Programming Language Independent Abstract Syntax Trees

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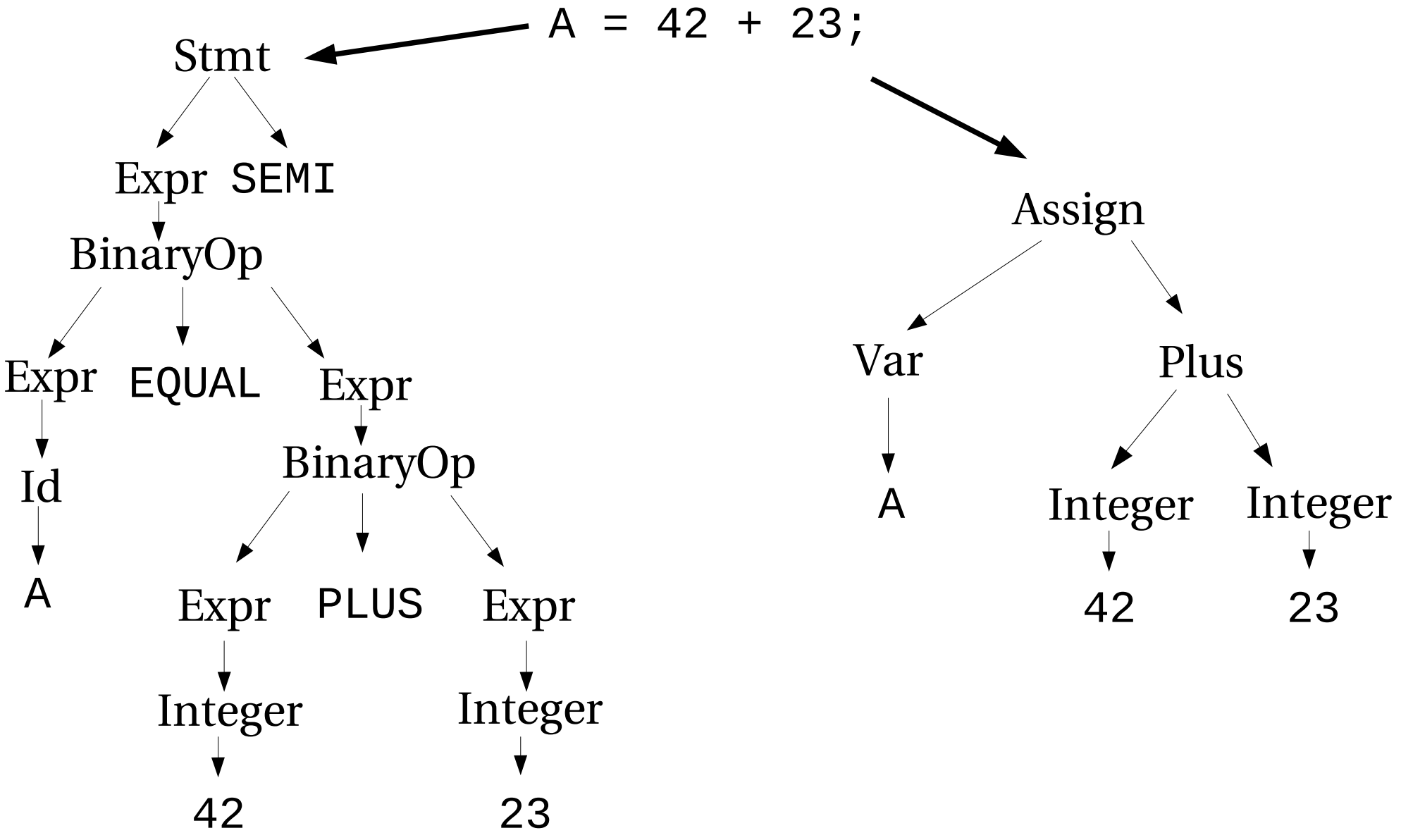
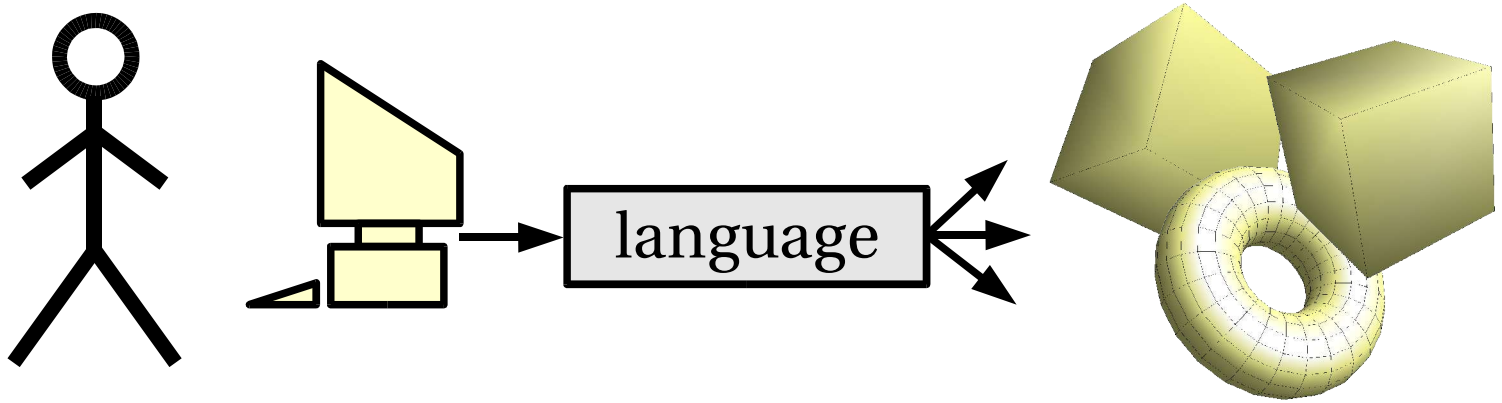
Overview

- Motivation
  - Better understand common/emerging
    - Programming concepts
    - Language properties
  - Language tool interoperability
    - Transformation
    - Refactoring
- Approach
  - Analysis + synthesis ➡ formalism

CSTs and ASTs



Programming languages vs programming concepts




```
(λx. Display x) “Hello world”
```

```
++++++++[>++++++++++<-]>.<+++++[>++++++<-]>-.+++++++..
+++.<++++++++[>>++++<<-]>>.<<++++[>------<-]>.<++++[>
++++++<-]>.+++.------.--------.>+.
```

Language evolution

- New concepts expressed through
  - Idioms
    - language-specific recipies
  - Patterns
    - recipies common to a class of languages
- New concepts require
  - Adaptation to existing semantics
  - Possibly new syntax

Evolution: `if+goto`

```
label:
... code ...
if(cond) goto label;
```

```
while(cond) {
    ... code ...
}
```

```
if(!cond) goto label1;
... code ...
goto label2
label1:
... code ...
label2:
```

```
if(cond) {
    ... code ...
} else {
    ... code ...
}
```

Evolution: assertions

- Assertions in Java 1.4

```
if(!cond)
  throw new AssertionError(stringExpr);
```

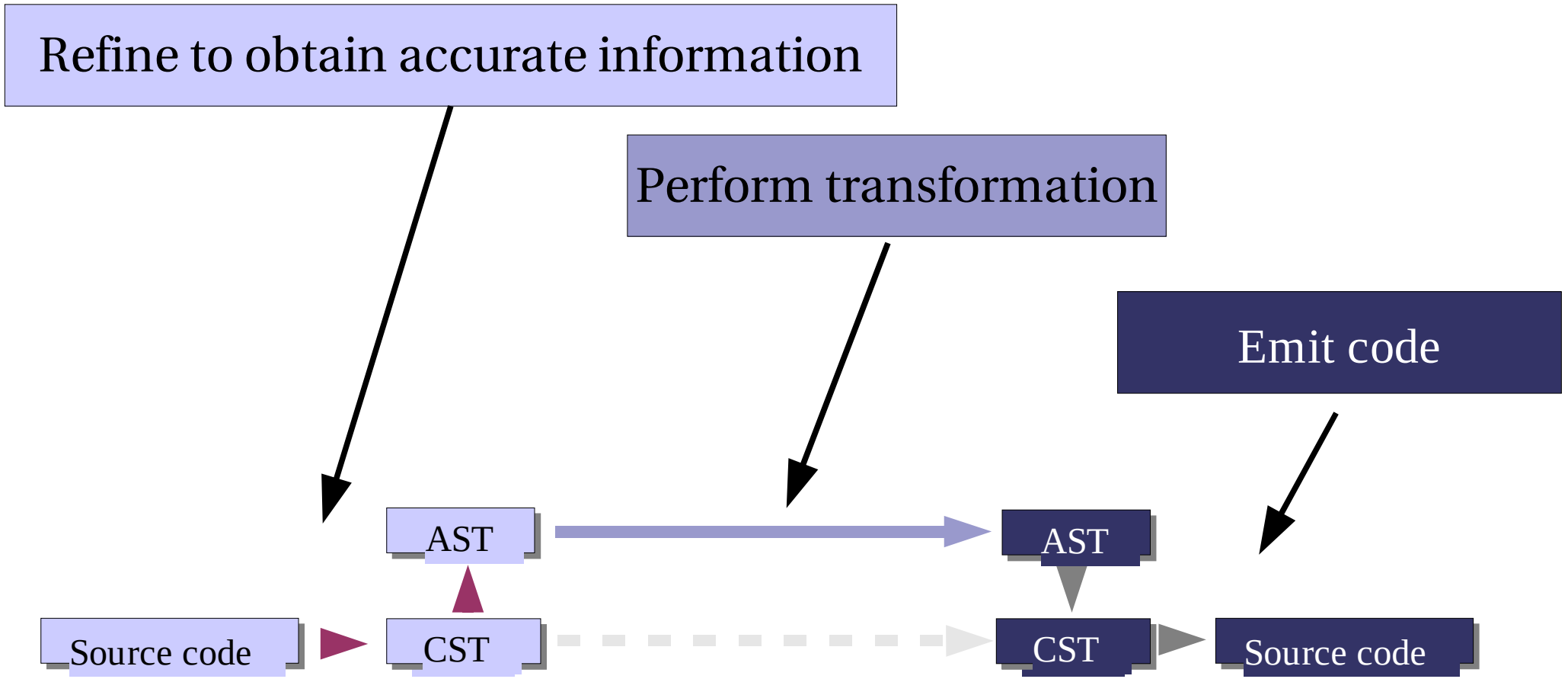
```
assert cond : stringExpr;
```

Evolution: contracts

- Pre/post conditions and class-invariants in Eiffel

```
func(arg: TYPE) is
  require
    boolean-expression
    ...
  do
    body
    ...
  ensure
    boolean-expression
    ...
  end
```

Use case: CodeBoost



Accurate information

- `for(exp1; exp2; exp3) body;`
  - Undecideable termination
  - Sugar for `exp1; while(exp2){body; exp3;}`
- `for x in [1,2,3]: body`
  - Will always terminate
- `map(λx.body, [1,2,3])`

Structuring and reuse

- Many concepts
  - Classes, inheritance, aspects, coordination, patterns, best practices
- Fewer constructs
  - `package`, `class`, `template`
- Experimentation easier at the abstract level
  - Not compounded by syntax
  - Allows domain-specific structuring

Conclusion

- Build more abstract AST using accurate information
  - Support language evolution in tandem with concept evolution
  - Increase convenience for tools
  - Simplify reasoning for programmer
- Not a new language!
  - Represented in contemporary languages