The context problem for software agents

Software agents provide assistance to users of interactive graphical interfaces

- What should I do for the user?
- How should I do it?

Agent needs to understand the intention of the user

- Intention often can be inferred from context
- Context reduces explicit input

Agent Personalities

Butler / Servant / Secretary

- Agent executes commands, satisfies goals, anticipates needs

Teacher / Student, Master / Apprentice

- Agent learns skills taught by user

The context problem for learning agents

Agent can only learn from concrete experience

Concrete experience needs to be *generalized*

- Conservative: Stick close to experience
    - Increased Accuracy
- Liberal: Try to do as much abstraction as possible
    - Increased Applicability

Programming by Example [or "by Demonstration"]

Agent "watches what you do" in the interactive interface

Records sequence of operations, data involved in operation

Generalizes program so that you can use an analogous procedure in new examples

Strategies for generalization in Programming by Example

System *makes a guess,* heuristically

- Inferred from context, domain-dependent

System *asks user*

- System may supply choices to give user context

System *receives advice* from user

- Advice used as context for system's choices

The Data Description Problem

[Halbert]

How should objects involved in examples be described?

Intentional vs. extensional descriptions

Hierarchical descriptions

Machine Learning: Version Spaces

Also: Action Description Problem, generally easier

The Critique Problem

Don't do *that* again!

What's *that*?

Examples of PBE systems

Mondrian Graphical Editing

Grammex Text Recognition Agents

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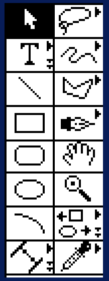
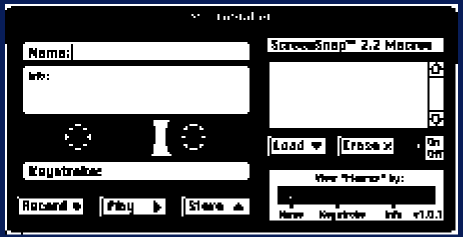
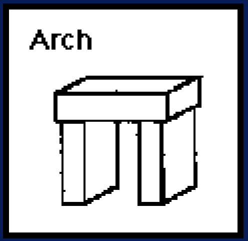
Mondrian: An Instructible Graphical Editor

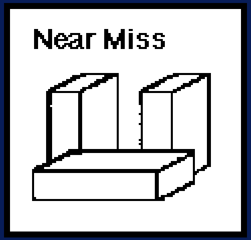
Mondrian=

- An object-oriented graphical editor +
- An agent that records user interface actions +
- Learning and generalization heuristics

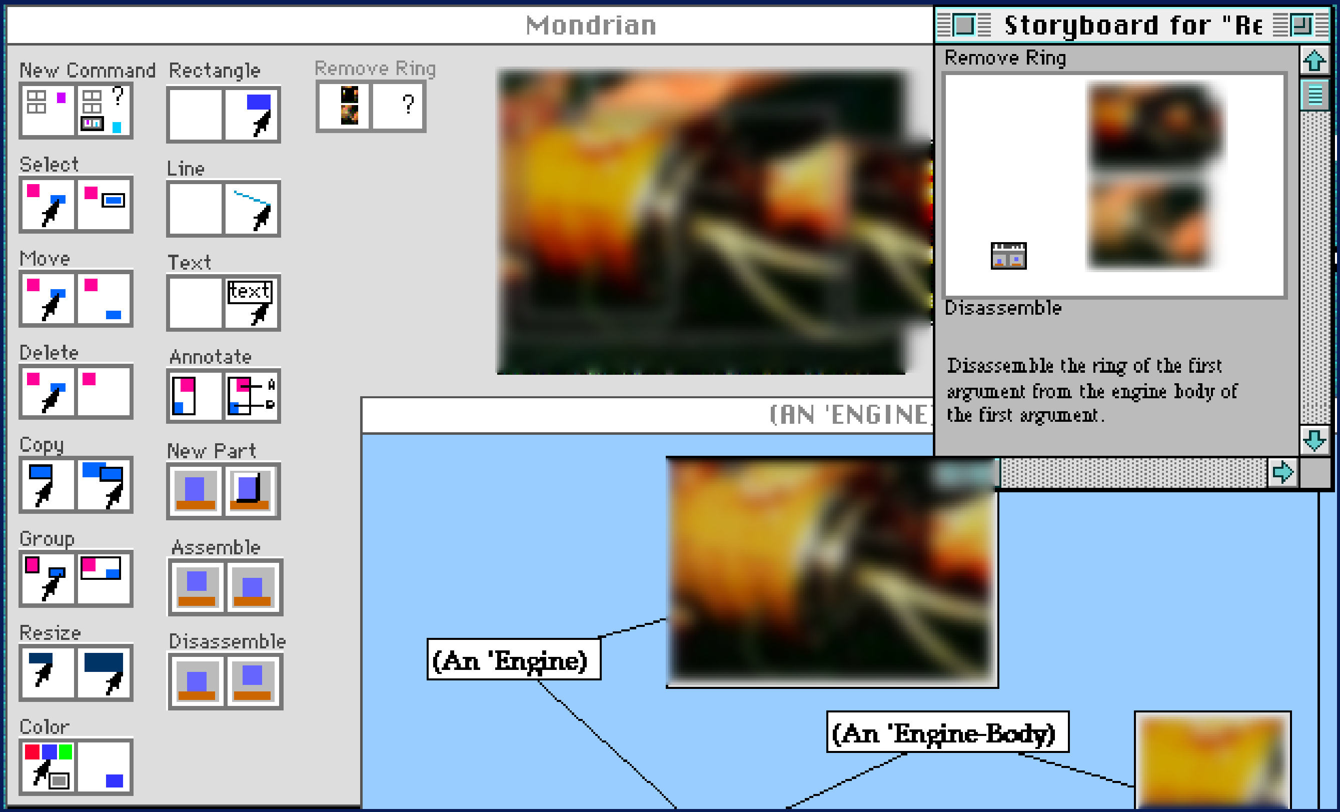








Mondrian: An Instructible Graphical Editor

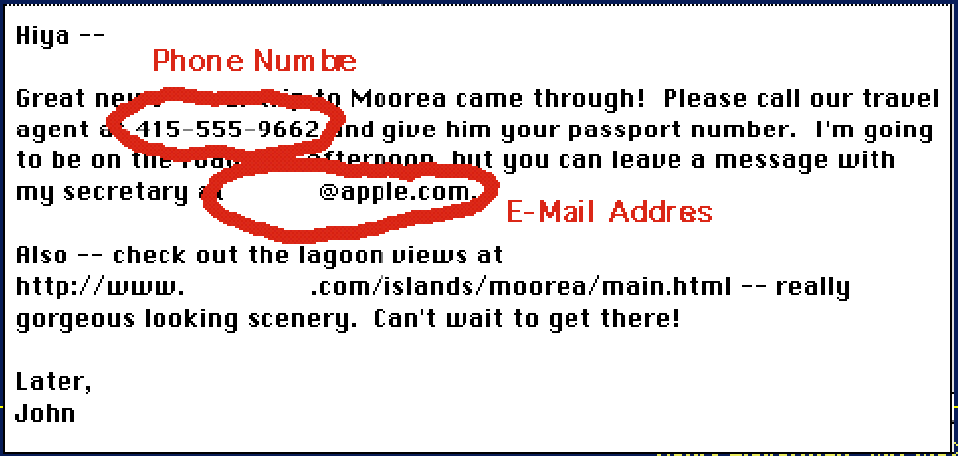


Disassemble the ring of the first argument from the engine body of the first argument.

Web has renewed interest in text parsing technology

Much information on the Web and in desktop applications exists in "semi-structured" form

- Structured data embedded in unstructured data



Hiya --

Great news -- our trip to Moorea came through! Please call our travel agent at 415-555-9662 and give him your passport number. I'm going to be on the road this afternoon, but you can leave a message with my secretary at @apple.com.

Also -- check out the lagoon views at http://www. .com/islands/moorea/main.html -- really gorgeous looking scenery. Can't wait to get there!

Later,
John

Parsers are controlled by grammars

Grammar is a set of rules, each of which recognizes a class of text strings

Usually written in BNF or equivalent

Users have difficulty writing in a formal language

… but they DO understand the concepts behind recognition

“An e-mail address is [usually] a person’s name, followed by an “@”, followed by a host”

Solution: Define grammars by example!

Grammars are difficult because they are abstract

- It's hard to understand what the effect of writing a rule will be in particular examples
- Stresses short-term memory, reasoning

People are much better at dealing with concrete examples than abstractions

So, present concrete textual examples and [illegible] the system how to interpret them

Grammex = “Grammars by Example”

A “programming by example” interface for defining grammars

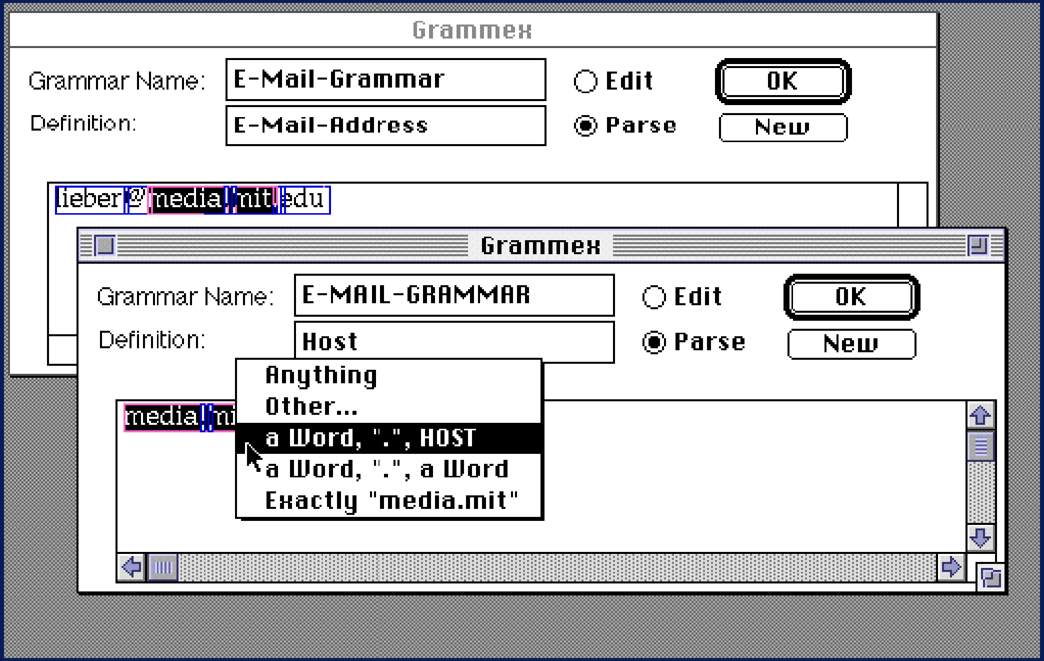
User supplies example of text to be recognized

System tries to parse text according to current grammar

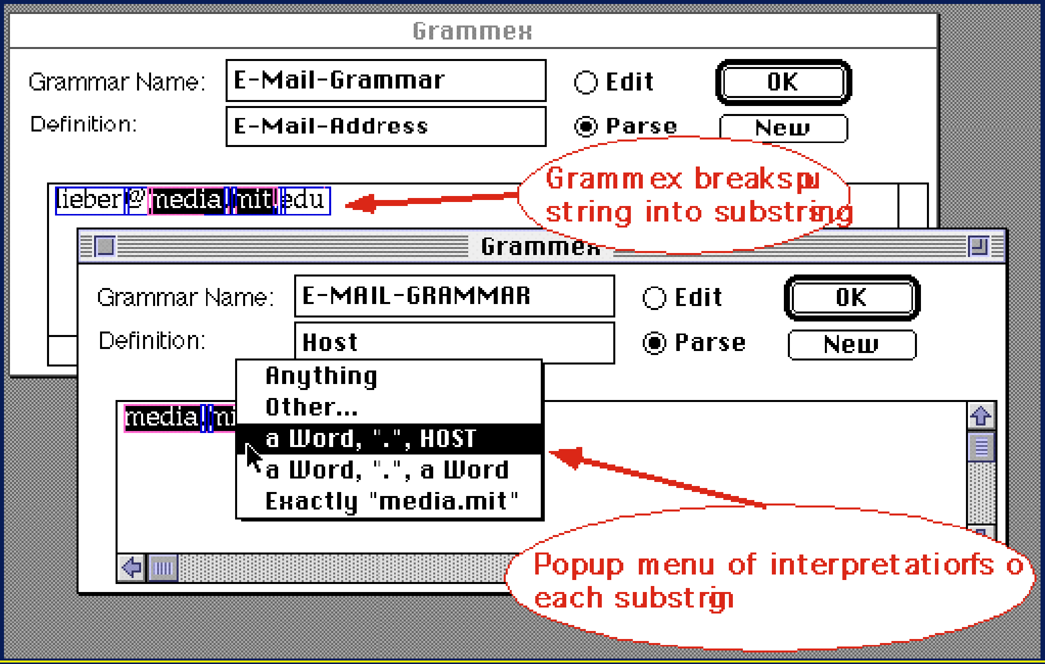
User can interactively specialize and generalize interpretations of substrings

Grammex compiles a BNF-like grammar

Grammex


Grammex
Grammar Name: E-Mail-Grammar
Definition: E-Mail-Address
○ Edit
● Parse
OK
New
lieber @ media . mit . edu
Grammex
Grammar Name: E-MAIL-GRAMMAR
Definition: Host
○ Edit
● Parse
OK
New
media . mi
Anything
Other...
a Word, ".", HOST
a Word, ".", a Word
Exactly "media.mit"

Grammex rule windows



Grammex

Grammar Name: E-Mail-Grammar

Definition: E-Mail-Address

Edit [✓ Parse]

OK New

lieber @ media . mit . edu

Grammex breaks up string into substring

Grammex

Grammar Name: E-MAIL-GRAMMAR

Definition: Host

Edit [✓ Parse]

OK New

media . mi

Popup menu of interpretations of each substring