Large-Scale,
Heterogeneous Teams

For CS 597
Nathan Schurr
schurr@usc.edu
(on behalf of Prof. Milind Tambe)
Computer Science Dept
University of Southern California
Research Goal

- **Research goal: Large-scale heterogeneous teams**
  - **Types of entities**: Agents, people, robots, resources, sensors,..
  - **Scale**: 1000s or more
  - **Domains**: Highly uncertain, real-time, dynamic
  - **Activities**: Form teams, persist for long durations, coordinate, adapt…

- **Some applications**:
  - Large-scale disaster rescue
  - Military crisis response
  - Large area security
Multiagent research:

- **Known knowns**: Hard problems (NEXP-complete), solve in “real-time”
  - Paradigm shift (e.g., BDI & POMDP hybrids)
  - New heuristic algorithms, abstraction & approximations
- **Known unknowns**: Self-interested vs team goals,…
- **Unknown unknowns**: “Team spirit”

Human interface issues:

- Natural dialogue with agents, emotions and personality,…
- Human culture/norms, e.g., agents may need to lie

Hardware:

- Significantly faster hardware to run complex algorithms
- Handheld devices, interfaces; reliable communication, sensors,…
## Known Knowns: Research Issues

**Role allocation/performance**

<table>
<thead>
<tr>
<th></th>
<th>Allocation</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent-agent</td>
<td>DCOP POMDPs</td>
<td>Adaptation</td>
</tr>
<tr>
<td>Agent-human</td>
<td><strong>Adjustable autonomy, privacy…</strong></td>
<td>Training camps?</td>
</tr>
</tbody>
</table>

**Communication/Monitoring**

<table>
<thead>
<tr>
<th></th>
<th>Explicit</th>
<th>Implicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent-agent</td>
<td>BDI theory POMDPs</td>
<td>Plan recog</td>
</tr>
<tr>
<td>Agent-human</td>
<td>Multi-modal</td>
<td></td>
</tr>
</tbody>
</table>

**Infrastructure/models to rapidly build large-scale heterogeneous teams of agents, humans, robots**

**Unified? Theory & practice**
Metrics

Task & domain complexity

High

Medium

Low

Small-scale homogeneous

Small-scale heterogeneous

Large-scale heterogeneous

Team Scale & Complexity
CALO (Cognitive Agent that Learns and Organizes)

- Joint project between USC Teamcore group, SRI, many others.
- We are working on one part of a much larger system.
How to schedule a meeting while…

- Respecting participants’ preferences
- Maintaining their privacy
- Discouraging selfish manipulation of the system
- Considering other real-world issues (costs, location, status, etc.)
http://teamcore.usc.edu

Milind Tambe
tambe@usc.edu
In many domains, agents collaborate with other agents, humans

Applications:

- Agents facilitated human organizations
- Robot-agent-person teams for disaster rescue, monitoring