

Knowledge Exchange

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Acknowledgements

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Use and Distribution of these Slides

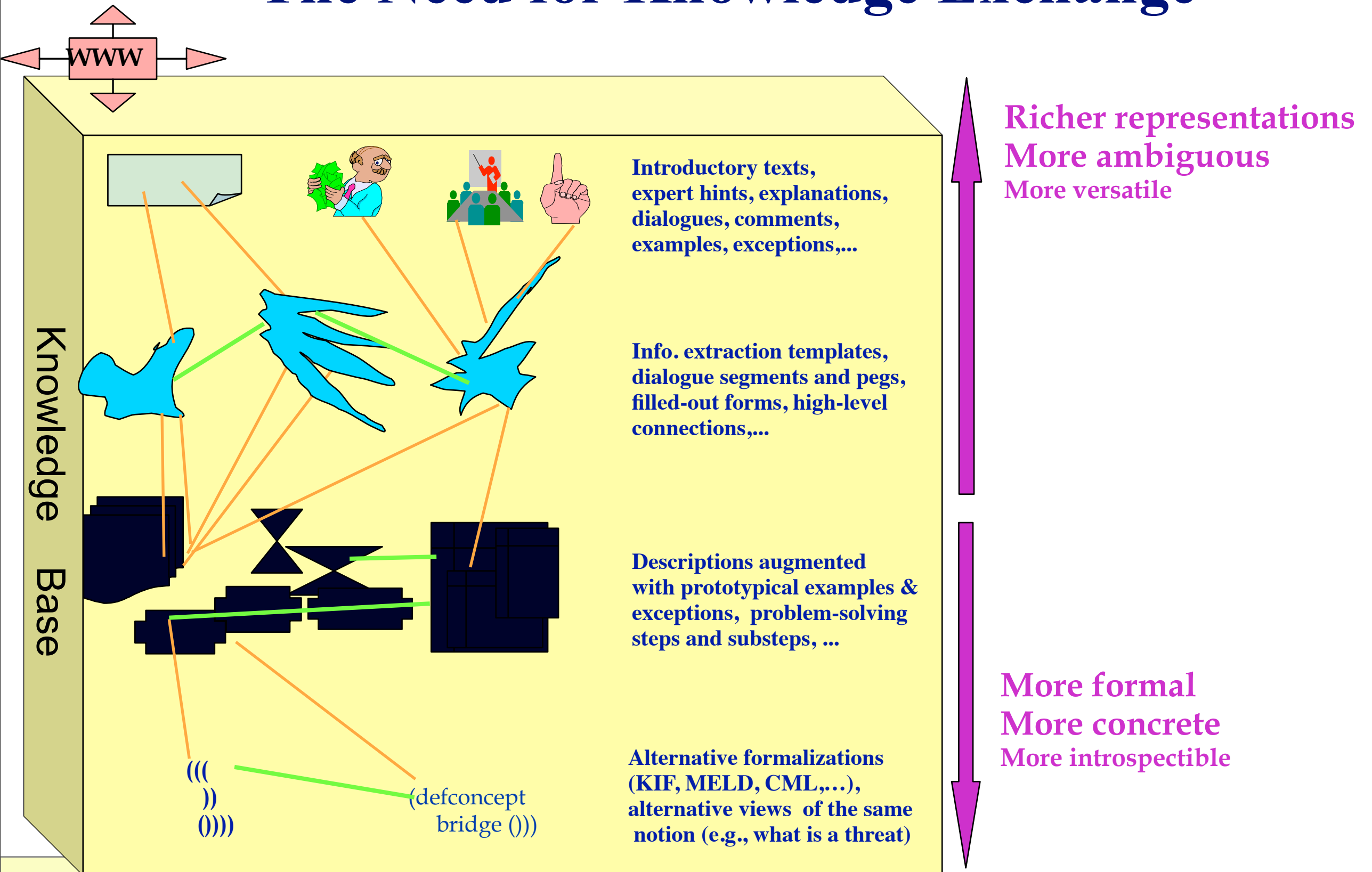
- ❖ These slides are primarily intended for the students in classes I teach. In some cases, I only make PDF versions publicly available. If you would like to get a copy of the originals (Apple KeyNote or Microsoft PowerPoint), please contact me via email at fkurfess@calpoly.edu. I hereby grant permission to use them in educational settings. If you do so, it would be nice to send me an email about it. If you're considering using them in a commercial environment, please contact me first.

Overview Knowledge Exchange

- ❖ Introduction
- ❖ Knowledge Capture
 - ❖ Explicit Capture
 - ❖ Extraction From Text
 - ❖ Case-based Reasoning
 - ❖ Enhancement of Existing Documents
- ❖ Transfer of Knowledge
 - ❖ Communication
 - ❖ Basic Concepts
 - ❖ Language and Communication
 - ❖ Natural Language
 - ❖ Formal Languages
 - ❖ Communication Models
- ❖ Distribution of Knowledge
 - ❖ Knowledge Repositories
 - ❖ Distribution Models

Introduction

The Need for Knowledge Exchange



Knowledge Mobility

- ❖ multiple views and versions of the same information
 - ❖ need to provide tools that establish connections among alternative versions/views of the same information
- ❖ hyper-connectivity
 - ❖ need to provide tools that suggest further connections to related sources when users compose documents
 - ❖ need to annotate hyperlinks
- ❖ basis to support information morphing
 - ❖ how one or more knowledge sources are used for
 - ❖ alternative purposes
 - ❖ track alternative knowledge transformations
 - ❖ various renderings and implementations of a knowledge source

Knowledge Capture

- ❖ before knowledge can be shared, it must be captured
- ❖ in an encoding and representation that is suitable for the sender and recipient of the knowledge
- ❖ the representation format must be suitable for transmission via a communication channel between sender and recipient
- ❖ for human-to-human knowledge exchange, natural language in written or spoken form is often suitable and convenient

Knowledge Capture Methods

- ❖ Explicit Capture
- ❖ Extraction from Documents
 - ❖ text
 - ❖ other formats
- ❖ Case-based Reasoning
- ❖ Enhancement of Existing Documents

Explicit Capture

- ❖ conventional techniques for knowledge acquisition
 - ❖ interviews with experts, knowledge engineers
- ❖ advantages
 - ❖ carefully constructed
 - ❖ suitable knowledge representation methods
 - ❖ usually common-sense evaluation
 - ❖ sometimes formal evaluation
 - ❖ consistency checks, other formal aspects

Extraction From Text

- ❖ syntactic level
 - ❖ keywords, descriptive features
 - ❖ construction of an index, meta data
- ❖ semantic level
 - ❖ document structure
 - ❖ requires information about structure (tags, DDT, RDF)
 - ❖ sentence structure
 - ❖ natural language processing (NLP)
- ❖ pragmatic level
 - ❖ context (thesaurus, ontology, NLP)

Case-based Reasoning

- ❖ solutions to a problem in a specific context are collected
- ❖ represented in a structured format
 - ❖ problem, context, solution
 - ❖ usable by a computer-based system
 - ❖ cases are often represented through frames or similar mechanisms
- ❖ new cases are matched against existing ones
 - ❖ patterns in the frames provide the basis for matching
 - ❖ the suitability of the solution is judged by the user

Enhancement of Existing Documents

- ❖ in addition to the methods mentioned above, collections of documents can be enhanced
- ❖ addition of meta-knowledge
- ❖ integration into an existing framework/ontology
 - ❖ manually through categorization
 - ❖ automatically through keyword extraction
 - ❖ indirectly through statistical correlations with other documents

Transfer of Knowledge

- ❖ Communication
 - ❖ Basic Concepts
 - ❖ Language and Communication
 - ❖ Natural Language
 - ❖ Formal Languages
 - ❖ Communication Models

Basic Concepts

- ❖ communication
 - ❖ exchange of information
 - ❖ requires a shared system of signs
 - ❖ greatly enhanced by language
- ❖ speaker
 - ❖ produces signs as utterances
 - ❖ general: not only spoken language
- ❖ listener (hearer)
 - ❖ perceives and interprets signs

Purpose of Communication

- ❖ sharing of information among agents or systems
 - ❖ query other agents for information
 - ❖ responses to queries
 - ❖ requests or commands
 - ❖ actions to be performed for another agent
- ❖ offer
 - ❖ proposition for collaboration
- ❖ acknowledgement
 - ❖ confirmation of requests, offers
- ❖ sharing
 - ❖ of experiences, feelings

Communication Problems

- ❖ intention
 - ❖ what is the expected outcome (speaker's perspective)
- ❖ timing
 - ❖ when is a communication act appropriate
- ❖ selection
 - ❖ which act is the right one
- ❖ language
 - ❖ what sign system should be used
- ❖ interpretation
 - ❖ will the intended meaning be conveyed to the listener
- ❖ ambiguity
 - ❖ can the intention be expressed without the possibility of misunderstandings

Language and Communication

- ❖ Natural Language
 - ❖ used by humans
 - ❖ evolves over time
 - ❖ moderately to highly ambiguous
- ❖ Formal Languages
 - ❖ invented
 - ❖ rigidly defined
 - ❖ little ambiguity

Natural Language

- ❖ formal description is very difficult
 - ❖ sometimes non-systematic, inconsistent, ambiguous
- ❖ mostly used for human communication
 - ❖ easy on humans
 - ❖ tough on computers
- ❖ context is critical
 - ❖ situation, beliefs, goals

Formal Languages

- ❖ symbols
 - ❖ terminal symbols
 - ❖ finite set of basic words
 - ❖ not: alphabet, characters
 - ❖ non-terminal symbols
 - ❖ intermediate structures composed of terminal or non-terminal symbols
- ❖ strings
 - ❖ sequences of symbols
- ❖ phrases
 - ❖ sub-strings grouping important parts of a string

Formal Languages Cont.

- ❖ sentences
 - ❖ allowable strings in a language
 - ❖ composed from phrases
- ❖ grammar
 - ❖ rules describing correct sentences
 - ❖ often captured as rewrite rules in BNF notation
- ❖ lexicon
 - ❖ list of allowable vocabulary words

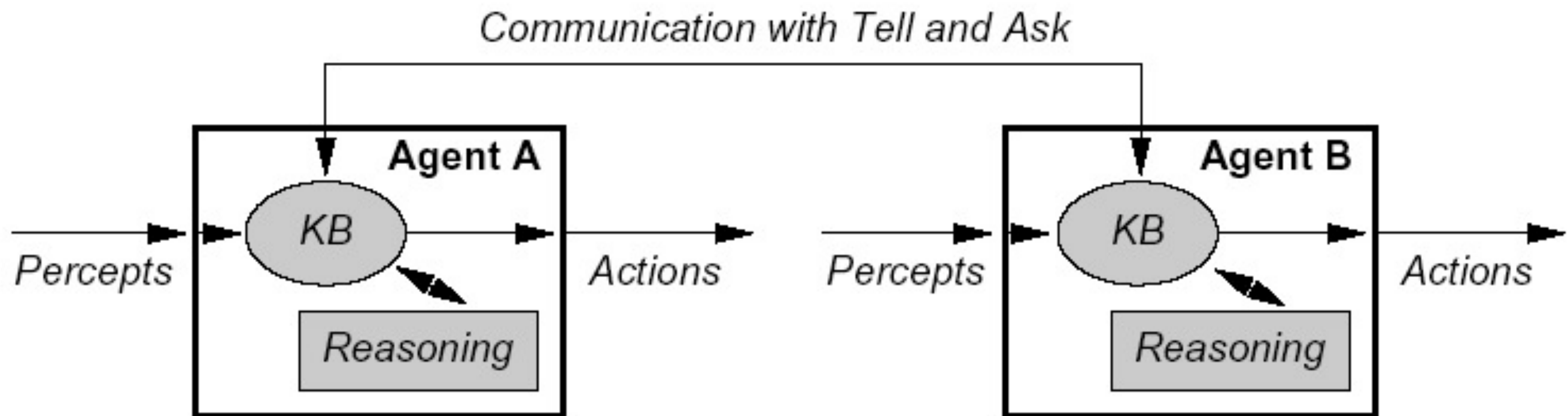
Communication Models

- ❖ encoded message model
 - ❖ a definite proposition of the speaker is encoded into signs which are transmitted to the listener
 - ❖ the listener tries to decode the signs to retrieve the original proposition
 - ❖ errors are consequences of transmission problems
- ❖ situated language model
 - ❖ the intended meaning of a message depends on the signals as well as the situation in which they are exchanged
 - ❖ mis-interpretation may lead to additional problems

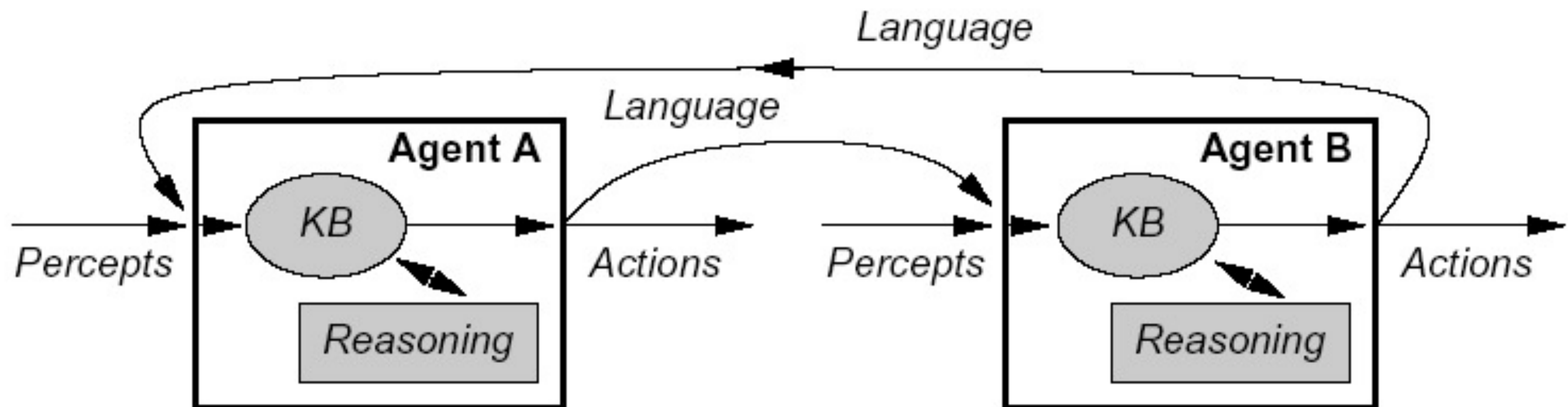
Communication Types

- ❖ telepathic communication
 - ❖ speaker and listener have a shared internal representation
 - ❖ communication through Tell/Ask directives
- ❖ language-based communication
 - ❖ speaker performs actions that produce signs which other agents can perceive and interpret
 - ❖ communication language is different from the internal representation
 - ❖ more complex
 - ❖ involves several mappings
 - ❖ language needs to be generated, encoded, transmitted, decoded, and interpreted

Telepathic Communication



Language-Based Communication



Communication Steps: Speaker

- ❖ intention
 - ❖ decision about producing a speech act
- ❖ generation
 - ❖ conversion of the information to be transferred into the chosen language
- ❖ synthesis
 - ❖ actions that produce the generated signs

Communication Steps: Listener

- ❖ perception

- ❖ reception of the signs produced by the speaker

- ❖ speech recognition, lip reading, character recognition

- ❖ analysis

- ❖ syntactic interpretation (parsing)

- ❖ semantic interpretation

- ❖ disambiguation

- ❖ selection of the most probable intended meaning

- ❖ incorporation

- ❖ the selected interpretation is added to the existing world model as additional piece of evidence

Communication Example

SPEAKER		
Intention:	Generation:	Synthesis:
$Know(H, \neg Alive(Wumpus, S_3))$	"The wumpus is dead"	[thaxwahmpahsihzdeyd]



HEARER		
Perception:	Analysis:	Disambiguation:
"The wumpus is dead"	(Parsing): <pre> graph TD S --> NP S --> VP NP --> Article NP --> Noun VP --> Verb VP --> Adjective Article --> The Noun --> wumpus Verb --> is Adjective --> dead </pre> (Semantic Interpretation): $\neg Alive(Wumpus, Now)$ $Tired(Wumpus, Now)$ (Pragmatic Interpretation): $\neg Alive(Wumpus, S_3)$ $Tired(Wumpus, S_3)$	$\neg Alive(Wumpus, S_3)$ Incorporation: TELL(KB, $\neg Alive(Wumpus, S_3)$

[Russell & Norvig 1995]

Knowledge Exchange Perspectives

Different Perspectives

- ❖ Roles
- ❖ Scope
- ❖ Purpose

Roles

- ❖ knowledge creator
 - ❖ source of the knowledge
- ❖ knowledge facilitator
 - ❖ supports the exchange of knowledge between creator and user
- ❖ knowledge user
- ❖ sender
 - ❖ initiates and conducts the transmission of knowledge
 - ❖ may be creator or facilitator
- ❖ recipient
 - ❖ typically the knowledge user

Scope of Knowledge Exchange

- ❖ number of people involved
 - ❖ individuals, groups, organizations, humanity
- ❖ coherence
 - ❖ domain knowledge, educational background, intellectual ability, familiarity with the environment, ...
- ❖ spread
 - ❖ geographical distribution

Individuals

- ❖ informal
- ❖ direct communication
- ❖ quick feedback
- ❖ low persistence tolerable
- ❖ clarification easy
- ❖ consistency issues easy to resolve

Groups

- ❖ informal
- ❖ direct communication
- ❖ coordination and synchronization required
- ❖ moderate persistence desirable
- ❖ clarification via discussion

Organization

- ❖ more formal repositories and exchange methods
- ❖ systematic communication, coordination and synchronization necessary
- ❖ persistence is important
- ❖ more structured approaches to clarification and consistency beneficial

Community

- ❖ formal “body of knowledge”
 - ❖ well-structured, reasonably controlled vocabulary, established repositories of knowledge, procedures for validation (“peer review”)
- ❖ established exchange methods
 - ❖ journals, official publications, books, conferences, portals
- ❖ professional organizations with controlled memberships
 - ❖ established communication, coordination, and synchronization methods

Humanity

- ❖ no coherent “body of knowledge”
- ❖ communication, coordination, and synchronization of knowledge exchange across boundaries is difficult
- ❖ differences in vocabulary, methods, knowledge validation processes make exchange of knowledge difficult
- ❖ serious problems with clarification, resolution of inconsistencies are possible

Purpose

- ❖ personal enrichment
- ❖ better product
- ❖ better working conditions
- ❖ commercial advantage
- ❖ stronger community
- ❖ societal benefits

Knowledge Distribution

Distribution of Knowledge

- ❖ Knowledge Repositories
 - ❖ Digital Libraries
- ❖ Distribution Models

Knowledge Repositories

- ❖ persistent storage of digital documents
 - ❖ internal representation in the original format
 - ❖ loss-less transformation may be acceptable
- ❖ transparent internal organization
 - ❖ multiple presentation methods for various users and usage methods
- ❖ multiple access methods
 - ❖ according to users' needs and capabilities

Wikipedia

- ❖ collaborative effort to capture knowledge
- ❖ contributions by volunteers
 - ❖ not restricted to “experts”
- ❖ liberal policy for entry modifications
 - ❖ editorial policies to limit abuse

Scientific American

“Edit This”

- ❖ public is invited to comment on some articles before they are published
- ❖ examples
 - ❖ “Science 2.0: Great New Tool, or Great Risk?”
 - ❖ “Does the U.S. Produce Too Many Scientists?”

Google Knols

❖ An example:

Canine Science: How Dogs Communicate

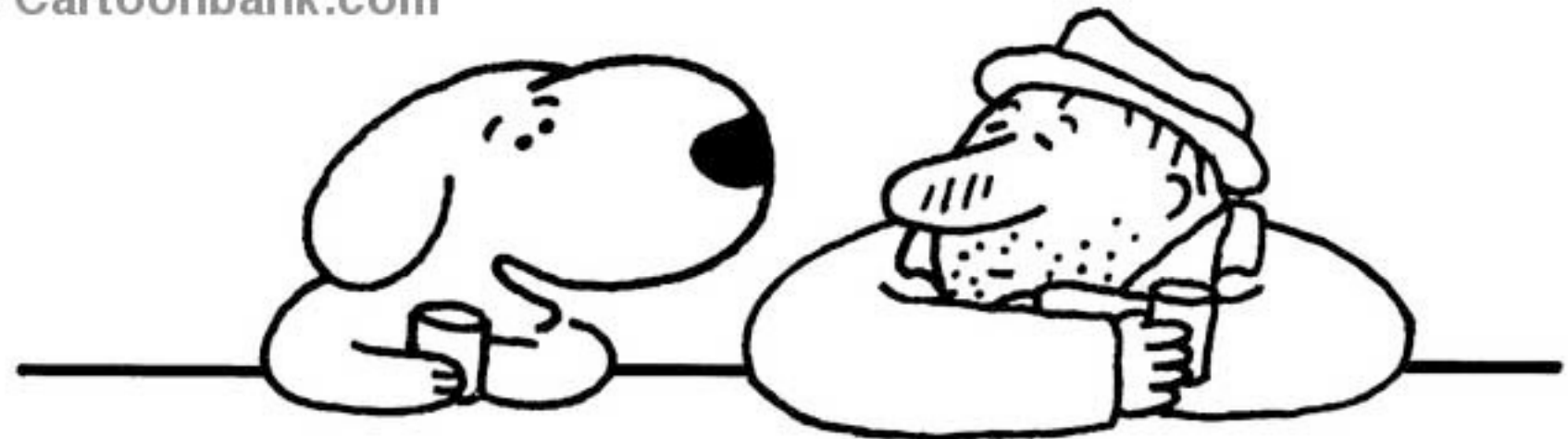
How Dogs Talk To Each Other Using Sound, Smell and Body Language

Dogs communicate with each other in a variety of ways, using sounds, smells and body language. This knol offers a guide to some of the weird and wonderful methods canines use to get their messages across.

Contents

- [Introduction](#)
- [Image: wikimedia.org Pet Sounds: What Dog Noises Mean](#)
- [Barking: Some Canine Statistics](#)
- [Body Talk: Physical Language](#)
- [Talking Dirty: Smells](#)
- [Further Reading:](#)

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cizzoratti

“Talk? Hell, after a few drinks you can’t shut me up.”

Franz Kurtess: Reasoning

Educational Repositories

- ❖ Open Course Ware Initiative
 - ❖ MIT
- ❖ Connexions
 - ❖ Rice University and Connexions Consortium
- ❖ Merlot
 - ❖ California State University System is a “Sustaining Partner”

General Repositories

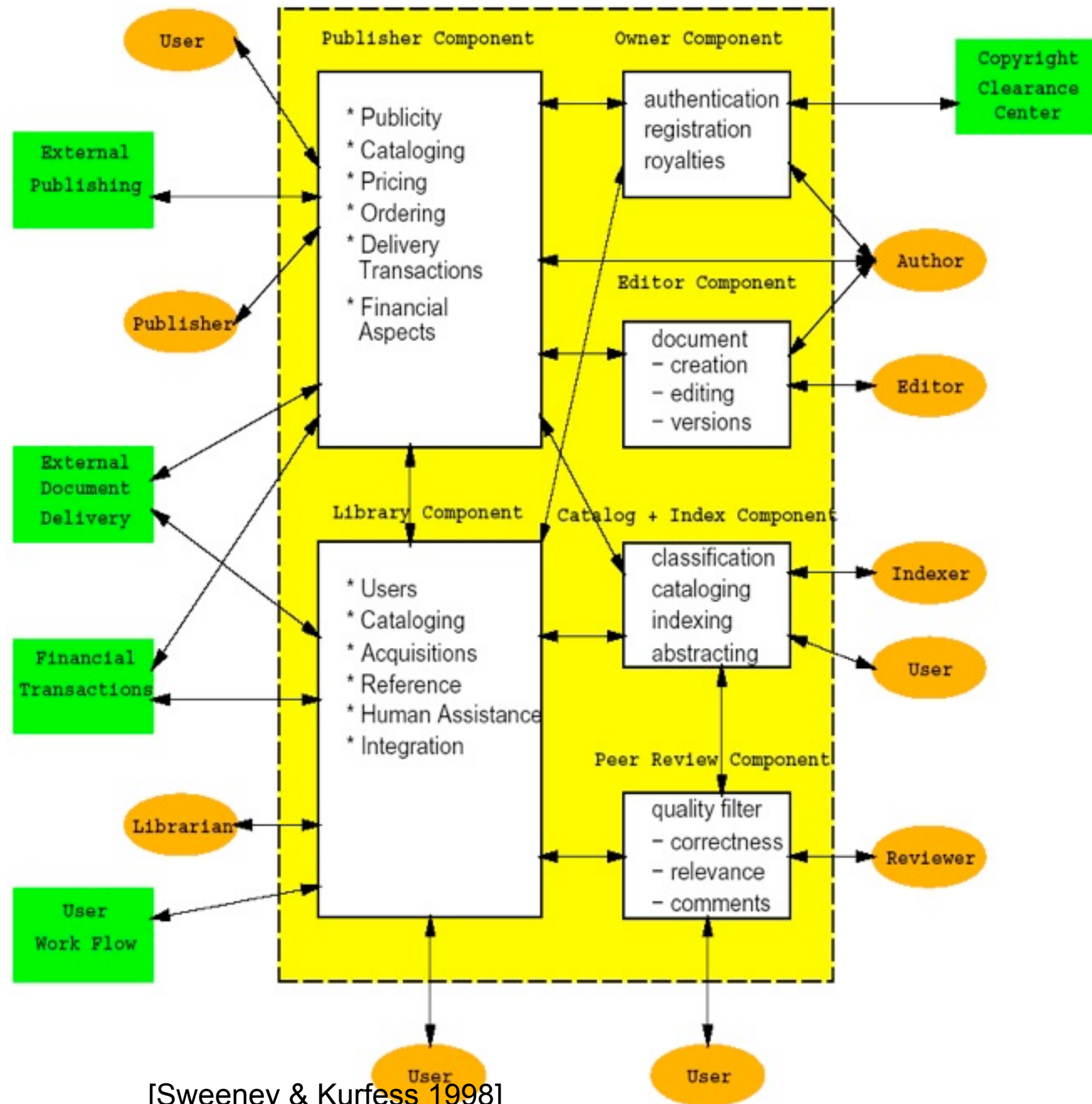
- ❖ Instructables.com
- ❖ Slideshare.com
- ❖ Blogs
- ❖ Youtube and similar sites

Digital Libraries

- ❖ collections of documents and artifacts stored and accessed via computers
- ❖ remotely accessible through networks
- ❖ enhanced functionality compared with paper-based libraries
 - ❖ access methods
 - ❖ organization principles
 - ❖ duplication
- ❖ implementation and usage unclear

Digital Library In-A-Box

Digital Library In - A - Box



[Sweeney & Kurfess 1998]

