

SOLIDITY TYPES CHEAT SHEET

BOOLEANS

`bool`: The possible values are constants `true` and `false`.
Operators:

- `!` (logical negation)
- `&&` (logical conjunction, "and")
- `||` (logical disjunction, "or")
- `==` (equality)
- `!=` (inequality)

The operators `||` and `&&` apply the common short-circuiting rules. This means that in the expression `f(x) || g(y)`, if `f(x)` evaluates to `true`, `g(y)` will not be evaluated even if it may have side-effects.

EXPONENTIATION

Exponentiation is only available for unsigned types.
Please take care that the types you are using are large enough to hold the result and prepare for potential wrapping behaviour.

DIVISION

Since the type of the result of an operation is always the type of one of the operands, division on integers always results in an integer.
In Solidity, division rounds towards zero.
This mean that `int256(-5) / int256(2) == int256(-2)`.

Note that in contrast, division on literals results in fractional values of arbitrary precision.

ADDITION, SUBTRACTION MULTIPLICATION

Addition, subtraction and multiplication have the usual semantics.
They wrap in two's complement representation meaning that for example

`uint256(0) - uint256(1) == 2**256 - 1`.

You have to take these overflows into account when designing safe smart contracts.

The expression `-x` is equivalent to `(T(0) - x)` where `T` is the type of `x`.

This means that `-x` will not be negative if the type of `x` is an unsigned integer type.

Also, `-x` can be positive if `x` is negative.

There is another caveat also resulting from two's complement representation:

```
int x = -2**255;  
assert(x == x);
```

INTEGERS

`int` / `uint` : Signed and unsigned integers of various sizes.

Keywords `uint8` to `uint256` in steps of 8
(unsigned of 8 up to 256 bits) and `int8` to `int256`.
`uint` and `int` are aliases for `uint256` and `int256`, respectively.

Operators:

- Comparisons: `<=`, `<`, `==`, `!=`, `>=`, `>` (evaluate to `bool`)
- Bit operators: `&`, `|`, `^` (bitwise exclusive or), `~` (bitwise negation)
- Shift operators: `<<` (left shift), `>>` (right shift)
- Arithmetic operators: `+`, `-`, unary `-`, `*`, `/`, `%` (modulo), `**` (exponentiation)

MODULO

The modulo operation `a % n` yields the remainder `r` after the division of the operand `a` by the operand `n`, where `q = int(a / n)` and `r = a - (n * q)`. This means that modulo results in the same sign as its left operand (or zero) and `a % n == -(a % n)` holds for negative `a`:

- `int256(5) % int256(2) == int256(1)`
- `int256(-2) == int256(1)`
- `int256(-5) % int256(2) == int256(-1)`
- `int256(-2) == int256(-1)`
- `int256(5) %`
- `int256(-5) %`

FIXED-SIZE BYTE ARRAYS

The value types `bytes1`, `bytes2`, `bytes3`, ..., `bytes32` hold a sequence of `bytes` from one to up to 32. `byte` is an alias for `bytes1`.

Operators:

- Comparisons: `<=`, `<`, `==`, `!=`, `>=`, `>` (evaluate to `bool`)
- Bit operators: `&`, `|`, `^` (bitwise exclusive or), `~` (bitwise negation)
- Shift operators: `<<` (left shift), `>>` (right shift)

Index access: If `x` is of type `bytes1`, then `x[k]` for `0 <= k < 1` returns the `k` th byte (read-only).

The shifting operator works with any integer type as right operand (but returns the type of the left operand), which denotes the number of bits to shift by. Shifting by a negative amount causes a runtime exception.

Members:

`.length` yields the fixed length of the byte array (read-only).

DYNAMICALLY-SIZED BYTE ARRAY

`bytes`:

Dynamically-sized byte array, see Arrays. Not a value-type!

`string`:

Dynamically-sized UTF-8-encoded string, see Arrays. Not a value-type!

SHIFTS

The result of a shift operation has the type of the left operand, truncating the result to match the type.

For positive and negative `x` values, `x << y` is equivalent to `x * 2**y`.

For positive `x` values, `x >> y` is equivalent to `x / 2**y`.

For negative `x` values, `x >> y` is equivalent to `(x + 1) / 2**y - 1` (which is the same as dividing `x` by `2**y` while rounding down towards negative infinity).

In all cases, shifting by a negative `y` throws a runtime exception.

ADDRESS

The address type comes in two flavours, which are largely identical:

`address`: Holds a 20 byte value (size of an Ethereum address).

`address payable`: Same as `address`, but with the additional members `transfer` and `send`.

The idea behind this distinction is that `address payable` is an address you can send Ether to, while a plain `address` cannot be sent Ether.

Type conversions:

Implicit conversions from `address payable` to `address` are allowed, whereas conversions from `address` to `address payable` are not possible (the only way to perform such a conversion is by using an intermediate conversion to `uint160`).

Address literals can be implicitly converted to `address payable`.

Explicit conversions to and from `address` are allowed for integers, integer literals, `bytes20` and contract types with the following caveat:

Conversions of the form `address payable(x)` are not allowed. Instead the result of a conversion of the form `address(x)` has the type `address payable`, if `x` is of integer or fixed bytes type, a literal or a contract with a payable fallback function. If `x` is a contract without payable fallback function, then `address(x)` will be of type `address`. In external function signatures `address` is used for both the `address` and the `address payable` type.

Operators:

`<=`, `<`, `==`, `!=`, `>=` and `>`

MEMBERS OF ADDRESS

For a quick reference of all members of `address`, see Members of Address Types.

`balance` and `transfer`

it is possible to query the balance of an address using the property `balance` and to send Ether (in units of wei) to a payable address using the `transfer` function:

```
address payable x = address(0x123);
address myAddress = address(this);
if (x.balance < 10 && myAddress.balance >= 10) x.transfer(10);
```

The `transfer` function fails if the balance of the current contract is not large enough or if the Ether transfer is rejected by the receiving account.

The `transfer` function reverts on failure.

