Programming in Java

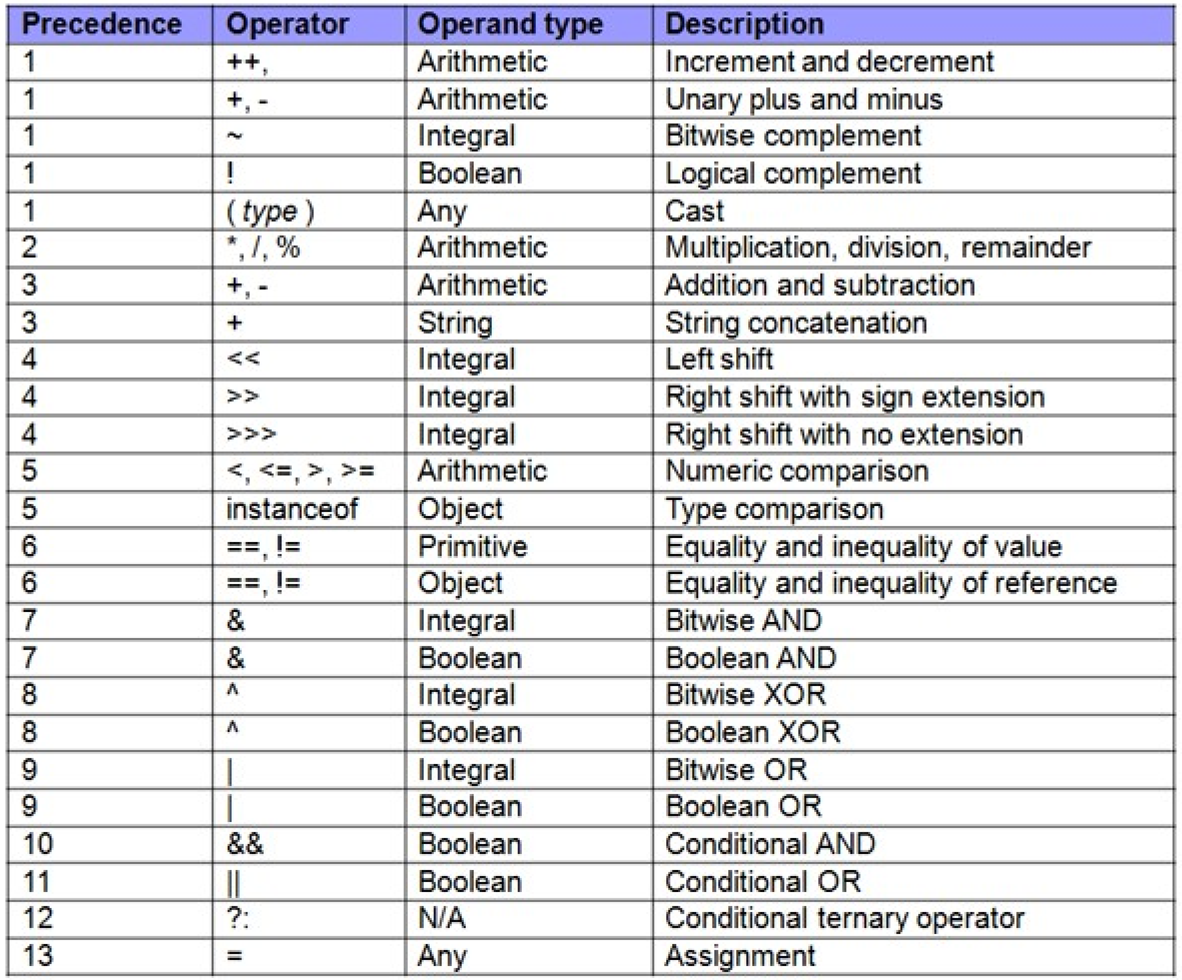
3a. Flow Control

Introduction

- The focus of this module is the imperative style of programming we do in methods
  - This is generally called flow control because it is the code that controls the flow of logic
  - Flow control also generally includes the basic operators of the language
  - Java is very similar to all other C-style languages at this level of code
- However, this module assumes you already know
  - How Boolean, arithmetic and other operators work
  - What the basic flow control structures are and how they work
- What this module will focus on are the following:
  - Things that Java does with operators and flow control that are unique to Java
  - Java gotchas
  - Best practices for operators and flow control

Operators

- The standard list of operators usually looks something like the chat shown
- There is also an order of precedence defined for Java operators
- Clean code tip
  - Always explicitly state the order of operations using () to group terms
  - This ensures that Java, you and anyone else reading your code agree on what is happening
- Some of the operators are holdover from C and really aren't used
  - |, &, ^, <<, >>, >>>
  - These were primarily used for bit-level operations



Precedence	Operator	Operand type	Description
1	++,	Arithmetic	Increment and decrement
1	+, -	Arithmetic	Unary plus and minus
1	~	Integral	Bitwise complement
1	!	Boolean	Logical complement
1	(*type*)	Any	Cast
2	*, /, %	Arithmetic	Multiplication, division, remainder
3	+, -	Arithmetic	Addition and subtraction
3	+	String	String concatenation
4	<<	Integral	Left shift
4	>>	Integral	Right shift with sign extension
4	>>>	Integral	Right shift with no extension
5	<, <=, >, >=	Arithmetic	Numeric comparison
5	instanceof	Object	Type comparison
6	==, !=	Primitive	Equality and inequality of value
6	==, !=	Object	Equality and inequality of reference
7	&	Integral	Bitwise AND
7	&	Boolean	Boolean AND
8	^	Integral	Bitwise XOR
8	^	Boolean	Boolean XOR
9	|	Integral	Bitwise OR
9	|	Boolean	Boolean OR
10	&&	Boolean	Conditional AND
11	||	Boolean	Conditional OR
12	?:	N/A	Conditional ternary operator
13	=	Any	Assignment

Bitwise Operators

- These operators were very common in C and C++ when an integer might represent a set of status flags to encode a lot of information in a small amount of data
  - This was done to save bandwidth in transmission
  - Data encoded and extracted from the integer by XORing
- Notice that we still use sub-net masks when working with IP addresses – same idea
- Java is not usually used for this sort of work so it's rare to see these operations in Java code
- There are examples in the demos

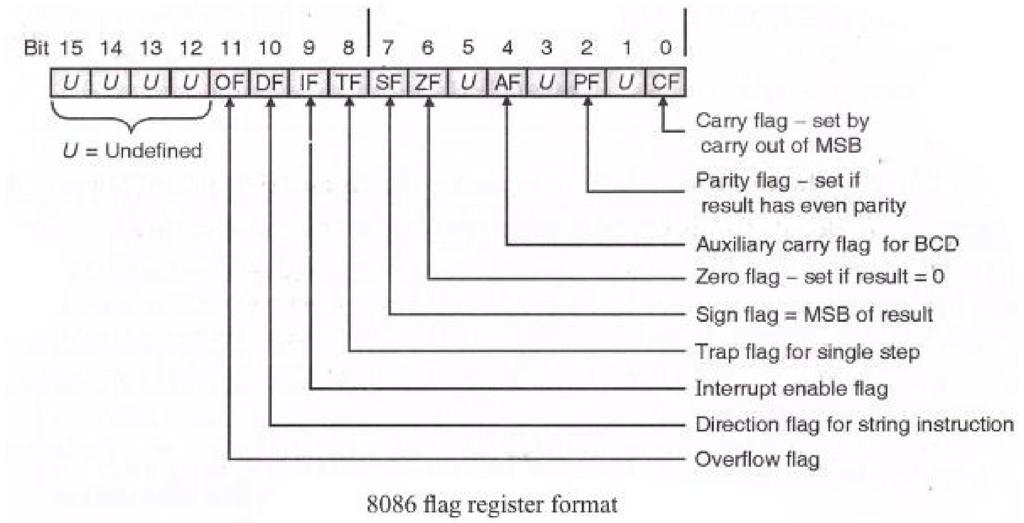

Bit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
U U U U OF DF IF TF SF ZF U AF U PF U CF
U = Undefined
Carry flag – set by carry out of MSB
Parity flag – set if result has even parity
Auxiliary carry flag for BCD
Zero flag – set if result = 0
Sign flag = MSB of result
Trap flag for single step
Interrupt enable flag
Direction flag for string instruction
Overflow flag
8086 flag register format

Image Credit: https://www.ques10.com/p/28709/

Mixed Mode Arithmetic

- In the module on data types, you saw that Java will cast data from one type to another during assignment operations
  - But if the assignment violates Java's type safety rules, Java will generate a compiler error
- Mixed mode arithmetic is when the two operands of an arithmetic operator are of different data types
  - Java can only apply the operator if the two operands are of the same type
  - Java will start casting the operands until the operands are the same type
  - The same casting rules as before apply
  - If Java cannot cast an operand, a compile error is generated
  - For example:
    - *If we have int + long, then the int is cast to a long*
    - *If we have float + int, then the int is cast to a float*
    - *If we have string + int, then the int is cast to a string*
- Best practices for mixed mode arithmetic
  - Avoid it like the plague because it is the source of subtle bugs
  - Instead, ensure you cast all the operands yourself so you can control the data type conversions

Image Credit: https://www.ques10.com/p/28709/

The Increment and Accumulate Operators

- The ++ increment and decrement operator -- are simple in concept
  - Confusion occurs as to the difference between i++ and ++i
  - For i++ the value of i is used then incremented
  - For ++i the value of i is incremented then used
  - In most cases, it doesn’t matter which form is used
  - But it can be the source of subtle bugs
  - Demonstrated in the demo
- The accumulate operator is of the form x (operator)= value
  - This is the same as x = x (operator) value
  - For addition, it would be x+=3 would be the same as x = x + 3
- Generally, accumulate expressions are
  - Anything other than the simplest accumulate expression can be hard to understand
  - They can also be tricky to use and make the code more difficult to debug

Image Credit: https://www.ques10.com/p/28709/

Demo

Operators

Walkthrough

Java Flow Control – Oracle Docs

Lab 3-1

Operators

Java™