Program 10

Implement Alpha-Beta Pruning.

Code:

```
import math
def minimax(node, depth, is_maximizing):
    """
    Implement the Minimax algorithm to solve the decision tree.

    Parameters:
    node (dict): The current node in the decision tree, with the following structure:
        {
            'value': int,
            'left': dict or None,
            'right': dict or None
        }
    depth (int): The current depth in the decision tree.
    is_maximizing (bool): Flag to indicate whether the current player is the maximizing player.

    Returns:
    int: The utility value of the current node.
    """
    # Base case: Leaf node
    if node['left'] is None and node['right'] is None:
        return node['value']

    # Recursive case
    if is_maximizing:
        best_value = -math.inf
        if node['left']:
            best_value = max(best_value, minimax(node['left'], depth + 1, False))
```

```python
        if node['right']:
            best_value = max(best_value, minimax(node['right'], depth + 1, False))
        return best_value
    else:
        best_value = math.inf
        if node['left']:
            best_value = min(best_value, minimax(node['left'], depth + 1, True))
        if node['right']:
            best_value = min(best_value, minimax(node['right'], depth + 1, True))
        return best_value

# Example usage
decision_tree = {
    'value': 5,
    'left': {
        'value': 6,
        'left': {
            'value': 7,
            'left': {
                'value': 4,
                'left': None,
                'right': None
            },
            'right': {
                'value': 5,
                'left': None,
                'right': None
            }
        },
        'right': {
```

```
            'value': 3,
            'left': {
                'value': 6,
                'left': None,
                'right': None
            },
            'right': {
                'value': 9,
                'left': None,
                'right': None
            }
        }
    },
    'right': {
        'value': 8,
        'left': {
            'value': 7,
            'left': {
                'value': 6,
                'left': None,
                'right': None
            },
            'right': {
                'value': 9,
                'left': None,
                'right': None
            }
        },
        'right': {
            'value': 8,
```

```
            'left': {
                'value': 6,
                'left': None,
                'right': None
            },
            'right': None
        }
    }
}

# Find the best move for the maximizing player
best_value = minimax(decision_tree, 0, True)
print(f"The best value for the maximizing player is: {best_value}")
```

Output:

```
The best value for the maximizing player is: 6
```