**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

Batch No. :

**DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION SYSTEMS**

**Artificial Intelligence (BITS F444/ CS F407)**

**I Semester 2019-20**

**Programming Assignment**

**Coding Details**

**(October 17, 2019)**

*Instruction: Type the details precisely and neatly*

1. ID \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_2016B1A70929P\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_G ADITYAN\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Mention the names of Submitted files :
   1. <driver.py>
   2. <board.py>
   3. <minimax\_pruning.py>
   4. <coding details>
   5. <filename.ext>
   6. <filename.ext>
   7. <filename.ext>
2. Total number of submitted files: \_\_\_\_\_4\_\_\_\_\_\_
3. Name of the folder :\_\_\_\_\_\_\_\_\_\_\_\_2016B1A70929P\_\_\_\_\_\_\_\_\_\_\_\_\_
4. Have you checked that all the files you are submitting have your name in the top?(yes/no) yes
5. Have you checked that all the files you are submitting are in the folder as specified in 4 (and no subfolder exists)?(yes/no) yes
6. Problem formulation
   1. State representation:

Each state is the current condition of the game board. So, state representation is by a 2D array with 16 values depicting coins placed and empty spaces.

* 1. Pseudo code of your successor function

while k<4 and self.current\_state[k][i]!='-':

k+=1

if k<4:

count += 1

self.current\_state[k][i] = '2'

(m, min\_i, min\_j, count) = self.min\_alpha\_beta(alpha, beta, count)

# (m, max\_i, max\_j, count) = self.max\_alpha\_beta(alpha, beta, count) (In case of min function)

if m > maxv:

# if m < minv: (In case of min function)

maxv = m

# minv = m (In case of min function)

px = k

py = i

self.current\_state[k][i] = '-'

else:

continue

* 1. Terminal states generation process

Generated similar to as any other state is generated. We just check if the given state is terminal or not.

* 1. Data structure to store terminal states

2D Array

* 1. Method to access terminal states and corresponding utility values

Terminal\_test() for checking terminal states.

1. Minimax Technique details
   1. Node structure: 2D array depicting the state of the board

* 1. Method to ensure the correctness of terminal test (describe in maximum 4 lines)

I am checking if the game has been won in a horizontal way, vertical way or diagonal way. So, if there are 3 consecutive 1s or 3 consecutive 2s present in any of the above mentioned configurations, the game is over. In case the board is full with no 3 consecutive coins placed, the game is tied.

* 1. Total number of nodes generated to play one game: 900000
  2. Write the statistics here as asked

R1 = ~900000 R2 = 800 bytes R3 =

R4 = ~70-80 s R5=0.6

* 1. Code status (implemented fully/ partially/ not done) implemented fully

1. Alpha Beta technique details:
   1. Explain the logic used for pruning (in maximum four lines)

Just the minimax algorithm with the modification by range of values specified by alpha and beta.

If max >= beta, we prune the nodes.

If min <= alpha, we prune the nodes.

* 1. Total number of nodes generated to play one game 17000
  2. Write the statistics here as asked

R6 = ~17000 R7 = ~0.998 R8 = ~12 s

1. Code status (implemented fully/ partially/ not done) implemented fully

1. Comparative analysis

R9 = Minimax uses over 500 times the memory compared to alpha beta pruning R10 = 12 s R11= 3-4 R12= 3-4

Fill in the following information based of 10 independent games

|  |  |  |
| --- | --- | --- |
|  | Minimax Algorithm | Alpha Beta Pruning |
| Average number of nodes created | Around 700000 – 1000000 | Around 15000 – 17000 |
| Average time taken | Around 75 seconds | Around 12 seconds |
| Number of times machine wins (player M) | Around 3-4 (Depends on human too though) | Around 3-4 (Depends on human too though) |

1. GUI details
   1. Created the GUI (yes/ No): yes
   2. Have created it according to the specifications?(yes/No) partially
   3. Which module of Python is used for creating graphics? turtle
   4. Is this under the standard Python library or not? yes
   5. If not, why?
2. Graphics details:
   1. Is graphics working fine for displaying the board and coins? yes
   2. How have you calibrated the board and accepted human input to play the game? yes
   3. How are you showing the base line? It is shown by a horizontal line at the top of the matrix.
   4. How are you showing the move of the machine? yes
   5. How are you showing the move of the human player? yes
3. Compilation Details:
   1. Code Compiles (Yes/ No):\_\_\_\_\_\_\_yes\_\_\_\_\_\_\_
   2. Mention the .py files that do not compile:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   3. Any specific function that does not compile:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   4. Ensured the compatibility of your code with the specified Python version(yes/no)\_\_\_\_\_\_yes\_\_\_\_\_\_
   5. Instructions for compilation of your files mentioning the multi file compilation process used by you (We may use the replica of these for compiling your files while evaluating your code) Run the driver.py function
4. Driver Details: Does it take care of the options specified earlier(yes/no):\_\_\_\_yes\_\_\_\_\_\_\_
5. Execution status (describe in maximum 2 lines)

Driver program runs correctly. All the required details are printed accordingly in Python Shell.

1. Declaration: I, \_\_\_\_\_\_\_\_\_G Adityan\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (name) declare that I have put my genuine efforts in creating the python code for the given programming assignment and have submitted only the code developed by me. I have not copied any piece of code from any source. If the code is found plagiarized in any form or degree, I understand that a disciplinary action as per the institute rules will be taken against me and I will accept the penalty as decided by the department of Computer Science and Information Systems, BITS, Pilani.

ID\_\_\_\_\_\_\_\_\_\_\_2016B1A70929P Name: G ADITYAN\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_17-10-19\_\_\_\_\_\_\_\_

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