- “Everything should be as simple as possible, but not simpler.” – Einstein
- Occam (of Razor fame – parsimony, economy, succinctness in logic/problem-solving)
  - “Entities should not be multiplied more than necessary”
  - “Of two competing theories or explanations, all other things being equal, the simpler one is to be preferred.”
- “All that is complex is not useful. All that is useful is simple.” – Mikhail Kalashnikov (of AK-47 fame)

Decision Making: Communication

2016-06-14

Questions

1. How can we describe decision making?
2. What do the algorithms we’ve seen share?
3. What are the dimensions we tend to assess?
4. FSMs/Btrees: _____ :: Planning : ______
5. For the 2nd blank, we need m______s.
6. When is reactive appropriate? Deliberative?
7. What is the ‘hot-potato’ passed around (KE)?
8. H_______ have helped in most approaches.
9. Which approach should you use?

DM: Communication. Why?

- Lens: Multi-agent system
  - Collection of collaborative agents
  - Communicate & cooperate
  - Retain autonomy
  - Need for negotiation / mutually acceptable agreements (cooperative problem solving)
- Reasoning decomposition: distributed expertise
  - Problems too large for single / centralized agent
  - Reactive agents rarely communicate / collaborate
  - Problem independence, partial result sharing
- Hope: Sum greater than parts

Distributed DM

1. Decompose the task
2. Allocate subtasks to “experts”
3. Await task accomplishment
4. Synthesize & Arbitrate results

Information sharing needed for most/all!

Communication Types

- Point to Point
  - Experts directly communicate w/eachother
  - Where have we seen this?
- Broadcast
  - Send information to group of experts
  - Talk about today.
- Mediated
  - Experts go through facilitator/arbitrator

Communication Mediums

- Firm software interfaces
- Databases
- Protocol layers (e.g.: TCP/IP + JSON)
- Hierarchies (hybrids)
- Pub/Sub services

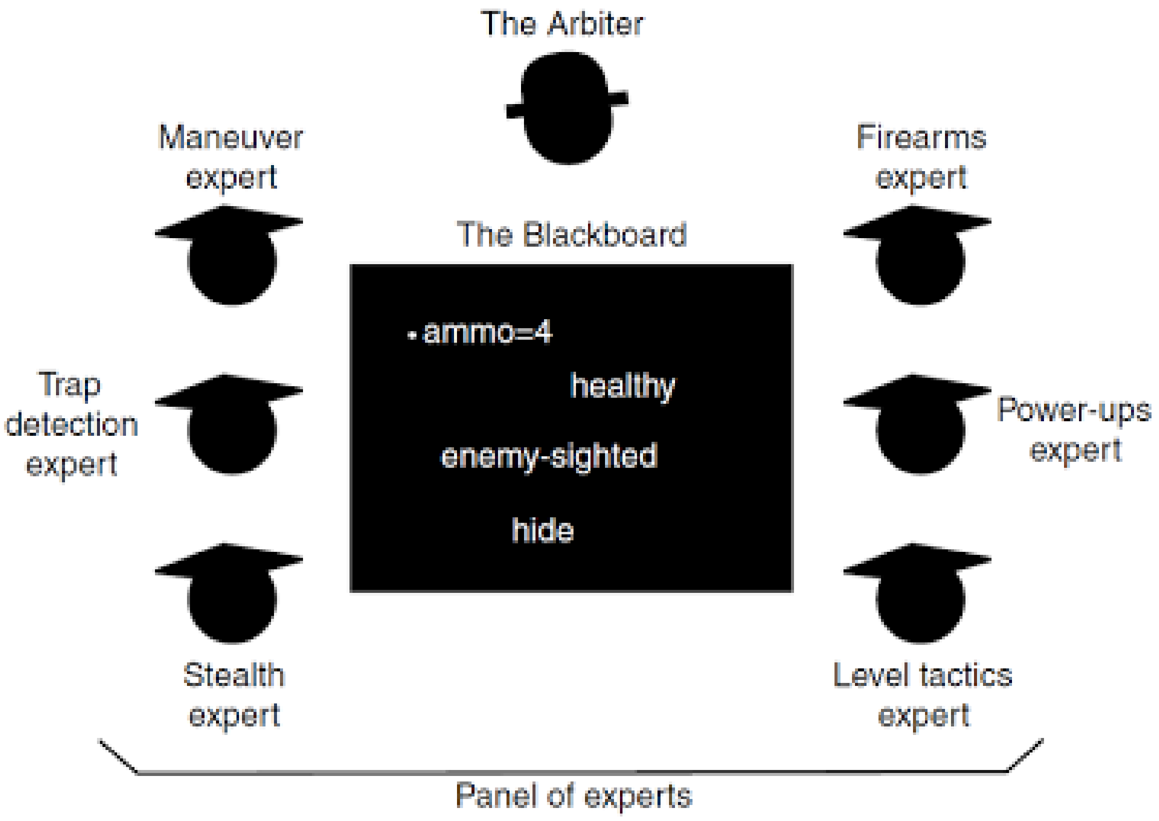
BLACKBOARD ARCHITECTURES

Blackboards

- Isn’t a decision making algorithm
- Architecture / coord. mechanism / pattern
- Problem: Multiple decision making systems (experts). How to communicate (share data)?

Basic BB Architecture

- 3 main parts:
  - – Experts
  - – BB
  - – Arbiter
- Other:
  - – Action history
  - – Scheduled Actions



Millington & Funge, Figure 5.54

Information on the BB

- Shared data
- Present task of each expert
- Current state of solution
- Intermediate results
- Next subproblems to be solved
- Requests for help
- Action scheduling

BB Data Format

- Often uses application specific organization
- Highly domain-dependent
  - 3D locations, maneuver (steering) info
  - FOL strings (flat, hierarchical)
  - Polymorphic data types
- Three typical features:
  - Value (e.g. 3)
  - Type (e.g. float)
  - Semantic Information (e.g. lives remaining)

BB Arbiter

- Advertises next problems to be solved
- Checks on progress of experts
- Assign pending problems
- Monitor change
  - Polling vs Observer patterns
  - Can notify experts of relevant changes

BB Uses

- Conflict detection
  - Task level
  - (incompatible) solution level
- Task sharing
- Result / information sharing
  - Includes both partial and complete results

Is a BB?

- RBS?
  - Experts: rules
  - BB: Facts DB
  - Arbiter: which rule(s) to fire
- FSMs?
  - Subset of RBS
  - Experts: transitions (rewrite state)
  - BB: current state + related info
  - Arbiter: which transition(s) to fire

Pros and Cons

- Pro:
  - Flexible, allowing for comm. + coop.; (*n* bb’s)
  - Independent of cooperation strategy
  - Does not restrict internal structure of agent
- Con
  - Management code
  - Complicated data structures
  - Centralized structure (single point of failure)
  - System bottleneck
- Have a bad rep among game+academic AI.
  But they’re used anyway, and “shall not be named”