



PAUL G. ALLEN SCHOOL
OF COMPUTER SCIENCE & ENGINEERING

CSE 341

Section 2

Winter 2018

Adapted from slides by Nick Mooney, Nicholas Shahan, Patrick Larson, and Dan Grossman

Today's Agenda

- Type synonyms
- Type generality
- Equality types
- Syntactic sugar

Type Synonyms

- What does `int * int * int` represent?
- In HW1 we called it a date
- Wouldn't it be nice to reflect this representation in the source code itself?

```
type date = int * int * int
```

type VS datatype

- **datatype** introduces a new type name, distinct from all existing types

```
datatype suit = Club | Diamond | Heart | Spade
datatype rank = Jack | Queen | King | Ace
              | Num of int
```

- **type** is just another name

```
type card = suit * rank
```

Type Synonyms

Why?

- For now, just for convenience
- It doesn't let us do anything new

Later in the course we will see another use related to modularity.

Type Generality

Write a function that appends two string lists...

Type Generality

- We would expect

```
string list * string list -> string list
```

- But the type checker found

```
`a list * `a list -> `a list
```

- `a are called Polymorphic Types
- Why is this OK?

More General Types

- The type

```
'a list * 'a list -> 'a list
```

is more general than the type

```
string list * string list -> string list
```

and “can be used” as any less general type, such as

```
int list * int list -> int list
```

- But it is not more general than the type

```
int list * string list -> int list
```


The Type Generality Rule

The “more general” rule

A type $t1$ is more general than the type $t2$ if you can take $t1$, replace its type variables **consistently**, and get $t2$

What does **consistently** mean?

Equality Types

Write a list “contains” function...

Equality Types

- The double quoted variable arises from use of the = operator
 - We can use = on most types like **int**, **bool**, **string**, tuples (that contain only “equality types”)
 - Functions and **real** are not “equality types”
- Generality rules work the same, except substitution must be some type which can be compared with =
- You can ignore warnings about “calling polyEqual”

Syntactic Sugar

- If-then-else is implemented as syntactic sugar for a case statement

If-then-else

- We've just covered case statements
- How could we implement if-then-else?

```
case x of
  true => "apple"
| false => "banana"
```

```
if x then "apple" else "banana"
```

Adventures in pattern matching

- Shape example
- Function-pattern syntax if we get to it