ABS Notes

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1 Pervasive Trends In Computing

- Ubiquity - Cost of processing power decreasing
- Interconnection - System interaction
- Complicity - Elaboration of tasks carried out by computers
- Delegation - Giving control to a computer
- Human-orientation - Increase use of metaphors that better reflect human intuition

2 What Is an Agent?

An agent id anything that can perceive its environment(through its sensors) and act upon that environment(through its effectors)

3 Environment Classification

- Accessible vs Inaccessible
- Deterministic vs Non-deterministic
- Static vs Dynamic
- Episodic vs Non-episodic
- Discrete vs Continuous
- Open Environment

4 Abstract Agents

Run = sequence of interleaved environment states and actions $r : e_0 \rightarrow e_1 \rightarrow e_2 ... e_{u-1} \rightarrow e_u$ R = r,r',... the set of all possible runs

4.1 State Transformer Function

$\tau : R^{Ac} \rightarrow \varphi(E)\tau$maps each run ending with an agent action to the set of possible resulting states if $\tau(r) = \theta$ then the system will terminate

Agents are behavioural equivalent if R(Ag1,Env) = R(Ag2,Env).

5 Reactive Agents

Bases decisions only on current state. Every reactive agent can be mapped to an agent defined on runs(the reverse is not usually true).

Ag: E → Ac An environment state maps to an agent action.

6 Perception and Action

see: E: → Per action: Per* → Ac Where Per is a non-empty set of perceptions and actions defines decisions based on perceptions. Two perceptions are indistinguishable if see(e1) = see(e2)

7 State Based Agents

Think FSM with states: see: E → $Peraction : I \rightarrow Acnext : IxPer \rightarrow I$

8 Utilities

Utilites describe "quality" of a state through some numerical value u: E → R This makes the long-term view difficult to account for, can use runs instead

Using utilities we can make optimal agents, "An optimal agent is one that maximises expected utility" define P(r—Ag,Env) is the probability that a run occurs given an agent, Ag, and an environment, Env. So, Ag$_{opt}$ = $argmax\Sigma$ P(r— Ag,Env)u(r)

9 MetateM

Concurrent MetateM is based on direct execution of logical formulae. Concurrently executing agents communicate via message passing. Look up the tutorial with Snow White to get an Idea about this.

10 Practical Reasoning Agents

Reasoning towards actions (deciding what to do)

- Deliberation: deciding what to do

- Means-end reasoning: deciding how to do it

Combining these is the foundation of deliberative agency. Deliberation generates intentions, Means-end generates plans.

10.1 BDI Architecture

- Belief Revision Function
- Generate Options
- Filtering Function
- Planning Function
- Action Generator

11 Subsumption Architecture

See Mars Rover Example

12 InteRRaP

InteRRaP: Integrated of rational planning and reactive behaviour Has a vertical layering architecture. Has 3 layers:

- Behaviour-base Layer
- Local Planning Layer
- Social Planning Layer

13 Agent Interaction

- Non-/quasi-communicative interaction - shared environment
- Communication - info exchange, collaboration, negotiation

Most multiagent approaches to communication based on speech act theory, consists of Locution, Illocution, Perlocution.

Common communication laguagews are KQML and FIPA Look up the exact working of these languages - there's loads

14 Agent Coordination

14.1 Relationships

Positive relationships are between two agents where at least one agent benefits if the plans are combined. Requests: Explicitly asking for help with own activities

14.2 Partial Global Planning

PGP: exchange information to reach common conclusion Three iterated stages:

- Agents deliberate locally and generate short-term plans for goal achievement
- They exchange information to determine where plans and goals interact
- Agents alter local plans to better coordinate their activities

15 Agent Preferences

Preference ordering OxO for agent i is a total, antisymmetric, transitive relation. Preferences are often expressed through a utility function.

15.1 Game Theory

Some games have a dominant strategy equilibrium - all agents have a dominating strategy

15.2 Nash Equilibrium

A join strategy S is said to me a Nash equilibrium if no agent has a incentive to deviate from this strategy combination.

16 Social Choice

16.1 Preference Aggregation

How do we combine a collection of potentially different preference orders in order to derive a group decision? Voters submit orderings of preferences, the outcome that appears first in most orderings wins.

Condorcet's Paradox: There are scenarios in which no matter which outcome we choose the majority of voters will be unhappy with the outcome chosen

16.2 Borda Count

only top-ranked candidate taken into account, rest of orderings disregarded. Borda count looks at entire preference ordering, counts the strength of opinion in favour of a candidate

17 Coalitions

The three stages of Cooperative action:

- Coalition structure generation

- Solving the optimisation problem of each coalition
- Dividing the value of the solution of each coalition

The core of a coalitional game is the set of outcomes that no sub-coalition can object to.

17.1 Shapley Value

- Symmetry: if two agents contribute the same they should receive the same pay-off (they are interchangeable)
- Dummy player: agents that do not add value to any coalition should get what they earn on their own
- Additivity: if two games are combined, the value a player gets should be the sum of the values it gets in individual games

$sh_i = \frac{1}{|Ag|!} \Sigma_o \varepsilon \pi(Ag) \mu i^{C_i(o)}$

18 Auctions

- English
- Dutch
- Vickrey

19 Bargaining

I'll get back to this

20 Argumentation

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