

CSE 341

Section 2

Spring 2019

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

Let's revisit the “append” function...

```
fun append (xs, ys) =  
  if null xs  
  then ys  
  else hd xs :: append(tl xs, ys)
```

Type Generality

- We would expect

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

- But the type checker found

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

- 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 function called `Contains` that takes a value and a list and returns `true` if the value is in the list...

What type will `Contains` have?

Equality Types

Let's take a look at Contains...

```
fun contains(x, xs) =  
  if null xs  
  then false  
  else (hd xs = x) orelse contains(x, tl xs)
```

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

Syntactic Sugar

- Tuples are actually Records with fields $1 \sim n$
- 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