Multiple Argument Calls

With multiple arguments, just pass them in one by one, e.g.

```
(((e e1) e2) e3)
```

For example

```
>>> pat 31 42 56
3038
```

(1) Final = Programming Assignment except done ALONE

(2) OO-lambda score on CANVAS → Github userid on CANVAS

EXERCISE

Write a function `myMax` that returns the *maximum* of two inputs

```
myMax :: Int -> Int -> Int
myMax = ???
```

When you are done you should see the following behavior:

```
>>> myMax 10 20
20

>>> myMax 100 5
100
```

How to Return Multiple Outputs?

In → Out

(2, "cat")

Tuples

A type for packing `n` different kinds of values into a single "struct"

```
(T1,..., Tn)
```

For example

(e1, e2, e3, ..., en)
↓ ↓ ↓ ... ↓
(T1, T2, T3, ..., Tn)

```
tup1 :: ???
tup1 = ('a', 5)
```

Char Int

```
tup2 :: (Char, Double, Int)
tup2 = ('a', 5.2, 7)
```

QUIZ

What is the type `???` of `tup3`?

```
tup3 :: ???
tup3 = ((7, 5.2), True)
```

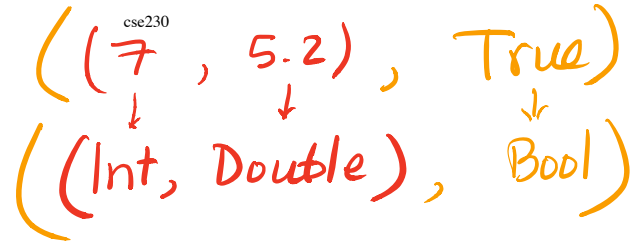
A. `(Int, Bool)`

B. `(Int, Double, Bool)`

C. `(Int, (Double, Bool))`

D. `(Double, Bool)`

E. `(Tuple, Bool)`



"Tuple"

(Int, Bool)

Fixed Size - different

case e of
(x1, x2) →

"x1 names first
x2 names snd"

Extracting Values from Tuples

We can **create** a tuple of three values `e1`, `e2`, and `e3` ...

```
tup = (e1, e2, e3)
```

... but how to **extract** the values from this tuple?

Pattern Matching

```
fst3 :: (t1, t2, t3) -> t1
fst3 (x1, x2, x3) = x1

snd3 :: (t1, t2, t3) -> t1
snd3 (x1, x2, x3) = x2

thd3 :: (t1, t2, t3) -> t1
thd3 (x1, x2, x3) = x3
```

QUIZ

What is the value of `quiz` defined as

```
tup2 :: (Char, Double, Int)
tup2 = ('a', 5.2, 7)

quiz = snd3 tup2
```

A. `'a'`

B. `5.2`

C. `7`

D. `('a', 5.2)`

E. `(5.2, 7)`

Lists

Unbounded Sequence of values of type `T`

`[T]` of any size

For example

```
chars :: [Char]
chars = ['a','b','c']
```

```
ints :: [Int]
ints = [1,3,5,7]
```

```
pairs :: [(Int, Bool)]
pairs = [(1,True),(2,False)]
```

QUIZ

What is the type of `things` defined as

```
things :: ???
things = [ [1], [2, 3], [4, 5, 6] ]
```

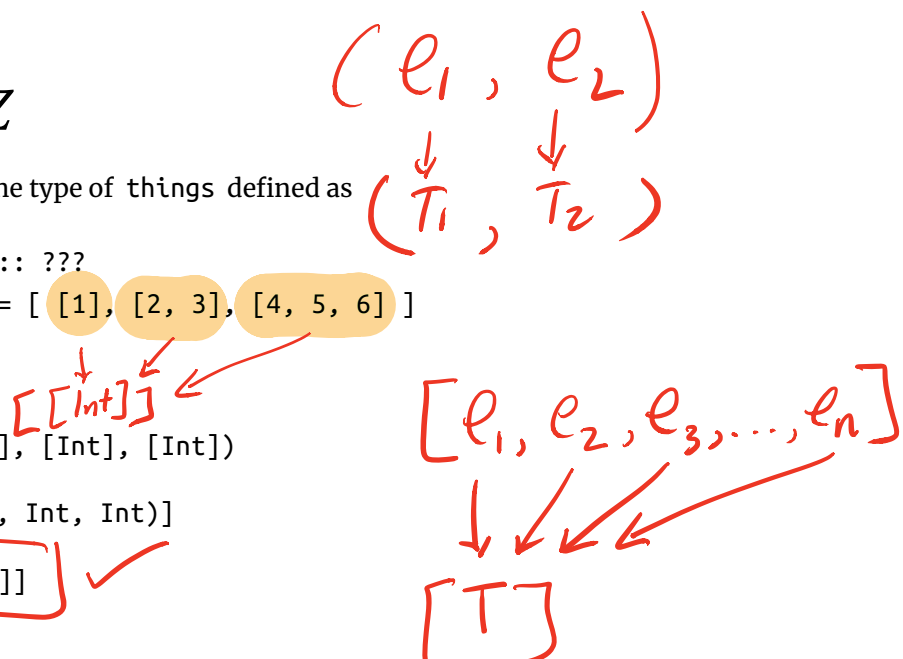
A. `[Int]`

B. `([Int], [Int], [Int])`

C. `[(Int, Int, Int)]`

D. `[[Int]]`

E. `List`



List's Values Must Have The SAME Type!

The type `[T]` denotes an unbounded sequence of values of type `T`

Suppose you have a list

```
oops = [1, 2, 'c']
```

There is no `T` that we can use

- As last element is not `Int`
- First two elements are not `Char` !

Result: Mysterious Type Error!

Constructing Lists

There are two ways to construct lists

```
[]     -- creates an empty list
h:t    -- creates a list with "head" 'h' and "tail" t
```

For example

```
>>> 3 : []
[3]

>>> 2 : (3 : [])
[2, 3]

>>> 1 : (2 : (3 : []))
[1, 2, 3]
```

Cons Operator : is Right Associative

`x1 : x2 : x3 : x4 : t` means `x1 : (x2 : (x3 : (x4 : t)))`

So we can just avoid the parentheses.

Syntactic Sugar

Haskell lets you write `[x1, x2, x3, x4]` instead of `x1 : x2 : x3 : x4 : []`

Functions Producing Lists

Lets write a function `copy3` that

- takes an input `x` and
- returns a list with *three* copies of `x`

```
copy3 :: ???
copy3 x = ???
```

When you are done, you should see the following

```
>>> copy3 5
[5, 5, 5]

>>> copy3 "cat"
["cat", "cat", "cat"]
```