



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**

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Spring Semester 2007**

**February 5, 2007**

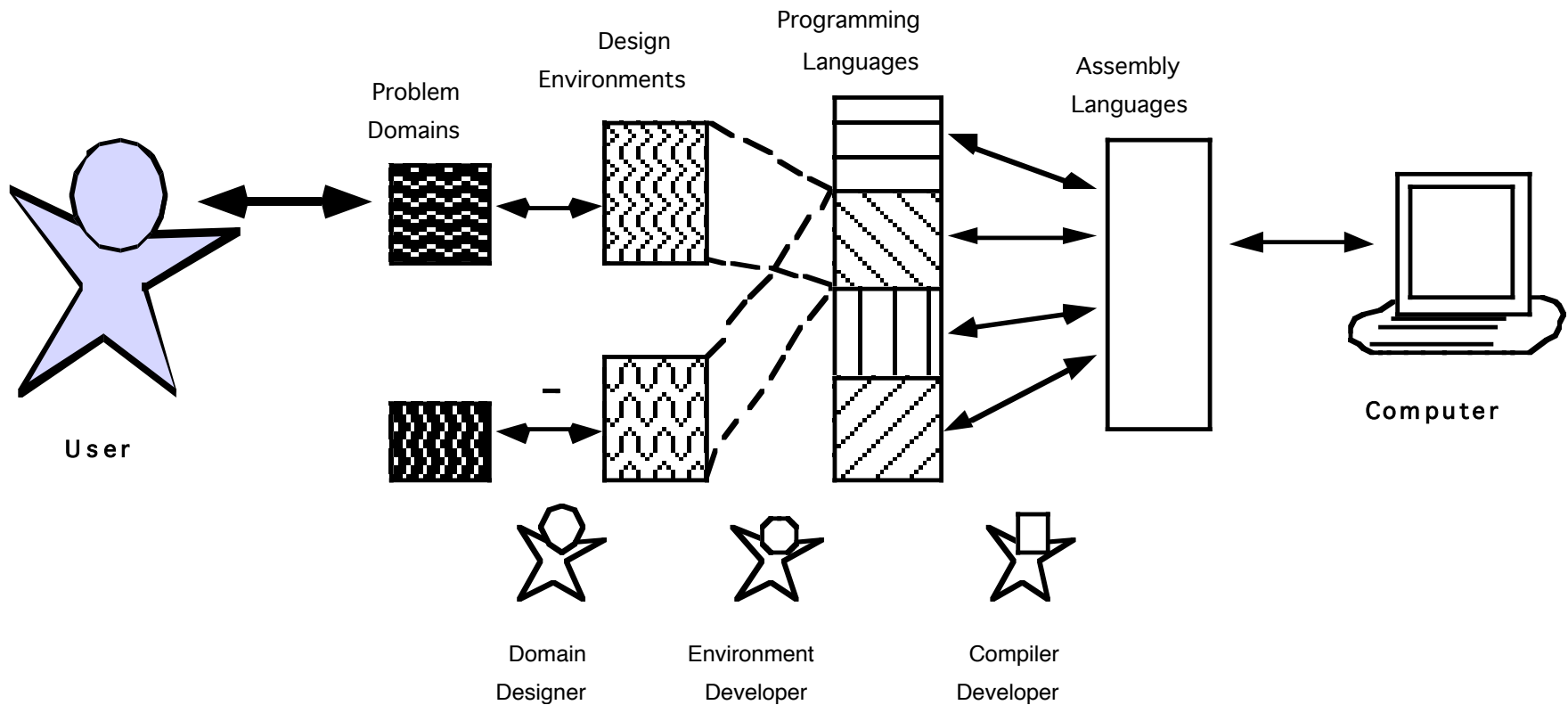
**paper:** Fischer, G., Nakakoji, K., Ostwald, J., Stahl, G., & Sumner, T. (1998) "Embedding Critics in Design Environments." In M. T. Maybury & W. Wahlster (Eds.), *Readings in Intelligent User Interfaces*, Morgan Kaufmann, San Francisco, pp. 537-561.

# Overview

- 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

# The Objectives of Domain-Oriented Design Environments



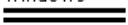
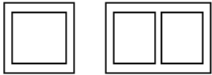
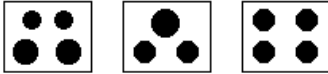
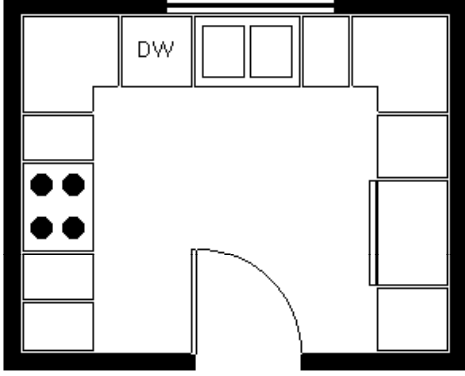
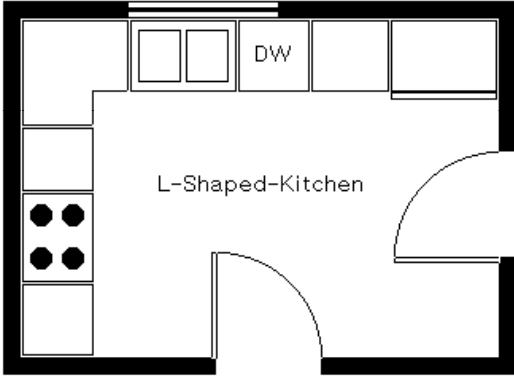
## Supporting Human Problem-Domain Interaction



# 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

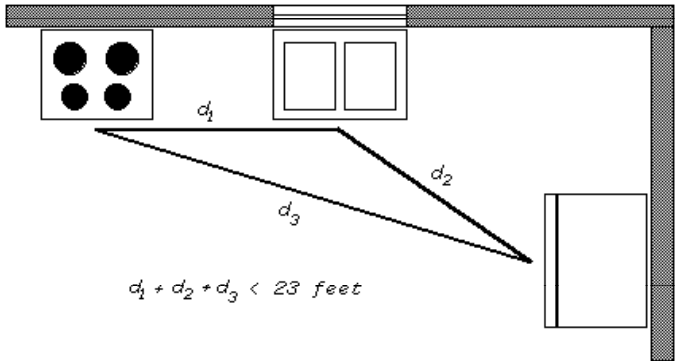
# Domain-Oriented Design Environments (Janus-Construction)

<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 style="text-align: center;">L-Shaped-Kitchen</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,

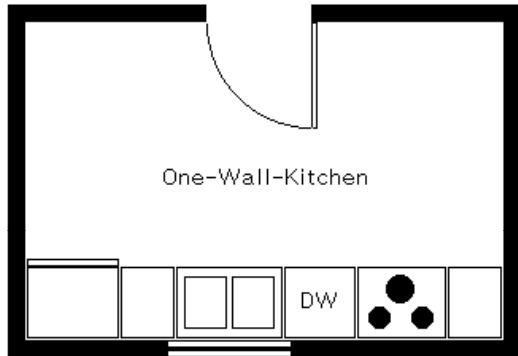
**Viewer: Default Viewer**

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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

**Toolbar:** Start, End, Menu, Get-Time, Get-Data, Data, to, Else, Global Data, Data, Range-Test, Voice-Menu, T-Button, Beep, Message, Prompt, Voice-Coll, Tbl-Collect, Digit-Coll.

**Worksheet: new-residential**

```

    graph TD
      Start --> Listen[1 Listen]
      Listen --> Personal[2 Personal]
      Personal --> Send[3 Send]
      Send --> PersonalOptions[1 Personal Options Menu]
      PersonalOptions --> Security[1 Security]
      Security --> Record[3 Record]
      Record --> Notify[4 Notification]
      Notify --> Schedule[5 Schedule]
      PersonalOptions --> ReturnMain[Return Main Menu]
      PersonalOptions --> AcceptCancel[Accept or Cancel]
      PersonalOptions --> MsgBeep[Msg Beep]
  
```

**Critic 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

**Buttons:** Explain Rule, Disable Rule, Critique All, Clear Msg, Clear All, Close Pane

**VDDE-Stack: Voice Mail Personal Options Menu**

**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	#

**Global Arguments:**

**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).

The screenshot displays the NetDE software interface. At the top, a Netscape browser window shows the URL "file:///uu-gm-bin/menu.pl". The main workspace is titled "Worksheet: Publications -- OT 8-6" and contains a network diagram with several "Pc" icons and a "Printer" icon connected by red lines. A "Launch Construction Component" button is visible at the bottom of the workspace.

On the left, a "Catalog" panel lists various network components: "Ox8-7", "Cr1-1", "Ox6-9", and "Ae5-3".

A dialog box titled "Priorities to be used for devices in this area" is open, showing the following settings:
 

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

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

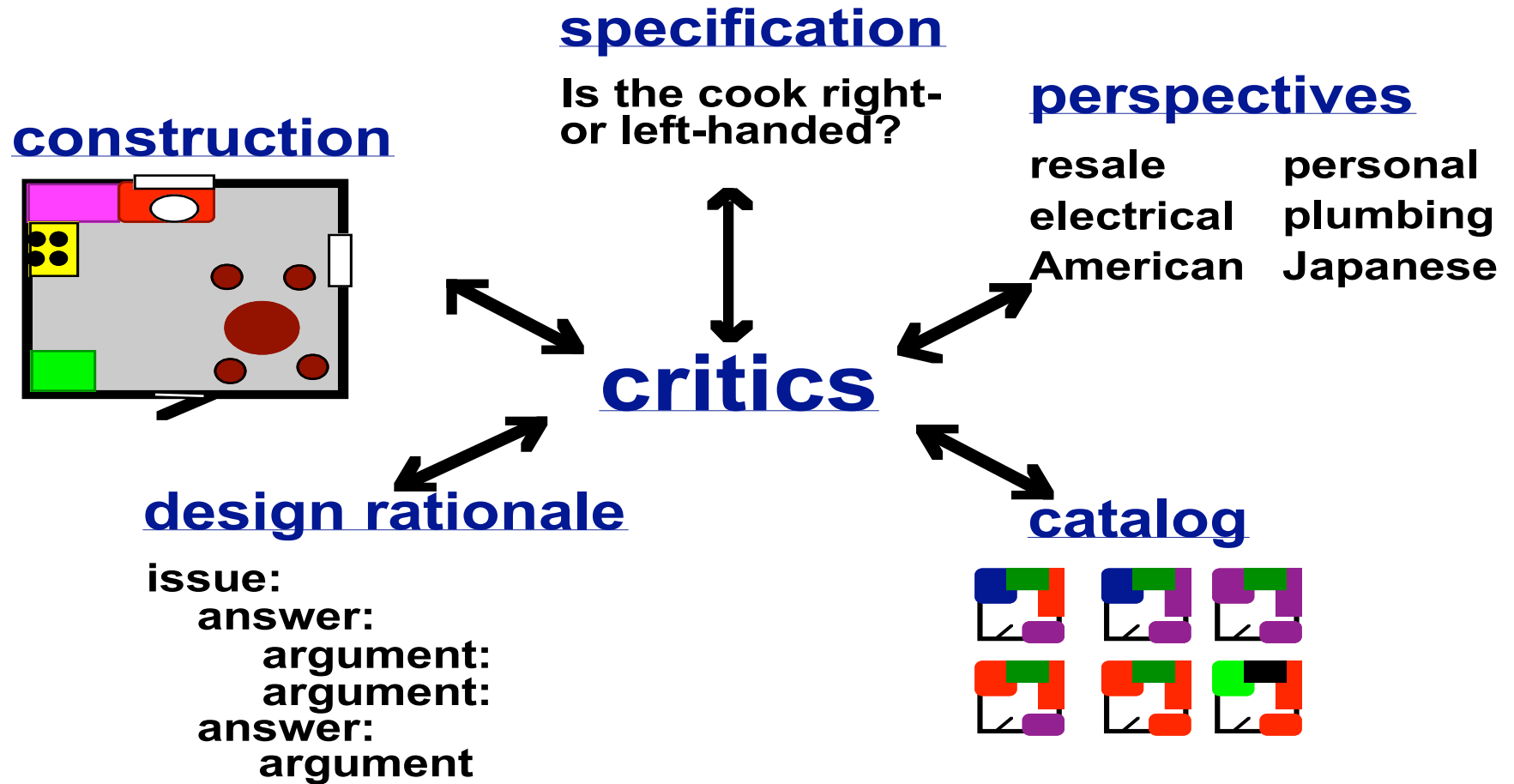
On the right, a component palette lists: "Wire", "Mac", "Sun", "Server", "Printer", and "Local-Area".

Below the workspace, there are sections for "Group Memory" and "Design". The "Group Memory" section includes checkboxes for "Meeting Notes", "Priorities", "Machinery", "Miscellaneous", and "All email". The "Design" section shows a small network diagram with a hand cursor over it.

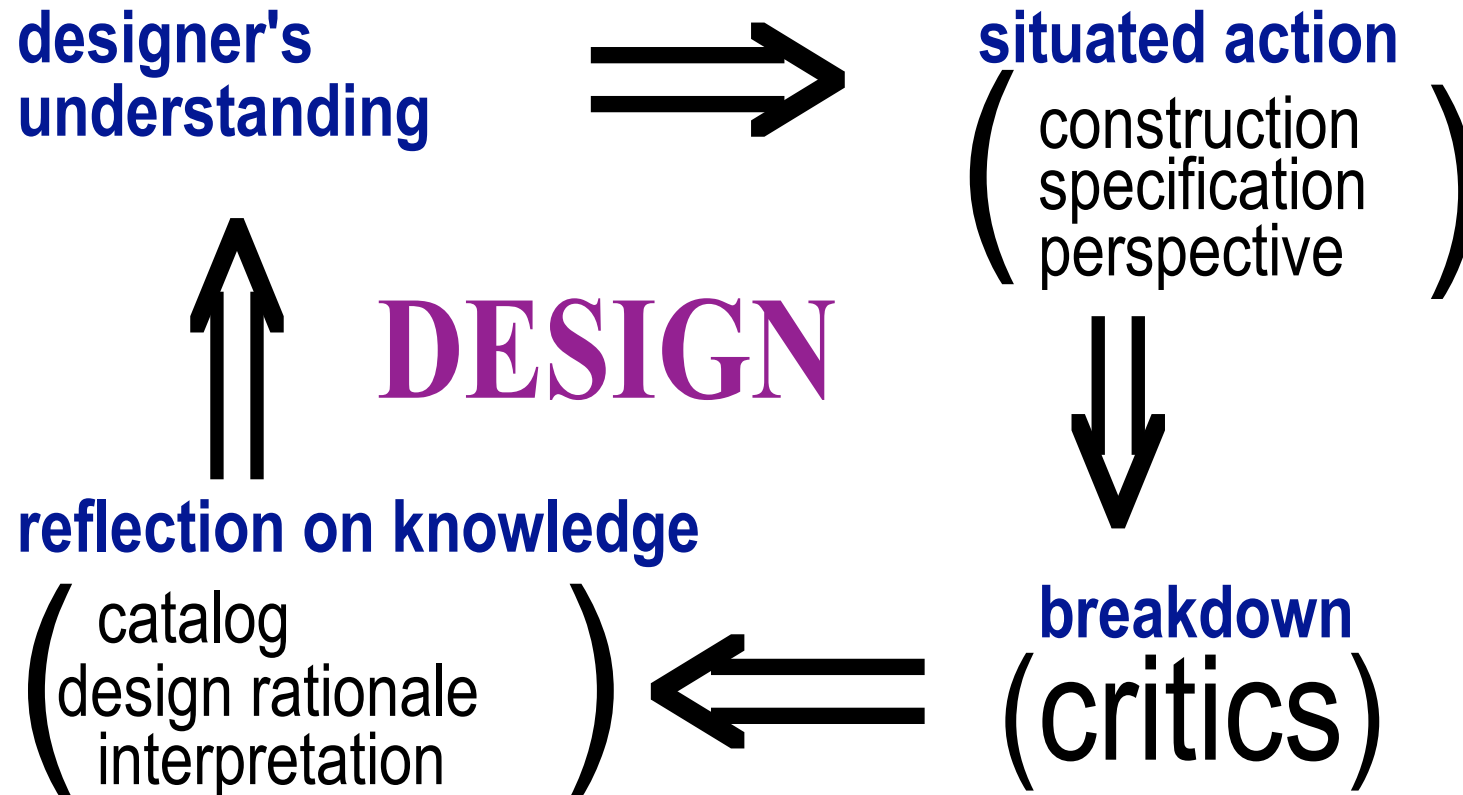
Handwritten annotations in large numbers (1, 2, 3, 4, 5) are placed over the interface to highlight specific elements: (1) points to the "Group Memory" section, (2) points to the component palette, (3) points to the network diagram, (4) points to the priority dialog box, and (5) points to the "Catalog" panel.



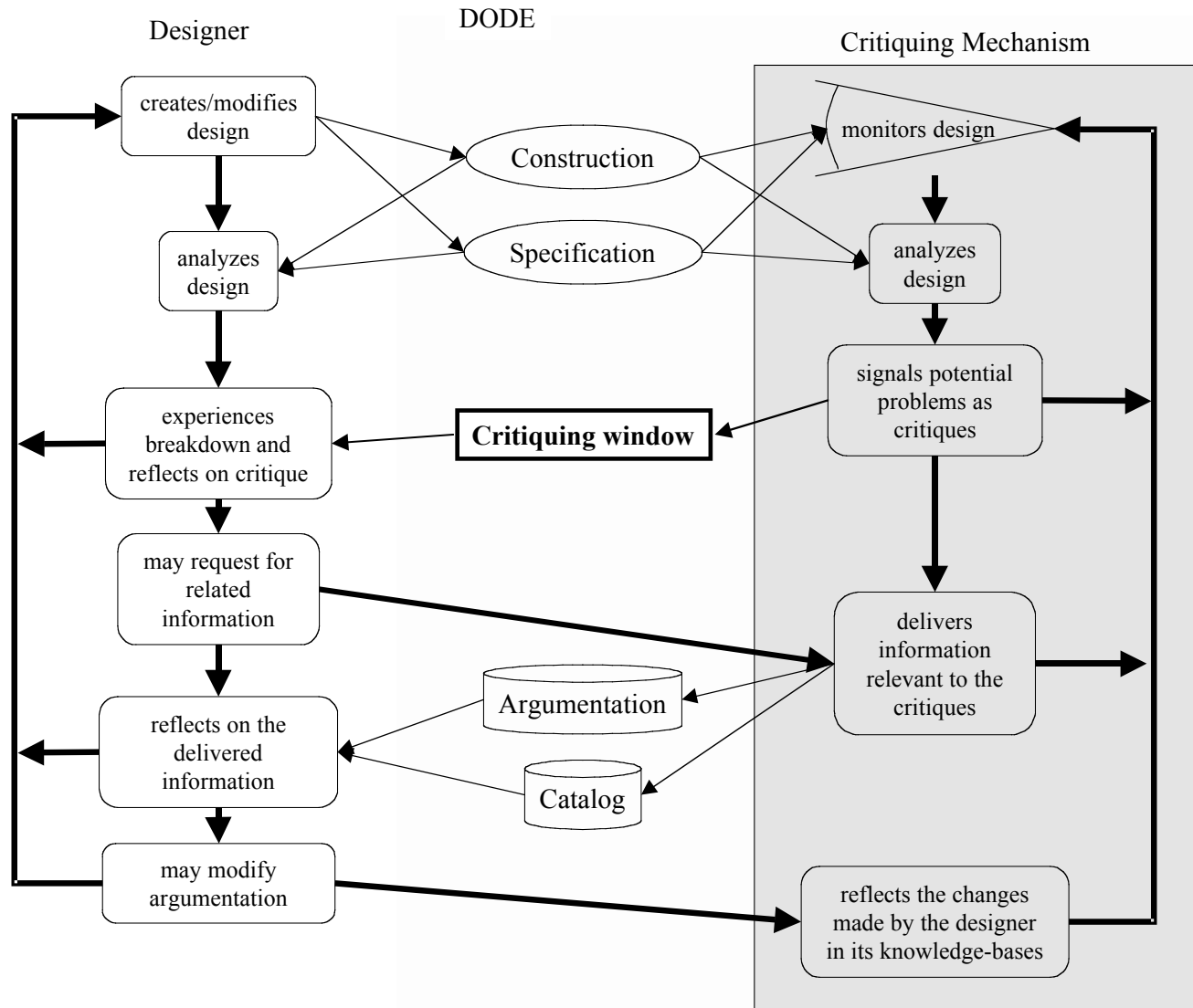
# Domain-Oriented Design Environments (DODEs)



# Reflection-in-Action as a Problem Solving Theory



# Critiquing Process in a DODE



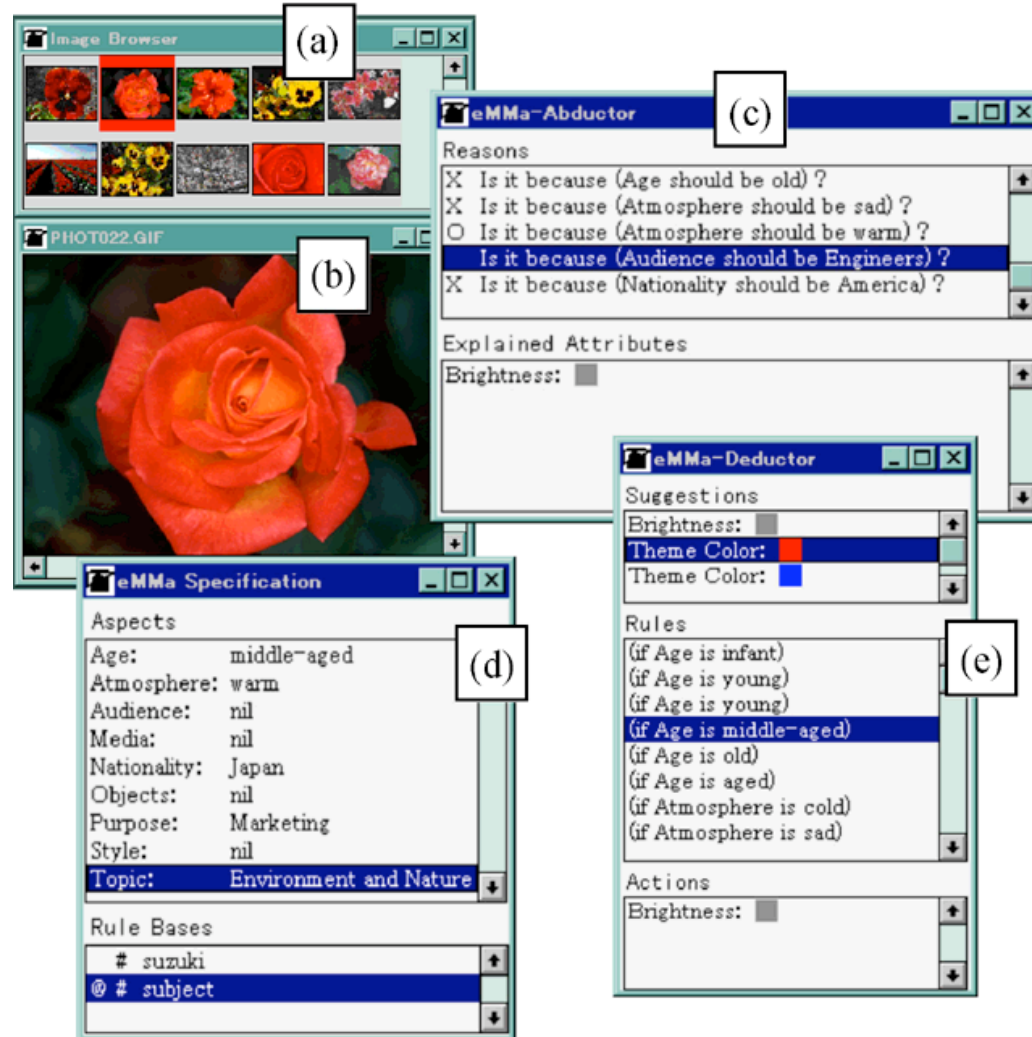
# Computational Critics (= “Virtual Human Critics”)

- **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.”*
  - question: what are the benefits of “critiquing systems” compared to “guidelines”
- **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”*
  - 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

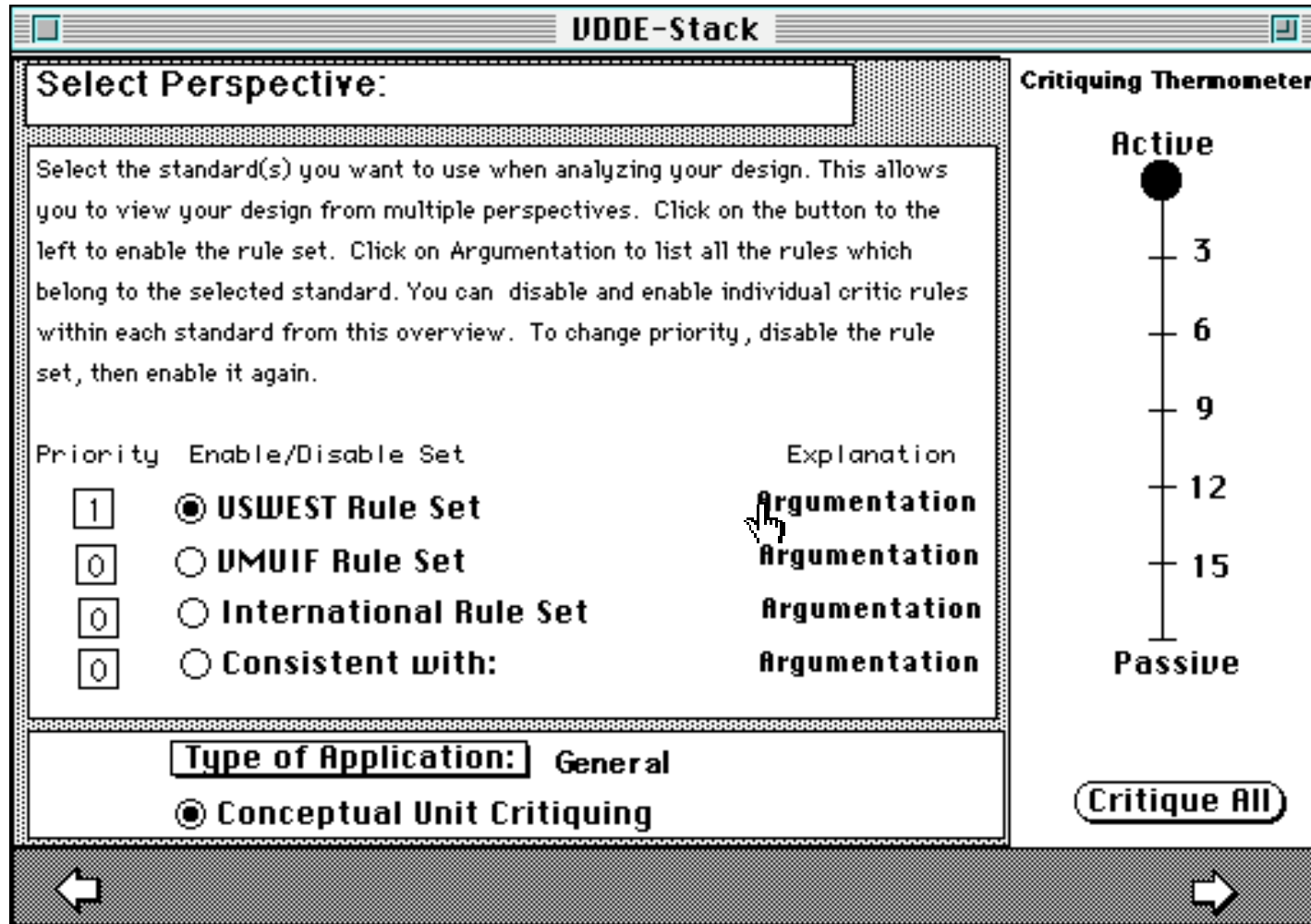
## ▪ **examples:**

- 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:**

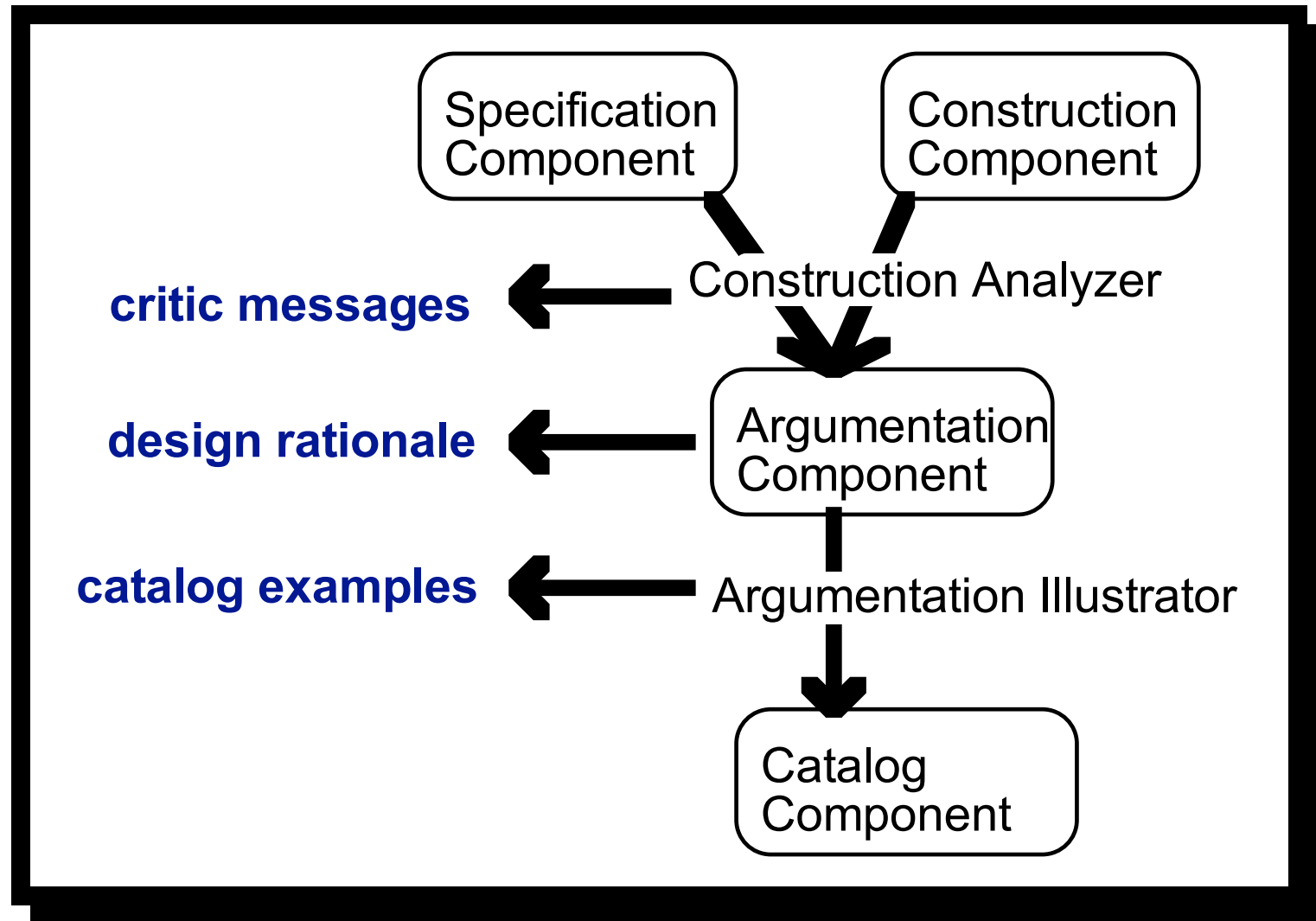
- enable relevant critics
- analyze construction and specification (e.g., the specification states that this is a part of town where many old people live)
- signal breakdowns
- deliver relevant knowledge
- identify the right level of intrusiveness:  
on demand  $\leftrightarrow$  critical points (“windows in Janus”)  $\leftrightarrow$  all the time (MS Word)

# Giving Domain Designers Control about the Intrusiveness of Critics

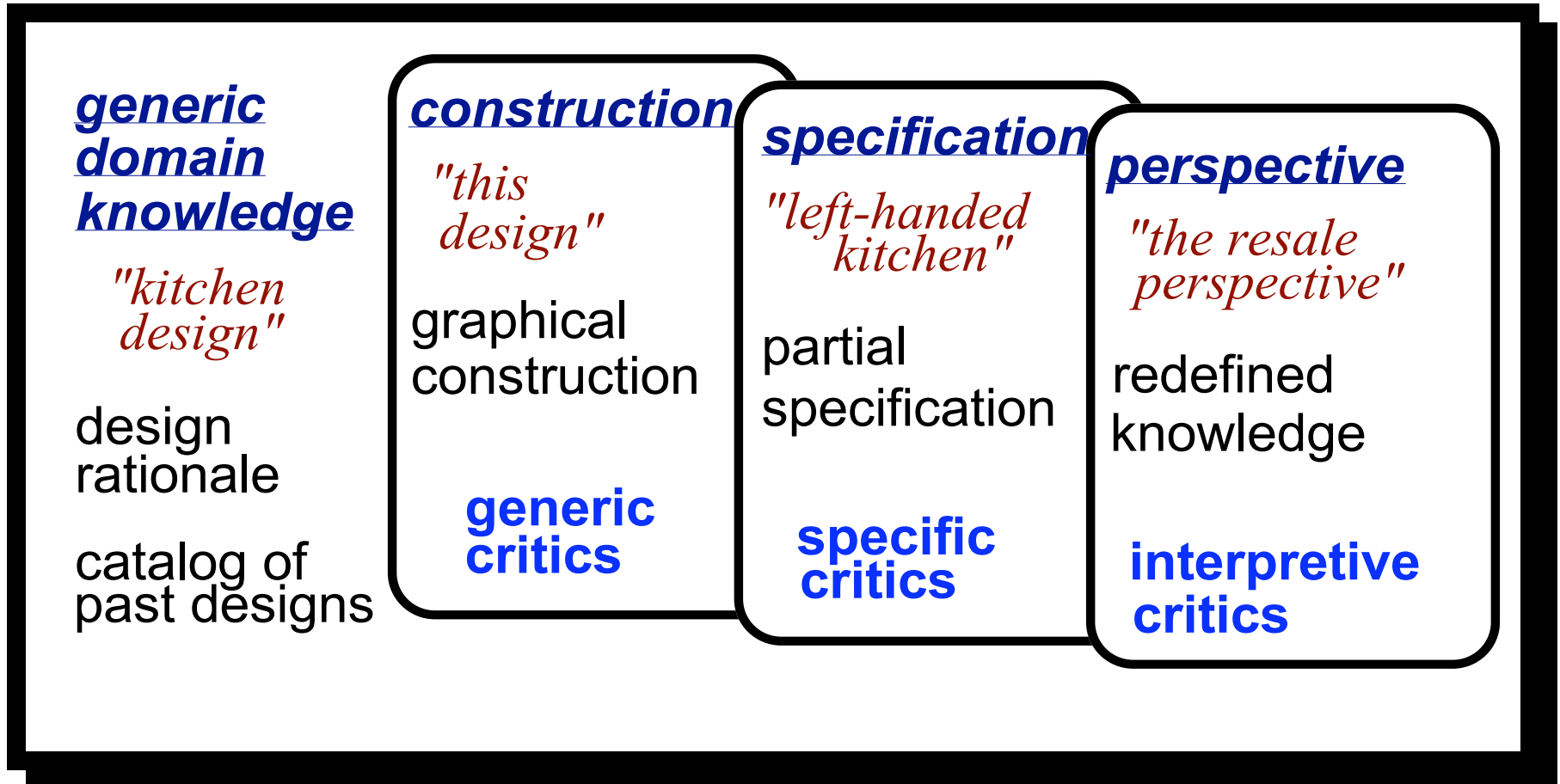




# An Implementation of Critics

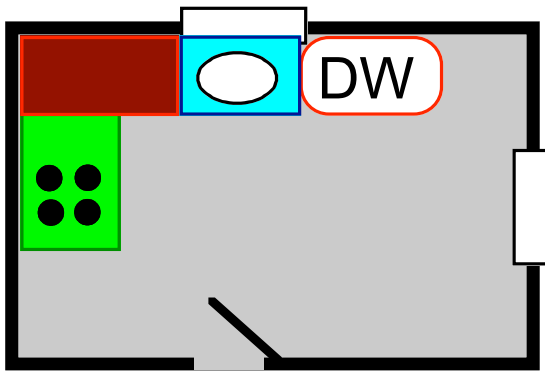


# Embedding Critics in the Contexts of Design



# 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?

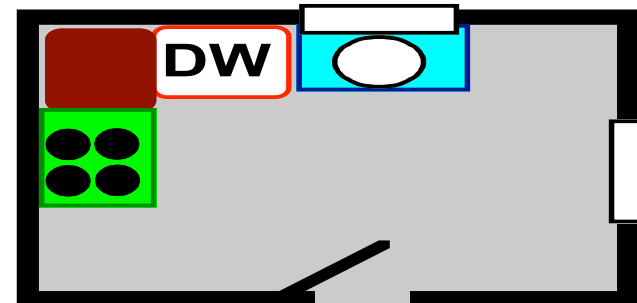
*answer:*

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



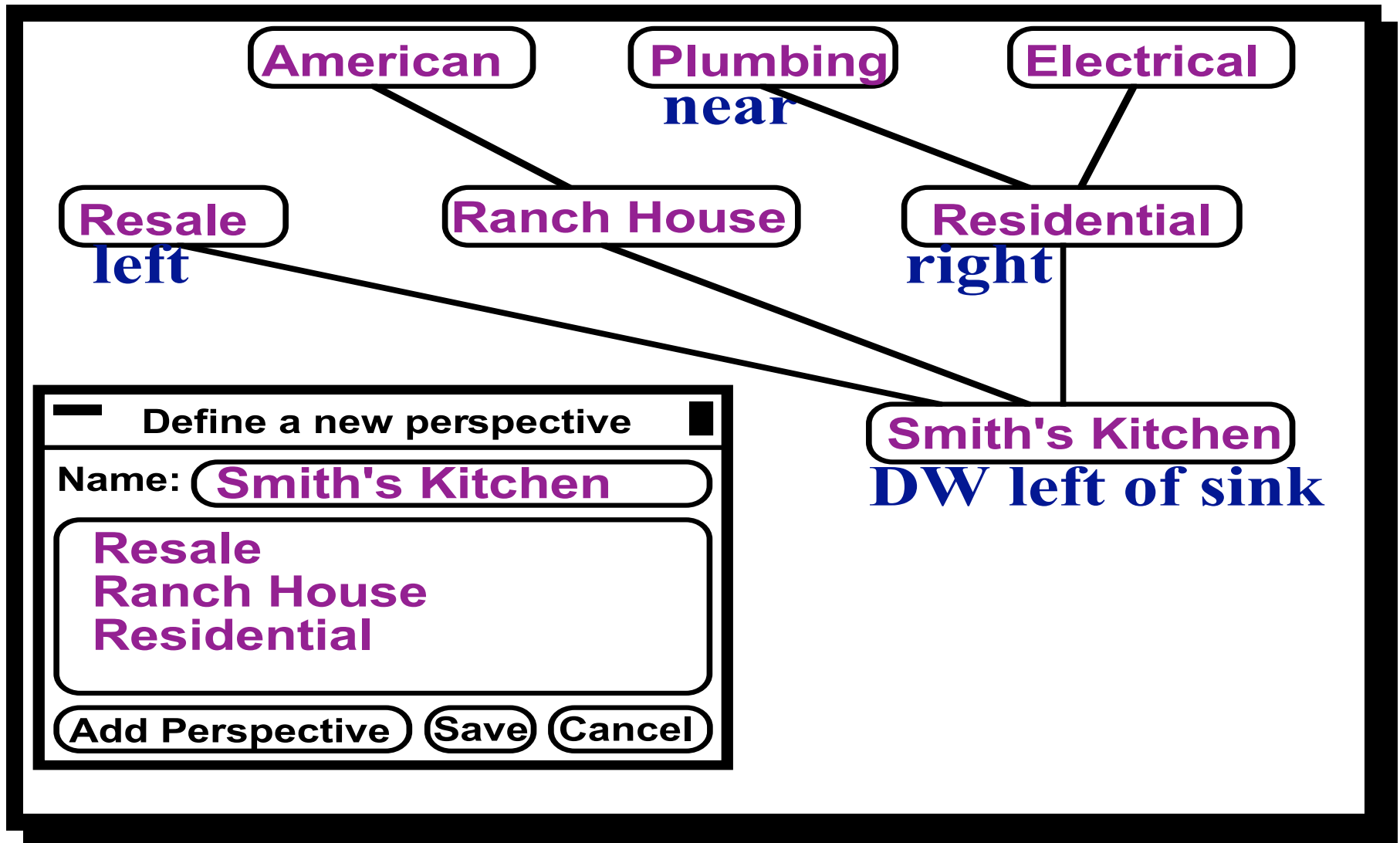
## Specific Critic

(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**