
Agent Technology for Cooperative Information Systems

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Characteristics of Cooperative Info. Systems

- A CIS exhibits a flat structure of its components where the sources of responsibility alternate depending on where the posed task originates from (opportunistic processing).
- Components in CIS are used in unanticipated combinations.
- A CIS comprises a large collection of pre-existing components with each having its own domain of expertise & problem solving abilities. These need to be able to interact & cooperate in a pairwise manner.
- CIS are highly dynamic. In these environments components should know about each other's capabilities & exchange knowledge & data.

Information Agents: Definitions

- *Info. agents can be seen as active objects with special properties tailored to distributed & open environments with particular emphasis on large scale & dynamic nature applications.*
- *The key aspects of agents are their autonomy their ability to perceive & reason & act in their surrounding environments, as well as to cooperate with other such agents.*
- *Intelligence is the amount of learned behavior & reasoning that an agent may possess. It ranges from:*
 - set of rules pre-defined by the user
 - agent ability to learn.

Characteristics of Information Agents

- Agenthood is a *behavioral* property. An entity is an information agent if it communicates correctly in an agent communication language
 - **Autonomy:** *agents can operate on their own without guidance. They have individual internal states & goals, & act to meet their goals. They are **proactive**, i.E., Able to take the initiative rather than acting simply to respond to their environment*
 - **Cooperation:** *they can participate in task-oriented dialogues through the use of interaction protocols in conjunction with built-in organizational knowledge.*

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- Agents **learn** as they react and/or interact with their external environment. Agents that are able to learn can **adapt** & improve with experience.
 - A collection of planner agents can combine the work of task decomposition & allocation by treating agents as specialized resources that interact & depend upon each other.
 - Multi-agent planning can be done by a centralized planner with global plan synchronization & conflict elimination or with distributed planners that make joint multi-agent plans.
 - Conflicts in task allocation can be resolved by allowing agents with related interests to exchange and elaborate proposed activities using techniques termed:
 - Negotiation, &
 - Partial global planning.

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- To achieve coordination multi-agent systems may have to **negotiate** in order to reach mutually acceptable agreements.
 - Negotiation can be stateful & may consist of a “conversation sequence”, where multiple messages are exchanged to a prescribed protocol.
 - Partial global plans are representations of aggregated local plans of agents, with conflicts removed. They provide incrementally global or regional views of planned activity, enabling agents to allocate resources selectively.

Further Characteristics of Information Agents

- Agents tend to be static & “coarse”, they are specialized to single area of expertise & provide access to info. sources in that domain.
- An agent possesses self-representation abilities (knowledge representation capabilities & reflection protocols).
- Agent Communication Languages & Protocols

○ *Agent-enabled computing is concerned with combining appropriately info. agents working cooperatively over space & time to solve a variety of complex problems*

- *In each problem domain there is:*
- distribution of data;
 - distribution of control;
 - distribution of expertise;
 - spatial distribution of resources.

Distributed AI: Multi-agent Systems

- Multi-agent systems are concerned with how a set of agents can work together to solve problems that are beyond their individual capabilities (bottom-up approach).
- Each agent is capable of sophisticated problem solving & can work autonomously. Agents can work cooperatively by:
 - using their local expertise, resources & info. to formulate partial problem solutions and by
 - integrating their solutions with those of other agents in order to build an overall solution that meets the goals of the system.

Negotiation in DAI

- Negotiation occurs in situations where potential conflicts exist among agents due to their independent activities.
- Negotiation has been designed as a form of reducing inconsistency & uncertainty on common view points through the structured exchange of information.
 - Contracting involves the exchange of info. between interested parties, an evaluation of the info. By each party from its own perspective & a final agreement on mutual selection.

Planning

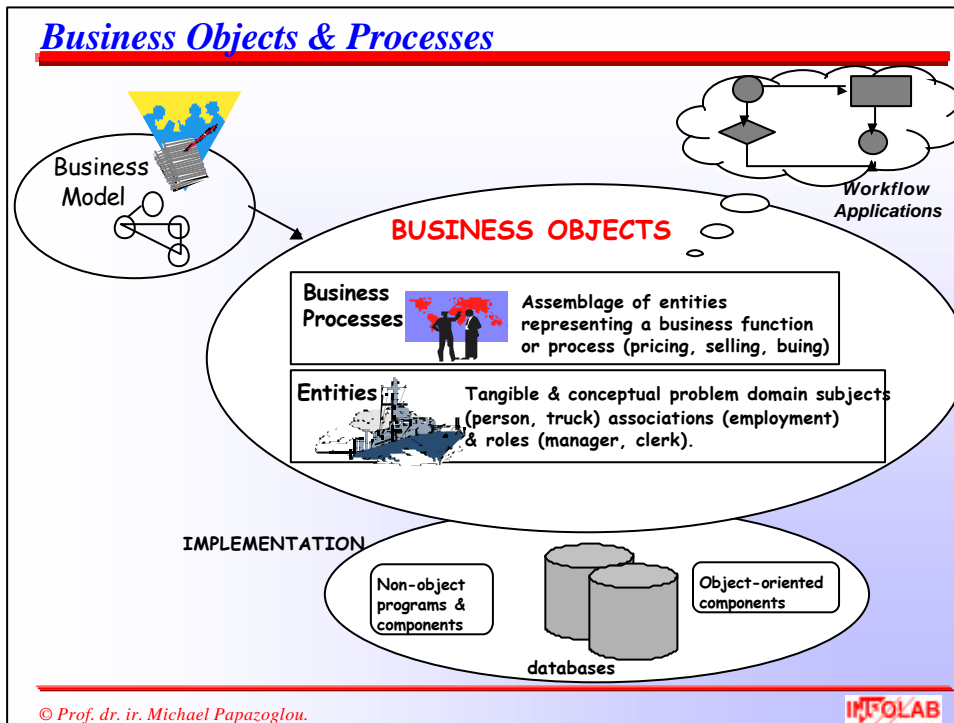
- A planning program is an AI system that reasons about the actions in the service of an agent that is acting in a way that will achieve a set of goals.
- In multi-agent planning, agents form a MAS plan that specifies future actions & interactions.
- One or more agents possess a plan that indicates their future activities. Plans can range from static to dynamic.
- Planning is different from contracting in which agents make pair-wise agreements about how they will coordinate & there is no complete view of network coordination activities.
- Contracting may lead to incoherent behavior that MAS planning avoids.

Integrated Value Chain: Definitions

- A *value chain* is a collection of activities that go into designing, producing goods & services that have as purpose to add value to this product or service.
- *Integrated value chain* is the process by which multiple enterprises within a shared market sector collaboratively plan, implement & manage the flow of goods, services & info. along a value chain in a way that increases customer-perceived value & increases the efficiency of the chain.

In other words “extended enterprises” ...

Business Objects & Processes



Types of Agents

- **Application Agents:**
Agents that typically support users in effectively performing complicated tasks, e.g., medical diagnosis, engineering design, using the most appropriate info. & computing resources.
- **General Commerce Activity Agents:**
Agents that provide the general functionality that is required by application agents, e.g., searching & navigation, negotiation, billing, marketing, to solve a variety of EC problems.
- **System-level Agents:**
Agents responsible for realizing the technical infrastructure that makes it possible to develop business to business applications.

