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

Domain-Oriented Design Environments

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course information environment: http://xwiki.cs.colorado.edu/bin/view/DCNM2009/
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Overview

- Domain-Oriented Design Environments (DODEs)

- Examples
  - video-tape of Janus: a DODE for kitchen design

- Critiquing in DODEs
  - reflection-in-action
  - intrusiveness
  - generic, specific, interpretive critics
Design: Beyond Binary Choices

- **Turing Tar Pit:** “Beware of the Turing Tar Pit, in which everything is possible, but nothing of interest is easy.”
  - why are current interactive programming environments, such as Logo, Smalltalk, Squeak, Agentsheets, …… not sufficient for supporting meta-design?
  - claim: level of representation is still too far removed from the conceptual world of the domain workers
  - claim: they emphasize objective computability → the challenge: subjective computability

- **The Inverse of the Turing Tar Pit:** “Beware of the over-specialized systems, where operations are easy, but little of interest is possible.”
  - domain-specific tools (such as SimCity) provide extensive support for certain problem contexts
  - the ability to extend these environments is limited — even minor incremental changes are often impossible in these systems
The Objectives of Domain-Oriented Design Environments — Supporting Human Problem-Domain Interaction
Examples of Domain-Oriented Design Environments

- kitchen design
- voice dialog design
- computer network design
- urban design and transportation planning — Envision and Discovery Collaboratory (EDC)
- multi-media design (color)
- website design
Human Problem Domain Interaction — Pinball Construction Kit
Human Problem Domain Interaction — **Music Construction Kit**
SchemePaint (M. Eisenberg): a programmable application combining direct manipulation with interactive programming
SketchUp — A DODE for 3D Models
Domain-Oriented Design Environments (Janus-Construction)

Janus-Construction

Appliance Palette
- walls
- doors
- windows
- sinks
- stoves

Catalog
- L-Shaped-Kitchen

Messages
- The length of the work triangle (Double-Bowl-Sink-1, Four-Element-Stove-1, Single-Door-Refrigerator-1) is greater than 23 feet.
- Single-Door-Refrigerator-1 is not near Four-Element-Stove-1.

Work Area
- DW

Clear Work Area
- Load Catalog
- Critique All
- Save In Catalog
- Edit Global Descriptions
- Select Context

Commands
- Critique All
Janus-Argumentation

Answer (Refrigerator, Sink, Stove)
The distance between sink, stove and refrigerator, the work triangle, should be less than 25 feet.

\[ d_1 + d_2 + d_3 < 25 \text{ feet} \]

Figure 10: the work triangle

Argument (Walking Distance)
The work triangle is an important concept in kitchen design. The work triangle denotes the center front distance between the three main appliances: sink, stove and refrigerator. This length should be less than 25 feet to avoid unnecessary walking and to ensure an efficient work flow in the kitchen.

Argument (Small Room)
In small kitchens where the work triangle is less than 16 feet.
The Multi-Faceted Architecture behind DODEs
Domain-Oriented Design Environments (DODEs)

- **specification**: Is the cook right- or left-handed?
- **perspectives**: resale, personal, electrical, plumbing, American, Japanese
- **critics**:
  - **design rationale**: issue:
    - answer:
      - argument:
        - argument:
        - answer:
        - argument
Reflection-in-Action as a Problem Solving Theory

**designer's understanding** → **situated action**

**reflection on knowledge**

- catalog
- design rationale
- interpretation

**DESIGN**

- construction specification
- perspective

**breakdown**

- (critics)

**Movie: The Janus DODE**
VDDE: Voice Dialog Design Environment
Computer Network Design

Netscape: NetDE -- College of Engineering, University of Colorado

Priorities to be used for devices in this area

1st priority
- Cost
  weight: 10

2nd priority
- Expandability
  weight: 0

3rd priority
- Reliability
  weight: 4

OK  Cancel

Publications OT 8-6, College of Engineering, University of Colorado

1. Group Memory
   - Meeting Notes
   - Priorities
   - Machinery
   - Miscellaneous
   - All email

2. Worksheet: Publications -- OT 8-6

3. Launch Construction Component

4. NetDE
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 Seeding, Evolutionary Growth, Reseeding (SER) Model

Seeded Information Space

Evolved Information Space

Reseeded Information Space

Seeding

Evolutionary Growth

ReSeeding

Developers

Users

Users

Developers
Seeding, Evolutionary Growth, and Reseeding (SER) Model
Seeding, Evolutionary Growth, and Reseeding (SER) Model
Computational Critics (= “Virtual Human Critics”)

- **spelling correctors** — example of a “simple” critiquing system
  - simple: a “correct” answer exists
  - passive $\leftrightarrow$ active
  - suggestions for corrections $\leftrightarrow$ “auto-correct” in MS-Word

- **unlimited opportunities for application**: grammar checkers, color critics, graphs critics, webpage critics

- **webpage critics and universal access**
  - http://analyze.websiteoptimization.com/
  - http://validator.w3.org/
The Rationale / Need for Critiquing

  - “but when color is used inappropriately it can be very counter productive and few software designers have much experience with the use of color; the aim of this book is to synthesize our current knowledge in the area and specify **guidelines** so that programmers, engineers, and psychologists can use color.”
  - question: what are the benefits of “critiquing systems” compared to “guidelines”

  - “one reason for the abundance of bad graphs is the proliferation of low-cost microcomputers and ‘business graphics’ packages which often seduce the user into producing flashy but muddled displays; many graphs are designed without consideration of principles of human perception and cognition”
  - question: can a critiquing system be developed for “human perception and cognition”
EMMA (Environment for MultiMedia Authoring) and Color Critiquing
Computer-Based Critiquing: Examples and Mechanisms

- **examples:**
  - the length of the work triangle is more than 23 feet
  - a critiquing rule in the Envisionment and Discovery Collaboratory: “the maximum distance between two bus stops is 1 mile”

- **mechanism:**
  - enable relevant critics
  - analyze construction and specification (e.g., the specification states that this is a part of town where many old people live)
  - signal breakdowns
  - deliver relevant knowledge
  - identify the right level of intrusiveness:
    - on demand ↔ critical points (“windows in Janus”) ↔ all the time (MS Word)
Giving Domain Designers Control about the Intrusiveness of Critics
An Implementation of Critics

- Specification Component
- Construction Component
-critic messages
- design rationale
- catalog examples

Construction Analyzer

Argumentation Component

Argumentation Illustrator

Catalog Component
Embedding Critics in the Contexts of Design

generic domain knowledge
"kitchen design"
design rationale
catalog of past designs

construction
"this design"
graphical construction
generic critics

specification
"left-handed kitchen"
partial specification
specific critics

perspective
"the resale perspective"
redefined knowledge
interpretive critics
Generic Critics in Construction

**Construction**

**Generic Critic**

IF the dishwasher is right of sink, THEN "move dishwasher left of sink"

**Design Rationale**

**issue:**
Where should the dishwasher be placed?

**answer:**
Left side of sink.

**argument:**
Dishwasher on left provides efficient work flow for right-handed people.
A Partial Specification of a Specific Client

<table>
<thead>
<tr>
<th>questions in specification component</th>
<th>answers by client:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- name:</td>
<td>Smith’s kitchen</td>
</tr>
<tr>
<td>- size of family:</td>
<td>four to six</td>
</tr>
<tr>
<td>- primary cook:</td>
<td>left-handed</td>
</tr>
<tr>
<td>- size of meals:</td>
<td>huge (big eaters)</td>
</tr>
<tr>
<td>- entertainment:</td>
<td>often</td>
</tr>
<tr>
<td>- cooking frequency:</td>
<td>often</td>
</tr>
<tr>
<td>- type of sink:</td>
<td>double bowl sink</td>
</tr>
</tbody>
</table>

**specification component in EDC:** questionnaire for citizens how long they would wait for the bus
Specific critics in specification

**Specification**
Is the primary cook right or left-handed?
  *left-handed*
(left-handedness)

**Design Rationale**

*issue:*
Where should the dishwasher be placed?

*answer:*
Right side of sink.
(right-of dishwasher sink)

*argument (pro):*
If the cook is left-handed then the dishwasher should be right of the sink.

**Construction**

**Specific Critic**
(left-handedness)
(right-of dishwasher sink)

**Critic Message**
"Move the dishwasher to the right of the sink."
Interpretive critics in perspective

Define a new perspective

Name: Smith's Kitchen

- Resale
- Ranch House
- Residential

Add Perspective  Save  Cancel

Smith's Kitchen
DW left of sink
Benefits of Embedding Critics

- increase integration of design environment components
- allow system to infer “task at hand”
- enabling only relevant critic rules
- deliver richer, more relevant information
Global Objective of Embedding Critics

- increasing the “back-talk” of the situation

- supporting reflection-in-action

- supporting learning on demand

- reducing information overload: saying the ‘right’ thing at the ‘right’ time in the ‘right’ way to the ‘right’ person

- making information relevant to the task at hand