

'Let me send relevant pictures to my friends while we chat.'

Select a picture from a collection

Show pictures aligned with text

Send pictures over a chat connection

Locate relevant items
Display a collection of pictures
Confirm a selection

Builder

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Chat {  
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Let people specify their instructions informally

- avoid premature precision
- more helpful to programmers
- enable a new generation of flexible, intelligent(?) programs

**FSE
2010**

Managing Ambiguity by Example

Kenneth C. Arnold and Henry Lieberman
MIT Media Lab & Mind Machine Project
`{kcarnold, lieber}@media.mit.edu`

Informality Managing ~~Ambiguity~~ by Example

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Informality vs. Ambiguity

- Specs and tests are formal but ambiguous.
- Formal = controlled semantics; incl. programming languages.

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Executing informal
descriptions is hard!

Strategy: Examples Clarify

Select a picture
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Locate relevant items
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Two hard parts

- Acquiring and interacting with examples
- Finding appropriate examples for new queries

Progress on both fronts

- Acquiring and interacting with examples
- **Zones:** integrate intent into development process
- Finding appropriate examples for new queries
- **ProcedureSpace:** relates code and informal descriptions using code features and natural language background knowledge

Zones Demo

Backend: Code search?

- At the lowest level (directly to code), if keywords match, maybe.
- Finding vocabulary is a large part of the problem-solving process
- Need to understand the *relationship* between code and statements of its purpose

ProcedureSpace Relates Code and Descriptions

natural language
descriptions

background knowledge

follow
chase

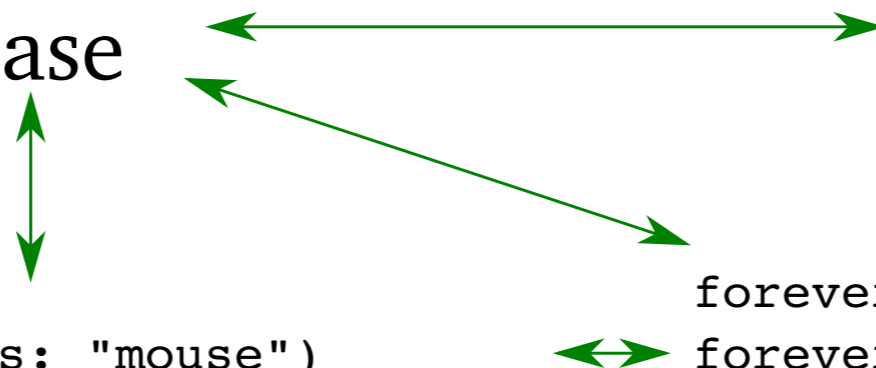
kind of movement
opposite of *lead*

```
(forever  
  (pointTowards: "mouse")  
  (forward: 10))
```

```
forever > pointTowards:  
forever > forward:  
pointTowards: ~ forward:
```

code fragments

static analysis



Informal Inference

Current knowledge

→ reading to your children is for educating them .	by  kinchin	Score: 6	  
→ teaching other people is for educating them .	by  Jake512	Score: 4	  
→ seeing art is for Education .	by  MarkFarrar	Score: 4	  
→ Education is acquisition of knowledge and understanding	by  Bryan	Score: 4	  
→ answering questions is for educating .	by  Laserjoy	Score: 3	  
→ watching television is for education .	by  justjim	Score: 3	  
→ The effect of going to school is education	by  damien29	Score: 3	  
→ education can further your career	by  budo	Score: 3	  

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Open Mind wants to know...

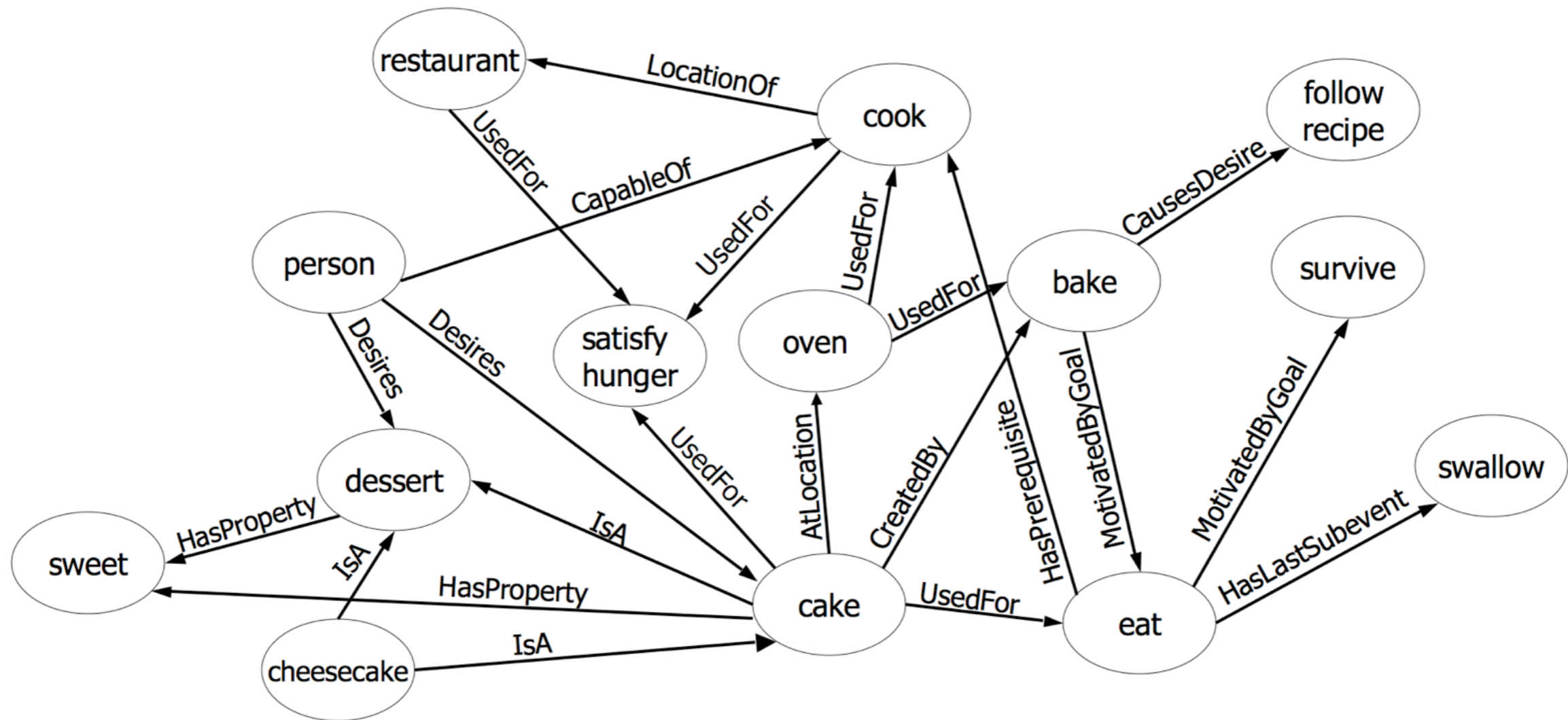
is similar to .

is similar to .

One of the things you do when you is .

AnalogySpace (Speer et al., AAAI 2008)

Informal Inference



Informal Inference

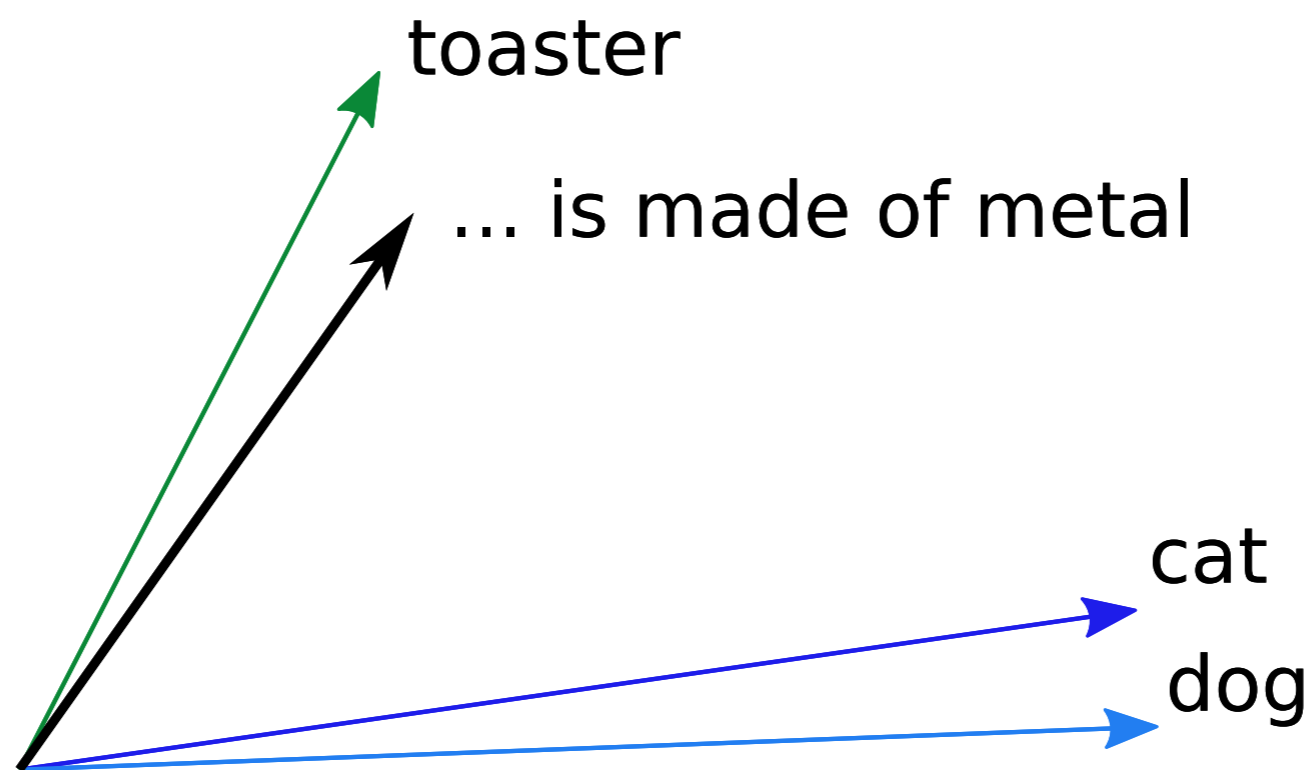
	cat	dog	airplane	toaster
... IsA pet	+6	+5		
... AtLocation home	+8	+2		+1
... CapableOf fly	-3	-5	+9	
... MadeOf metal			+1	+1
fur PartOf ...	+6	+5		

Informal Inference

$$\begin{array}{c} \text{features} \\ \mathbf{A} \end{array} \approx \begin{array}{c} \text{concepts} \\ \mathbf{U}_k \end{array} \begin{array}{c} \text{concepts} \\ \mathbf{\Sigma}_k \end{array} \begin{array}{c} \text{features} \\ \mathbf{V}_k^T \end{array}$$

The diagram illustrates the SVD decomposition of matrix A . The matrix A is shown as a grid with 'concepts' on the vertical axis and 'features' on the horizontal axis. It is approximated by the product of three matrices: U_k , Σ_k , and V_k^T . U_k is a grid with 'concepts' on the vertical axis and 'k axes' on the horizontal axis. Σ_k is a grid with 'k axes' on both the vertical and horizontal axes, containing a diagonal of values. V_k^T is a grid with 'features' on the vertical axis and 'k axes' on the horizontal axis. The matrices U_k and V_k^T are shaded with light blue vertical bars, and Σ_k is shaded with light blue diagonal bars. A red crosshair is drawn on each matrix, and a blue arrow points from the top-left corner of Σ_k towards the top-left corner of V_k^T .

Informal Inference

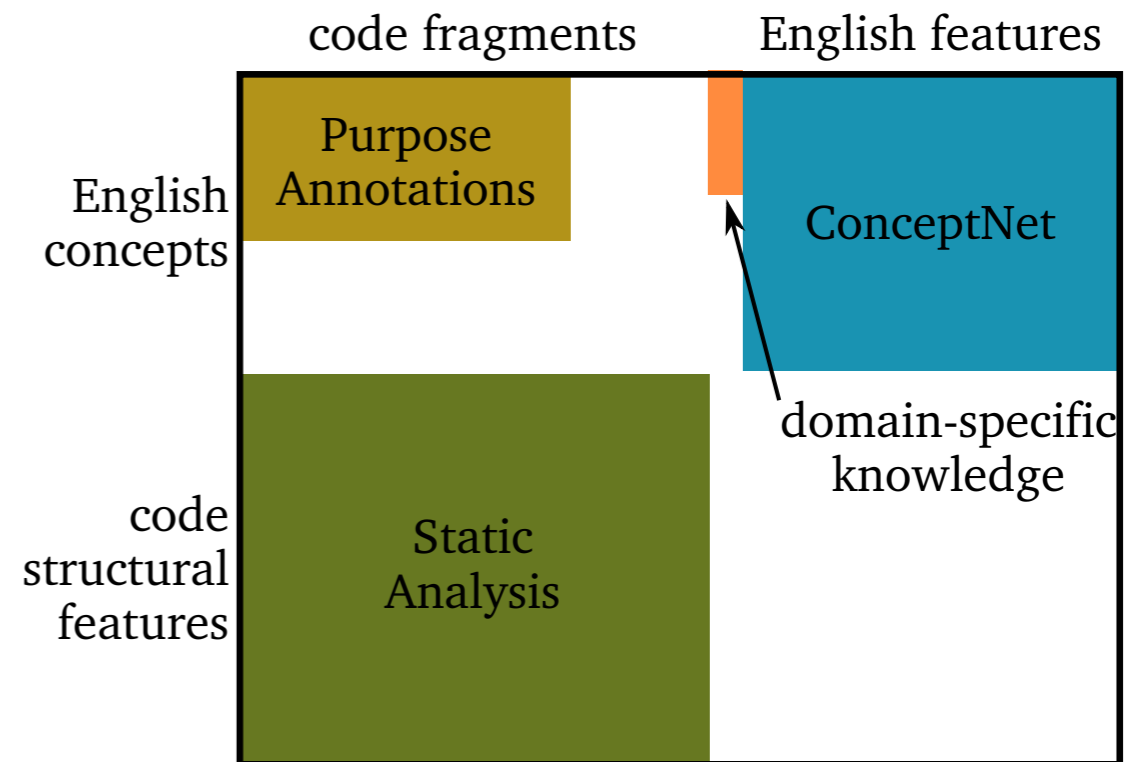


Can also *blend* multiple
knowledge sources.

Like code and
descriptions.

ProcedureSpace Blends Code and Descriptions

- Zones Annotations
- Code Features
 - static analysis now,
dynamic analysis soon?
- Commonsense Knowledge
- Domain Knowledge



Search Results

Users searched for

- gravity
- follow player
neither result
was annotated

The image displays three distinct blocks of Scratch code on a dark blue background. The top block is a 'when green flag clicked' event that triggers a 'forever' loop. Inside the loop, there are two conditional 'if' statements: the first checks 'if not touching color [red]?' and executes 'change y by -5'; the second checks 'if touching color [red]?' and executes 'change y by 5'. The middle block is a 'when I receive Follow' event that triggers a 'forever' loop containing 'point towards' and 'move 1 steps' blocks. The bottom block is a 'when green flag clicked' event that sets a 'caught' variable to 0, followed by a 'forever if chase = 1' loop containing 'point towards' and 'wait 0.4 secs' blocks.

Related Ideas

- Keyword Programming: Match keywords, align types, synthesize code. (Little and Miller, ASE '07)
- Example-Centric Programming: integrated search for examples (Brandt et al., CHI '10)

Natural Language Programming

- Many attempts to formalize or restrict natural language.
- But that's unnatural!

Natural Language Programming

- Many attempts to formalize or restrict natural language.
- But that's unnatural!
- Imprecision is a feature.

Tests, not code?

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Let programmers
be informal!

Have you heard of x ?

- Probably not.
- Talk afterwards, or email:
kcarnold@mit.edu
- (thanks, Professor Forrest)

Getting familiar with
existing programs

Try on Python, Java, ...
the essence of the
analysis is simple