1. The parameters of the game are $\tau, b_{Ss}, b_{Sc}, b_{Cs}, b_{Cc}$, all numbers in $(0,1)$ (i.e. strictly between 0 and 1). The parameters satisfy the restrictions $b_{Ss} < b_{Cs}$ and $b_{Sc} < b_{Cc}$.

2. We will use the following notation in describing payoffs in what follows. For $M \in \{S, C\}$ and $q \in \{s, c\}$ define
$$F_{Mq} = \tau + (1-\tau)b_{Mq}.$$
Define a function F which takes M and q as input, as well as the parameters, and returns F_{Mq}.

3. The possible strategies for player 1 are SS, SC, CS, CC. (Note that even though there are two letters, this describes just a single strategy; the two letters describe what the player is to do at different situations he might face; there are two possible situations in this case.) The possible strategies of player 2 are the same. Thus a strategy profile (fully describiing how both players play) is a pair such as (SS, SC). Here the first player plays SS and the second player plays SC.

4. Many strategy profiles have the same payoff. The following table says the payoff for Player 1 for each group of strategy profiles; these exhaust the pure strategies. The payoff of Player 2 is MINUS the payoff of player 1 (i.e. the game is zero-sum).

Strategies	Payoff of Player 1
(SS,SS), (SS,SC), (SC,SS), (SC,SC)	$\frac{\tau+(1-\tau)(1-b_{Ss})F_{Ss}}{\tau+(1-\tau)[b_{Ss}+(1-b_{Ss})F_{Ss}]}$
(CC,CC), (SC,CC), (CC,SC)	$\frac{\tau+(1-\tau)(1-b_{Cc})F_{Cc}}{\tau+(1-\tau)[b_{Cc}+(1-b_{Cc})F_{Cc}]}$
(SS,CC), (SS,CS), (CS,CC), (CS,SC)	$\frac{\tau+(1-\tau)(1-b_{Sc})F_{Cs}}{\tau+(1-\tau)[b_{Sc}+(1-b_{Sc})F_{Cs}]}$
(CC,SS), (CS,SS), (CC,CS), (SC,CS), (CS,CS)	$\frac{\tau+(1-\tau)(1-b_{Cs})F_{Sc}}{\tau+(1-\tau)[b_{Cs}+(1-b_{Cs})F_{Sc}]}$

5. Let $u_1(\sigma_1, \sigma_2)$ denote the payfoff of player 1 under a given strategy profile. A *pure-strategy equilibrium* is a strategy profile (σ_1^*, σ_2^*) so that for every σ_1' among the possible strategies of Player 1, we have
$$u_1(\sigma_1', \sigma_2^*) \leq u_1(\sigma_1^*, \sigma_2^*)$$
and also for every σ_2' among the possible strategies of Player 2, we have
$$u_1(\sigma_1^*, \sigma_2') \geq u_1(\sigma_2^*, \sigma_2^*).$$

This says that for every possible deviation of Player 1, that player has a weakly lower payoff *and* for every possible deviation of Player 2, it results in Player 1 having a weakly *higher* payoff, which is not appealing for Player 2 (recall the game is zero-sum).

6. *The task*: write an algorithm to do the following. Systematically vary the parameters in point 1 of this writeup over the space of allowed parameters, and for each parameter specification list all the pure-strategy equilibria of the game described above. This can be done by iterating over all strategies, and checking that none of the deviations feasible for Player 1 yield him a strictly higher payoff, and none of the deviations feasible for Player 2 yield Player 1 a lower payoff. For example, to check the strategy profile (SS,CS) is an equilibrium, we would want to make sure that (CS,CS) does not do better for Player 1 (and many other deviations) and also we would want to make sure that (SS, CC) does not yield a worse payoff for Player 1 (else Player 2 would want to deviate), and again we would check many other deviations. The table gives the payoffs of all strategy profiles, and hence of all deviations.

   Be careful to find all pure strategy equilibria, not just one.

7. **Main question** Does an equilibrium with the same payoff as (CC, SS), i.e. the last item in the list above, ever occur? If this does occur, do your best to give as much information as possible about the parameter range for which it occurs.

8. If it never occurs, do your best to figure out the reason. Is the deviation that refutes the equilibrium always of one specific type? Give as much information as you can that will help me prove that this never occurs.