CS 295A/395D: Artificial Intelligence

Elementary Game Theory

Prof. Emma Tosch

30 March 2022

The University of Vermont

Agenda

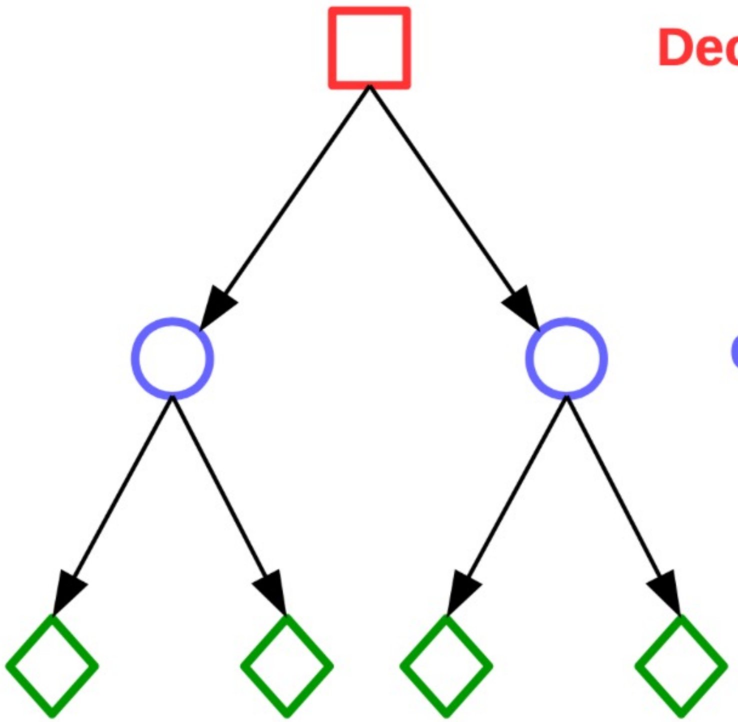
Review decision theory

Elementary game theory

- Optimum vs. optimal solutions
- Strategies
- Vocabulary

Logistics

- BB theory assignment out today
- Exam through game theory
  - Temporal reasoning pushed to next unit
  - Exam next Friday (April 8)
- Next unit: temporal reasoning and program synthesis
  - Removed machine learning



Note: "decision tree" also refers to a classification algorithm in machine learning and is completely different from the type of decision tree we will talk about here.

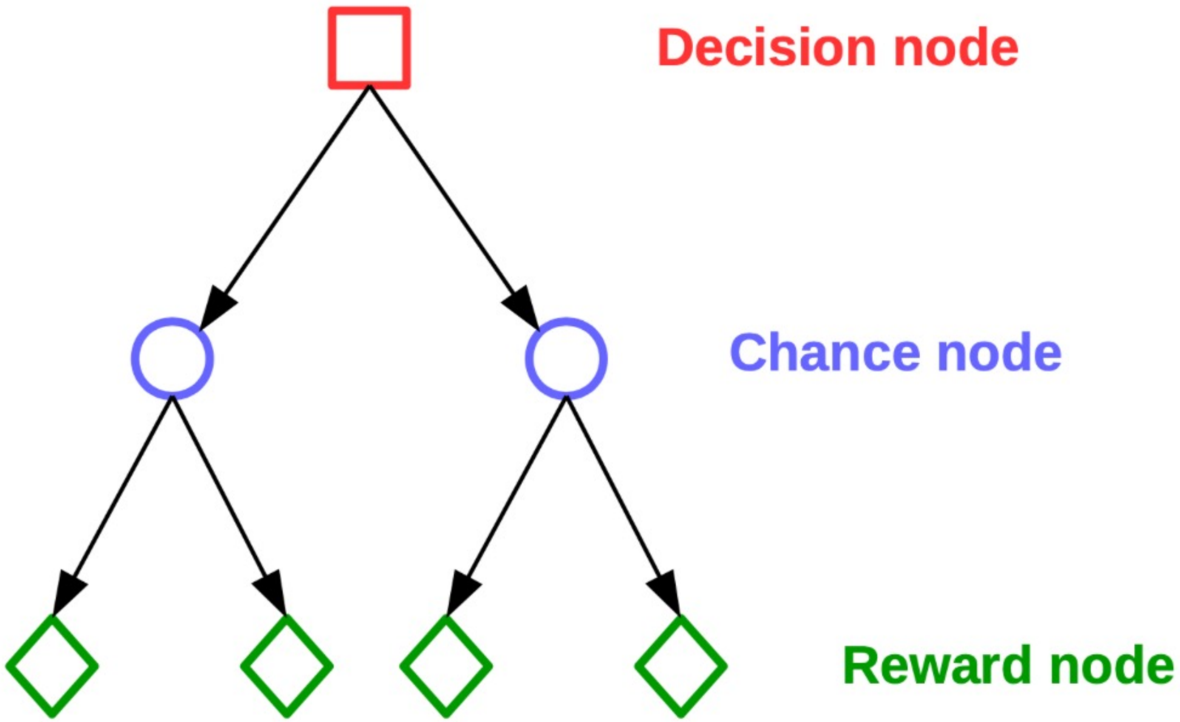
Recap: Decision Theory

We can express taking actions in a world with uncertainty via *decision trees*

Decisions trees are temporally-ordered nodes where each level corresponds to alternating:

- **Decision nodes –** state of the system; outgoing edges represent different actions
- **Chance nodes –** probability distributions over outcomes; outgoing edges represent reachable states with some probability
- **Reward nodes** – utility obtained from following the path

Recap: Maximize expected utility



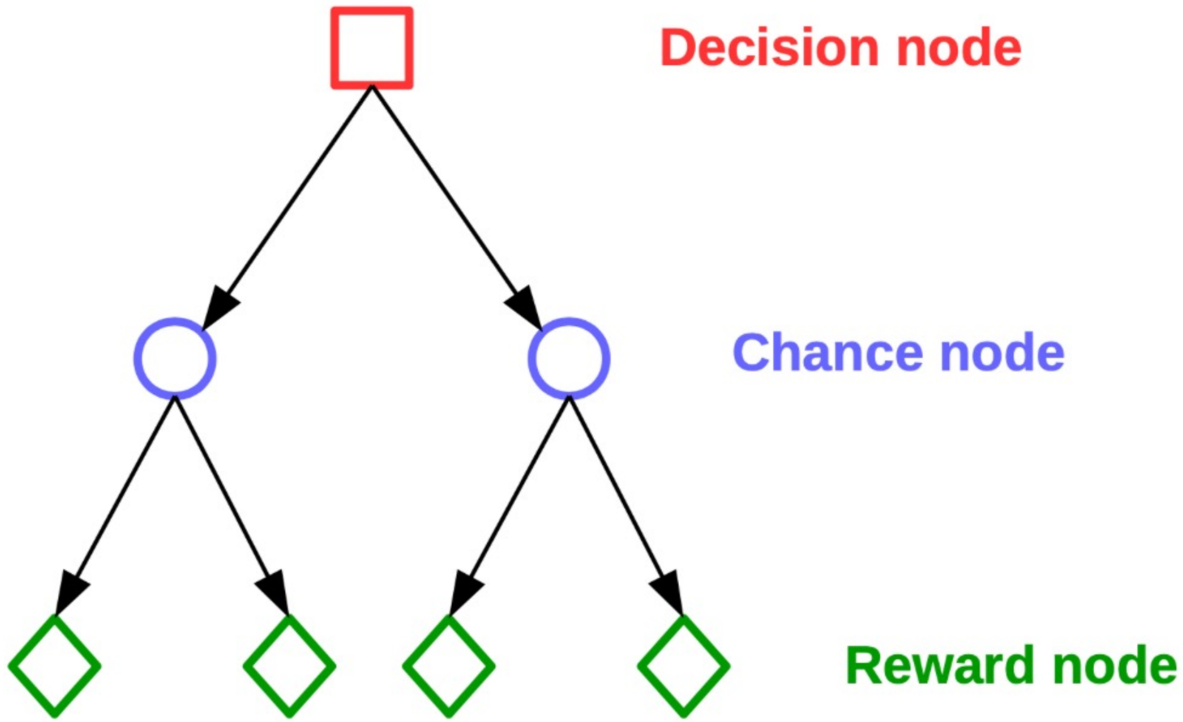
$$EU[\,a \mid e_1, e_2, \dots\,] = \sum_{s'} P(\,S_{t+1} = s' \mid a, e_1, e_2, \dots)\,U(s')$$

Best action is the action a that maximizes $EU[\,a \mid e_1, e_2, \dots\,]$

Sum of the utility of actions taken.

Note: "decision tree" also refers to a classification algorithm in machine learning and is completely different from the type of decision tree we will talk about here.

Recap: Comparing actions



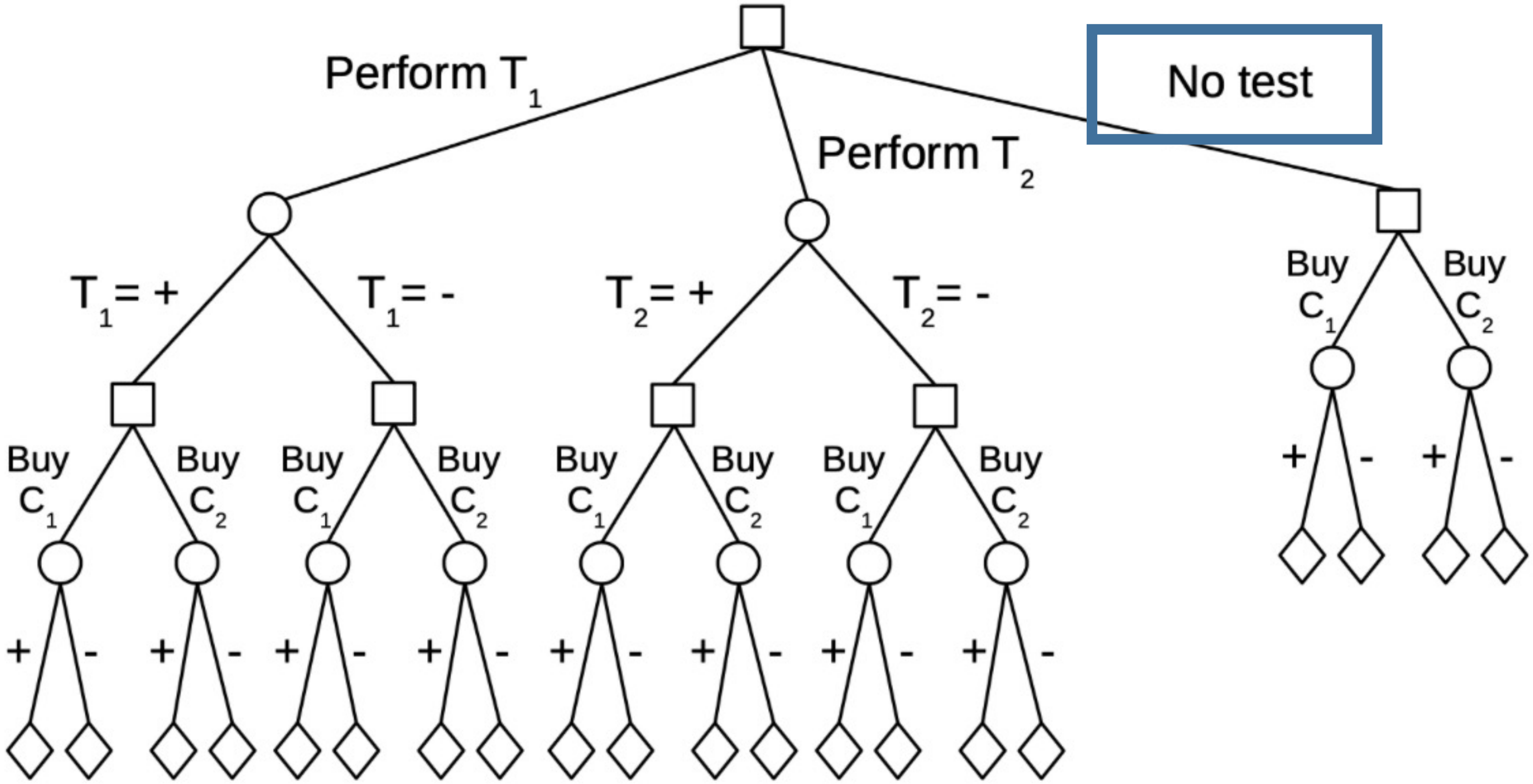
Note: "decision tree" also refers to a classification algorithm in machine learning and is completely different from the type of decision tree we will talk about here.

$$EU[\, a \mid e_1, e_2, \ldots \,] = \sum_{s'} P(\, S_{t+1} = s' \mid a, e_1, e_2, \ldots)\, U(s')$$

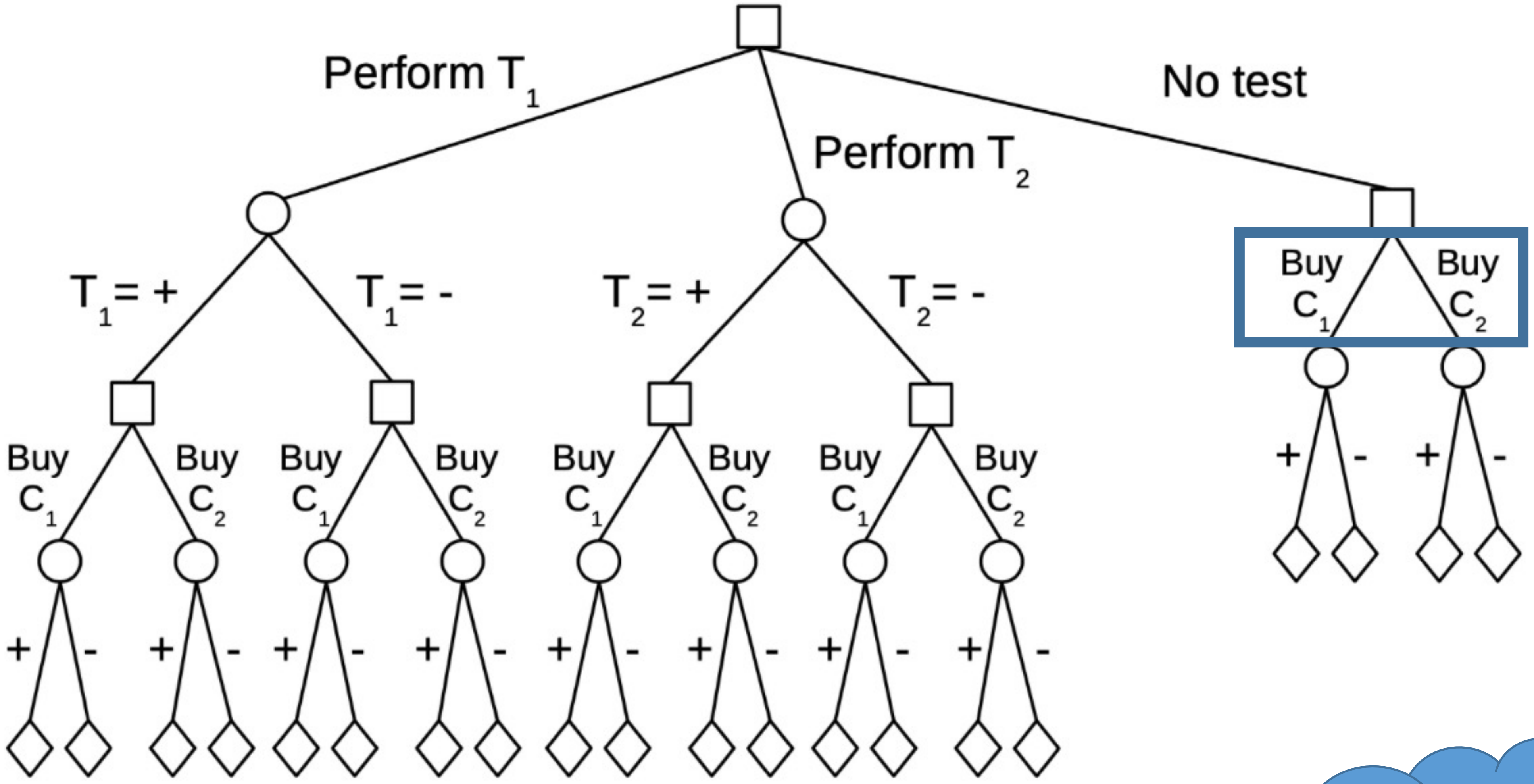
Probability mass function – over all sources of uncertainty associated with this action.

Utility function

- Basic actions: reward
- Actions with subsequent actions with uncertain outcomes: EU of those actions



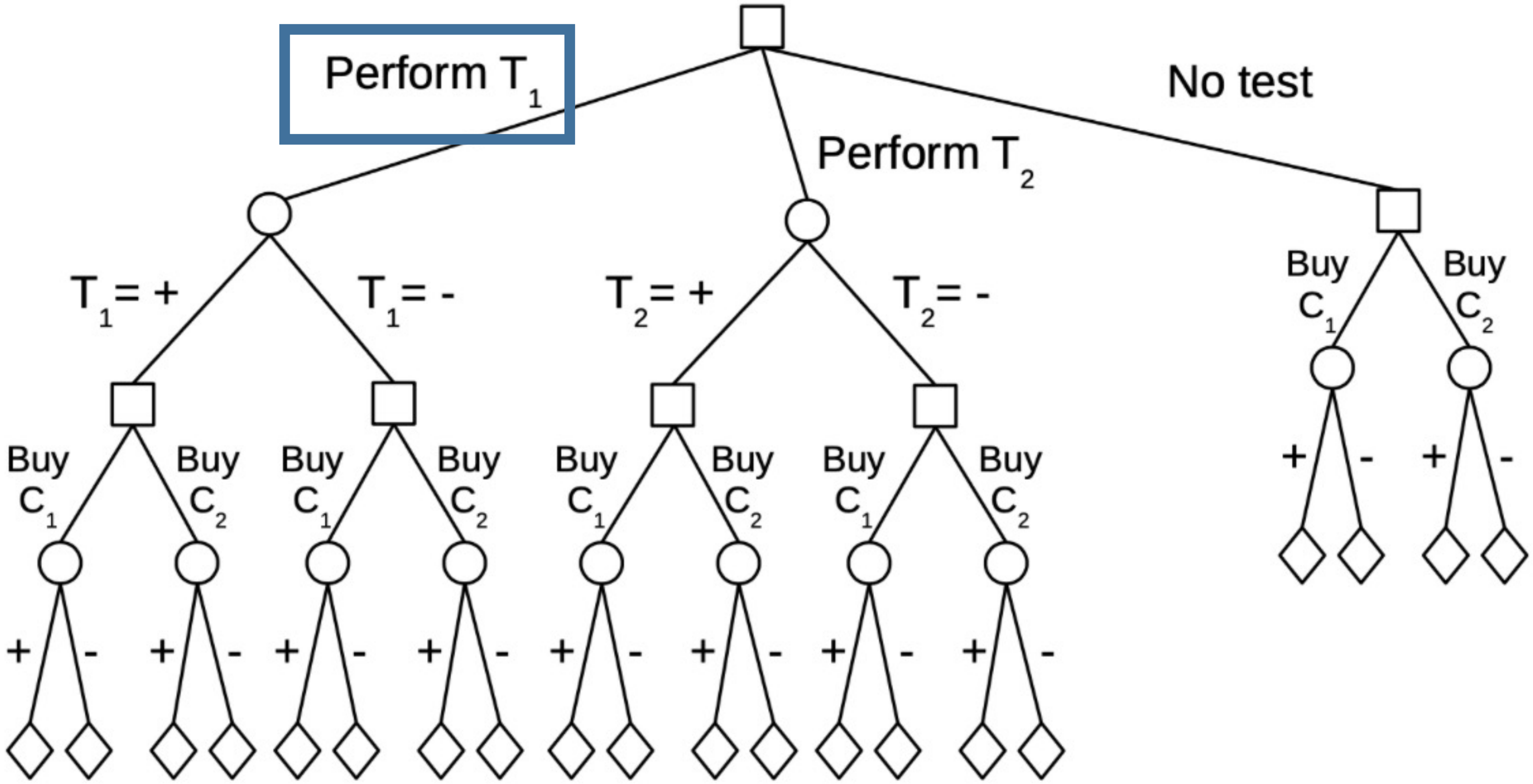
Perform T_1
Perform T_2
No test
$T_1 = +$
$T_1 = -$
$T_2 = +$
$T_2 = -$
Buy C_1
Buy C_2
Buy C_1
Buy C_2
Buy C_1
Buy C_2
Buy C_1
Buy C_2
Buy C_1
Buy C_2
+
-



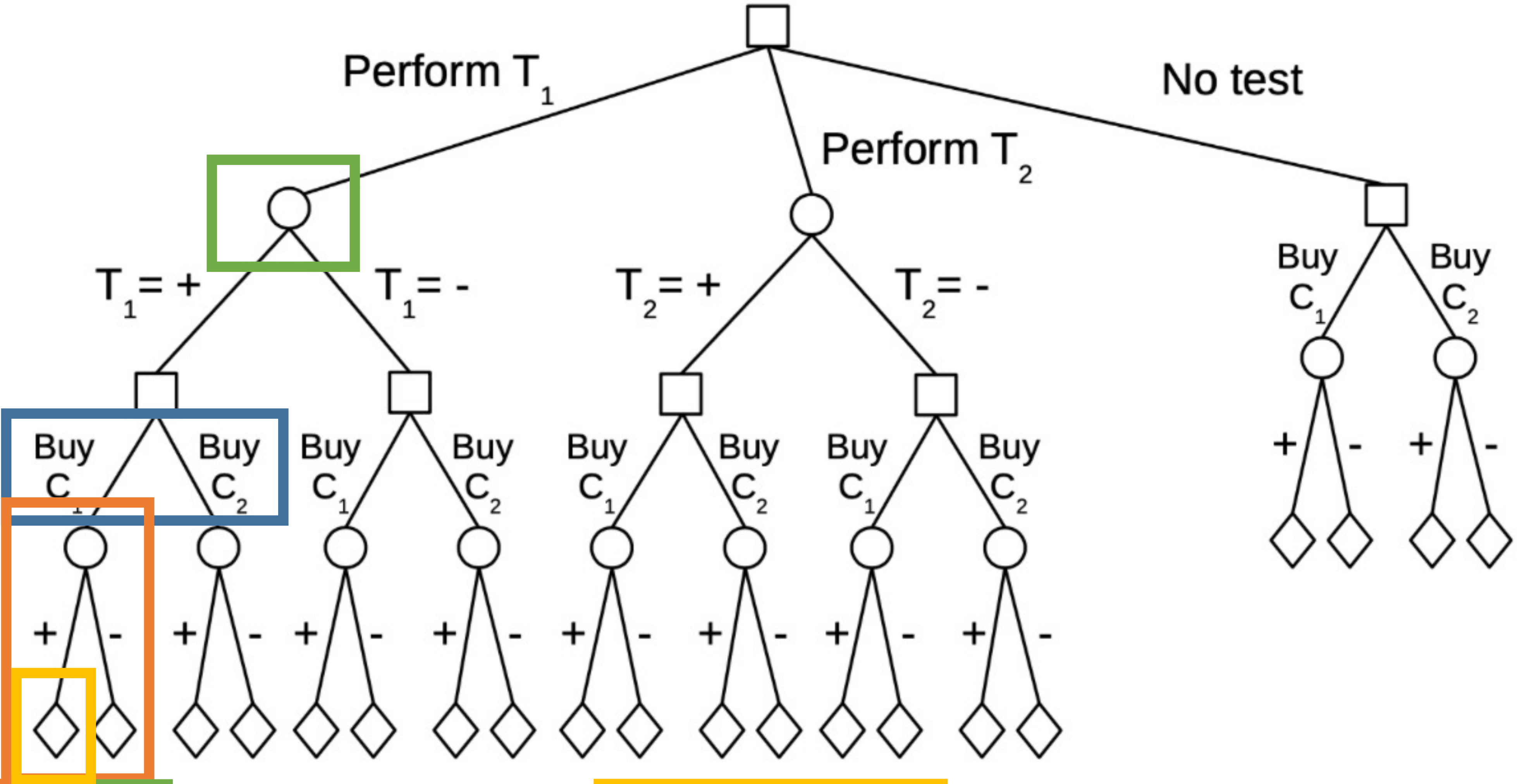
$$EU[C_1] = P(C_1 = +)\big(cost(C_1)\big) + P(C_1 = -)(cost(C_1) + repair(C_1))$$

$$EU[C_2] = P(C_2 = +)\big(cost(C_2)\big) + P(C_2 = -)(cost(C_2) + repair(C_2))$$

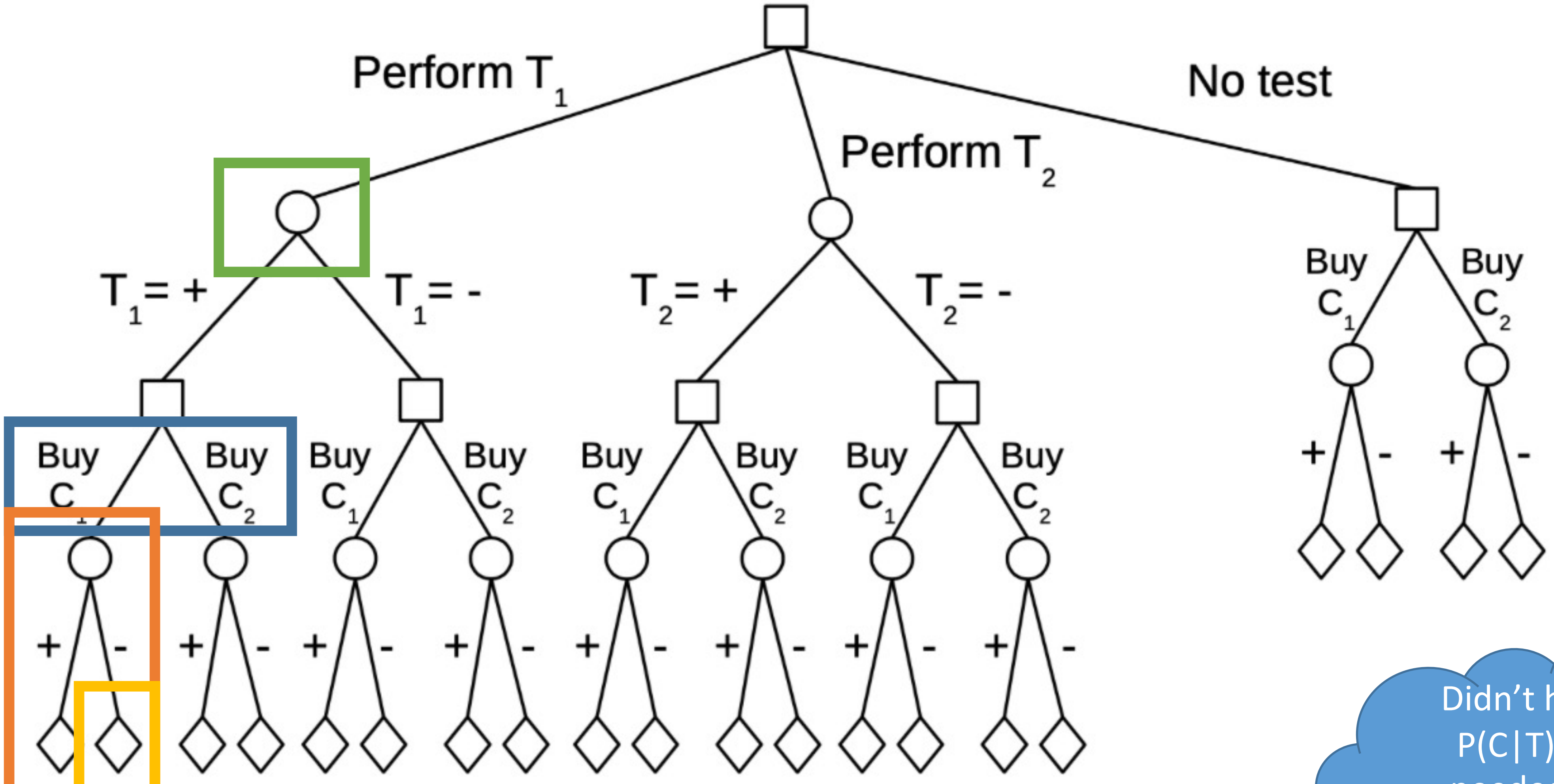
Pick the car with the higher EU



Perform T_1
Perform T_2
No test
$T_1 = +$
$T_1 = -$
$T_2 = +$
$T_2 = -$
Buy C_1
Buy C_2
+
-

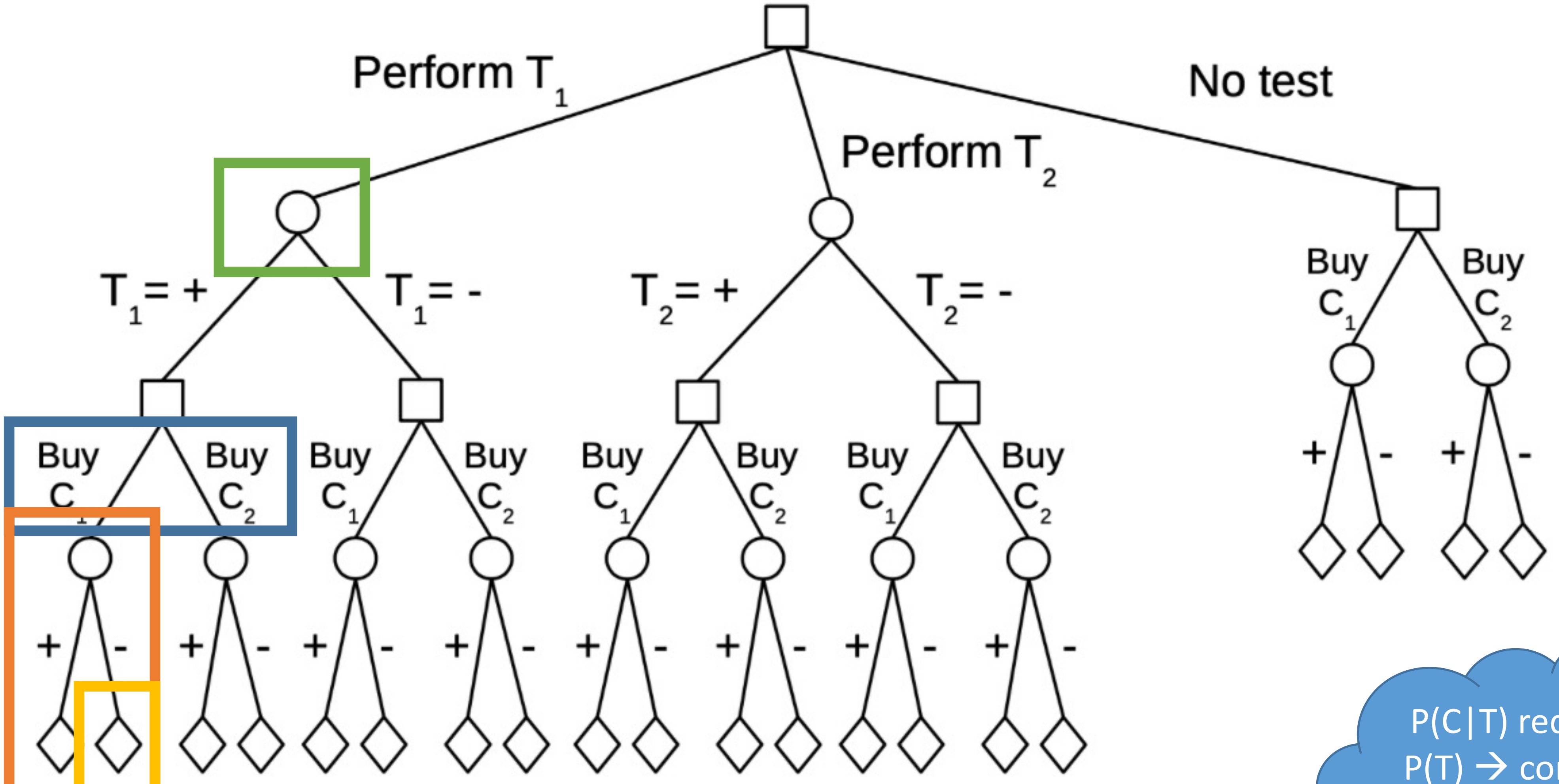


$$EU[C_1 \mid T_1 = +] = P(C_1 = + \mid T_1 = +)(cost(C_1) + cost(T_1)) + P(C_1 = - \mid T_1 = +)(cost(C_1) + repair(C_1) + cost(T_1))$$



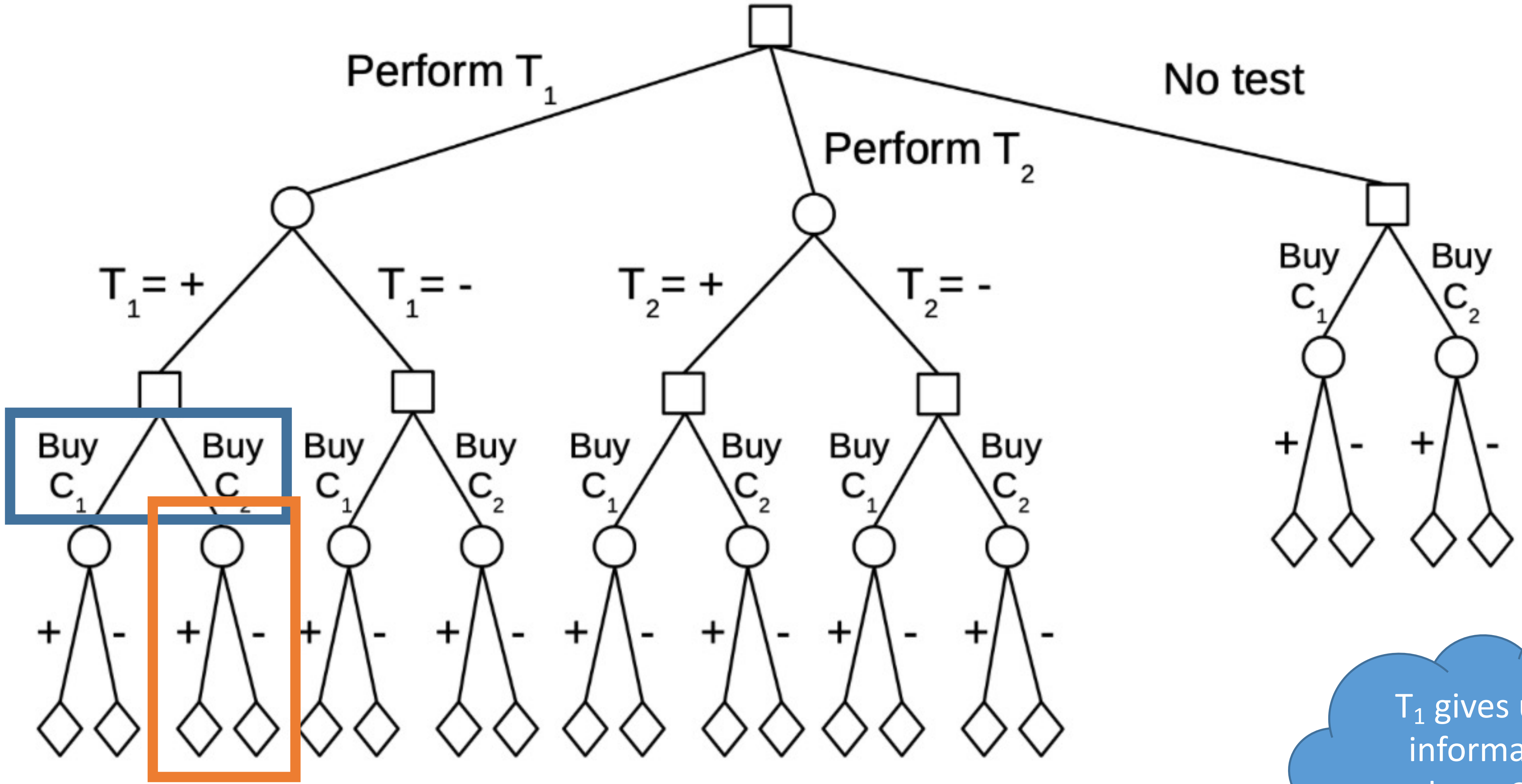
$$EU[C_1 \mid T_1 = +] = P(C_1 = + \mid T_1 = +)(cost(C_1) + cost(T_1)) + P(C_1 = - \mid T_1 = +)(cost(C_1) + repair(C_1) + cost(T_1))$$

Didn't have P(C|T) → needed to compute via Bayes Rule



$$EU[C_1 \mid T_1 = +] = P(C_1 = + \mid T_1 = +)(cost(C_1) + cost(T_1)) + P(C_1 = - \mid T_1 = +)[cost(C_1) + repair(C_1) + cost(T_1)]$$

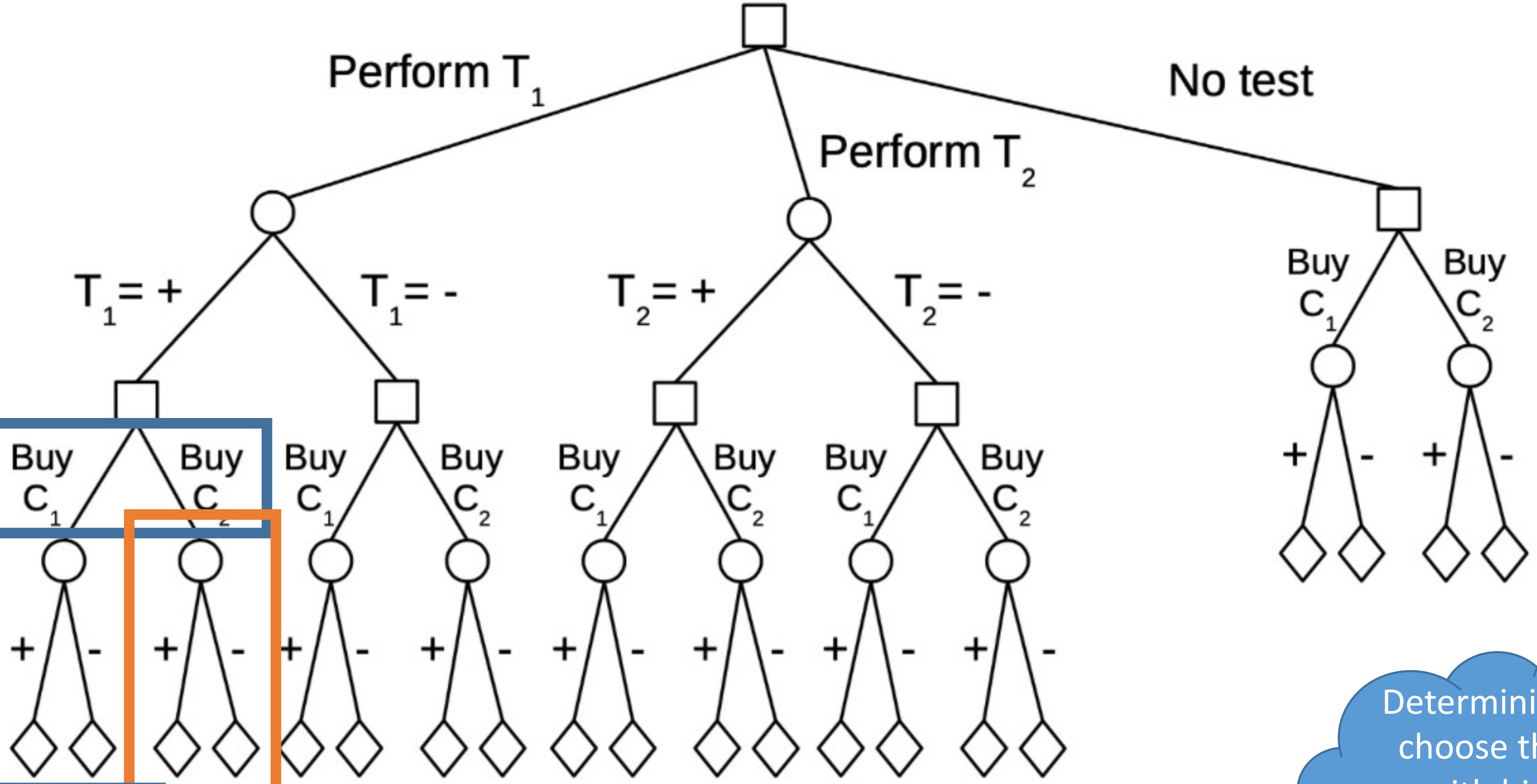
P(C|T) required
P(T) → compute via law of total probability



$$EU[C_1 \mid T_1 = +] = P(C_1 = + \mid T_1 = +)(cost(C_1) + cost(T_1)) + P(C_1 = - \mid T_1 = +)(cost(C_1) + repair(C_1) + cost(T_1))$$

$EU[C_2 \mid T_1 = +]$

T_1 gives us no information about C_2 → independent

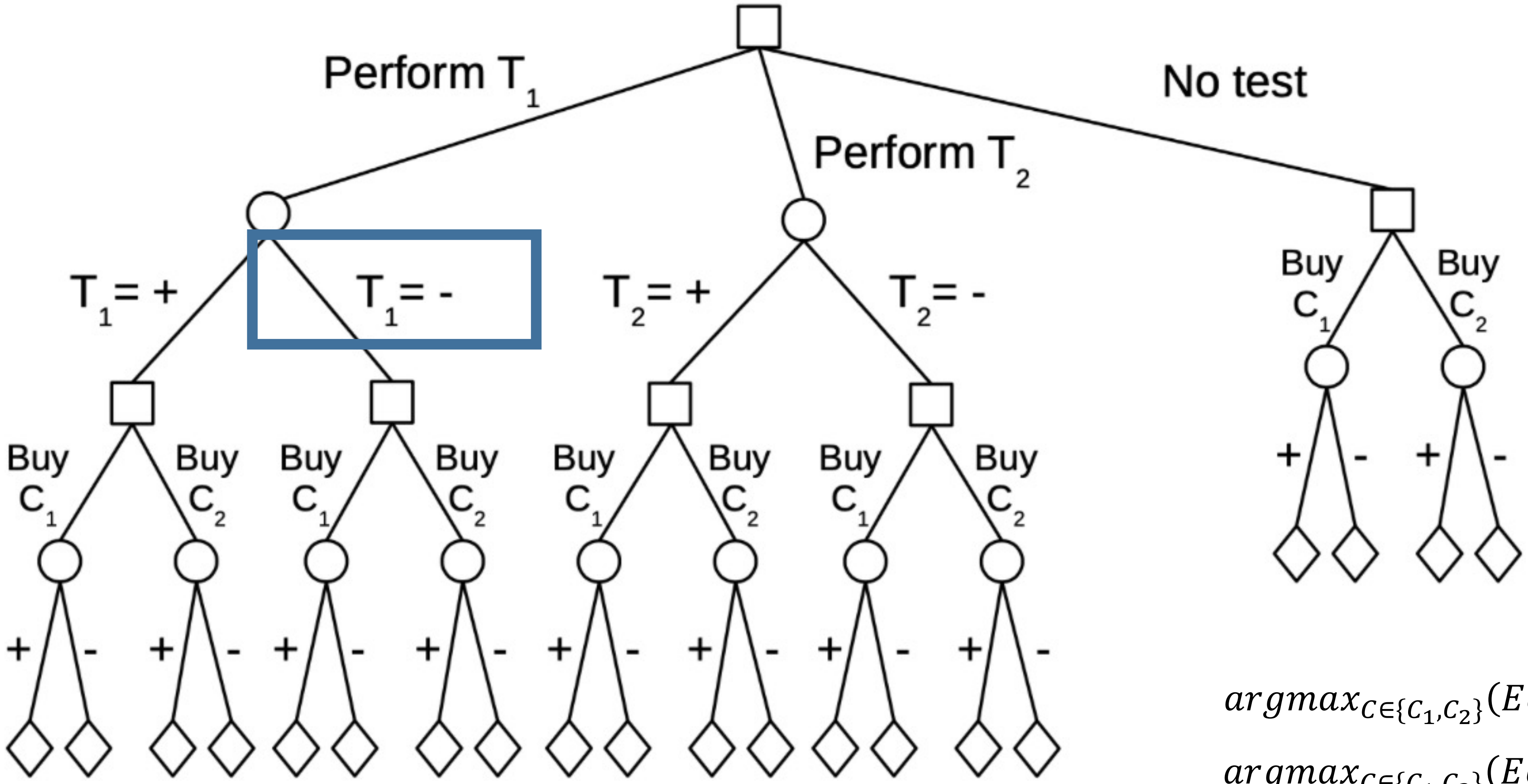


$$\boxed{EU[C_1 \mid T_1 = +]} = P(C_1 = + \mid T_1 = +)(cost(C_1) + cost(T_1)) + P(C_1 = - \mid T_1 = +)(cost(C_1) + repair(C_1) + cost(T_1))$$

$$\boxed{EU[C_2 \mid T_1 = +]} = P(C_2 = +)(cost(C_2) + cost(T_1)) + P(C_2 = -)\big(cost(C_2) + repair(C_2) + cost(T_1)\big)$$

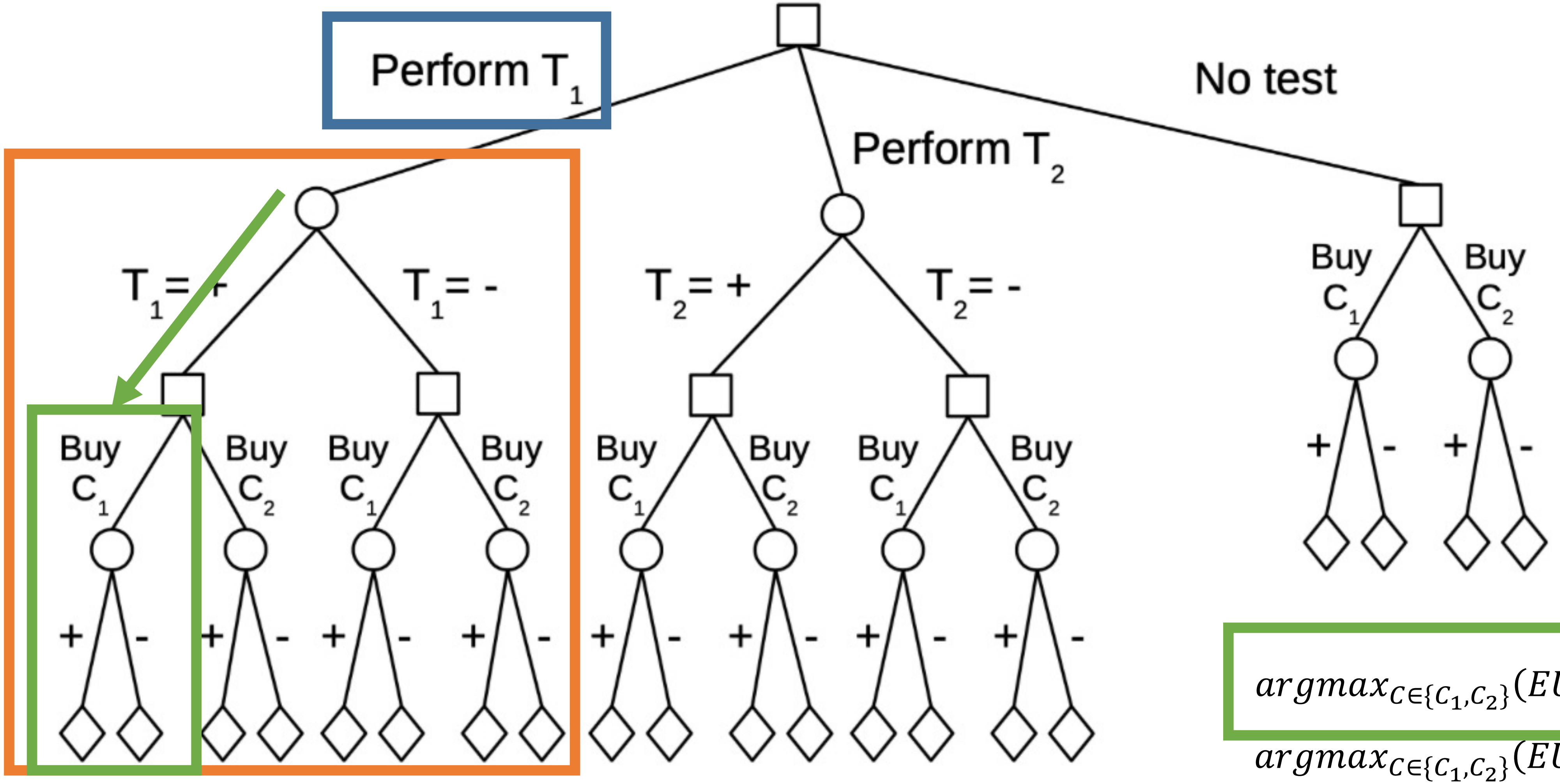
Deterministically choose the car with higher expected utility given T_1 = +

$$argmax_{C \in \{C_1, C_2\}}(EU[C \mid T_1 = +])$$



$$argmax_{C\in\{C_1,C_2\}}(EU[C|T_1 = +])$$

$$argmax_{C\in\{C_1,C_2\}}(EU[C|T_1 = -])$$



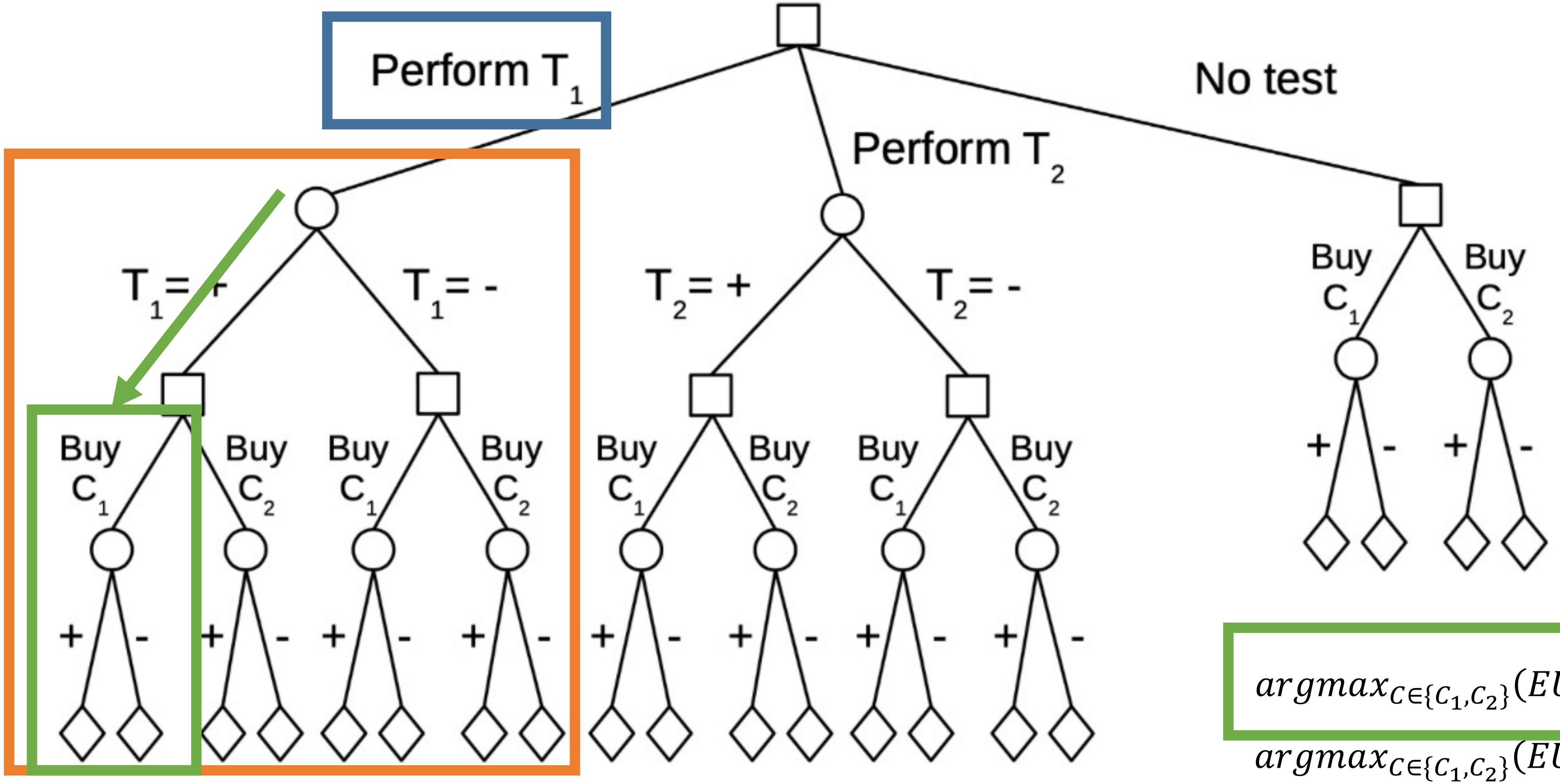
$$\boxed{argmax_{C\in\{C_1,C_2\}}(EU[C|T_1 = +])}$$

$$argmax_{C\in\{C_1,C_2\}}(EU[C|T_1 = -])$$

$$EU[T_1] = P(T_1 = +)\boxed{U(T_1 = +)} + P(T_1 = -)U(T_1 = -)$$

????

If we deterministically choose C_1 when T_1 = +, …

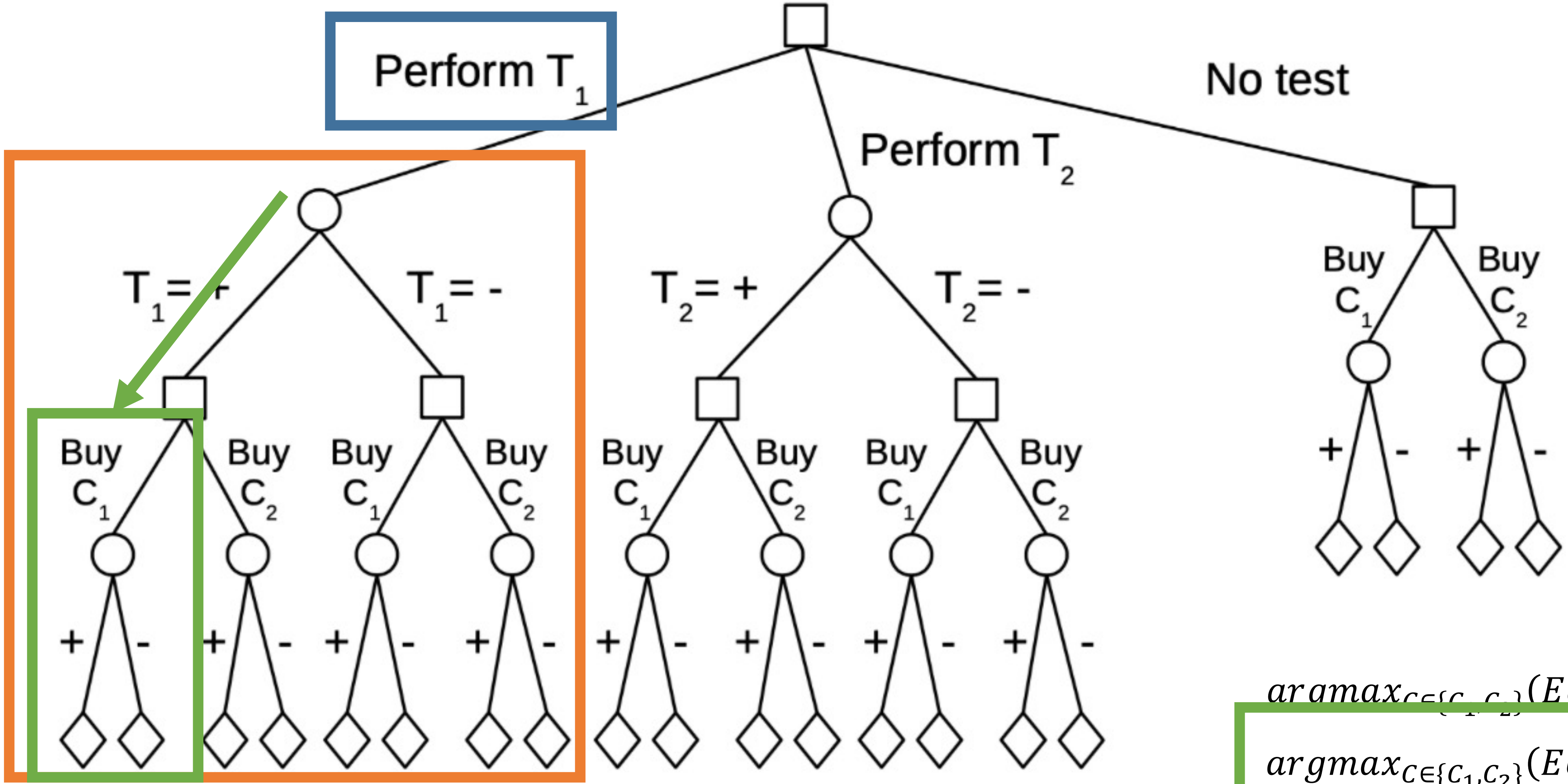


$$argmax_{C\in\{C_1,C_2\}}(EU[C|T_1 = +])$$

$$argmax_{C\in\{C_1,C_2\}}(EU[C|T_1 = -])$$

$$EU[T_1] = P(T_1 = +)EU(C_1|T_1 = +) + P(T_1 = -)U(T_1 = -)$$

If we deterministically choose C_1 when T_1 = +, …

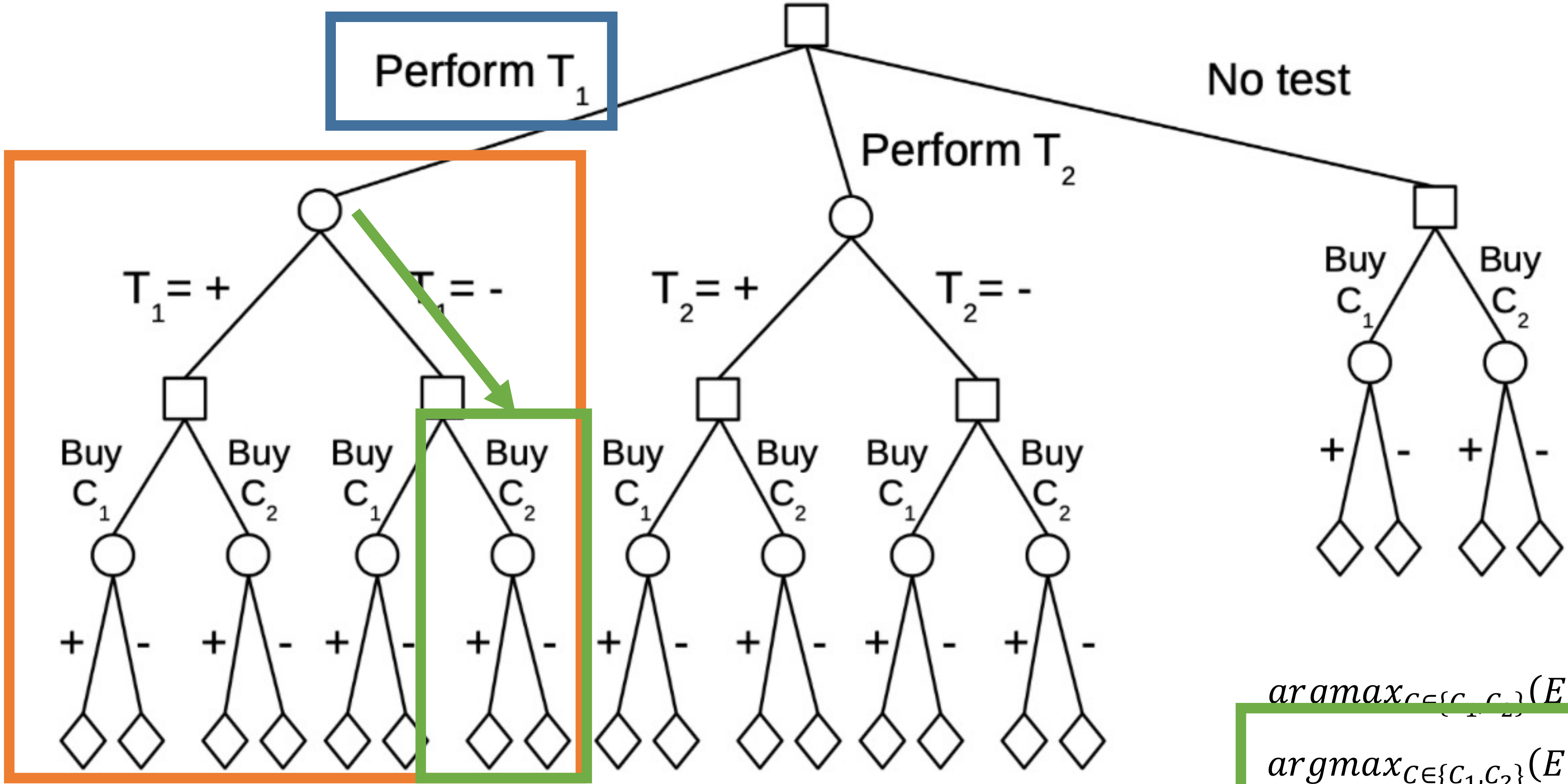


$argmax_{C \in \{C_1, C_2\}}(EU[C|T_1 = +])$

$\boxed{argmax_{C \in \{C_1, C_2\}}(EU[C|T_1 = -])}$

$$EU[T_1] = P(T_1 = +)EU(C_1|T_1 = +) + P(T_1 = -)U(T_1 = -)$$

If we deterministically choose C_2 when T_1 = -, …

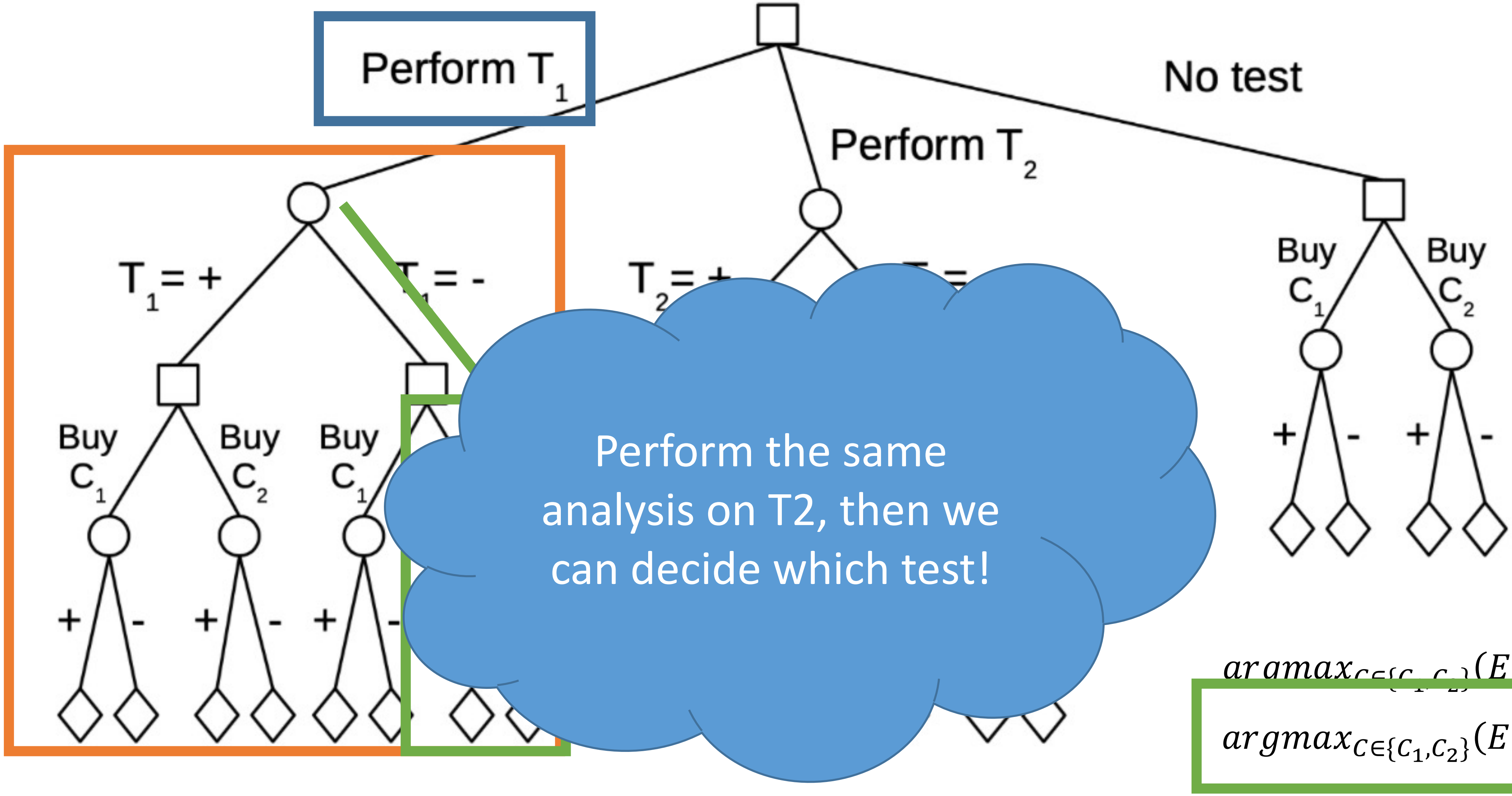


$argmax_{C \in \{C_1, C_2\}}(EU[C|T_1 = +])$

$argmax_{C \in \{C_1, C_2\}}(EU[C|T_1 = -])$

$EU[T_1] = P(T_1 = +)EU(C_1|T_1 = +) + P(T_1 = -)U(T_1 = -)$

If we deterministically choose C_2 when T_1 = -, …



$argmax_{C \in \{C_1, C_2\}}(EU[C|T_1 = +])$

$$\boxed{argmax_{C \in \{C_1, C_2\}}(EU[C|T_1 = -])}$$

$$EU[T_1] = P(T_1 = +)EU(C_1|T_1 = +) + P(T_1 = -)EU(C_2|T_1 = -)$$

If we deterministically choose C_2 when T_1 = -, …

When uncertainty comes from another agent's actions

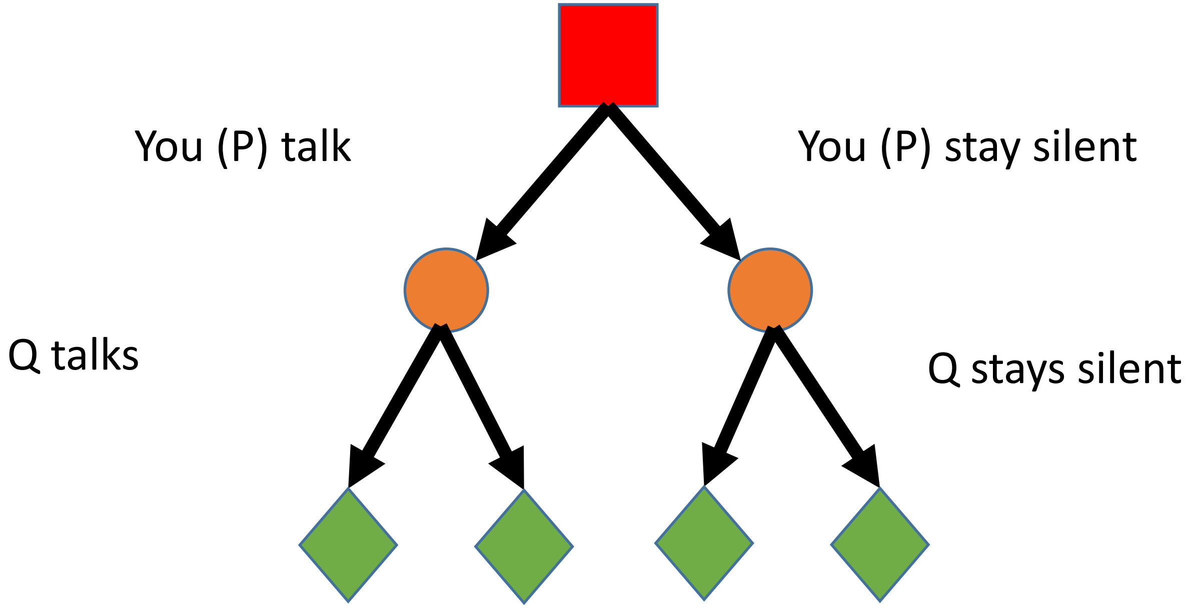
Car example: taking an action in one branch closes off possibilities in another

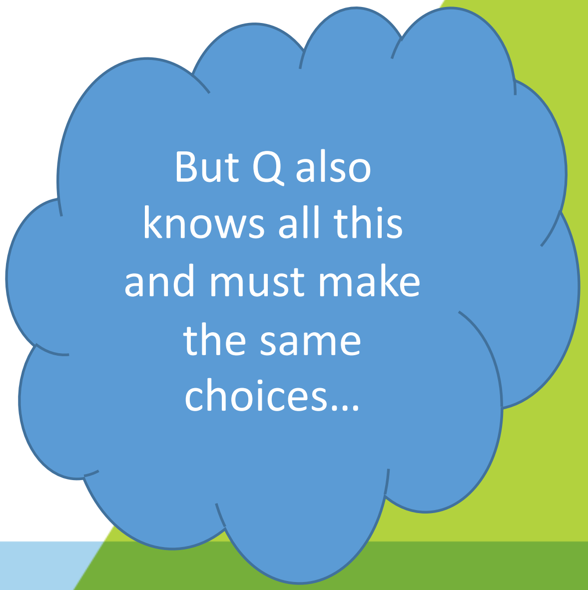
- Randomness comes from
  - Epistemic uncertainty about effects of past actions (e.g., accuracy of test results)
  - Epistemic uncertainty about future state (e.g., quality of car)

Consider the case when randomness comes from another agent's actions…

Example: Prisoner’s Dilemma

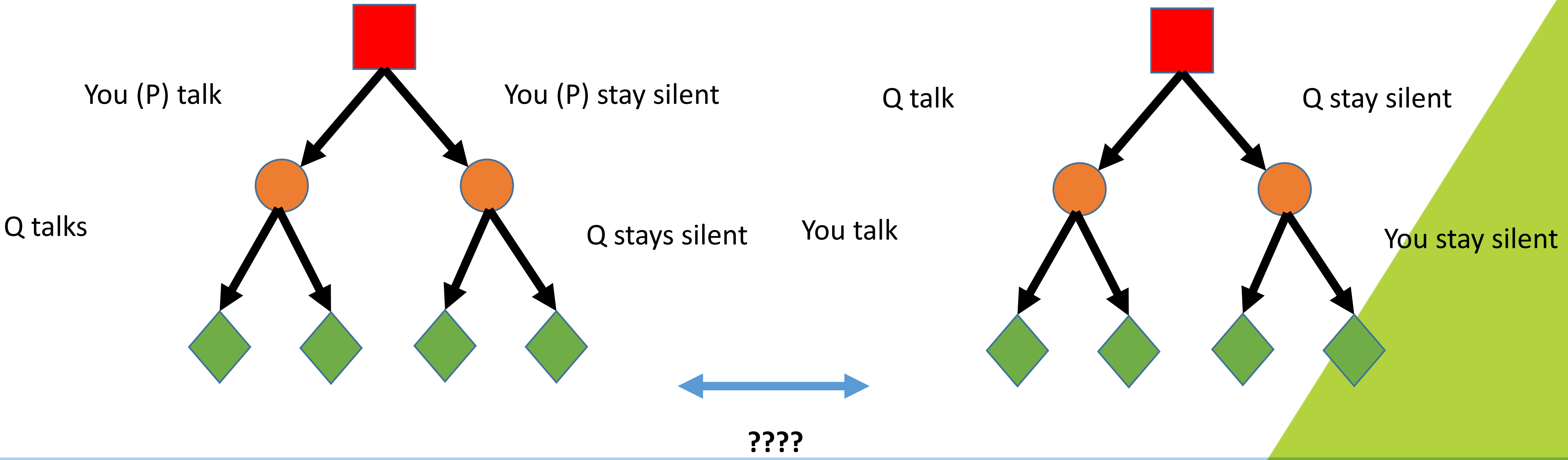
You (agent P) and an accomplice (agent Q) have been arrested for a crime…





Example: Prisoner's Dilemma

You (agent P) and an accomplice (agent Q) have been arrested for a crime…



Both parties know this

Example: Prisoner's Dilemma

P and Q have been arrested for a crime and separated for in
the choice of whether or not to confess and each action is as
You don't know how your accomplice will act. What do you do?

Utility function:
Collective cost?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Both parties know this matrix

Weak case

Example: Prisoner's Dilemma

P and Q have been arrested for a crime and separated for in
the choice of whether or not to confess and each action is as
You don't know how your accomplice will act. What do you do?

Utility function:
Collective cost?

	P silent	P talks
Q silent	0	-7
Q talks	-7	-20

Both choose silent if both are using the same utility function

Both parties know this matrix

Weak case

Example: Prisoner's Dilemma

P and Q have been arrested for a crime and separated for in

the choice of whether or not to confess and each action is as

You don't know how your accomplice will act. What do you do?

Utility function:
Collective cost?

	P silent	P talks
Q silent	$\boxed{0}$	-7
Q talks	-7	-20

What if one uses a different utility function?

Both parties know this matrix

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and

interrogation. You have the choice of whether or not to confe

associated with a cost. You don't know how your accomplice will you

do?

Utility function:
Individual Cost?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Both parties know this matrix

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and interrogation. You have the choice of whether or not to confe associated with a cost. You don't know how your accomplice will you do?

Utility function:
Individual cost?

	P silent	P talks
Q silent	0	-2
Q talks	-5	-10

Both parties know this matrix

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and

interrogation. You have the choice of whether or not to confe

associated with a cost. You don't know how your accomplice will you

do?

Utility function:
Individual cost?

	P silent	P talks
Q silent	0	-5
Q talks	-2	-10

Both parties know this matrix

Weak case

Example: Prisoner’s Dilemma

You and an accomplice have been arrested for a crime and interrogation. You have the choice of whether or not to confe associated with a cost. You don’t know how your accomplice will you do?

Utility function:
Individual Cost?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Both parties know this matrix

Weak case

Example: Prisoner’s Dilemma

You and an accomplice have been arrested for a crime and
interrogation. You have the choice of whether or not to confe
associated with a cost. You don’t know how your accomplice will you
do?

Local reasoning, rather than global

Decision/action

Uncertainty

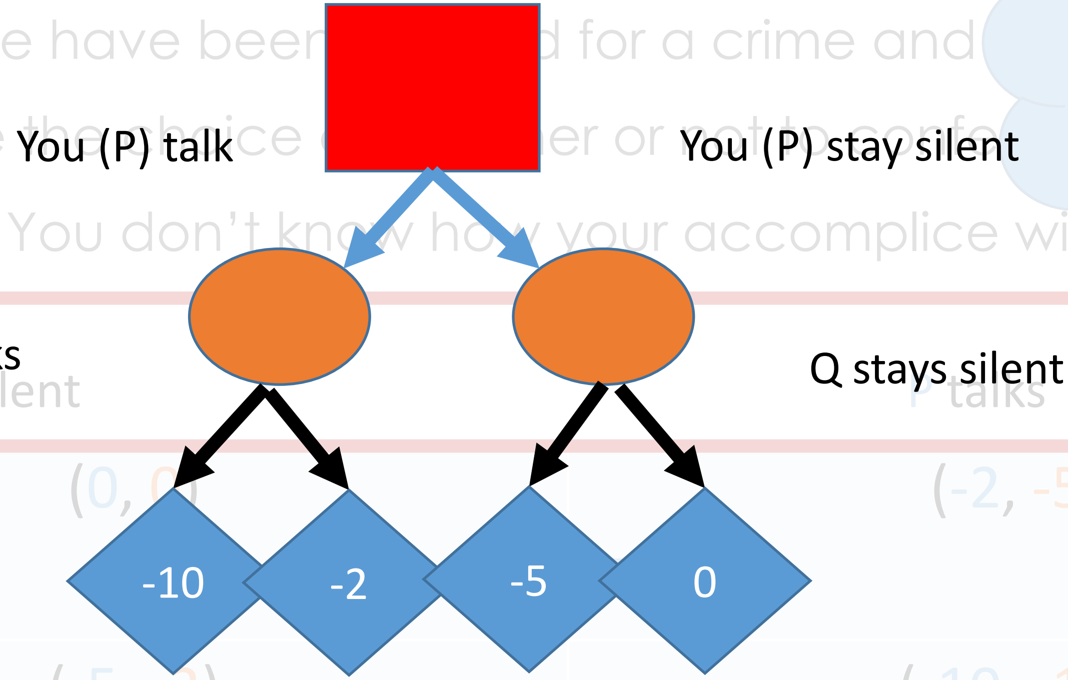
	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been … d for a crime and … interrogation. You have the choice … er or not to confe… associated with a cost. You don't know how your accomplice will … you do?

Local reasoning, rather than global



Decision/action

Uncertainty

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and

interrogation. You have the choice of whether or not to confe

associated with a cost. You don't know how your accomplice will you

do?

Local reasoning, rather than global

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Decision/action

Uncertainty

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

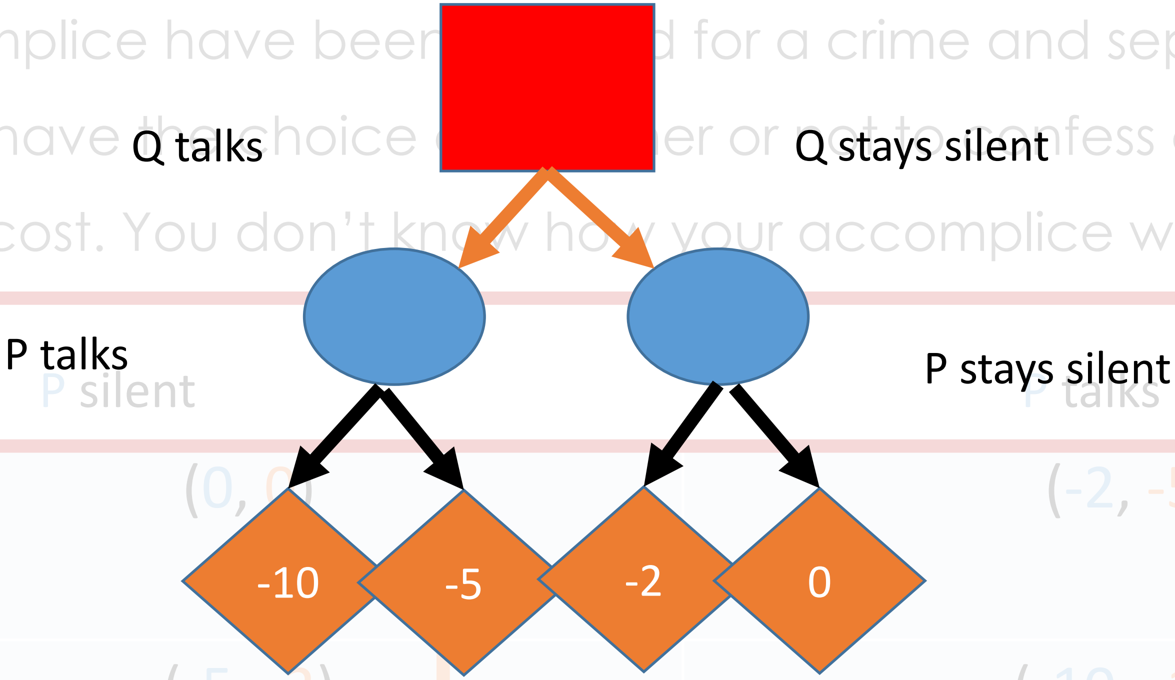
		P silent	P talks
Decision/action	Q silent	(0, 0)	(-2, -5)
	Q talks	(-5, -2)	(-10, -10)

Uncertainty

Weak case

Example: Prisoner’s Dilemma

You and an accomplice have been [illegible]d for a crime and separated for interrogation. You have the choice [illegible]er or [illegible] to confess and each action is associated with a cost. You don’t know how your accomplice will act. What do you do?



Decision/action

Uncertainty

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner’s Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don’t know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner’s Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don’t know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(0, 0)	(-2, -5)
Q talks	(-5, -2)	(-10, -10)

Same as globally optimal case for both utility functions

Weak case

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and se interrogation. You have the choice of whether or not to confess associated with a cost. You don't know how your accomplice will d o you do?

Consider a different payoff matrix

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Still globally optimal for collective utility?

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	$\boxed{-4}$	-15
Q talks	-15	-20

Still globally optimal for collective utility?

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and se interrogation. You have the choice of whether or not to confess associated with a cost. You don't know how your accomplice will d o you do?

Assume Q uses collective utility, but P uses individual utility…

	P silent	P talks
Q silent	-2	0
Q talks	-15	-10

Incentivize talking

Still globally optimal for individual utility for P?

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and se[…] interrogation. You have the choice of whether or not to confess [...] associated with a cost. You don't know how your accomplice will act. Wha[…] you do?

What if Q knows P's utility function and decides to mimic?

	P silent	P talks
Q silent	-2	-15
Q talks	0	-10

Still globally optimal for individual utility?

Incentivize talking

Example: Prisoner's Dilemma

What if Q knows P's utility function and decides to mimic?

You and an accomplice have been arrested for a crime and se interrogation. You have the choice of whether or not to confess associated with a cost. You don't know how your accomplice will act. Wha you do?

	P silent	P talks
Q silent	-2	-15
Q talks	$\boxed{0}$	-10

Still globally optimal for individual utility?

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	-4	-15
Q talks	-15	-20

Worst possible global outcome!

Incentivize talking

Example: Prisoner’s Dilemma

You and an accomplice have been arrested for a crime and
interrogation. You have the choice of whether or not to confe
associated with a cost. You don’t know how your accomplice will … you
do?

Local reasoning, rather than global

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	($\boxed{-15}$, 0)	($\boxed{-10}$, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	(-10, -10)

Incentivize talking

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-2, -2)	(0, -15)
Q talks	(-15, 0)	$\boxed{(-10, -10)}$

Same result!

Incentivize talking

Example: 2-finger Morra

Choose between 1 and 2 fingers. P wins if sum is even. Q wins if sum is odd. Loser pays the winner.

	P plays 1	P plays 2
Q plays 1	(+2, -2)	(-3, +3)
Q plays 2	(-3, +3)	(+4, -4)

Zero-sum

Example: 2-finger Morra

Choose between 1 and 2 fingers. P wins if sum is even. Q wins if sum is odd. Loser pays the winner.

	P plays 1	P plays 2
Q plays 1	0	0
Q plays 2	0	0

Zero-sum

Example: 2-finger Morra

Choose between 1 and 2 fingers. P wins if sum is even. Q wins if sum is odd. Loser pays the winner.

	P plays 1	P plays 2
Q plays 1	+2	-3
Q plays 2	-3	$\boxed{+4}$

Zero-sum

Example: 2-finger Morra

Choose between 1 and 2 fingers. P wins if sum is even. Q wins if sum is odd. Loser pays the winner.

	P plays 1	P plays 2
Q plays 1	-2	+3
Q plays 2	+3	-4

Zero-sum

Example: 2-finger Morra

Choose between 1 and 2 fingers. P wins if sum is even. Q wins if

pays the winner.

Choose probabilistically

	P plays 1	P plays 2
Q plays 1	(+2, -2)	(-3, +3)
Q plays 2	(-3, +3)	(+4, -4)

Zero-sum

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-4, -4)	(0, -6)
Q talks	(-5, -2)	(-10, -10)

No free ride for Q

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	-8	$\boxed{-6}$
Q talks	-7	-20

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-4, -4)	(0, -6)
Q talks	(-5, -2)	(-10, -10)

No free ride for Q

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	-4	0
Q talks	-5	-10

No free ride for Q

Example: Prisoner’s Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don’t know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-4, -4)	(0, -6)
Q talks	(-5, -2)	(-10, -10)

No free ride for Q

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	-4	-6
Q talks	$\boxed{-2}$	-10

No free ride for Q

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-4, -4)	(0, -6)
Q talks	(-5, -2)	(-10, -10)

No free ride for Q

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-4, -4)	(0, -6)
Q talks	(-5, -2)	(-10, -10)

No free ride for Q

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don't know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-4, -4)	(0, -6)
Q talks	(-5, -2)	(-10, -10)

No free ride for Q

Example: Prisoner’s Dilemma

You and an accomplice have been arrested for a crime and separated for interrogation. You have the choice of whether or not to confess and each action is associated with a cost. You don’t know how your accomplice will act. What do you do?

	P silent	P talks
Q silent	(-4, -4)	(0, -6)
Q talks	(-5, -2)	(-10, -10)

No free ride for Q

Example: Prisoner's Dilemma

You and an accomplice have been arrested for a crime and se interrogation. You have the choice of whether or not to confess associated with a cost. You don't know how your accomplice will d o you do?

Suppose we model Q's choice probabilistically…

	P silent	P talks
Q silent	(-4, -4)	(0, -6)
Q talks	(-5, -2)	(-10, -10)

No free ride for Q

Do stuff on board

Vocabulary & Concepts

- Always assume local decision making (all players maximizing individual utility)
- **Zero sum** – every entry in global collective payoff is 0
- **Pure strategy** – always pick the same action no matter what
- **Mixed strategy** – pick an action probabilistically
- **Dominant strategy** – one action is strictly better no matter what the other plays does