

# HDL - Types

Last updated 1/18/21

# HDL - Types

- `std_logic_1164.all`

```
library ieee;
```

```
use ieee.std_logic_1164.all;
```

- Invokes a standard library of types

- `std_logic`
- `std_logic_vector`

- and a set of operations

- Logical operations
- `rising_edge()` - 2008
- `falling_edge()` - 2008

- **Not sufficient for arithmetic operation**

- **arithmetic is not defined for `std_logic_vector`**

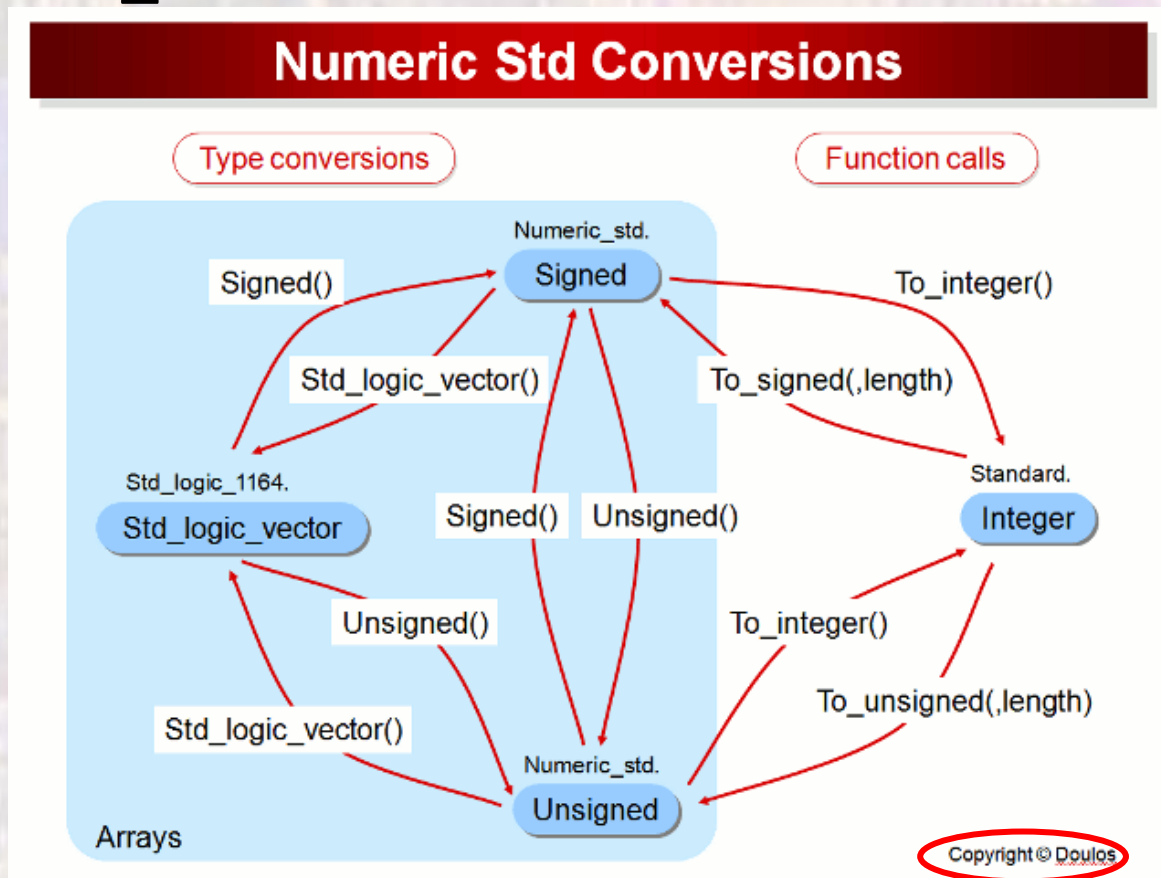
Character	Value
'U'	uninitialized
'X'	strong drive, unknown logic value
→ '0'	strong drive, logic zero
→ '1'	strong drive, logic one
→ 'Z'	high impedance
'W'	weak drive, unknown logic value
'L'	weak drive, logic zero
'H'	weak drive, logic one
'-'	don't care

# HDL - Types

- `numeric_std.all`
  - library ieee;
  - use ieee.std\_logic\_1164.all;
  - use ieee.numeric\_std.all;
- Invokes a standard library of types
  - unsigned
  - signed (2's compliment)
- and a set of operations
  - adds arithmetic
  - type casting
    - to\_unsigned
    - to\_signed
    - to\_integer
- Arithmetic operations are properly defined for signed and unsigned types

# HDL - Types

- numeric\_std.all



types are similar  
→ type casting

types are not related  
→ function calls

# HDL - Types

- numeric\_std.all

## Summary of NUMERIC\_STD

+ - \* / rem mod  
< <= > >= = /=

UNSIGNED ■ UNSIGNED  
UNSIGNED ■ NATURAL  
NATURAL ■ UNSIGNED  
SIGNED ■ SIGNED  
SIGNED ■ INTEGER  
INTEGER ■ SIGNED

sll srl rol ror

UNSIGNED ■ INTEGER  
SIGNED ■ INTEGER

not and or nand nor  
xor xnor

UNSIGNED ■ UNSIGNED  
SIGNED ■ SIGNED

```
TO_INTEGER [UNSIGNED      ] return INTEGER
TO_INTEGER [SIGNED        ] return INTEGER
TO_UNSIGNED [NATURAL,     NATURAL] return UNSIGNED
TO_SIGNED   [INTEGER,     NATURAL] return SIGNED
RESIZE      [UNSIGNED,    NATURAL] return UNSIGNED
RESIZE      [SIGNED,     NATURAL] return SIGNED
```

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