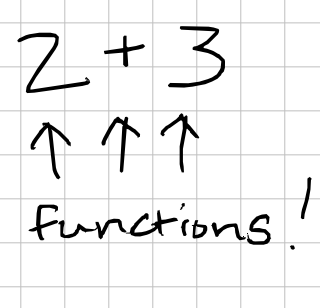


CSE1114A lecture 2

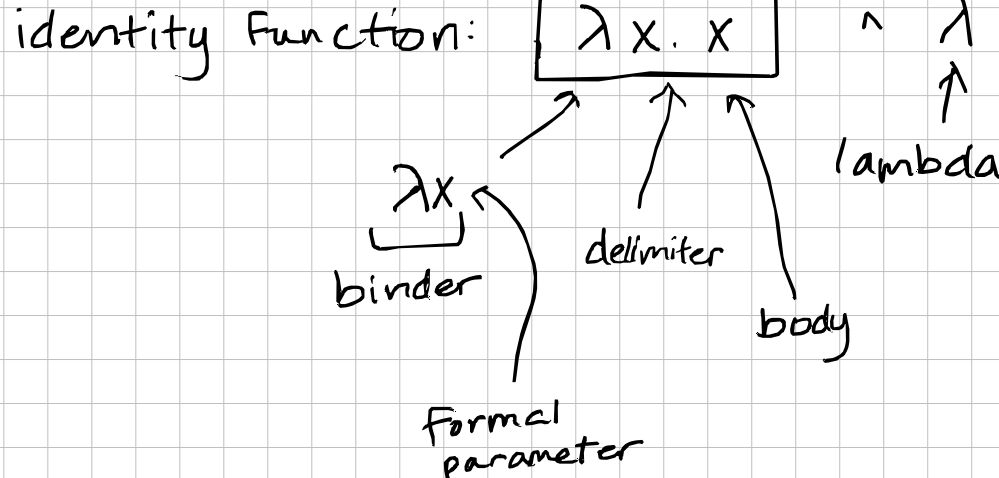
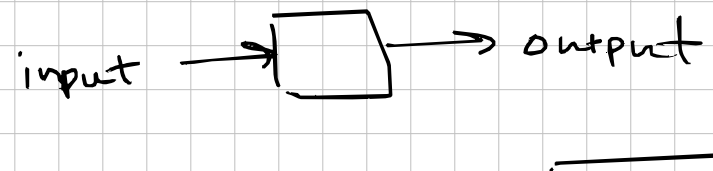
agenda: Intro to lambda calculus

Everything is a function!



a system of reasoning

1936 - Turing machines were invented! (Alan Turing) and, lambda calculus was invented! (Alonzo Church)



(in Elsa: $\backslash x \rightarrow x$)

$\backslash y \rightarrow y$

also the identity function

```
Python:
lambda x: x
def identity(y):
    return y
```

Quiz question 1: What does this function do?

$\lambda z. (\lambda x. x)$
 $\backslash z \rightarrow (\backslash x \rightarrow x)$

function application, aka calling a function

$(\backslash x \rightarrow x)$ "yuki"

Put the function next to its argument!

```
Python:
> identity("yuki")
"yuki"
> (lambda x: x)("yuki")
"yuki"
```

Convention: the body of a function extends as far to the right as possible

$\backslash x \rightarrow$ x "yuki"

This is a function call!

```
Python
lambda x: x("yuki")
```

$(\backslash x \rightarrow x$ x "yuki") len

or sorted, or whatever

Quiz question 2: What does this function do?

$\backslash f \rightarrow f (\backslash x \rightarrow x)$

let's apply this function to $\backslash y \rightarrow y \dots$

How to evaluate this?

$(\backslash f \rightarrow f (\backslash x \rightarrow x))$ $(\backslash y \rightarrow y)$
 function argument

plug in the argument for occurrences of the formal parameter in the function's body.

So we get:

$\Rightarrow (\backslash y \rightarrow y) (\backslash x \rightarrow x)$

(this is the body of the original function, but with the argument $(\backslash y \rightarrow y)$ substituted in for f .)

Now what?

$(\backslash y \rightarrow y) (\backslash x \rightarrow x)$

$\Rightarrow \backslash x \rightarrow x$

The β -rule

aka the substitution rule:

$(\backslash x \rightarrow e1) e2 = \text{body } e1 [x := e2]$

This means:

$e1$, but with occurrences of x replaced by $e2$. *