Advancing STEAM

Analyzing Collaborative Negotiation of Joint Goals in STEAM

A Research Presentation by Andrew Nuxoll

01 June 2002

What is STEAM?

- ## A Shell for TEAMwork
  - a framework for cooperative, multi-agent systems
  - a Soar7 Implementation of Joint Intentions
- ## Accomplishments:
  - 3rd place finish in RoboCup '97
 - Real-world, distributed combat simulator (helicopters)

Joint Intentions

- A model for teamwork
  - Extends the Belief-Desire-Intention (BDI) model
- Joint Persistent Goal (JPG)
  - Each team member *believes* that p is false
  - Each team member persistently *desires* that p be true
- Joint Intention
  - A team has a JPG to establish p
  - Each team member believes the team is performing the action throughout
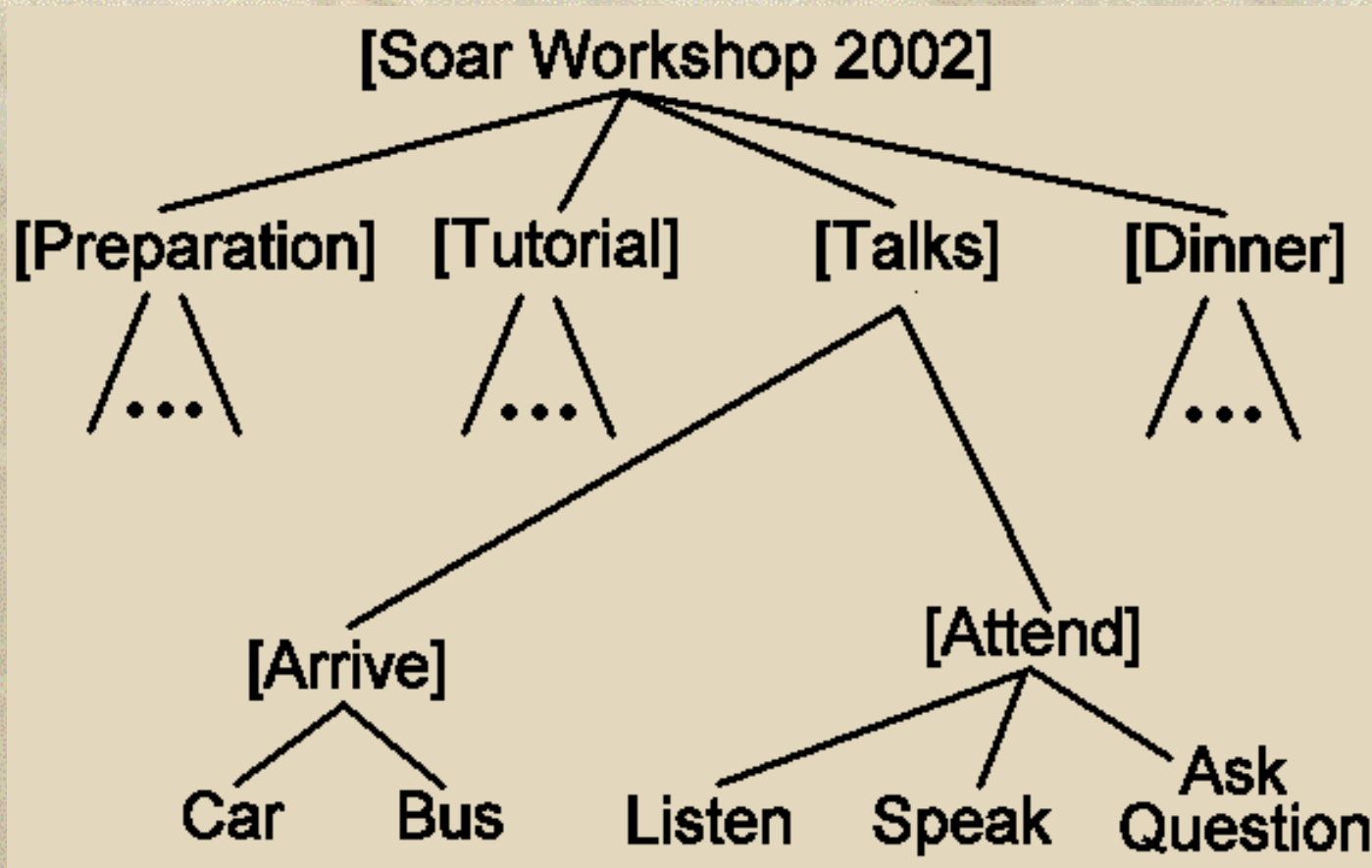
Joint Intention: An Example

- Soar Workshop 2002 is a Joint Intention:
  - Each attendee believes that there has not been a Soar Workshop in 2002
  - Each attendee desires that Soar Workshop 2002 take place
  - Each attendee currently believes that we are jointly having a Soar Workshop

} JPG

} Joint Intention
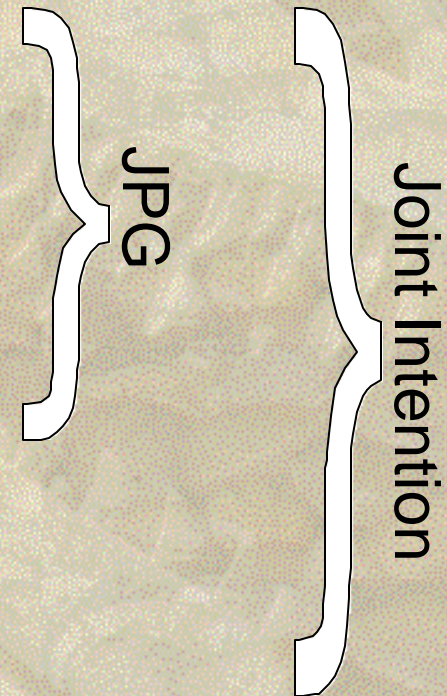
STEAM Goal Hierarchy

- Two types of operators: individual, team

Using STEAM

- Top State
  - Team definitions including members and roles
  - Communication channels
- Operators
  - Conditions for: achieved, unachievable, irrelevant
  - Cost of miscoordination

Advancing STEAM:
Adding Collaboration

- Original architecture: Dictatorial
  - Next action is selected by a "leader" agent.
- Recent Research: Adding collaboration
  - CONSA – COllaborative Negotiation System based on Argumentation
  - Selective argumentation for contestable decisions
  - Formal argumentation structure (Toulmin)

My Research

- When is collaboration a detriment?
- Variables:
  - Number of agents*
  - Performance requirements*
  - Number of options available at each decision: fixed
  - Team success measure: weakest link
- Goal: Meaningful measure based upon a formal definition of collaborative domains
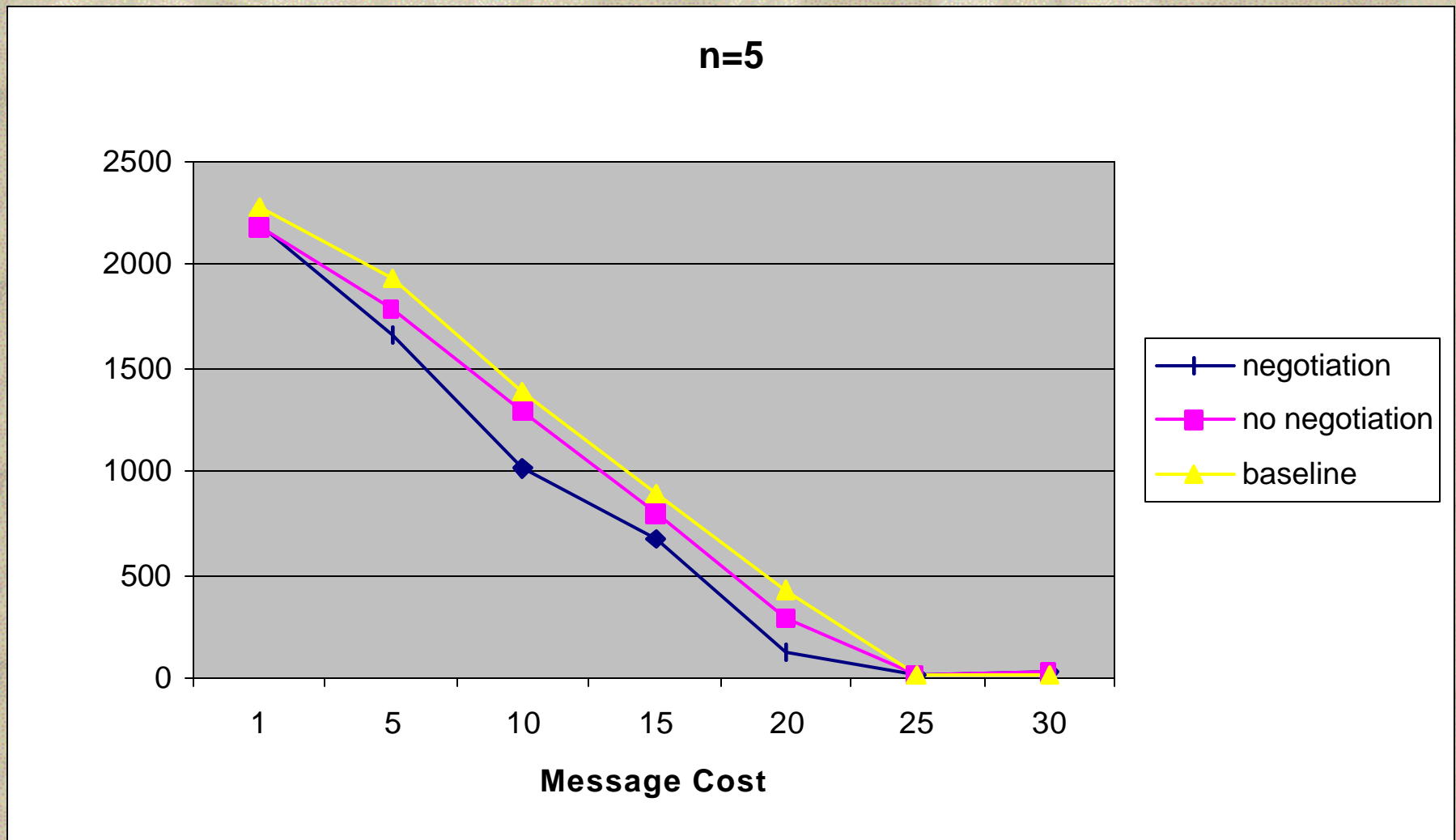
Strategies

- ## No Negotiation
  - Leader chooses the task

- ## Negotiation
  - Agents _may_ tell leader what their favorite task is
  - Cost of communication
  - Leader picks best task for weakest known agent

- ## Baseline
  - Message cost is simulated zero.
  - Leader selects the best task for the weakest agent.

Typical Results

Nuggets

Coal

- Good experience
- Promising results

- Acquiring believably domain unspecific results: lots of variables
- Performance measurement is difficult

11