Considerations on Society as a Global System - 2

Symbiosis of societies

in the absence of government

What is the behavioral consequence of individuals?

- Is it possible to establish entire political order in the absence of government (when no one gives directions)?

Schelling's Models of Segregation

- Thomas C. Schelling (1921-): the 2005 Nobel Prize laureate in Economics. Renowned for his theory on nuclear arms control during the cold war.
- "Dynamic Models of Segregation," Journal of Mathematical Sociology, 1 (1971), 143-86.

Individual's Behavioral Rule

- A person is in one place. He looks around him and checks what kind of neighborhood he is in.
- If he finds a certain number of people or more of his type in that place, he will stay in that place.
- If he can not find a certain number of people or more of his type, he will move to another place.

Schelling's Model

- Two groups of people exist.
- Every one in a group has a certain degree of tolerance (local tolerance) which makes him determine whether he will stay in a group or not.
- If one's neighbors' tolerance level exceeds his own, it will make him move to another place.
- Segregation proceeds in a group with a high local tolerance, but it does not in a group with a low local tolerance.
- This model assumes that segregation does not occur in a group where individuals are less discriminatory against their neighbors. Is it true?

egregation.model- artisoc
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RedTurtle
BlueTurtle

Implication of Schelling's Model

- Behavioral characteristics of a group are not simply derived from those of individuals. Group behaviors result in an unanticipated result in some cases.

Note

- The preference over status depends on values and conditions of the person who judges.
- This model suggests that in racial diversity (segregation), separation should be preferred.
- According to this model, smokers should be segregated from non-smokers. (The higher the tolerance, the better?)

Multi-agent Simulation

- A methodology to manifest possible outcomes when several agents inter-react according to one's own rules of action.
- "*artisoc player*" is available for download from the following URL.
- Please download "*bunkyo*" from a list of sample programs.
- URL:

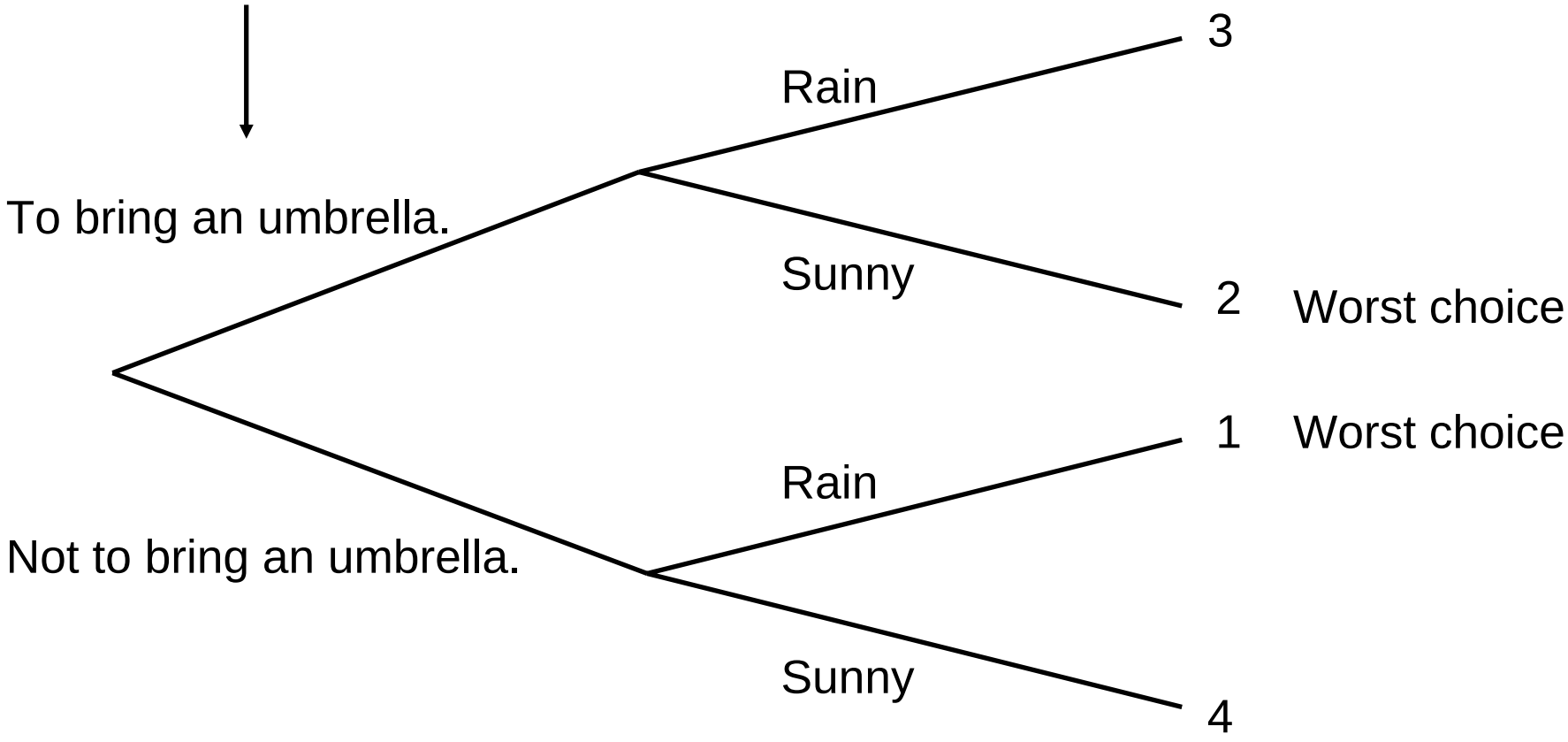
  http://mas.kke.co.jp/index.php [Japanese]
  https://www.kke.co.jp/iit/mas/artisoc_player_registration_e.html [English]

A few more basic points…

- Why is it in the first place that individuals make a rational decision?
- What are participants' goals and preferences in collective action? What is it to achieve the collective goal involving individuals' preference?
- Rational Decision-Making Model
- Game Theory

Decision-Making under Uncertainty

Which one is a rational choice?



Minimax Decision Criterion

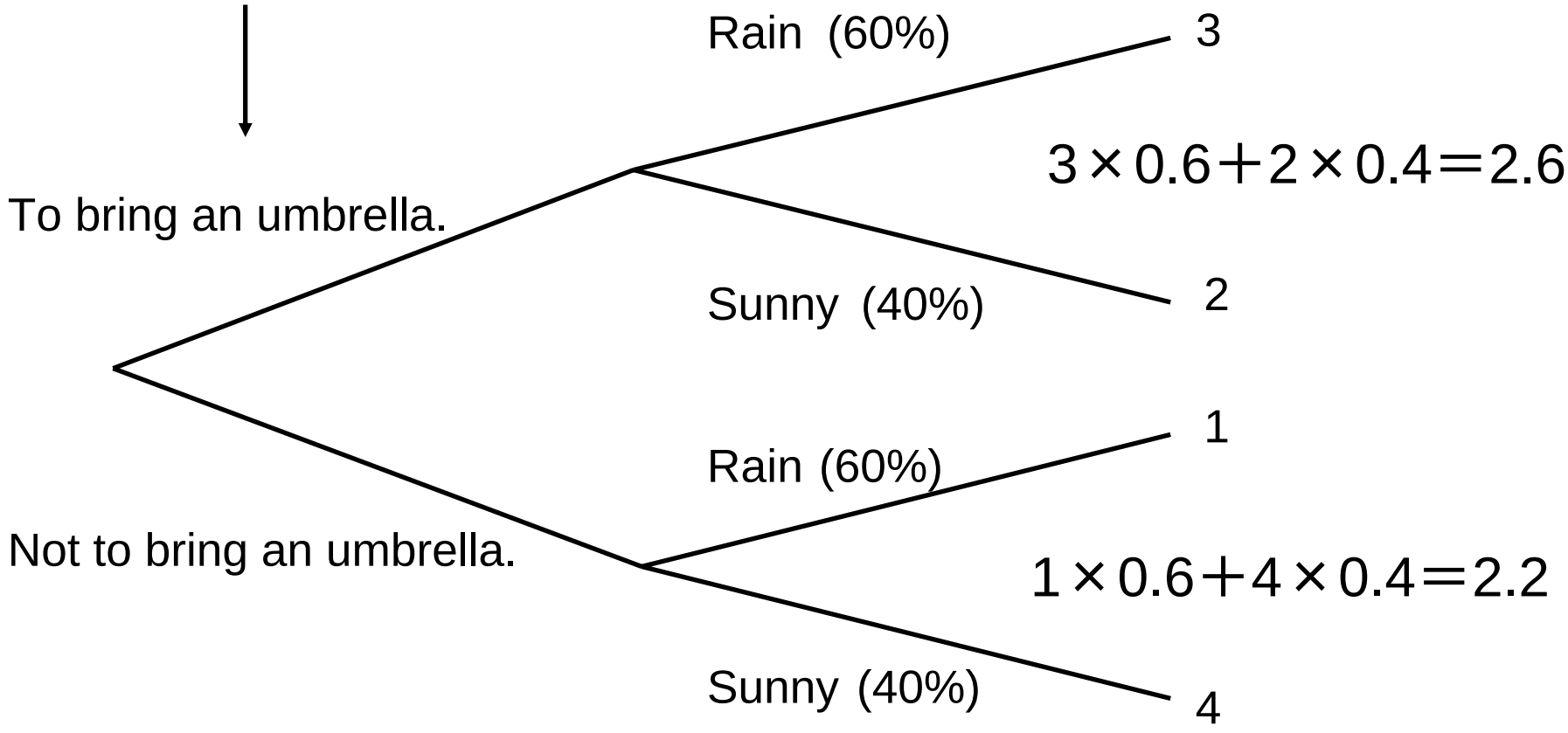
- Simulate the maximum possible loss for each choice. Take the best choice that maximizes the gain. This is to minimize the maximum (loss).
- The worst outcome is 2 when bringing an umbrella.
- The worst outcome is 1 when not bringing an umbrella.
- 2 is better than 1, and therefore to bring an umbrella is a rational choice.

To reduce uncertainty

- For example, a reliable weather forecast is offered.
- In other words, probability information is available regarding possible outcomes.

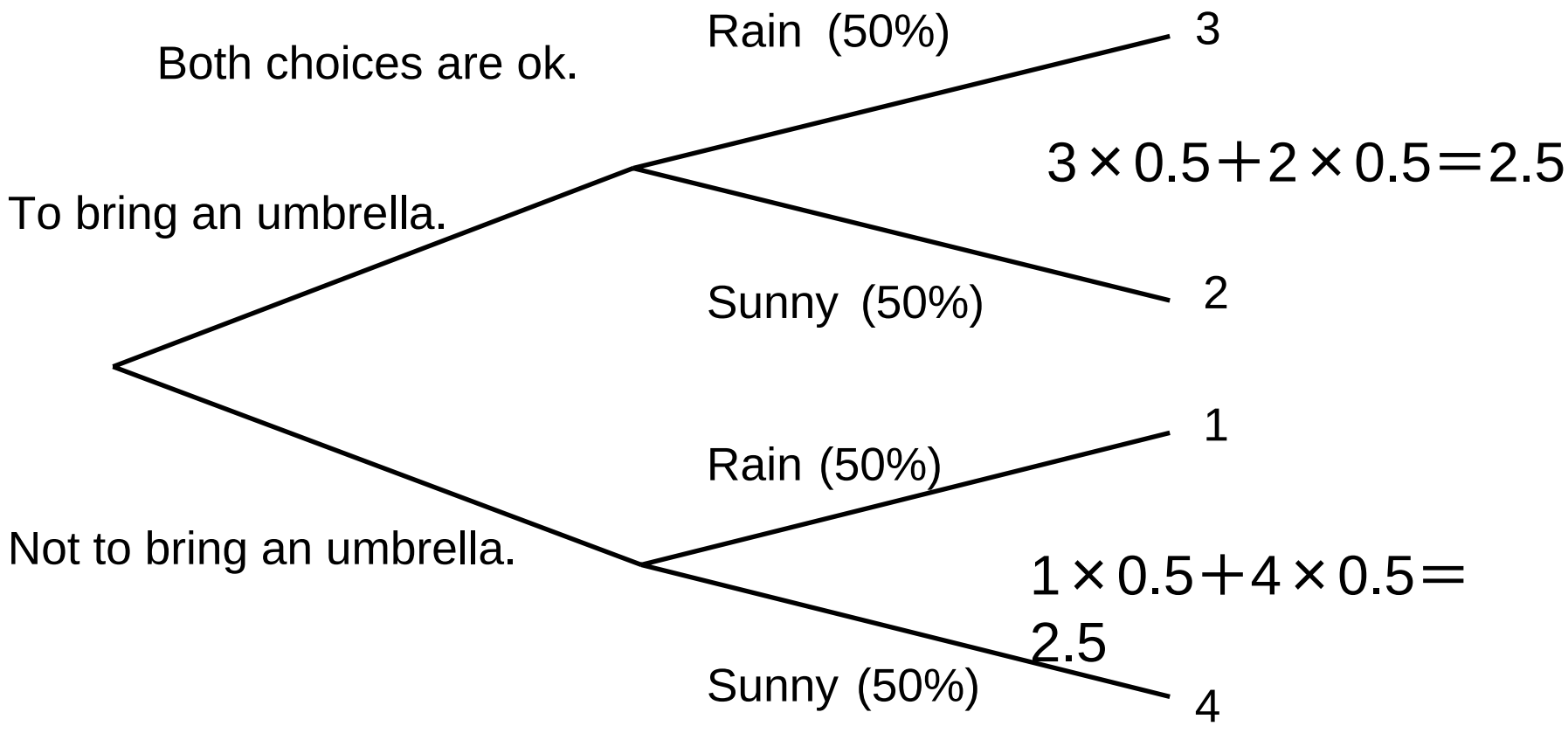
Decision Making with Probability Information

Which one is a rational choice?



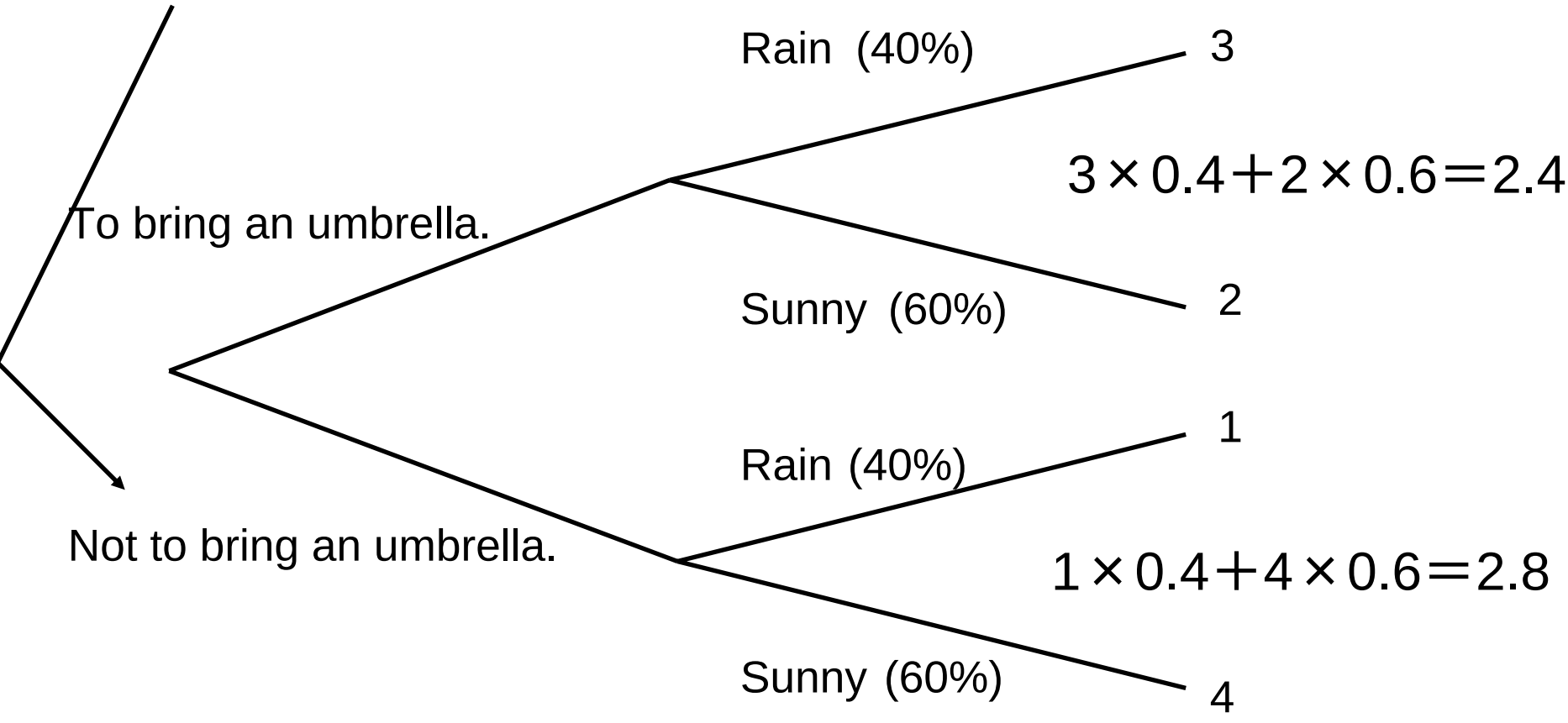
If the probability distribution has changed…

Which one is a rational choice?



If the probability distribution has changed again…

Which one is a rational choice?

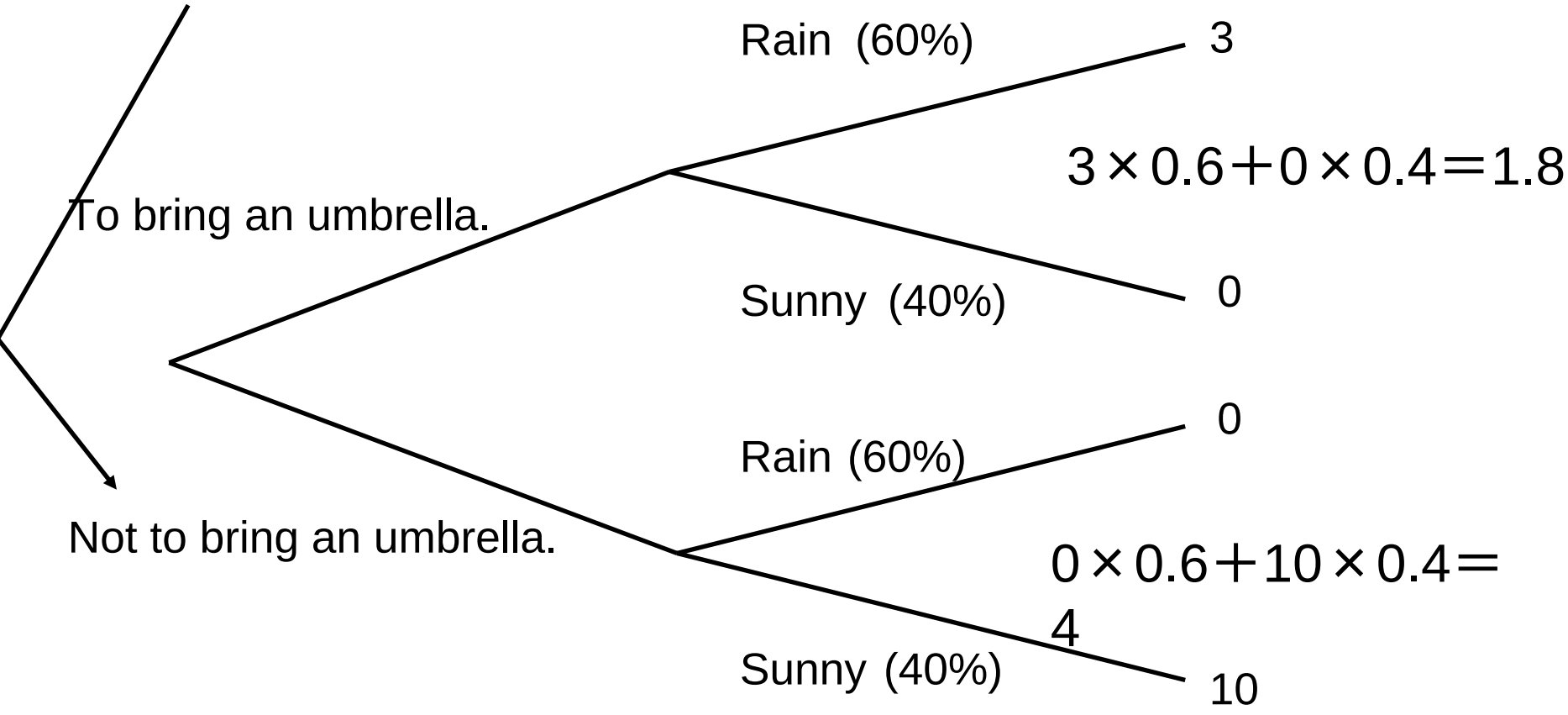


$3 \times 0.4 + 2 \times 0.6 = 2.4$

$1 \times 0.4 + 4 \times 0.6 = 2.8$

If the gain has changed…

Which one is a rational choice?



Rational Decision Making based on Max Expected Value

- Expected value is the addition of every action, each of which can lead to several possible outcomes, with chance determining the outcome.

$$E(a_i) = \sum_{j=1}^{m} c_j p_j$$

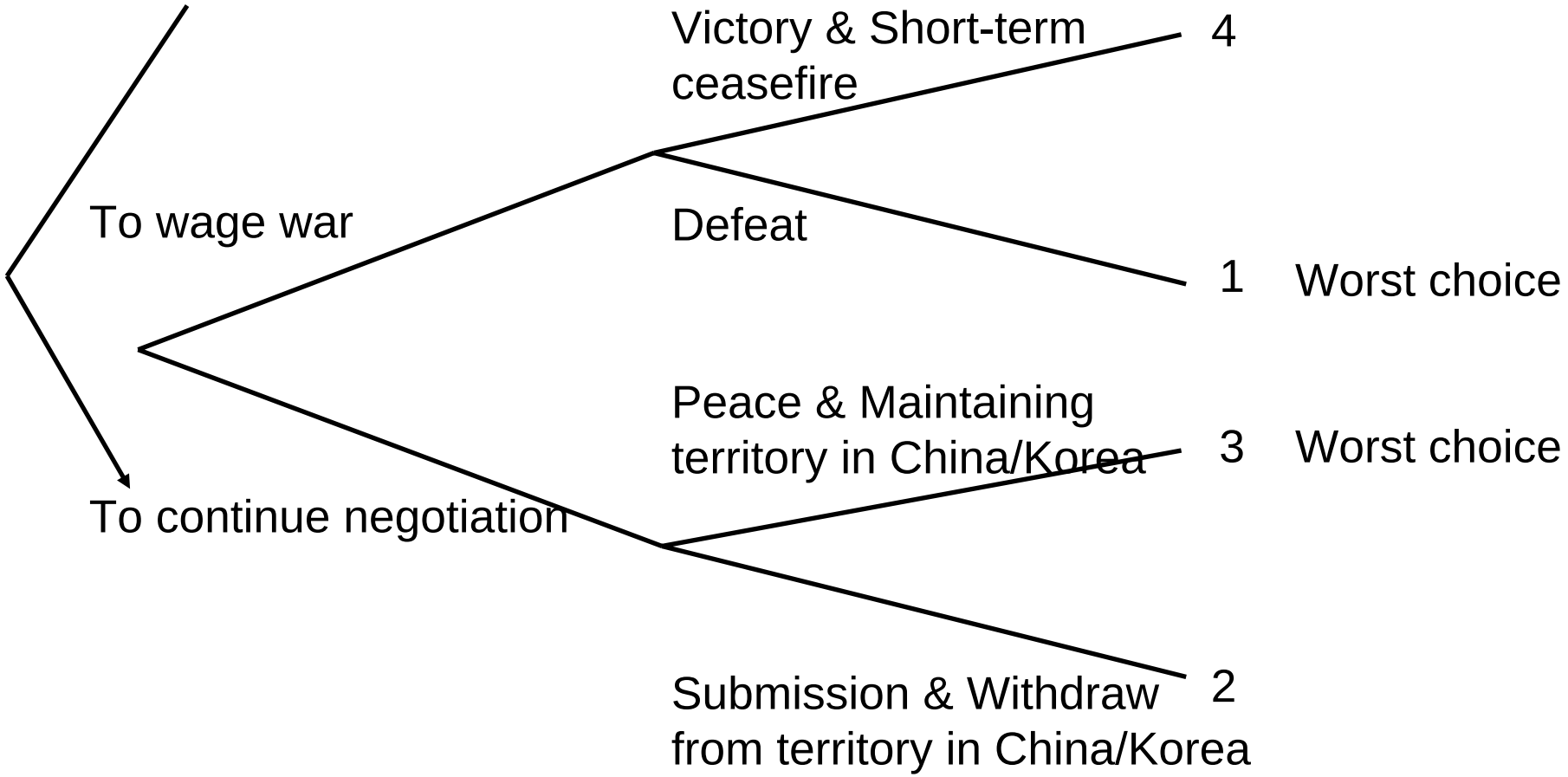
where $$\sum_{j=1}^{m} p_j = 1$$

- A choice over the action with the highest expected value is considered rational.

$$\max_{i=1}^{n} [E(a_i)]$$

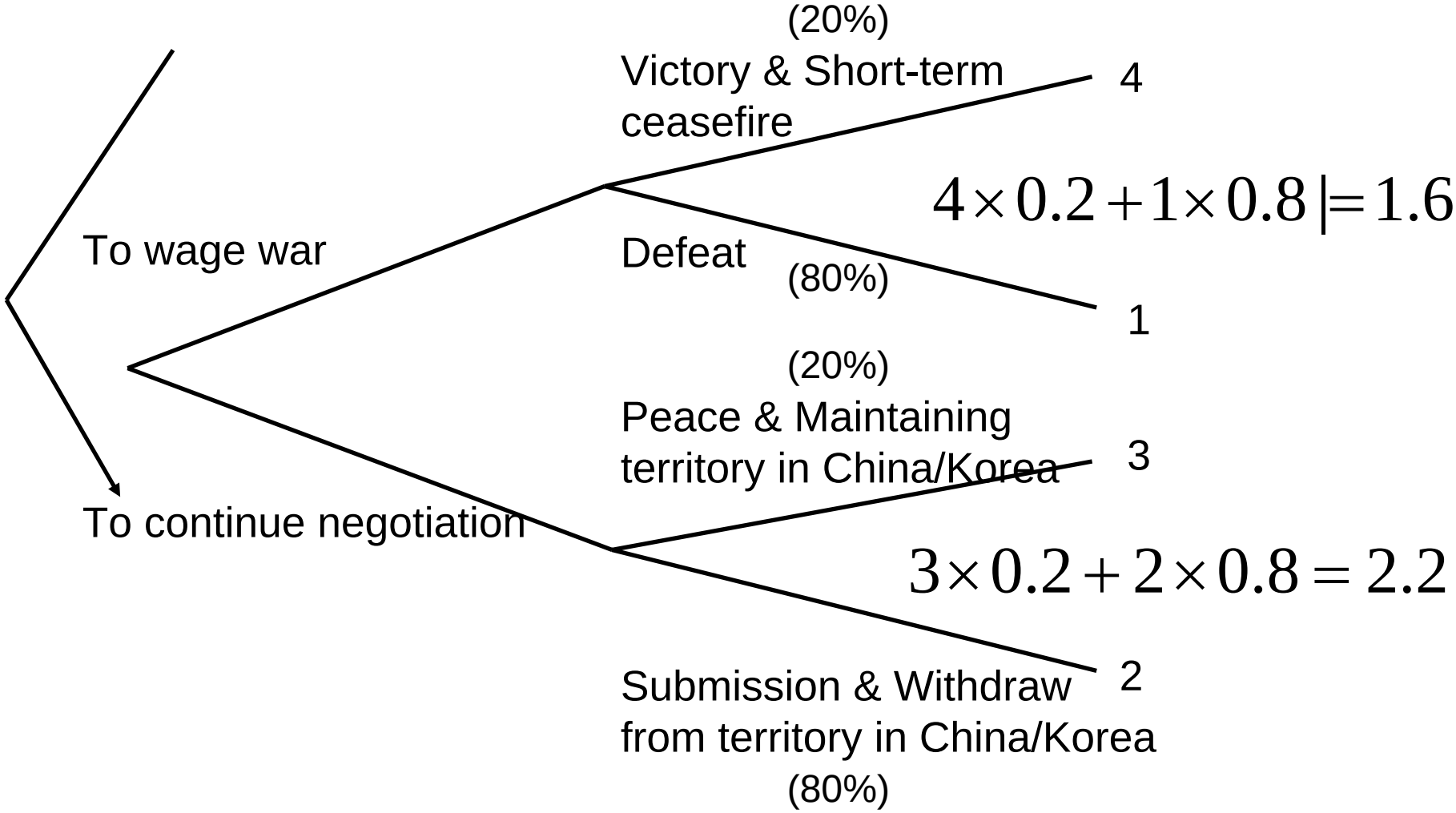
The Attack on Pearl Harbor

Which one is a rational choice?



The Attack on Pearl Harbor (with Probability Information)

Which one is a rational choice?

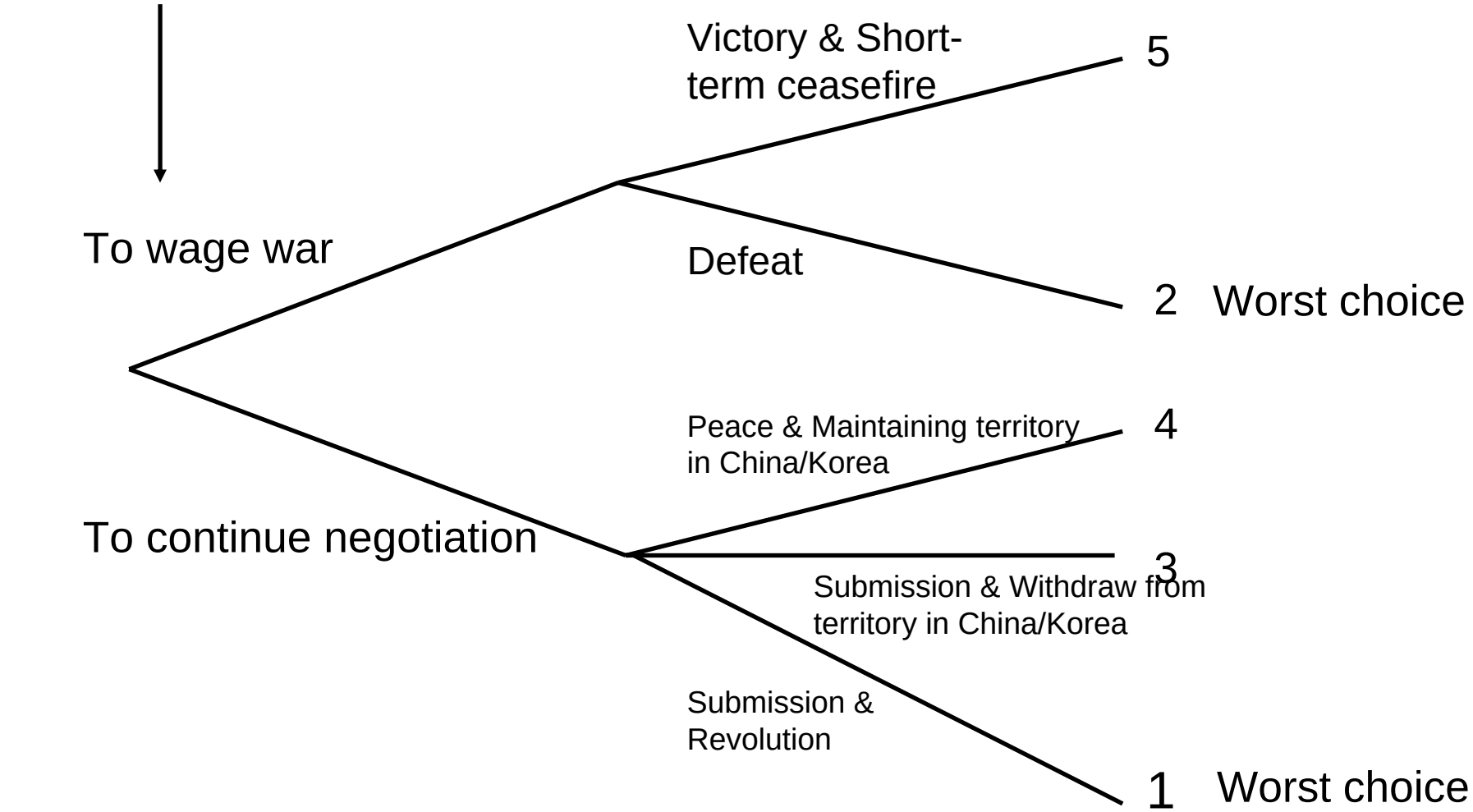


Various Questions

- Deterministic world is rare in reality.
- Probability is assigned accurately in few cases.
- Furthermore…
- Decision makers may not achieve full coverage of all possible choices.
- They may not be able to cover all possible outcomes for one of such choices.

The Case of the Attack on Pearl Harbor may be different… (with Probability Information)

Which one is a rational choice?



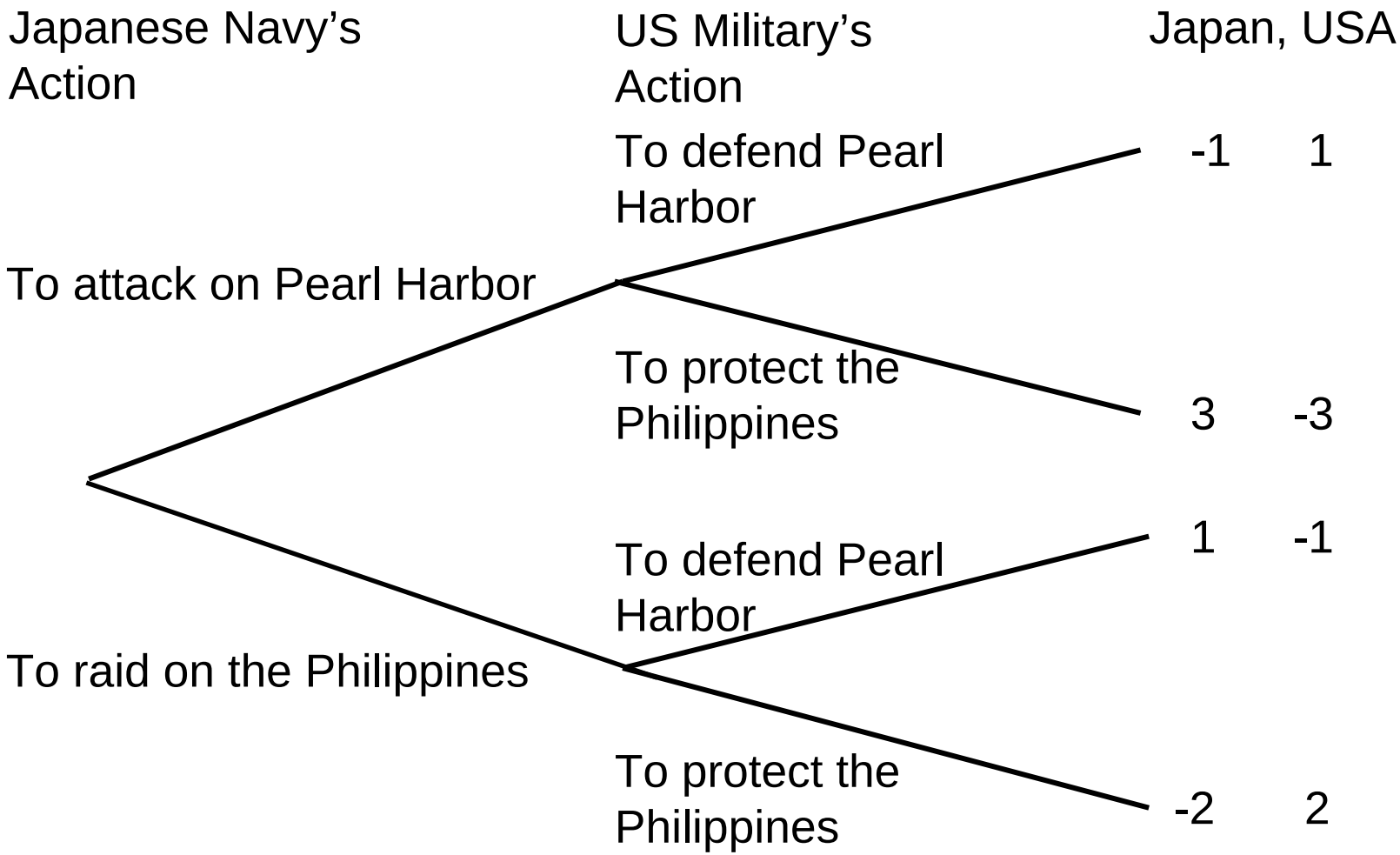
What does the interrelation bring?

- What will happen when several agents inter-react based on rational decision-making patterns?
- ->-> Game Theory

Game Theory

- Game theory situations:
  - A set of players involved
  - A player takes counterpart's possible moves into account before choosing his/her action.
  - The combination of actions chosen by oneself and others leads to one outcome.

Strategy at the Launch of the War of the Pacific



A matrix for the previous case example:

Japan's Choice \ USA's Choice	To defend Pearl Harbor	To protect the Philippines
To defend Pearl Harbor	-1, 1	3, -3
To protect the Philippines	1, -1	-2, 2

Zero Sum Game

- In zero-sum games, the total benefit to oneself and the other players adds up to zero.
- A gain for oneself corresponds to a loss for the others. A benefit for the others is a loss for oneself.
- Some outcomes have net results at an equilibrium, but others may not.

Japan's Transportation of Base from Rabaul to Lae (Battle of Bismarck Sea)

Japan's Choice / USA's Choice	To take a north route (cloudy)	To take a south route (sunny)
To reconnoiter the north	2 -2	2 -2
To reconnoiter the south	1 -1	3 -3

Nozomu Matsubara (2001). *Game toshite no Syakai Senryaku*: Social Game Strategies, Maruzen Co., pp.40-44

Paper-Scissors-Rock Game

	Rock	Scissors	Paper
Rock	0	1	-1
Scissors	-1	0	1
Paper	1	-1	0

Zero Sum Game

- In a game where there is no equilibrium, players can find the best strategy provided probability information is available (mixed strategies）.
- Few political situations are zero-sum in reality.

Non-Zero Sum Game

- The total benefit to oneself and to others does not add up to zero.
- The total benefit will be a net plus or minus.

What would you do if your car stalled due to an engine failure along a wavy, steep road?

A \ B	Cooperate	Oppose
Cooperate	5 5	0 1
Oppose	1 0	-5 -5

You promised to see someone at "*Todai Komaba Mae*" (University of Tokyo *Komaba* Campus Station).

	Kichijoji Ticket Gate	Platform	*Shibuya* Ticket Gate
Kichijoji Ticket Gate	1 1	0 0	0 0
Platform	0 0	1 1	0 0
Shibuya Ticket Gate	0 0	0 0	1 1

How are you supposed to stand on an escalator?

A \ B	On the right side	On the left side
On the right side	1 1	0 0
On the left side	0 0	1 1

What should you do?

- When you plan to see someone…
  - You can have a cell phone.
  - You can look for a distinctive sign or landmark.
- When you stand on an escalator…
  - Someone can give directions. (“Let’s all stand on the right side.”)
  - You can remember and follow a pattern which has happened to work well before.

Nash’s Equilibrium Theorem

- John Nash (1928-), the 1994 Nobel Prize laureate in Economics
- When no one takes any further action, one’s arbitrary alternatives or a change of strategy will not create a gain.
- When the payoff function reaches (1 1), it is referred to Nash’s equilibrium, in which players will have no incentive to move away from this situation. If everyone stands on the right side, you stand on the right. If you want to walk, you do so on the left side.

Negotiation Game

- Types of negotiation games:
  - Frequency allocation
  - Language?
  - Currency?
- Do governments have an essential role to play in negotiation games?
- Players' standpoint affects the outcome of the game.
  - What would you do to prevent a civil disturbance? (To prevent those involved from winning in a negotiation game.)
- The outcome of the negotiation can be unfair.

Dating Game

Girlfriend / Boyfriend	To go to a baseball game	To go to a music concert
To go to a baseball game	2 3	0 0
To go to a music concert	0 0	3 2

Minimax will not be achieved.
To compare the best options does not work.
This game, however, yields a Nash's equilibrium.

Pareto Principle (Pareto Optimality)

- V. F. D. Pareto (1848-1923)
- To evaluate benefits on the whole, all individual conditions should be considered.
- Pareto Optimality = ”One can make no further improvement without making any other individual worse."
- In the case where only (3 2), (2 3) and (0 0) are available, both (3 2) and (2 3) are Pareto efficient.

In negotiation games,

- In a game where cooperation is explicitly preferred, Pareto optimality is rationally achieved. The outcome is at Nash’s equilibrium point, in which a government or a similar form of authority is not required.
- Pareto efficiency is not attained with no further signals given in negotiation games. If Pareto efficiency is achieved, Nash’s equilibrium is yielded in the resulting situation.
- Is there a specific condition, which may inhibit Pareto improvement?

Rousseau's Parable of Deer Hunting

If a deer was to be taken, every one saw that, in order to succeed, he must abide faithfully by his post: but if a hare happened to come within the reach of any one of them, it is not to be doubted that he pursued it without scruple, and, having seized his prey, cared very little, if by so doing he caused his companions to miss theirs. (Part II)

Jean-Jacques Rousseau [tr. G. D. H. Cole, 1754]

Discourse on the Origin of Inequality

Available at http://www.constitution.org/jjr/ineq.htm

Deer Hunting Game

A \ B	To abide faithfully by his post	To seize his prey (a rabbit)
To abide faithfully by his post	3, 3	0, 2
To seize his prey (a rabbit)	2, 0	1, 1

In the end, the man captured a rabbit instead of a deer. What would be the best solution for both?

Lessens learned from the deer hunting game

- Even when both parties would obviously have gains, players may accept the second best option to minimize the maximum loss (or minimax). Therefore, the outcomes that are Pareto efficient are avoided.
- However, Pareto optimality can be attained with a certain signal or enforced action. (Nash's equilibrium)
- In some cases, situations are more mysterious.

Prisoner’s Dilemma

- Two suspects will make a choice, who are arrested by the police as conspirators.
- They are separately being kept in a solitary cell.
- They can choose to confess or remain silent.
- If both decide to confess, both will need to serve five years.
- If both decide to remain silent, both will serve two years for a minor crime.
- If one chooses to confess and the other keeps silent, he will be released and the other will serve ten years.
- If one keeps silent and the other betrays, he will serve ten years while the other will be released.
- What would they do?

Prisoner's Dilemma

Prisoner B / Prisoner A	To keep silent	To confess
To keep silent	-2 -2	0 -10
To confess	-10 0	-5 -5

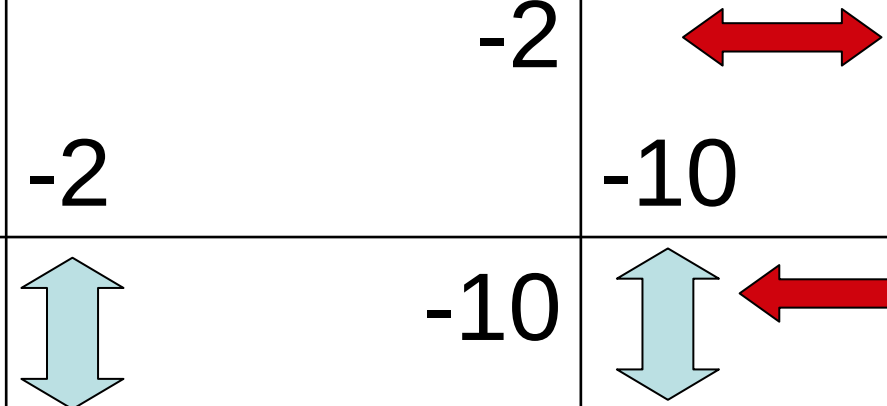
According to the Minimax principle…

Prisoner B / Prisoner A	To keep silent	To confess
To keep silent	-2 -2	0 -10
To confess	-10 0	-5 -5

Both prisoners decide to confess, which is the second best situation.

Even when the Minimax principle is not applied…

Prisoner A \ Prisoner B	To keep silent	To confess
To keep silent	-2 -2	0 -10
To confess	-10 0	-5 -5



The option of confession will yield a better result regardless of the other's choice. (A dominant strategy exists.)

The dilemma faced in the prisoner's dilemma

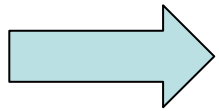
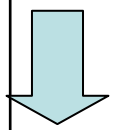
- When all parties make decisions with rationality stricter than Minimax, the outcomes will not be preferable for them.
- In this type of games, players are always subject to temptation to betray their counterpart in each play.
- In comparison to the deer hunting game…

They worked together a few times and achieved a good outcome, then…

A \ B	To abide faithfully by his post	To seize his prey (a rabbit)
To abide faithfully by his post	3 3	? 0 2
To seize his prey (a rabbit)	? 2	0 1 1

Actions based on short-term perspectives can be abandoned.

How about in Prisoner's dilemma?

Prisoner B / Prisoner A	To keep silent	To confess
To keep silent	-2 -2	0 ?  -10
To confess	 ? 0	-10 -5 -5

The payoff is always better when a prisoner unilaterally betrays the counterpart! Pareto optimality does not equal to Nash's equilibrium.

Deep dilemma in Prisoner's dilemma

- The payoff function might yield gains for both parties by chance. However, even in such a case, players may choose to betray in the next game. Past experience does not bring future benefits?
- In case players can discuss in advance (for instance, they have a cell phone), they are still tempted to betray.
- Does Prisoner's dilemma rarely occur?

Dilemma in Security

A \ B	Arms Control	Military Expansion
Arms Control	-2 -2	0 -10
Military Expansion	-10 0	-5 -5

Versions of the Prisoner's Dilemma

- Dilemma in security issues
- Tragedy of the commons
- Pension
- Supply of public goods

- Prisoner's dilemma is not always evil.
  - The case of prisoners; carte formation

Chicken Game

- A version of game which people play to demonstrate that they are not a coward (chicken).

- Two drivers on motorcycle both head for a single lane from opposite directions. The motorcycles run at the top speed. The first to put on the brakes, a chicken, will lose.
- Drivers on motorcycle head for a cliff. The motorcycles run side by side at the top speed. The first to put on the brakes, a chicken, will lose.

Chicken

A \ B	Brakes	Accelerator
Brake	0 0	5 -5
Accelerator	-5 5	-10 -10

According to the Minimax principle…

A \ B	Brakes	Accelerator
Brake	0 0	5 -5
Accelerator	-5 5	-10 -10

It is natural that both players put on the brakes.

What would happen if they play the game multiple times? What if a player pretends to be out of his/her mind?

A \ B	Brake	Accelerator
Brake	0 0	5 -5
Accelerator	-5 5	-10 -10

Accelerator for oneself and brake for the other?

Another version of Chicken Game?

USA / North Korea	Assistance	Hard-line Measures
Abandonment of Nuclear Arms	0 0	5 -5
Nuclear Arms Development	-5 5	-10 -10

Does a player receive a gain by pretending to be a crazy?

Applications

- To understand the current situation: this type of methodology gives us a clue to identify the nature of particular issues.
- In a game similar in one form or another, it is easy to clarify if the resolution of issues can be anticipated or not.
- In negotiation, dating, and chicken games, it almost suggests that a player making the first move will win.
- In the deer hunting game, players need discussion and agreement.
- In Prisoner’s dilemma, it is hard to find a solution.

Formation of Institutions and Order (1)

- Which type of institution is associated with which type of question (game)?
- Does the negotiation game require an exogenous institution?
- The formation of institutions naturally occurs in some cases.
  - What if pertaining issues become complicated, for instance, in the case of frequency allocation?
- The agreement on rules should be useful.
- For offenders, countermeasures are not really necessary.
- How about the dating game? How to deal with discontents?

Formation of Institutions and Order (2)

- In the deer hunting game, having communication and agreement in advance are favorable. Past experience in which players receive gains through mutual cooperation is also useful. The preparation of punitive provisions are not necessarily required.
- In Prisoner's dilemma, communication and agreement do not create benefits in and of themselves. In a society where long-term interactions are the norm, it is suggested that in some cases players naturally come to terms with each other through cooperation. Otherwise, clear punitive provisions must be set. (The legitimacy of government?)

Formation of Institutions and Order (3)

- The best option to take in the chicken game is not to play in the first place.
- The complete set of rules including punitive provisions must be established to prevent it. (The necessity of government)
- In a world system in which no government exists, the prisoner's dilemma and the chicken game are hard ones to play, but there are many negotiation games.