

COS125 - Precept 2 (Data Types)

1 Data Types

Java Types

Form a group of 3-4. Choose two rows of the table below to fill in with your group. Feel free to look things up online! (You may find [this website](#) useful.)

Type	Values	A Literal	Operators	Warning!
byte				
short				
int	Integers between -2^{31} and $2^{31} - 1$.	2147483647	+, -, *, /, %	$2147483647 + 1$ evaluates to $-2147483648!$
long				
float	Same as below except $0 \leq m < 2^{24}$ and $-101 \leq e \leq 104$.			
double	Real numbers $\pm m \cdot 2^e$ where $0 \leq m < 2^{53}$ and $-1074 \leq e \leq 971$ are integers, plus NaN and $\pm\infty$.			
boolean				
char		'A'		
String	All sequences of characters (in practice limited by memory).			

Type Conversion

Form a group of 3-4. Choose two rows of the table below to fill in with your group.

Type conversion	Expression	Type	Value
Automatic			
System method			
Explicit cast			
	(long) 1.0E10		

2 Truth Tables

XOR

The XOR (eXclusive OR) operation between two booleans `a` and `b` is `!(a == b)`.¹ Fill in its truth table below.

a	b	!(a == b)
false	false	
false	true	
true	false	
true	true	

Download `precept2.zip` from the precepts webpage. Unzip and open the project folder. Compile and run `XORTruthTable.java` and verify that its output matches what you calculated.

Implication (Bonus)

The \implies (implies) operation between two booleans `a` and `b` is `(!a) || (a && b)`. Fill in its truth table below.

¹In mathematics, the XOR operation is often denoted \oplus while the AND operation is denoted \cdot ; these operations behave like addition and multiplication in the so-called finite field of size 2 (often denoted \mathbb{F}_2), [which has vast applications in computer science](#). In particular, we can do linear algebra over \mathbb{F}_2 just as well as over \mathbb{R} !

a	b	!(a) (a && b)
false	false	
false	true	
true	false	
true	true	

3 Converting Units of Measurement

Write a program called `MilesToKilometers.java` that converts a distance measured in miles to the corresponding distance in kilometers. Recall that a mile equals 1.609344 kilometers.

Your program should read a single `double` argument.

4 Complex Numbers

Norm and Angle

Open `Polar.java` and fill in the code so that it reads two integers a and b from the command line, interprets them as the Gaussian integer $a + bi$ and outputs its polar representation.

Recall that the polar representation of a complex number is given by its *norm* $\rho = \sqrt{a^2 + b^2}$ and *angle* $\theta = \arctan(b/a)$.

Complex Calculator

Fill in the program `ComplexOps.java` that reads four integers a , b , c , and d from the command line, interprets them as the pair $(a + bi, c + di)$ of Gaussian integers, then outputs the result of their sum, difference, product and quotient.

Recall that the product of two complex numbers is

$$(a + bi) \cdot (c + di) = (ac - bd) + (ad + bc)i,$$

which can be used to calculate the ratio too:

$$\frac{a + bi}{c + di} = \frac{a + bi}{c + di} \cdot \frac{c - di}{c - di} = \frac{(a + bi) \cdot (c - di)}{c^2 + d^2}.$$