Assignment 2 Report

Q1. Alpha Beta Pruning :- Avg. Time taken = (3.19 + 3.15 + 3.39)/3 = 3.24 sec
Min Max :- Avg Time Taken = (17.61 + 16.22 + 16.81)/3 = 16.88 sec

The game is simulated for computer vs computer, hence moves made by both the players will be optimal.

The following values are provided to the leaf nodes :
1 -> if max wins
-1 -> if min wins
0 -> if it is a draw

As can be seen above, alpha beta pruning takes very less time to simulate tic tac Toe as compared to Min Max. This is very intuitive since alpha beta pruning prunes all those nodes which needn't be explored, hence exploring less nodes in total.

The final tic tac toe state is noted to be always at a draw state. This is also quite intuitive since both min and max always play optimally, hence the only value that the root node can have is 0 (draw).

Note that the simulation is done by assigning the first move by max at every possible cell in the matrix, and then simulating the rest of the moves. Hence, the time observed above is the time to simulate 9 different tic tac toe games.

Q2. a) The following constraints have been defined :

- 1 course class per week
- 1 professor -> 1 class per day
- 1 professor -> max 2 courses
- A professor has at least 1 course
- 1 course in a classroom at a particular time slot

b) Let p -> professor
M -> course
N -> classroom
T -> Time slot

Gene : A gene is defined as a combination (an object) of all the above variables as attributes.
Chromosome : Since there are 8 time slots in a day, with 5 working days in a week, a chromosome is a 5x8 matrix, with each cell in the matrix denoting a gene.
Fitness Function : Fitness of a chromosome is calculated keep in mind the constraints defined in the previous part of the question. Fitness value of a chromosome is incremented by 1 if there is
I. There is 1 course class per week
II. A professor has 1 class per day
III. A professor has at most 2 courses and at least 1 course to teach
IV. On a particular day, only 1 course is scheduled in a classroom at a particular time slot.

Crossover :
I. A random day and 2 random chromosomes are selected and one point crossover is performed, with the point being the random day. This generates 2 new chromosomes.
II. A random number between 1 and 40 is selected, and one point crossover is performed, with the point being the random number, signifying a particular time slot on a particular day. This generates 2 new chromosomes.

Mutation : A random number between 1 and 40 is selected and a random chromosome are selected. The time slot and day corresponding to this random number of calculated and the corresponding gene is selected. The professor of this gene is changed to a random professor number (within the professor number range).

Assumption : M>p

Algorithm : 100 initial chromosomes are taken with each gene being generated randomly. The fitness value of each chromosome is calculated and 10 best performing chromosomes are kept, and then rest are removed. From the remaining set of chromosomes, 90 more chromosomes are generated by crossover and mutation.

Memetic Algorithm : All the neighbors of a particular chromosome are explored for a chromosome with a possible better fitness value. Neighbours are defined as follows:

For a gene,

I. Increment and decrement the professor number(if possible) for 2 new chromosomes.
II. Increment and decrement the time slot (if possible) for 2 new chromosomes.
III. Increment and decrement the course number(if possible) for 2 new chromosomes.

All these neighbors are evaluated for their fitness function, and the best among them(neighbors + the chromosome being searched for) is added to the chromosome set.

c) Genetic algorithm runs faster than Memetic algorithm with respect to the various things defined above. While genetic algorithm ran for 75 seconds in one the experiments performed, Memetic algorithm completed only 12 out of the 1000 iterations. But, it is important to note that while, Genetic algorithm achieved the fitness value of 32 in about 560 iterations, it took only 20 iterations for Memetic algorithm to achieve the fitness value. Similar patterns were noted in various other iterations.
Hence, it is noted that Memetic Algorithm has a high probability of achieving a better optimal solution as compared Genetic algorithm, since Memetic Algorithm evaluates the neighbors of a chromosome for possible better ones.