Assignment Topic: Tic-tac-toe Implementation with Min-max Algorithm

Course Title: Artificial Intelligence

Course Code: **SWE 323**

Date of Submission: **31st May 2023**

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```cpp
//Tic-tac-toe solving with min-max algorithm
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#include <bits/stdc++.h>

using namespace std;

struct Move {
    int row, col;
};

class TicTacToe {
public:
    TicTacToe() : board(3, vector<char>(3, '_')) {}

    void play() {
        cout << "Enter the initial state of the board:" << endl;
        readBoardState();

        Move bestMove = findBestMove();

        cout << "The optimal move is:" << endl;
        cout << "ROW: " << bestMove.row << " COL: " << bestMove.col << endl << endl;

        cout << "Updated board state:" << endl;
        board[bestMove.row][bestMove.col] = player;
        printBoard();
    }

private:
    vector<vector<char>> board;
    char player = 'x';
    char opponent = 'o';

    void readBoardState() {
        for (int i = 0; i < 3; i++) {
            for (int j = 0; j < 3; j++) {
                cin >> board[i][j];
            }
        }
    }

    bool isMovesLeft() {
        for (int i = 0; i < 3; i++) {
            for (int j = 0; j < 3; j++) {
                if (board[i][j] == '_') {
                    return true;
                }
            }
        }
        return false;
    }
```

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int evaluate() {
    for (int row = 0; row < 3; row++) {
        if (board[row][0] == board[row][1] && board[row][1] == board[row][2]) {
            if (board[row][0] == player)
                return +10;
            else if (board[row][0] == opponent)
                return -10;
        }
    }

    for (int col = 0; col < 3; col++) {
        if (board[0][col] == board[1][col] && board[1][col] == board[2][col]) {
            if (board[0][col] == player)
                return +10;
            else if (board[0][col] == opponent)
                return -10;
        }
    }

    if (board[0][0] == board[1][1] && board[1][1] == board[2][2]) {
        if (board[0][0] == player)
            return +10;
        else if (board[0][0] == opponent)
            return -10;
    }

    if (board[0][2] == board[1][1] && board[1][1] == board[2][0]) {
        if (board[0][2] == player)
            return +10;
        else if (board[0][2] == opponent)
            return -10;
    }

    return 0;
}

int minimax(int depth, bool isMax) {
    int score = evaluate();

    if (score == 10)
        return score;

    if (score == -10)
        return score;

    if (!isMovesLeft())
        return 0;

    if (isMax) {
        int best = -1000;
        for (int i = 0; i < 3; i++) {
            for (int j = 0; j < 3; j++) {
                if (board[i][j] == '_') {
                    board[i][j] = player;
                    best = max(best, minimax(depth + 1, !isMax));
```

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                    board[i][j] = '_';
                }
            }
        }
        return best;
    } else {
        int best = 1000;
        for (int i = 0; i < 3; i++) {
            for (int j = 0; j < 3; j++) {
                if (board[i][j] == '_') {
                    board[i][j] = opponent;
                    best = min(best, minimax(depth + 1, !isMax));
                    board[i][j] = '_';
                }
            }
        }
        return best;
    }
}

Move findBestMove() {
    int bestVal = -1000;
    Move bestMove;
    bestMove.row = -1;
    bestMove.col = -1;

    for (int i = 0; i < 3; i++) {
        for (int j = 0; j < 3; j++) {
            if (board[i][j] == '_') {
                board[i][j] = player;
                int moveVal = minimax(0, false);
                board[i][j] = '_';
                if (moveVal > bestVal) {
                    bestMove.row = i;
                    bestMove.col = j;
                    bestVal = moveVal;
                }
            }
        }
    }

    cout << "The value of the best move is: " << bestVal << endl << endl;
    return bestMove;
}

void printBoard() {
    for (int i = 0; i < 3; i++) {
        for (int j = 0; j < 3; j++) {
            cout << board[i][j] << " ";
        }
        cout << endl;
    }
}
};
```

```
int main() {
    TicTacToe game;
    game.play();

    return 0;
}
```