# Agile Design of Social Applications

Professor Kuldar Taveter
Department of Informatics
Tallinn University of Technology

Part I

# INTRODUCTION

# Who am I?

- Name: Kuldar Taveter
- Position: Professor, Chair of Software Engineering
- Education:
  - Dip.Eng., TUT, 1988
  - M.Sc., TUT, 1995
  - Ph.D., TUT, 2004
- Work experience:
  - 1985-1989: Institute of Cybernetics
  - 1989-1993: Private companies
  - 1993-1998: Department of Informatics of TUT
  - 1997-2005: Technical Research Centre of Finland
  - 2005-2008: The University of Melbourne, Australia
  - 2008- : Department of Informatics of TUT
  - Jan-Aug 2011: University of South Carolina, USA
- Research areas: Agile product design and prototyping, intelligent systems, ambient intelligence, simulation systems

# Who are you?

# Why agile?

- We need to design a product fast
- We need to develop a prototype fast

# Why social?

- Products that perceive their environment and interact
- Products that support people in their everyday activities –> sociotechnical systems

# Socio-technical system

- A software intensive system that has defined operational processes followed by human operators and which operates within an organization
- A system that contains both a social aspect, which may be a subsystem, and a technical aspect

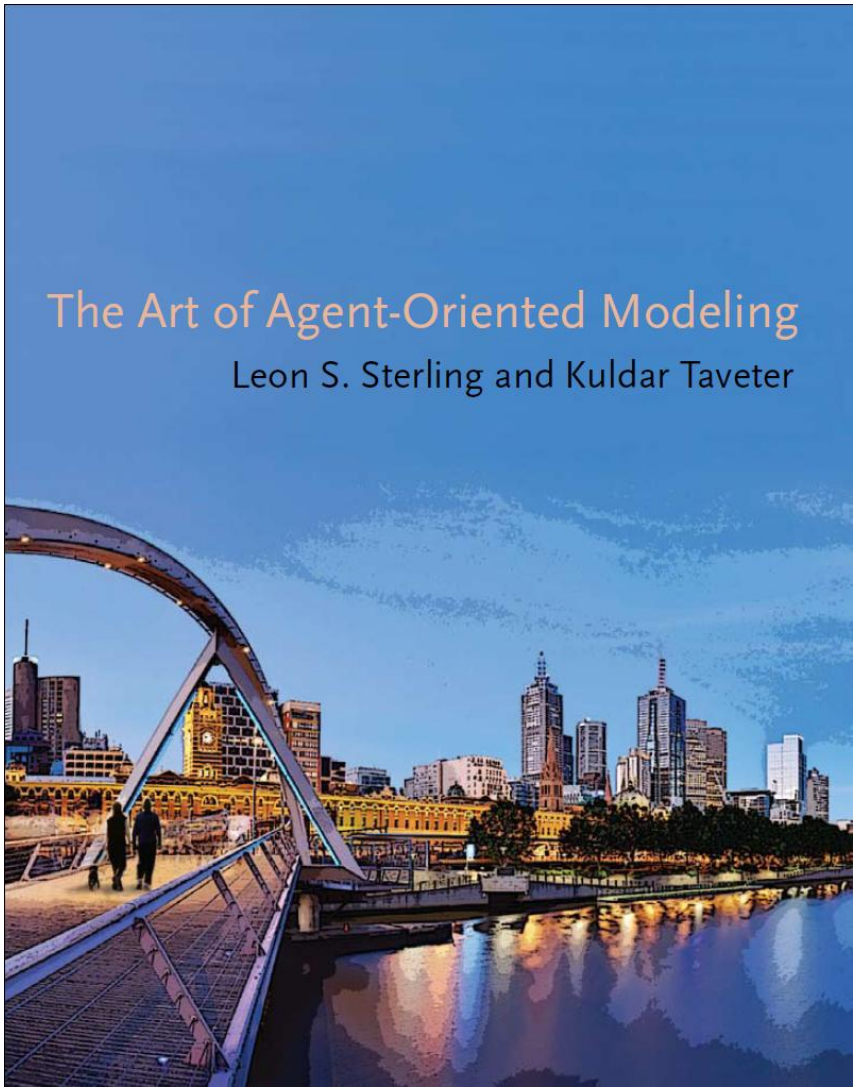
# Where are we?

- We have a business model
  - Customer segments
  - Value propositions
  - Channels
  - Customer relationships
  - Revenue streams
  - Key resources
  - Key activities
  - Key partnerships
  - Cost structure
- We need to design a product

# Different kinds of products

- Physical
- Digital
- Hybrid

# Agent-oriented modelling



# The book's mission

- To address how computing can support individuals and social organizations in the environment where the computing is:
  - Pervasive;
  - Deployed over a range of devices;
  - With multiplicity of users
- Approach for engineering software systems that are:
  - Open;
  - Intelligent;
  - Adaptive

# Examples

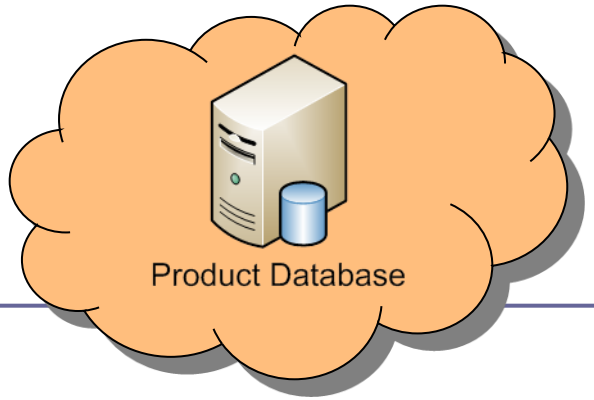
- Tourist advisor
- Smart parking
- Fair grocery shopping
- Personal medical assistant

# Tourist advisor

# Smart parking

# Fair grocery shopping

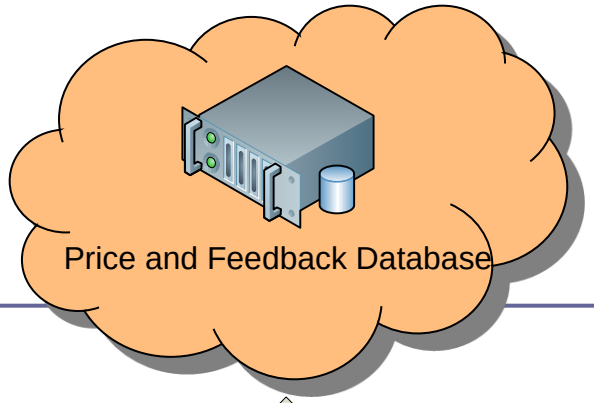
- Customers post the prices they paid for their groceries and QoS information
- A prospective shopper enters a grocery list and obtains a pointer to the store(s) with the lowest total price (and best service)
- Each customer has an app representing his/her interests and interacting with the agents of the other customers
- Results from initial experiments by Prof. Michael Huhns and Hongying Du: savings up to 21% can be obtained!

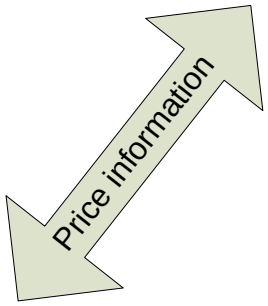


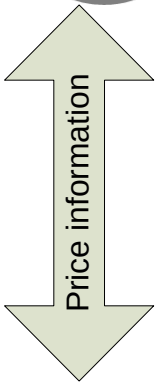

Product information

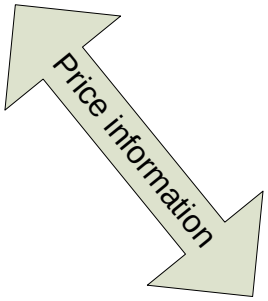
Product information

Product information


Price and Feedback Database


Price information


Price information


Price information

# Personal medical assistant

# Revisiting Busines Model Canvas

## The Business Model Canvas

Designed for:

Designed by:

On: Day Month Year

Iteration: No.

### Key Partners

Who are our Key Partners?
Who are our key suppliers?
Which Key Resources are we acquiring from partners?
Which Key Activities do partners perform?

**MOTIVATIONS FOR PARTNERSHIPS:**
*Optimization and economy*
*Reduction of risk and uncertainty*
*Acquisition of particular resources and activities*

### Key Activities

What Key Activities do our Value Propositions require?
Our Distribution Channels?
Customer Relationships?
Revenue streams?

**CATEGORIES**
*Production*
*Problem Solving*
*Platform/Network*

### Key Resources

What Key Resources do our Value Propositions require?
Our Distribution Channels? Customer Relationships?
Revenue Streams?

**TYPES OF RESOURCES**
*Physical*
*Intellectual (brand patents, copyrights, data)*
*Human*
*Financial*

### Value Propositions

What value do we deliver to the customer?
Which one of our customer's problems are we helping to solve?
What bundles of products and services are we offering to each Customer Segment?
Which customer needs are we satisfying?

**CHARACTERISTICS**
*Newness*
*Performance*
*Customization*
*"Getting the Job Done"*
*Design*
*Brand/Status*
*Price*
*Cost Reduction*
*Risk Reduction*
*Accessibility*
*Convenience/Usability*

### Customer Relationships

What type of relationship does each of our Customer Segments expect us to establish and maintain with them?
Which ones have we established?
How are they integrated with the rest of our business model?
How costly are they?

**EXAMPLES**
*Personal assistance*
*Dedicated Personal Assistance*
*Self-Service*
*Automated Services*
*Communities*
*Co-creation*

### Channels

Through which Channels do our Customer Segments want to be reached?
How are we reaching them now?
How are our Channels integrated?
Which ones work best?
Which ones are most cost-efficient?
How are we integrating them with customer routines?

**CHANNEL PHASES:**
1. *Awareness*
*How do we raise awareness about our company's products and services?*
2. *Evaluation*
*How do we help customers evaluate our organization's Value Proposition?*
3. *Purchase*
*How do we allow customers to purchase specific products and services?*
4. *Delivery*
*How do we deliver a Value Proposition to customers?*
5. *After sales*
*How do we provide post purchase customer support?*

### Customer Segments

For whom are we creating value?
Who are our most important customers?

*Mass Market*
*Niche Market*
*Segmented*
*Diversified*
*Multi-sided Platform*

### Cost Structure

What are the most important costs inherent in our business model?
Which Key Resources are most expensive?
Which Key Activities are most expensive?

**IS YOUR BUSINESS MORE:**
*Cost Driven (leanest cost structure, low price value proposition, maximum automation, extensive outsourcing)*
*Value Driven (focused on value creation, premium value proposition)*

**SAMPLE CHARACTERISTICS:**
*Fixed Costs (salaries, rents, utilities)*
*Variable costs*
*Economies of scale*
*Economies of scope*

### Revenue Streams

For what value are our customers really willing to pay?
For what do they currently pay?
How are they currently paying?
How would they prefer to pay?
How much does each Revenue Stream contribute to overall revenues?

**TYPES:**
*Asset sale*
*Usage fee*
*Subscription Fees*
*Lending/Renting/Leasing*
*Licensing*
*Brokerage fees*
*Advertising*

**FIXED PRICING:**
*List Price*
*Product feature dependent*
*Customer segment dependent*
*Volume dependent*

**DYNAMIC PRICING:**
*Negotiation( bargaining)*
*Yield Management*
*Real-time-Market*

www.businessmodelgeneration.com

# The Viewpoint Framework

| | **Viewpoint aspect** | | |
|---|---|---|---|
| **Abstraction layer** | Interaction | Information | Behavior |
| Analysis | Role models and organization model | Domain model | Goal models |
| Design | Agent models, acquaintance model, and interaction models | Knowledge model | Agent behavior models |
| Prototyping | Interaction prototyping | Information prototyping | Behavior prototyping |

# What is model?

- A hypothetical, simplified description of a complex entity or process
- “A model should be as complex as it needs, but not more complex”, David Lorge Parnas
- What features...
  - are important?
  - can be ignored?

# Examples of models

- A model of the solar system
- The model of a gold mine
- The model of a chemical plant
- Air traffic simulator:

Part III

# GOAL MODELLING

# The Viewpoint Framework

| | **Viewpoint aspect** | | |
|---|---|---|---|
| **Abstraction layer** | Interaction | Information | Behavior |
| Analysis | Role models and organization model | Domain model | **Goal models** |
| Design | Agent models, acquaintance model, and interaction models | Knowledge model | Agent behavior models |
| Prototyping | Interaction prototyping | Information prototyping | Behavior prototyping |

# Concepts for goal models

- Goal
  - Functional goal
  - Quality goal
- Role

# What is goal?

- Dream with a deadline ☺
- A particular state of affairs intended by one or more agents

# Two kinds of goals

- Functional goal: a goal that captures one or more desired scenarios. Example: attend the lecture
- Quality goal: quality requirement of the achievement of the functional goal. Example: attend the lecture *attentively*

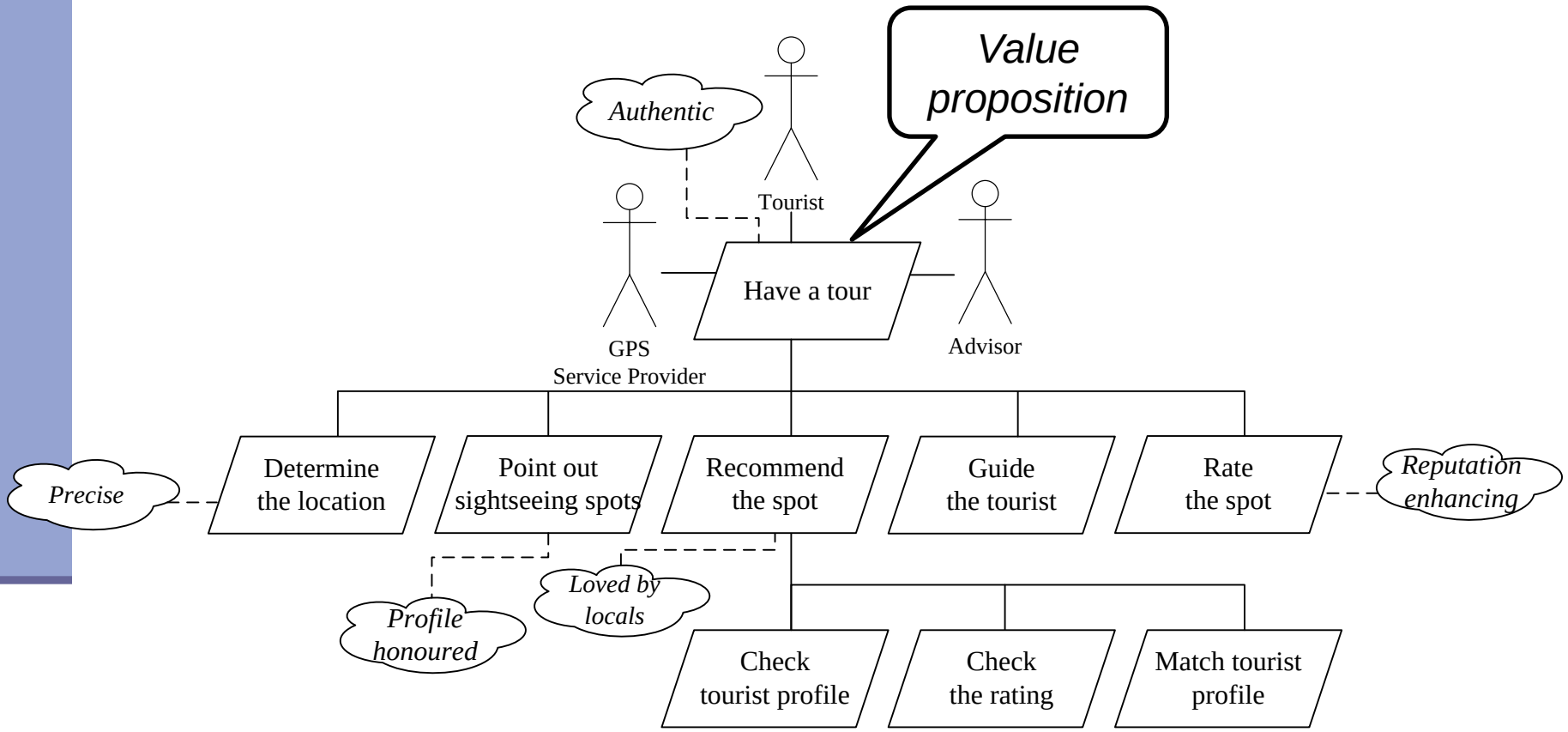
# What is role?

- Some capacity or position that the system requires in order to achieve its goals
- Examples

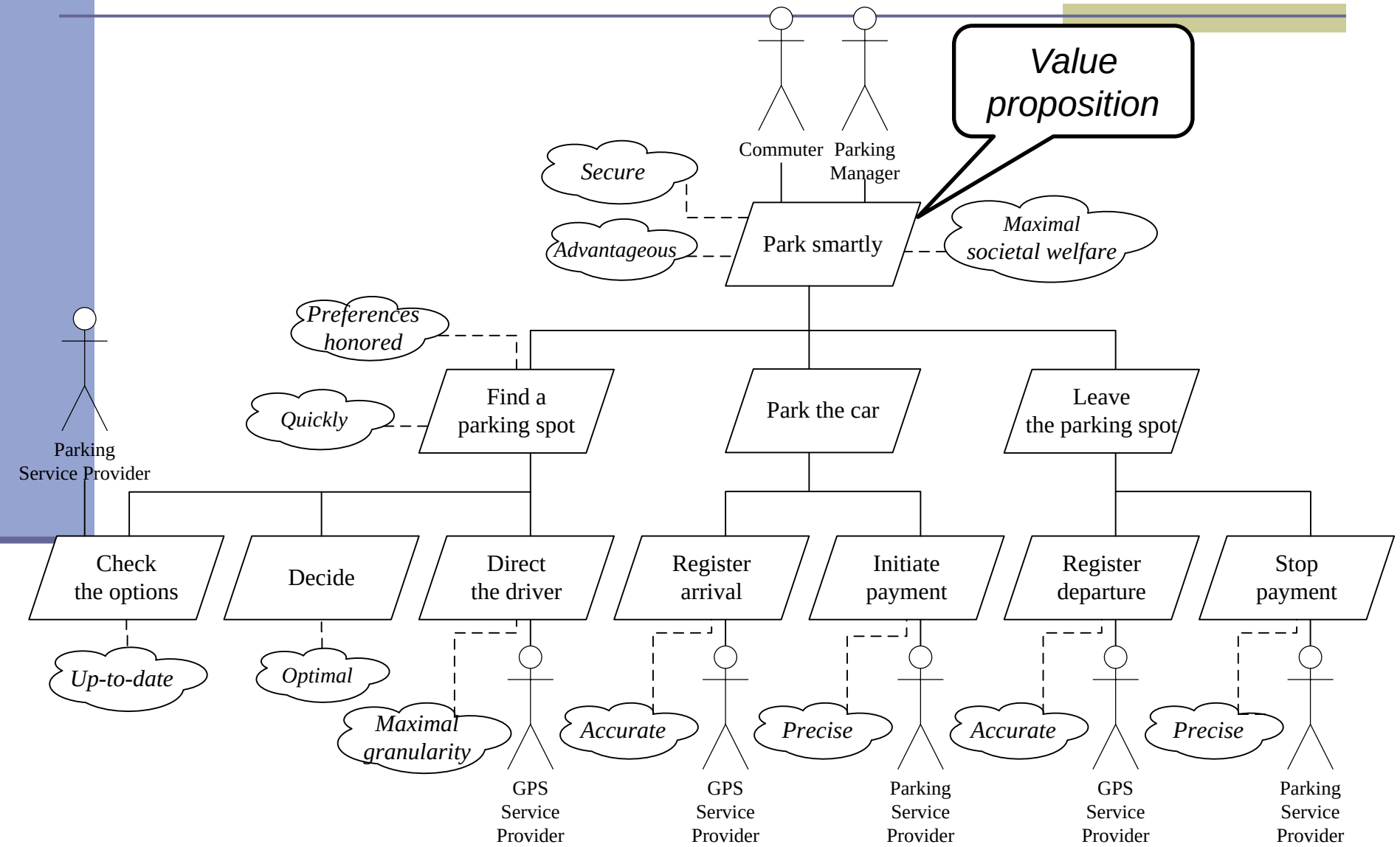
# Goal model

- Hierarchy of goals
- Roles associated with goals
- Quality goals attached to goals

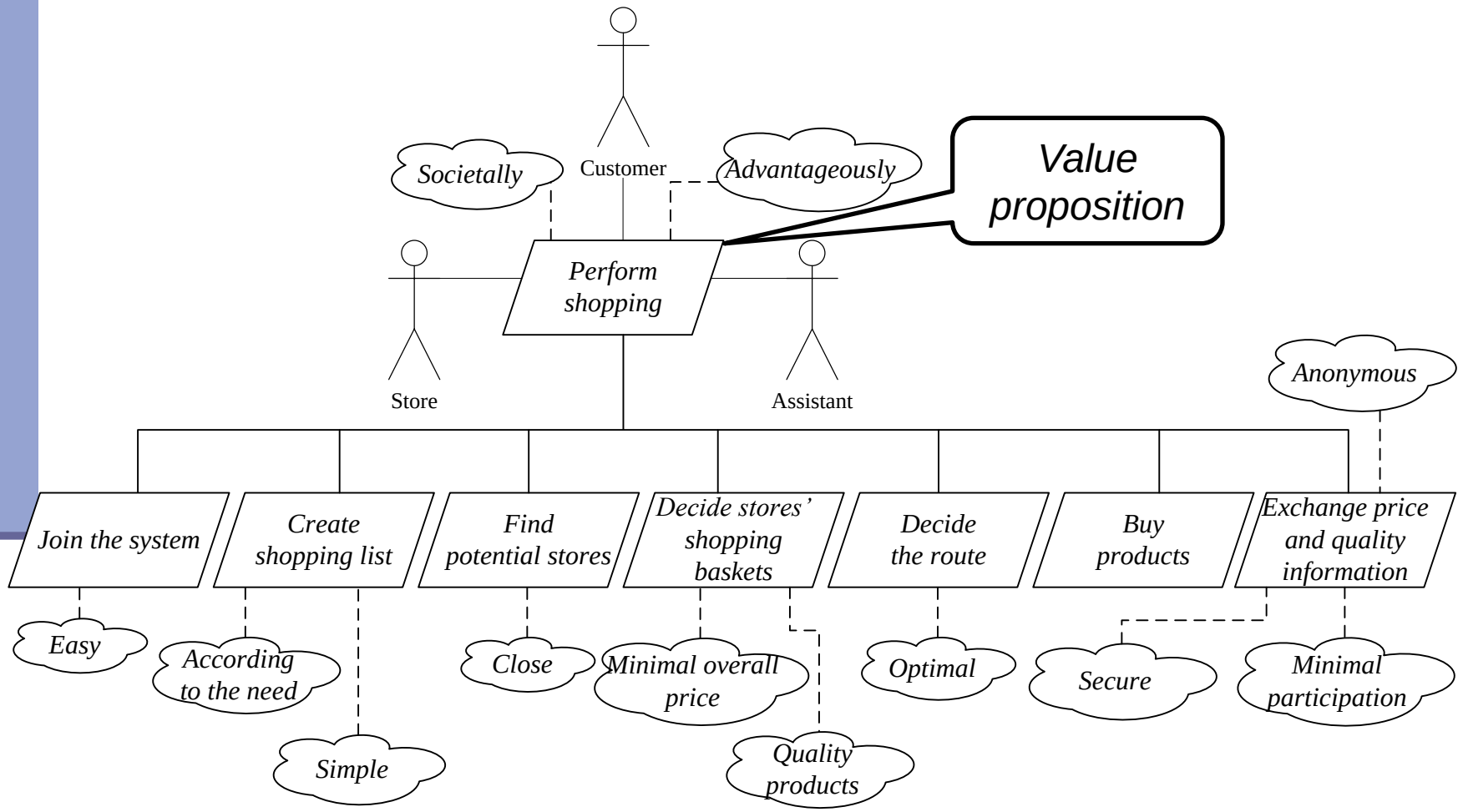
# Goal model for tourist advisor



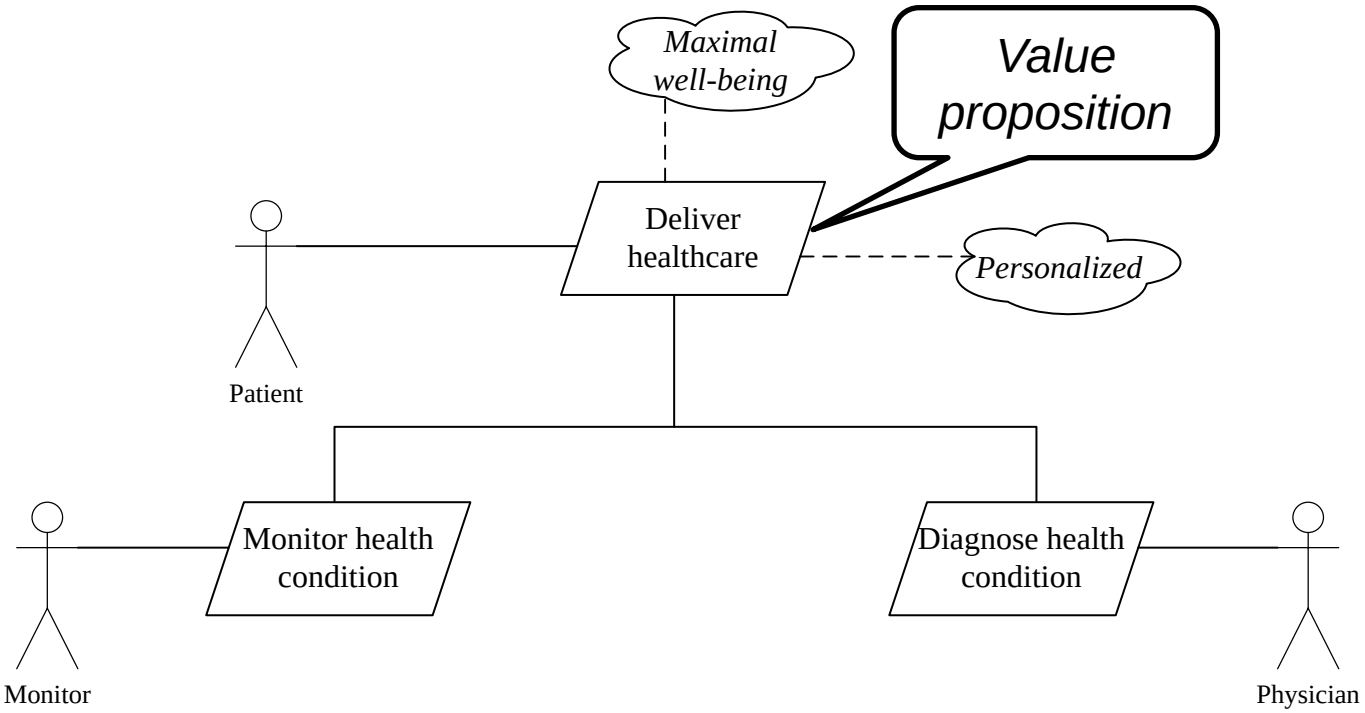
# Goal model for smart parking



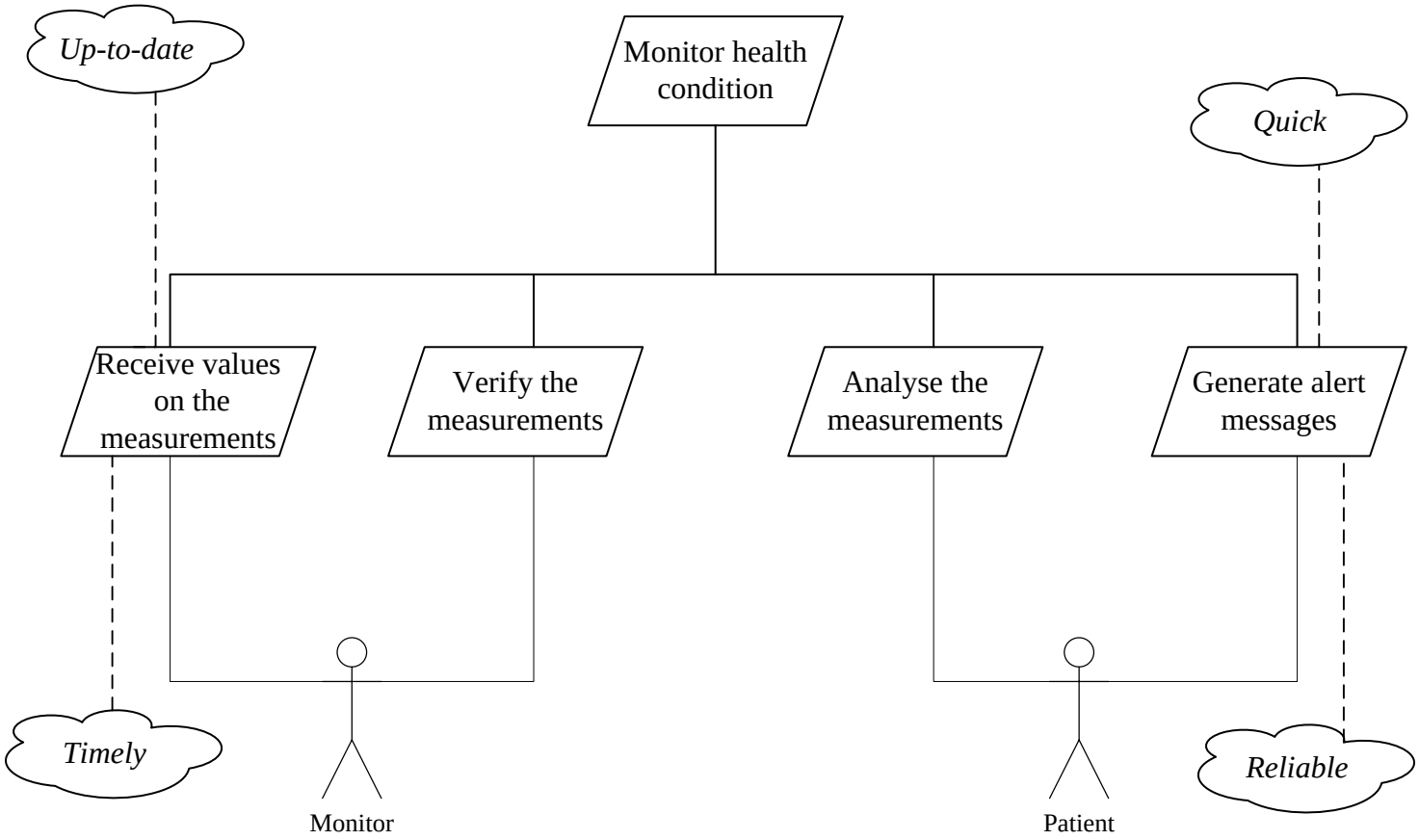
# Goal model for fair grocery shopping



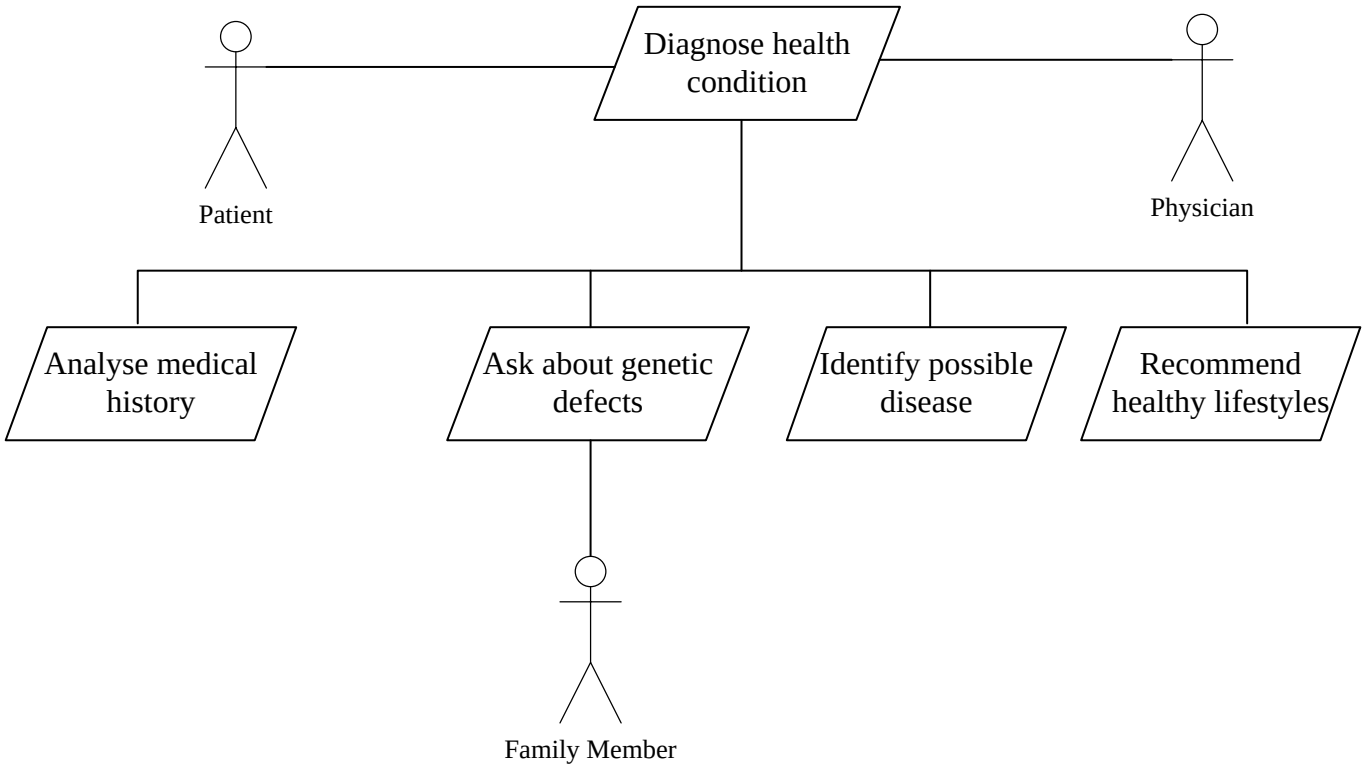
# Goal model for personal medical assistant (1)



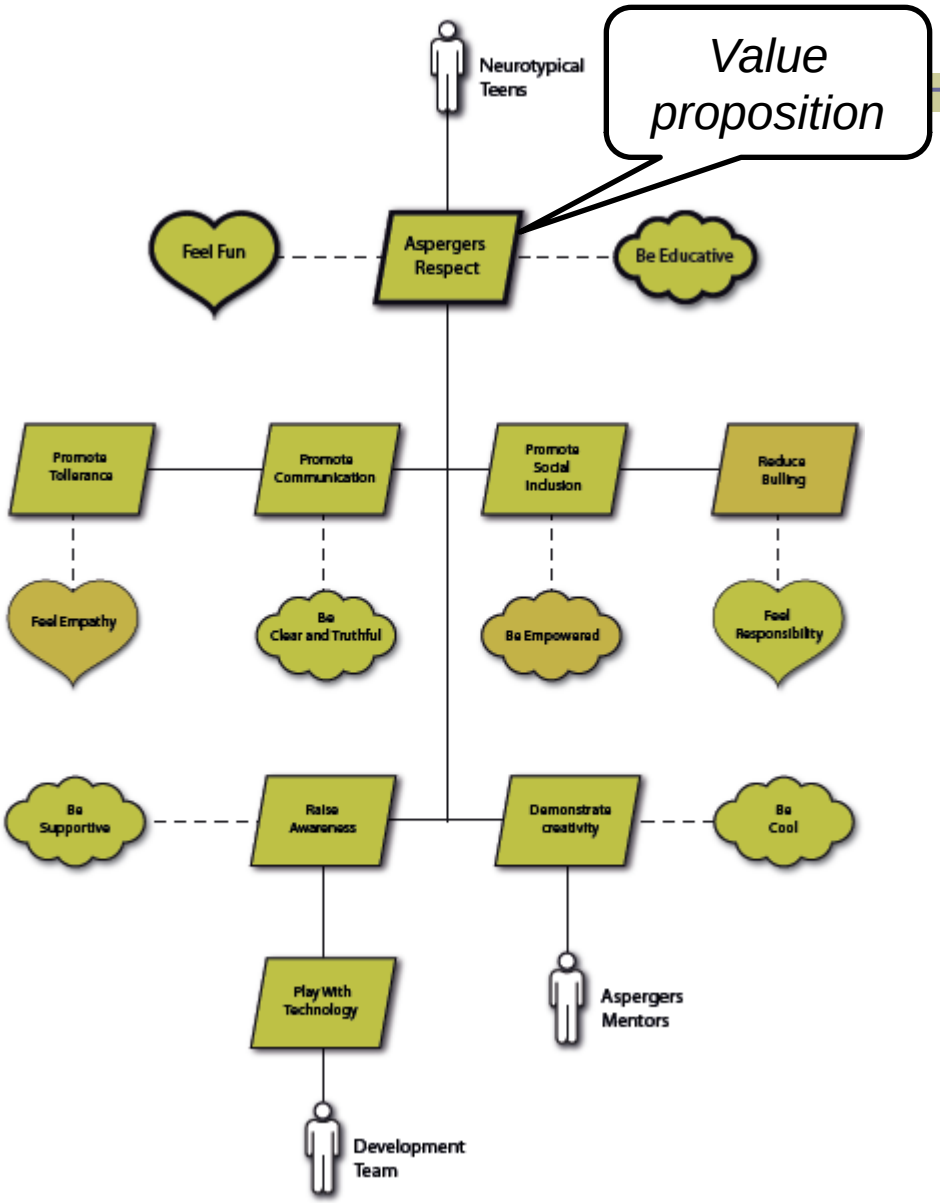
# Goal model for personal medical assistant (2)



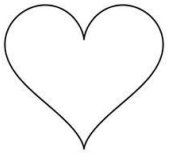
# Goal model for personal medical assistant (3)



# Goal model for Asperger's Game



# Notation for goal models

| Symbol | Meaning |
|---|---|
|  | **(Functional) Goal:**<br>**To-Do goal** |
|  | **Quality Goal:**<br>**To-Be goal** |
|  | **Quality Goal:**<br>**To-Feel goal** |
|  | **Role** |
|  | **Relationship between goals** |
|  | **Relationship between goals and quality goals** |

# Goal model as a project management tool

# Teamwork

- Create a goal model for the product idea of your team
- Include relevant quality goals and roles
- Use an A1 paper **OR**
- Use the Microsoft Visio Stencils for AOM: http://maurus.ttu.ee/sts/wp-content/uploads/2012/07/AOM-Visio-Stencils.zip

Part IV

# ROLE AND ORGANIZATION MODELLING

# The Viewpoint Framework

| | **Viewpoint aspect** | | |
|---|---|---|---|
| **Abstraction layer** | Interaction | Information | Behavior |
| Analysis | **Role models** and organization model | Domain model | Goal models |
| Design | Agent models, acquaintance model, and interaction models | Knowledge model | Agent behavior models |
| Prototyping | Interaction prototyping | Information prototyping | Behavior prototyping |

# Role model

- Role models are orthogonal to goal models
- A role model consists of the following four elements to describe the role:
  - Role name: A name identifying the role
  - Description: A textual description of the role
  - Responsibilities: A list of responsibilities that the agent playing the role must perform in order for a set of goals and their associated quality goals to be achieved
  - Constraints: A list of conditions that the agent playing the role must take into consideration when exercising its responsibilities

# Role model for Parking Assistant in smart parking

| | |
|---|---|
| **Role name** | Parking Manager |
| **Description** | The role of a commuter's parking manager in the smart parking system |
| **Responsibilities** | Obtain parking preferences from the commuter<br>Obtain destination from the commuter<br>Check parking service provider for parking spots<br>Express the destination and preferences<br>Negotiate with other commuters if needed<br>Receive from the parking service provider options for parking spots<br>Present the commuter with the options (including prices)<br>Decide one of the options<br>Direct the commuter to the parking spot<br>Inform the parking service provider about taking a parking spot<br>Leave the parking spot<br>Receive the charge<br>Inform the commuter about the charge<br>Inform the parking service provider about leaving the parking spot |
| **Constraints** | Parking preferences by the commuter should be honored<br>Negotiations with other customers should be anonymous and fair<br>Driver should be directed to the parking spot with maximal granularity<br>Arrival and departure times should be accurately registered<br>Minimal possible parking charge should be chosen (e.g., -15 minutes)<br>Information exchange with the parking manager should be opaque and anonymous |

# Role model for Commuter in smart parking

| | |
|---|---|
| **Role name** | Commuter |
| **Description** | The role of a commuter in the smart parking system. |
| **Responsibilities** | Provide the parking manager with the parking preferences<br>Provide the parking manager with the destination<br>Receive from the parking manager options for parking spots<br>Decide one of the options<br>Follow the directions by the parking manager<br>Park the car in the parking spot chosen<br>Accept the charge<br>Leave the parking spot |
| **Constraints** | A car has to be parked in the parking spot chosen |

# Role model for Customer in fair grocery shopping

| **Role** | **Customer** |
|---|---|
| **Description** | The role of customer in grocery shopping |
| **Responsibilities** | Join the system |
| | Create the shopping list |
| | Pick products from the typical shopping list |
| | Confirm the stores and shopping baskets suggested by the assistant |
| | Confirm the route suggested by the assistant |
| | Drive to the stores |
| | Buy products |
| | Register product information |
| **Constraints** | To benefit from the product information posted by other customers, the customer must authorize posting of his/her product information. |

# Role model for Assistant in fair grocery shopping

| **Role** | **Assistant** |
|---|---|
| **Description** | The role of a customer's assistant in grocery shopping |
| **Responsibilities** | Find potential stores |
| | Decide and propose the stores and their respective shopping baskets |
| | Decide and propose the route |
| | Create the typical shopping list |
| | Post price and quality-of-product information |
| | Receive price and quality-of-product information |
| **Constraints** | Creating a shopping list should be simple and reflect the need by the customer |
| | Potential stores must be close to the customer |
| | The preferences by the customer must be honored when deciding the stores and their shopping baskets |
| | The overall price should be as low as possible |
| | Quality of products chosen should be as high as possible |
| | Informing other customers should be secure and anonymous |
| | To post price and quality-of-product information, the customer must have scanned or inserted the product information |

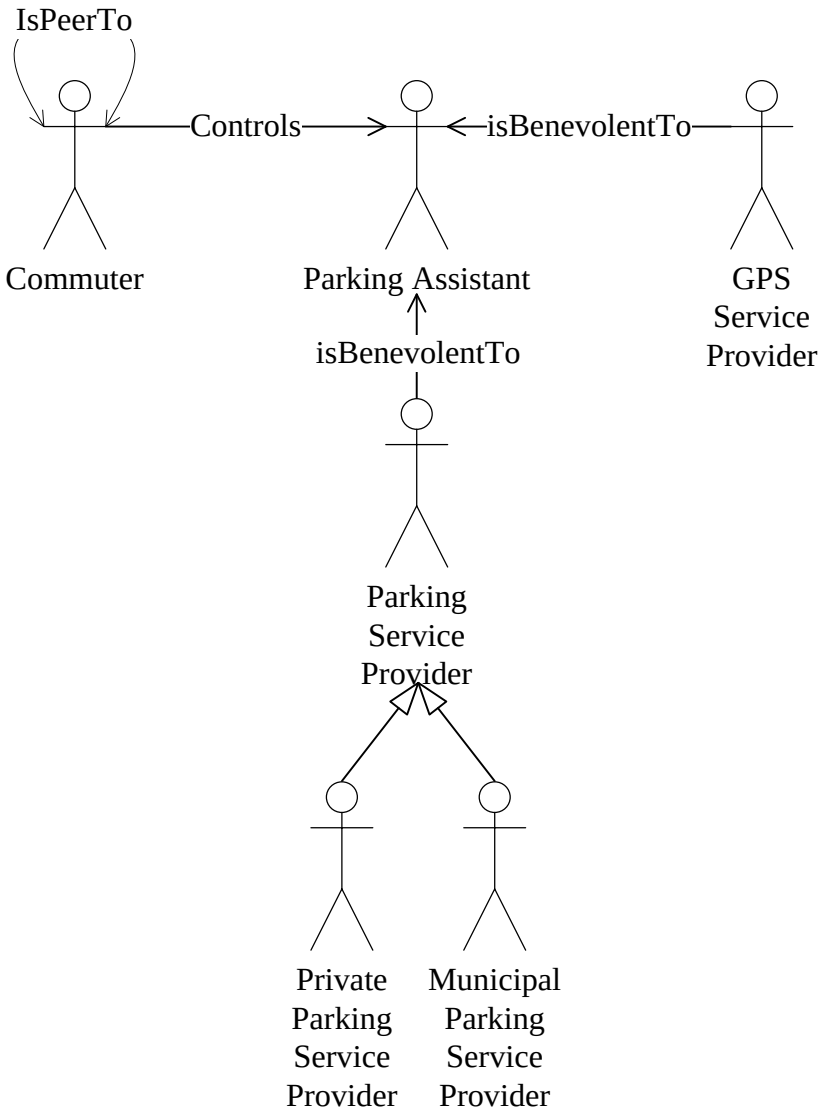
# The Viewpoint Framework

| | **Viewpoint aspect** | | |
|---|---|---|---|
| **Abstraction layer** | Interaction | Information | Behavior |
| Analysis | Role models and **organization model** | Domain model | Goal models |
| Design | Agent models, acquaintance model, and interaction models | Knowledge model | Agent behavior models |
| Prototyping | Interaction prototyping | Information prototyping | Behavior prototyping |

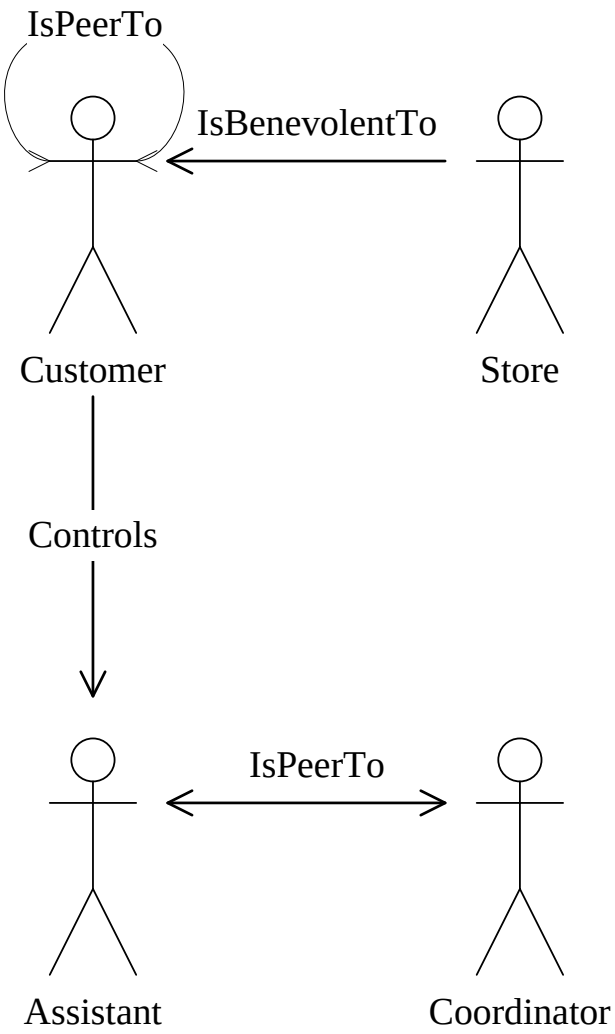
# The organization model

- The model that represents relationships between the roles of the socio-technical system
- There can be different types of organizational relationships:
  - Is controlled by
    - Between a „boss“ and his subordinates
  - Is benevolent to
    - Between self interested roles
  - Is peer to
    - Between equal roles
  - Is dependent for resource
  - …

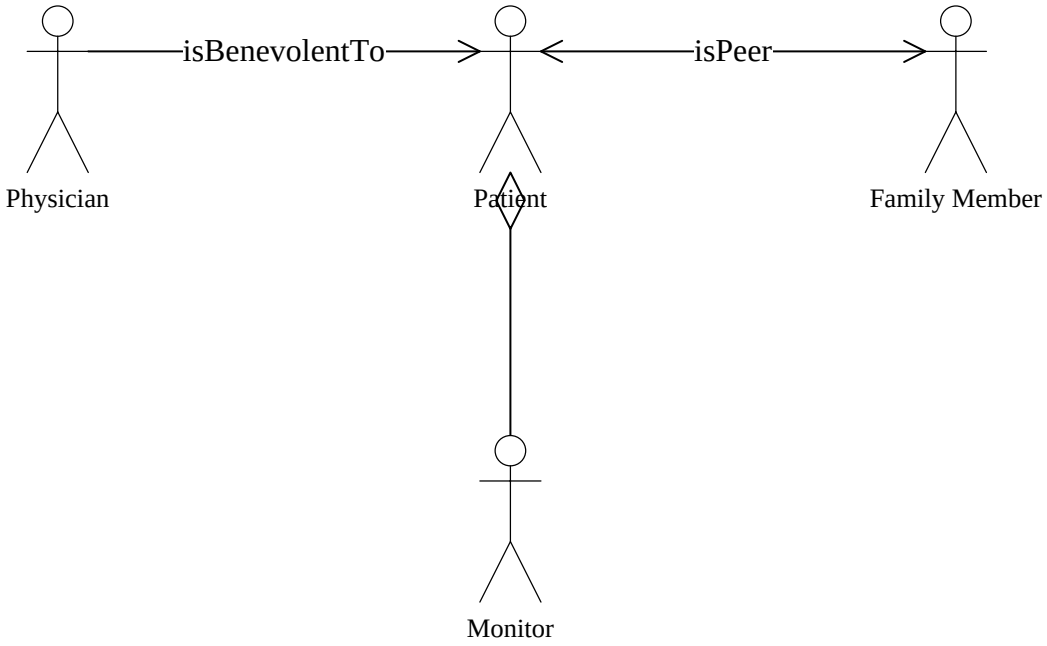
# Organization model for smart parking



# Organization model for fair grocery shopping



# Organization model for personal medical assistant



Part V

# MODELLING KNOWLEDGE FOR THE SYSTEM

# The Viewpoint Framework

| | **Viewpoint aspect** | | |
|---|---|---|---|
| **Abstraction layer** | Interaction | Information | Behavior |
| Analysis | Role models and organization model | **Domain model** | Goal models |
| Design | Agent models, acquaintance model, and interaction models | Knowledge model | Agent behavior models |
| Prototyping | Interaction prototyping | Information prototyping | Behavior prototyping |

# Concept for domain models

- Domain entity

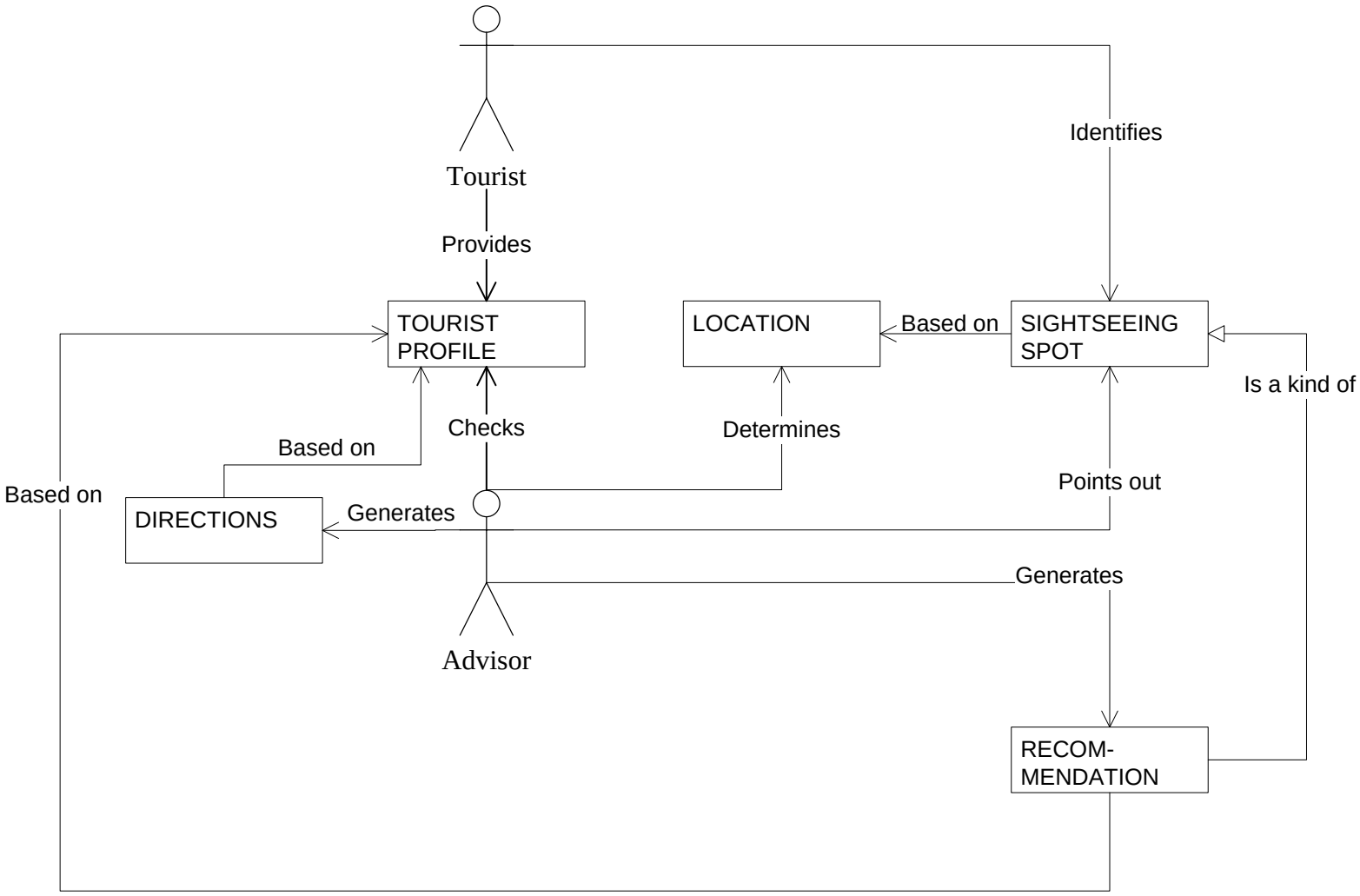
# What is domain entity?

- A modular *unit of knowledge* handled by a sociotechnical system
- Examples

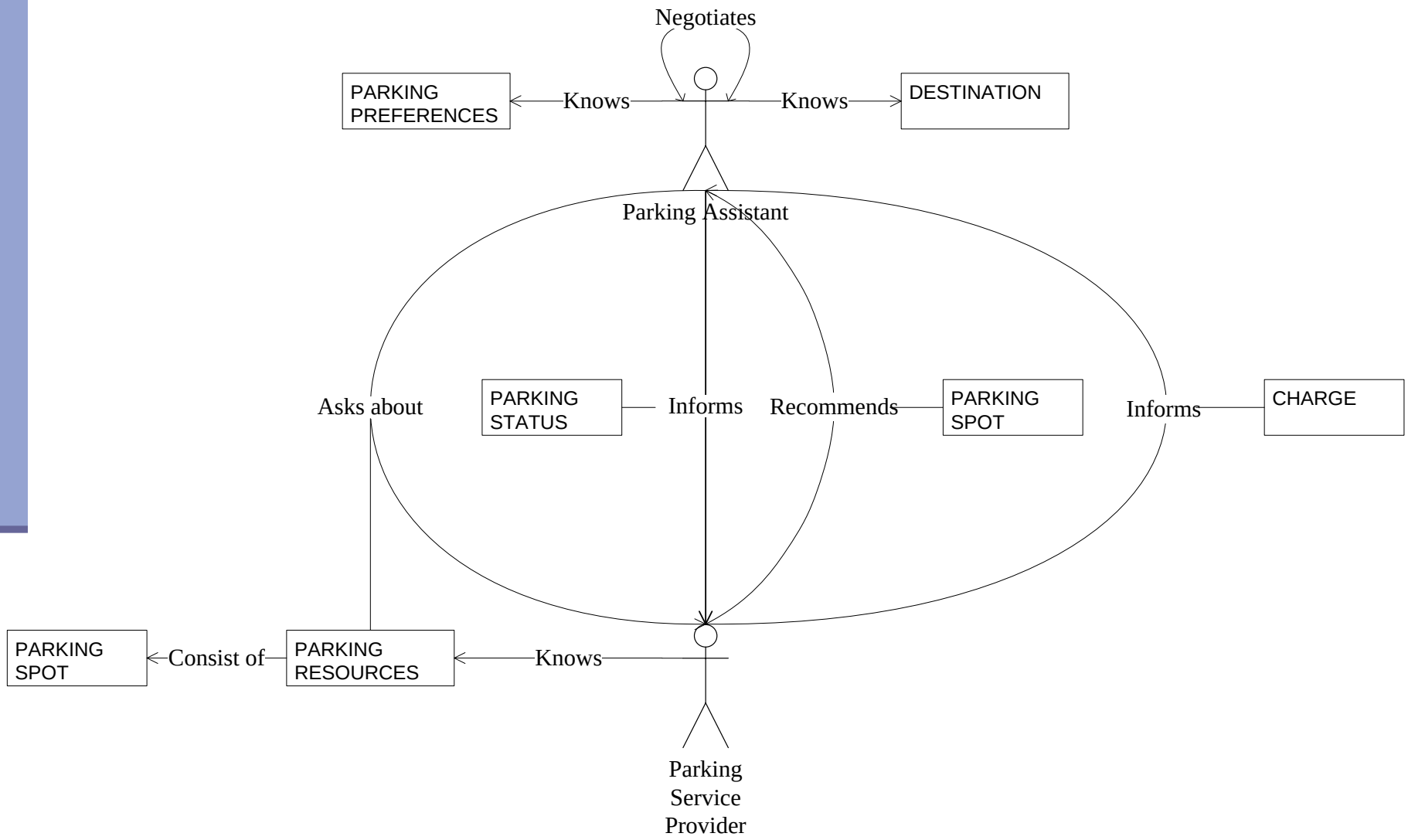
# Domain model

- Domain model represents the knowledge within the system that the system is supposed to handle
- A domain model consists of domain entities and relationships between them. A domain entity is ? A domain model relates domain entities to roles

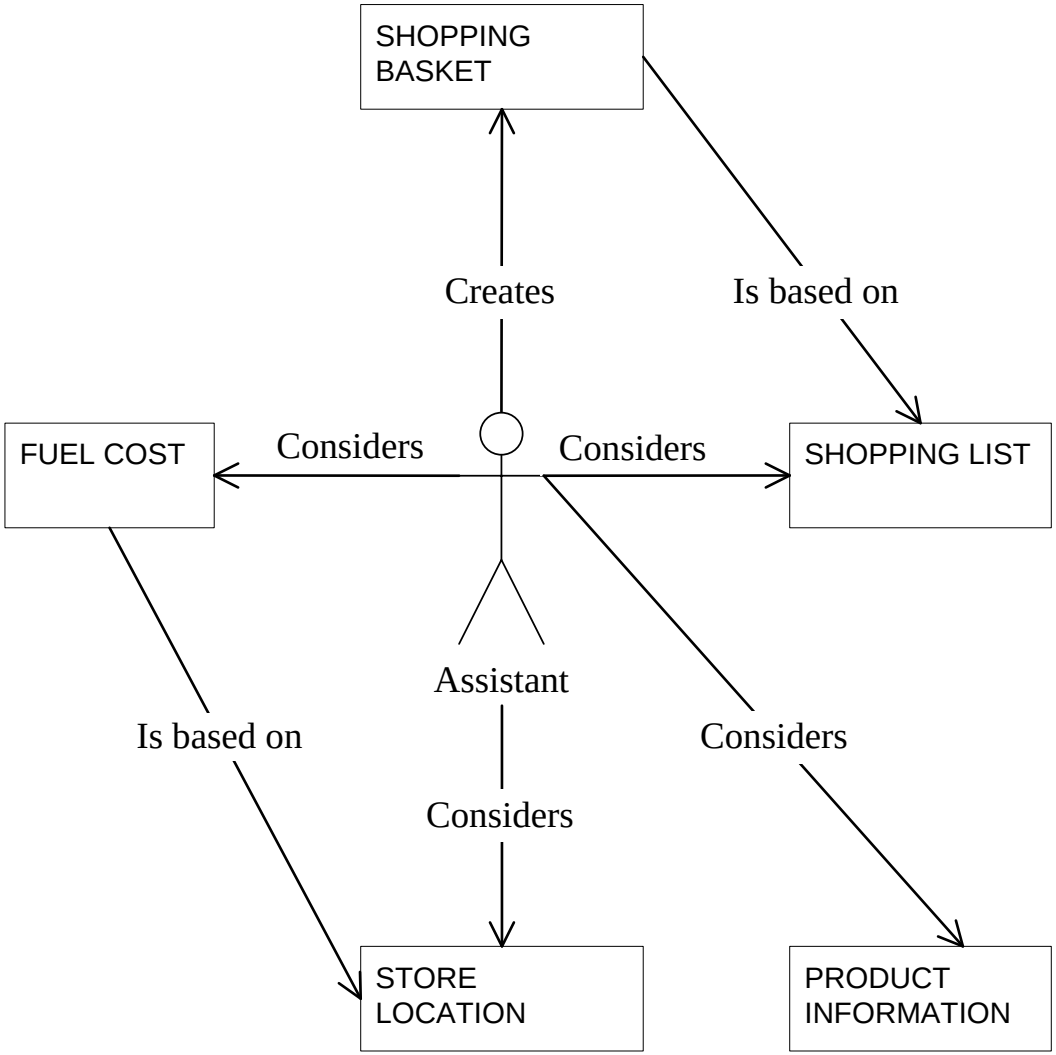
# Domain model for tourist advisor



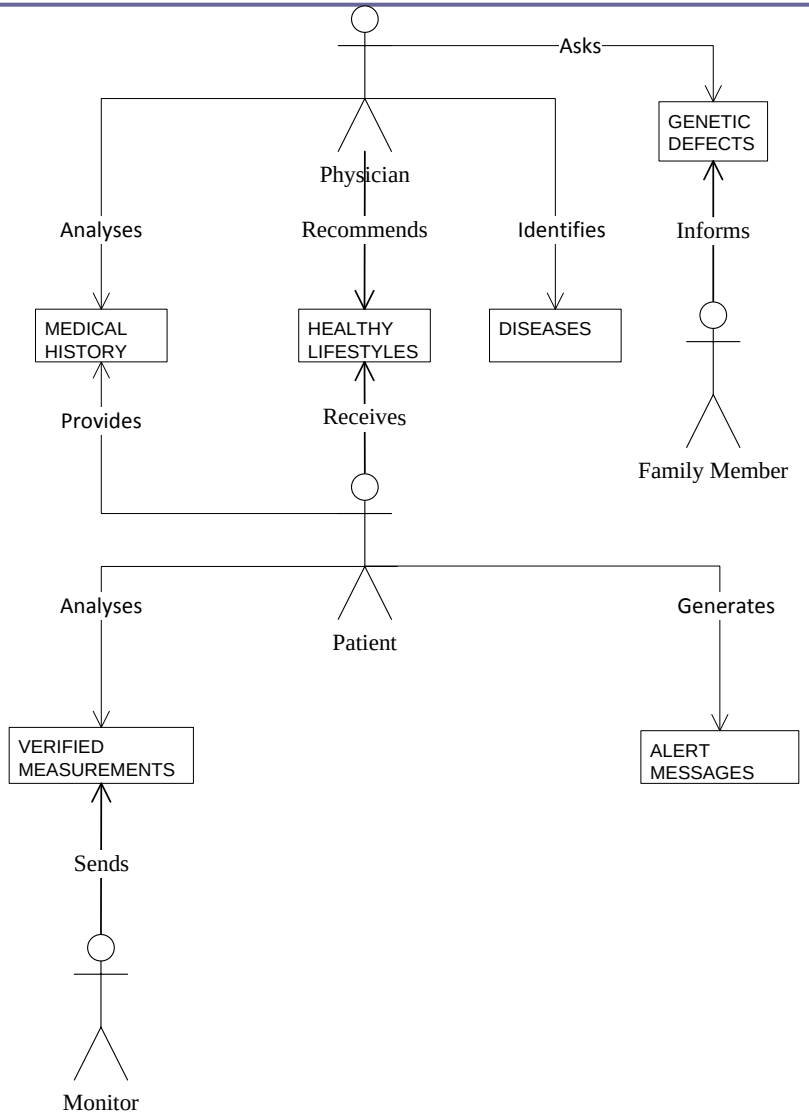
# Domain model for smart parking



# Domain model for fair grocery shopping



# Domain model for personal medical assistant



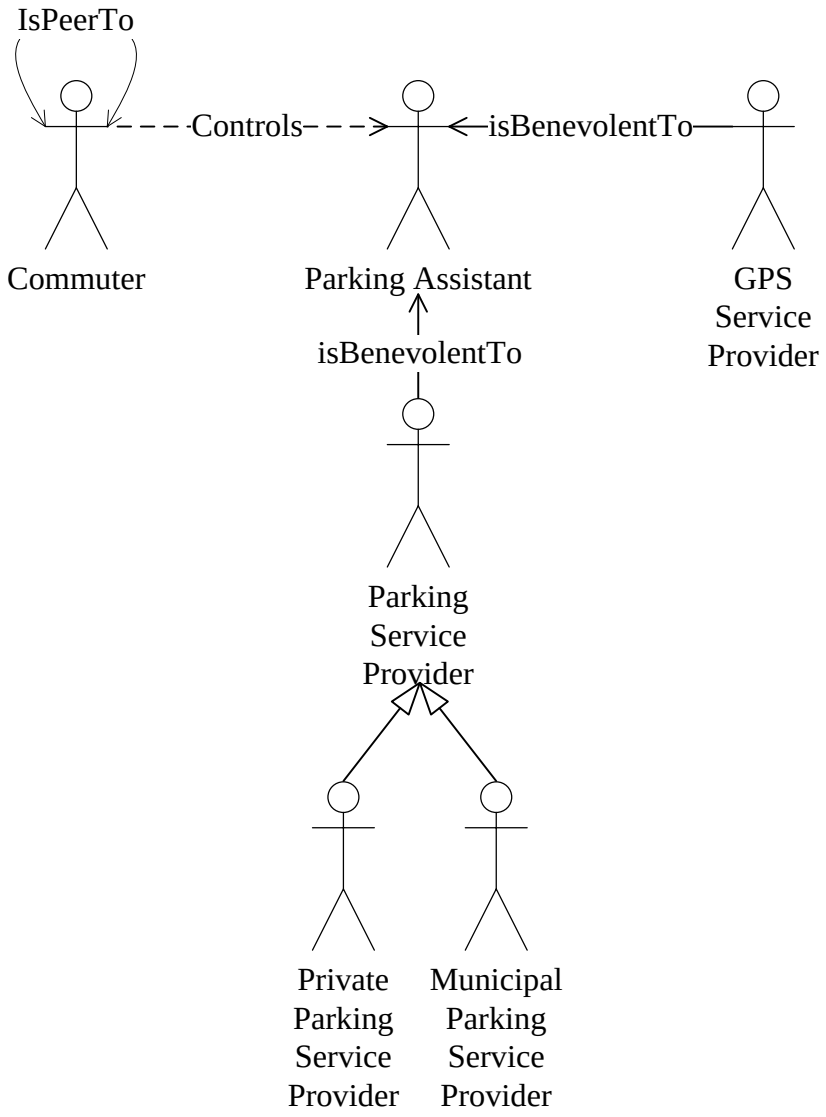
Part VI

# DECIDING SOFTWARE COMPONENTS

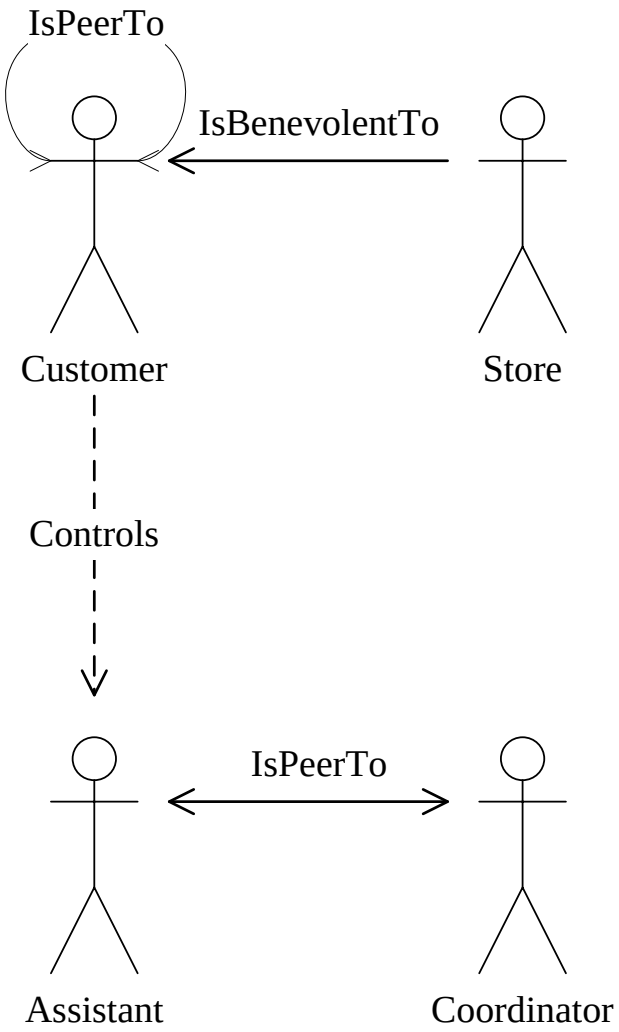
# Software, hardware, humans, …?

- We now need to decide the *software system boundary* of the socio-technical system

# Software system boundary for smart parking



# Software system boundary for fair grocery shopping



# Agents

- We now need to decide the types of components – agents – of the sociotechnical system
- Why agents?
  - Proactivity
  - Reactivity
  - Social nature

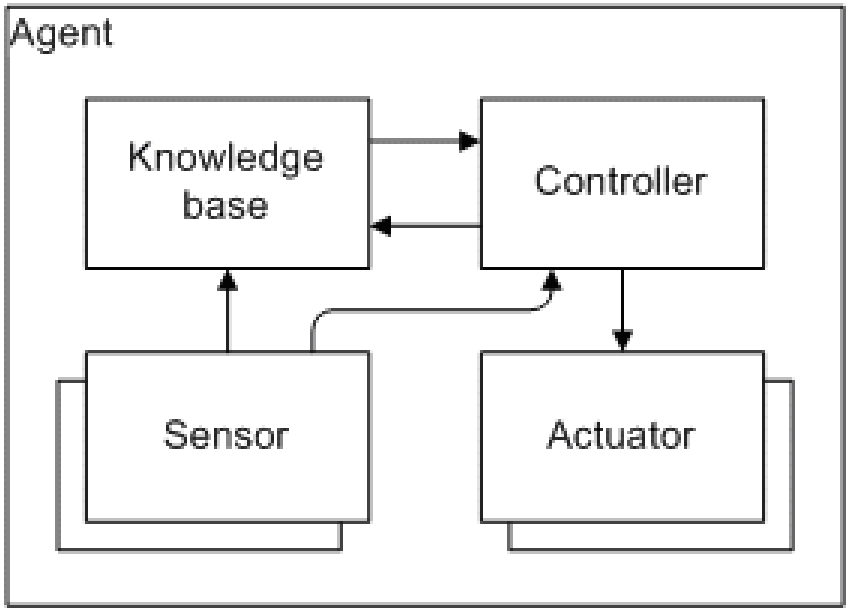
# What is agent?

- An active entity as opposed to a passive entity
- An entity that can act in the environment, perceive events, and reason
- An entity that acts on behalf of someone or somebody

# Agent

- Agent is an entity that perceives and affects its environment and performs reasoning
- Agent is:
  - reactive;
  - proactive;
  - social.
- Agent interacts in an asynchronous way

# The abstract agent architecture



# The execution loop of an abstract agent

***while*** *the agent is unfulfilled* ***do***
*sense the environment;*
*update the knowledge base;*
*reason;*
*choose actions;*
*act;*
***end while***

# What is intelligent agent?

- An agent that is reactive, proactive, and social
- Examples

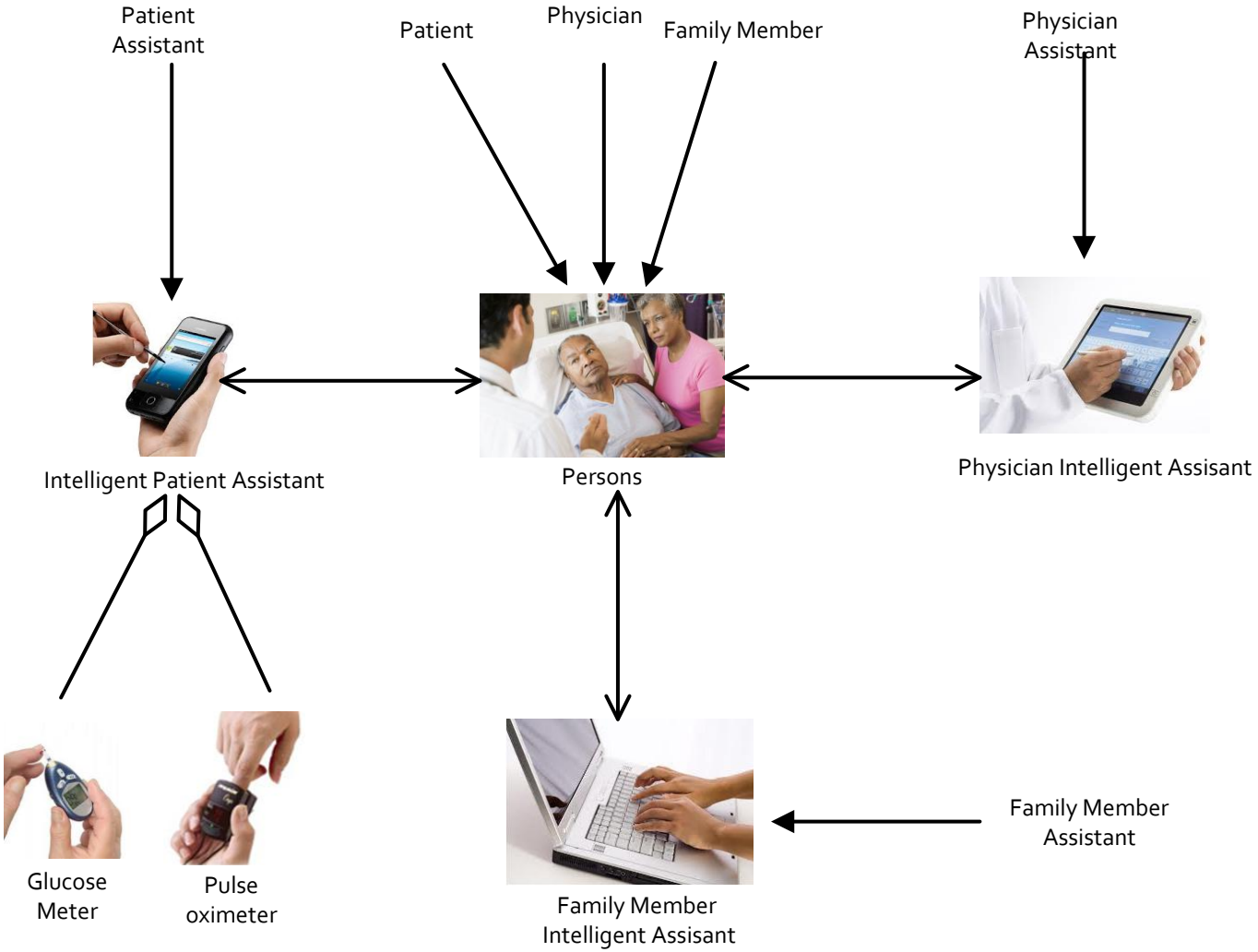
# Anthropomorphic qualities

- Beliefs
- Responsibilities
- Expectations
- Capabilities
- Goals
- Desires
- Intentions

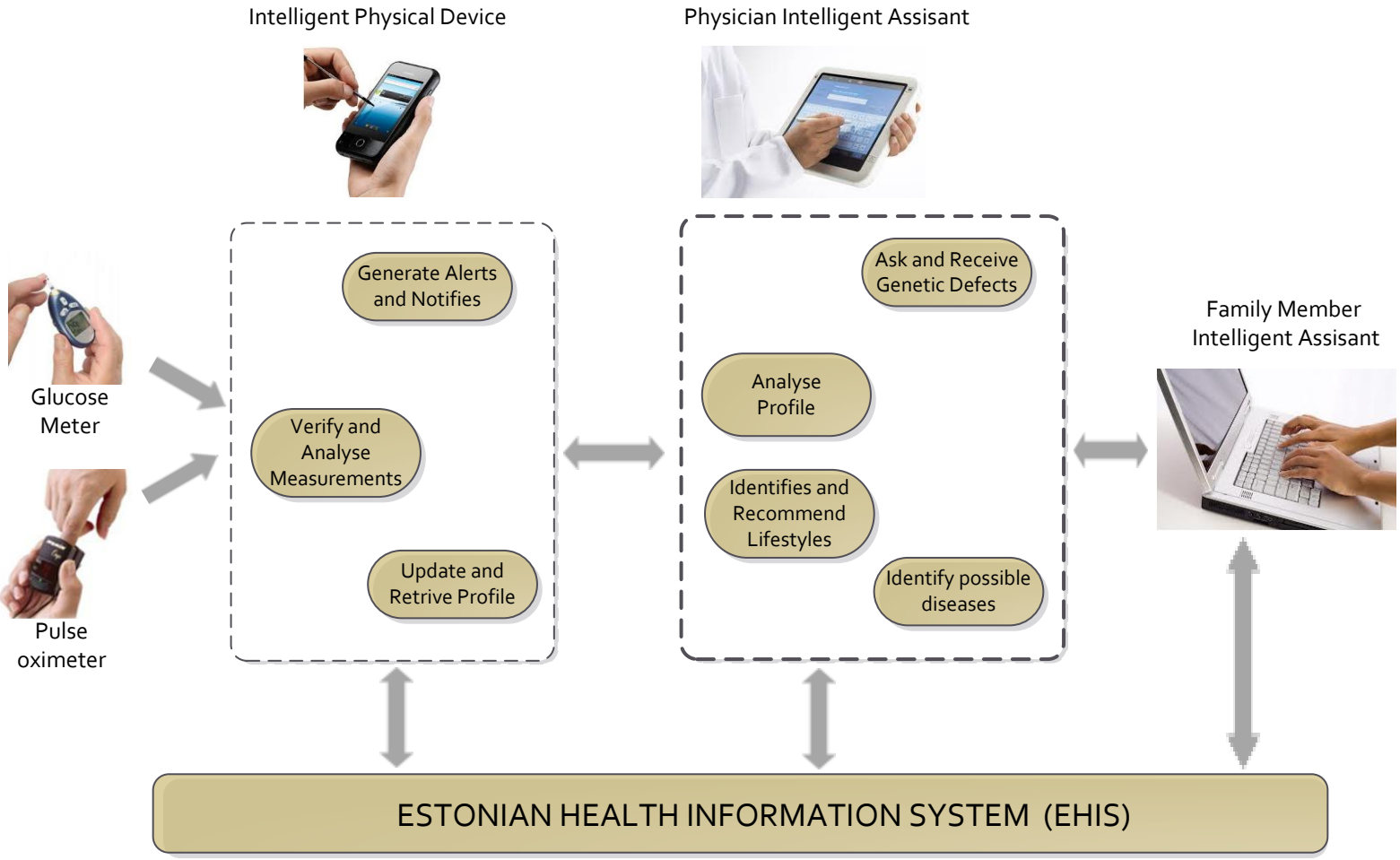
# Mobile devices

- Personal
- Social
- Are aware of their location at least up to the granularity of a GSM cell
- Can perceive their immediate environment through embedded light, sound, and motion sensors

# Mapping roles to agents in the individualized healthcare system



# Architecture of the individualized healthcare system



# The execution loop of an abstract agent

***while*** *the agent is unfulfilled* ***do***
*sense the environment;*
*update the knowledge base;*
*reason;*
*choose actions;*
*act;*
***end while***

# A part of the execution loop of the tourist advisor

***while*** *the tourist advisor is unfulfilled* ***do***
*determine the location;*
*find sightseeing spots;*
*point out sightseeing spots;*
*If (sightseeing spot matches with the tourist profile and has high rating)*
*recommend the sightseeing spot;*
***end while***

# A part of the execution loop of the parking assistant

***while*** *the parking assistant is unfulfilled* ***do***
*perceive parking;*
*determine the location;*
*find the parking service provider;*
*negotiate parking fee;*
*start parking;*
***end while***

# A part of the execution loop of the monitor

***while*** *the monitor is unfulfilled* ***do***
*perceive blood glucose level;*
*analyse blood glucose level;*
*if (blood glucose level is high)*
*alert intelligent patient assistant;*
***end while***

# Teamwork

- Create a part of the execution loop for the main software component of your product idea