(n))$ as defined using the two-tape read-only model can be simulated with a single tape model using at most $O(n)$ space. Similarly, any language in $SPACE(f(n))$ as defined using a single tape model can be simulated with a two-tape read-only model with an improvement of a most $O(n)$ space. Thus, the complexity classes are equivalent where $f(n) \geq n$.

2. The winning strategy for X is to move to the top-right position. O can then move to block only either the top-centre or centre-right position. If O moves to the top-centre, X moves to the centre-right. If O move to the centre-right, X moves to the top-centre.

3. Player I has a winning strategy as follows:

    - Player I begins at node 1.
    - Player 2 chooses node 2.
    - Player I chooses node 4. Node 3 has only one outgoing edge which connects to node 6. As node 6 has no outgoing edges, this path would guarantee a win for Player II.
    - Player II chooses node 5.
    - Player I chooses node 6. As no unchosen nodes remain, Player I wins.

4. Let L_i be a language decided by PSPACE turing machine M_i. We define languages $L_\cup = L_i \cup L_j$, $\bar{L_i} = \{w \mid w \notin L_i\}$, $L_i^* = \{x_1 x_2 \ldots x_k \mid k \geq 0 \text{ and each } x_i \in L_i\}$.

    We define $M_\cup$, $\bar{M_i}$ and M_i^* as follows:

    $M_\cup$ = "On input w

    1. Run $M_i\langle w \rangle$. If M_i accepts, *accept*.
    2. Run $M_j\langle w \rangle$. If M_j accepts, *accept*.
    3. If neither $M_i\langle w \rangle$, $M_j\langle w \rangle$ accepted, *reject*."

    $\bar{M_i}$ = "On input w

    1. Run $M_i\langle w \rangle$. If M_i accepts, *reject*, else *accept*."

    M_i^* = "On input w

    1. If $w = \epsilon$, *accept*.
    2. For each m, where $1 \leq m \leq n$, $n = |w|$.
        3. Split w into m pieces, such that $w = w_1 w_2 \ldots w_k$.
        4. For all i, $1 \leq i \leq m$, run $M_i\langle w_i \rangle$. If M_i rejects, go to step 2.

5. M_i has accepted for all i, *accept*.

6. M_i has rejected for all m, *reject*."