Propagators: An Introduction

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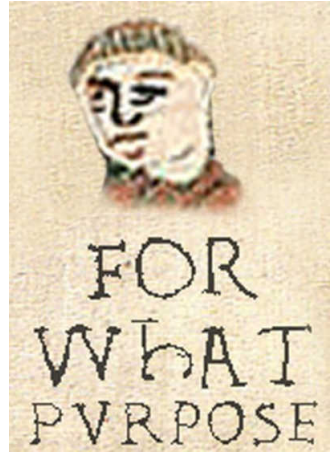
November 3, 2017

What?



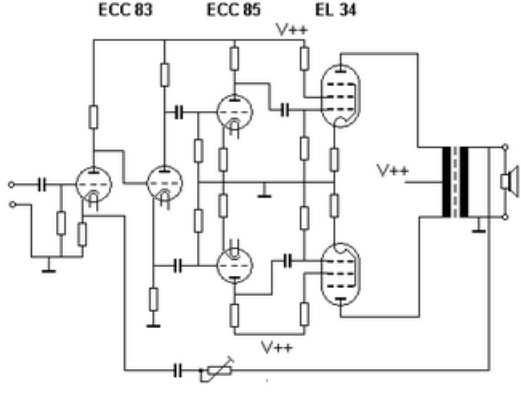
Why?

Roots as early as the 1970's at MIT

- Guy L. Steele Jr.
- Gerald J. Sussman
- Richard Stallman

More recently:

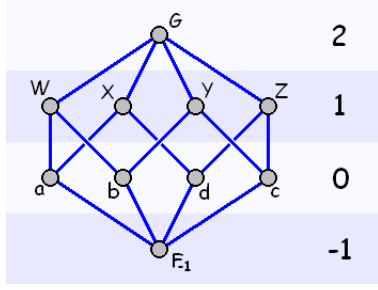
- Alexey Radul



```
(define (map f xs)
  (cond ((null? xs) '())
        (else (cons (f (car xs))
                    (map f (cdr xs)))))))
```

And then

- Edward Kmett



$$x \leq y \implies f(x) \leq f(y)$$

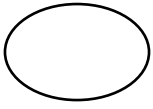
Propagators

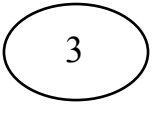
The *propagator model* is a model of computation

We model computations as *propagator networks*

A propagator network comprises

- cells
- propagators
- connections between cells and propagators

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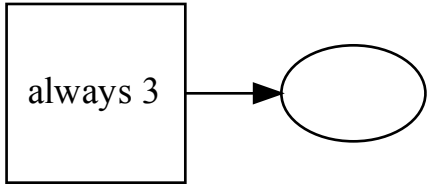
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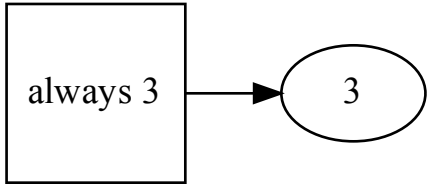
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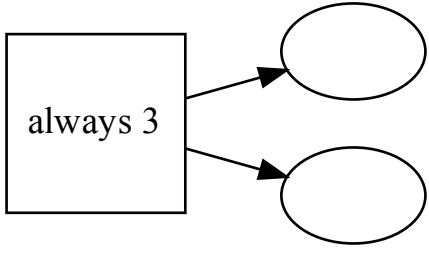
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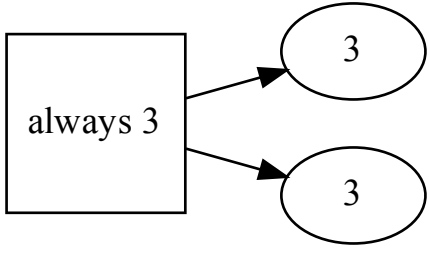
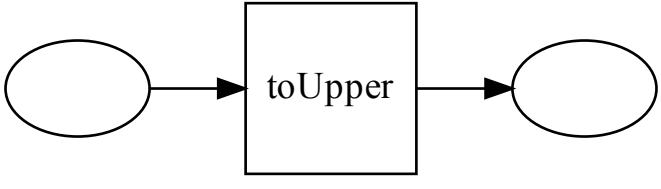
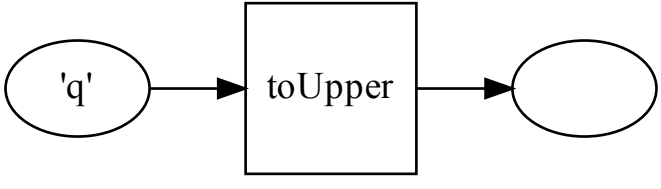
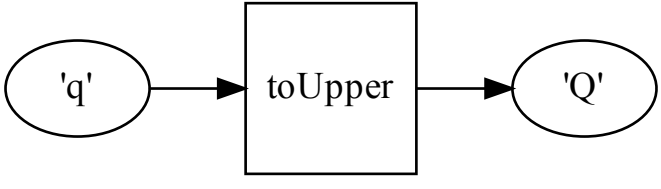

always 3
3
3


toUpper


'q'
toUpper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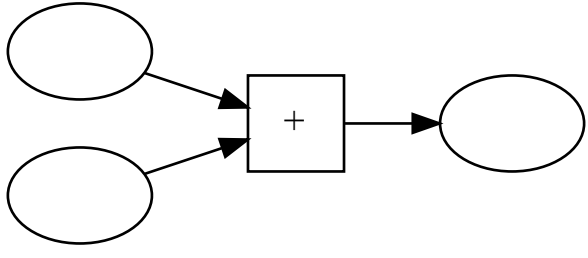
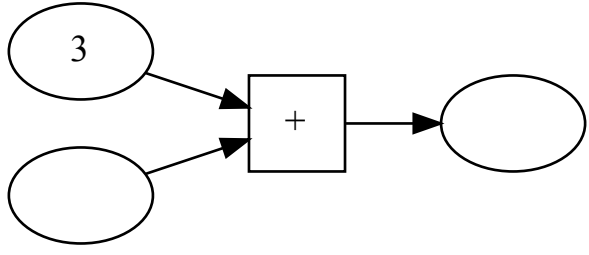
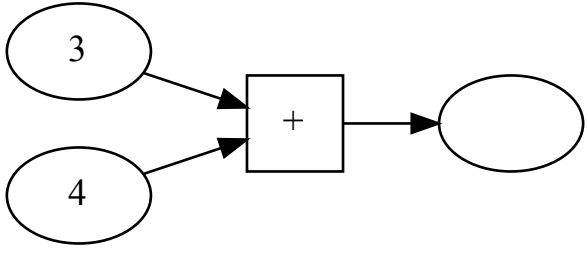
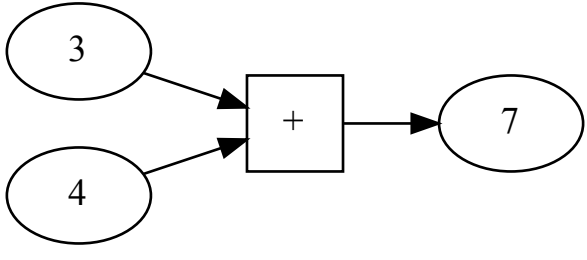
toUpper
'Q'




3
+


3
4
+


3
4
+
7

$$z \leftarrow x + y$$

$$z = x + y$$

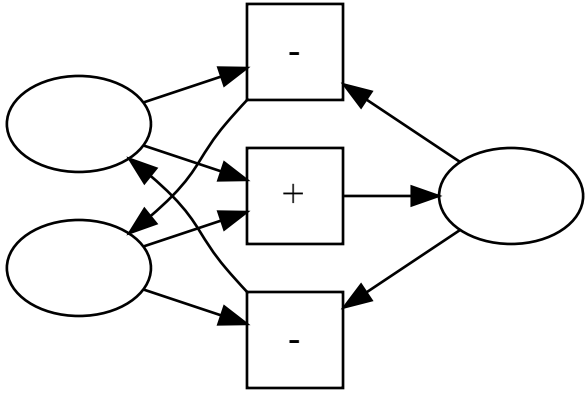
$$7 = x + 4$$

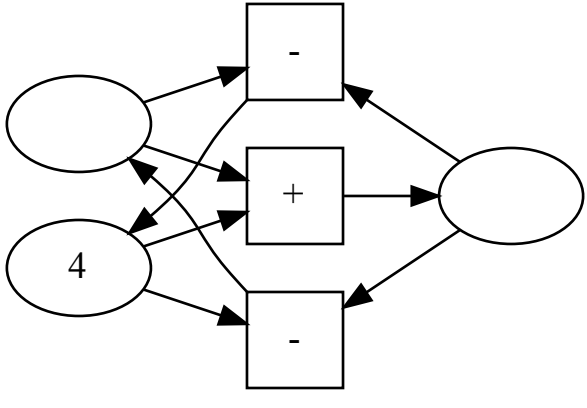
$$z = x + y$$

$$z \leftarrow x + y$$

$$x \leftarrow z - y$$

$$y \leftarrow z - x$$




-
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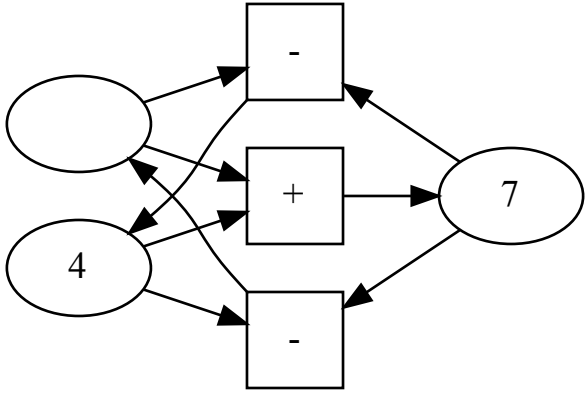
-
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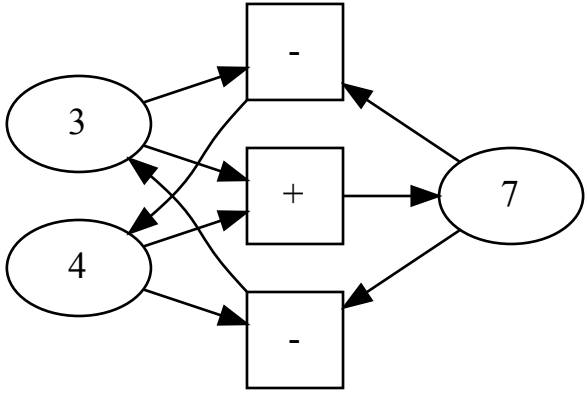
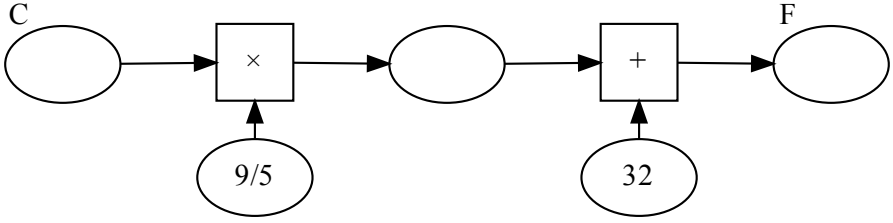
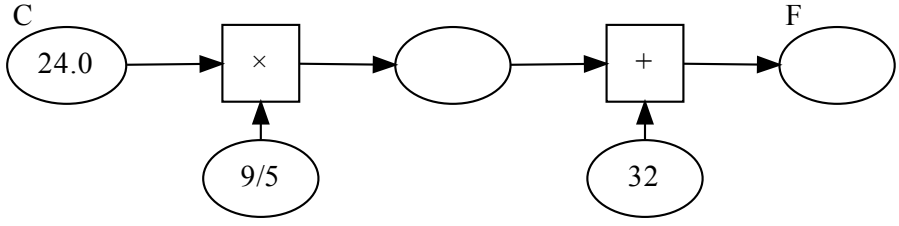

-
3
+
7
4
-

Propagators let us express multidirectional relationships!

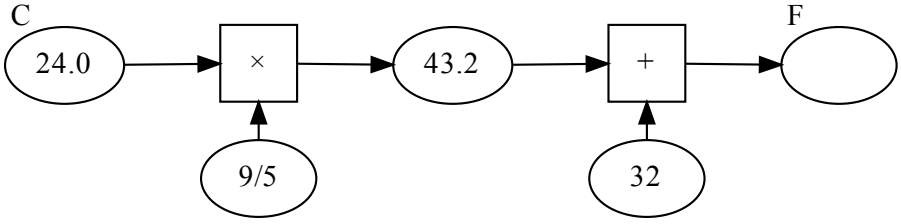
$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$



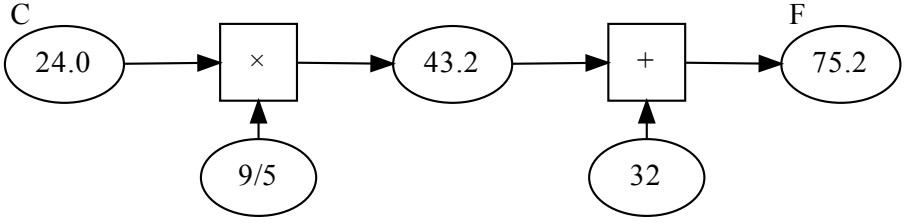
$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$



$$^\circ F = ^\circ C \times \frac{9}{5} + 32$$

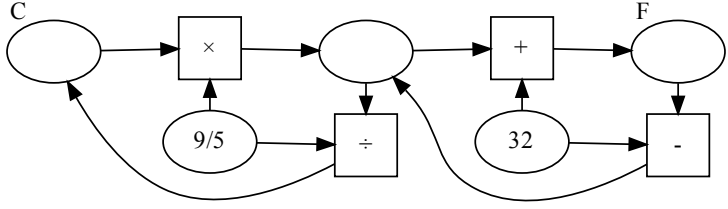


$$^\circ F = ^\circ C \times \frac{9}{5} + 32$$



$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$

$$^\circ C = ({}^\circ F - 32) \div \frac{9}{5}$$



$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$

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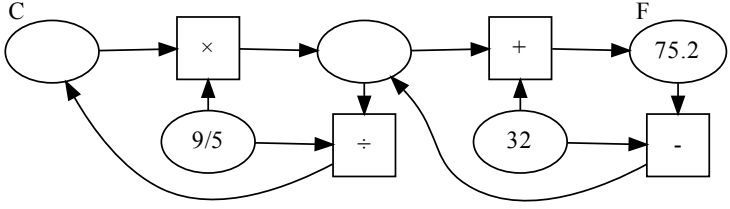
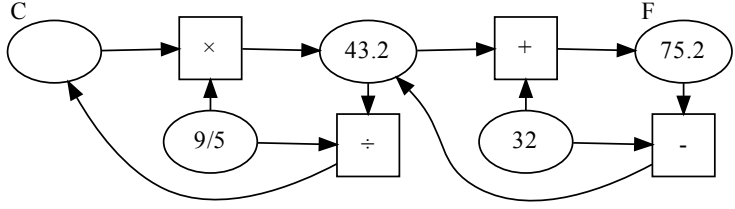


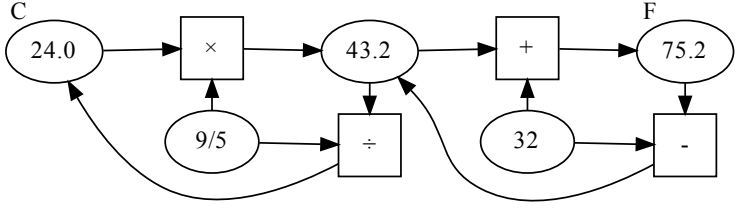
$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$

$$^\circ C = (^\circ F - 32) \div \frac{9}{5}$$



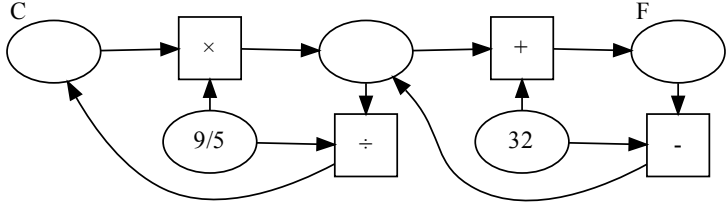
$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$

$$^\circ C = ({}^\circ F - 32) \div \frac{9}{5}$$



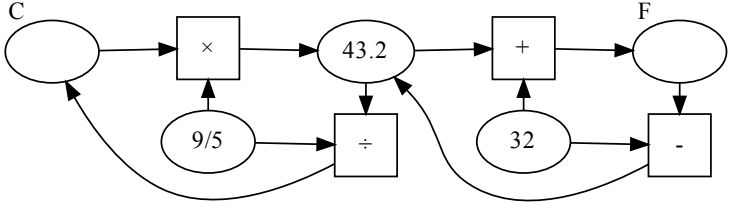
$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$

$$^\circ C = ({}^\circ F - 32) \div \frac{9}{5}$$



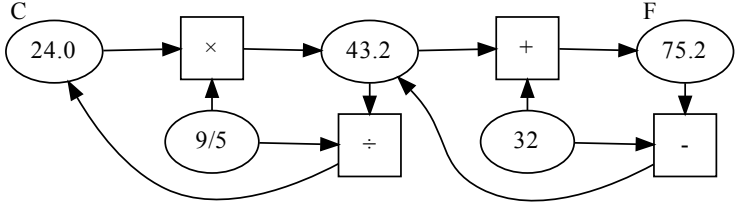
$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$

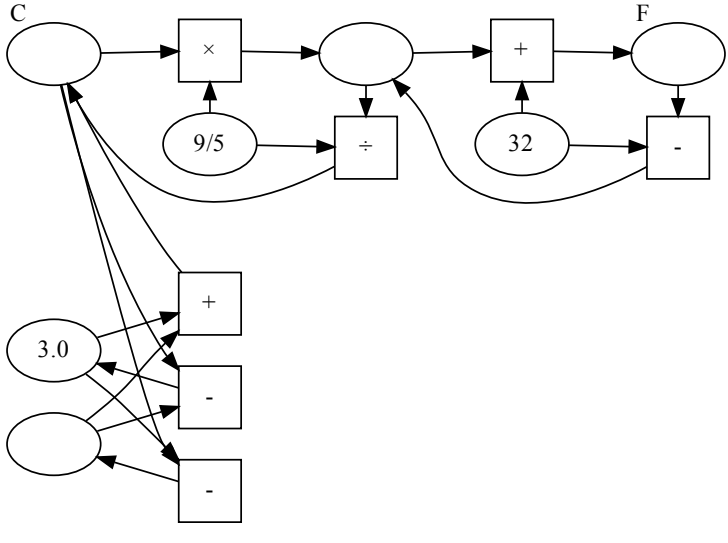
$$^\circ C = (^\circ F - 32) \div \frac{9}{5}$$

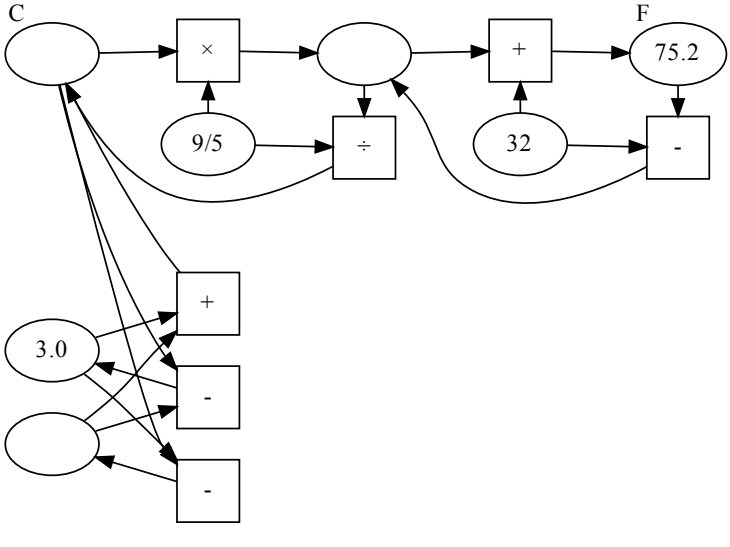


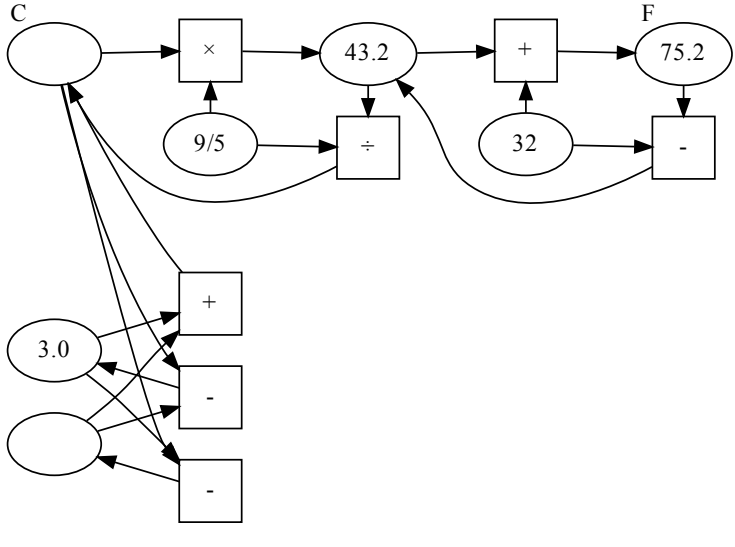
$$^\circ F = {}^\circ C \times \frac{9}{5} + 32$$

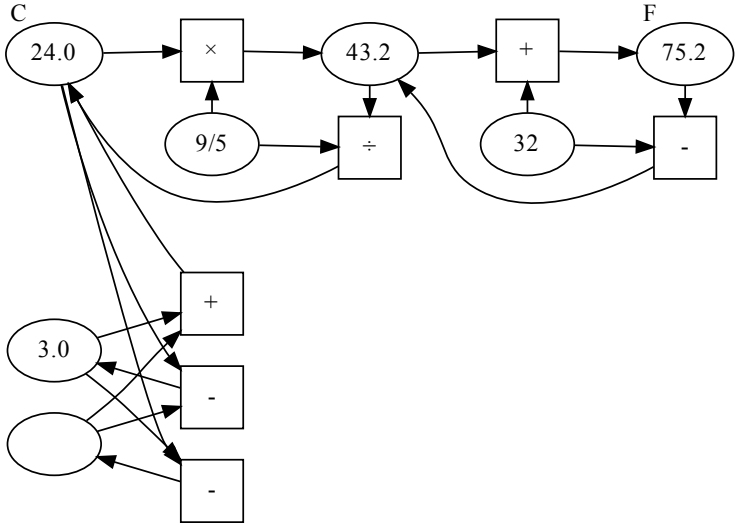
$$^\circ C = ({}^\circ F - 32) \div \frac{9}{5}$$

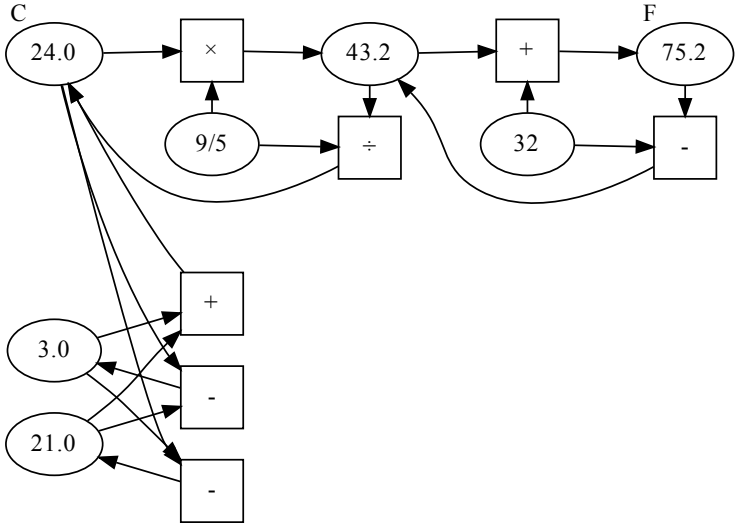



C
×
+
F
9/5
÷
32
-
+
3.0
-
-

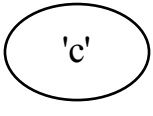

C
×
+
F
75.2
9/5
÷
32
-
+
3.0
-
-

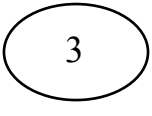

C
×
43.2
+
F
75.2
9/5
÷
32
-
+
3.0
-
-

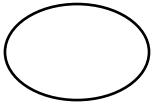

C
24.0
×
43.2
+
F
75.2
9/5
÷
32
-
+
3.0
-
-


C
24.0
×
43.2
+
F
75.2
9/5
÷
32
-
+
3.0
-
21.0
-

What types are the values of the cells?


'c'


3



```
data Maybe a = Nothing | Just a
```

Partial information!

?

$[1, 5]$

TODO interval arithmetic examples

$$\{True,\ False\}$$

TODO set intersection examples