Problem 1. Paper-Scissors-Rock game

A well-known game Paper-Scissors-Rock game is presented in a strategic form in a table below.

Show that this game does not admit Nash equilibrium in pure strategies.

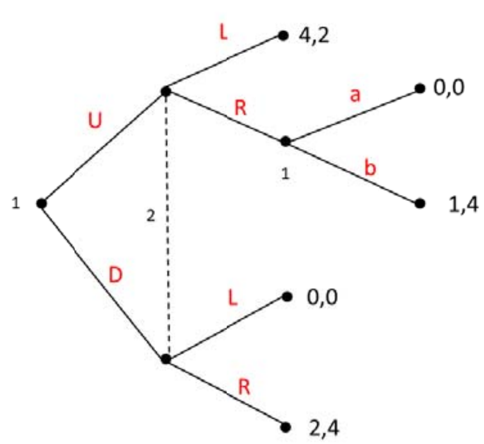
Find NE in mixed strategies (Answer: randomization among the 3 pure strategies assigning a probability of 1/3 each).

	s_2 = Paper	s_2 = Rock	s_2 = Scissors
s_1 = Paper	(0,0)	(1,−1)	(−1,1)
s_1 = Rock	(−1,1)	(0,0)	(1,−1)
s_1 = Scissors	(1,−1)	(−1,1)	(0,0)

Problem 2. Game in extensive form with Imperfect Information

A two-player game is given on a figure below in extensive form. Answer the following questions:

(1) How many information sets has player 1? Player 2?
(2) How many strategies has player 1? Player 2?
(3) Re-write this game in a matrix form
(4) Using Best Response approach find NEs
(5) Using Backward Induction find equilibrium?
(6) Find all subgames in this game
(7) What is subgame perfect equilibrium in this game?



Problem 3. Power control in CDMA

Consider a single-cell CDMA network. Imagine that there are 2 users in a cell (they will be our players). The received Signal-to-Noise-and-Interference (SINR) ratio of user i is given by a formula:

$$SINR_i = \frac{p_i h_i}{\sigma^2 + p_j h_j}$$

where p_i is the transmit power of player i, h_i is the channel gain from player i's transmitter to the base station and σ^2 is the variance of the Gaussian noise.

Lets assume that , $h_1 = 0.25$, , $h_2 = 0.75$, $\sigma^2 = 1$. Power control can be done over three power levels $p = \{1, 2, 3\}$. Each user would like to maximize the experienced SINR. As one can see from the formula, SINR depends not only on the channel noise, but also on the power level selected by another user.

Formulate this game in a strategic form. Does it have a NE? Discuss the solution – would be reasonable to apply the obtained solution in a real system?