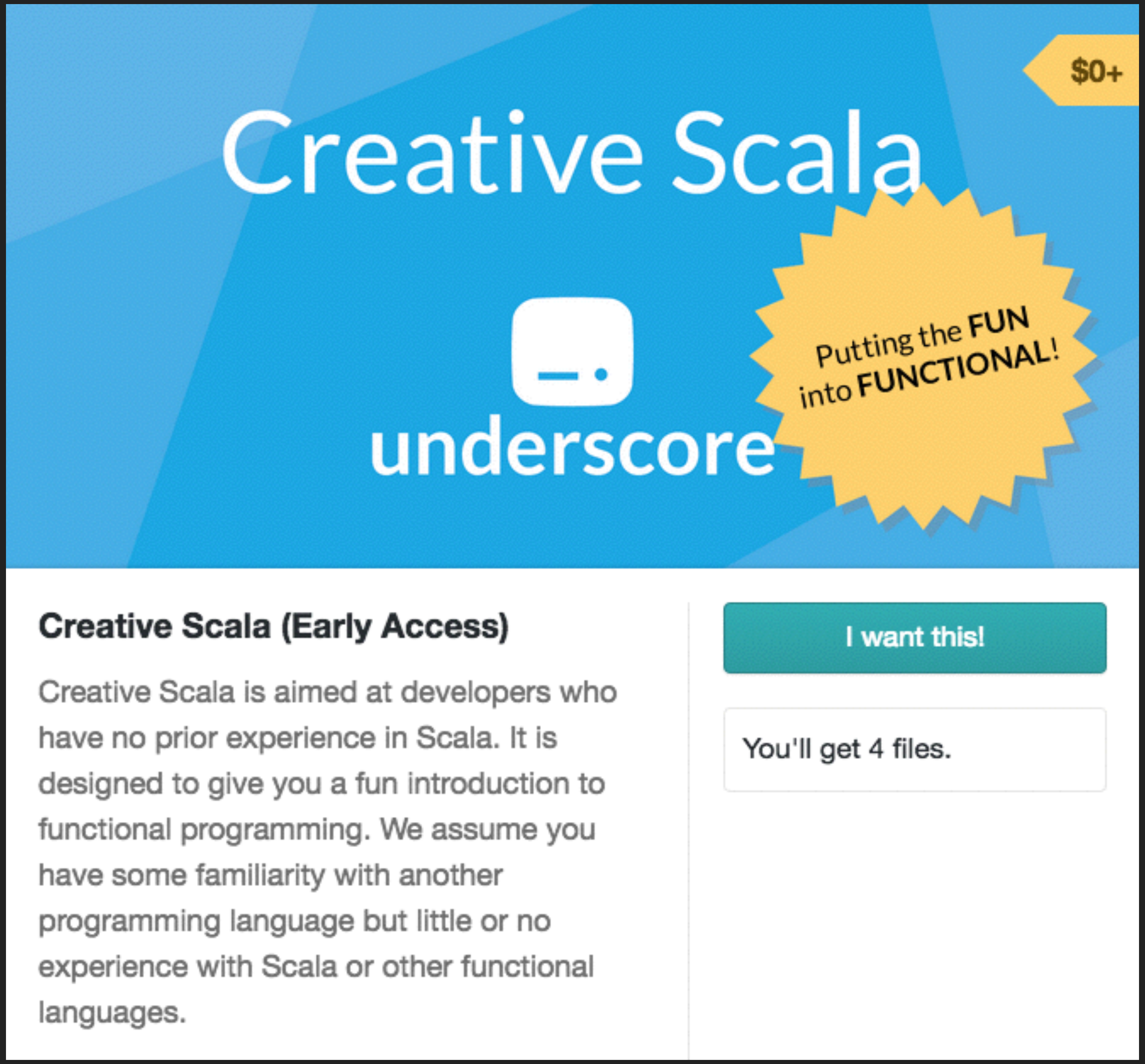
Creative FP

Dave Gurnell, @davegurnell

underscore



Creative Scala (Early Access)

Creative Scala is aimed at developers who have no prior experience in Scala. It is designed to give you a fun introduction to functional programming. We assume you have some familiarity with another programming language but little or no experience with Scala or other functional languages.

You'll get 4 files.

http://underscore.io/training/courses/creative-scala

Agenda

What is FP?

Creative Drawing with Doodle
https://github.com/davegurnell/doodlejs

Creative Music with Compose
https://github.com/davegurnell/composejs

FP Elsewhere

What is FP?

Functions as values

Higher order functions

Haskell

Immutability

Composition and transformation

Purity (no side-effects)

Recursion

Types

Monads! (Scala joke)

Algebraic data structures

Functions as values

Higher order functions

Haskell

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Types

Algebraic data structures

Monads!
(Scala joke)

Functions as values

Higher order functions

Haskell

Immutability

Interpreters

Composition and transformation

Purity (no side-effects)

Recursion

Types

Monads! (Scala joke)

Algebraic data structures

“Almost all designs fall into the ‘compiler’ or ‘interpreter’ pattern, using a model of the data and functions on that data …”

Don Syme on Stack Overflow

http://stackoverflow.com/questions/27852709/
enterprise-patterns-with-functional-programming

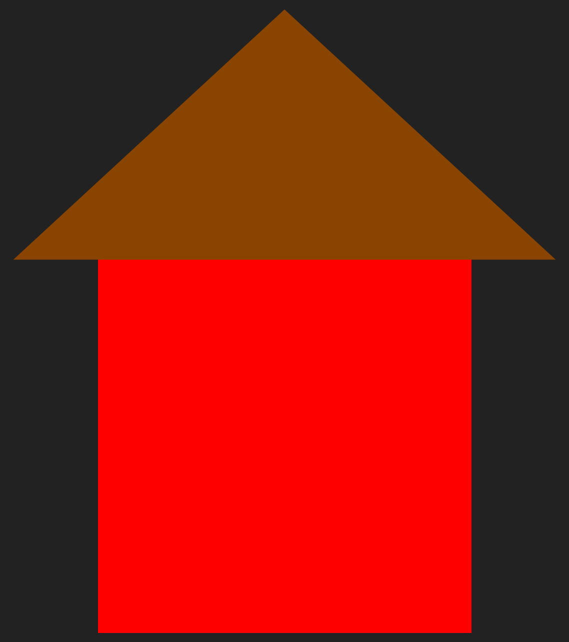
"You can implement most systems by writing a compiler (or interpreter). So learn to write compilers."

Don Syme on Stack Overflow
http://stackoverflow.com/questions/27852709/enterprise-patterns-with-functional-programming

Motivation

What does this code draw…?

```
var canvas  = document.getElementById('canvas');
var context = canvas.getContext('2d');

context.fillStyle = 'brown';
context.moveTo(50, 0);
context.lineTo(100, 50);
context.lineTo(0, 50);
context.lineTo(50, 0);
context.fill();

context.fillStyle = 'red';
context.fillRect(10, 50, 80, 80);
```



Problems

Unclear

“Magic numbers”

Implementation detail

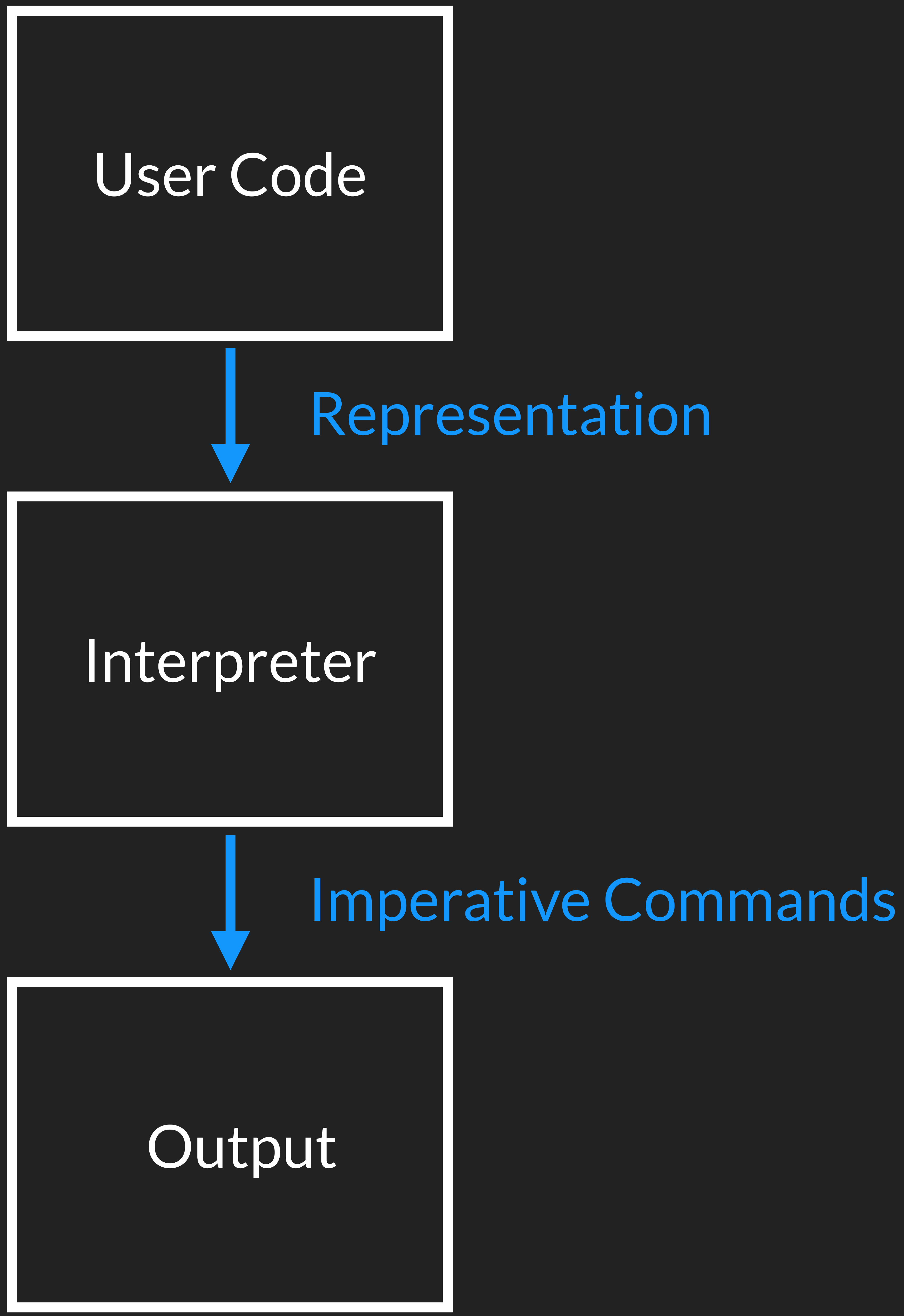
Not reusable

Doodle

Graphics Interpreter

https://github.com/davegurnell/doodlejs

```
var house = triangle(100, 50).
  above(rectangle(80, 80));

draw(house);
```


User Code
Representation
Interpreter
Imperative Commands
Output

Demo

Recipe

Representation
Primitives
Combinators

Interpreter

Syntax

Primitives

Combinators

Interpreter

Syntax

Primitives

Images: Circle, Rectangle, Triangle

Combinators

Interpreter

Syntax

Primitives

Images: Circle, Rectangle, Triangle

Combinators

Interpreter

Syntax

Primitives

Images: Circle, Rectangle, Triangle

Combinators

Geometric: Above, Beside, Overlay

Interpreter

Syntax

Code

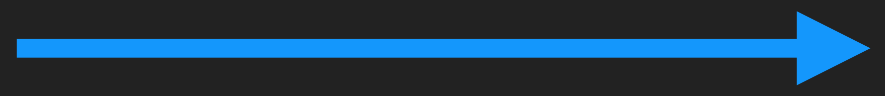


image-ast.js

Primitives

Images: Circle, Rectangle, Triangle

Combinators

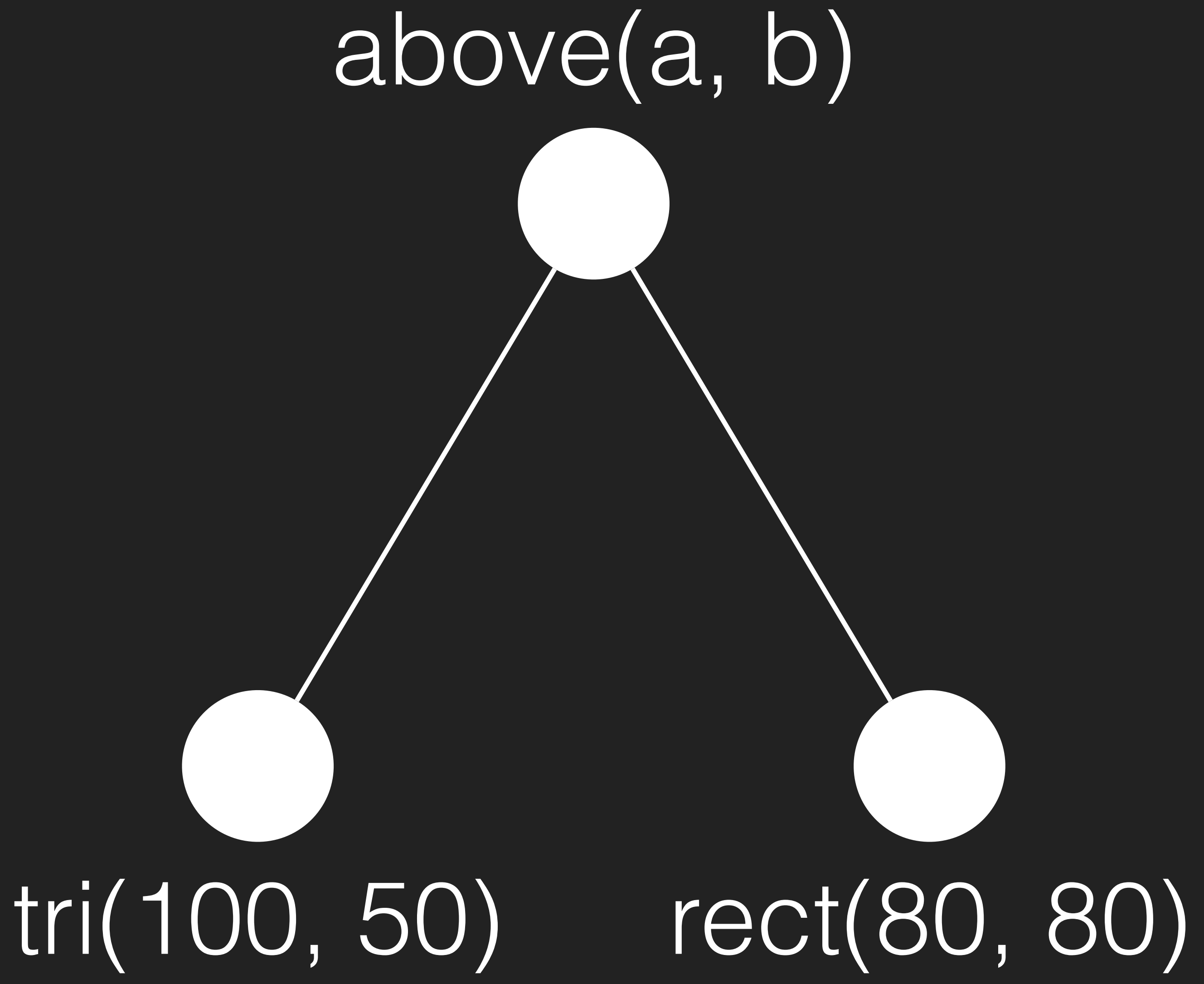
Geometric: Above, Beside, Overlay

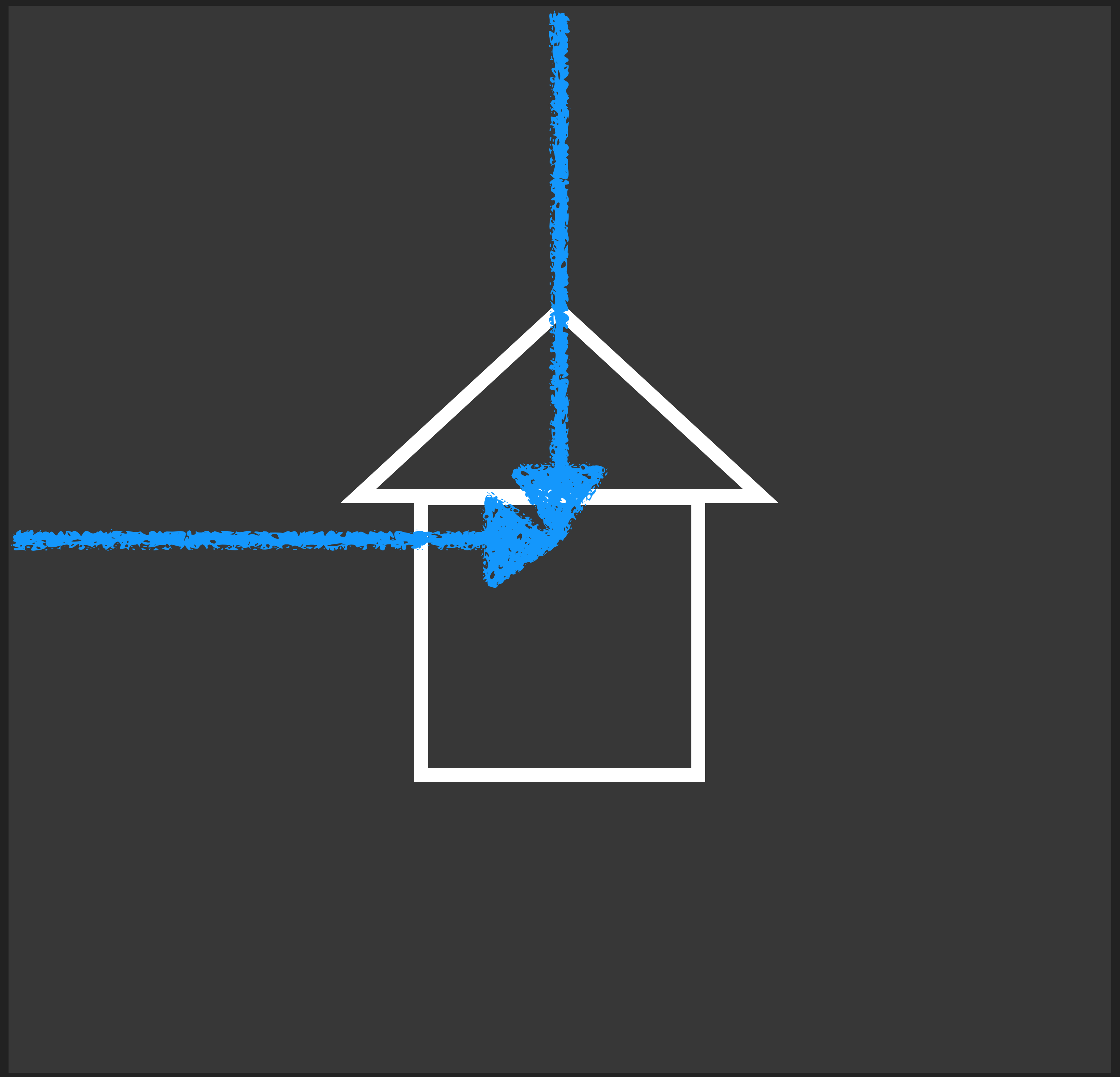
Interpreter

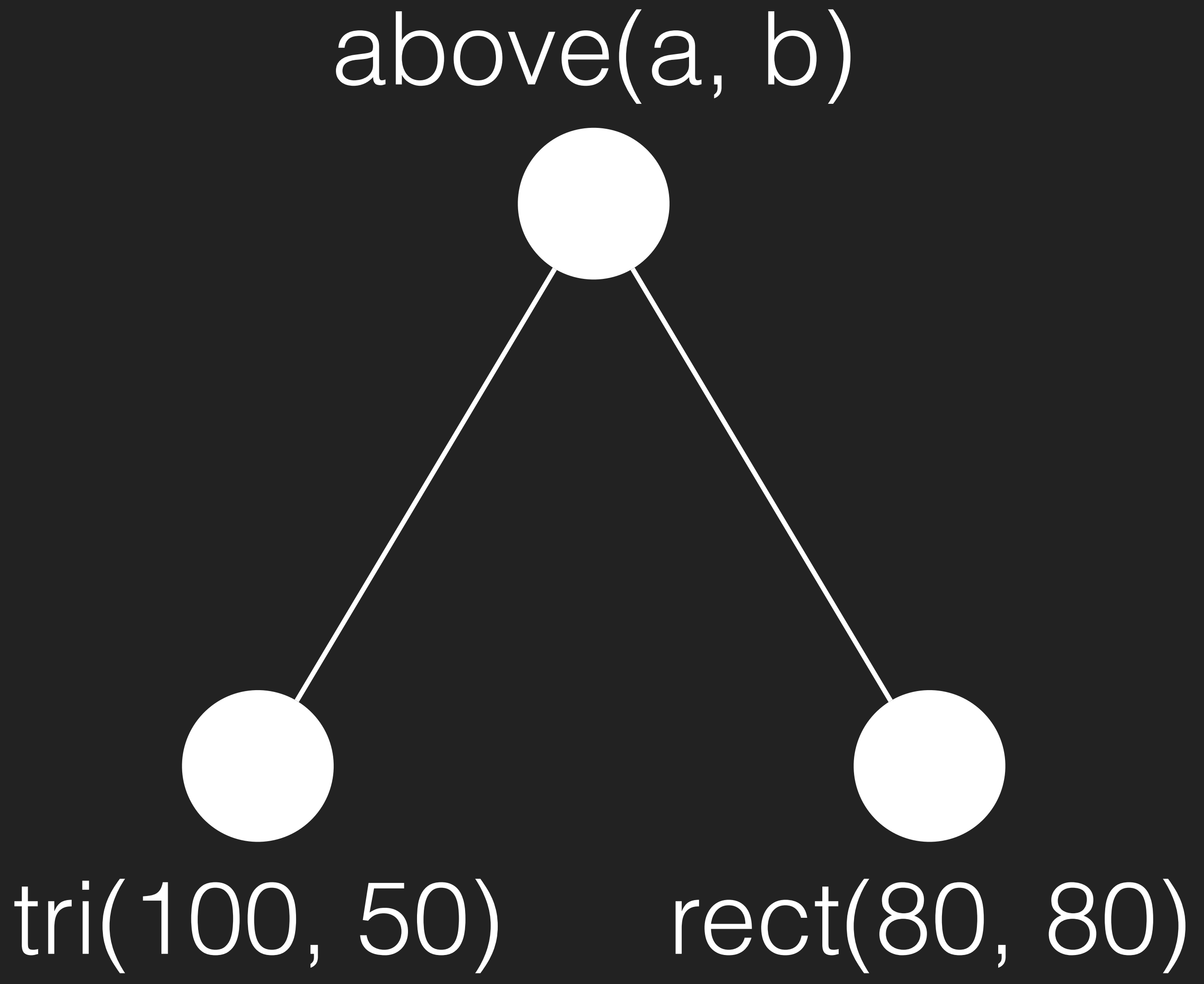
Syntax

```
// CanvasContext Image -> Void
function draw(ctx, image) {
  // ...


}
```

```
// CanvasContext Image -> Void
function draw(ctx, image) {
  var bounds = boundingBox(image);

  drawImageAt(ctx, bounds, image);
}
```


above(a, b)
tri(100, 50)
rect(80, 80)

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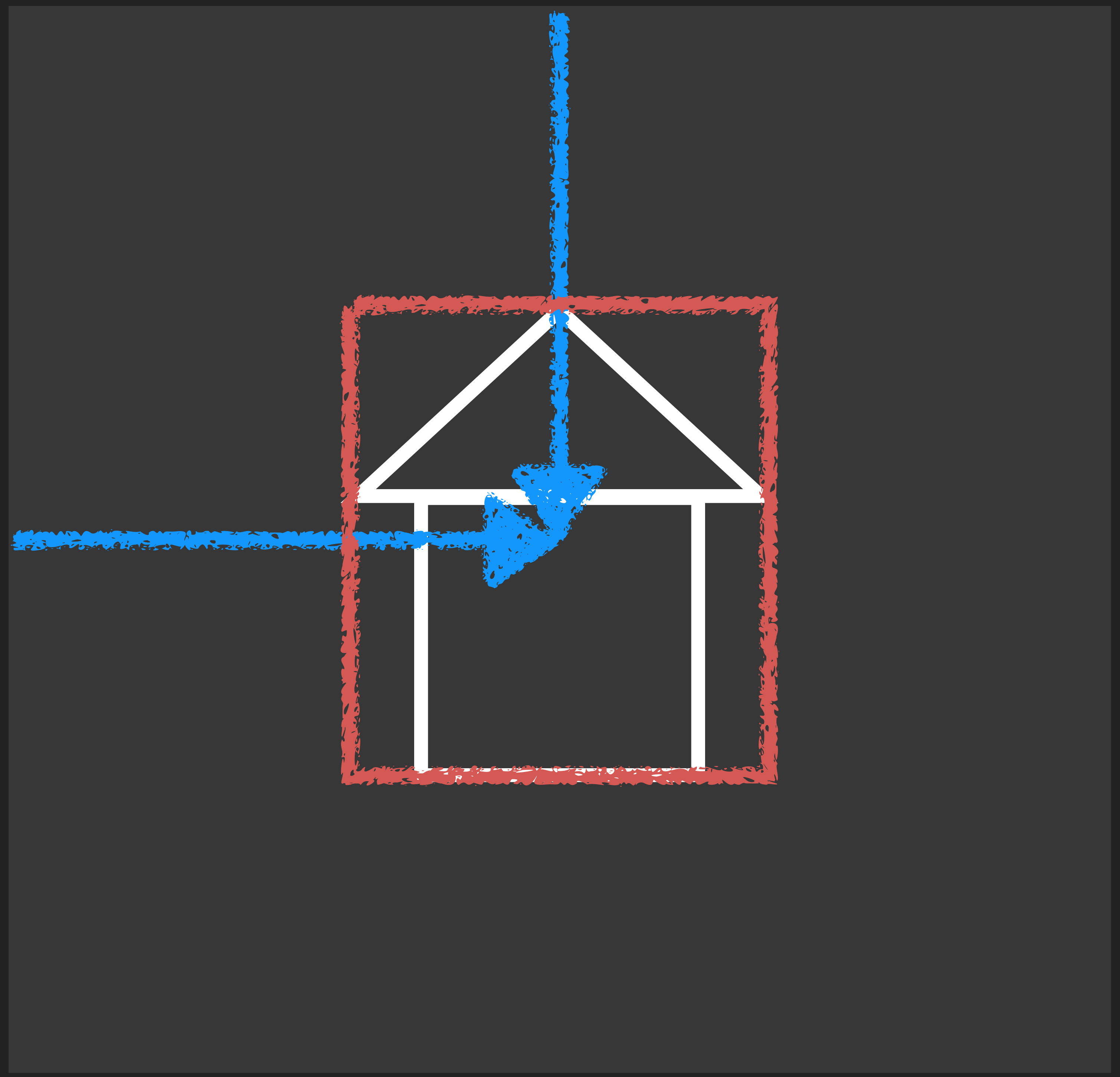

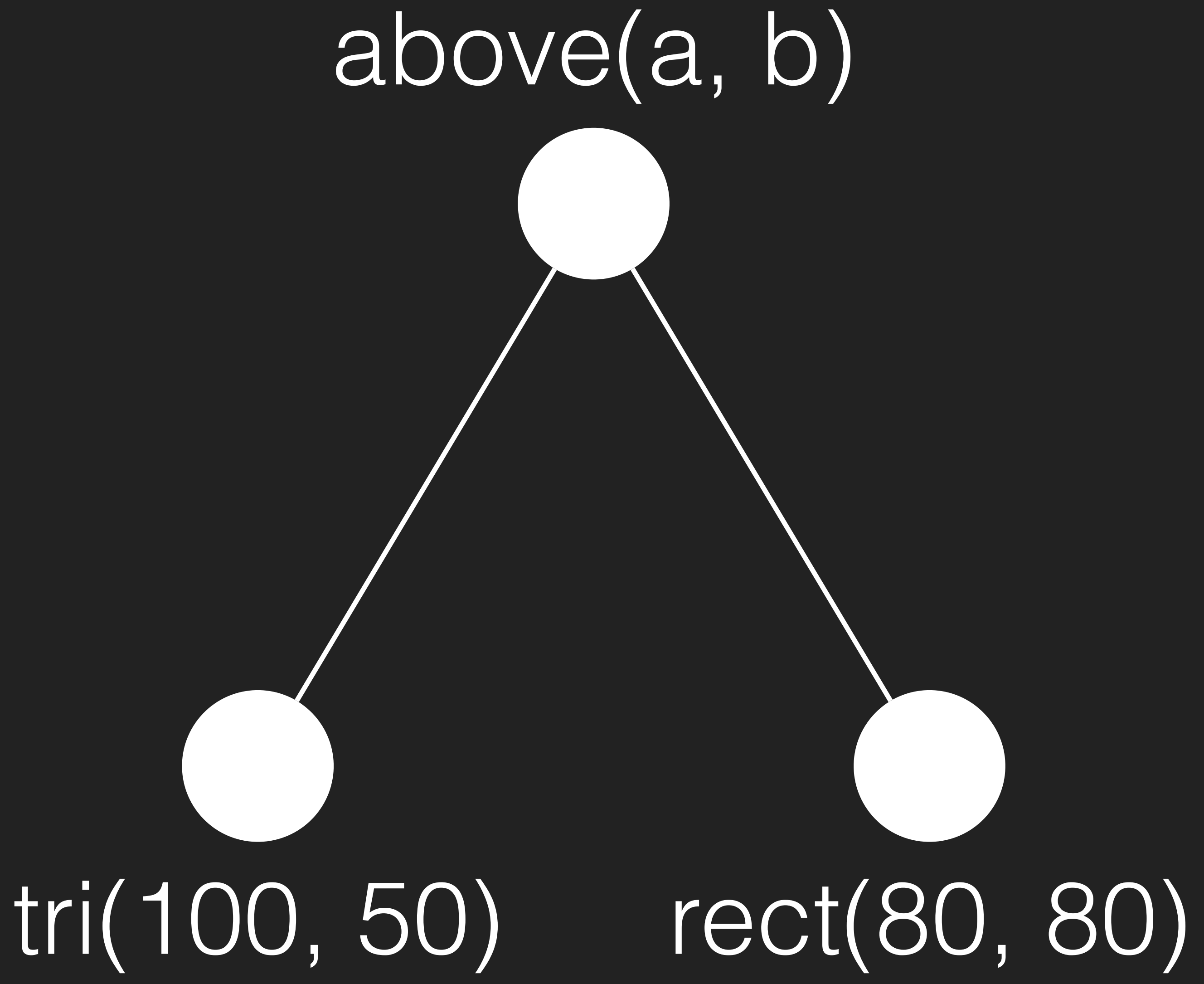
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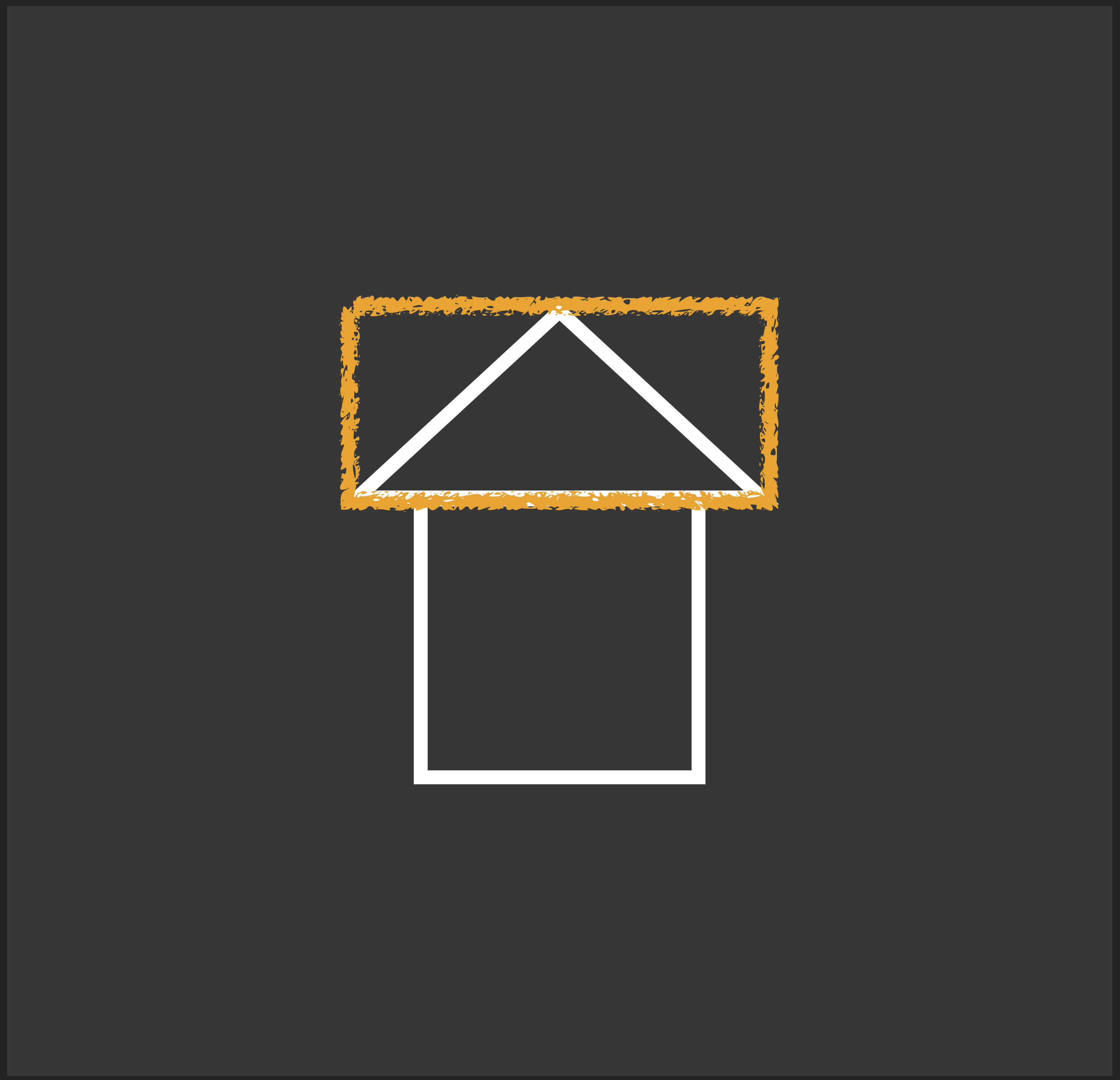

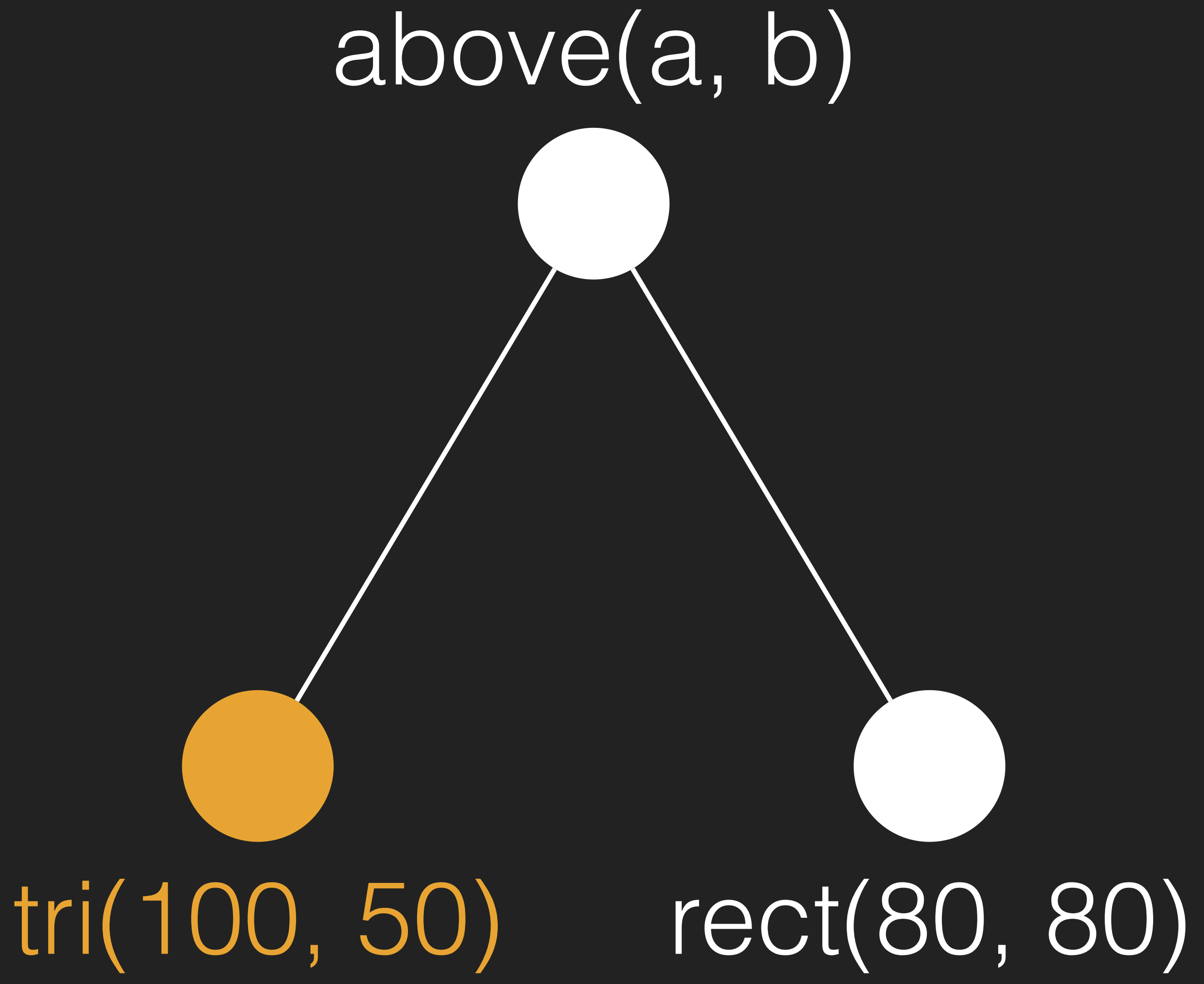
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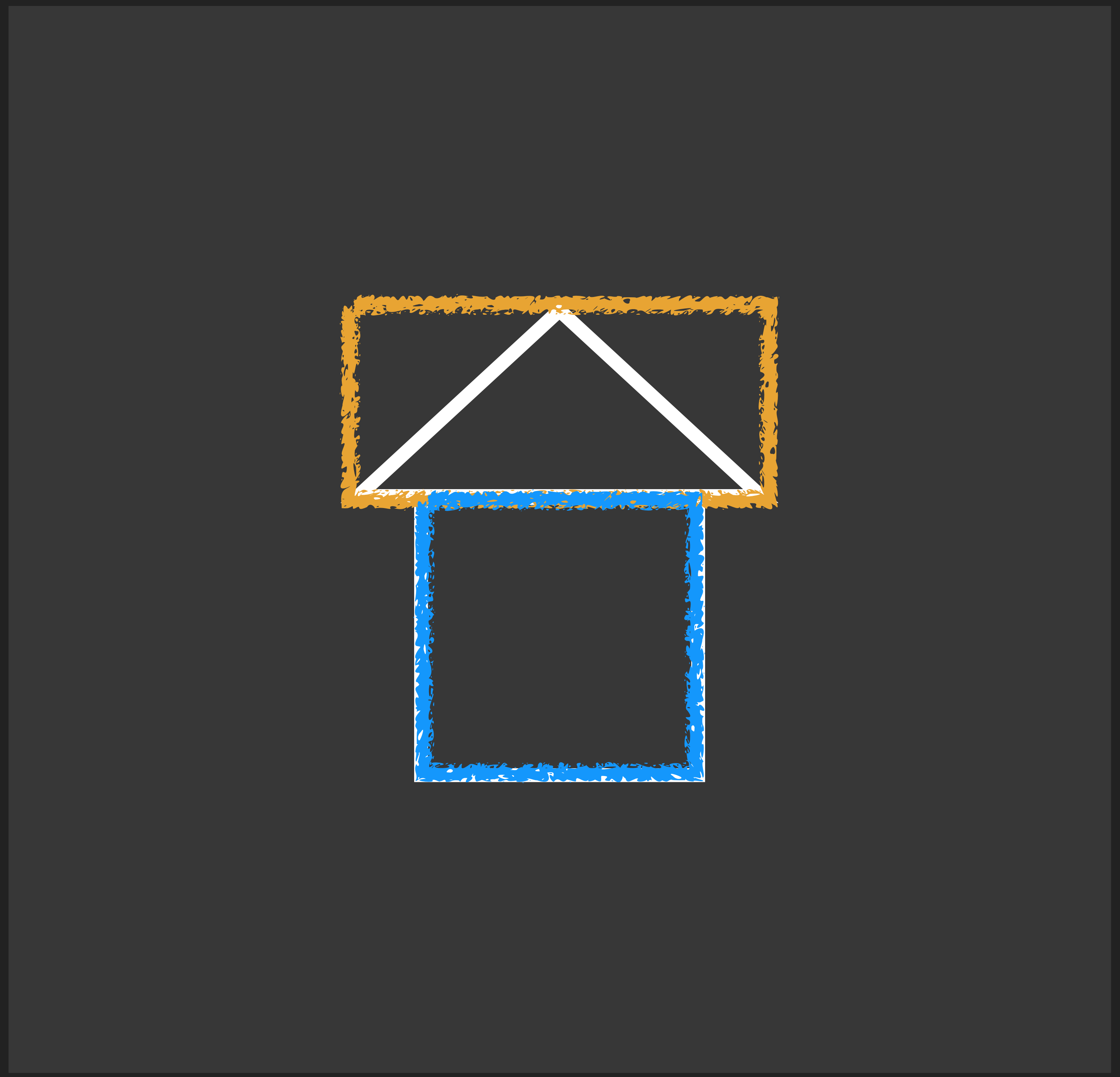

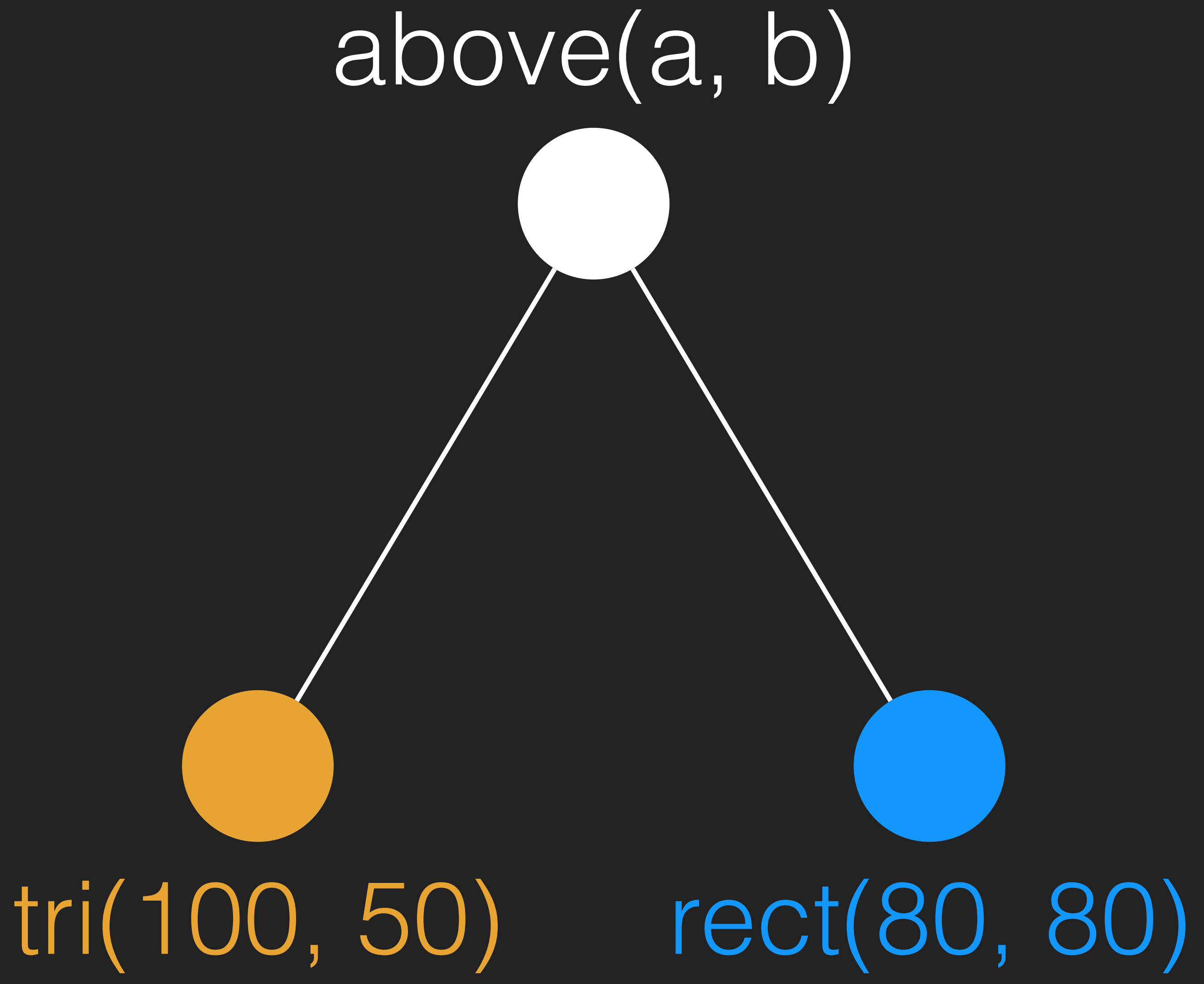
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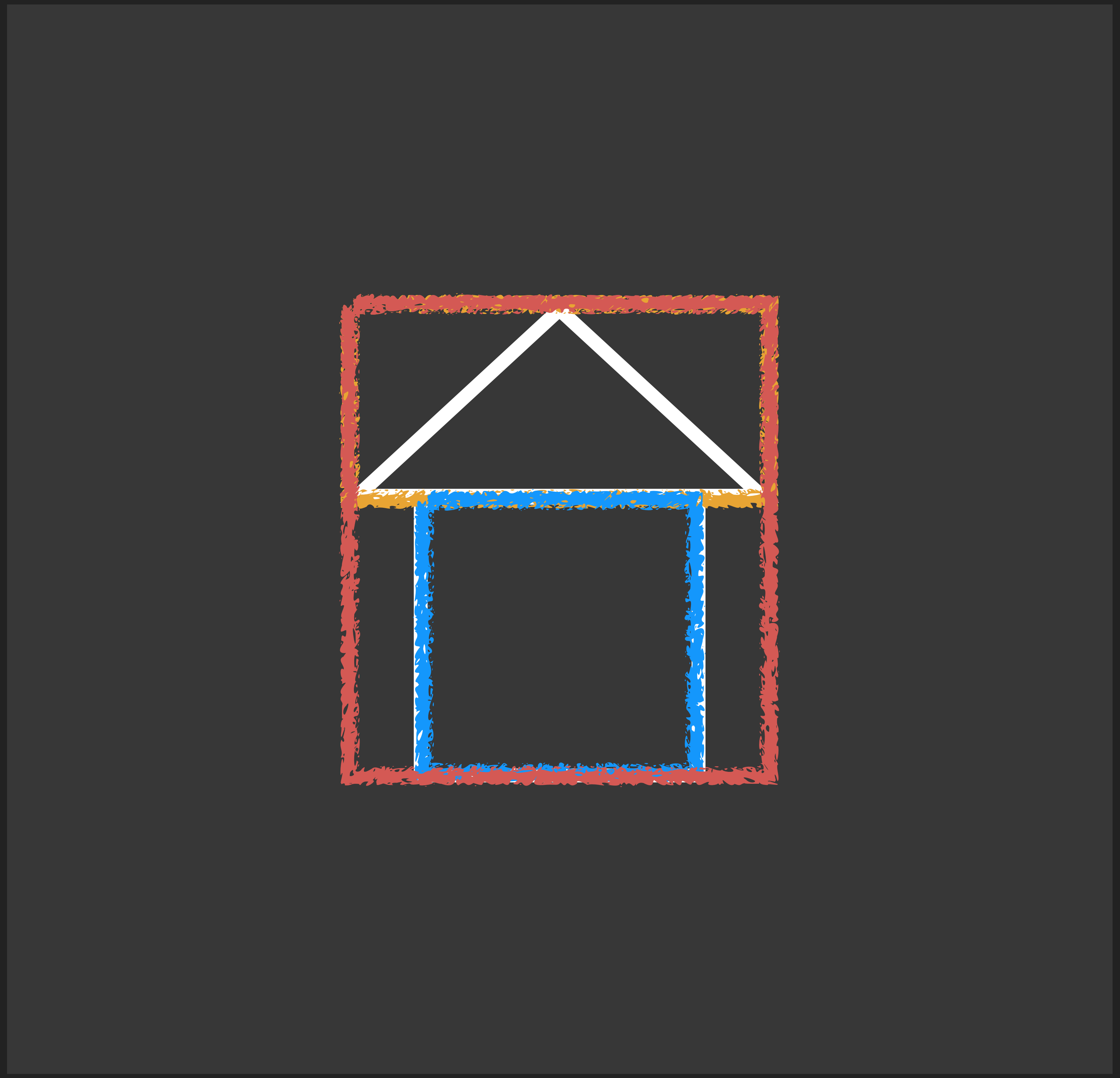
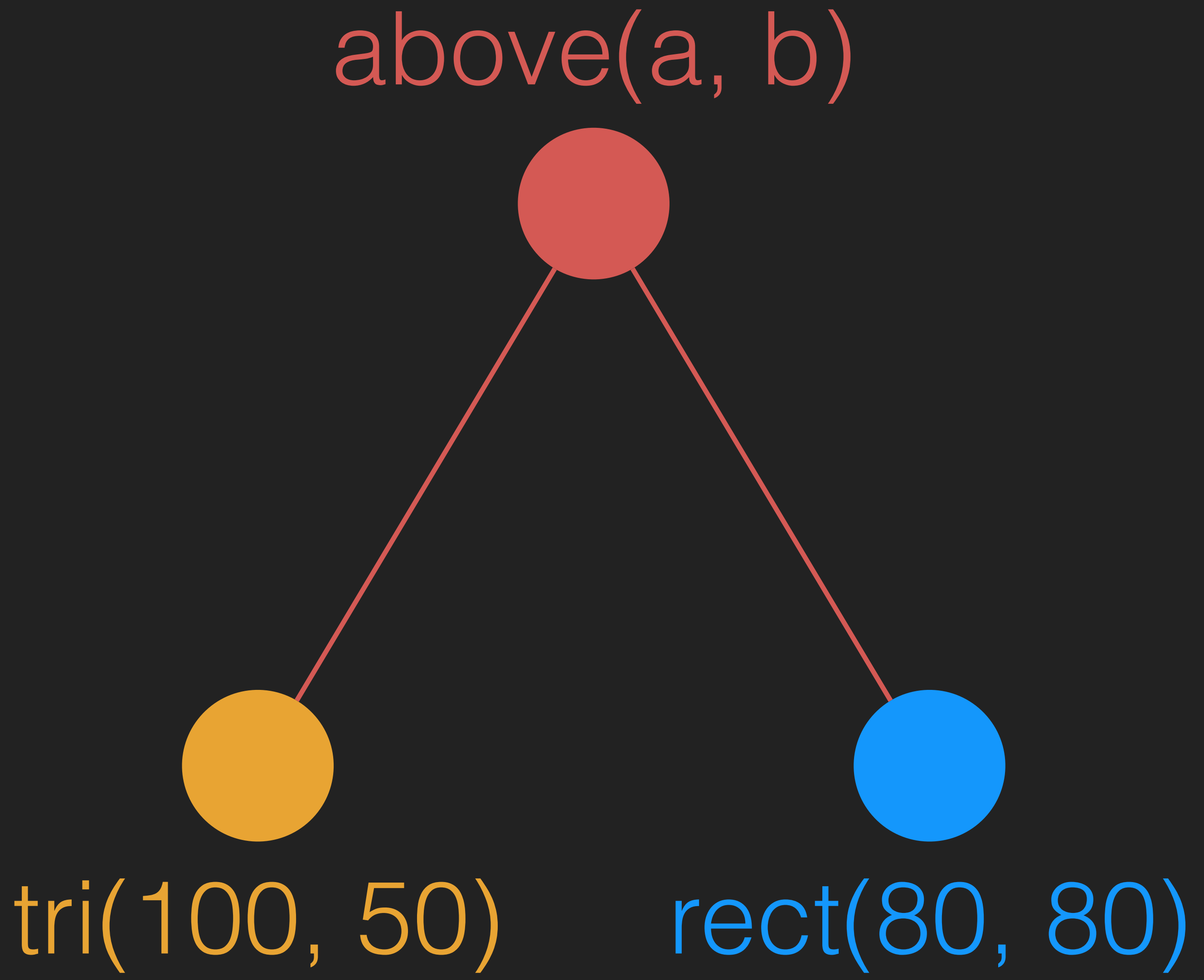



above(a, b)
tri(100, 50)
rect(80, 80)

Code

bounds.js, canvas.js

Primitives

Images: Circle, Rectangle, Triangle

Combinators

Geometric: Above, Beside, Overlay

Interpreter

Syntax

```
image1.above(image2);
// new Above(image1, image2)

beside(image1, image2, image3);
// new Beside(
//   new Beside(
//     image1,
//     image2),
//   image3)
```

Code and Demo

image-ast.js, image-helpers.js

Recap

Build a Representation

small set of primitives and combinators

Write an Interpreter

simple functions, switch on type, structural recursion

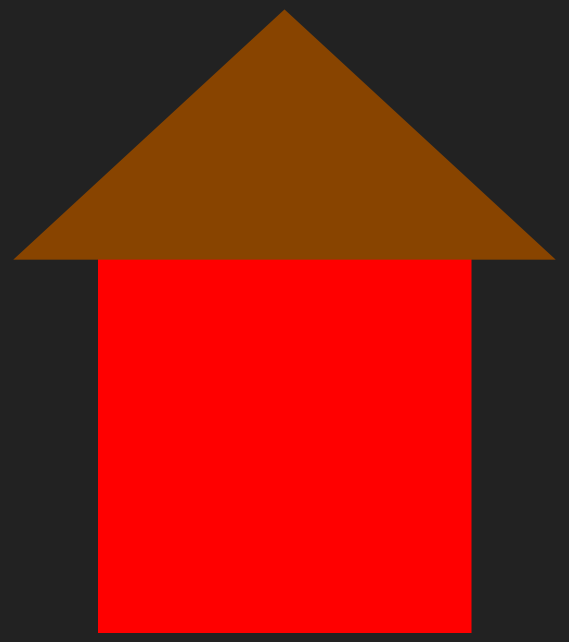
Advantages

simple, dependency-free, composable, reusable,
can plug in different front/back-ends

Stop!

Sierpinski Time

Doodling with Style



Primitives

Images: Circle, Rectangle, Triangle

Combinators

Geometric: Above, Beside, Overlay

Interpreter

Syntax

Primitives

Images: Circle, Rectangle, Triangle

Styles

Combinators

Geometric: Above, Beside, Overlay

StyleTransform

Interpreter

Syntax

Code and Demo

image-ast.js, canvas.js

Compose

Music Interpreter

https://github.com/davegurnell/composejs

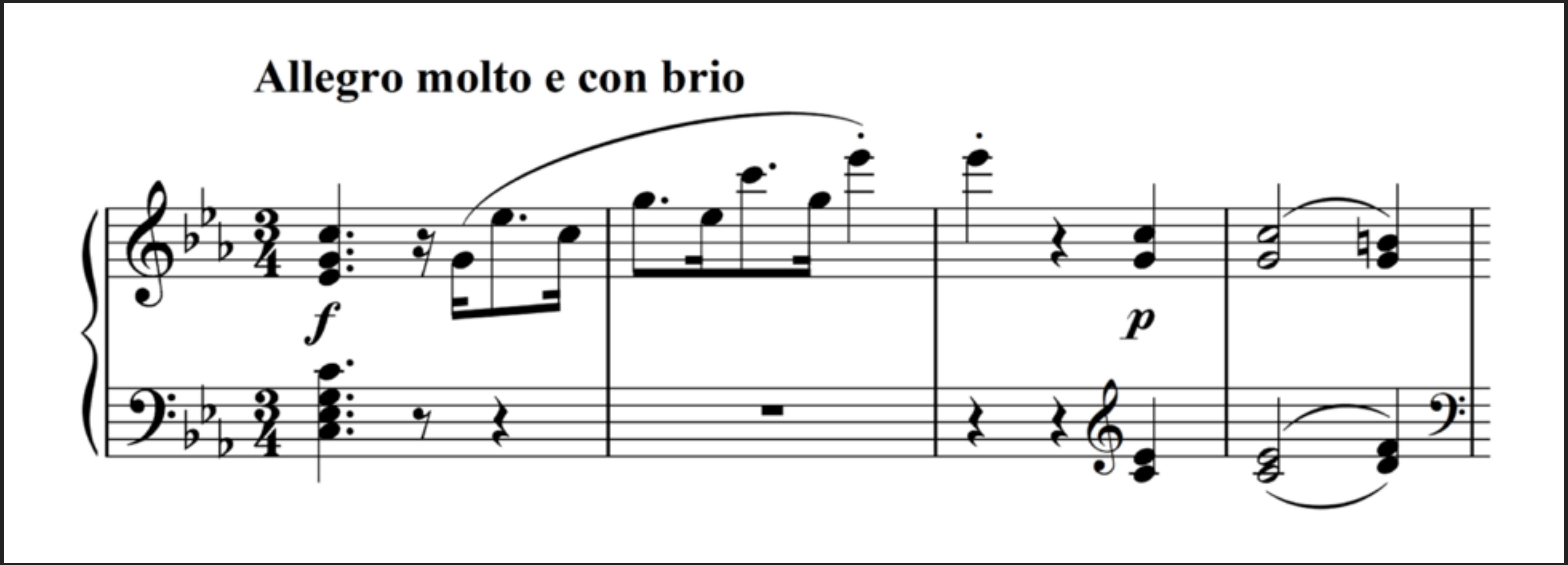
Recipe

Primitives

Combinators

Interpreter

Syntax



Piano Sonata No. 5 (Beethoven), Ocean Shores, CC BY-SA 3.0
http://en.wikipedia.org/wiki/Piano_Sonata_No._5_(Beethoven)

Recipe

Primitives
Pitches, Durations
Notes, Rests

Combinators

Interpreter

Syntax

Recipe

Primitives
Pitches, Durations
Notes, Rests

Combinators
Parallel, Sequential

Interpreter

Syntax

Code and Demo

→

score-ast.js

Recipe

Primitives
Pitches, Durations
Notes, Rests

Combinators
Parallel, Sequential

Interpreter

Syntax

```
// Score -> ???
function play(score) {
  // ...
}
```

```
var ctx = new AudioContext();

var req = new XMLHttpRequest();
req.open('GET', 'samples/bell.wav', true);
req.responseType = 'arraybuffer';

req.onload = function() {
  ctx.decodeAudioData(req.response, function(buffer) {
    var source = ctx.createBufferSource();
    source.buffer = buffer;
    source.connect(ctx.destination);
    source.playbackRate.setValueAtTime(2.0, 0);
    source.start(0);
  });
};

req.send();
```

Promises!

```
// PromiseOf(String)
var stringPromise = Q.fncall(function() {
  return "Some Value";
});

// PromiseOf(Number)
var waitABit = Q.delay(300);

// PromiseOf(B)
var aThenB = promiseOfA.then(function(a) {
  return promiseOfB;
});

// PromiseOf([A, B])
var aAndB = Q.all([ promiseOfA, promiseOfB ]);
```

```
// Score -> Promise
function play(score) {
  // ...
}
```

```
// Score -> PromiseOf(Any)
function play(score) {
  return initialize().then(function(config) {
    return playScore(score, config);
  });
}

// Score SomeConfig -> PromiseOf(Any)
function playScore(score, config) {
  // ...
}
```

Code

$\longrightarrow$

player

Recipe

Primitives
Pitches, Durations
Notes, Rests

Combinators
Parallel, Sequential

Interpreter

Syntax

Code and Demo

score-helpers.js

Re-recap

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SAME PATTERNS

Interpreters Elsewhere

Promises

Primitives
Promises, Functions

Combinators
then, all, ...

Interpreter
???

Syntax
then, all, ...

Form Validation

Primitives

Combinators

Interpreter

Syntax

Form Validation

Primitives
Result, Pass, Fail, Rule (function)

Combinators

Interpreter

Syntax

Form Validation

Primitives

Result, Pass, Fail, Rule (function)

Combinators

Sequence, Parallel, Drill-Down

Interpreter

Syntax

Form Validation

Primitives

Result, Pass, Fail, Rule (function)

Combinators

Sequence, Parallel, Drill-Down

Interpreter

Run the rule!

Syntax

```
// String -> ResultOf(String)
function nonEmpty(str) {
  return (str.length == 0) ? fail(...) : pass(str);
}

// String -> ResultOf(Int)
function stringToInt(str) { ... }

// Object -> ResultOf(Signup)
var validateSignup = validateAll(
  validateSeq(getField('name'), nonEmpty),
  validateSeq(getField('age'),  nonEmpty, stringToInt)
).spread(function(name, age) {
  return new Signup(name, age);
});
```

Form Validation

My talk at Scala Exchange
https://skillsmatter.com/skillscasts/5837-functional-data-validation

Batching API Calls

Haxl

https://github.com/facebook/Haxl

Stitch

https://www.youtube.com/watch?v=VVpmMfT8aYw

Final Demo

→

???

Thank You

Dave Gurnell, @davegurnell

https://github.com/davegurnell/asyncjs-creative-fp

underscore