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- Agents that reason and act autonomously can't be modeled as nature.

# Multi-agent framework

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- Each agent's value depends on the outcome.



# Normal Form of a Game

The **strategic form of a game** or **normal-form game**:

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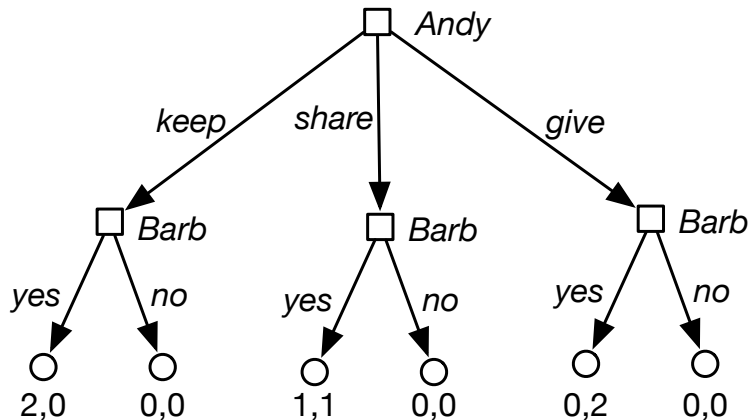
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- a utility function  $utility(\sigma, i)$  for action profile  $\sigma$  and agent  $i \in I$ , gives the expected utility for agent  $i$  when all agents follow action profile  $\sigma$ .

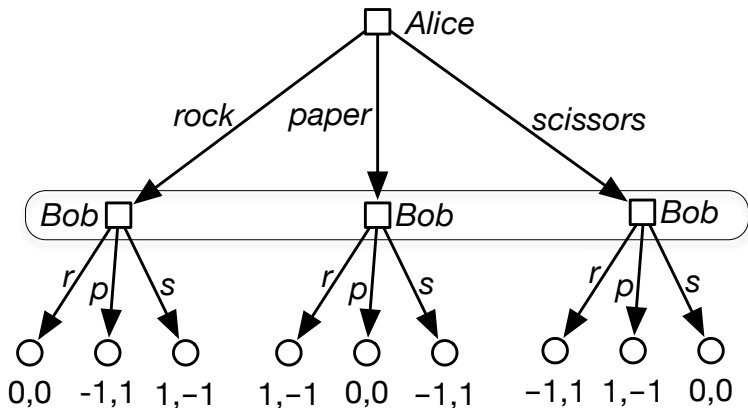
# Rock-Paper-Scissors

		Bob		
		<i>rock</i>	<i>paper</i>	<i>scissors</i>
Alice	<i>rock</i>	0, 0	-1, 1	1, -1
	<i>paper</i>	1, -1	0, 0	-1, 1
	<i>scissors</i>	-1, 1	1, -1	0, 0

# Extensive Form of a Game

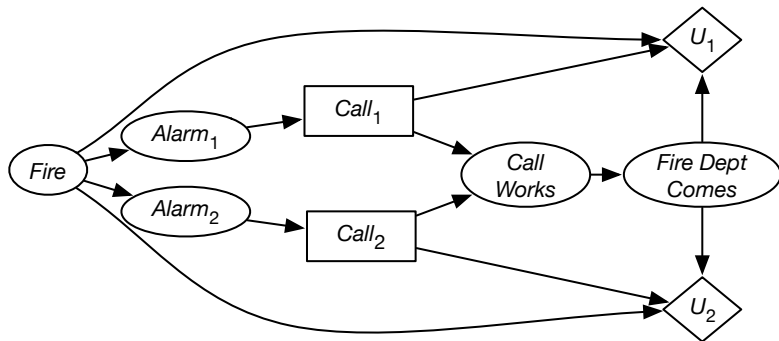


# Extensive Form of an imperfect-information Game



Bob cannot distinguish the nodes in an **information set**.

# Multiagent Decision Networks

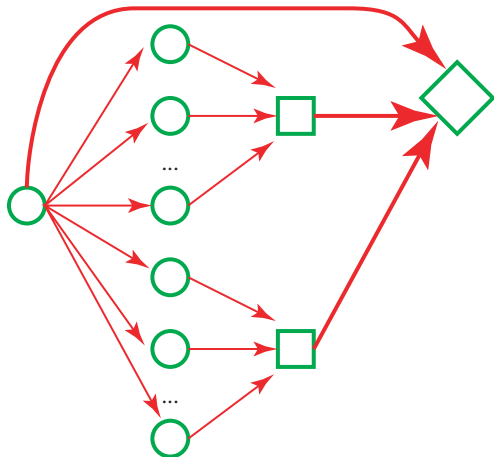


Value node for each agent.

Each decision node is owned by an agent.

The parents of each decision node specify what that agent will observe when making the decision

# Multiple Agents, shared value





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- **Why?** Because dynamic programming doesn't work:
  - ▶ If a decision node has  $n$  binary parents, dynamic programming lets us solve  $2^n$  decision problems.
  - ▶ This is much better than policies (where  $d$  is the number of decision alternatives).
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