



Center for
**LifeLong
Learning
& Design**

University of Colorado at Boulder

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

Embedding Critics into Domain-Oriented Design Environments

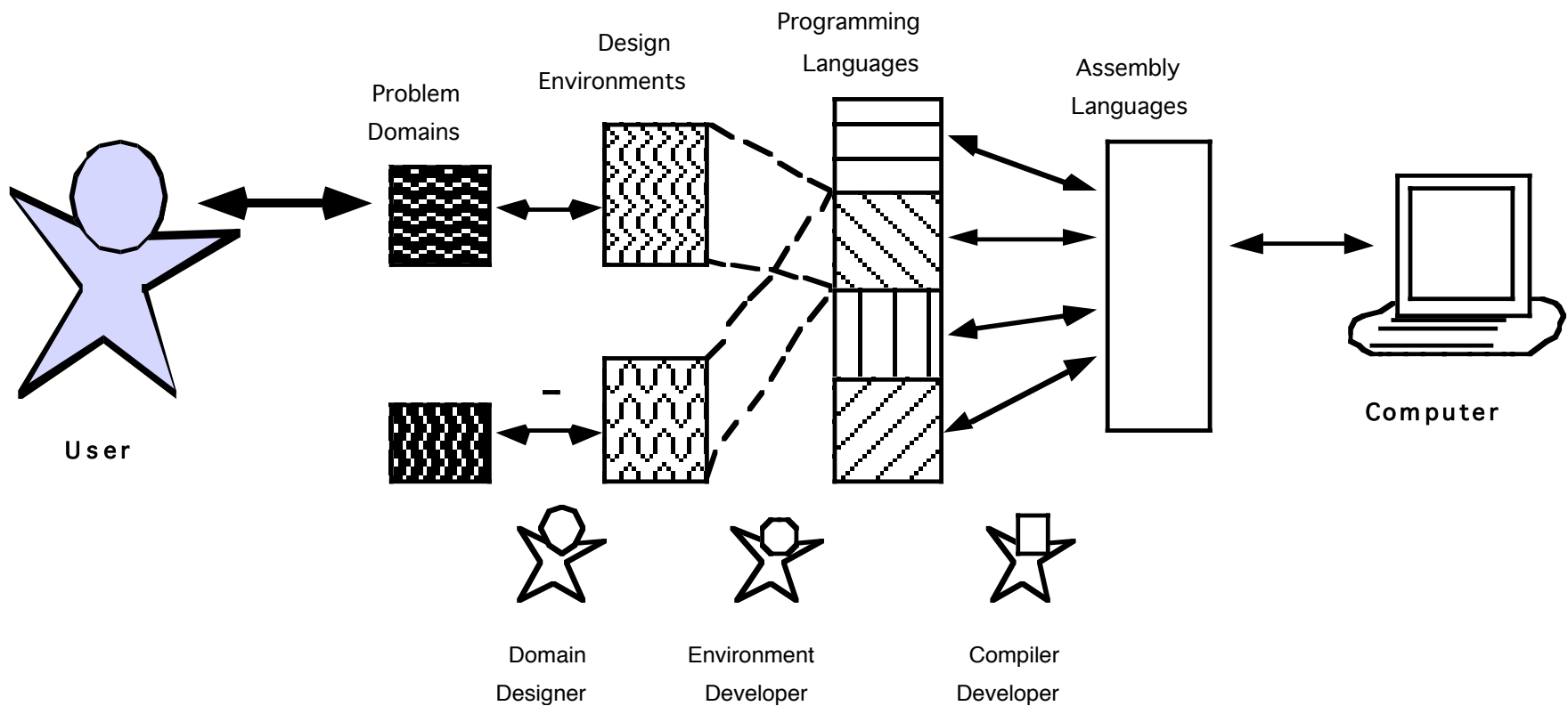
**Gerhard Fischer and Hal Eden
Spring Semester 2004**

March 4, 2004

paper: Fischer, G., Nakakoji, K., Ostwald, J., Stahl, G., & Sumner, T. (1998) "Embedding Critics in Design Environments." In M. T. Maybury & W. Wahlster (Eds.), *Readings in Intelligent User Interfaces*, Morgan Kaufmann, San Francisco, pp. 537-561.

The Objectives of Domain-Oriented Design Environments



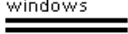
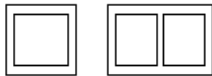

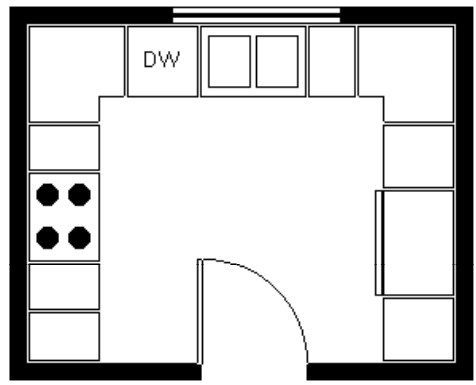
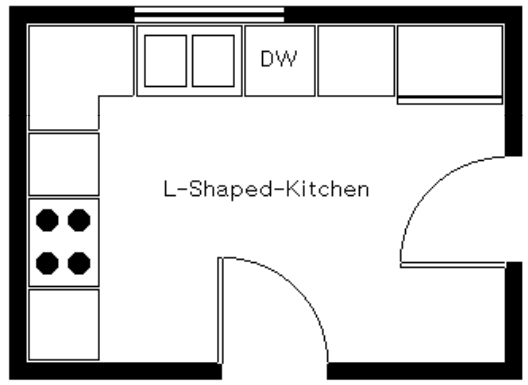
Supporting Human Problem-Domain Interaction



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

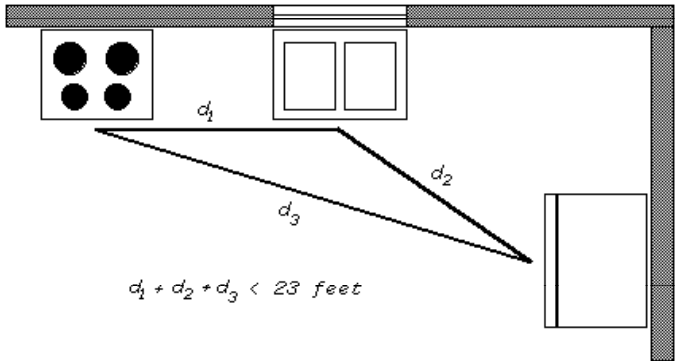
Domain-Oriented Design Environments (Janus-Construction)

<i>Janus-Construction</i>		Clear Work Area Load Catalog	Critique All Save In Catalog	Edit Global Descriptions Select Context
<p>Appliance Palette</p> <p>walls</p>  <p>doors</p>  <p>windows</p>  <p>sinks</p>  <p>stoves</p> 		<p>Work Area</p> 		
<p>Catalog</p>  <p style="text-align: center;">L-Shaped-Kitchen</p>		<p>Messages</p> <ul style="list-style-type: none"> • 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. 		
		<p>Commands</p> <ul style="list-style-type: none"> ▶ Critique All ▶ ■ 		

Janus-Argumentation

Janus-Argumentation

Answer (Refrigerator, Sink, Stove)
 The distance between sink, stove and refrigerator, the *work triangle*, should be less than 23 feet.



$d_1 + d_2 + d_3 < 23 \text{ feet}$

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 23 feet to avoid unnecessary walking and to ensure an efficient work flow in the kitchen!

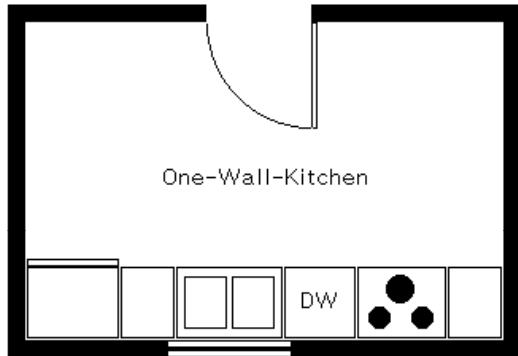
Argument (Small Room)
 In small kitchens where the work triangle is less than 16 feet,

Viewer: Default Viewer

Commands

- ▶ Show Example: "Answer (Refrigerator, Sink, Stove)"
- ▶ Show Example Answer (Refrigerator, Sink, Stove)

Catalog Example



One-Wall-Kitchen

The length of the work triangle (Stove, Refrigerator, Sink) is less than 23 feet.

Visited Nodes

- ⇒ Answer (Refrigerator, Sink, Stove) Section

Show Outline

Search For Topics

Show Argumentation

Show Context

Resume Construction

Show Construction

Show Example

Show Counter Example

VDDE: Voice Dialog Design Environment

The screenshot displays the VDDE software interface with several key components:

- Tool Palette:** Located at the top, it contains various icons for actions such as Start, End, Menu, Get Data, Data, to, Else, Note, Global Data, Data, Voice-Menu, R-Button, Get-Time, Get-Data, Data-Test, Range-Test, and Else. Below the icons are labels for Subsystem, Data-Unit-C, Set-Data-C, Beep, Message, Prompt, Voice-Colle, Tbl-Collect, and Digit-Cole.
- Worksheet: new-residential:** A central workspace showing a flowchart of a voice menu. It includes a 'Main Menu' with options 1 (Listen), 2 (Personal), 3 (Send), and Invalid. A 'Personal Options Menu' follows, with options 1 (Security), 3 (Record), 4 (Notific), and 5 (Schedule). Each option is linked to specific actions like 'Beep', 'Msg', and 'Accept or Cancel'.
- VDDE-Stack:** A window on the right titled 'Voice Mail Personal Options Menu'. It contains:
 - VMUIF Guidelines:** Text explaining that menu options are shown below and that (M) or (R) in parentheses indicates mandatory or reserved functions. If not displayed, the function is optional and/or not-reserved.
 - Global Arguments:** A large empty text area.
 - Specific Arguments:** A table with 9 columns and 4 rows.

1	2	3
	Greetings (WR)	Rec. Name (WR)
4	5	6
7	8	9
*	0	#
 - Comment:** A text box containing the comment: "11/3/93: Jill Rejected because consistency with related design 'Voice Mail Business' is more important for usability than compliance with the VMUIF guidelines. (This comment regards the Voice Mail Residential application)."
- Critic Message Pane:** A window at the bottom center displaying several consistency and generic messages:
 - Consistency: Function 'Personal Options' in Main Menu is assigned key 3 in the related design 'voice mail business'
 - Consistency: Key 2 in Main Menu is associated with function 'send' in the related design 'voice mail business'
 - Consistency: Key 1 in Personal Options Menu is associated with function 'greeting' in the related design 'voice mail business'
 - Consistency: 'Listen Menu' is missing. It only exists in the related design 'voice mail business'
 - Generic: The keys in Personal Options Menu should have no gaps
 - USWEST: Function 'greeting' is mandatory in Personal Options Menu
 Below the messages are buttons for 'Explain Rule', 'Disable Rule', 'Critique All', 'Clear Msg', 'Clear All', and 'Close Pane'.

The screenshot displays the Netscape browser interface for the NetDE application. The browser window title is "Netscape: NetDE -- College of Engineering, University of Colorado". The address bar shows "file:///uu-gm-bin/menu.pl".

On the left, a "Catalog" sidebar lists several network diagrams: "Ox8-7", "Cr1-1", "Ox6-9", and "Ae5-3".

The main content area features the "NetDE" logo and a section titled "Publications OT 8-6, College of Engineering, University of Colorado". Below this, a "Group Memory" section contains a list of items with checkboxes: "Meeting Notes", "Priorities", "Machinery", "Miscellaneous", and "All email". A "Design" section is partially visible at the bottom left.

A "Worksheet: Publications -- OT 8-6" window is open, showing a network diagram with multiple "Pc" icons and a "Printer" icon connected by red lines. A "Launch Construction Component" button is located below the diagram.

A "Priorities to be used for devices in this area" dialog box is open, showing three priority settings:

- 1st priority: **Cost** (weight: 10)
- 2nd priority: **Expandability** (weight: 8)
- 3rd priority: **Reliability** (weight: 6)

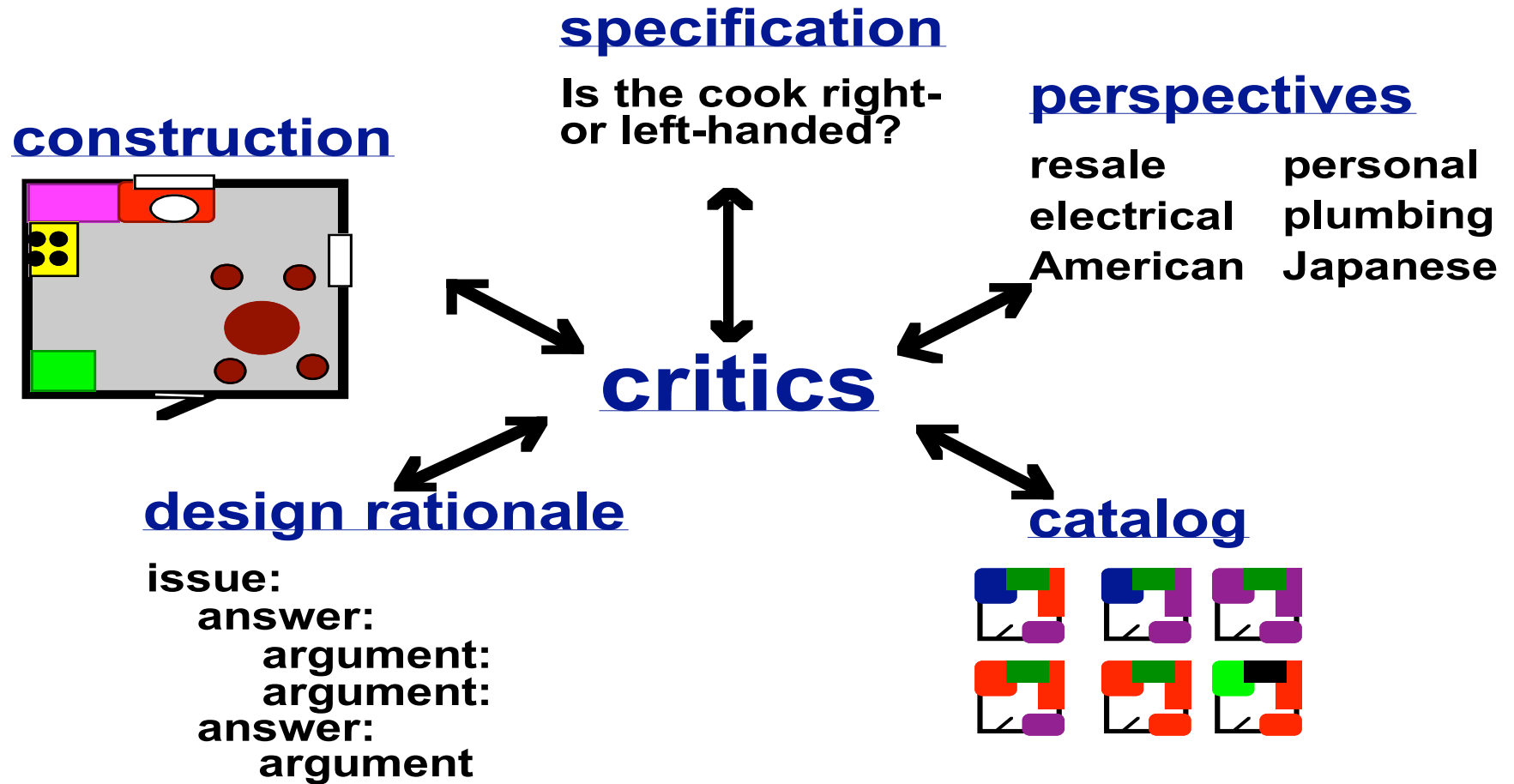
 The dialog includes "OK" and "Cancel" buttons.

On the right, a vertical toolbar contains icons for "Wire", "Mac", "Sun", "Server", "Printer", and "Local-Area".

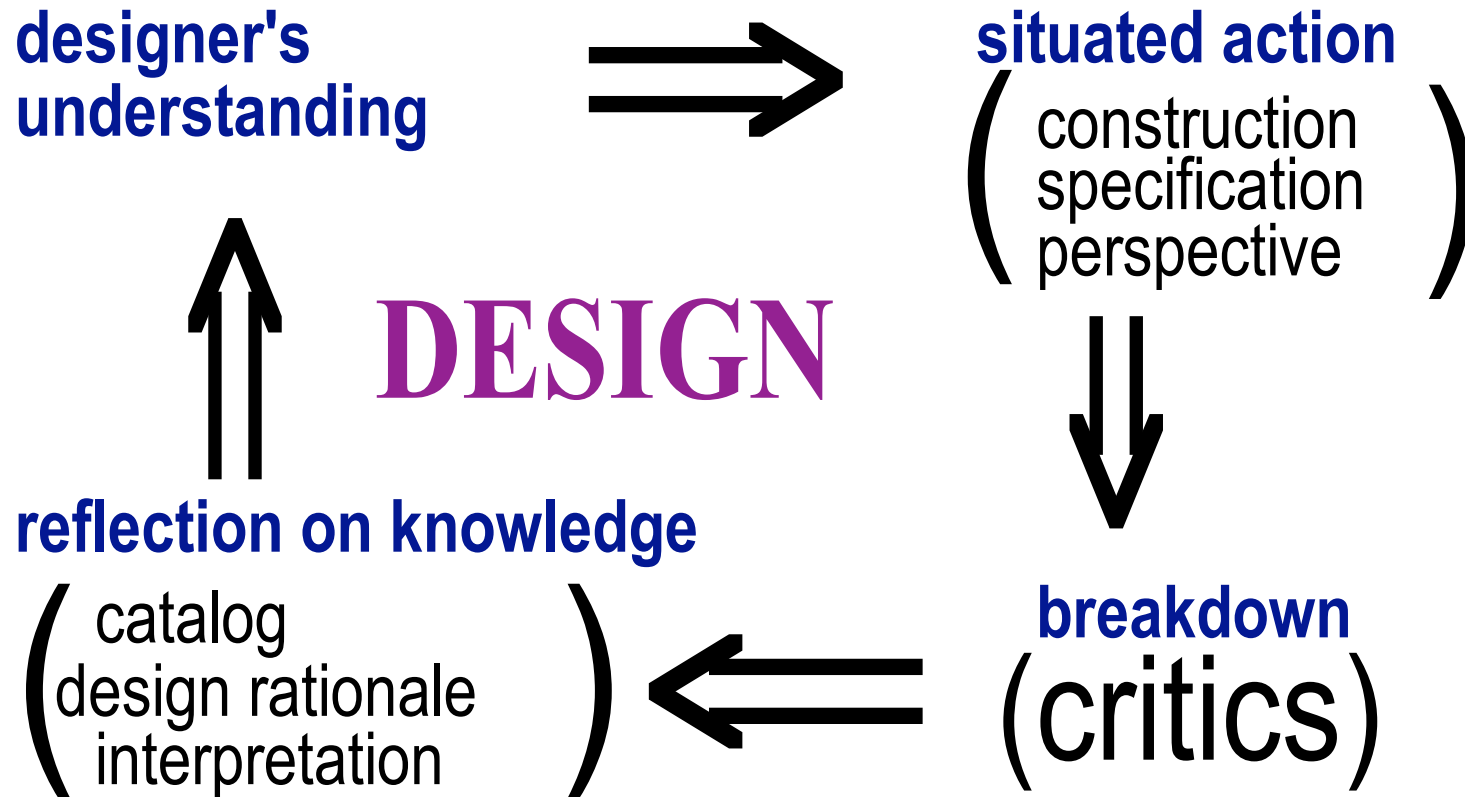
Handwritten annotations in large numbers are present:

- (1) points to the "Group Memory" section.
- (2) points to the vertical toolbar.
- (3) points to the network diagram in the worksheet.
- (4) points to the "Priorities" dialog box.
- (5) points to the "Catalog" sidebar.

Domain-Oriented Design Environments (DODEs)



Reflection-in-Action as a Problem Solving Theory



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://bobby.watchfire.com/bobby/html/en/index.jsp>
This free service will allow you to test web pages and help expose and repair barriers to accessibility and encourage compliance with existing accessibility guidelines, such as Section 508 and the W3C's WCAG. To learn about products to test websites of all sizes for accessibility issues, please visit the accessibility section on www.watchfire.com.

The Rationale / Need for Critiquing

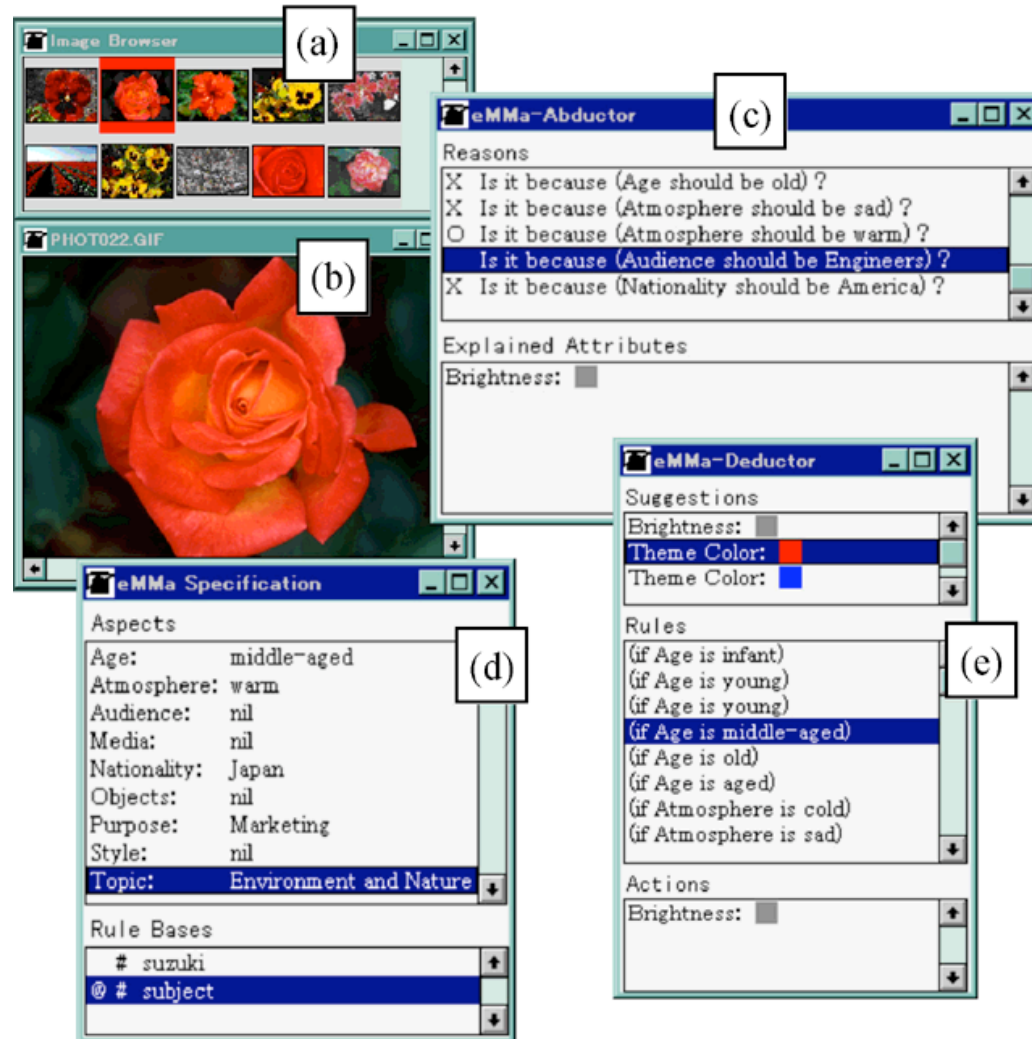
- **color** → Travis, D. (1991) *Effective Color Displays—Theory and Practice*, Academic Press, London:

“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 psychologist can use color.”

- **graphs** → Kosslyn, S. M. (1994) *Elements of Graph Design*, W.H. Freeman and Company, New York

“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”

EMMA (Environment for MultiMedia Authoring) and Color Critiquing



Computer-Based Critiquing: Examples and Mechanisms

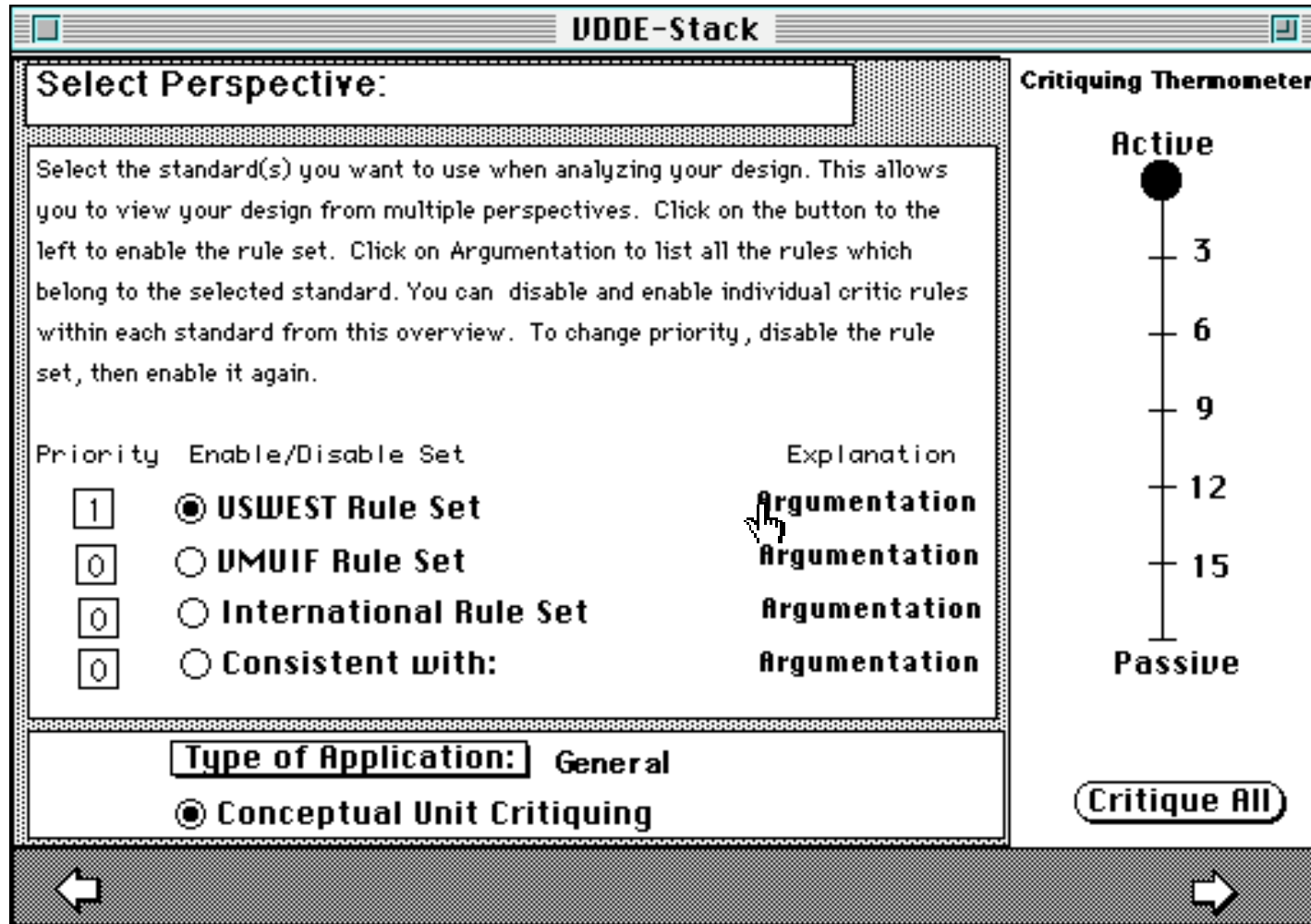
- **examples:**

- the length of the work triangle is more than 23 feet
- a critiquing rule in the EDC: “the maximum distance between two bus stops is 1mile”

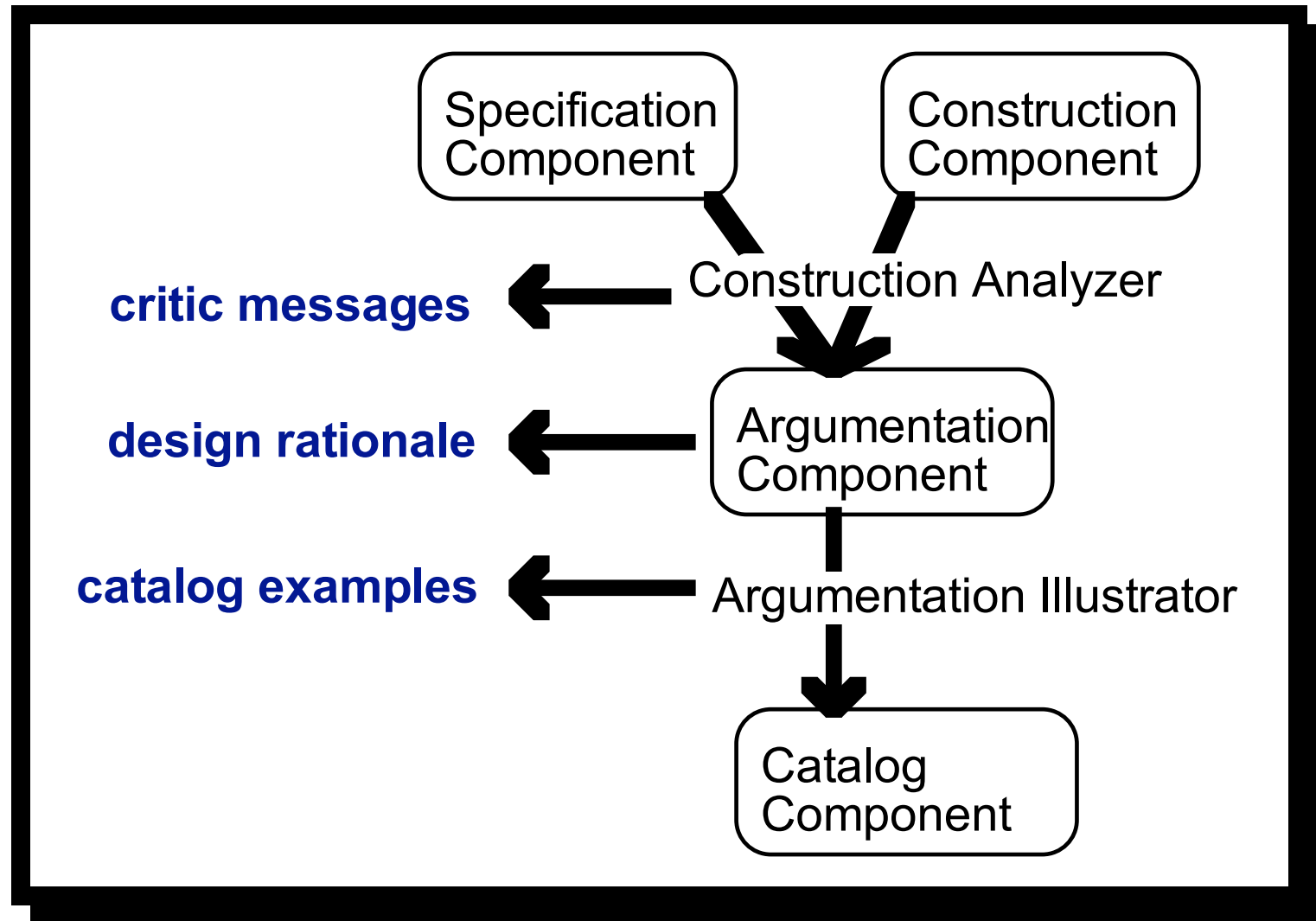
- **mechanism:**

- 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

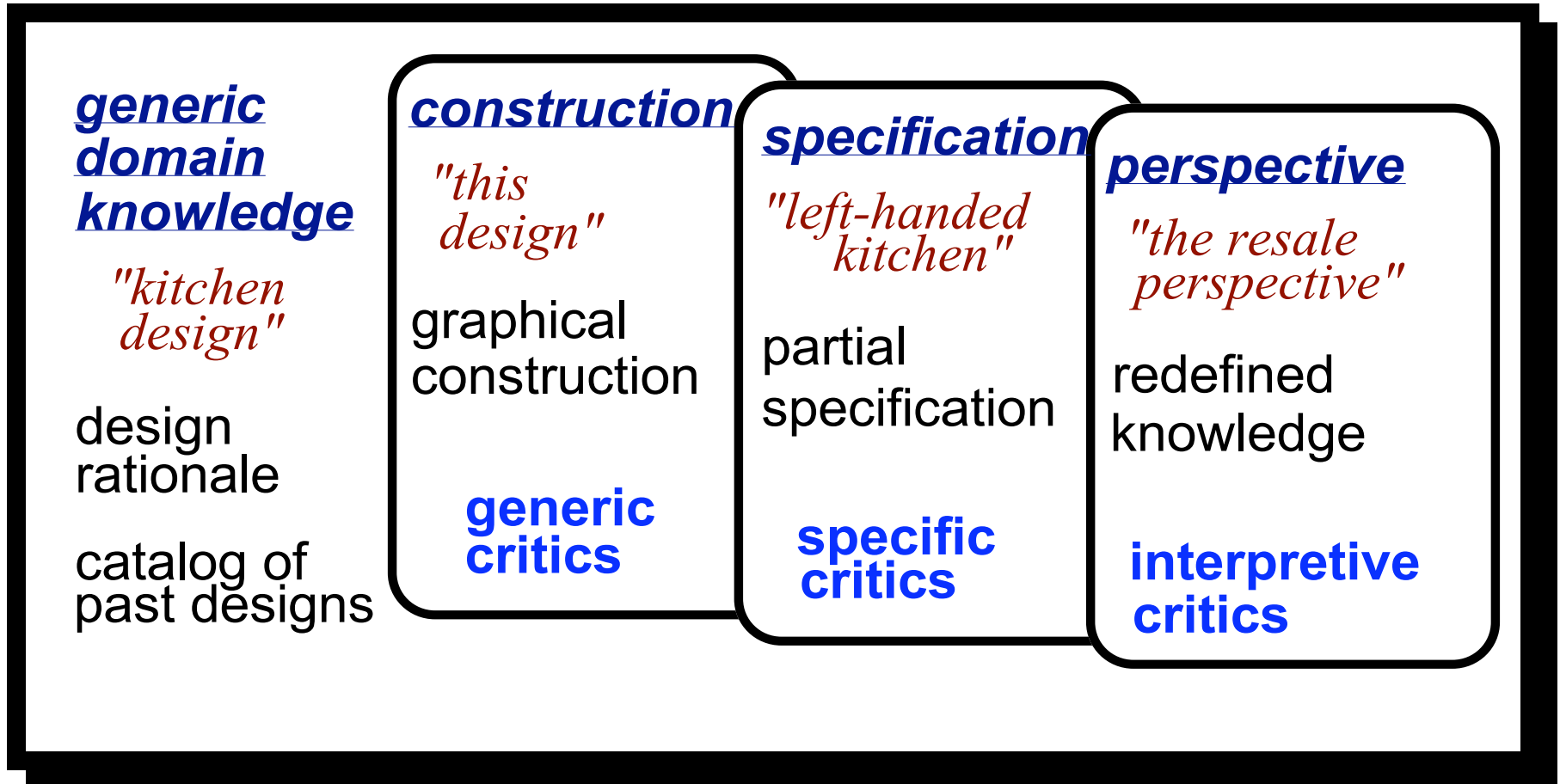
Giving Domain Designers Control about the Intrusiveness of Critics



An Implementation of Critics

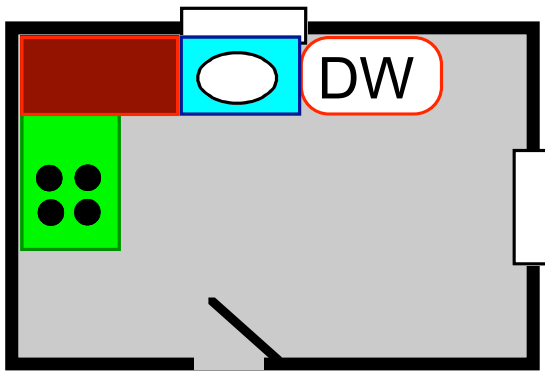


Embedding Critics in the Contexts of Design



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

questions in specification component

answers by client:

- | | |
|----------------------|-------------------|
| - name: | Smith's kitchen |
| - size of family: | four to six |
| - primary cook: | left-handed |
| - size of meals: | huge (big eaters) |
| - entertainment: | often |
| - cooking frequency: | often |
| - type of sink: | double bowl sink |

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?

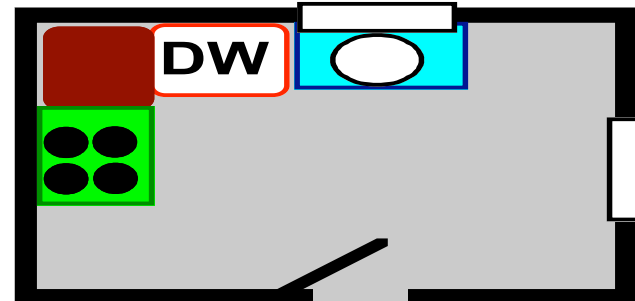
answer:

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



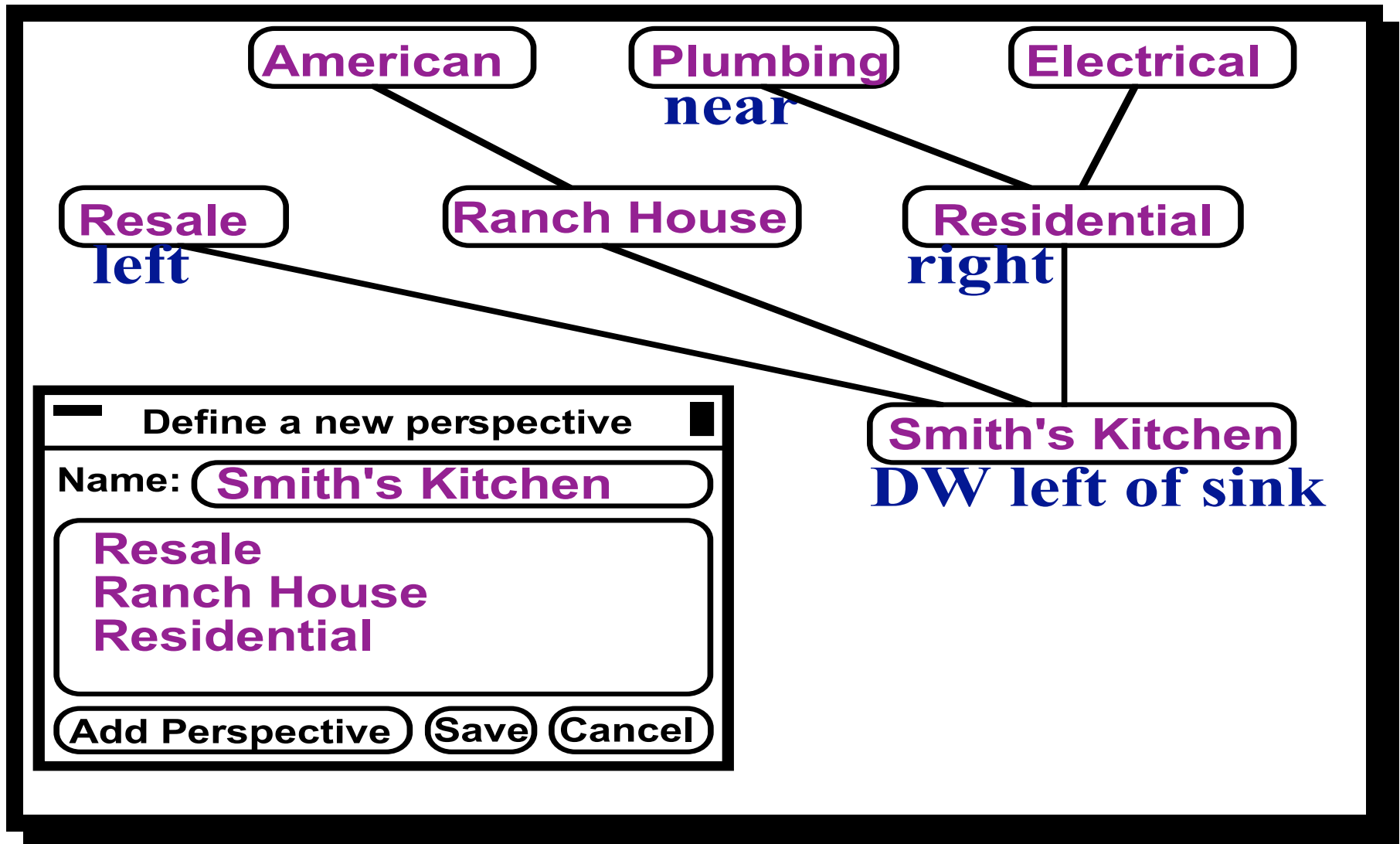
Specific Critic

(left-handedness) →
(right-of dishwasher sink)

Critic Message

"Move the dishwasher to the right of the sink."

Interpretive critics in perspective



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**