```python
from tictactoe_board import *

def main():
    the_board = Tictactoe_board(['XOX',
                                  'OXO',
                                  'XOO'])
    print(the_board)
    print("The winner is %s" % the_board.get_winner())
    print()

    the_board.place_piece(2, 0, 'O')
    print(the_board)
    print("The winner is %s" % the_board.get_winner())

if __name__ == "__main__":
    main()

```

```python
"""
Testing utilities.  Do not modify this file!
"""

VERBOSE = True
num_pass = 0
num_fail = 0

def assert_equals(msg, expected, actual):
    """
    Check whether code being tested produces
    the correct result for a specific test
    case. Prints a message indicating whether
    it does.
    :param: msg is a message to print at the beginning.
    :param: expected is the correct result
    :param: actual is the result of the
    code under test.
    """
    if VERBOSE:
        print(msg)

    global num_pass, num_fail

    if expected == actual:
        if VERBOSE:
            print("PASS")
        num_pass += 1
    else:
        if not VERBOSE:
            print(msg)
        print("**** FAIL")
        print("expected: " + str(expected))
        print("actual: " + str(actual))
        if not VERBOSE:
            print("")
        num_fail += 1

    if VERBOSE:
        print("")

```

```python

def fail_on_error(msg,err):
    """
    if run-time error occurs, call this to insta-fail

    :param msg: message saying what is being tested
    :param err: type of run-time error that occurred
    """
    global num_fail
    print(msg)
    print("**** FAIL")
    print(err)
    print("")
    num_fail += 1


def start_tests(header):
    """
    Initializes summary statistics so we are ready to run
tests using
    assert_equals.
    :param header: A header to print at the beginning
    of the tests.
    """
    global num_pass, num_fail
    print(header)
    for i in range(0,len(header)):
        print("=",end="")
    print("")
    num_pass = 0
    num_fail = 0

def finish_tests():
    """
    Prints summary statistics after the tests are complete.
    """
    print("Passed %d/%d" % (num_pass, num_pass+num_fail))
    print("Failed %d/%d" % (num_fail, num_pass+num_fail))
    print()

```

```
Lab Question 1
__row_as_string
__three_in_row
__is_winner

Lab Question 2
self.__board

Lab Question 3
With the given rows, lists of 'O' and 'X' are appended to the board, but it appears as X | O | X with new lines
in the Tictactoe_board object.
```

```python
"""
defines the behavior of a tic-tac-toe board
"""

NUM_ROWS = 3

class Tictactoe_board:

    def __init__(self, rows):
        """
        Constructor. Creates a tictactoe board with given cell values.
        If no initial cell values are given, creates an empty tictactoe board.

        :param rows: A list of three 3-character strings, where each character
        is either 'X', 'O', or ' '.  Each of the
        3-character strings represents a row of the tictactoe board.
        Example: [" X ", "O O", "XXO"] is the board
           | X |
        -----------
         O |   | O
        -----------
         X | X | O
        """
        self.__board = []
        if rows is None:
            empty_row = [' ', ' ', ' ']
            for i in range(NUM_ROWS):
                self.__board.append(empty_row)
        else:
            for i in range(NUM_ROWS):
                row = []
                for j in range(NUM_ROWS):
                    row.append(rows[i][j])
                self.__board.append(row)

    def place_piece(self, i, j, piece):
        """
        Places a piece (either 'X' or 'O') on the board.

        :param i: The row in which to place a piece (0, 1, or 2)
        :param j: The column in which to place a piece (0, 1, or 2)
        :param piece: The piece to place ('X' or 'O')
        """
        self.__board[i][j] = piece

    def clear_cell(self, i, j):
        """
        Clears a cell on the tictactoe board.

        :param i: The row of the cell to clear
        :param j: The column of the cell to clear
        """
        self.place_piece(i, j, ' ')

    def __row_as_string(self,row):
        """
        returns row in a format suitable for printing
        :param row: row of board as list of strings
        :return: row in prettified string format
        """
        str = ''
        for column in row[:len(row)-1]:
            str += column + ' | '
        str += row[len(row)-1]
        return str

    def __str__(self):
        """
        Produces a string representation of a board, returns it.

        :return: The string version of the board.
        """
        result = ''
        for row in self.__board[:len(self.__board)-1]:
            result += self.__row_as_string(row)
            result += '\n----------\n'
        result += self.__row_as_string(self.__board[len(self.__board)-1])
        result += '\n'
        return result

    def __three_in_row(self, player, start_x, start_y, dx, dy):
        """
        Determines if a player has three in a row, starting
        from a starting position (start_x, start_y) and going
        in the direction indicated by (dx, dy)
        """
        x = start_x; y = start_y
        for i in range(0,NUM_ROWS):
            if self.__board[y][x] ≠ player:
                return False
            x += dx
            y += dy
        return True


    def __is_winner(self, player):
        """Returns True if and only if the given player has won"""

        if self.__three_in_row(player, 0, 0, 1, 1):
            return True
        elif self.__three_in_row(player, 2, 0, -1, 1):
            return True
        else:
            for i in range(0, NUM_ROWS):
                if (self.__three_in_row(player, 0, i, 1, 0)
                    or self.__three_in_row(player, i, 0, 0, 1)):
                    return True
            return False


    def get_winner(self):
        """
        Determines if there is a winner and returns the player who has won.
        :param board: A tictactoe board.
        :return: 'X' if player X is the winner; 'O' if player O is the winner; None if there is no winner.
        """
        if self.__is_winner('X'):
            return 'X'
        elif self.__is_winner('O'):
            return 'O'
        else:
            return None


```

```python
"""
:author: Chris Hegang Kim
:note: I affirm that I have carried out the attached academic endeavors with full academic honesty,
in accordance with the Union College Honor Code and the course syllabus.
"""

from tictactoe_board import *
from testing import *


def test_get_winner():
    start_tests("Tests for tictactoe_board.get_winner()")
    test_get_winner_horiz_X()
    test_get_winner_vertical_X()
    test_get_winner_diagonal_X_L()
    test_get_winner_diagonal_X_R()
    test_get_winner_incomplete_board()
    test_get_winner_empty()
    finish_tests()

"""
Individual unit tests start here
"""

def test_get_winner_horiz_X():
    a_board = Tictactoe_board(['XXX',
                               'OOX',
                               'XOO'])
    assert_equals(str(a_board) + "Three Xs in a row horizontally",
                  'X',
                  a_board.get_winner())


def test_get_winner_vertical_X():
    a_board = Tictactoe_board(['XXO',
                               'XOX',
                               'XOO'])
    assert_equals(str(a_board) + "Three Xs in a row vertically
",
                  'X',
                  a_board.get_winner())


def test_get_winner_diagonal_X_L():
    a_board = Tictactoe_board(['XOO',
                               'XXO',
                               'XOX'])
    assert_equals(str(a_board) + "Three Xs in a row in the left diagonal",
                  'X',
                  a_board.get_winner())


def test_get_winner_diagonal_X_R():
    a_board = Tictactoe_board(['XOX',
                               'XXO',
                               'XOO'])
    assert_equals(str(a_board) + "Three Xs in a row in the right diagonal",
                  'X',
                  a_board.get_winner())


def test_get_winner_incomplete_board():
    a_board = Tictactoe_board(['XXX',
                               'OOX',
                               'XOO'])
    a_board.clear_cell(0, 0)
    assert_equals(str(a_board) + "Incomplete board, no winner yet",
                  None,
                  a_board.get_winner())


def test_get_winner_empty():
    a_board = Tictactoe_board(None)
    assert_equals(str(a_board) + "Empty board, no winner yet",
                  None,
                  a_board.get_winner())
```

```python


if __name__ == "__main__":
    test_get_winner()

```