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Computational Logic ∴ Group

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Algorithmic Game Theory

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Exercises 2

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Problem 1.
From the lecture, you know that for *Rock-Paper-Scissors* and two players Ann and Bob with $\pi_{\texttt{Ann}} = \pi_{\texttt{Bob}} = (\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$, the mixed-strategy profile $\boldsymbol{\pi} = (\pi_{\texttt{Ann}}, \pi_{\texttt{Bob}})$ is a (strict) Nash equilibrium in mixed strategies.

- Explain why it is, in fact, a Nash equilibrium in mixed strategies.
- What happens if one player deviates from the strategy?
- Imagine you are competing in the *Rock-Paper-Scissors* world cup. How can you guarantee that you are playing the best strategy?

Problem 2.
Two bands, BandA and BandB, are competing in a Battle of the Bands competition. Each band has two strategies they can choose from: "Play Loudly" or "Play Softly". BandB impresses more when both play the same style whereas BandA shines when both bands play differently.

(BandA, BandB)	Loudly	Softly
Loudly	(1, 2)	(2, 1)
Softly	(2, 1)	(1, 2)

Do the following:

a) Argue why there exists no Nash equilibrium in pure strategies for this game.

b) Compute the Nash equilibrium in mixed strategies. For this and all subsequent exercises, compute mixed equilibria by choosing strategies that make the opposing player indifferent among their strategies.

c) Argue whether there always exists an equilibrium in mixed strategies for finite games when there is no equilibrium in pure strategies.

Problem 3.
Find all mixed equilibria (which always includes any pure equilibria) of this 3×2 game.

(Player1, Player2)	l	r
T	$(0,1)$	$(6,0)$
M	$(2,0)$	$(5,2)$
B	$(3,3)$	$(3,4)$

Hint: Note that in any mixed equilibrium for this game, Player 1 plays only two of the three available strategies with positive probability.

Problem 4.
In this 2×2 game, A, B, C, D are the payoffs to player I, which are real numbers, no two of which are equal. Similarly, a, b, c, d are the payoffs to player II, which are real numbers, also no two of which are equal.

(Player1, Player2)	left	right
Top	(A, a)	(B, b)
Bottom	(C, c)	(D, d)

(a) Under which conditions does this game have a mixed equilibrium which is not a pure-strategy equilibrium?

Hint: Consider the possible patterns of best responses and resulting possible dominance relations, and express this by comparing the payoffs, as, for example, $A > C$.

(b) Under which conditions in (a) is this the only equilibrium of the game?