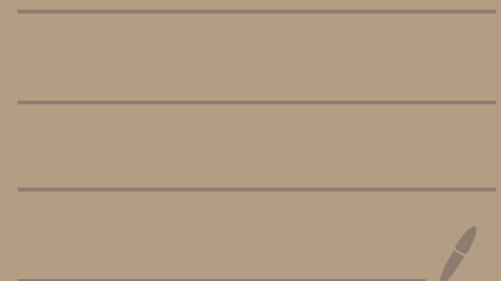


# Game Theory (CS 4187)

Lecture 34 (02/12/2024)



# Computing Pure Strategy

## Sequential Equilibrium :

### Approach 2

➤ Check the following two part YouTube video:

Part 1: <https://youtu.be/TMzRa272lPo>

Part 2: <https://youtu.be/WkrnBYpz-oU>

It is recommended that students who attended the lecture should also watch the videos (at least part 1). I **streamlined** the approach.

Overall Idea:

“Candidate” means it may not be the Solution

1) Verifying if a Candidate solution solves a problem or NOT  
is simpler than actually solving the problem.

2) So, if the number of candidate solutions are small, we  
can actually solve the problem by iterating over all candidate  
solutions and verifying if it solves the problem.

- This approach **MAY** be faster compared to actually solving the problem (if executed correctly).
- We stop immediately when we find a solution. We don't check the remaining candidate solution.

## Overall Idea:

?

3) In our case, the candidate solutions are all the allowed pure strategies profiles of EFG<sub>2</sub>. We iterate through all the allowed pure strategy<sub>1</sub> and check if it is a pure strategy sequential equilibrium (PSSE).

- This approach DOES NOT WORK for mixed strategy sequential equilibrium because there are infinitely many mixed strategy profiles.

## Overall Idea:

4) How to check if a pure strategy profile of an EFG is a PSSE?

Answer: The pure strategy profile must satisfy BOTH the following conditions in ALL the information set of the EFG:

- Sequential rationality.
- Consistent belief.

## Steps to find PSSE:

- 1) Select a pure strategy profile of the EFG from the set of allowed pure strategy profile.
- 2) The Selected pure strategy profile will induce probability for every decision nodes of all the information sets. This probabilities must be calculated using Baye's Rule. This step ensures the *consistent belief* criteria.
  - There may be information sets for which ALL the decision nodes may have ZERO probability of reaching for the chosen pure strategy profile. In such cases,

## Steps to find PSSE:

we use **trembling-hand** concept to calculate probability of the decision nodes of the information set. The probability of the decision nodes **MAY BE** a range of values (this is always not the case).

3) Iterate through **ALL** the information sets of the EFG. Let the current information set be I.

a) Check if the chosen pure strategy is **sequentially rational** by comparing the **expected** utility of the chosen pure strategy with respect to **expected** utility of other pure strategy available in information set I.  
→ expectation w.r.t. to the prob. calculated in step 2).

## Steps to find PSSE:

b) If the chosen pure strategy is NOT sequentially rational:

Jump to step 1 and select another allowed pure strategy profile.

If the chosen pure strategy satisfies sequential rationality in ALL the information sets, then we have found a PSSE. So, stop

the search; don't go to step 1.

## Steps to find PSSE:

To be noted:

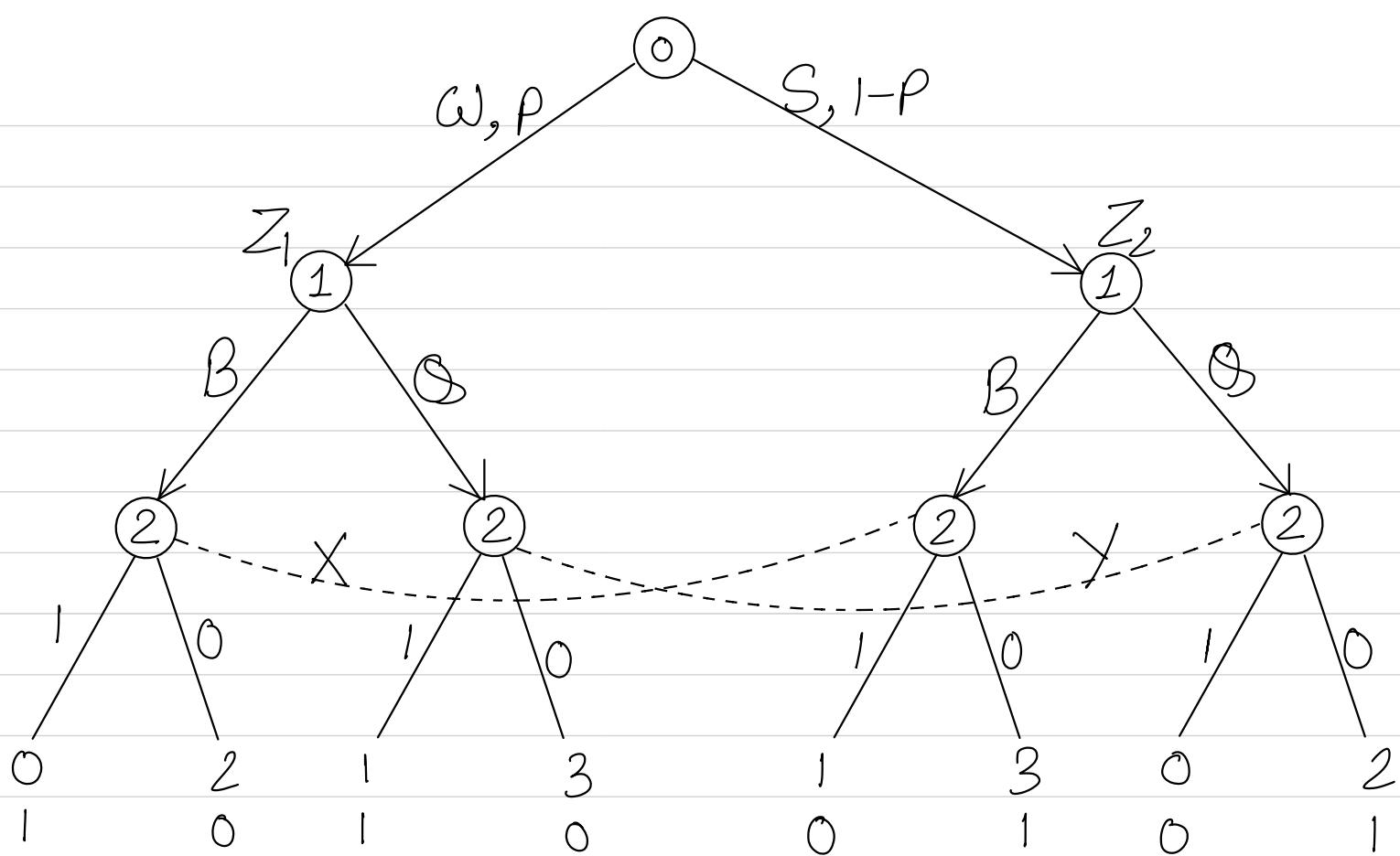
- > In Step 3), it is suggested that we check the singleton information sets first. This is because it is easier to compute expected utility for singleton information sets. If the chosen strategy profile fails sequential rationality in these singleton information sets, we can quickly rule them out and jump back to step 1.

## Steps to find PSSE:

To be noted:

- > If a range of probability is associated with an information set,  
then the chosen pure strategy profile is sequentially rational  
in this information set, if there is atleast one probability in  
this range of probability for which sequential rationality holds.

→ Trembling-hand case



Is there a PSSE where in info. set  $Z_2$  the player plays  $B$  and in info. set  $Y$  the player plays 1?