Informatics 1

Functional Programming Lecture 2

Functions

Don Sannella

University of Edinburgh

Part I

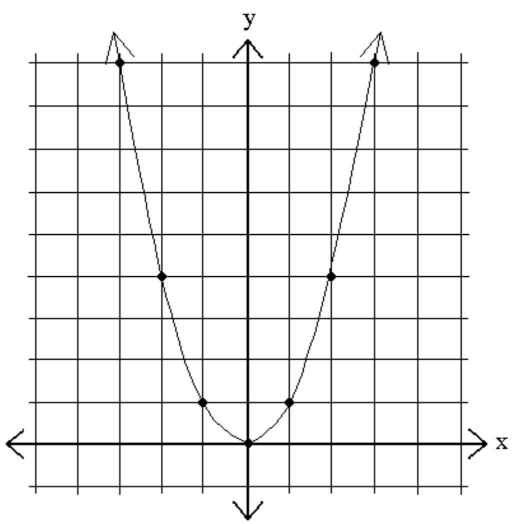
Functions

What is a function?

- A recipe for generating an output from inputs:
  "Multiply a number by itself"
- A set of (input, output) pairs:
  (1,1) (2,4) (3,9) (4,16) (5,25) ...
- An equation:

$$f\ x = x^2$$

- A graph relating inputs to output (for numbers only):



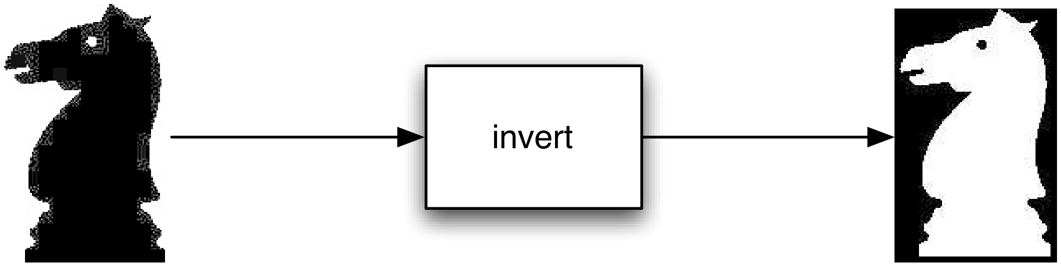
Kinds of data

- Integers: `42`, `-69`
- Floats: `3.14`
- Characters: `'h'`
- Strings: `"hello"`
- Booleans: `True`, `False`
- Pictures: 

Applying a function

```
invert :: Picture -> Picture
knight :: Picture

invert knight
```

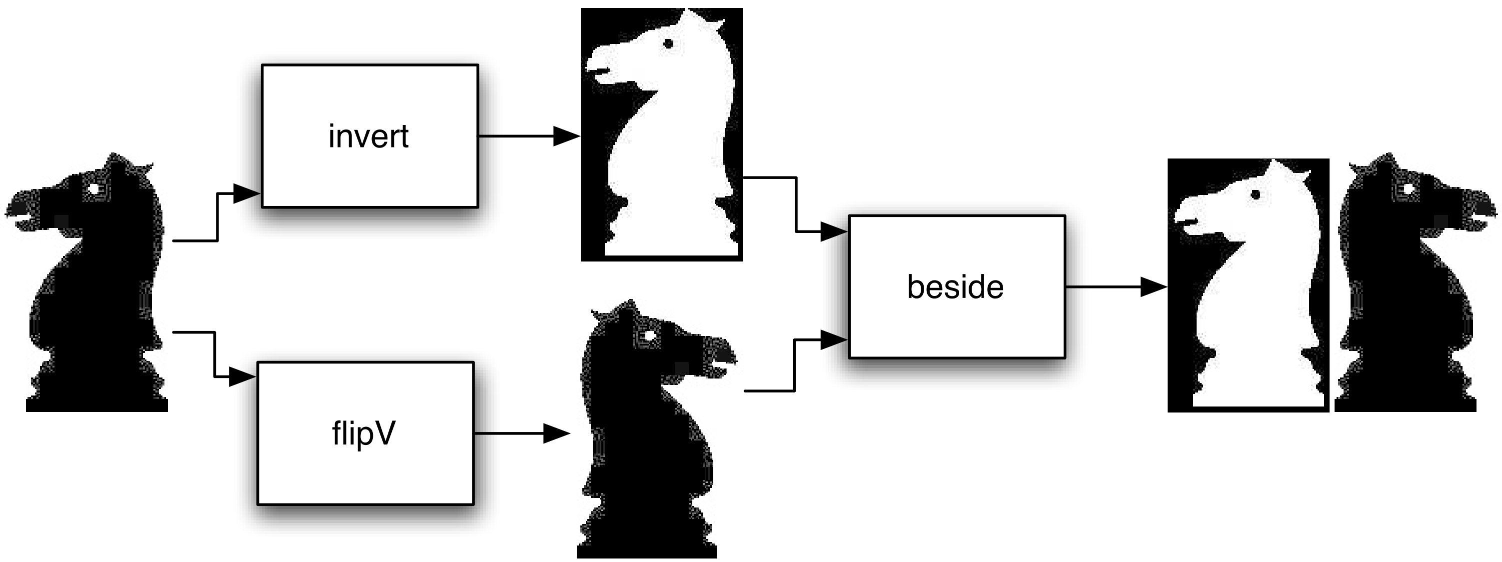


invert is a function. Every value in Haskell has a type, maybe more than one. We write value :: type.
A type is a category of values. Types of functions contain arrows.
When we write an expression (example: invert knight) then Haskell will complain if it can't make sense of the types.

Composing functions

```
beside :: Picture -> Picture -> Picture
flipV :: Picture -> Picture
invert :: Picture -> Picture
knight :: Picture

beside (invert knight) (flipV knight)
```

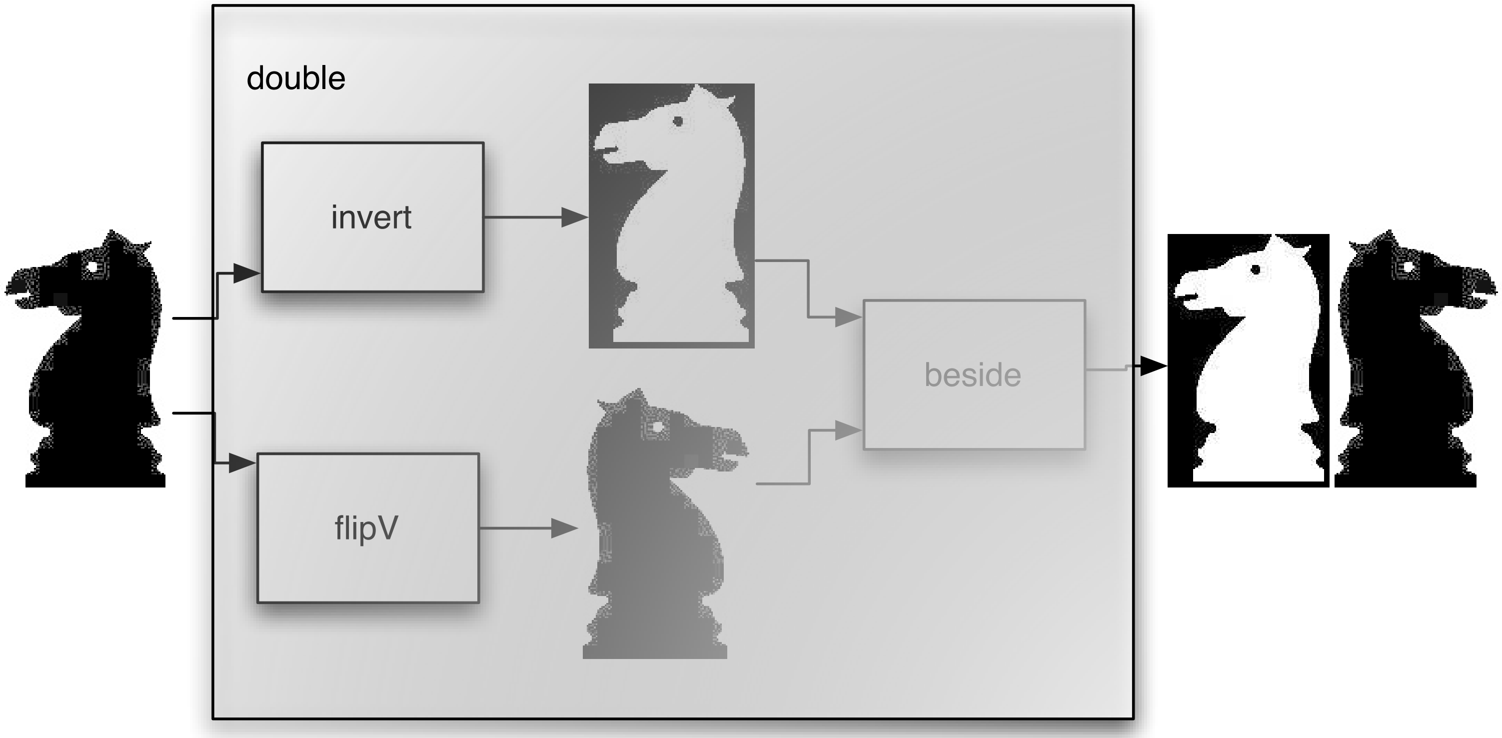


beside is a function with two arguments. There is a reason for writing the type this way, to be explained later.

Defining a new function

```
double :: Picture -> Picture
double p  =  beside (invert p) (flipV p)

double knight
```

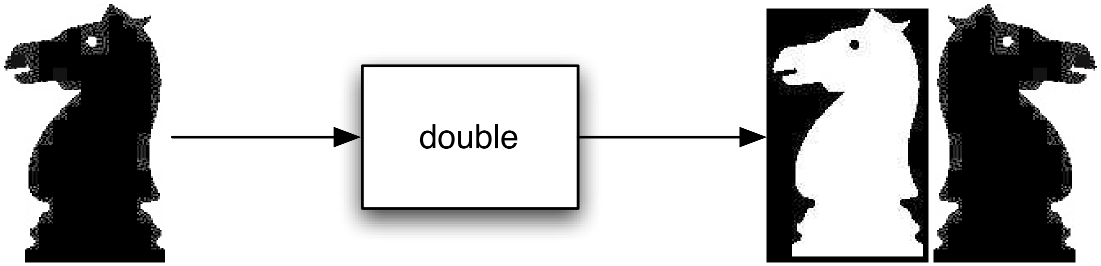


Functions are defined using equations. The variable name (p) is irrelevant - we could use pic or x instead.
double produces the picture we had before, but packaged to work on any picture, not just knight.

Defining a new function

```
double :: Picture -> Picture
double p  =  beside (invert p) (flipV p)

double knight
```



We could write beside as an infix function instead:
double p = (invert p) `beside` (flipV p)
Any function can be written as infix by enclosing it in backquotes.

Terminology

Type signature

```
double :: Picture -> Picture
```

Function declaration

```
double p  =  beside (invert p) (flipV p)
```

function name

function body

Terminology

formal parameter

actual parameter

```
double p  =  beside (invert p) (flipV p)
```

```
double knight
```

function definition

expression