Scala, Binary, Machine Arithmetic

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Opening Discussion

- Minute Essay comments
  - Copy/paste with middle click on Linux. On Windows?
  - vi color-coding.
  - Never touch the mouse.
  - Low learning curve in Scala.
  - Case sensitivity
  - Going to the web for help. Google

Key Terms

- Token – A set of characters that has meaning to the language. (Words)

- Statement – A set of tokens that give a complete instruction. (Sentences)

- Expression – Tokens put together that produce a value. (Phrases)

- Type – All values have types. A type is a set of values and the operations allowed on them.

- Literal – A token that represents a value.

  - Numeric, String, Character, Boolean

Statements and Semicolon Inference

- In Scala, as with most programming languages, programs are made by putting together statements.

- In Scala, any expression is a valid statement as are a few other constructs.

- Statements end with semicolons, but they will be inferred at the end of a line if they make sense so you rarely type them.

Operators

- We can build longer expressions by putting literals together with operators.

- Let's start off by playing with some of the numeric operations you are probably familiar with.

  - +, -, *, /

- You can get the remainder after division with %.

Objects

- An object is defined to be information along with the things you can do with that information.

- The information in an object is called the properties.

- The actions are called methods.

- In Scala, even things like Int are objects and have methods on them.

Methods

- The normal way to call a method in Scala (and most other object-oriented languages) is to put a period after the object and follow it with the method name.

- The REPL will do tab completion and list methods for you.

- Let's look at the methods on some basic types and try calling them.

Arguments

- Some methods need additional information to work.

- To give this to the method we pass in arguments.

- Arguments are put in parentheses and separated by commas if there is more than one.

- The parentheses are generally optional in Scala if there is no argument.

Operator Syntax

- All the "operators" in Scala are really just methods.

- Scala allows any method with zero or one arguments to be called with an operator syntax.

- That means you leave off the dot and the parentheses.

- If a method takes no arguments you can call it without the dot.

Bases and Binary

- The decimal numbers we use are base 10. Each digit to the left is a higher power of 10.

- There is nothing special with decimal (other than perhaps we have 10 fingers). Other bases are equally valid.

- Computers use binary numbers to store everything.

- All digits are 0 or 1 and each position is a higher power of 2.

- toBinaryString

Binary Addition

- Adding binary numbers is very easy. Just do the long addition that you are used to.

- You will carry a lot more frequently because anything above 1 causes a carry.

- Let's run through some examples.

- Consider implications of fixed precision.

Negative Numbers

- We don't have a – in the computer for negative numbers. All we have are 1 and 0. So how do we make negative numbers?

- Remember the definition of negative numbers as additive inverse.

    - a+(-a)=0

- We want to preserve this to keep addition simple.

- This gives us 2s-compliment numbers.

Binary Multiplication

- Multiplying binary numbers works just like long multiplication with decimals, but easier.

- My only recommendation is you only add two numbers at a time and take it in steps.

Hexadecimal

- Binary is unwieldy for humans because of the large number of digits.

- Hexadecimal (base 16) is commonly used because it converts nicely to binary, but has few digits.

- Four bits is a hex digit. Start at the right and group bits by 4.

- Use letters A-F for numbers 10-15.

- Hex literals start with 0x

- toHexString

Octal

- Octal (base 8) is less common than hex, but not uncommon.

- Group bits into groups of three.

- Octal literals and toOctalString().

The math Object

- For other math functions use methods on the math object.

- For example, use math.sqrt() to take the square root of a number.

Minute Essay

- Convert 276 to binary.
- We have our first quiz next class.