



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 2006**

**February 13,2006**

**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.

# Overview

- Feedback from Students
- Domain-Oriented Design Environments (DODEs)
- Examples
  - video-tape of Janus: a DODE for kitchen design
- Critiquing in Domain-Oriented Design
  - reflection-in-action
  - intrusiveness
  - generic, specific, interpretive critics

## Feedback from Students

- **Nathan:** This research could be extended by looking at software that is vastly available and used that contains critiquing (such as Word, Eclipse, Visual Studio) and studying the effects of these critics on their users. Do they help or hurt the user, does the user learn or does he/she ignore them, etc.
- **Min-Chieh:** Maybe this can be applied to the programming development software like “eclipse”, “visual studio”. It seems this software can help the customer to become designer.
- **John/Gary:** One way this could be extended is seeing an easy to use user interface that allows the designer to add new rules to the system instead of just relying on the pre-defined ones.
- **Kirill:** I would like to learn more about the mechanism for creating/maintaining rules and constraints that HYDRA and other similar systems use. Creating such rules (and making sure they’re consistent, complete, etc) seems a difficult issue, especially for non-programmers

## Feedback from Students — Continued

- **Keisuke:** The actual usefulness of the concept is not assessed in the article. Perhaps we should evaluate the effectiveness of the system in terms of the completeness of designed artifacts and the designer's preference compared with other design environments.
- **Lisa:** The HYDRA-KITCHEN makes designing a kitchen seem almost trivial so that average homeowners could customize and design their own kitchens. This is bit of an oversimplification since there are still many things to take into account when designing a kitchen, but it doesn't seem like a giant leap to suggest that anyone could use the software to do what kitchen designers do for a career.
- **Cortney:** a critiquing system that avoids unnecessary interruptions

## Feedback from Students – Continued

**Laoleng:** What about independent design? It is obvious that a designer doesn't have to follow the suggestions and critiques of the system, but what if a designer does so blindly. Would this critique system allow for human creativity?

**Mark:**

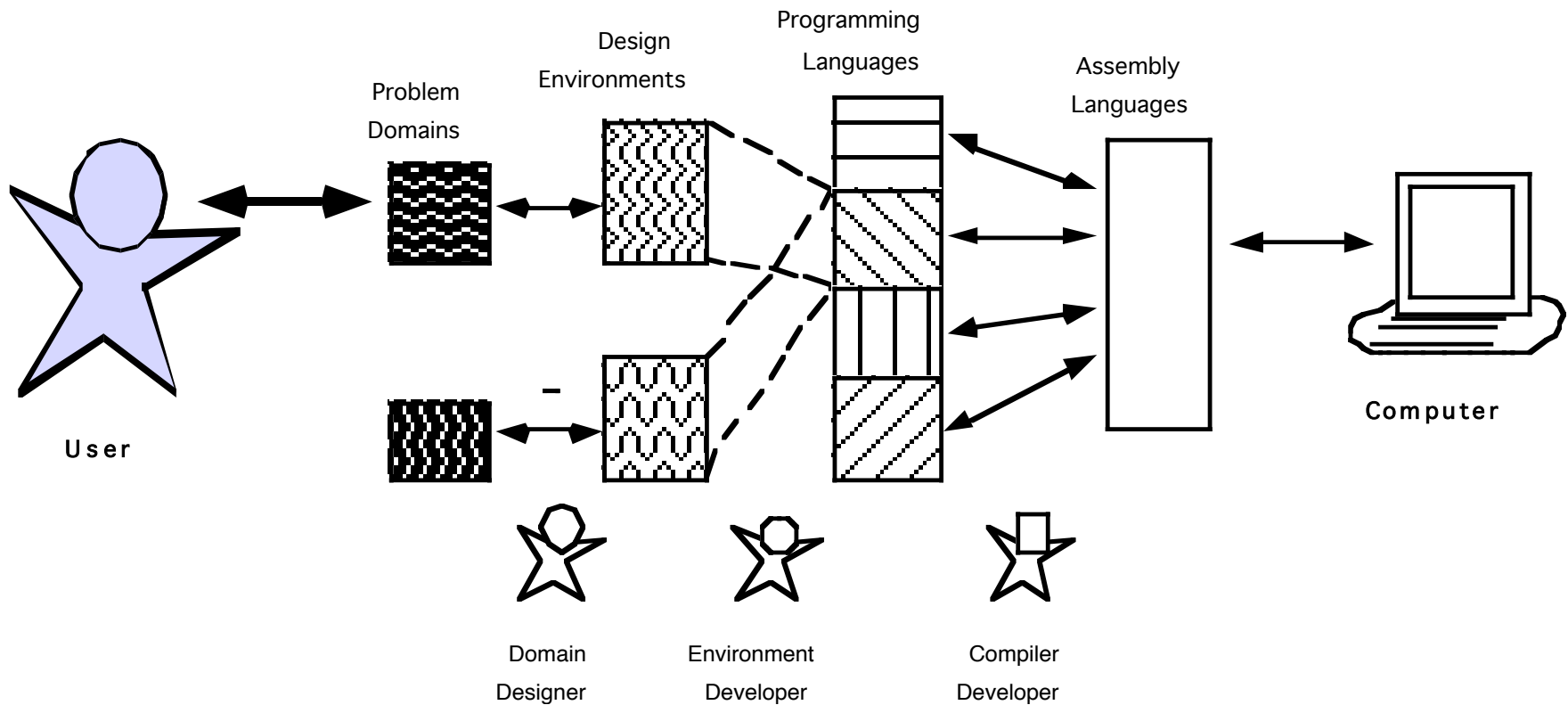
- (a) Simply being critiqued with being guided to requisite pertinent knowledge that address a criticism is of limited value.
- (b) An important addition might be to focus on HOW to critique since critiquing carries with it a negative connotation that something was not done right

**Malte:** another example for critiquing: Turbo Tax →

- (a) what can we learn from Turbo Tax;
- (b) what can Turbo Tax learn from us?

# The Objectives of Domain-Oriented Design Environments




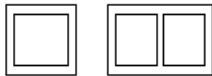

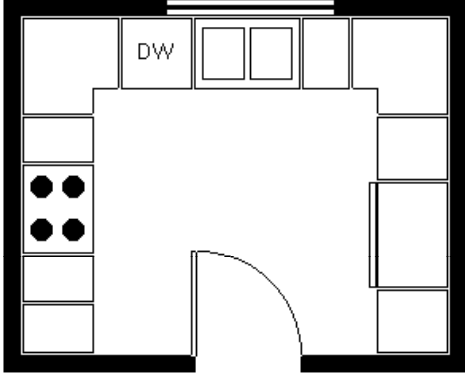
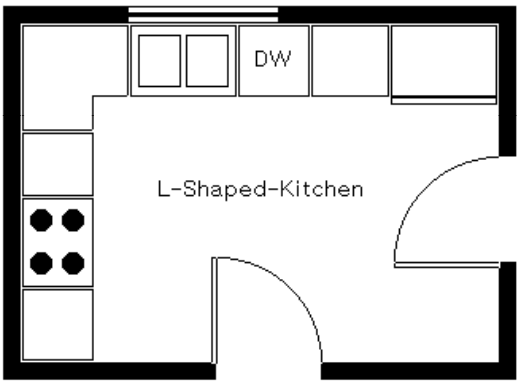
## Supporting Human Problem-Domain Interaction



# 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)

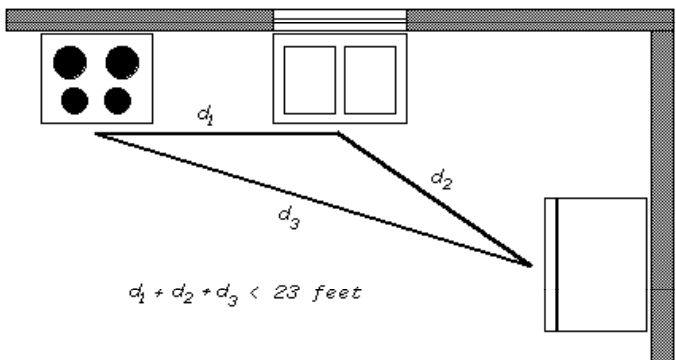
<i>Janus-Construction</i>		Clear Work Area Load Catalog	Critique All Save In Catalog	Edit Global Descriptions Select Context
<p><b>Appliance Palette</b></p> <p>walls</p>  <p>doors</p>  <p>windows</p>  <p>sinks</p>  <p>stoves</p> 		<p><b>Work Area</b></p> 		
<p><b>Catalog</b></p> 		<p><b>Messages</b></p> <ul style="list-style-type: none"> <li>• The length of the work triangle (Double-Bowl-Sink-1, Four-Element-Stove-1, Single-Door-Refrigerator-1) is greater than 23 feet.</li> <li>• Single-Door-Refrigerator-1 is not near Four-Element-Stove-1.</li> </ul>		
		<p><b>Commands</b></p> <ul style="list-style-type: none"> <li>▶ Critique All</li> <li>▶ ■</li> </ul>		



# 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,

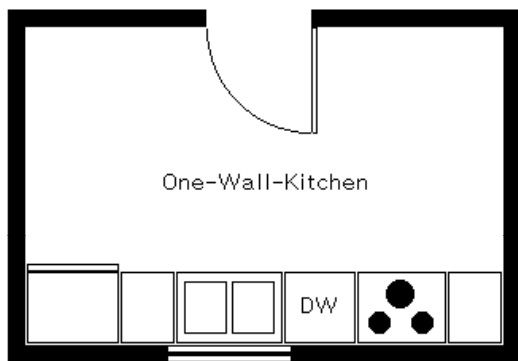
**Viewer: Default Viewer**

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**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.

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**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-Time, Get-Data, Data, to, Else, and others.
- Worksheet: new-residential:** A central workspace showing a flowchart of a voice dialog. It includes a 'Main Menu' with options like Listen, Personal, Send, Disconn, and Invalid. A 'Personal Options Menu' is also shown with options like Security, Record, Notific, and Schedul. Arrows indicate the flow between these menus.
- VDDE-Stack:** A window on the right titled 'Voice Mail Personal Options Menu'. It contains 'VMUIF Guidelines' (text describing menu options and mandatory/reserved functions), a table of menu options, and 'Global Arguments' and 'Specific Arguments' sections.
- Critique Message Pane:** A window at the bottom displaying several consistency and generic messages. It includes buttons for 'Explain Rule', 'Disable Rule', 'Critique All', 'Clear Msg', 'Clear All', and 'Close Pane'.

**VMUIF Guidelines:**

The Menu options are shown below. Whether the functions are mandatory (M) and/or Reserved (R) is shown in parentheses. If M or R is not displayed, then the function is Optional and/or Not-Reserved.

1	2	3
	Greetings (MR)	Rec. Name (MR)
4	5	6
7	8	9
*	0	#

**Specific Arguments:**

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).

**Critique Message Pane:**

- 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

The image displays the NetDE software interface, which is used for network design. The main window is titled "Netscape: NetDE -- College of Engineering, University of Colorado". It features a navigation bar with buttons for Back, Forward, Home, Reload, Images, Open, and Print. Below this is a "Goto:" field containing the file path "file:///uu-gm-bin/menu.pl".

On the left side, there is a "Catalog" panel with a list of network components: "Ox8-7", "Cr1-1", "Ox6-9", and "Ae5-3". A question mark icon is visible at the top of this panel.

The central workspace is titled "Publications OT 8-6, College of Engineering, University of Colorado". It contains a "Group Memory" section with several checkboxes: "Meeting Notes", "Priorities", "Machinery", "Miscellaneous", and "All email". Below this is a "Design" section with a "Launch Construction Component" button. A large network diagram is shown in the center, labeled "Worksheet: Publications -- OT 8-6", featuring multiple "Pc" icons connected by red lines, and a central "Printer" icon. A question mark icon is also present in the top-left corner of this workspace.

A dialog box titled "Priorities to be used for devices in this area" is open in the upper right. It contains three priority settings:
 

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

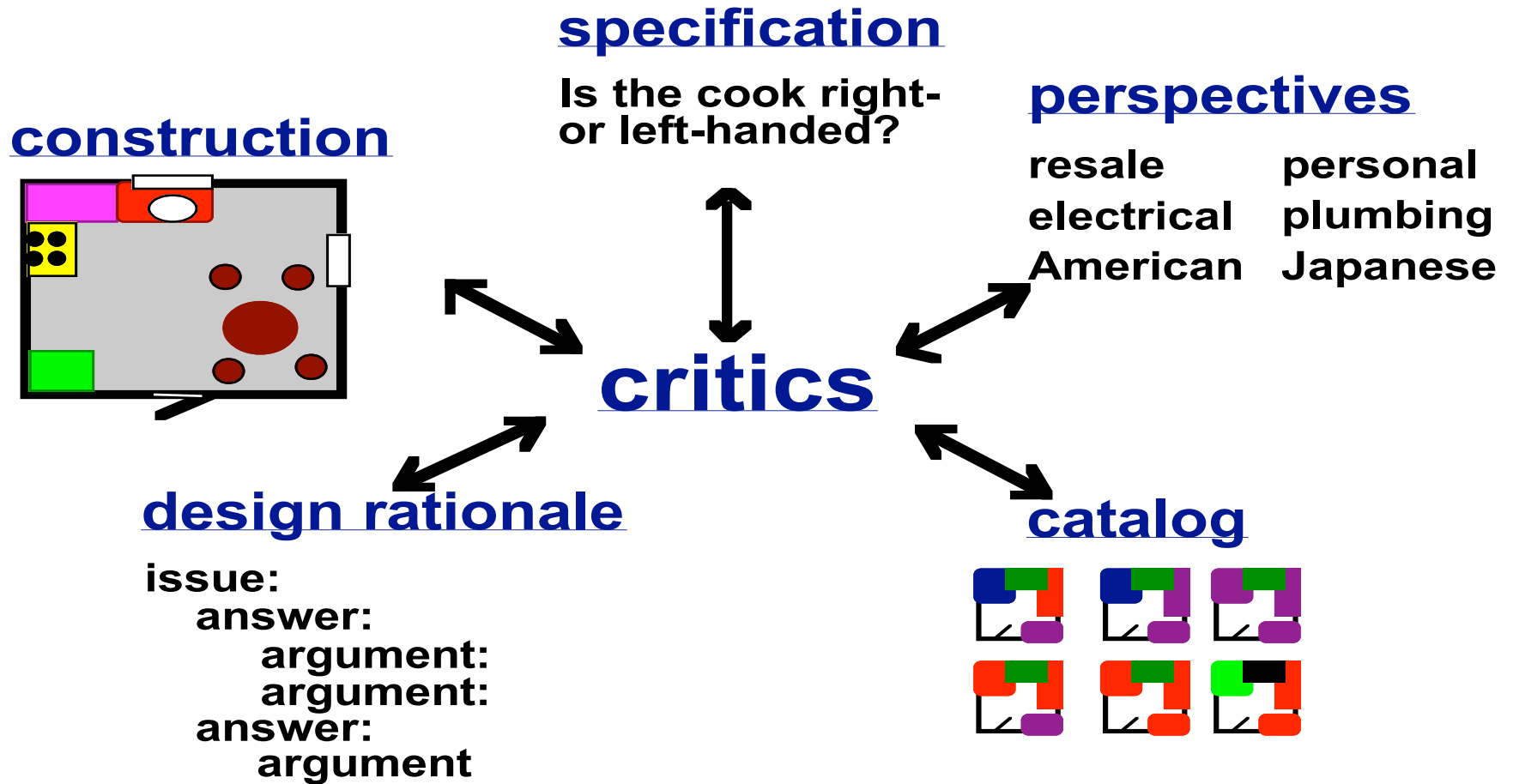
 The dialog has "OK" and "Cancel" buttons.

On the right side, there is a vertical component palette labeled "Wire" at the top. It lists various components: "Mac", "Sun", "Server", "Printer", and "Local-Area". A question mark icon is at the top of this palette.

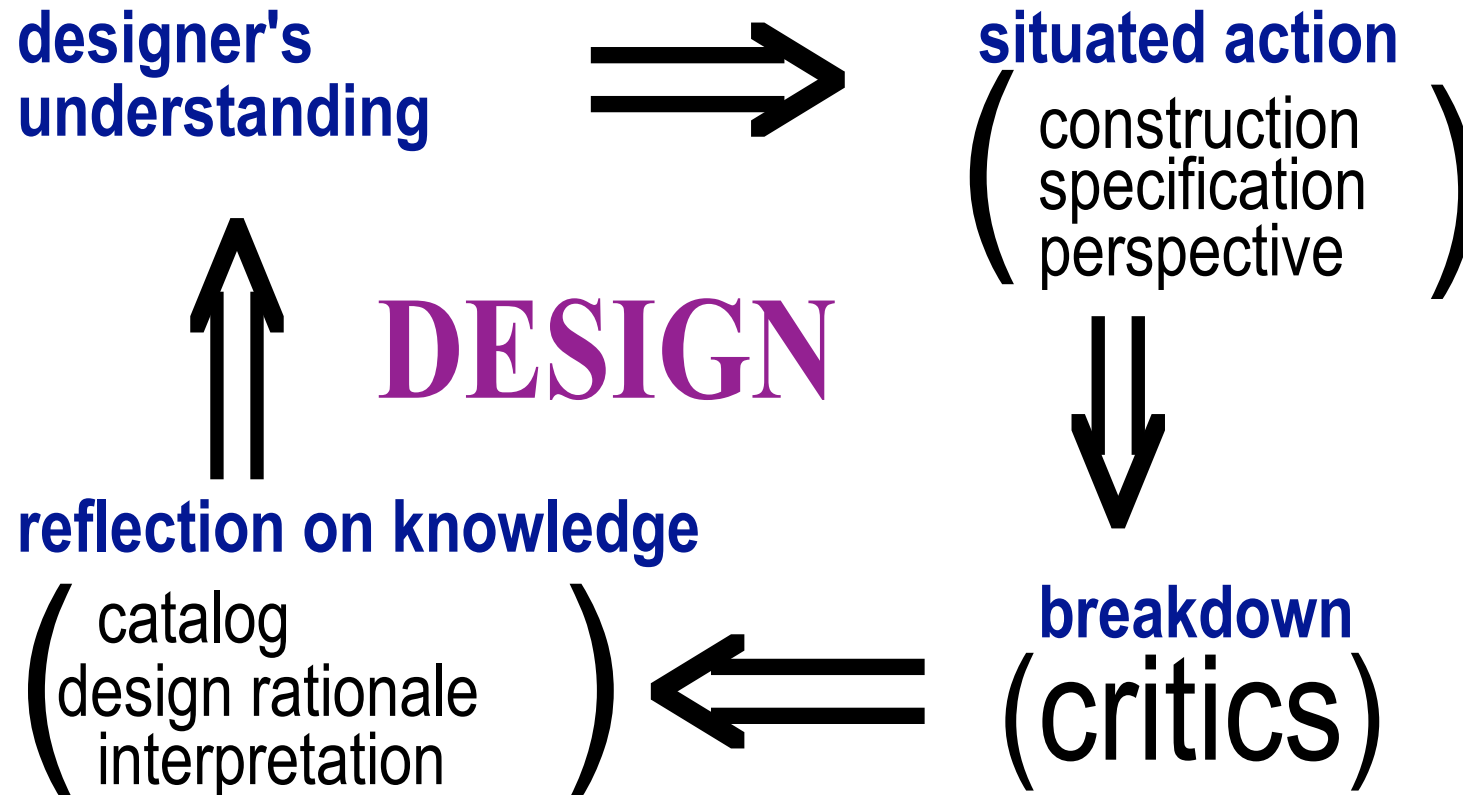
Handwritten annotations in large numbers are placed over the interface:
 

- (1) is placed over the "Group Memory" section.
- (2) is placed over the component palette.
- (3) is placed over the network diagram.
- (4) is placed over the priority dialog box.
- (5) is placed over the "Catalog" panel.

# 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](http://www.watchfire.com).

## The Rationale / Need for Critiquing

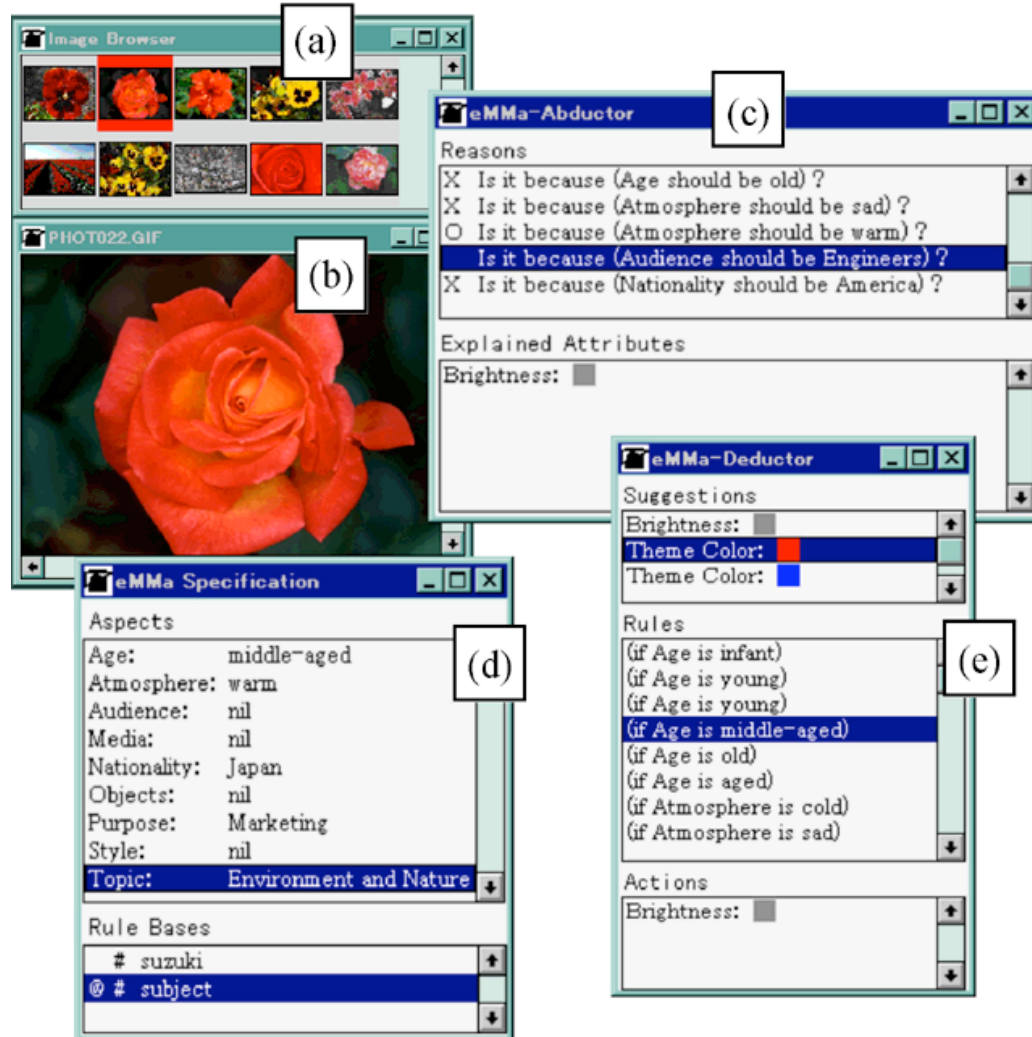
- **color** → Travis, D. (1991) *Effective Color Displays—Theory and Practice*, Academic Press, London:

*“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

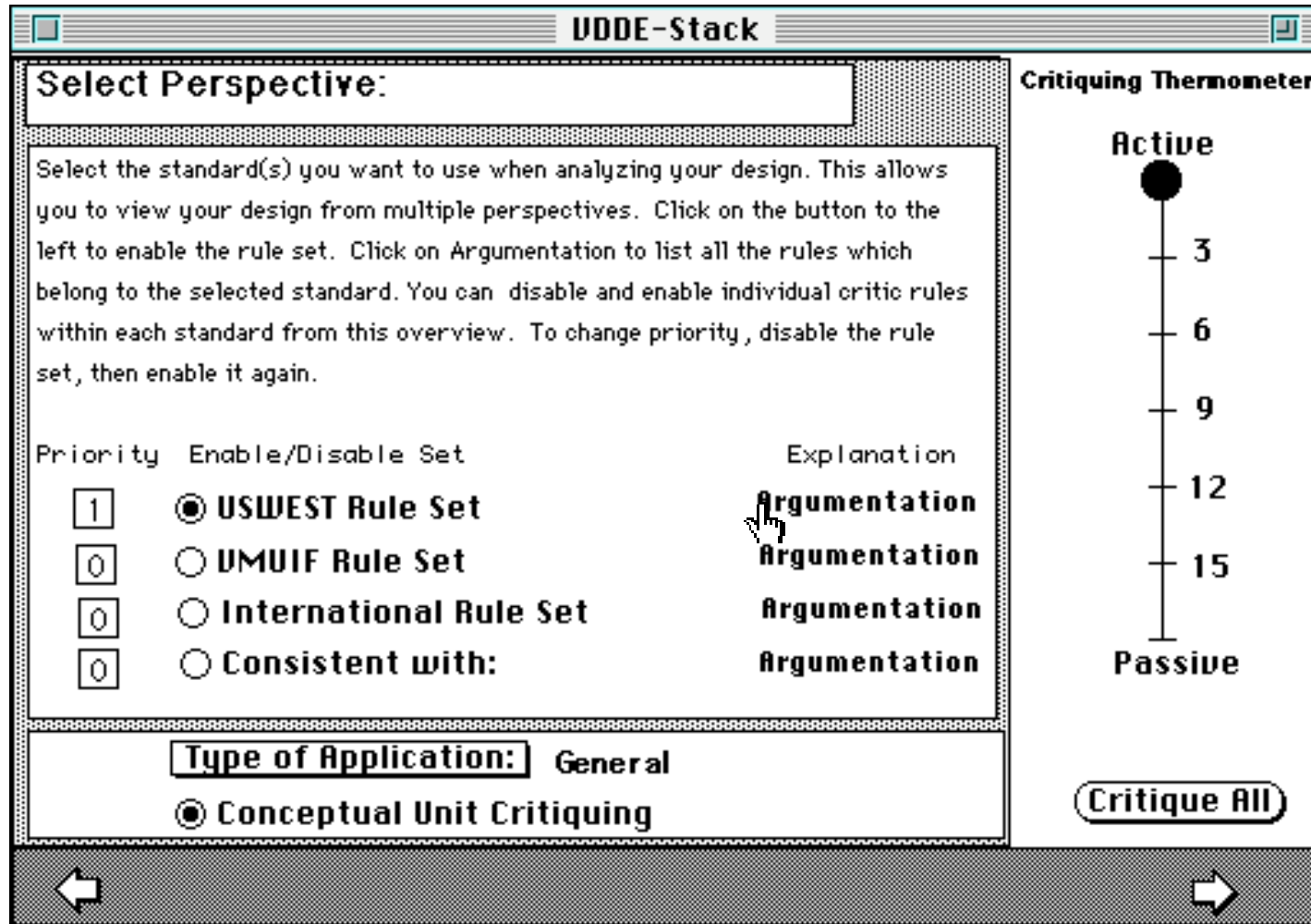
- **examples:**

- 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”

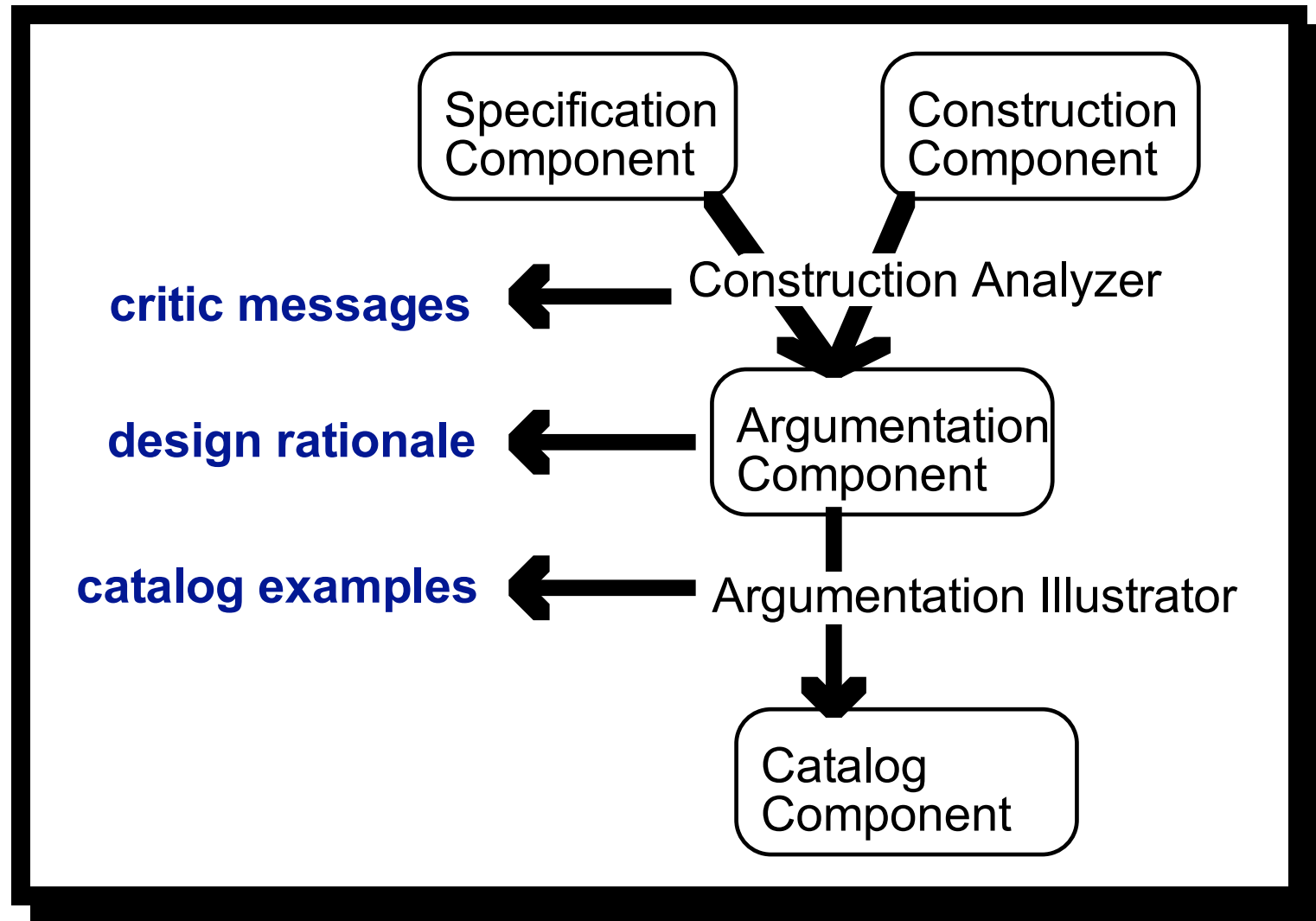
- **mechanism:**

- 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

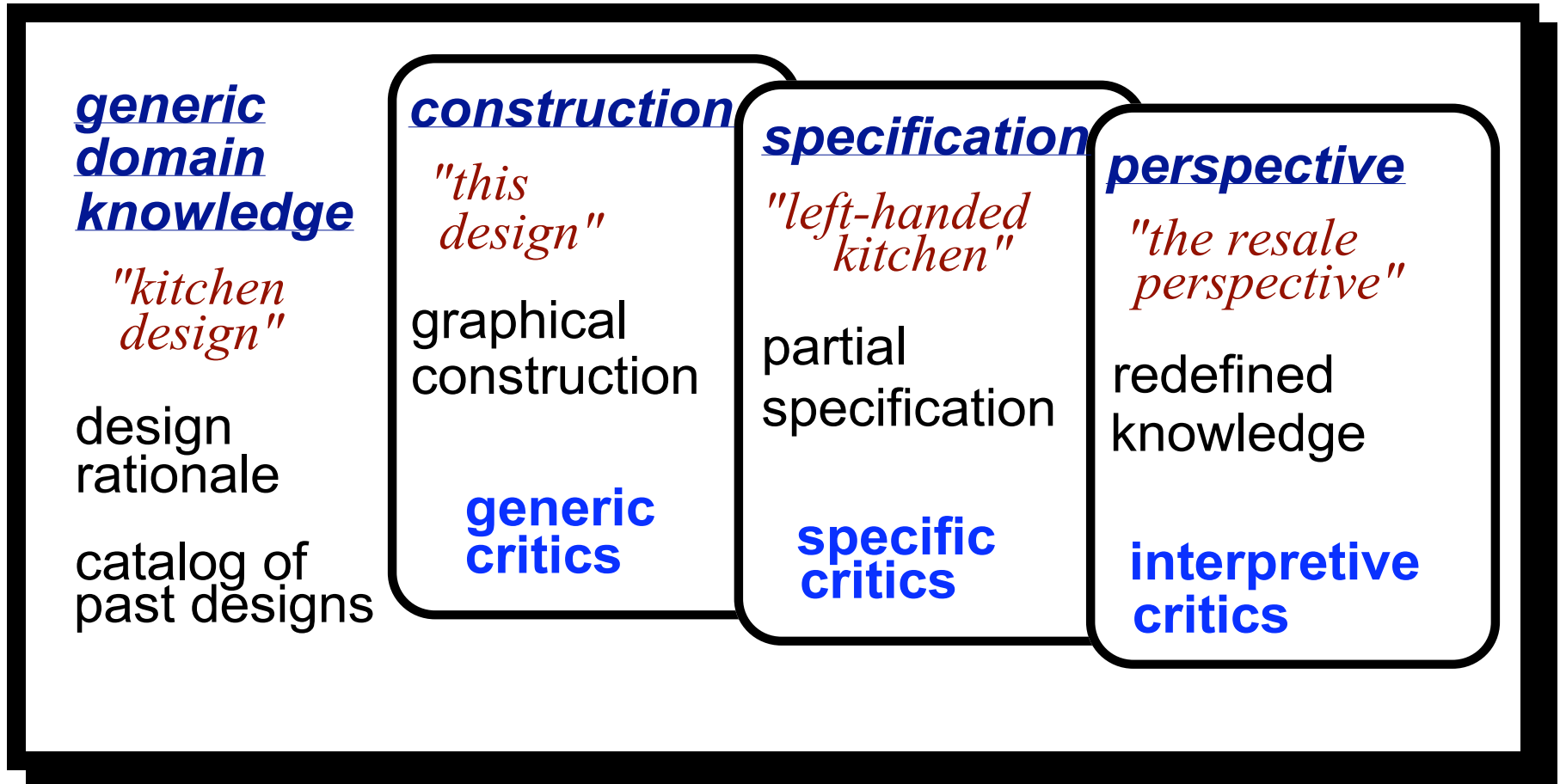
# Giving Domain Designers Control about the Intrusiveness of Critics



# An Implementation of Critics

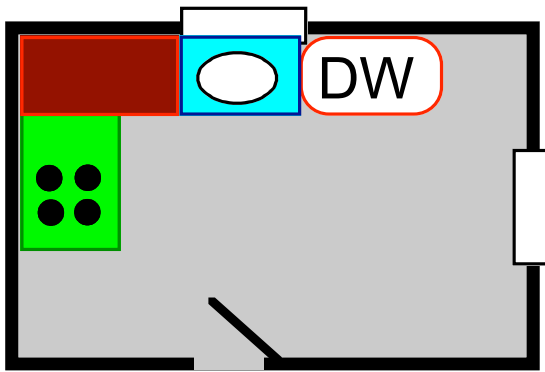


# Embedding Critics in the Contexts of Design



# 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?

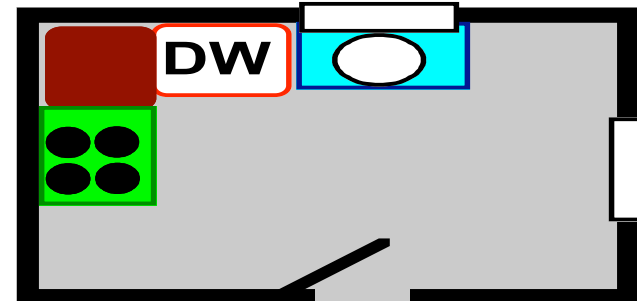
*answer:*

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



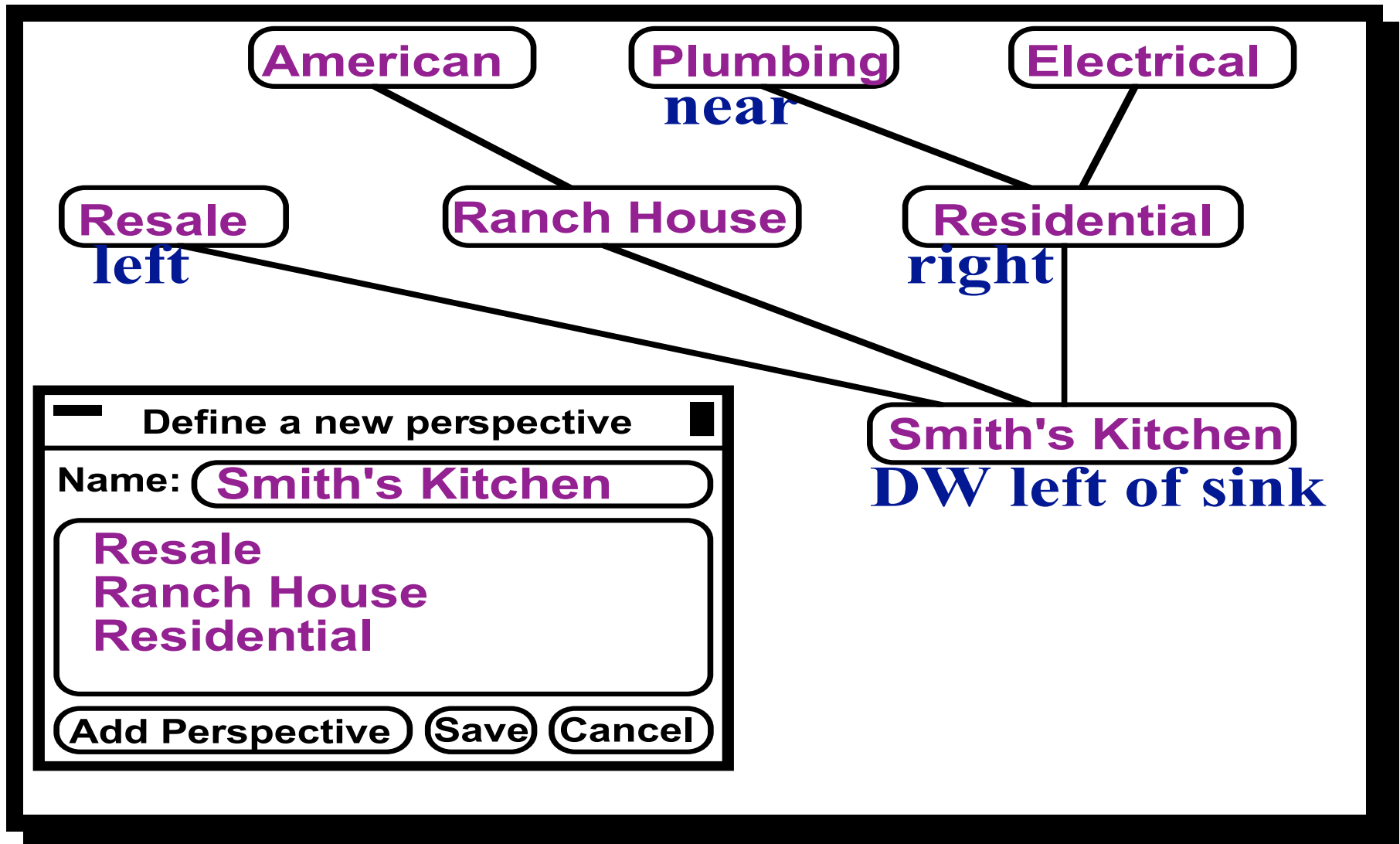
## Specific Critic

(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**