Multiagent Systems G. Weiss 2001

- what is an agent
  - computational entity
  - perceives and acts upon its environment
  - autonomous: behaviour depends at least partially on own experience
  - operates in a variety of environments
  - makes use of problem solving, planning, decision making and learning
  - interacts with other agents
    * goal and task co-ordination
    * question: when and how to interact, with whom

- three main features of agents
  - autonomous: control over behaviour, act without human intervention
  - intelligent: optimize performance, operate flexibly (given the information they have and their capabilities to perceive and act)
  - interacting: may be affected by other agents or humans in pursuing goals, may use shared language, may need to coordinate (cooperative) or maximize individual beneft (self-interested)

- characteristics of multiagent systems
  - each agent limited in what it can do alone
  - control in system is distributed
  - computation may be asynchronous, data may be decentralized

- challenging issues for multiagent systems
  - enabling communication: languages and protocols
  - representing and reasoning about actions, plans of other agents
  - enabling agents to decompose their own goals and tasks and to synthesize subtasks at the end
  - reasoning about coordination with other agents
  - reconciling conflicts
  - enabling formation of teams
  - formally describing multiagent systems

- applications of multiagent systems
  - e-commerce: buyer and seller agents
  - information handling agents: gathering, filtering
  - automated meeting scheduling, transportation
  - business processes: workflow, supply chains, etc.
  - electronic entertainment

- Cooperative Information Agents by M. Klusch (2000)
  - access to information on the web, e-commerce as primary applications
  - tasks for agents:
    * inform when data of interest becomes available
    * search knowledge sources on our behalf
    * negotiate for, purchase and receive goods, services
  - information agents can be cooperative or non-cooperative

- collaboration amongst information agents
  - use of ontologies (shared knowledge) and information integration
    - resolve semantic conficts among objects in different information sources
    - wrapper agents access to local information
    - mediator agents enable interoperability
    - facilitator agents may coordinate mediators
  - language for knowledge interchange: KQML, FIPA
  - architectures
    - broker: find those who can help, protect anonymity, get list back to requester
    - matchmaker: find those who can help, supply list to requester
    - introducer: find those who can help, tell them and let them decide whether to respond
    - blackboard: post messages on common data structure, everyone checks and takes what they need
  - social obligations (basis for trust)
  - joint intentions, plans
  - negotiation protocols

- mobile agents
  - security issues
  - ubiquitous access
  - reduce network load
- electronic commerce
  - modeling economic systems as multi-agent systems
  - game theoretic issues
  - user profiling
  - buying, selling and supply chain management
- collaborative learning agents
  - coordinated reinforcement learning
  - forming negotiation coalitions