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Week 2 - Assignment - Game Theory

Q1) a) → If each s_i^* is weakly dominant, then for any deviation s_i, for all s_{-i}.

$$u_i(s_i^*, s_{-i}) \geq u_i(s_i, s_{-i})$$

→ So no player can strictly gain by deviating → s^* in a Nash Equilibrium.

b) If each s_i^* is strictly dominant, then
$u_i(s_i^*, s_{-i}) > u_i(s_i, s_{-i})$ $\forall s_i \neq s_i^*$.
So each player will strictly prefer s_i^*, making s^* the only NE.

c) A dominant strategy maximises $u_i(s_i, s_{-i})$ $\forall s_{-i}$.
Maxmin strategy maximizes $\min_{s_{-i}} u_i(s_i, s_{-i})$.
So dominant strategy also gives best worst case → it is a maxmin strategy.

Q2) a) Payoff matrix :

William/Henry	A (10K)	B (give 40K)
A	(10K, 10K)	(10K, 40K)
B	(40K, 10K)	(0, 0)

b) Both prefer 40K over 10K and 10K over 0.
each wants the other to choose A.
So, (B, B) is the only NE - no incentive to deviate if the other picks B.

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3) a) Let x be number of others who clean.

If i chooses C: $u_i = 10 - 1 = 9$

If $x = 0$ and i chooses NC: $u_i = 0$.

Else (at least one cleans): $u_i = 10$

So: • If someone else cleans: C → 9, NC → 10

• If no one else cleans: C → 9, NC → 0

b) PSNE: only when exactly one student chooses C.

then: • Cleaner gets 9

• others get 10

→ No one wants to change: C person would get 0 if they switch, others drop to 9 if they switch to C. So 10 PSNEs, each with 1 cleaner and 9 non cleaners

Q.4) a)

	C1	C2
R1	(2,1)	(0,0)
R2	(0,0)	(1,2)

NEs: (R1, C1), (R2, C2)

b) 1. C2 weakly dominated by C1 for columns → remove C2.

2. Then R2 weakly dominated by R1 → remove R2.

→ left with (R1, C1)

c) 1. C1 weakly dominated by C2 → remove C1

2. R1 weakly dominated by R2 → remove R1

→ left with (R2, C2)

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Q.5) Suppose player i bids $b_i \neq v_i$.

- If $b_i < v_i$ → may loose → even when they value more than price → regret
- If $b_i > v_i$, may win and overpay (price > value) → negative utility.

→ Truthful bid

$b_i = v_i$:
- wins only if v_i highest
- pays second-highest bid ($< v_i$)

→ utility v_i − 2nd bid ≥ 0, else gets 0 if loses.

→ So truthful bidding is weakly dominant.