Wisdom is not the product of schooling but the lifelong attempt to acquire it.
- Albert Einstein

Community-Driven Evolution of Knowledge Artifacts: Frameworks, Systems, Experiences, Obstacles, and Challenges

Gerhard Fischer
Center for LifeLong Learning & Design (L^3D)
http://www.cs.colorado.edu/~l3d/
Department of Computer Science and Institute of Cognitive Science
University of Colorado, Boulder

Workshop "Community-Driven Evolution of Knowledge Artifacts", Irvine, December 2003

Overview

- Core Message
- Frameworks:
  - **Community** and Social Creativity,
  - **Evolution**, Meta-Design, and SER
- Systems
- Experiences
- Obstacles
- Challenges

Core Message

- community-driven evolution of knowledge artifacts is one of the **most promising design methodologies** for complex socio-technical systems

- **but:** our understanding of what it takes to make this happen is still **very limited**

- **challenges:**
  - community-driven evolution of knowledge artifacts → **co-evolution of knowledge artifacts and communities**
  - technology is necessary**, but not sufficient**

Focus: Design Problems

- **design** (Herbert Simon "Sciences of the Artificial")
  - **natural science**: how things are
  - **design**: how things ought to be

- **design problems** require **learning and collaboration** because they are
  - **complex** → requiring multidisciplinary approaches in which stakeholders from different disciplines have to **collaborate**
  - **ill-defined** → requiring the integration of problem framing and problem solving leading to **evolutionary** improvements
  - **unique** ("a universe of one") → **learning when the answer is not known**
  - **have no (single) answer** → **argumentation**

Design Communities: Communities of Practice and Communities of Interest

- ***Communities of Practice (CoPs)***, defined as groups of people who share a professional practice and a professional interest

- ***Communities of Interest (CoIs)***, defined as groups of people (typically coming from different disciplines) who share a common interest (e.g., solve complex design problems, engage in complex decision making)

- **more information:**
  Fischer, G. (2001) "Communities of Interest: Learning through the Interaction of Multiple Knowledge Systems," 24th Annual Information Systems Research Seminar In Scandinavia (IRIS'24), pp. 1-14.
  [http://www.cs.colorado.edu/~gerhard/papers/iris24.pdf]

Communities of Practice (CoPs)

- **CoPs:**
  - **homogenous design communities**: practitioners who work as a community in a certain domain
  - **examples:** architects, urban planners, research groups, software developers, software users, kitchen designers, computer network designers, voice dialog systems designers ……

- **learning in CoPs:**
  - masters and apprentices
  - legitimate peripheral participation (LPP) → one accepted, well-established center of expertise and a clear path of learning towards this center exist
  - creates a notion of belonging and an identity

- **problems:** ***"group-think"*** → when people work together too closely in communities, they sometimes suffer illusions of righteousness and invincibility

- **systems:** domain-oriented design environments (e.g.: kitchen design, computer network design, voice dialogue design, …..)

Communities of Interest (CoIs)

- **CoIs**
  - **heterogeneous design communities**: bring different CoPs together to solve a problem
  - **membership** in CoIs is defined by a shared interest in the framing and resolution of a design problem
  - **bring together diverse cultures** (academia and from industry, software designers and software users)

- **learning in CoIs:** primary goal is not "moving toward a center" (CoP) but **"integrating diversity and making all voices heard"**

- **problems:**
  - establish a **common ground** → develop a common language
  - building a **shared understanding** of the task at hand → negotiation of meaning
  - learning to communicate with others who have a different perspective → **boundary objects**

- **systems**: Envisionment and Discovery Collaboratory

A Comparison Between Different Social Networks

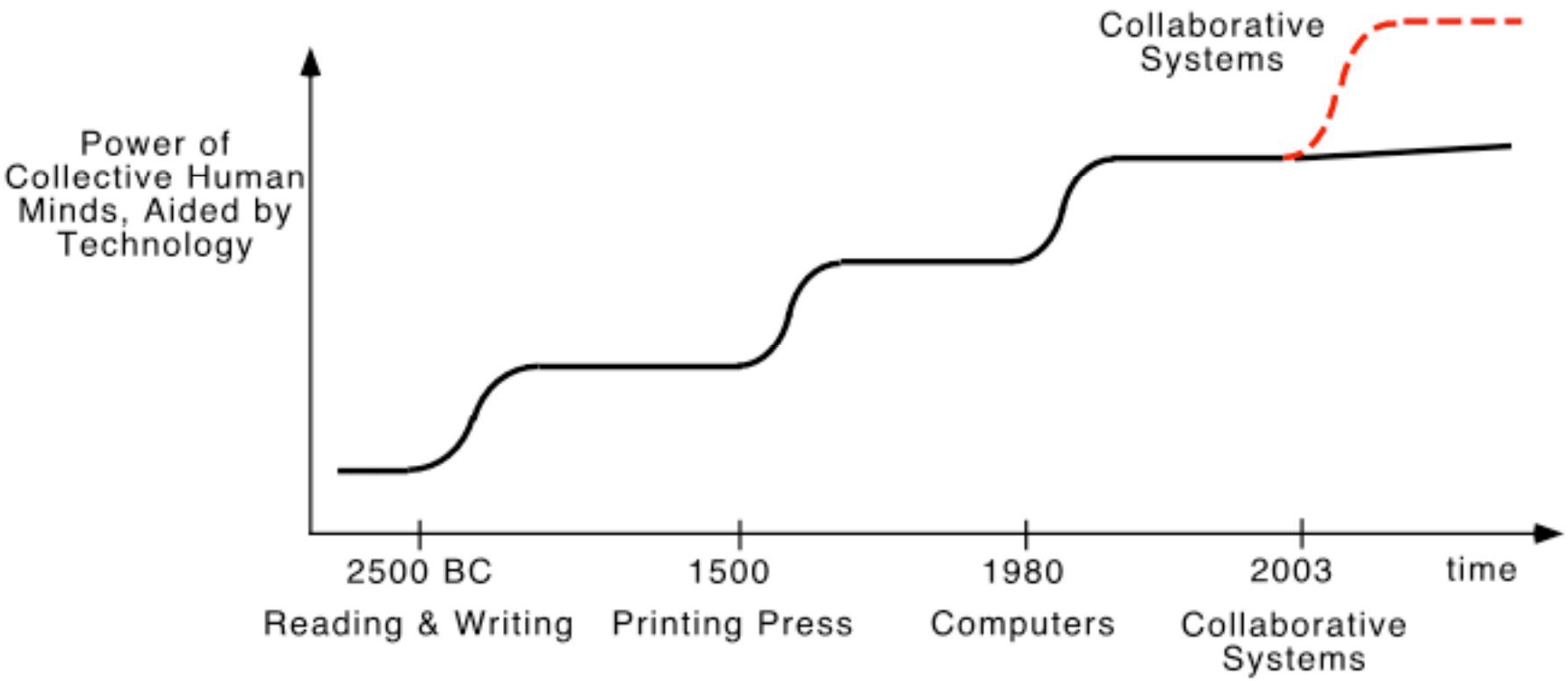
	Communities of Practice (CoPs)	Communities of Interest (CoIs)	Teams	Intensional Networks	Knotworking
example domains	claims processor (Wenger) open source communities	complex design problems (L3D)	units in organizations assembly line work	particular work projects cutting across organizational boundaries (Nardi et al)	flight crews operating room teams (Engeström et al)
how do they come into existence	Co-evolve with practice	solving complex design problems require multiple expertise	organizational planning and structuring	Active cultivation by those who need their support	patterns in a work configuration
working conditions	well-defined professions	Confluence of multiple practices, other interested parties	Problem oriented situation focus on solving problem/task	flux and instability	responsibilities are distributed,
well-established roles	masters and apprentices	stakeholders from different disciplines	Team as unit Team leader	collaboration across organizational boundaries	roles well defined collaborative practice is “plug and play”
duration	long-term	associated with specific projects	created and terminated from the outside	evolving over time	for specific tasks

A Comparison Between Different Social Networks— Continued

	Communities of Practice (CoPs)	Communities of Interest (CoIs)	Teams	Intensional Networks	Knotworking
characteristics	defined by a shared and well-established practice	CoIs = communities of CoPs	defined by management	defined by a shared concern	non-negotiable roles in specific teams operational units
challenges	identity; well established centers	shared understanding; boundary objects shifting centers	flexible, less predictable configuration of workers	"who do I tell" and "who do I ask"	working together without knowing each others as persons
learning	legitimate peripheral participation; working shops	exploit symmetry of ignorance as a source of power	Workshops Feedback to/interaction with design process	"who do I ask" and "who do I tell" "not what you know but who you know"	plays little role in flight crews → highly trained professionals
problems	"group think"	lack of shared understanding	too much "formally" defined; inflexible	Need to continually maintained, updated	only applicable to environments in which people are highly trained
technological support	DODEs Expert-Exchange	Envisionment and Discovery Collaboratory	group memories	Web2gether; Eureka	workflow systems

The Individual Human Mind is Limited

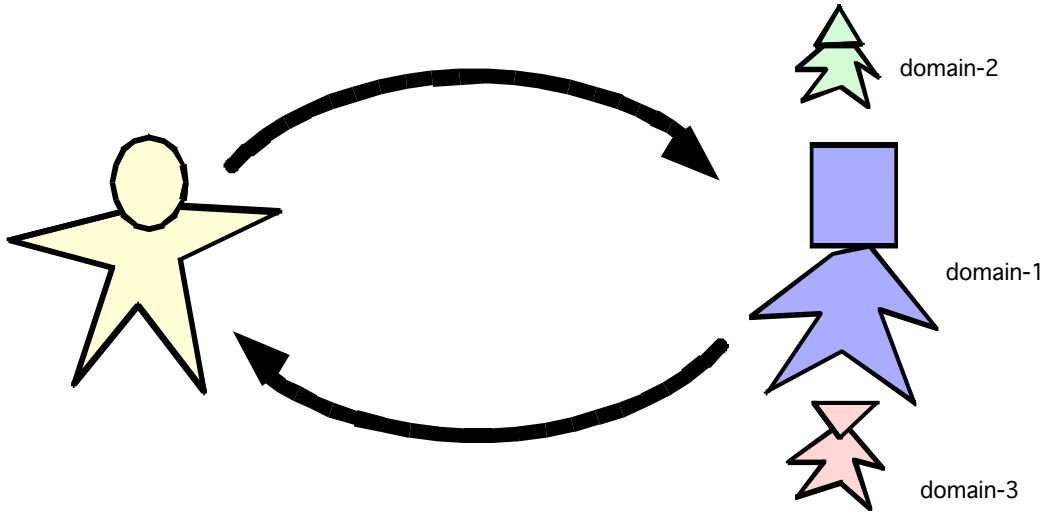
- the Renaissance scholar does not exist anymore → distributed cognition



Knowledge is Distributed

- distinct domains of human knowledge exist → of critical importance: mutual appreciation, efforts to understand each other, increase in socially shared cognition and practice (Snow, C. P. (1993) "The Two Cultures")

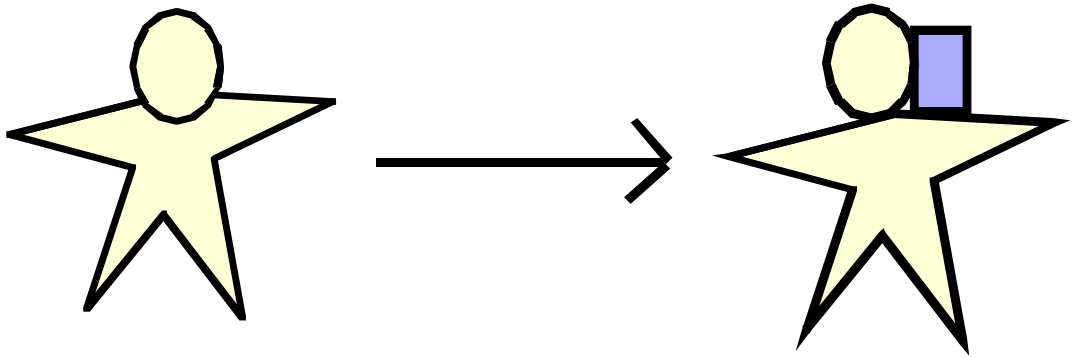
- **example:** software design in application domains



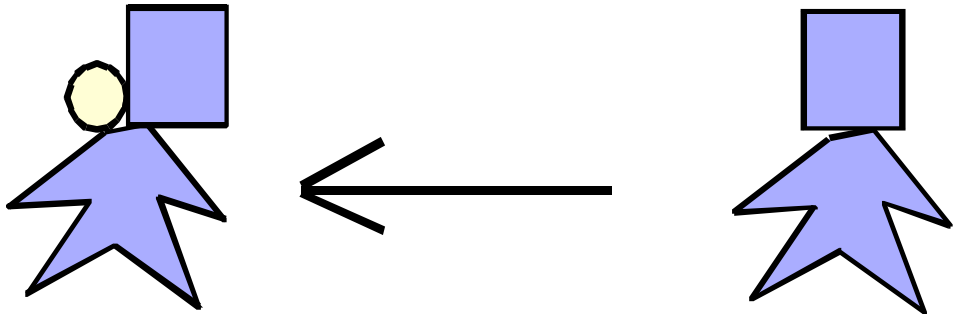
- **example from:** *"System development is difficult not because of the complexity of technical problems, but because of the social interaction when users and system developers learn to create, develop and express their ideas and visions"* — Greenbaum & Kyng) (Eds.) (1991) "Design at Work"

Coping with Application Domains — Are Power-Users the Answer?

- Software Engineers Acquiring Application Domain Knowledge



- Domain Designers Acquiring Software Engineering Knowledge

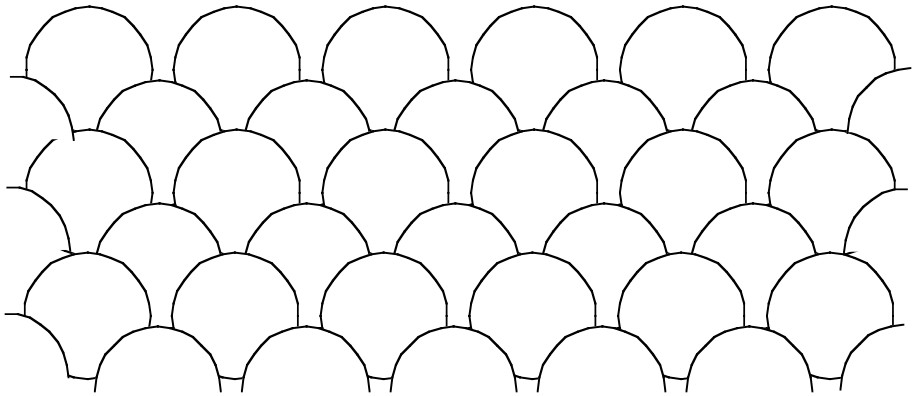


Fish-Scale Model

- **Claim:** none of the two models above will work, because the amount of knowledge to be known is too large

- **Objective**: persons from one domain learn enough from other domains that they can collaborate

- **Fish-Scale Model:** "collective comprehensiveness through overlapping patterns of unique narrowness" → Campbell, D. T. (1969) "Ethnocentrism of Disciplines and the Fish-Scale Model of Omniscience." In M. Sherif & C. W. Sherif (Eds.), *Interdisciplinary Relationships in the Social Sciences,* Aldine Publishing Company, Chicago, pp. 328-348.



Social Creativity

- **claim**: an idea / product / artifact /design that deserves the label "creative" arises from the synergy of many sources and not only from the mind of a single person

- **evidence**: "Edison's and Einstein's discoveries would be inconceivable without the prior knowledge, without the intellectual and social network that simulated their thinking, and without the social mechanisms that recognized and spread their innovations" — Csikszentmihalyi, M. (1996) Creativity, HarperCollins Publishers, New York, NY

- social creativity requires and supports new forms of **learning when the answer is not known** → "In important transformations of our personal lives and organizational practices, we must learn new forms of activity which are not there yet. They are literally learned as they are being created. There is no competent teacher. Standard learning theories have little to offer if one wants to understand these processes." — Yrjö Engeström, "Expansive Learning at Work"

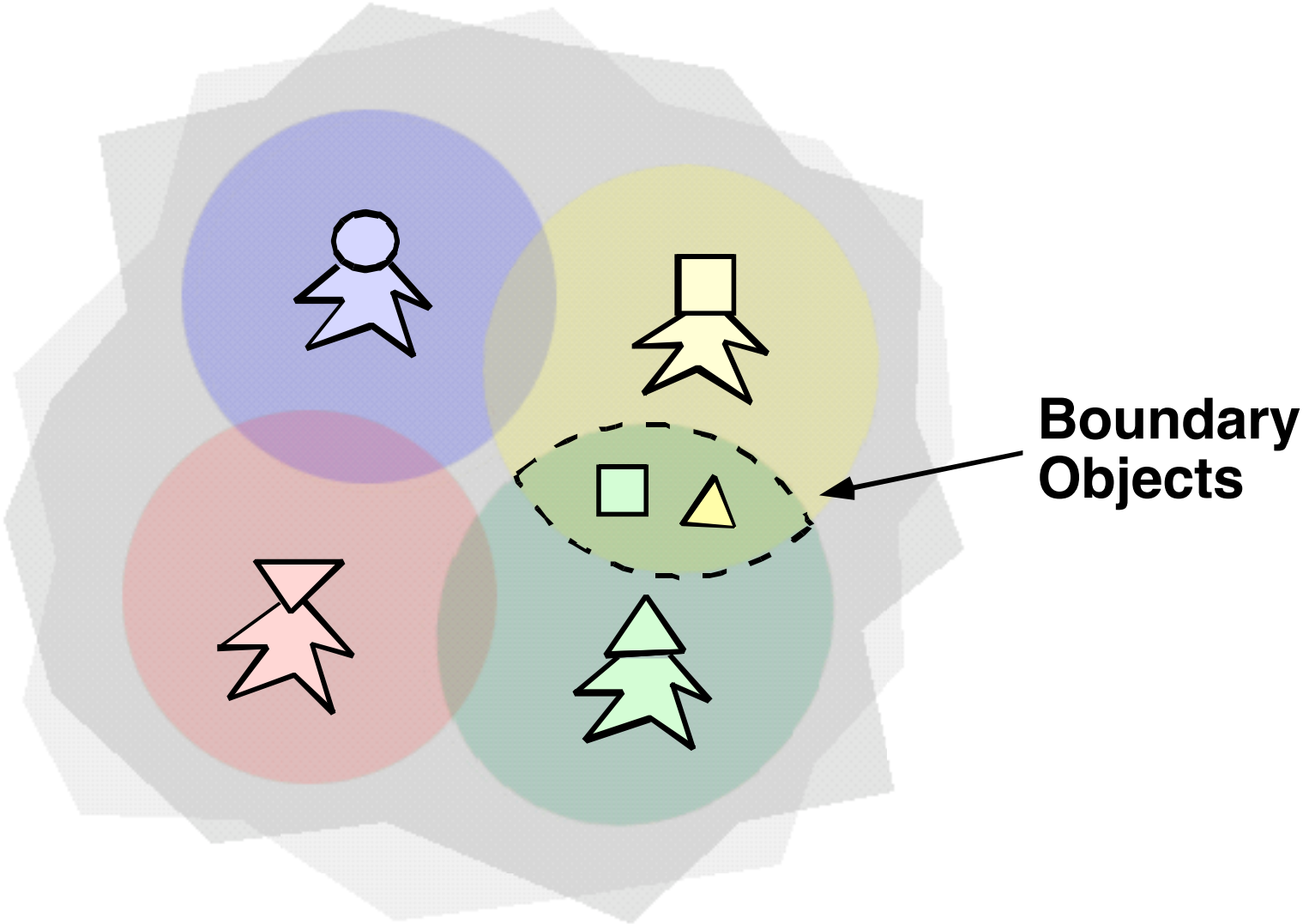
Individual and Social Creativity

"The strength of the wolf is in the pack, and the strength of the pack is in the wolf."
Rudyard Kipling

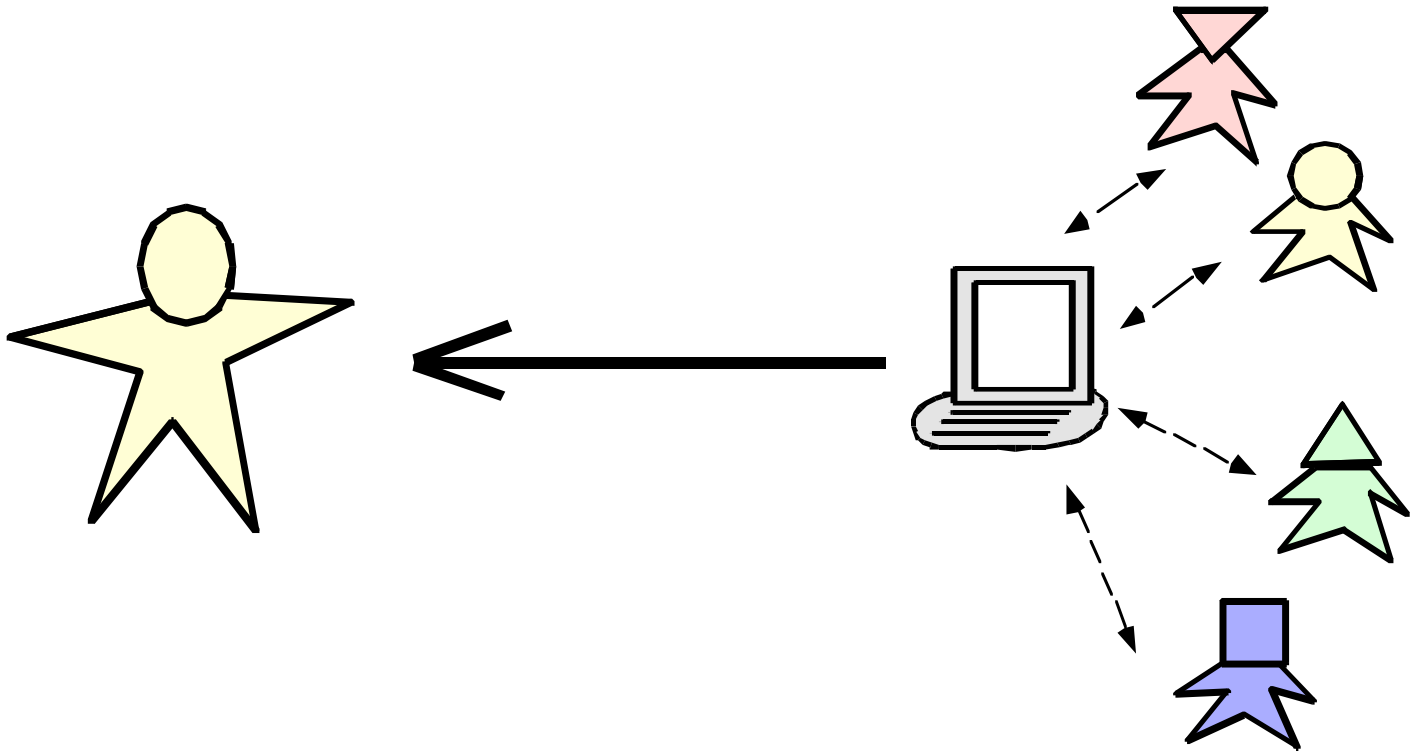
- **individual versus social creativity** → individual **and** social creativity
  - not a binary choice
  - explore the relationship between the individual and the social (e.g., autonomy ←→ collective goals)
  - tension between creativity and organization: elements of organization (e.g., workflow systems) can stifle creativity

- **social creativity:**
  - requires designers not consumers
  - requires externalizations/oeuvres to serve as boundary objects

Cols: Social Creativity and Boundary Objects

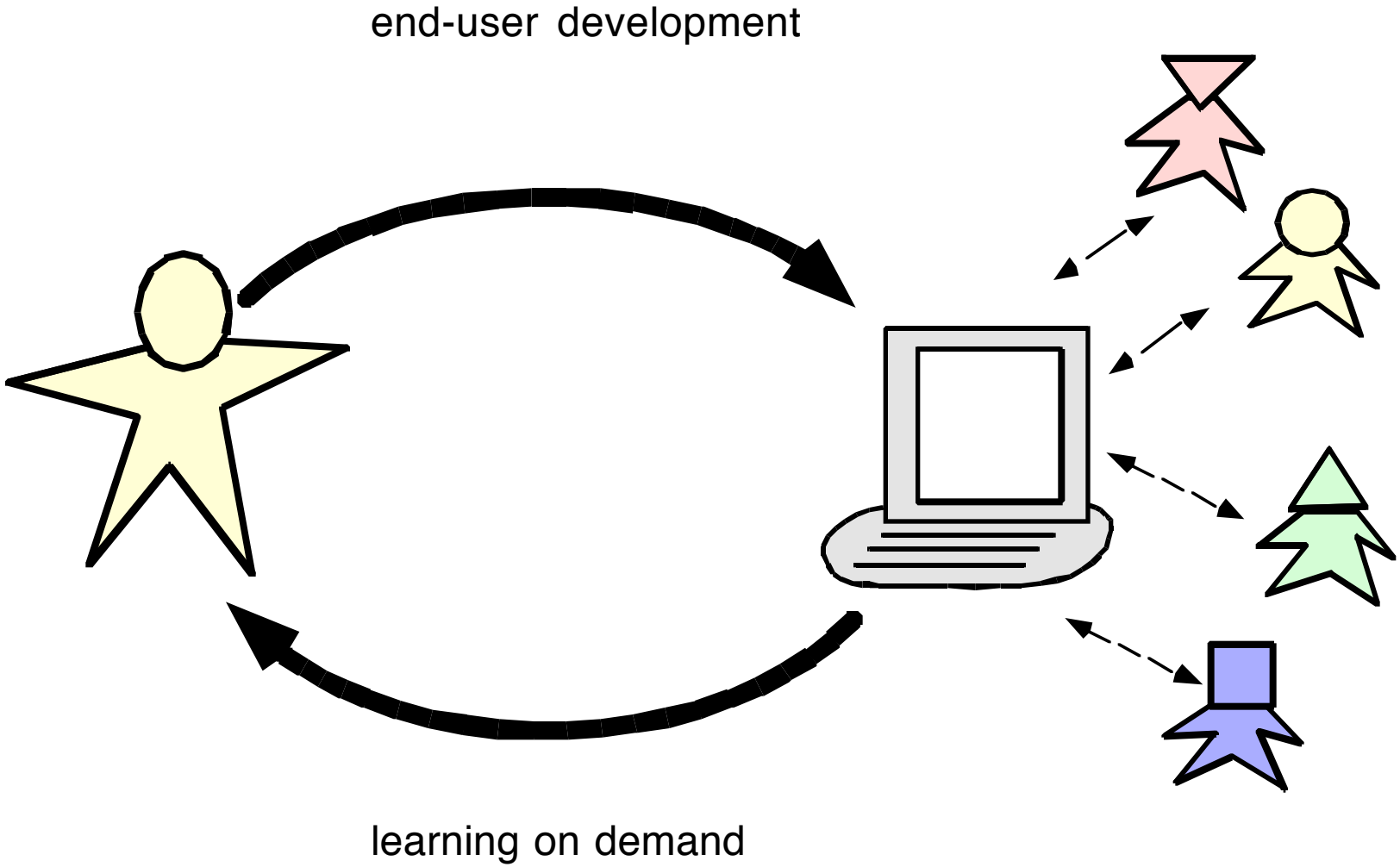


Access: Learning When the Answer is Known



- **examples:** instructionist classroom, accessing information on the Web

Informed Participation: Learning and Contributing



- **examples**: collaborative learning and knowledge construction, open source

A Frameworks for Evolution

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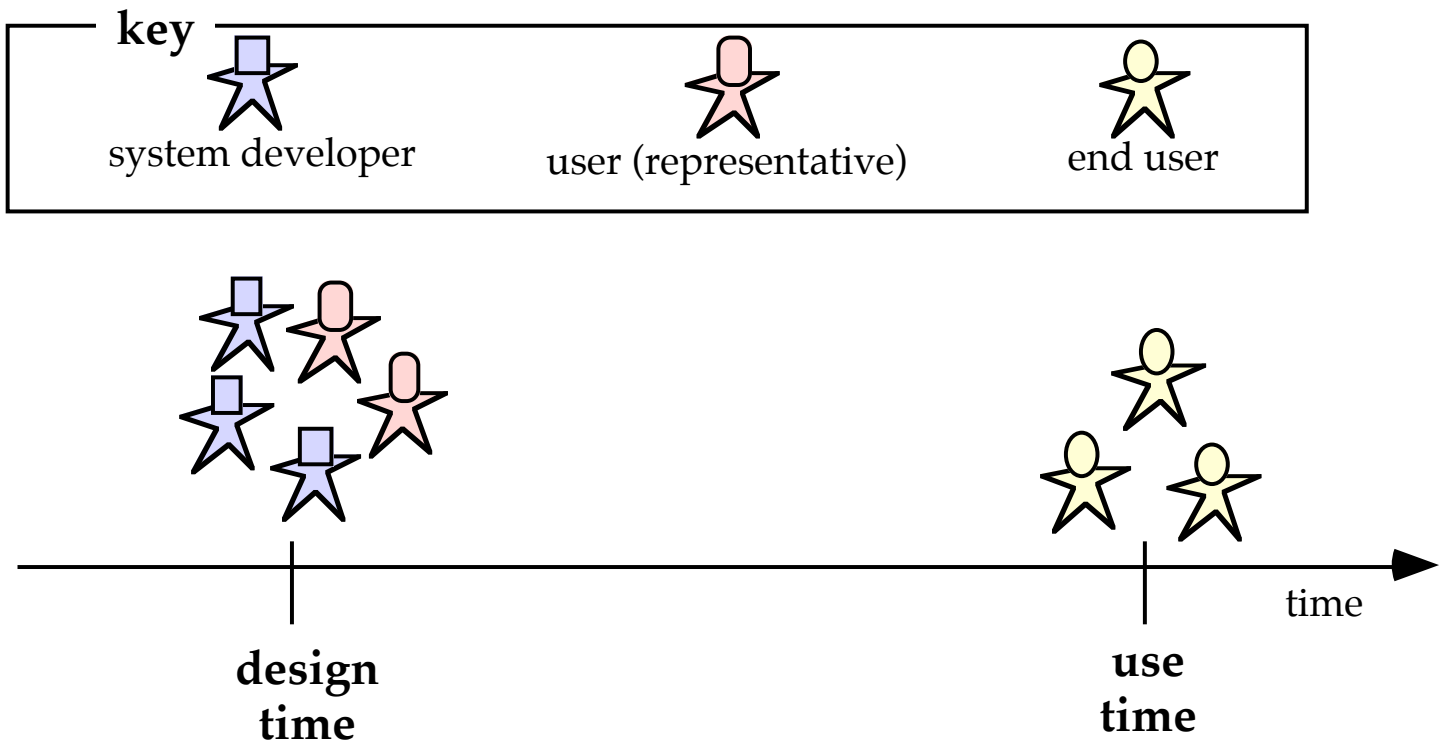
Design Time and Use Time



world-as-imagined planning

world-as-experienced situated action

Computational Media: Extending Design Opportunities to Use Time

- **print media:** content for use time is decided at design time
- **computational media**: presentations at use time can take advantage of contextual factors only known at use time (about tasks, users, social systems,.....) in the form of specification sheets and usage data, supporting dynamic forms, dynamic websites, ...
- **evolving the existing systems**: users (acting as designers) can transcend the boundaries of the systems as developed at design time

Meta-Design — How We Think About It

- "if you give a fish to a human, you will feed him for a day — if you give someone a fishing rod, you will feed him for life" (Chinese Proverb)

- **meta-design** extends this to:

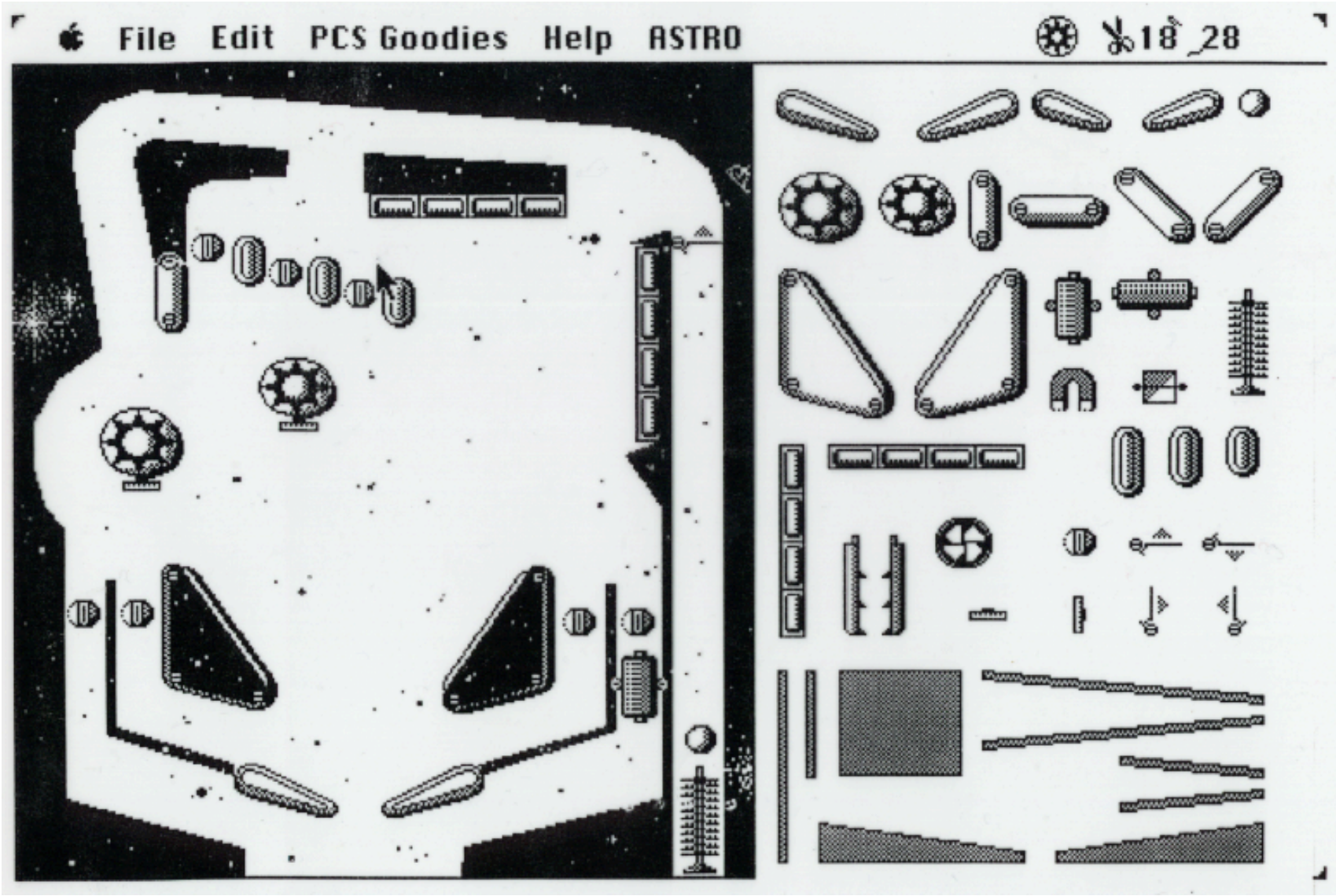
  "if we can provide the knowledge, the know-how, and the tools for making fishing rods, we can feed the whole community"

Meta-Design

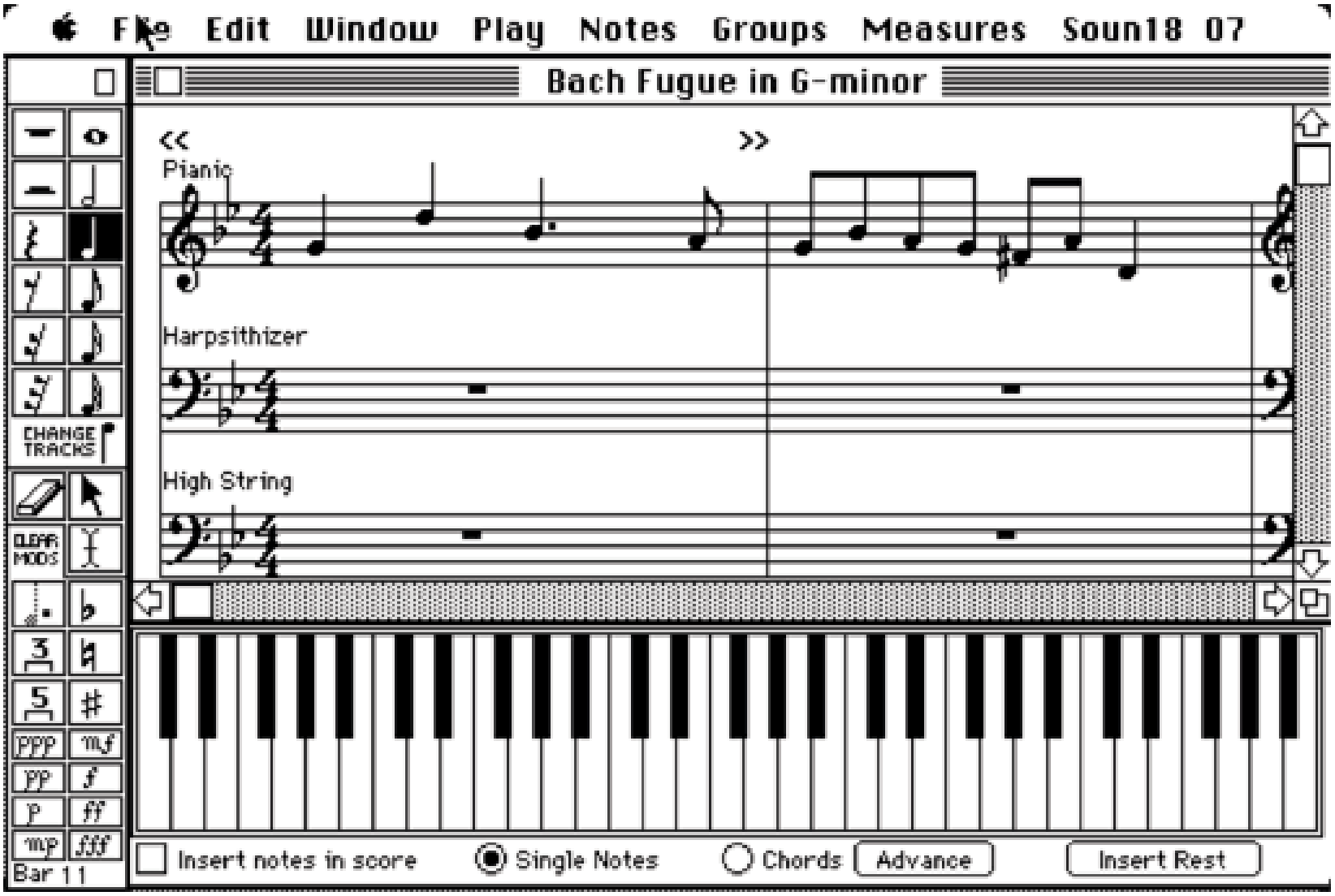
- **meta-design**
  - new media that allow users to act as designers and be creative
  - the creation of context rather than content
  - puts the tools rather than the object of design in your hands
  - does not define a product, but the conditions for a process of interaction

- **why meta-design?**
  - design for diversity (for “a universe of one” → CLever Project)
  - design as a process is tightly coupled to use and continues during the use of the system
  - addresses and overcome problems of closed systems
  - prerequisite for social creativity and innovation
  - transcends a “consumer mindset”

Human Problem Domain Interaction — Pinball Construction Kit



Human Problem Domain Interaction — Music Construction Kit



Comparing Self-conscious and Unself-conscious Cultures of Design

	self-conscious	unself-conscious
definition	an explicit, externalized description of a design exists (theoretical knowledge)	process of slow adaptation and error reduction; situated
original association	professionally-dominated design	primitive societies, handmade things
examples	seeding and reseeding designed cities: Brasilia, Canberra, Abudja	evolutionary growth naturally grown cities: London, Paris
strengths	activities can be delegated; division of labor becomes possible	many small improvements → artifacts well suited to their function; coping with ill-defined, unarticulated problems
weaknesses	many artifacts are ill-suited to the job expected of them	no general theories exist or can be studied (because the activity is not externalized)
requirements	externalized descriptions must exist—issue: how adequate are these externalized descriptions?	owner of problems must be involved because they have relevant, unarticulated knowledge

Meta-Design: Beyond Professionally-Dominated, User-Centered Design and Participatory Design

- **professionally-dominated design**
  - works at best for people with the same interests and background knowledge

- **user-centered design:**
  - analyze the needs of the users
  - understand the conceptual worlds of the users

- **participatory design**
  - involve users more deeply in the process as co-designers by empowering them to propose and generate design alternatives
  - focus on system development at design time by bringing developers and users together to envision the contexts of use

- **meta-design:**
  - create design opportunities at use time
  - requires co-creation

What Do Meta-Designers Do?

- use their own creativity to create socio-technical environments in which other people can be creative

- create the technical and social conditions for broad participation in design activities which are as important as creating the artifact itself

Meta-Design: Transforming Application Areas

- **open source:** a success model of decentralized, collaborative, evolutionary development (Eric Scharff, PhD thesis)
- **courses-as-seeds:** reinventing university courses (Ernesto Arias, Gerhard Fischer)
- **digital libraries:** community digital library (Michael Wright and Tamara Sumner)
- **interactive art:** collaboration, co-creation, put the tools rather than the object of design in the hands of users (Elisa Giaccardi)
  - examples: http://www.sito.org/ — **Gridcosm, HyGrid**

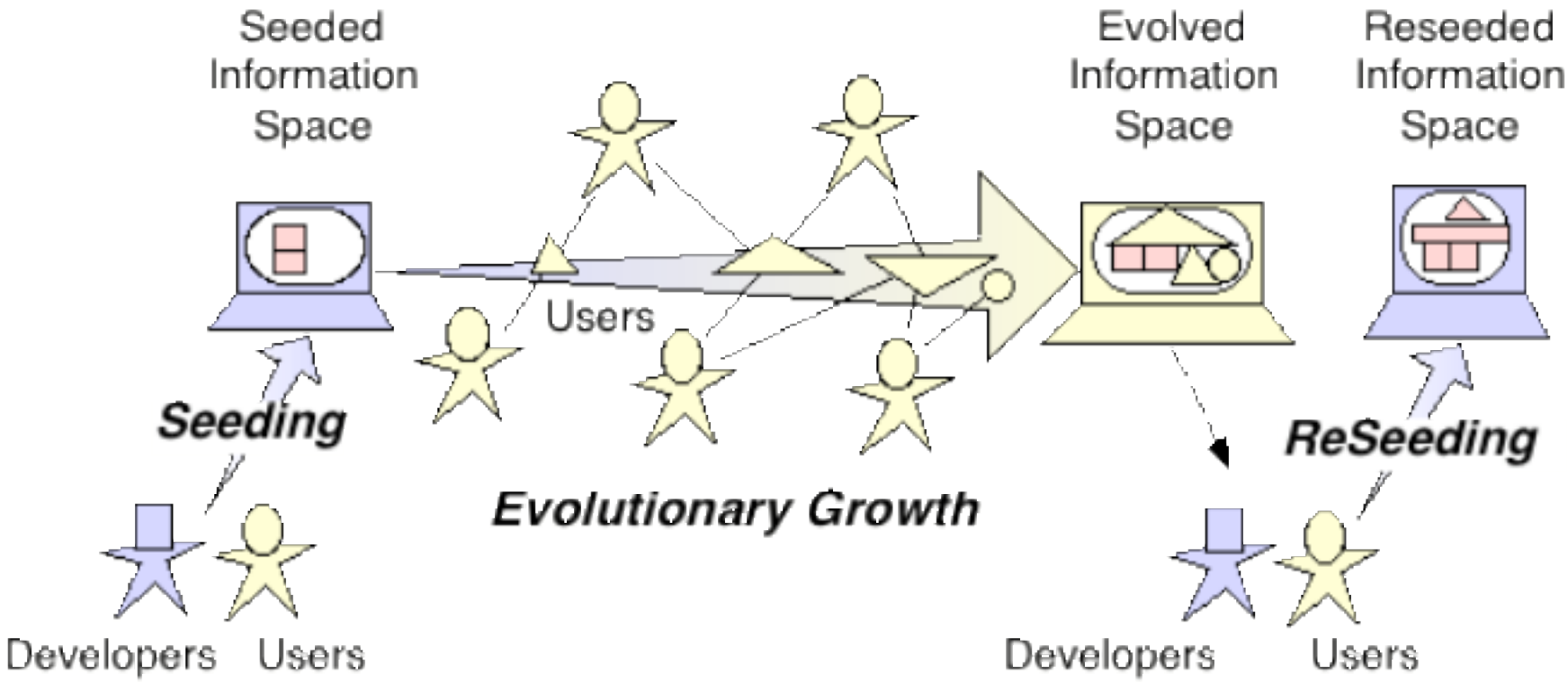
The Seeding, Evolutionary Growth, Reseeding (SER) Model

- **at design time:**
  - development of an initial system that can change over time (seed)
  - underdesign: creating design options for users

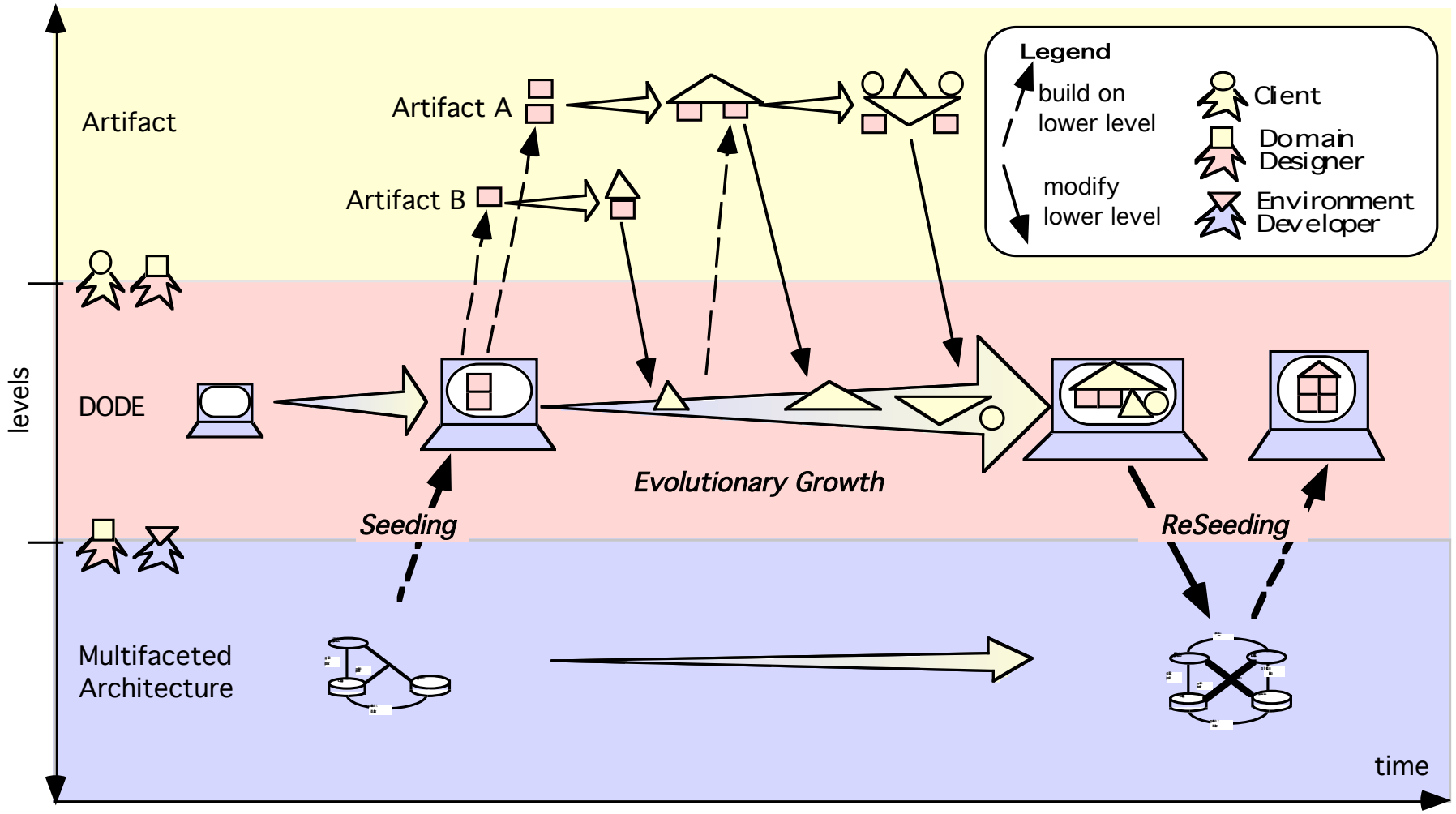
- **at use time:**
  - support for “unself-conscious culture of design”: users will experience breakdowns by recognizing “bad fit” at use time
  - end-user modifications allow users to address limitations they experience
  - evolutionary growth through incremental modifications

- **reseeding:**
  - significant reconceptualization of the system
  - account for incremental modifications, mitigate conflicts between changes, and establish an enhanced system

The SER Model



The SER Model Applied to Domain-Oriented Design Environments



Self-organizing Evolution ←→ Reseeding

—

Information Repositories Evolved by Specialists versus Evolved in the Working Context

	evolved by specialists	evolved in the working context
examples	digital library of ACM	websites of communities of practice, Eureka
nature of individual entries	database like entries	narratives, stories
economics	requires substantial extra resources	puts an additional burden on the knowledge workers
delegation	possible in domains in which entries/objects are well-defined	problem owners need to do it, because the entries/objects are emerging products of work
design culture	self-conscious	unself-conscious
motivation	work assignment	social capital

Some L3D System Developments

(supporting "Community-Driven Evolution of Knowledge Artifacts")

- **Envisionment and Discovery Collaboratory (E. Arias and H. Eden) —** computational support in face-to-face meetings for communities of interest
- **Web2gether (R. dePaula) —** social networks (teachers, parents) caring for people with cognitive disabilities
- **Living Organizational Memories (J. Ostwald)** — collaboratively evolved information repositories
- **CodeBroker (Y. Ye) —** software reuse as a CSCW/CSCL problem

The Envisionment and Discovery Collaboratory

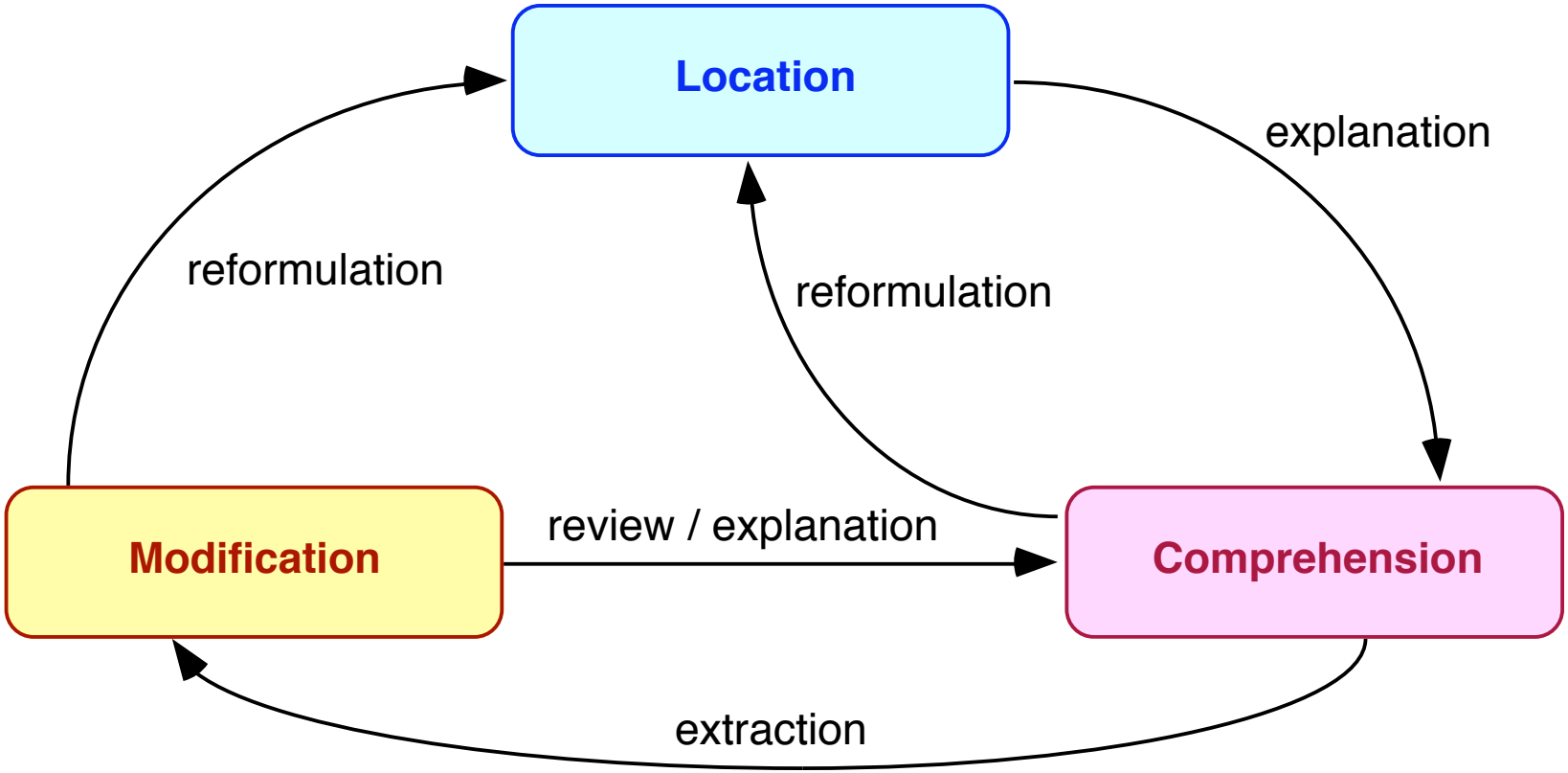
Meta-Design Aspects in the Envisionment and Discovery Collaboratory: Closed versus Open Systems

- **example for a closed system: SimCity —** too much crime
  - solution supported: build more police stations (**fight crime**)
  - solution not supported: increase social services, improve education (**prevent crime**)

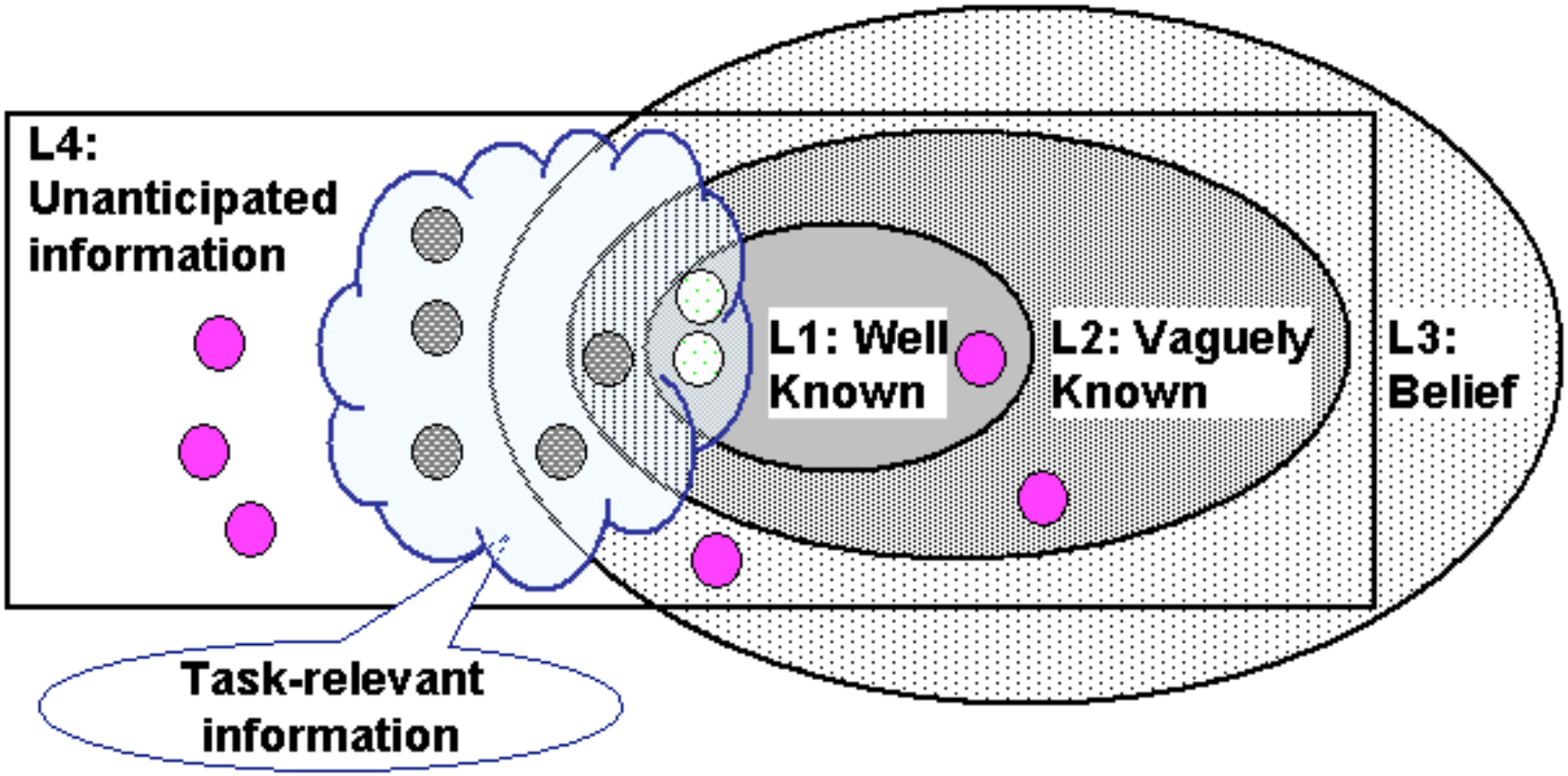
- **important goal of EDC:** create end-user modifiable versions of SimCity
  - background knowledge can never be completely articulated
  - the world changes

- **user control:**
  - end-user modifiability
  - conviviality: putting owners of problems in charge

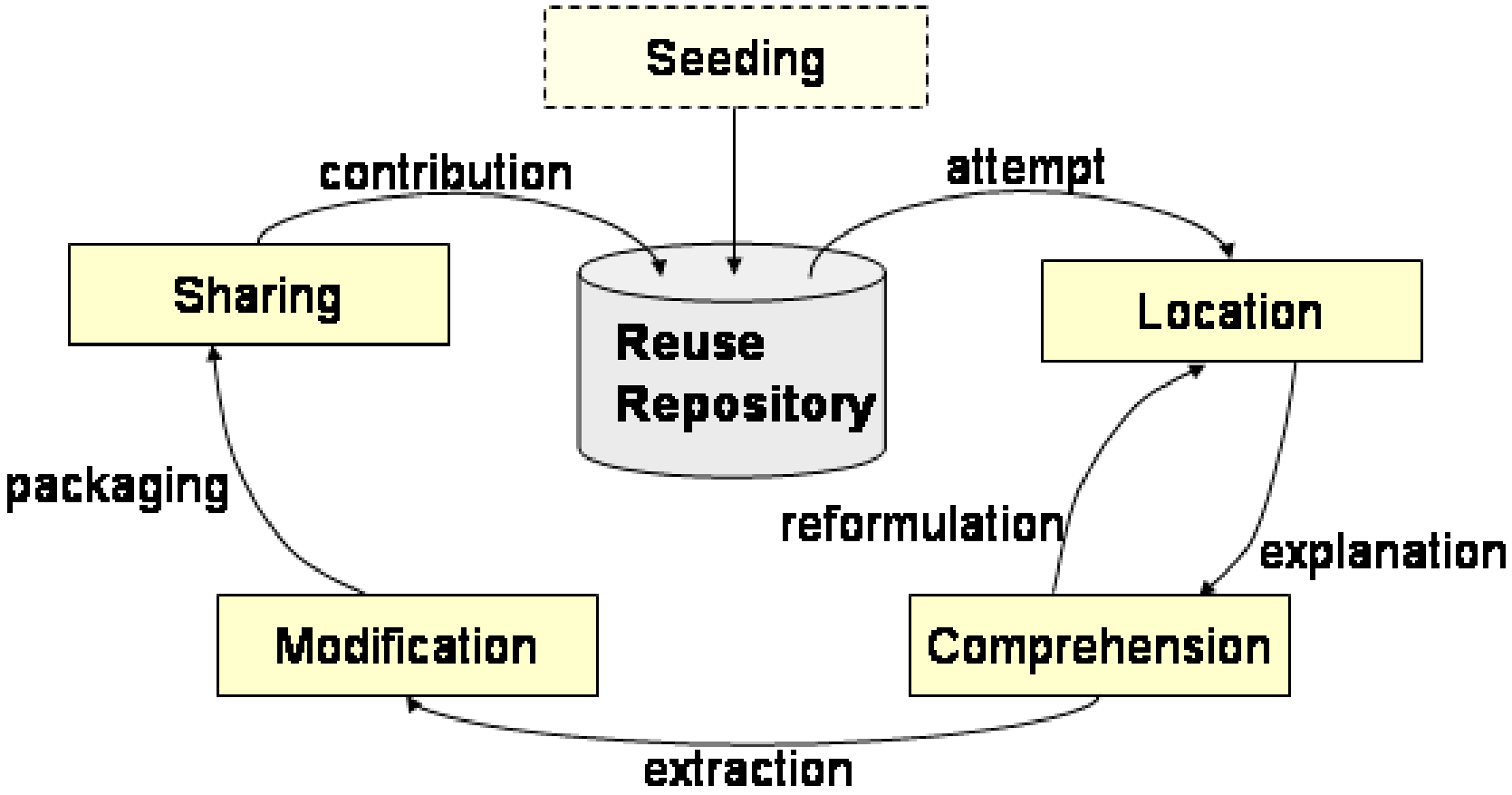
The Location-Comprehension-Modification Cycle



CodeBroker (Yunwen Ye): User Modeling and Personalization Supporting Software Reuse and High-Functionality Applications



The seeding, Location, Comprehension, Modification, and Sharing (sLCMS) Model



Experiences

- open source → open systems
- urban planning → Envisionment and Discovery Collaboratory work
- architects in the Discovery Learning Center: learning versus getting the work done (paradox of the active user)
- media competition (should be turned into media complementation)
- consumer mindsets among the students in our course

Obstacles

- social capital
- who is the beneficiary and who has to do the work
- Swiki and Dynasite for my courses: reliability ←→ research prototypes
- privacy in Web2gether
- improvisations versus standardization

Explore Technical Issues in Real-World Settings
—
Improvisations versus Standardization

- **example:** SAP Info, July 2003, p 33: “Reduce the Number of Customer Modifications”

- **rationale:**
  “every customer modification implies costs because it has to be maintained by the customer. Each time a support package is imported there is a risk that the customer modification may have to be adjusted or re-implemented. To reduce the costs of such on-going maintenance of customer-specific changes, one of the key targets during an upgrade should be to return to the SAP standard wherever this is possible”

- **compare:**
  - **“forking”** in Open Source
  - **“reseeding”** in Seeding, Evolutionary Growth, Reseeding Model

Challenges

- authentic communities
- utility = value / effort
- individual ←→ social creativity (autonomy versus shared goals)
- change of mindsets

Utility = Value / Effort

- **increase in value: motivation and rewards for a "design culture"**
  - feeling in control (i.e., independent from "high-tech scribes")
  - being able to solve or contribute to the solution of a problem
  - mastering a tool in greater depth
  - making an ego-satisfying contribution to a group
  - enjoying the feeling of good citizenship to a community ("social capital")

- **decrease in effort:**
  - meta-design is hard
  - extending meta-design to design for design communities

- **examples:**

- oral	→ literate society:	high value, very large effort
- paper-based literacy	→ digital literacy:	?????? ,???????
- individual	→ social:	?????? ,???????

Conclusions

- community-driven evolution of knowledge artifacts **offers:**
  - to invent and design a culture in which all participants in collaborative design can express themselves and engage in personally meaningful activities

- community-driven evolution of knowledge artifacts **raises many issues and research problems of fundamental importance**
  - new design methodologies
  - a new understanding of cognition, collaboration, and motivation
  - the design of new media and new technologies

- community-driven evolution of knowledge artifacts **is more than a technical problem; it requires**
  - a new **mindset** of all participants
  - designers giving up some **control**
  - **active contributors** and not just passive consumers at use time