Department of Telecooperation

JOHANNES KEPLER UNIVERSITÄT LINZ

Smart Technologies for Smart Ageing

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Overview

- Enabling Technologies
  - Web 1.0, 2.0, 3.0
  - Mobile Devices (miniaturisation, connectivity, sensors)
- "Smart" Technologies
  - from context awareness to proactive support
- Knowledgeable Technologies
  - from leg irons of the 21st century to loyal companions

ENABLING TECHNOLOGIES

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Web 1.0

- Linked documents
- Annotated, structured text / data
- New media types (image, audio, video)

Hypertext

Hypermedia

- Focus on building the web and making it accessible
- But also interest in commercial exploitation (of content and services)

Web 2.0

- No clear definition but emphasis on interaction, sharing and collaboration
  - Social networks, lightweight collaboration, wikis, social bookmarking, media sharing, …
- Ubiquitous access with advances in wireless networks and mobile devices

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Web 3.0

[John Markoff, NY Times, 2006]

- Annotations and metadata allowing machines to understand the web
  - Semantic processing, natural language search, data-mining, machine learning, recommendation agents
- Network / cloud computing
- Aera of cognitive computing systems
  - Process of perception, memory, judgement, learning and reasoning

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Mobile Devices

2000+
The Phone reaching into the Internet

2003+
Digital Multimedia, Video, Stereo, Audio, Camera, Camcorder, Mobile DTV, Email, SMS, MMS, Office applications, GPS, Wi-Fi, Bluetooth, …

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Mobile Devices

Magneto Meter
Gyro
Location/GPS
Light Sensor
Microphones
Text Messages
Cameras
Phone Calls
Finger Print
Bluetooth
WiFi
e-Mail
NFC
Acceleration
Ant+
Compass

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The Human Face of Mobile

- They are portable
- They are personal
- They are with us almost all the time
- They are easy and fast to use
- They are always on
- They are everywhere!

SMART TECHNOLOGIES

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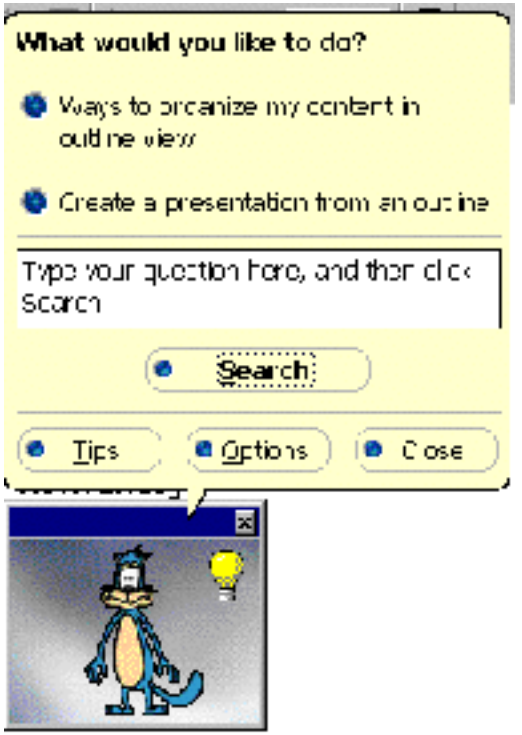
Smart Assistants: Example Microsoft

- trie to help in the use of MS Office programs
- user can choose the appearance of the agent
  - unfortunately, this has no effect on the capabilities of the agent
- A paper clip most likely is a better presentation for the assistant than a Merlin character



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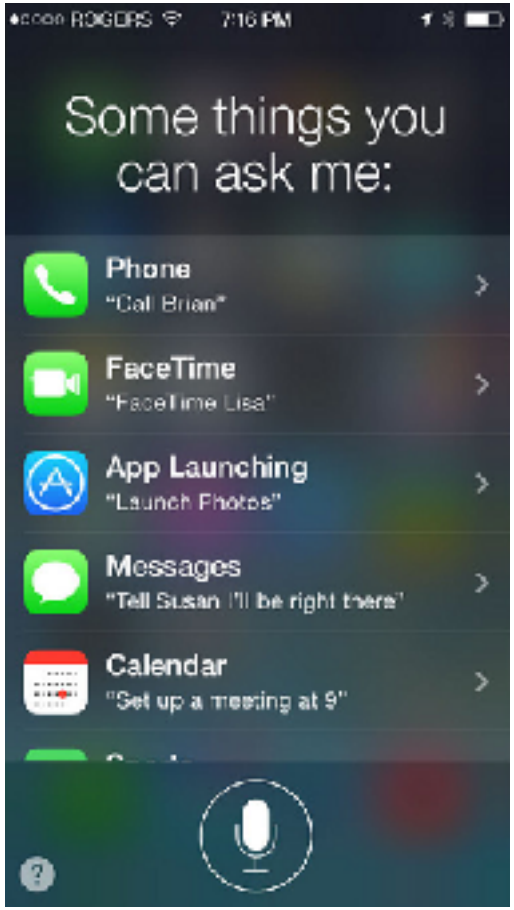
Smart Assistants: Example Siri

- Siri is an intelligent personal assistant and knowledge navigator which works as an application for Apple Inc.'s iOS.
- The application uses a natural language user interface to answer questions, make recommendations, and perform actions by delegating requests to a set of Web services.
- Apple claims that the software adapts to the user's individual preferences over time and personalizes results.



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Can Siri answer this question?

- What nearby restaurant would I like best?
  - What restaurants are nearby?
  - How far is “nearby”? by foot, by cab?
  - Are you in the mood for anything in particular?
  - What do you usually like?
  - How much variety do you like?
  - What restaurants have you been to?
  - what price range suits you?
  - Are you with companions
  - What are their preferences? …

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Connected → Talking → Interacting → Proacting → Smart ????

- Some kind/level of intelligence, but softer, wider and more flexible than “intelligence”
  - aware of their/others/users presence
  - interact intuitively/spontaneously/naturally
  - sensitive, adaptive, interactive to the user needs, capabilities, habits and emotions
  - acting according to rules (common knowledge)
  - adaptive (changes in the environment)
- Identify the important **contextual elements** that help answer the hard questions that normally require human intelligence

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KNOWLEDGEABLE TECHNOLOGIES

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Context – the dictionary definition

- the set of circumstances or facts that form the setting for an event, statement, or idea, and in terms of which it can be fully understood and assessed: the decision was taken within the context of planned cuts in spending.
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Example

Break

- fracture, time-off, good fortune, interruption, escape, etc.,
  - *Let us take a break*
  - *There is a break in the dam*
  - *Don't break my concentration*

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Context „in our Context“

- Associations between a central item of interest and surrounding items
  - Context is coded as metadata describing both the existence of a relationship between two items and the nature of the relationship
  - These relationships form a semantic network with which to clarify the meaning of items in the network

Threads of Context

- Physical Context
  - people, devices, and objects
  - Time, location, light, sound, weather, temperature, physiological state,
  - sensors, cameras, vehicle telematics

Threads of Context

- Social context
  - Communication tools (email, phone, social networks)
  - product rating, website popularity

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Threads of Context

- Behavioral context
  - patterns of interaction with devices and services
  - Such patterns detect and predict formalized procedures (work-flows), recurring sequences of actions (routine tasks and typical locations), types of motion (walking, running, and standing). tasks (having dinner, washing clothes, and fixing the car), and goals (socialize, hire, sell, or simply enjoy)

From Context to Awareness

- Physical awareness
  - identifying where people and things are relative to each other
- Preference awareness
  - characterizing the typical tastes and interests of a person or group
- Rhythm awareness
  - Predicting temporal patterns (arrival and departure times, times of events, and durations of tasks)

From Context to Awareness

- Receptivity awareness
  - detecting a person's mental receptivity to intrusion, interruption, and information
- Goal awareness
  - inferring the overarching goal or purpose of an individual
- Relationship awareness
  - identifying how set of facts, information sources, and people relate to each other
- Activity awareness
  - knowing the sequence of actions that are related to an activity

Context Filtering

- Using associations between the user's current location, time, nearby people and other aspects of a person physical or digital environment (context) to constrain the search space and / or the results of queries
  - location-based search
  - location-based advertising
  - route planning considering current traffic
  - …

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The vision

- Personal assistant who knows your personal tastes, can tell how would you react in any given situation, adjusts for social/political objectives and behaves proactively only when you want them to.
- The analysis and presentation of context can help the human making a decision by providing information she is not otherwise aware of by providing associations among information that she can navigate to find what she needs
- In some instances, systems can proactively anticipate a subset of alternative actions that are most likely to be selected in a given situation
- If the cost of being wrong is low and out-weighted by the benefit of automation, it may be appropriate for the system to proactively take action on behalf of the user reducing user's load

SAGAware systems

Complexity increases with semantic level of contextual inference

Sensors, Digital Information, Usage Data, etc.

Simple — Semantics — Complex

Goal-Aware Systems — Detect likely objective

Semantic Analysis ↑ Objectives

Activity-Aware Systems — Detect sequences of actions, tasks, workflow

Scripts ↑ Plans

Behavior-Aware Systems — Detect that a pattern is in progress

Sequence, Frequency ↑ Proximity, Recency, Recurrence

Context-Triggered Systems — Detect that a change occurred

Location, Sound | Time, People | Information

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Context Triggered Systems

- Systems have awareness of a person's current physical or digital environment and proximity to other items (information, people, places, events).
- Context-triggered systems enable applications that are triggered by a change in physical context and can take immediate action with little or no interaction from the user, because the action to take is agreed upon in advance.

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Context Triggered Systems

- Examples:
  - Motion-sensing light switches
  - Heating, ventilation, and air conditioning
  - Storage of data indexed by context (such as geotagged photographs)
  - Location-based services
  - Asset tracking
  - Reminder systems

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Behavior-aware systems

- Systems detect and use the patterns of an individual's actions in different contexts based on temporal characteristics (such as sequence, duration, frequency, recency, or recurrence).
- "Behavior" can be conscious or unconscious, overt or covert, and voluntary or involuntary, such as typing, walking, standing, holding, turning, clicking, and so on.
- Behavior-aware systems enable applications that infer, and potentially respond to, present behavior without necessarily understanding the user's conscious activity or intent.

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Behavior-aware systems

- Examples:
  - Shopping behaviors (behavioral advertising)
  - Presence patterns (call routing, HVAC and building-management systems)
  - Security monitoring (anomalous use of credit card detected)
  - Traffic patterns (Contextual reminders)
  - Information-use behaviors (systems that collect data about what information people are using and what they are doing with it, to assist in future information activities)

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Activity-aware systems

- Systems model the person's activity from observations of context and behavior patterns.
- In contrast to "behavior," in which a person's actions are not necessarily consciously made, "activity" is a conscious, voluntary pursuit (for example, shopping for clothes, writing a report, searching for "an answer, making tea, explaining a solution, and so on).

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Activity-aware systems

- Examples include these:
  - Intelligent communications: Detecting priority of incoming messages and best times to interrupt
  - Elder care: Detecting engagement in activities of daily living and alerting caregivers if problems arise
  - Activity-targeted advertising: Understanding a lifestyle, preferred ad placement, and work role
  - Shopping support: Identifying the stage of shopping and proactively providing useful information
  - Sales force automation: Autopopulating the stages of the sales process with relevant info

Goal-aware systems

- Systems have insight into what the person is aiming to accomplish, inferred from context, behavior, and activity models.
- Goal-aware systems not only detect the user's current situation, but also adequately predict future behaviors or actions that a person is likely to do to achieve the goal and suggest suitable alternatives for those steps.

Goal-aware systems

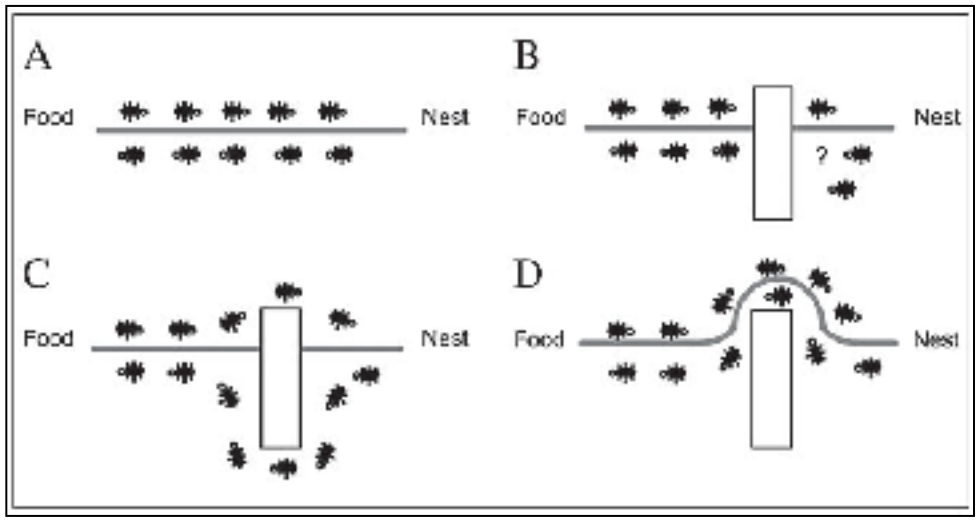
- Examples include these:
  - Proactive information delivery (a leisure activity planning tool to find shops, a restaurant, and a movie that you would like)
  - Planning systems (travel routes, service routes, task plans, and so on)

Actionable insights

- "Actionable information" is different for an individual than for a business.
- Information is "actionable" when it potentially causes you to act differently than you would have without the information.
- For an organization, that can mean high-level decisions such as budgeting and spending that may not show an impact on the business until a subsequent quarter.
- For an individual, though, actionable means something that causes you to operate differently in the moment of your actions (whether the activity is business or pleasure).

The ANT principle revisited

- Humans guided by technology?



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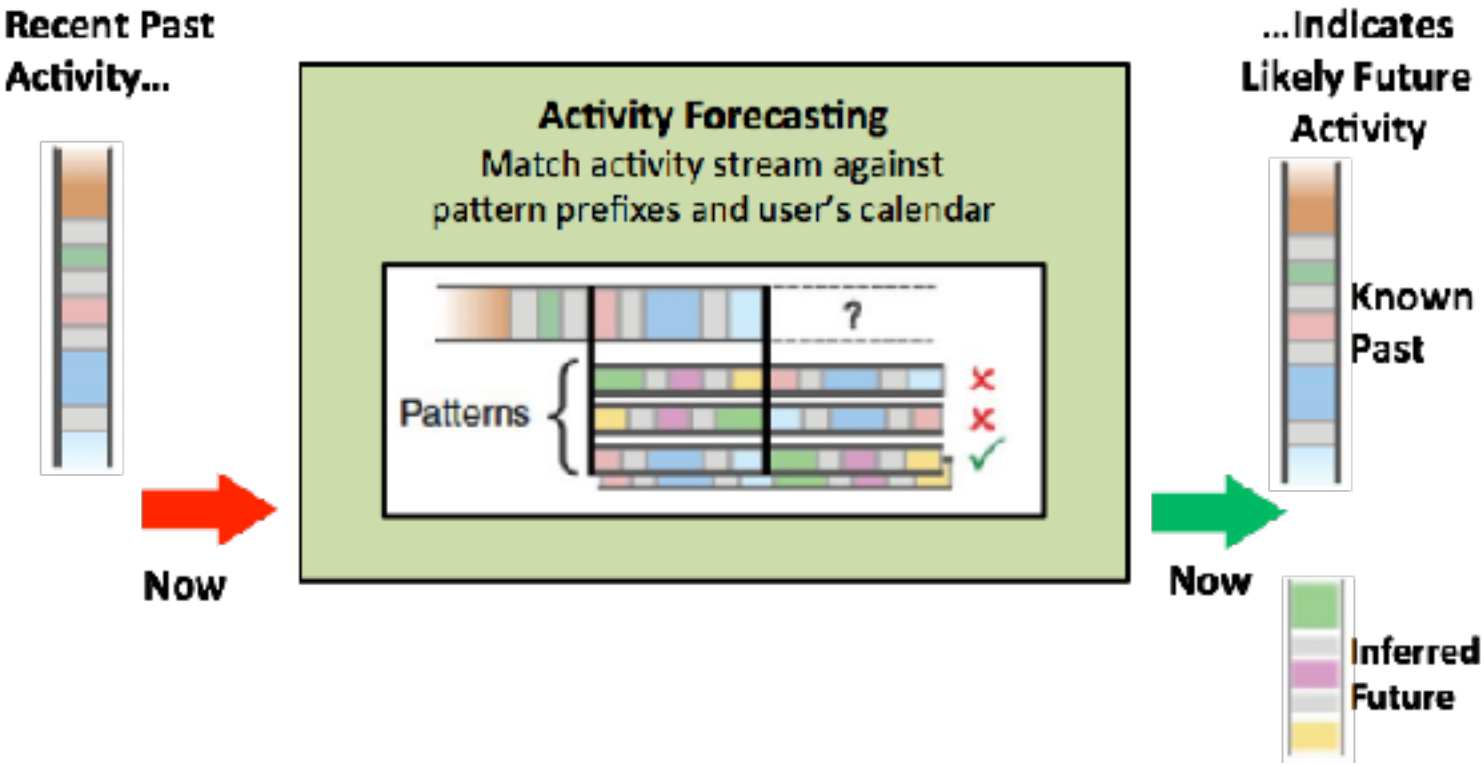
Activity Forecasting



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Web 4.0

- Combining „knowledge of the web“ with contextual information from various sources to deliver actionable information
- Supporting human intelligence not replacing it
  - Allow humans to communicate with technology in natural (multiple) language dialogues
  - Discover, visualize and reveal new insights
  - Support decisions in explaining and justifying the rationale behind

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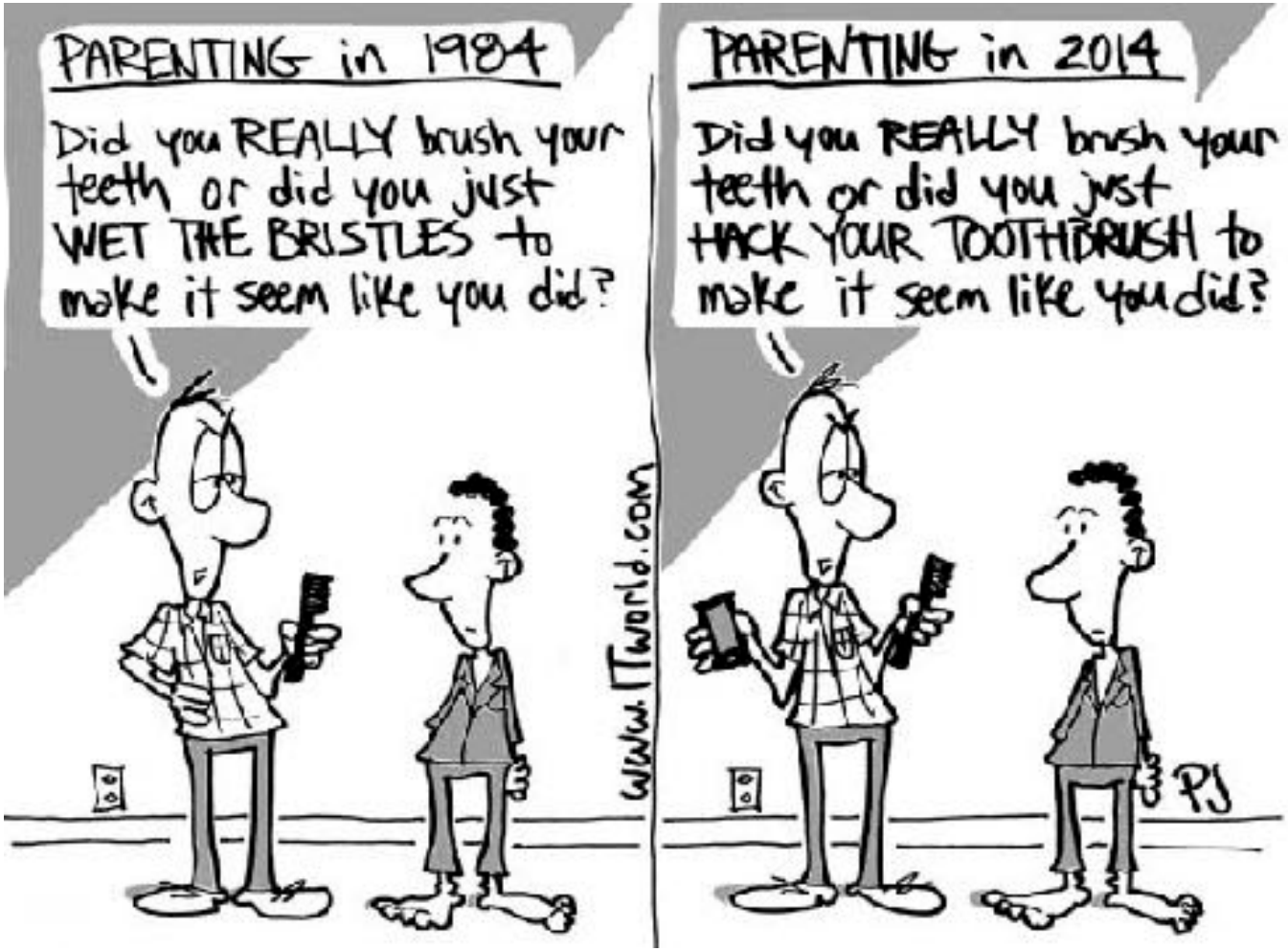
Thank you for your attention!



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