DCGI
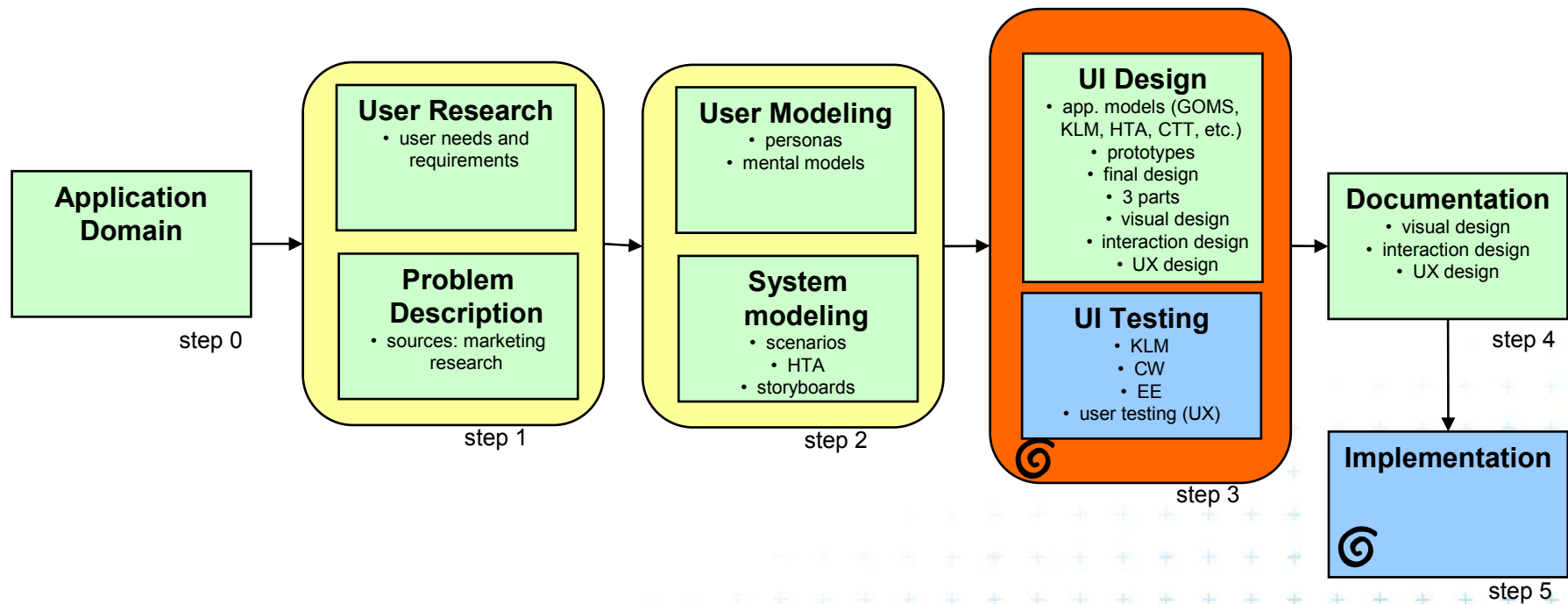
DEPARTMENT OF COMPUTER GRAPHICS AND INTERACTION

NUR –Intelligent User Interface

User interface design - big picture

Application Domain

step 0

User Research
- user needs and requirements

Problem Description
- sources: marketing research

step 1

User Modeling
- personas
- mental models

System modeling
- scenarios
- HTA
- storyboards

step 2

UI Design
- app. models (GOMS, KLM, HTA, CTT, etc.)
- prototypes
- final design
- 3 parts
- visual design
- interaction design
- UX design

UI Testing
- KLM
- CW
- EE
- user testing (UX)

step 3

Documentation
- visual design
- interaction design
- UX design

step 4

Implementation

step 5

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Problems during communication between the user and the system

- The user often inserts information that has been already inserted into the system

- The user often inserts information that could be derived by the system (based on already existing information in the system)

- Solution is usage of certain intelligence embedded in the system

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Reasons for introduction of IUI

- Computer applications grow increasingly complex and through the use of artificial intelligence technology software systems begin to achieve the ability to reason and make decisions on their own

Intelligent UI

- Main issues addressed by intelligent user interface research are the following:

  - How can interaction be made clearer and more efficient?

  - How can interfaces offer better support for their users' tasks, plans, and goals?

  - How can information be presented more effectively?

  - How can the design and implementation of good interfaces be made easier?

Intelligent User Interfaces

- Intelligent User Interface (IUI) - a bridge between user and machine that aims to improve the efficiency, effectiveness and naturalness of interaction by representing, reasoning, and acting on models of the user, domain, task, discourse, and media.

- User/Agent Model - a representation of the knowledge, beliefs, misconceptions, preferences, goals and plans, cognitive styles, etc. of an individual

Intelligence - reasoning

- Derivation of a new knowledge (not previously contained in the system)

- New knowledge is based on the existing knowledge

- Example?

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Intelligent versus Intuitive Interfaces

- Interface - a device that bridges different systems, people, ideas, etc. (interpretation and generation)

- Intuitive - having immediate mental perception or understanding (natural, no training)

- Intelligent Agent(s) - capable of communicating and reasoning (user, task, dialogue, information, media)

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Intelligent user interfaces (IUI)

- Systems that provide interactive support based on embedded AI mechanisms

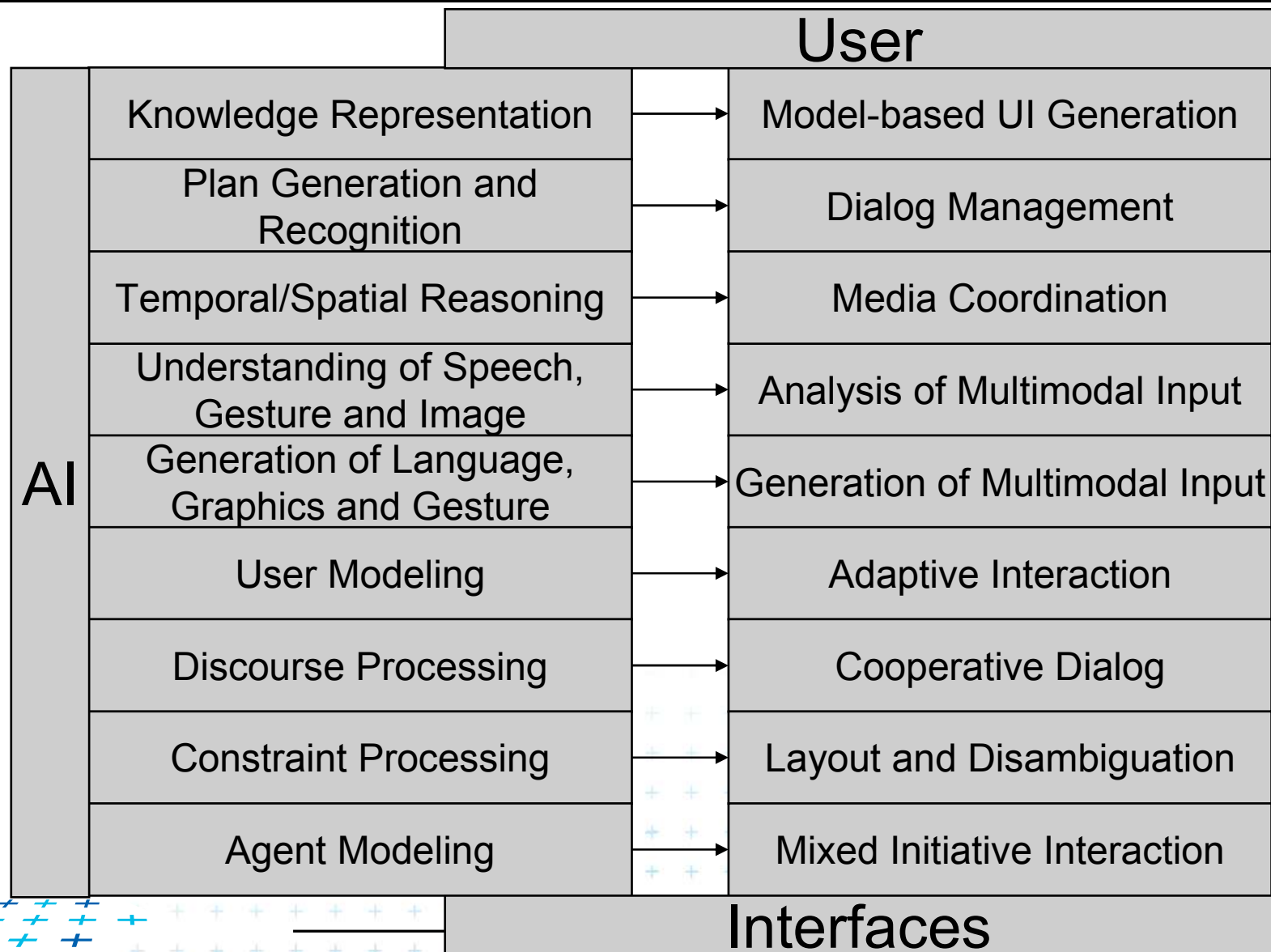- Interfaces to AI functionality and knowledge representations

Examples of IUI

- Adaptive systems

- Cooperative problem-solving systems

Traditional UI architecture
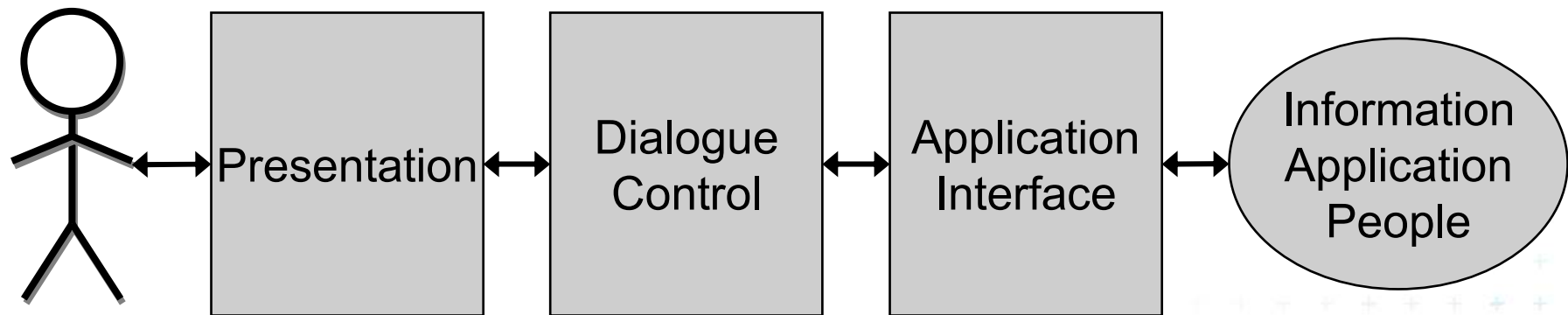
Intelligent UI architecture

AI		User
	Knowledge Representation →	Model-based UI Generation
	Plan Generation and Recognition →	Dialog Management
	Temporal/Spatial Reasoning →	Media Coordination
	Understanding of Speech, Gesture and Image →	Analysis of Multimodal Input
	Generation of Language, Graphics and Gesture →	Generation of Multimodal Input
	User Modeling →	Adaptive Interaction
	Discourse Processing →	Cooperative Dialog
	Constraint Processing →	Layout and Disambiguation
	Agent Modeling →	Mixed Initiative Interaction

Interfaces

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User Model used in IUI design

- Any information which a program has which is specific to a particular user

- The information itself could range from a simple count of errors, to some complicated data structure which purports to represent relevant parts of the user's knowledge of the problem domain

Acquisition of User Model

- Model based on a combination of:
  - Observations of system use
    - statistical history
    - chronological history
  - Self-assessment
  - Testing

- How can model evolve over time?
  - Any of the above

Natural human-computer communication

- The human has a feeling that he/she communicates with another human being

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Turing test

- Test whether we discover that our partner is a computer
- Behavioral view of intelligence
  - A behavior capable of fooling a human interrogator
- Acting humanly is sufficient to pass the test
  - Is it necessary the AI system also thinks humanly?

The interrogator

?
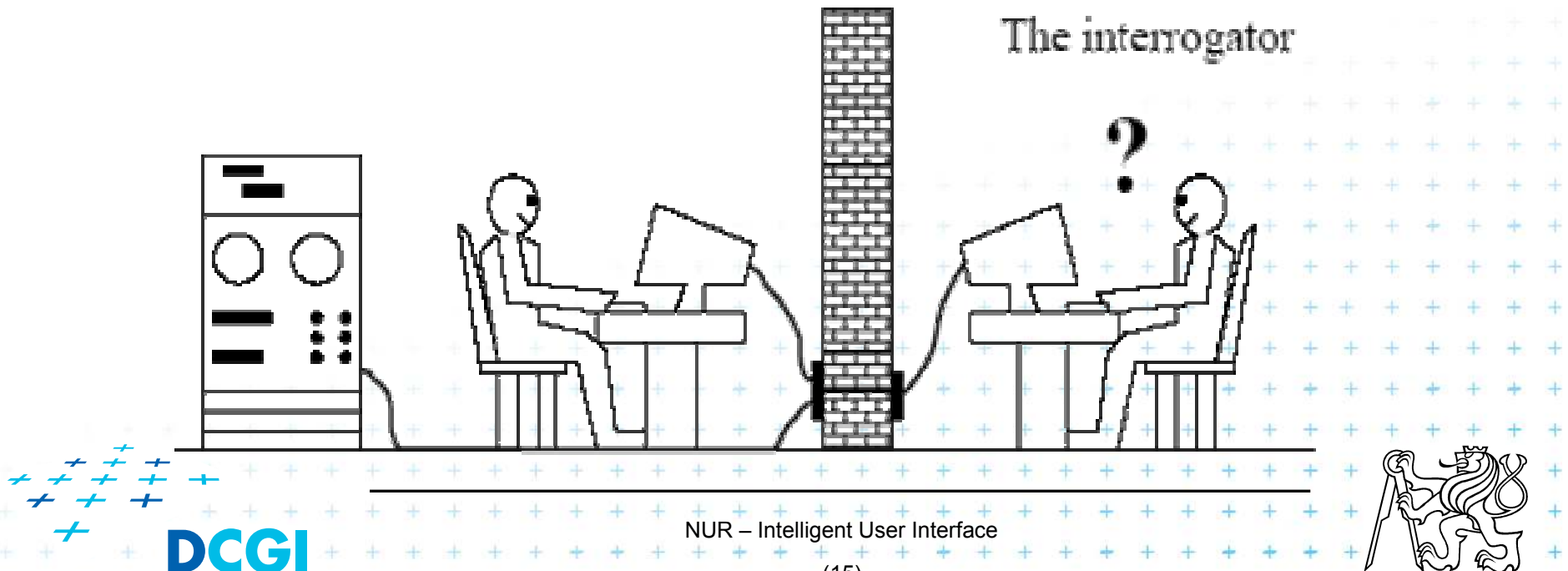
Example of an "intelligent" system

- Eliza – end of sixties (http://www-ai.ijs.si/eliza/eliza.html)
- Computer plays an psychoanalytics

Eliza: *Hello. I am ELIZA. How can I help you?*

You: I am frustrated by the traffic I have to face every morning.

Eliza: *How long have you been frustrated by the traffic you have to face every morning?*

You: For about a year now.

Eliza: *Please go on.*

You: Why should I go on? Give me some advice.

Eliza: *Ca you elaborate on that?*

You: Why? Give me some solution.

Eliza: *Can you elaborate on that?*

You: It is obvious you cannot pass the Turing test

Eliza: *Oh, I can pass the Turing test.*

You: That is correct.

Eliza: *Please go on.*

Goal: the dialog should be natural

- Scheme: the user tells a sentence and the system generates an answer (that looks "natural")

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Eliza

User input

Eliza responses

J:\AI\Eliza\Eliza.htm - Microsoft Internet Ex...

File   Edit   View   Favorites   Tools   Help

Back   →   ✖   🔄   🏠   🔍 Search   ⭐ Favorites

Address J:\AI\Eliza\Eliza.htm   → Go   Links

Norton ✓ ▼   🔒 ▼   😊 ▼

Hi! I'm Eliza. Let's talk.
How are you doing?
Are such questions on your mind often?
Not really
Are you sure?
Computers ar cool
Do computers worry you?
Oh brother!
Tell me more about your family.

Depress the Button or depress <Enter> to send to Eliza

Applet Eliza started   My Computer

Strategies for answer generation

- Keywords in the user sentence are detected and to these keywords proper answers are generated by the system

- Structure of the user sentence is analyzed and if certain pattern is discovered this pattern is used as a part of the generated answer

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Eliza

- **Classified typically expected words into categories**
  - Synonyms
  - Words that should have same response
- **Chose a corresponding response sentence at random**
- **Example: "family" sentences**

```
cq[4] = new ElizaChat();
cq[4].loadkeyword("family");
cq[4].loadkeyword("mother");
cq[4].loadkeyword("mom ");
cq[4].loadkeyword("dad ");
cq[4].loadkeyword("father");
cq[4].loadkeyword("sister");
cq[4].loadkeyword("brother");
cq[4].loadkeyword("husband");
cq[4].loadkeyword("wife");
cq[4].loadresponse("Tell me more about your family.");
cq[4].loadresponse("How do you get along with your family?");
cq[4].loadresponse("Is your family important to you?");
cq[4].loadresponse("Do you often think about your family?");
cq[4].loadresponse("How would you like to change your family?");
```

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Eliza

- **Often echoes back phrases entered by user to appear less canned:**
  - "can you _____" -> "You want me to be able to _____?"

Hi! I'm Eliza. Let's talk.
Can you run on a PC?
You want me to be able to run on a pc? ?
You are very annoying
Do you sometimes wish you were very annoying ?

Eliza

Key phrase to match

```
cq[8] = new ElizaChat();
cq[8].loadkeyword("can you");
cq[8].loadresponse("Don't you believe that I can*?");
cq[8].loadresponse("Perhaps you would like to be able to*");
cq[8].loadresponse("You want me to be able to*?");

cq[9] = new ElizaChat();
cq[9].loadkeyword("can i");
cq[9].loadresponse("Perhaps you don't want to*");
cq[9].loadresponse("Do you want to be able to*");
cq[9].loadresponse("Have you ever attempted to*");

cq[10] = new ElizaChat();
cq[10].loadkeyword("you are");
cq[10].loadkeyword("youre");
cq[10].loadresponse("What makes you think I am*?");
cq[10].loadresponse("Does it please you to believe I am*?");
cq[10].loadresponse("Perhaps you would like to be*");
cq[10].loadresponse("Do you sometimes wish you were*?");
```

Echo back all words in sentence after the key phrase

Alternative methods

- Johnston's algorithm

- It is based on randomness (example?)

- Various strategies can be combined

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Remember johnstone's "algorithm"

- If the last two answers were "No," then answer "Yes."

- Else, if more than 20 total answers, then answer "Yes."

- Else, if the question ends in vowel, then answer "No."

- Else, if question ends in "Y," then answer "Maybe."

- Else, answer "Yes."

Agents and user interfaces

Agents and IUI

- What is agent?

- Agent types

- Agent application in IUI

- Examples

Agent definition

- Agent is a theoretical concept from AI

- There is no single universal definition of an agent

- Agent in Webster's New World Dictionary: A person or thing that acts or is capable of acting or is empowered to act, for another.
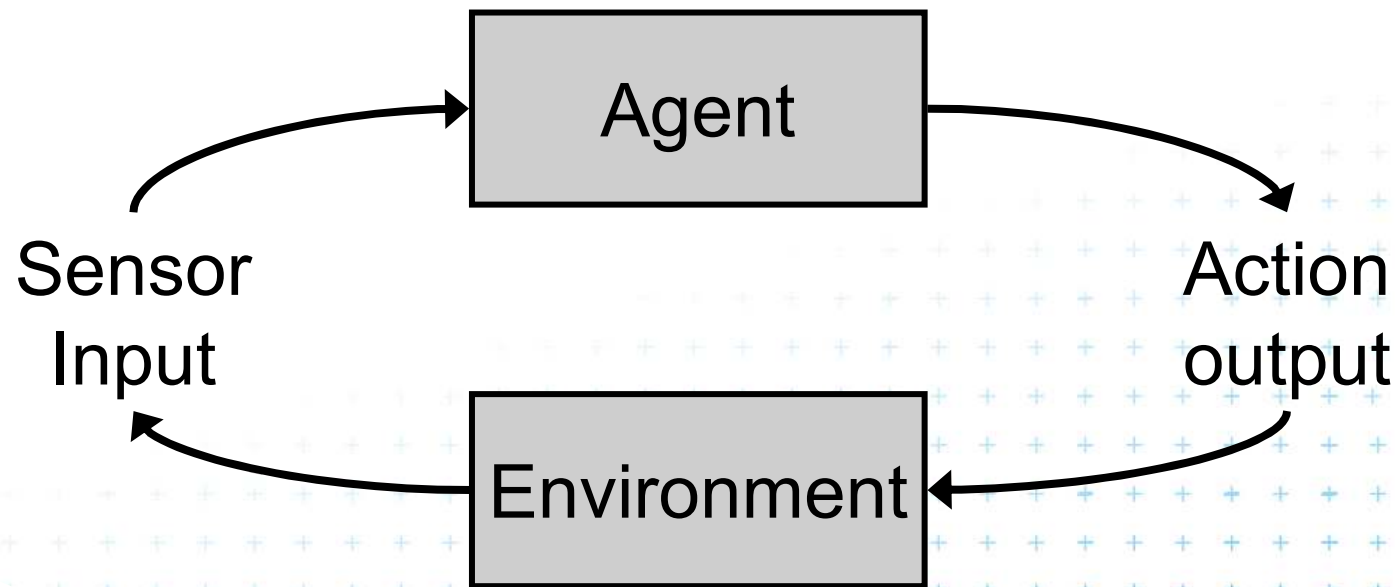
What is an intelligent agent?

- Intelligent agent is a computer system located in certain environment and is capable to react in a flexible way on events in its environment

Agent Types

Intelligent Agents

- **Human agents (Travel agent)**
- **Software agents**
  - **Information agents**
  - **Cooperation agents**
  - **Transaction agents**
- **Hardware agents (robots)**
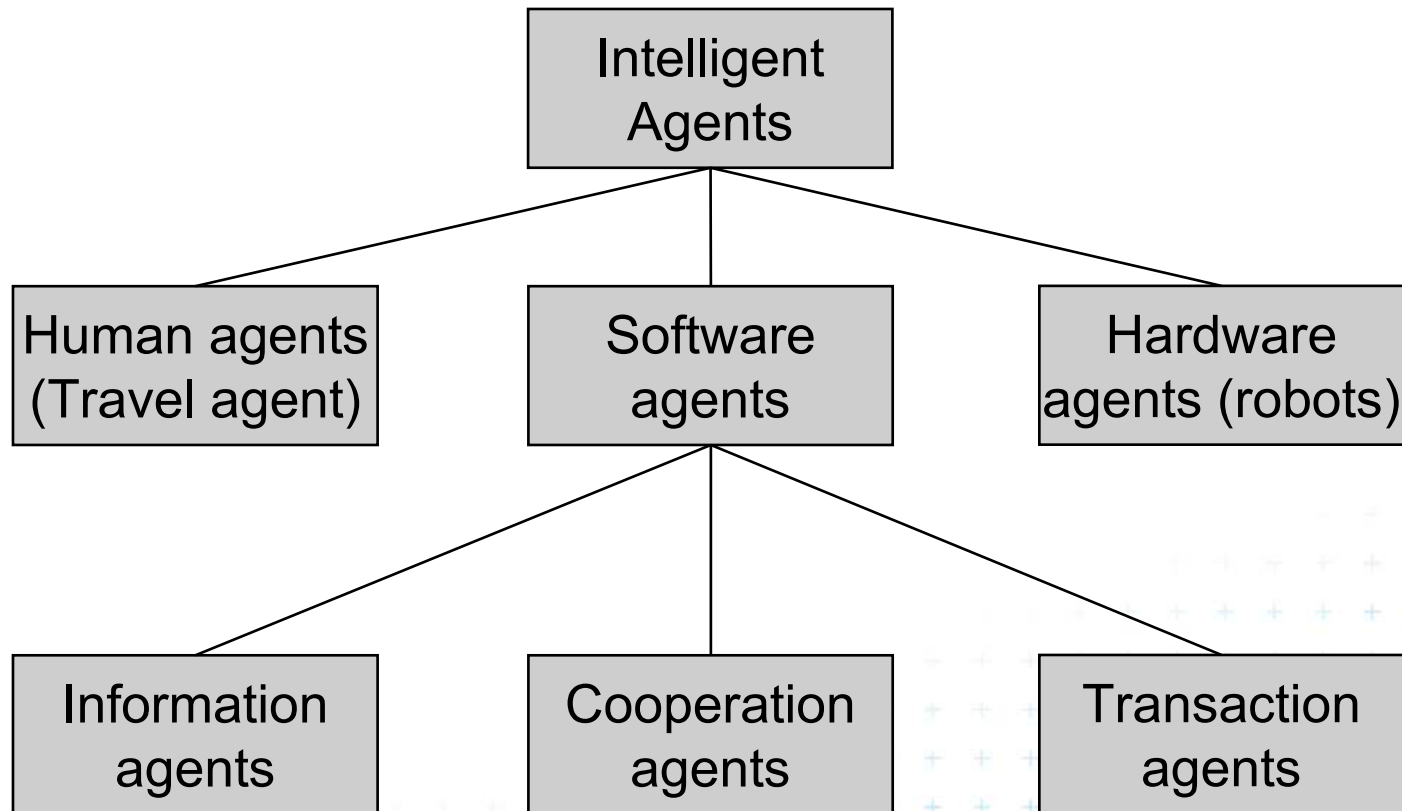
Characteristics of SW agents

Environment

Agent

Autonomy

Mobility

Learning

Proactivity

Character

Reactivity

Goal-oriented

Cooperation

Coordination
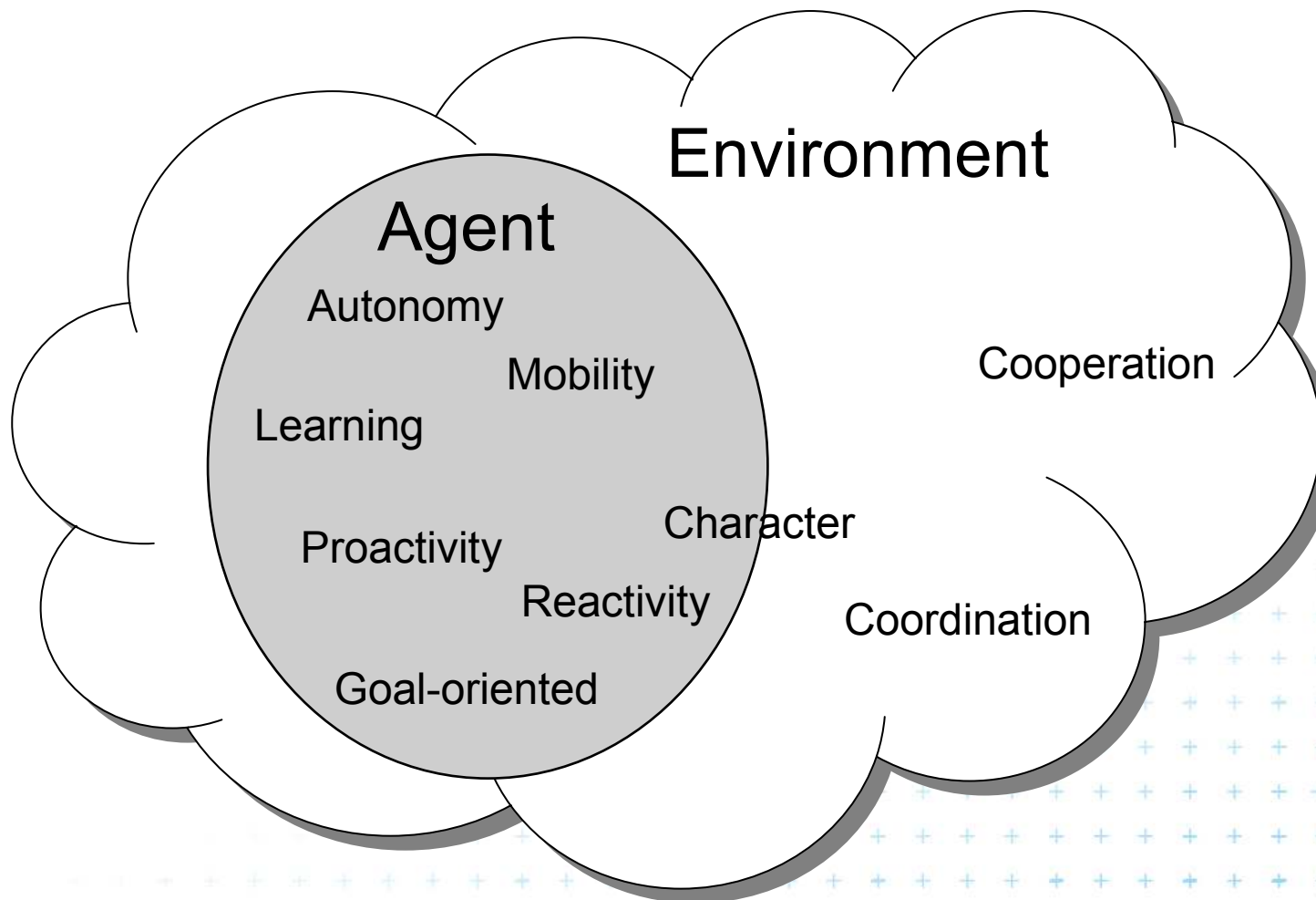
Source: W. Brenner, et al, Intelligent Software Agents

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Software Agents

- One view:

  Software processes that have non-trivial tasks delegated to them which require independent action and a report on the results.

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Issues for Software Agents (1)

- Personification

  - Should agents be represented as a living or animated character?

  - Does it improve adoption of software?

  - Does it create inflated expectations?

  - Is it just too annoying?

Issues for Software Agents (2)

- **Trust and Competence**
  - How does user develop an informed level of trust?
  - Can agent give self-assessment on likely outcome of task?

- **Delegation**
  - How can user delegate tasks?
  - How can user check on status of delegated tasks?

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Issues for Software Agents (3)

- ## Control

  - How does user set limits on the agent's activity?
  - When does the agent get to interrupt the user (mixed-initiative dialog)?

- ## Dealing with multiple agents

  - How can the user manage many agents?
  - How can interactions between agents be predicted?

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Autonomy

- Agent's activities are autonomous (no statements from the user)

- Properties of an agent: mobility, ability to communicate, ability to learn, …

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Reactivity

- Reactivity = proper reaction on events from environment

- Environment = other agents, people, information resources, physical objects

- Agent must have sensors (to identify evens in environment) and internal model (to interpret events properly)

Proactivity

- This occurs in situations when an agent should perform some action without any previous event detected.

- This capability demands existence of predictive capability

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Intelligence (necessary attributes)

- Reasoning: agent monitors environment and takes decisions (based on changes in the environment)

- Learning: agent's behavior is improving (based on previous experience)

- Adaptability: agent is able of adaptation to changes in its environment (robustness)

Mobility

- Agent mobility = "traveling" from one computer to another one

Cooperation with other agents

- Cooperation between agents makes possible to solve the problems much faster (usually the solution is better)

- Language for cooperation description

Agents and emotions

- Agents can communicate with people. It is desirable to humanize the agents

Why agents in UI

- In many situations problems are solved in an environment behavior of which is not well defined (autonomous decision should be taken)

- Agents can serve as "personal assistants" supporting the user

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Agents in user interfaces

- **Agents learn**
  - monitoring user's behavior (and they use behavioral patterns)
  - feedback from the user
  - question to other agents

- **Example**
  - e-mail filter
  - purchase of ticket

Interface agent architecture

Interaction with → **User**

Application

Observes
and imitates

User feedback and
programming by example

Interacts with

Asking
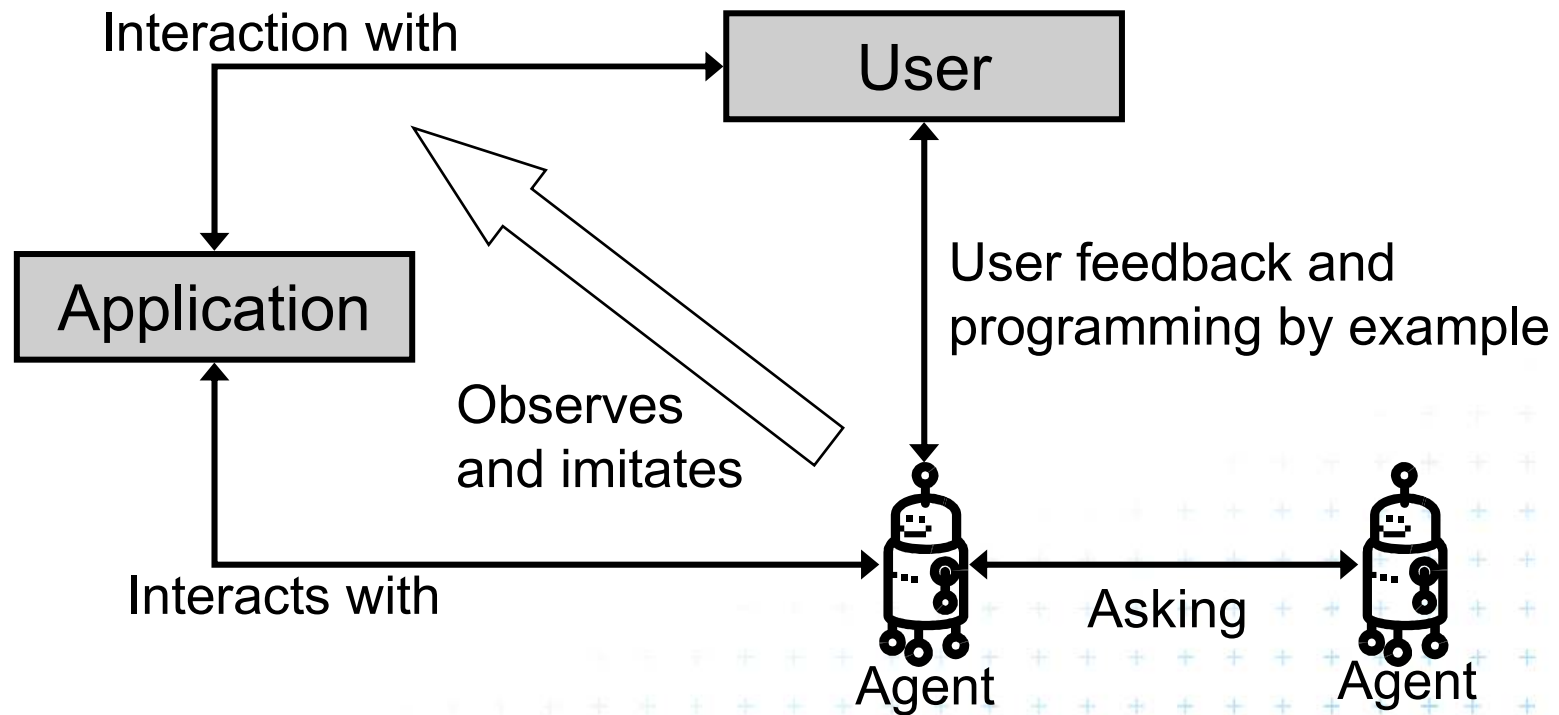
Agent

Agent

Personalized Interface Agents
for Virtual Web pages

Real system example - project DFKI
(Deutsches Forschungszentrum fuer Kuenstliche Intelligemz)

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What are Agent-based User Interfaces?

- appear as life-like characters
- plan interactive behavior autonomously
- can initiate interaction

ACTIVE

INTER-ACTIVE

INTERFACE AGENTS

RE-ACTIVE

PROACTIVE

- understand the user's requests
- answer clarification questions
- allow mixed initiative dialogs
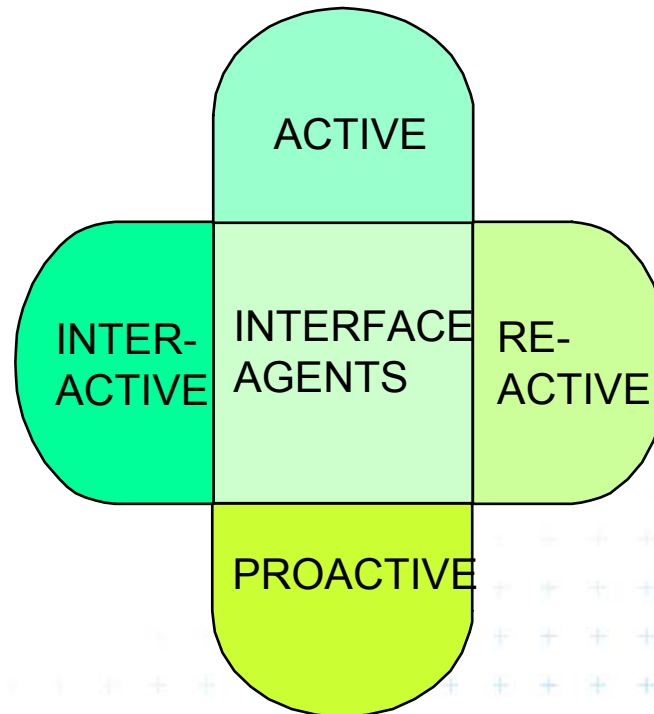
- respond immediately to interruptions
- criticism and clarification questions
- direct manipulation

- anticipate the user's needs
- adopt the user's goals
- provide unsolicited comments

DCGI

Virtual Webpage Augmented by Persona

Portsmouth Map
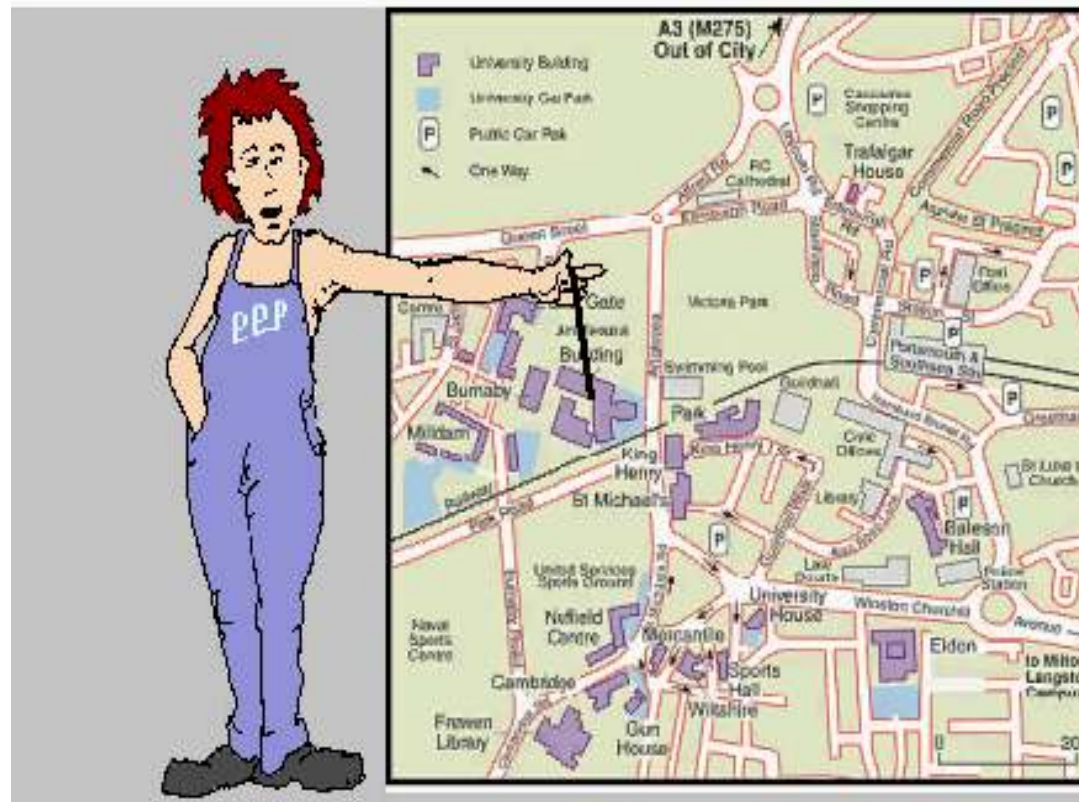
Enhancement of User Interfaces through Personalization

System is able to flexibly tailor presentations to the individual user and the current situation.

An animated character serves as "Alter Ego" of the presentation system.

Personalized Presenters at DFKI

Persona as a Personal Travel Consultant
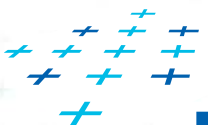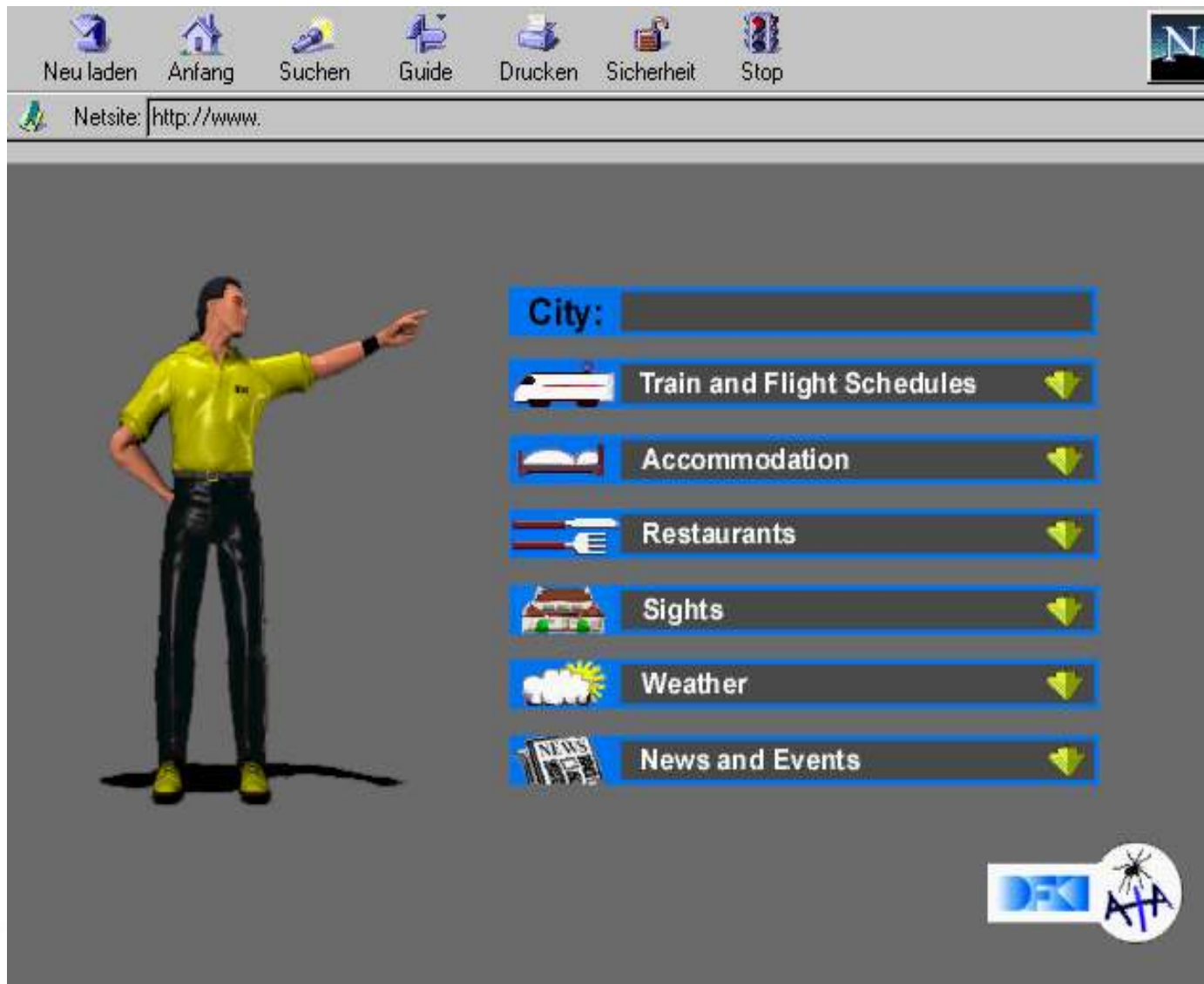
Personalized Package Presentation by an Animated Agent

- Personalization = adaptation of system behavior according to a user model

- Personalization = the "agent" appears as animated character which presents, explains and comments an offer, and to which the user can talk to.
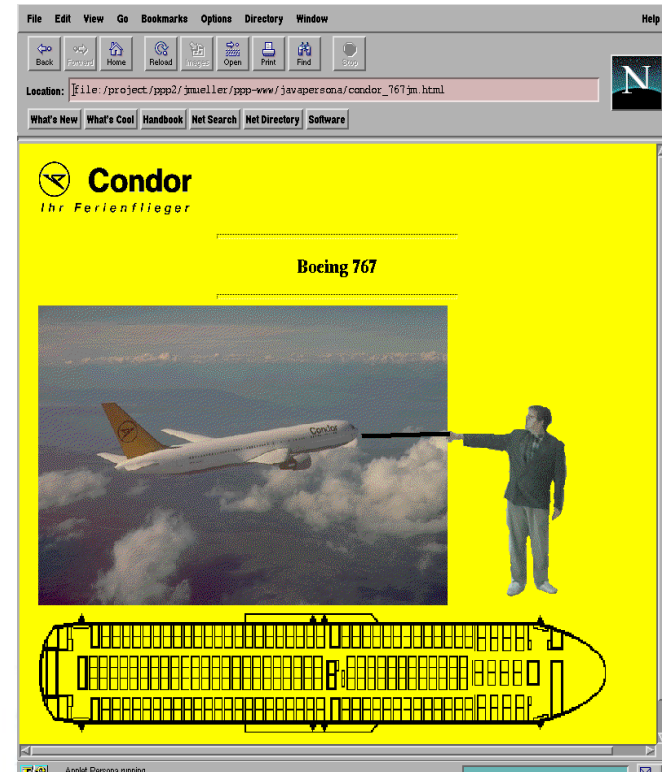
Video Character Presents the Interior of a Boeing 757
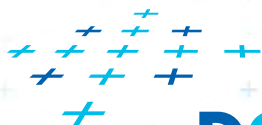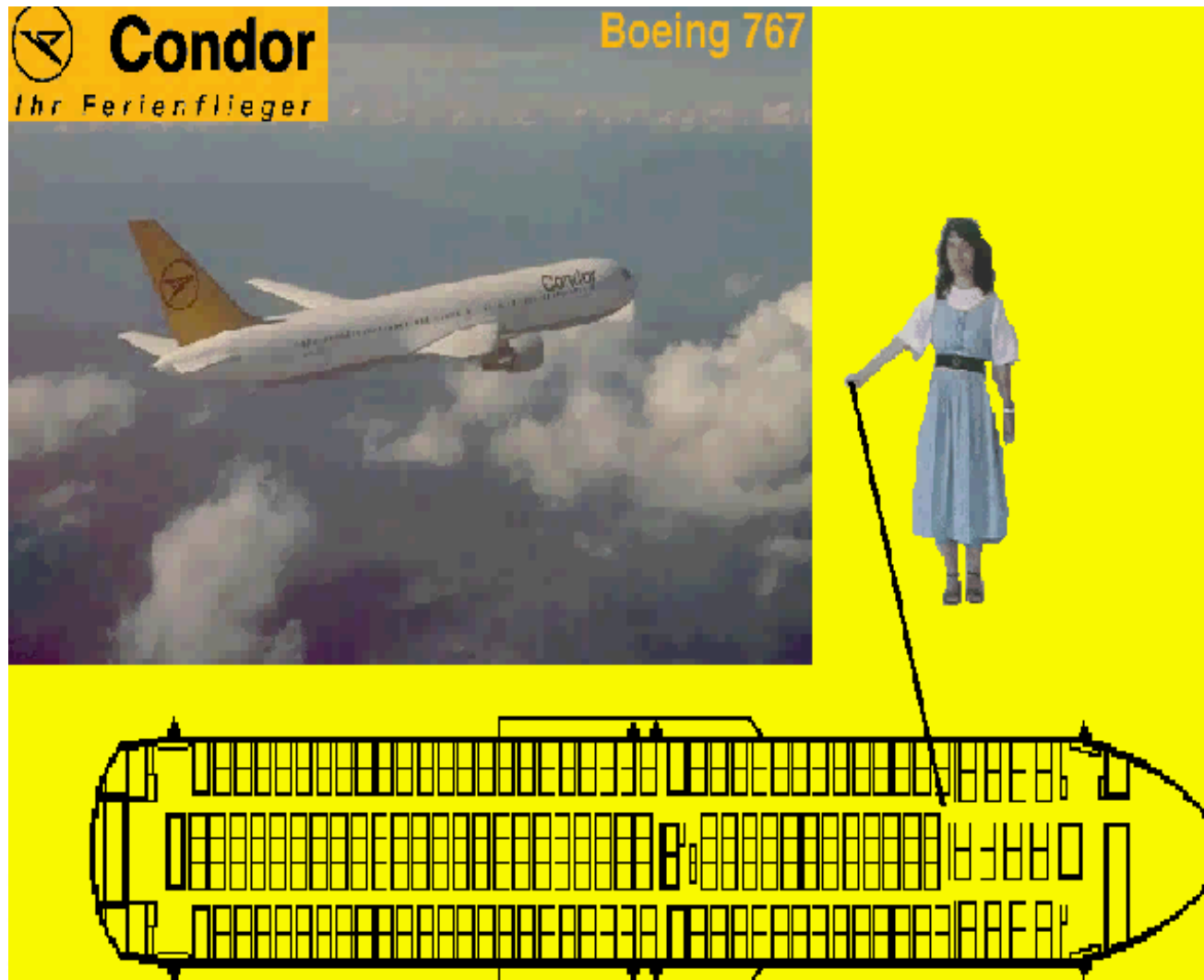
Reactive Behavior of the Persona Agent

In this particular projects the Agents are called Persona.
Do not confuse with Persona as a user model!

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Behaviors

- Presentation Gestures
- Reactive Behaviors
- Idle-time actions
- Navigation actions

Auditory Characteristics

- Sound effects, auditory icons
- Voice: male, female

Persona Server

## Visual Appearances

Hand-drawn Cartoon Bitmaps

Video Bitmaps

Generated Bitmaps from 3D-Models

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The frames of the visual appearance of persona can be cartoon-like images or video-frames which show real persons

More than 200 cartoon frames were drawn by a professional artist.
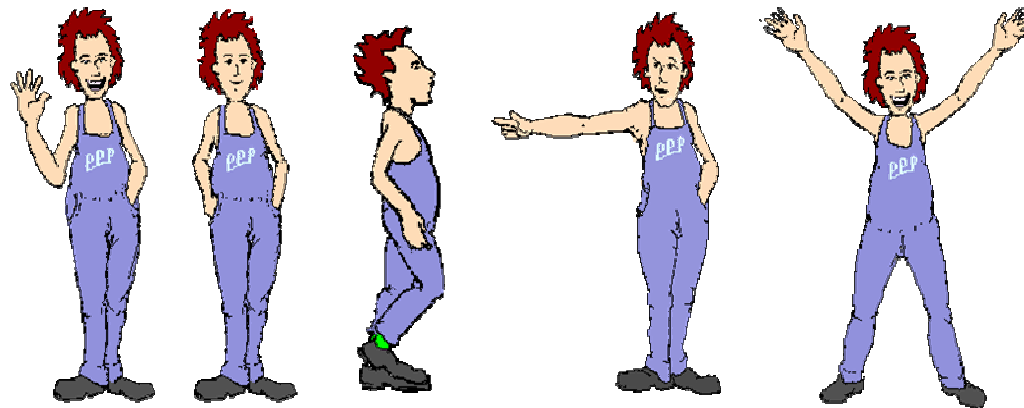
A real persona was filmed with a video-camera and the pictures were digitized with a frame grabber.

DCGI
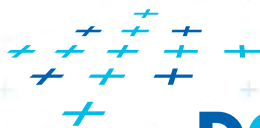
The Persona Editor
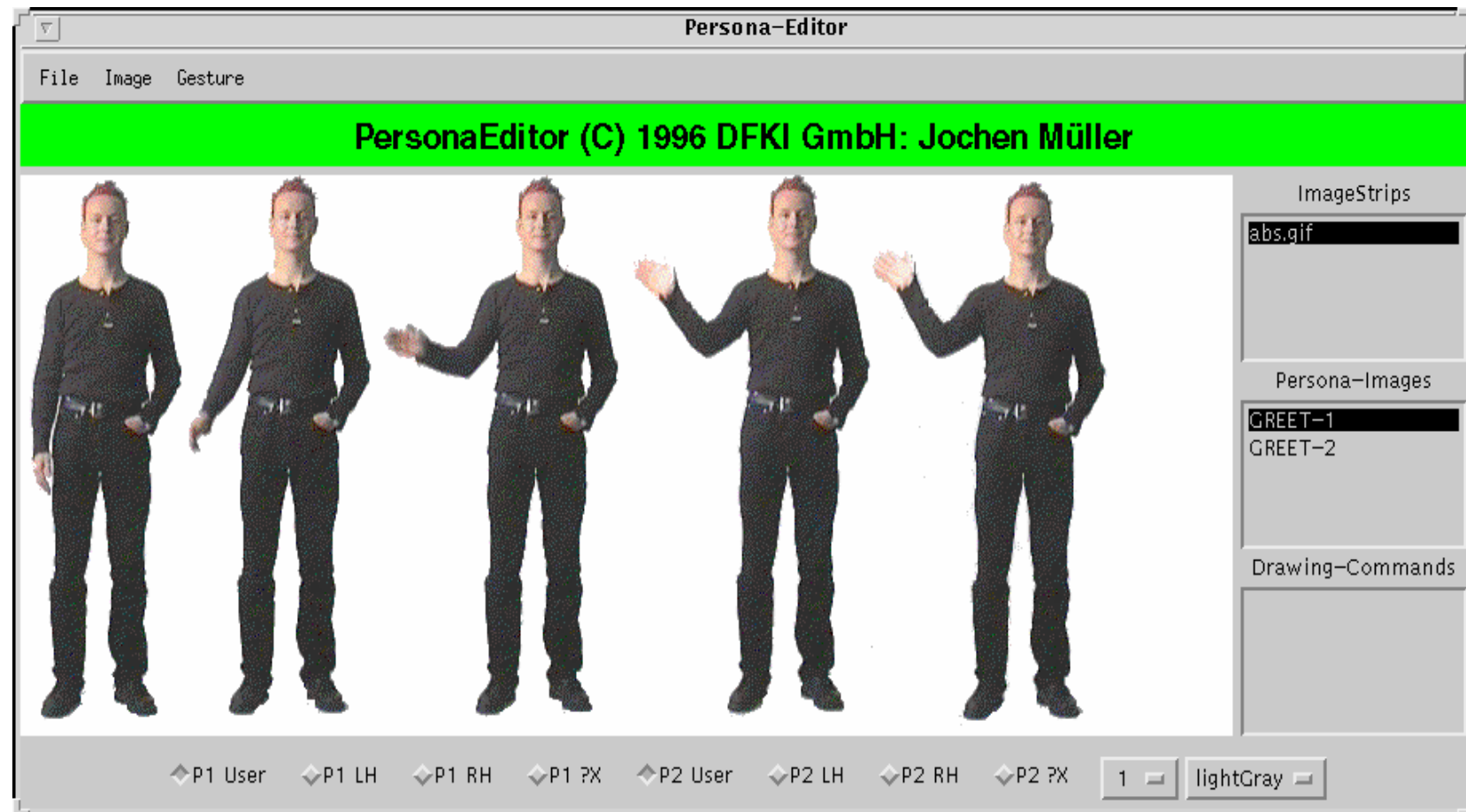
Context-Sensitive Decomposition of Persona Actions

High-Level Persona Actions

| take-position (t$_1$t$_2$) | | point-to (t$_3$ t$_4$) |

Context-Sensitive Expansion
(including Navigation Actions)

| move-to (t$_1$ t$_2$) | | r-stick-pointing (t$_3$t$_4$) |

Decomposition into Uninterruptable Basic Postures

r-turn (t$_1$ t$_{21}$)

r-step (t$_{21}$ t$_{22}$)

r-hand-lift (t$_3$ t$_{31}$)

f-turn (t$_{22}$ t$_2$)

r-stick-expose (t$_{31}$ t$_4$)

Bitmaps

Persona Presents an Automatically Designed Business Chart
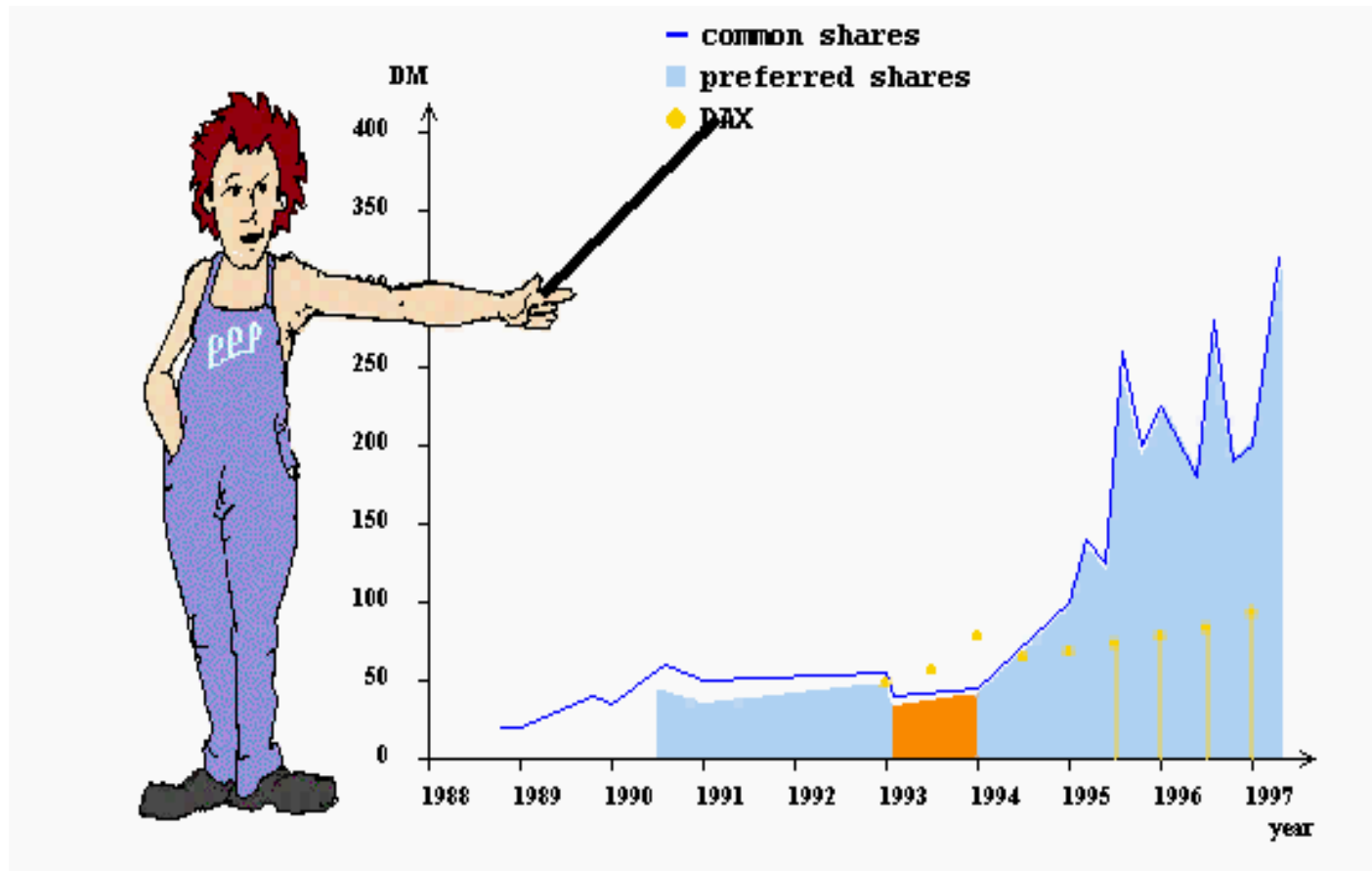
Functional View of PET

Bitmaps

Webpage with Reference to Java Applet

URL of Webpage with Persona Tag

```
<html>
<head>
<title> Persona Test </title>
</head>
<body>
<persona bitmap="cartoon"
...>
<uselib url= .../>
<do name="greet"/>
<do name="standard"/>
<do name ="speak"
args="hello"/>
</persona>
</body>
</html>
```

PET Application Server

PET Parser

PET Generator

```
<html> ...
<APPLET
archive="personaplayer.jar"
...</APPLET>
...</html>
```

Persona Scripts

```
waitscreen 4
gesture greet 0 0 null
gesture laugh 0 0 null
...
```

Persona Engine

Behavior Monitor

Event Handler

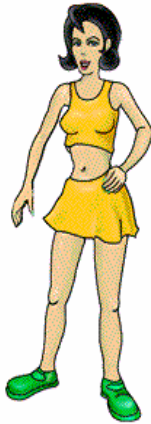Character Composer

Audio Data

face

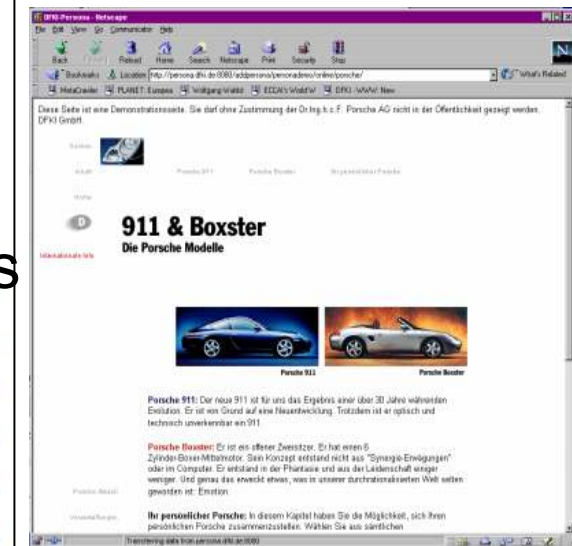# The Bidirectional Control Flow on Persona-Enabled Web pages

Triggers

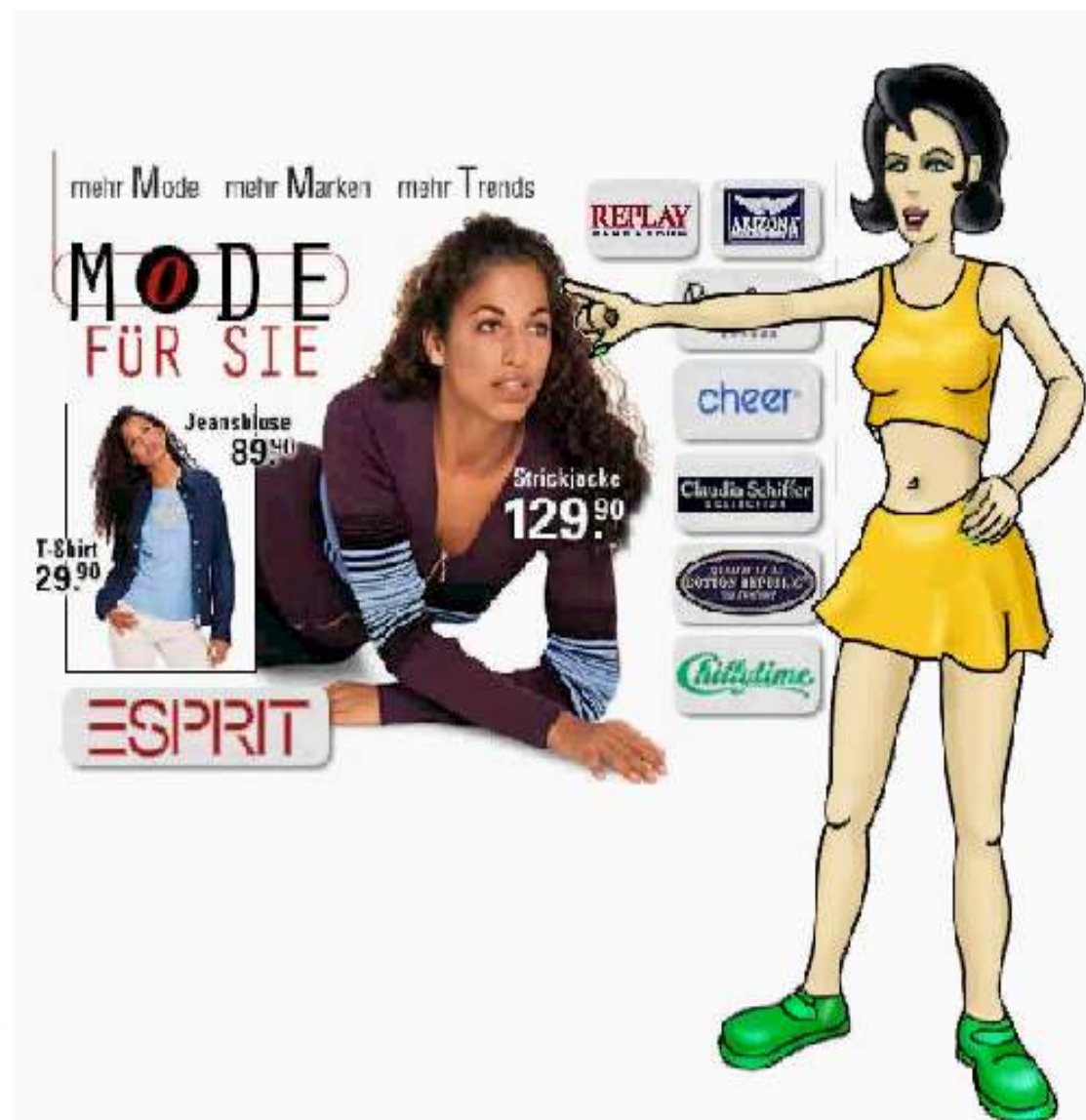actions of the Persona

- Mouse Clicks
- Mouse Movements

- Text Input
- Speech Input
- Menu Input
- Direct Manipulation Input

Triggers

operations on elements

of the webpage

Web Persona

# Use of a Life-like Character for Electronic Commerce

Use of a Life-like Character for Electronic Commerce

# Personified Agents Increase the User's Trust in the System's Presentation

Experimental evidence for effects of modality on the user's trust (van Mulken, 1999)
The system gives recommendations, which turn out to be wrong in some cases. How much does a user trust the system's advice depending on the modality of a presentation?
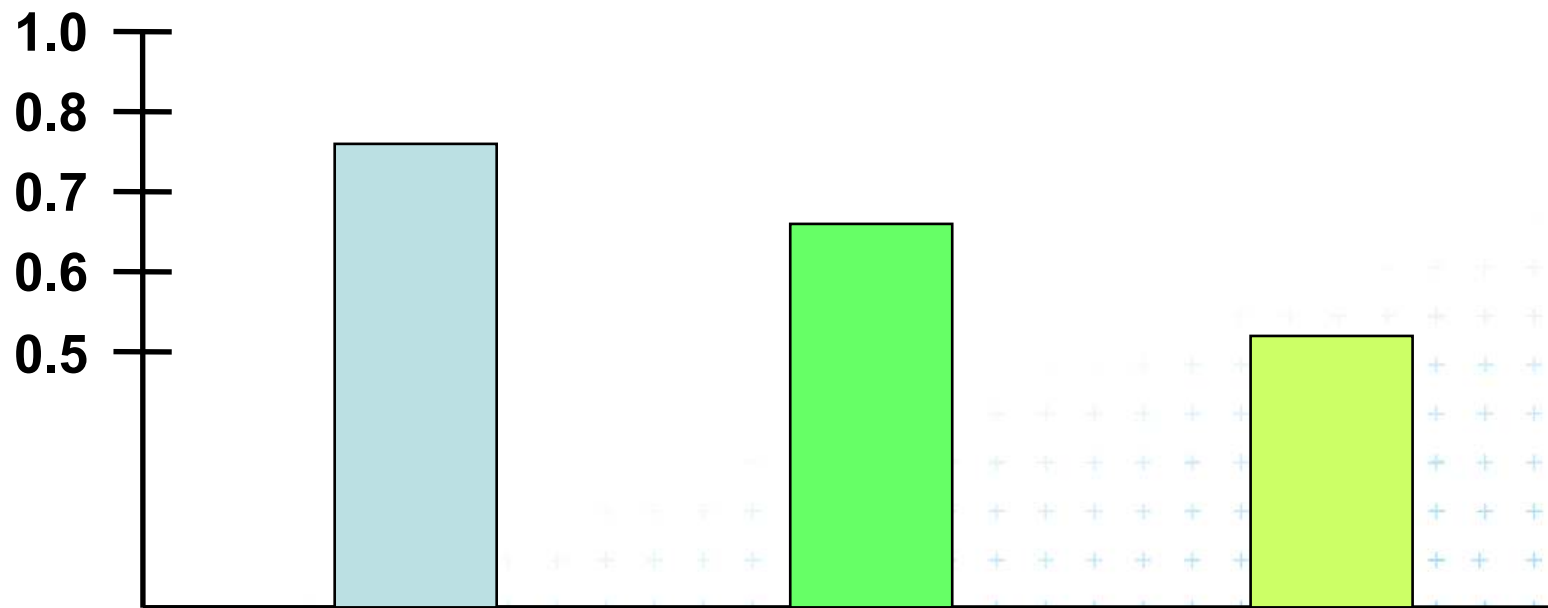
Self-animated Persona, Speech, Gesture, Facial Expression, Pointing | Speech, Graphical Highlighting | Text, Graphical Highlighting
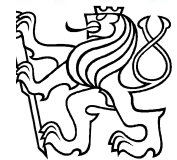
Impact of the modality of a Presentation on the User's Trustfulness

Result: **Persona** > **Speech** > **Text**
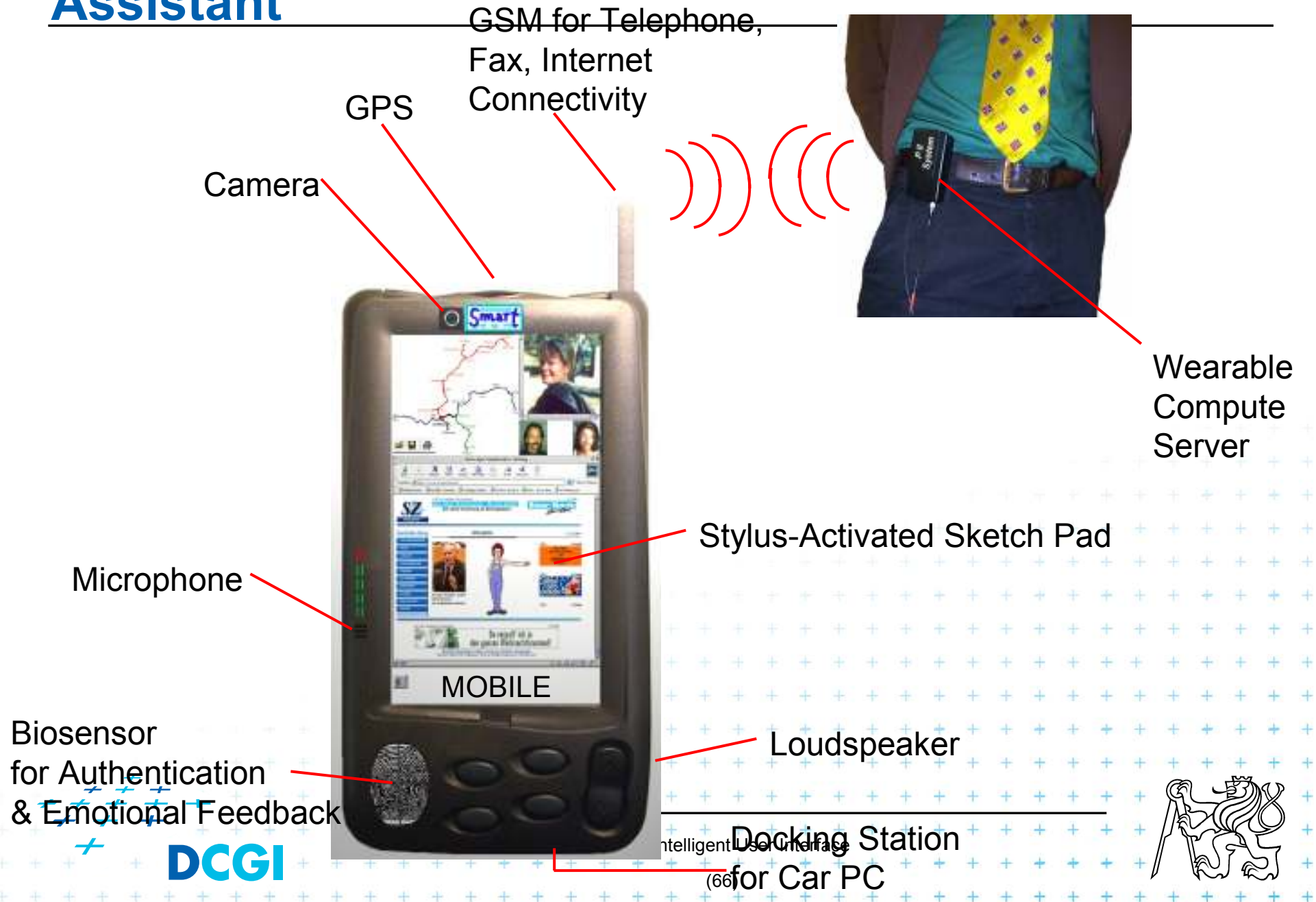
Conclusion: If the presentation is more human-like, recommendations are more readily followed

For   ● decision support systems
       ● tutoring systems
       ● recommendation systems
       ● virtual sales agents

personified interface agents have a clear advantage:
They increase the user's trust in the information presented by the system

SmartKom-Mobile: A Handheld Communication Assistant

GSM for Telephone, Fax, Internet Connectivity

GPS

Camera

Wearable Compute Server

Stylus-Activated Sketch Pad

Microphone

MOBILE

Biosensor for Authentication & Emotional Feedback

Loudspeaker

Docking Station for Car PC

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SmartKom-Home/Office: A Versatile Agent-based Interface

SpeechMike

Virtual Touchscreen

Natural Gesture Recognition

Use of a Life-like Character for Electronic Commerce

Digital Assistant Selector

Thank for your attention

DCGI