

**National University of Computer & Emerging Sciences**  
**Karachi Campus**  
**Artificial Intelligence**  
**Programming Assignment #2**

***Instructions***

***Each Problem of 40 points***

**Due Date:** The assignment is due by April 29, 2016 till midnight.

**Submission:** The assignment has to be submitted via slate website submission. You must submit the source code files with proper naming convention for example (Assignment No. 1 Problem No. 1) you should give CS401-Kxxxxxx-A1P1.cpp. You should copy all questions for the assignment in a single folder (named as your id e.g. K1xxxxx) and zipped it before uploading to slate.

**Sample Input and Output files:** There is no input file for this assignment, you required to provide three output files. First contains moves from the two players and the decision about the game, second contains the move evaluated once the move phase has started, it should have best move along with exactly how many nodes were generated and evaluated for minimax search. Similarly the third file is for the move along with the information about the nodes generated and evaluated for alpha-beta search.

**Objective:** The main objective of this assignment is to learn and apply adversarial search via minimax and alpha-beta searches.

**Three Men's Morris**

One of the simplest board games in the world is three men's morris. There are two distinct phases of the game (i) placing and (ii) move. Each player has three pieces, and the board is a grid of 3 X 3, in three rows of three. Players enter their pieces one at a time, in turn, trying to form a row/column of three (Just like Tic-tac-toe, diagonal is exception). In the start each player place a piece on the board, assume that the top left cell of first row is indexed as 1, we will have the third row last cell is 9. The output file contains move of each player till their pieces are consumed and no one wins. After this the next phase of the game started in which each player can move any of his piece to the adjacent linked cell if it is empty. You need to implement a computer version of this game, Here for computer we can estimate the best move by applying minimax or alpha-beta search. The first output file just has a move for each player and the decision whether who has won the game.

You need to implement a computer version of this game, the move will be search with adversarial searches like minimax and alpha-beta search. You need to implement both. From an initial board position after the placing phase is completed, from this state ( $s_0$ ) you need to generate an adversarial game tree and evaluate the tree on minimax search, after selecting the best optimal move, make the move and write it into a file, exactly how many nodes you have generated for the evaluation. In this assignment you need to

go for a depth of 3. You supposed to write a complete game into the output file. There is no input file for this assignment. The complete solution for minimax would be of 20 points.

Similarly, you need to apply alpha-beta search to find the best move for the game along with the estimated number of node generated and pruned for the search. The complete solution for alpha beta search would be of 20 points.

we use a linear evaluation function defined as  $Eval(s) = (3A_2(s) + A_1(s)) - (3B_2(s) + B_1(s))$ . Mark on your tree the evaluations of all the positions at depth 2. We define  $A_n$  as the number of rows, or columns with exactly  $n$  pieces of Player A. Similarly,  $B_n$  is the number of rows, or columns with just  $n$  pieces of Player B.

**Try it out at:**

**<http://www.cynningstan.com/game/106/three-mens-morris>**

**<The end>**