1. Consider the following sequential game:

$1 \setminus 2$	L	R
А	1,2	1,2
В	0,0	2,1

- a) Draw the extensive form of this game.
- b) Find the Nash equilibria. Which one of them makes more sense?
- c) Use Backward induction to solve the problem.
- 2. An entrant E is deciding whether to enter a market in a first stage. Then the incumbent I decides to play tough or to accommodate, and, simultaneously, the entrant decides whether to play tough, accommodate or leave the market.



- a) How many information sets are there for each player? Speficy the pure strategies for each player.
- b) How many subgames are there? Is the game solvable by backward induction?
- c) Find the Nash equilibria and subgame perfect Nash equilibria.
- 3. Stackelberg model: Two firms compete in quantities q_i of a homogeneous good, setting them sequentially. Firm 1 chooses quantities q_1 first. After observing q_1 , firm 2 chooses its quantity q_2 . The inverse demand is P = a bQ, where Q = q1 + q2. Both firms have a constant marginal cost equal to c.
- a) What is firm 2's best response?
- b) Find the subgame perfect Nash equilibrium (SPNE) by backward induction.
- c) Consider a market with inverse demand given by P = 1000 Q and a constant marginal cost equal to 100. Determine the SPNE.

Extra Exercises

1. An entrant E is deciding whether to enter a market in a first stage, followed by a decision of the incumbent I to play tough or to accommodate. This choice is observed, and at a third stage the entrant may also play tough, accommodate or leave the market.



- a) Write all possible paths the game can take.
- b) How many subgames are there? Identify them.
- c) Find the Nash equilibria and SPNE.
- 2. In 1962, the Soviet Union installed nuclear missiles in Cuba. When the US found out, President Kennedy discussed the following options:
 - do nothing,
 - air strike on the missiles,
 - a naval blockade on Cuba.

JFK decided on the naval blockade. Negotiations ensued, and Khrushchev threatened to escalate the situation; both sides believed that nuclear war was a possibility. Finally, the Soviet Union agreed to remove the missiles if the United States agreed not to invade Cuba.

First, Khrushchev must decide whether to place the missiles in Cuba or not. If the missiles are in place, JFK must decide on his 3 options. For the last two, Khrushchev must decide if acquiesce or escalate.

If Khrushchev does nothing, the payments are (4,3). If he places the missiles, and JFK responds with airstrike, then K can acquiesce and the payoffs are (2,4), or escalate with resulting payoffs (1,0). If JFK responds with the Blockade, K can acquiesce (3,5) or escalate (0,1). If JFK does nothing, then the payoffs are (5,2).

- (a) Draw the Tree of this game.
- (b) Solve this game (Use BI).

3. A chain store has branches in K cities, and in each city, k = 1, ..., K there is a competitor. In period k, the competitor in city k enters, the chain store must decide whether to fight or cooperate. This is a game of perfect information, with the payoffs in each city given in the figure. Firm k cares only about the actions taken in its city, but the chain store's payoff is the sum of the payoffs it generates in each city.

The following is the extensive form for the city k:



(a) In which paths of the game do you find Nash Equilibria?

(b) What is the unique subgame perfect Nash equilibrium?

(c) For many cities, would it not be better for the incumbent to signal to be tough, and play F?