## Decisions with Multiple Agents: Game Theory

Alice Gao Lecture 17

Based on work by K. Leyton-Brown, K. Larson, and P. van Beek

#### Outline

Learning Goals

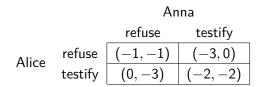
Revisiting the Learning goals

### Learning Goals

By the end of the lecture, you should be able to

- Determine dominant-strategy equilibria of a 2-player normal form game.
- Determine pure-strategy Nash equilibria of a 2-player normal form game.
- Determine Pareto optimal outcomes of a 2-player normal form game.
- Calculate a mixed strategy Nash equilibrium of a 2-player normal form game.

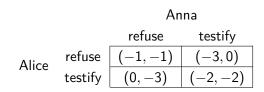
#### Prisoner's dilemma



### CQ: Prisoner's dilemma - dominant strategy equilibrium

**CQ:** Does this game have a dominant strategy equilibrium? If so, which outcome is such an equilibrium?

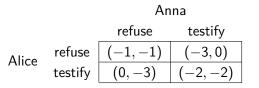
- (A) (refuse, refuse)
- (B) (refuse, testify)
- (C) (testify, refuse)
- (D) (testify, testify)
- (E) There is no dominant strategy equilibrium.



CQ: Prisoner's dilemma - Nash equilibria

# **CQ:** How many of the four outcomes are **pure strategy Nash equilibria**?

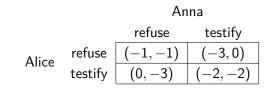
(A) 0 (B) 1 (C) 2 (D) 3 (E) 4



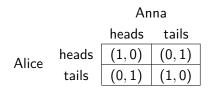
CQ: Prisoner's dilemma - Pareto optimality

CQ: How many of the four outcomes are Pareto optimal?

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4



### Matching quarters

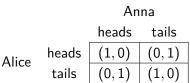


Alice wants the two coins to match whereas Anna wants the two coins to mismatch.

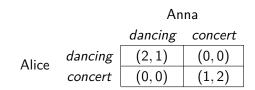
CQ: Matching quarters - Nash equilibria

# **CQ:** How many of the four outcomes are **pure strategy Nash equilibria**?

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4



### Conflicting interests



Alice and Anna want to sign up for an activity together. They both prefer to sign up for the same activity. However, Alice prefers dancing over a concert whereas Anna prefers a concert over dancing. CQ: Conflicting interests - mixed strategy Nash equilibria

**CQ:** At the mixed strategy Nash equilibrium, with what probability does **Alice go dancing**?

(A) [0, 0.2) (B) [0.2, 0.4) (C) [0.4, 0.6) (D) [0.6, 0.8) (E) [0.8, 1]

#### Anna

		dancing	concert
Alice	dancing	(2,1)	(0,0)
	concert	(0,0)	(1,2)

CQ: Conflicting interests - mixed strategy Nash equilibria

**CQ:** At the mixed strategy Nash equilibrium, with what probability does **Anna go dancing**?

(A) [0, 0.2) (B) [0.2, 0.4) (C) [0.4, 0.6) (D) [0.6, 0.8) (E) [0.8, 1]

#### Anna

		dancing	concert
Alice	dancing	(2,1)	(0,0)
	concert	(0,0)	(1,2)

### Revisiting the Learning Goals

By the end of the lecture, you should be able to

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