
DARPA
Charging Ahead into the Next Millennium
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ISO

Control of Agent Based Systems

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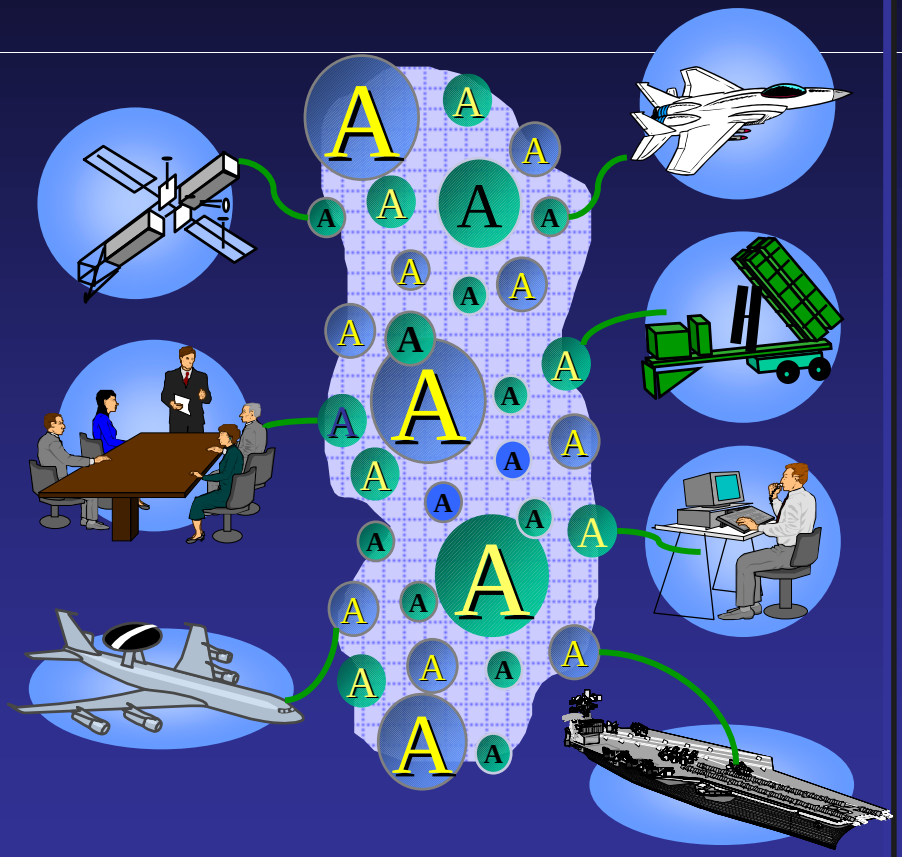
Agents and the Military Need

ISO

- Assignment problems ⟷ Auction mechanisms
- Bursty bandwidth use ⟷ Mobile code
- Open source information ⟷ Info agents
- Interoperability ⟷ brokering
- And many more

What is an Agent?

- An agent is a software component or system that is:
  - Communicative
  - Autonomous
  - Capable
  - Adaptive



Agent Evolution

A critical zone

Where we are → *The "desire"*

Web Agent	Information Agent	"Intelligent" Agent

Communicative

Autonomous

Capable

Adaptive

Gather Nuts

Fetch, point, carry, etc.

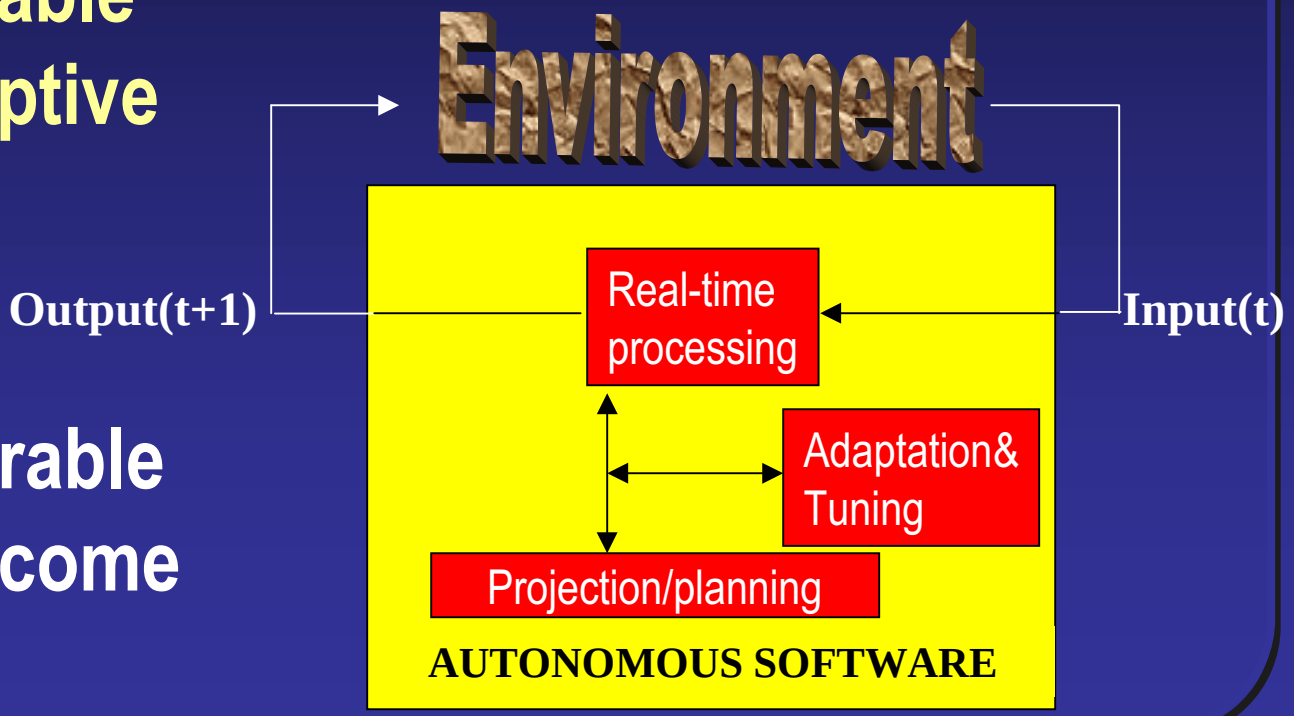
Make it so

Information Agent Challenge

Complexity

- Communicative
- Autonomous
- Capable
- Adaptive

These desirable properties come at a cost...



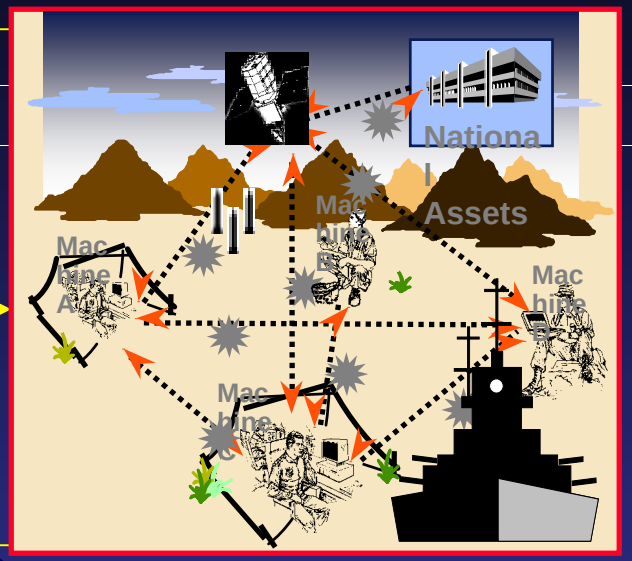
The "N-agent" Problem

CoABS Focus

- Examine these technologies in the context of an evolving military information management vision
  - AFSAB Information Management, AF C2 Conops
  - Army after next
  - Cooperative Engagement Capability
  - and numerous others

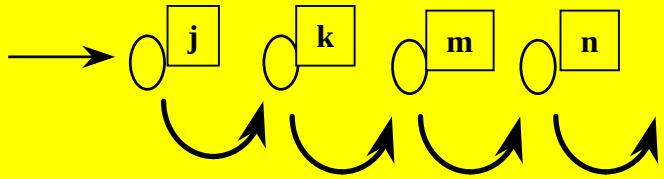
CoABS: Meeting the Challenge

- **Military TIEs stress *integration***
  - OOTW
  - Ballistic and Theatre Missile Defense
  - Coalition Force Interoperability



- **Scientific TIEs stress *scaling***
  - Negotiation Experiments
  - Mathematical Analyses
  - Control Scheme Comparison

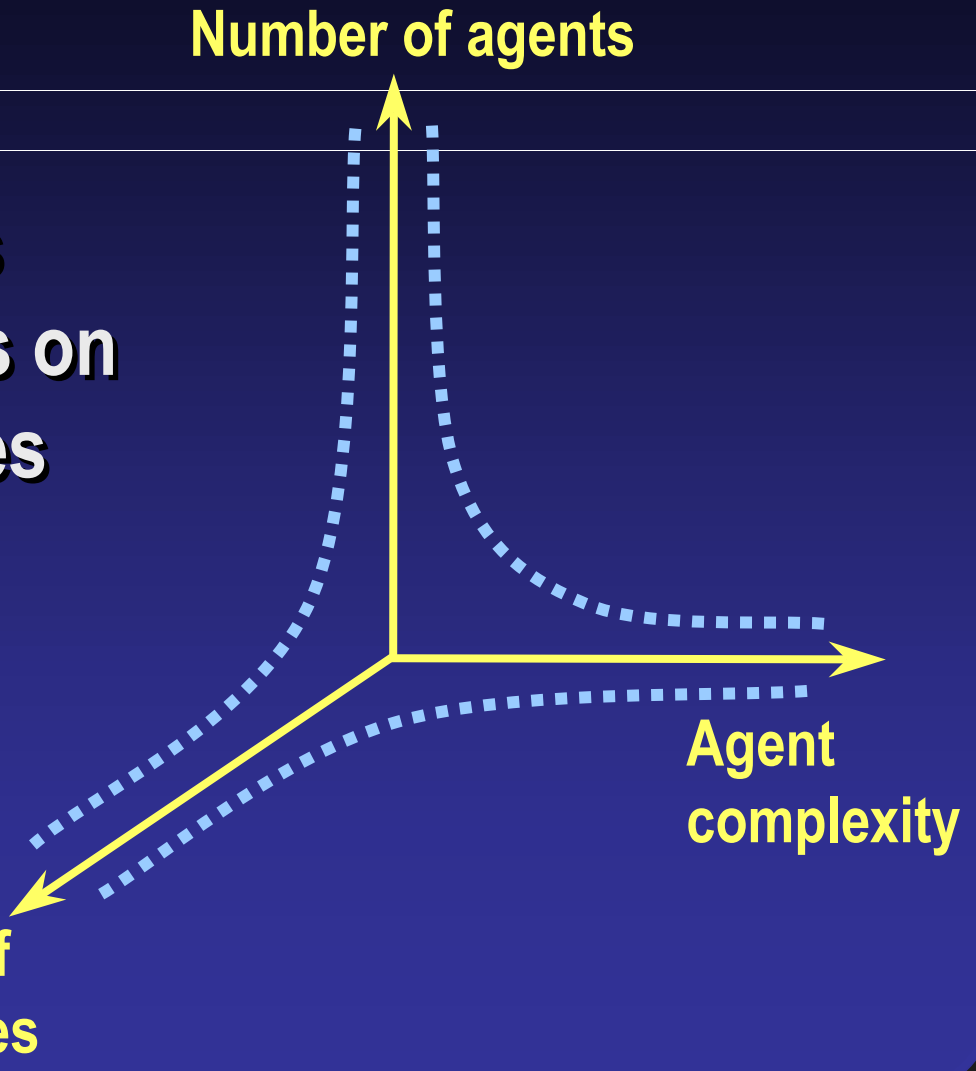
Site j "costs" c_j to visit and has probability p_j of success.
Visit sites until none left or successful.



Expected cost = $c_j + (1-p_j)c_k + (1-p_k)(1-p_j)c_m + \ldots$

Agent Scaling Experiments

Current experiments cluster near the axes on the orthogonal planes

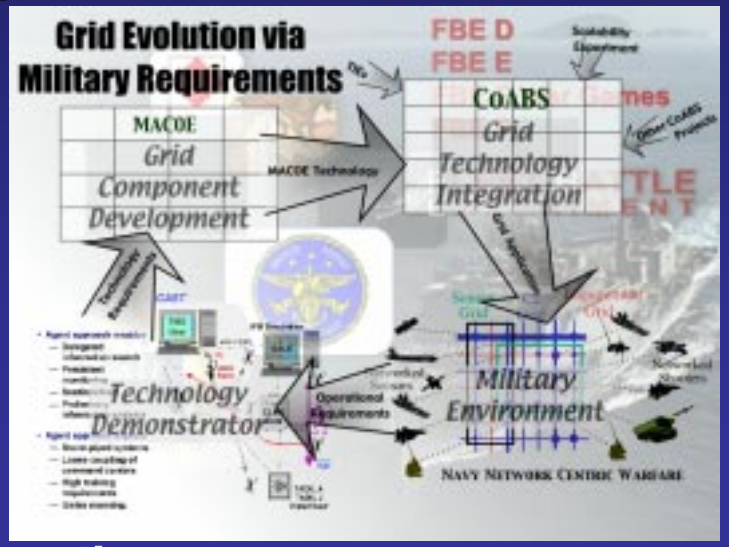


Agent Scaling Experiments

CoABS will show that we can get out into the middle of this space!

CoABS Agent Grid

- CoABS "Grid" provides a basis for tool development for DARPA and military computer programs
  - Legacy systems wrapping
    - Middleware approach
    - Service based
    - Logging/reporting tools included
  - New systems development
    - Tool refinement, testing, integration



Beyond CoABS: Agent Science

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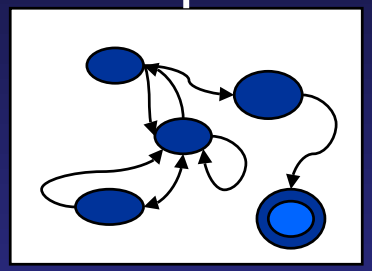
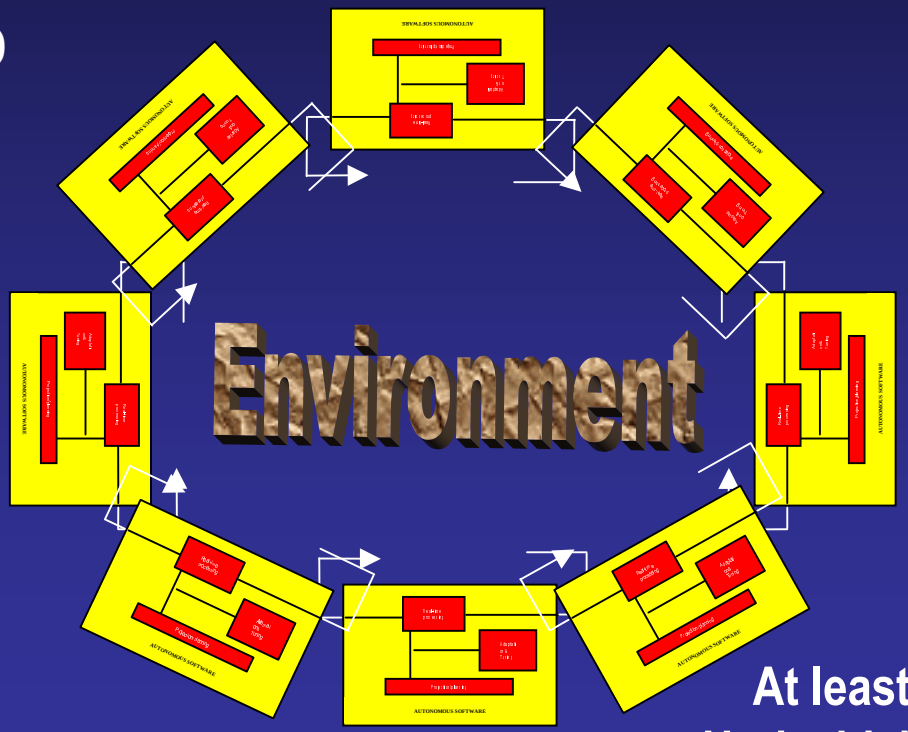


O(1)
O(logN)
…
O(2^n)

The Turing Machine

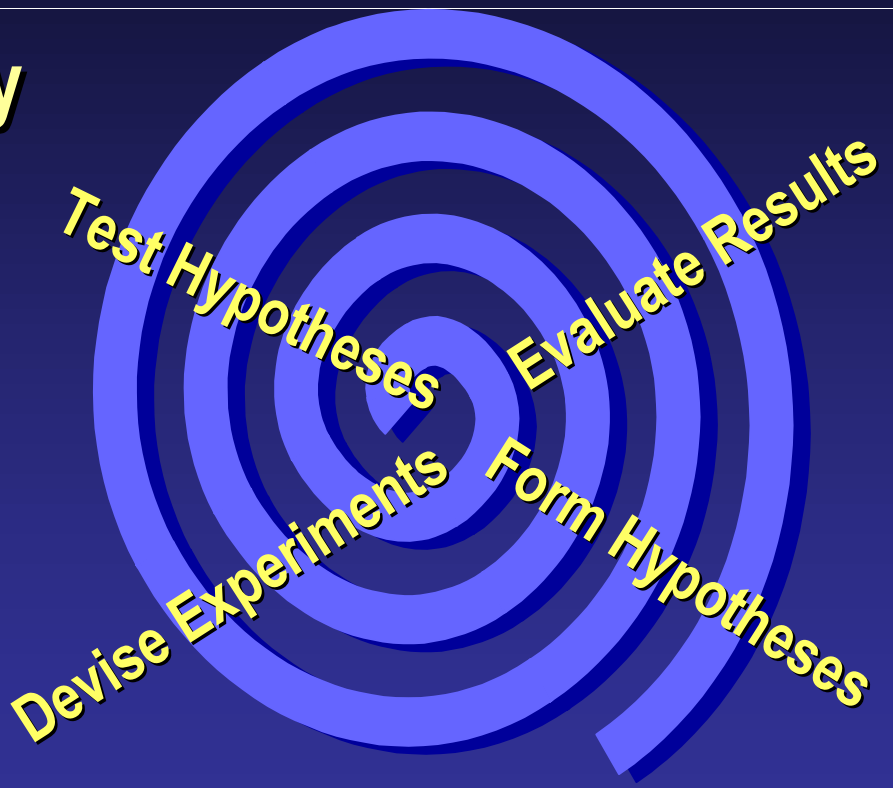
Cannot model agent-based systems!



At least Undecidable

The Science of Agency

- How do we apply scientific methodology to agent-based computing?
  - Bring the science of computing out of the 1950s
- 1999 Workshop
  - Leading computer scientists in the US and abroad being invited



Summary

ISO

- DARPA is exploring the use of agents for a wide range of military needs
  - CoABS focuses on critical challenges
    - interoperability of legacy systems
    - scaling of multi-agent systems
- DARPA is interested in helping the computer science community to explore the underlying theory of agent-based computing