‘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

```
Chat {
  void sendPicture(Picture p) {
    byte[] data = p.serialize();
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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
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Managing ~~Ambiguity~~ Informality by Example

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

Informality vs. Ambiguity

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

Select a picture from a collection

Show pictures aligned with text

Send pictures over a chat connection

Executing informal descriptions is hard!

Strategy: Examples Clarify

Select a picture
from a collection

↕

Locate relevant items
Display a collection of pictures

↕

`Builder`

Send relevant pictures to my friends
while we chat

↕

Send pictures over a chat connection

↕

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Strategy: Examples Clarify

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Strategy: Examples Clarify

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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

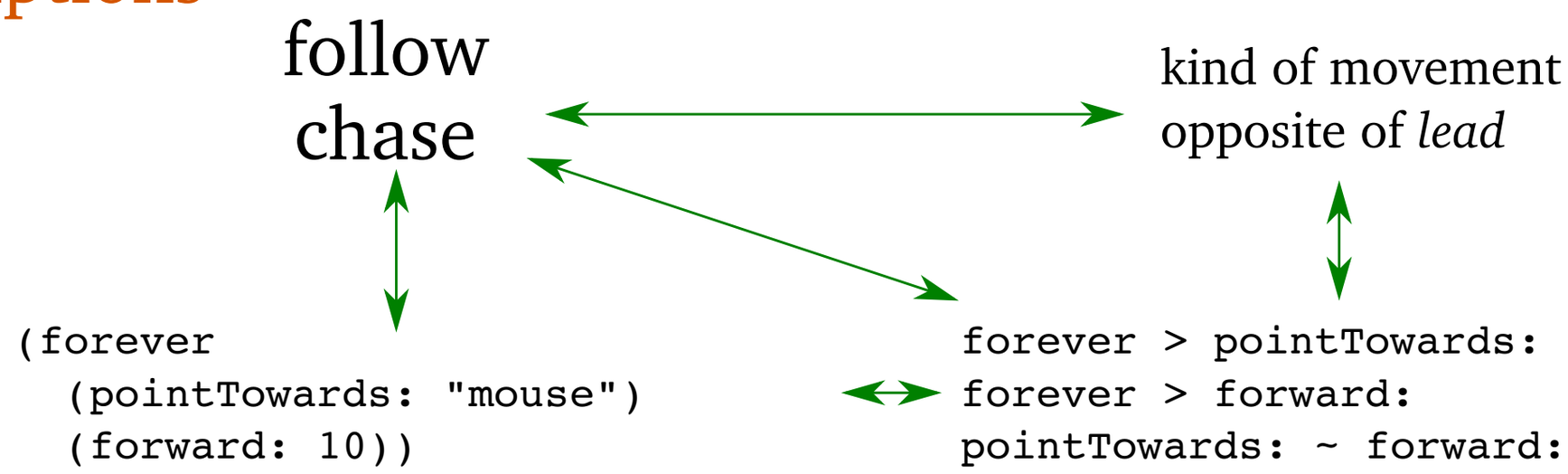
Backend: Code search?

- 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



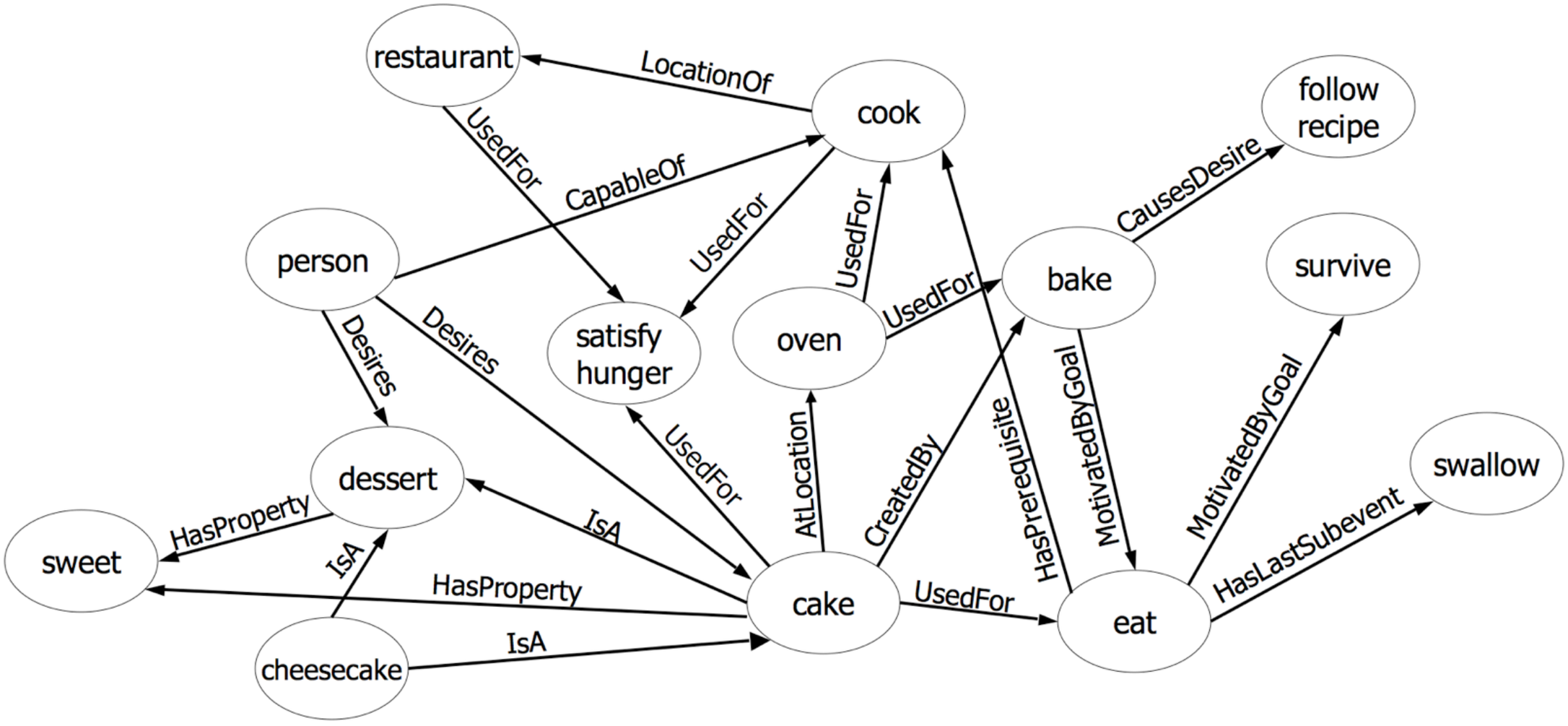
code fragments

static analysis

Informal Inference

AnalogySpace (Speer et al., AAAI 2008)

Informal Inference



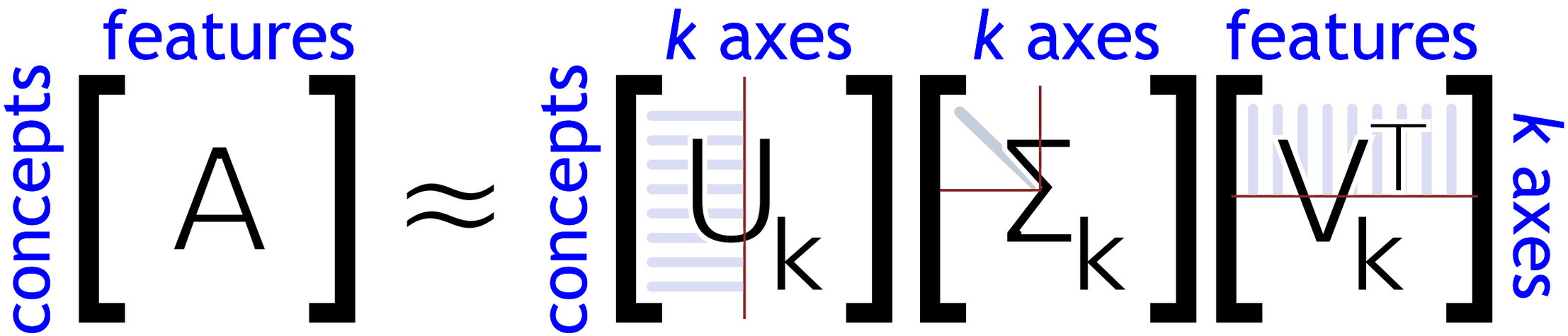
AnalogySpace (Speer et al., AAAI 2008)

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		

AnalogySpace (Speer et al., AAAI 2008)

Informal Inference



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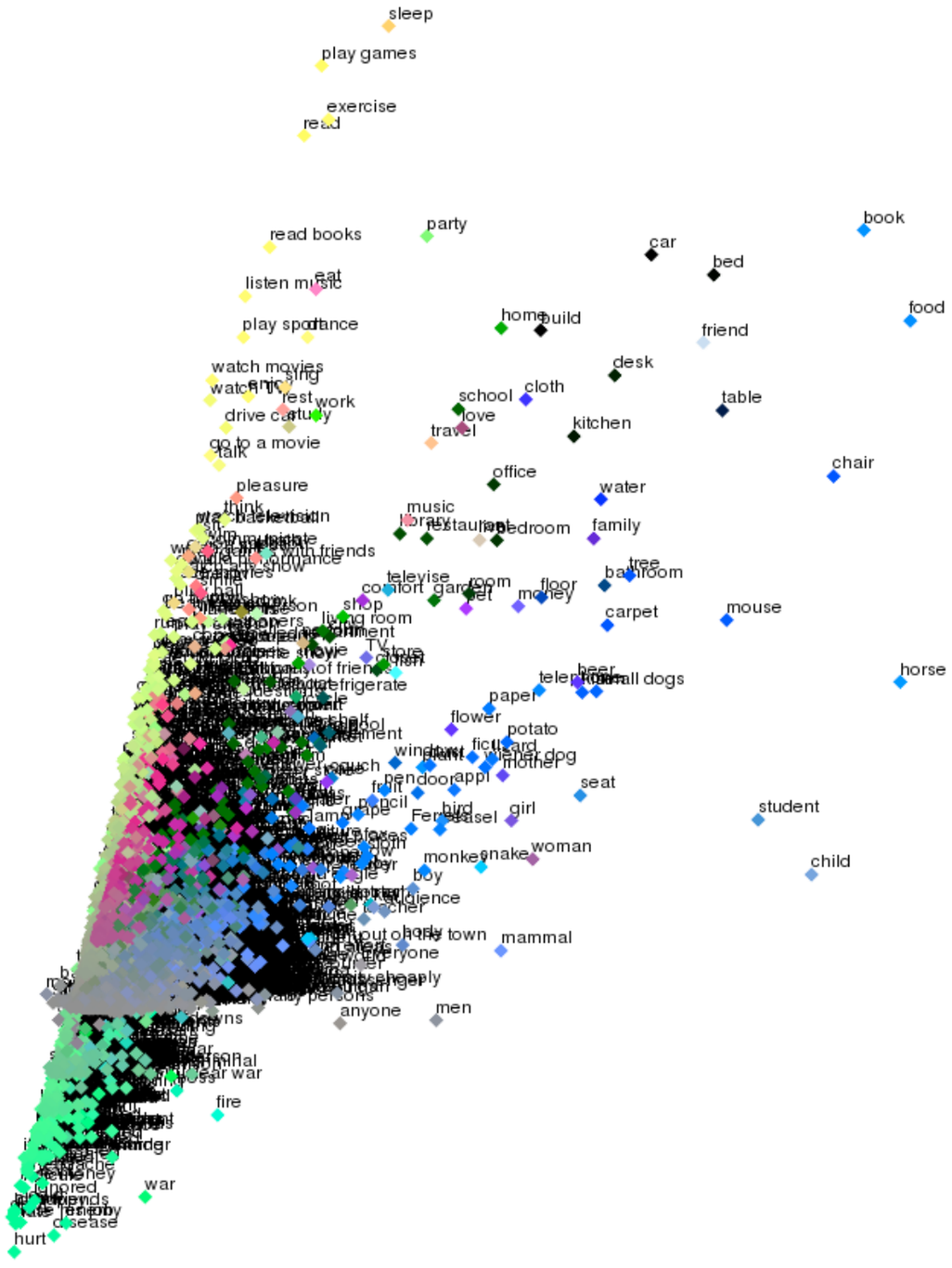

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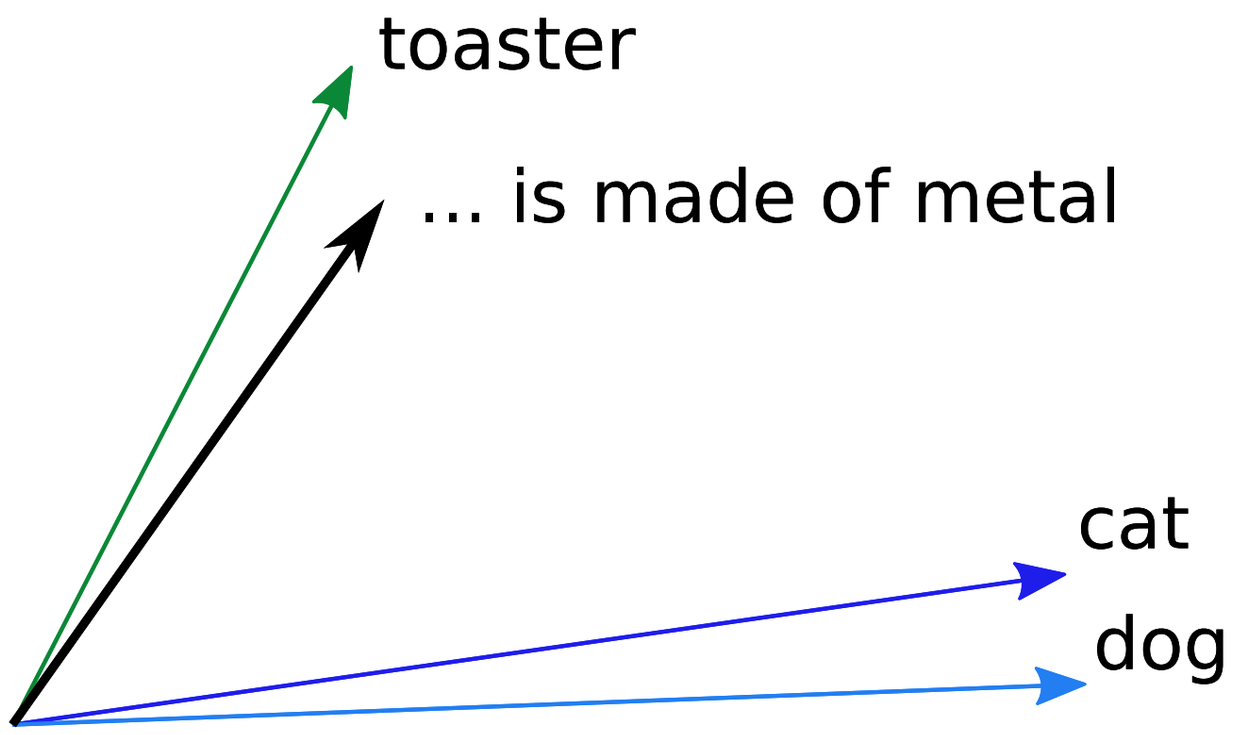


AnalogySpace (Speer et al., AAAI 2008)

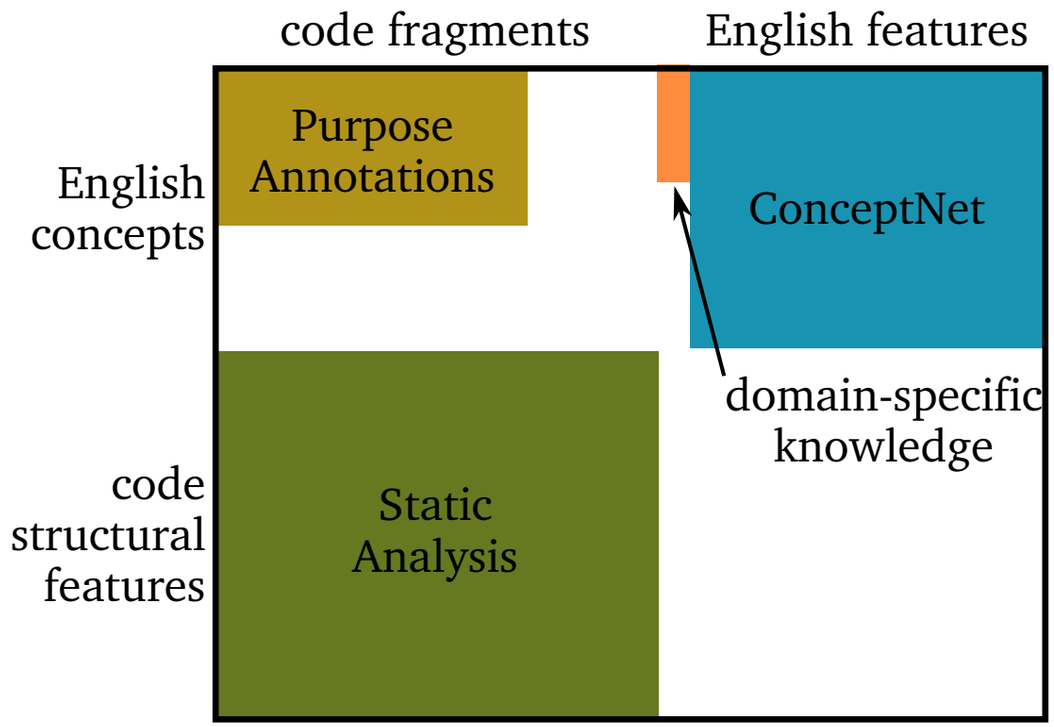
Can also *blend* multiple knowledge sources.

Like code and descriptions.

Blending (Havasi et al., IEEE Intelligent Systems 2009)

ProcedureSpace Blends Code and Descriptions

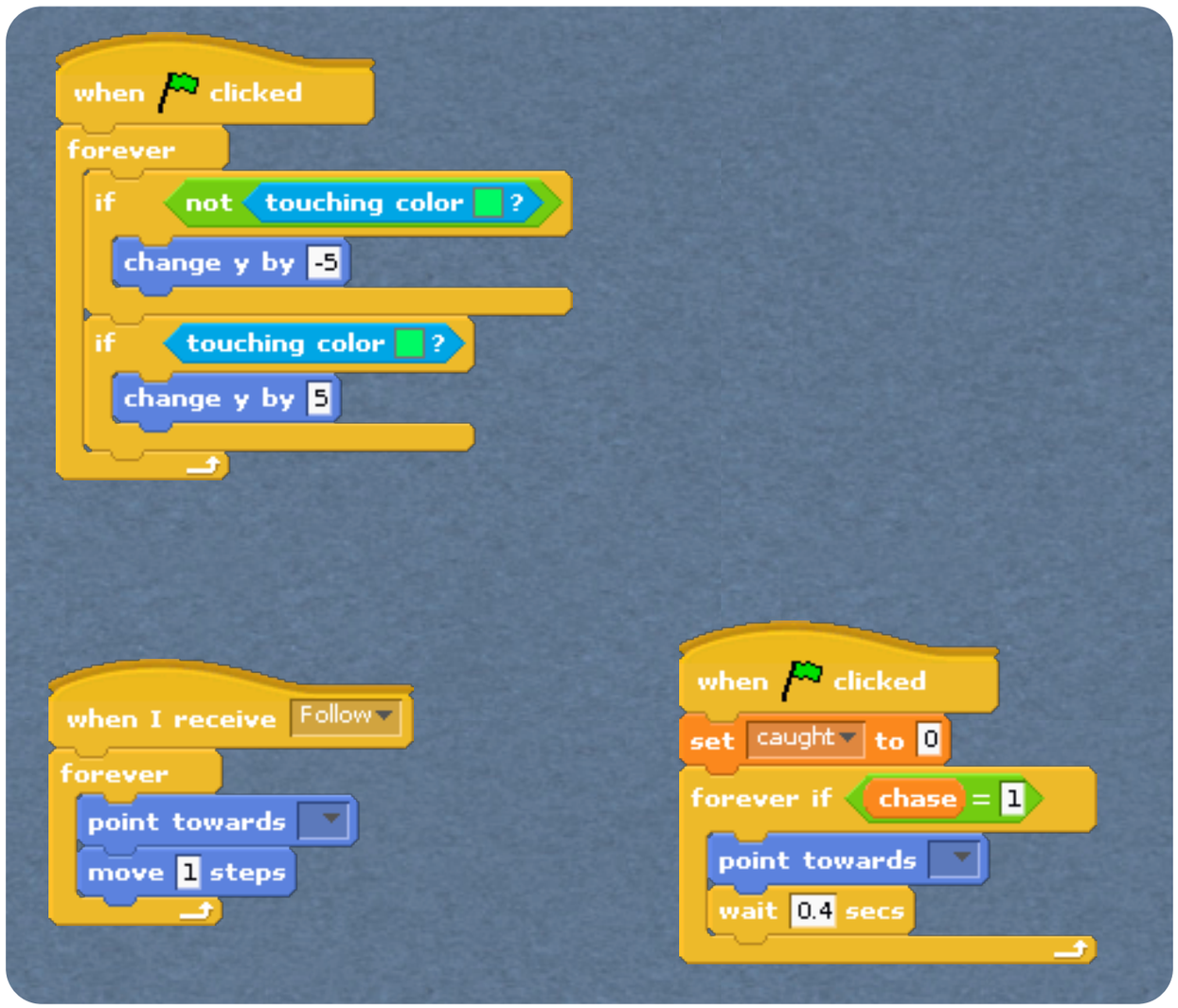
- Zones Annotations
- Code Features
  - static analysis now, dynamic analysis soon?
- Commonsense Knowledge
- Domain Knowledge



Search Results

Users searched for

- gravity



- follow player

neither result was annotated

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