1. (5 points) Solve the four player game below back to front. The number at each node indicates which player gets to move. The numbers at the end show payoffs (Player1,Player 2, Player 3, Player 4). Pay careful attention to who moves when:

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1

2   3
                              1   4

(10,8,40,10)
                                                        (11,15,15,3)

                                    (150,14,40,6)

(13,5,2,3)   (15,14,9,60)
                                            2   (1,2.5,40,12)

(5,3,3,,2)
                            (13,2,4,5)   (12,11,10,20)
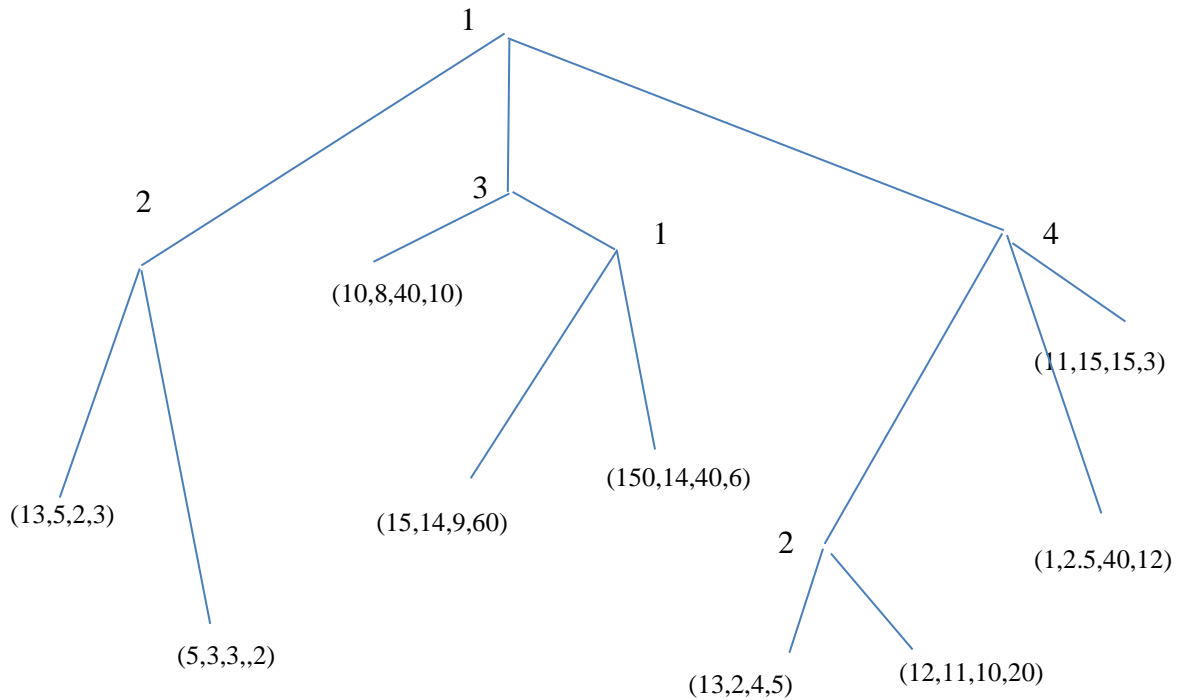
2 . (15 points) In the simultaneous move game below, find all the pure strategy Nash Equlibria, if they exist and find any minmax/maxmin equilibria. If necessary, you may use the concepts of dominant or dominated strategies in your approach.

	C1	C2	C3
R1	(2,5)	(11,3)	(6,4)
R2	(10,6)	(7,11)	(2,5)
R3	(1, 5)	(5,20)	(1,21)

3. (15 points) You and a friend are moving out of an apartment. There are two rooms and in each room there are two boxes. You take turns carrying boxes out of rooms. In each turn, you must choose one room. You can take however many boxes you wish from the room but you must take a box. The person to remove the last box must buy the other person a drink. Your friend moves first.

i. (5 points) Provide a back to front solution of the game to show who should win this game.

ii. (5 points) Suppose there are five boxes in one room and two in the other. Again, your friend moves first. Who should win now?

iii. (5 points) How would your answer to ii) change if your friend was only allowed to remove one box at a time but you could remove any number greater than zero?

4. (10 points) In the simultaneous move, two player game, G, below, Player 1 chooses Rows and Player 2 chooses Columns.

G

	C1	C2	C3
R1	(23,20)	(-3, 0)	(33, 7)
R2	(20,3)	(-2, 4)	(34,2)
R3	(21,4)	(-5,3)	(35,4)

i. (5 points) Characterize all the pure strategy Nash equilibria of the game, G.

ii. (5 points) Consider an extended, version of this game where Player 1 first chooses either to exit and receive a sure payoff of (0,0) or to enter. Once Player 1 enters, both players know this and then they play a Nash Equilibrium of the simultaneous move game, G. Use back to front reasoning to find the Nash equilibria of this extended game.

5. (10 points) Blog is an extra-terrestrial interested in finding a mate. It has spent two sols (a planetary unit of time) developing a relationship with Gloop, a prospective partner from another planet and Gloop looks promising and available. Blog is mildly attracted and believes the current probability of an eternity of happiness with Gloop is 20%. However, Blog would like to know if there are more suitable mates in the universe. Blog has to allocate the next 10 sols of time. Each additional sol Blog spends with Gloop increases the probability of success with this match by 2%. Blog can go out to the Space Bar. The first sol, Blog's probability of meeting a winner is 8%, the second sol it is 7%, the third sol it is 2%. After that, the probability is 1% for each additional sol. (So, for example, if Blog went to the Bar for 5 sols, Blog's probability of success from the Bar is 8+7+2+1+1=19%.)

i) (5 points) Use this information to provide examples of marginal benefits, sunk costs and opportunity costs.

ii) (5 points) Use marginal reasoning to show how Blog should allocate its 10 sols to maximize the total probability of finding a mate? (That is, the sum of the probability of success with Gloop and success at the Bar). If you need to make some additional assumptions to answer this, make clear what you are assuming.