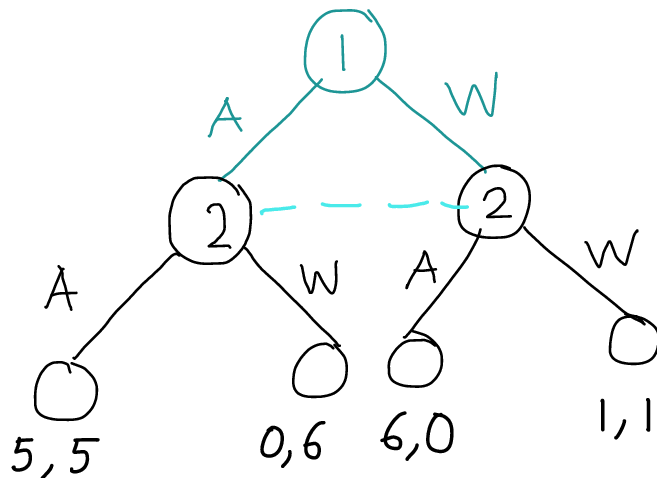


Games with imperfect information

- Games discussed so far (EFGs) are of perfect information
- Every player has perfect knowledge about all the developments in the game until that round
- Limited practical use - several games have states that are unknown to certain agents - e.g., card games
- not possible to represent simultaneous move games using EFGs

	Agri	War
Agri	5, 5	0, 6
War	6, 0	1, 1

Neighboring Kingdom's Dilemma



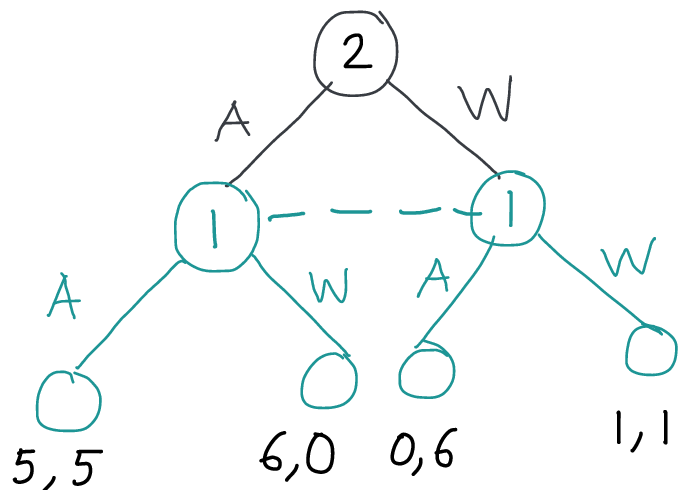
Imperfect information EFGs, indistinguishable nodes are connected via a dotted line

Player 2 does NOT know which node/history the game is in

- these indistinguishable histories form an **information set** for player 2.
- more general representation than PIEFGs, since information sets can be singleton

- IIEFGs are not unique for a given simultaneous move game

- The kingdom's dilemma can also be represented this way with (non singleton) information set for 1.



Imperfect Information Extensive Form Games

An IIEFG is a tuple $\langle N, A, \mathcal{H}, \chi, P, (u_i)_{i \in N}, (I_i)_{i \in N} \rangle$

where $\langle N, A, \mathcal{H}, \chi, P, (u_i)_{i \in N} \rangle$ is a PIEFG

for every $i \in N$, $I_i := (I_i^1, I_i^2, \dots, I_i^{k(i)})$ is a partition of

$\{h \in \mathcal{H} \setminus Z : P(h) = i\}$ with the property that $\chi(h) = \chi(h')$ and

$P(h) = P(h') = i$, whenever $\exists j$ s.t. $h, h' \in I_i^j$

I_i^j 's are called the information sets of player i , I_i is the collection of information sets of i .

At an information set, player and her available actions are same

That player is uncertain about which history in the information set is reached

Some differences with the PIEFG

- Since actions at an information set are identical, χ can be defined over I_i^j 's, i.e., $\chi(h) = \chi(h') = \chi(I_i^j)$, $\forall h, h' \in I_i^j$.

- Strategies can also be defined over information sets

Strategy set of player $i \in N$ is defined as the cartesian product of the actions available to i at her information sets, i.e.,

$$S_i = \prod_{\tilde{I} \in I_i} \chi(\tilde{I}) = \prod_{j=1}^{k(i)} \chi(I_i^j)$$

With IIEFGs, NFGs can be represented using EFGs, although not very succinct. Representations are appropriate for certain kind of games.

However, IIEFG is a richer representation than both NFG and PIEFG.