Logical data type

The **logical data type** is a special type of data that can have one of only two possible values: true or false.

Relational operators: operators with 2 numerical or strings operands that yield a logical result.

Operator	Operation
==	Equal to
~=	Not equal to
>	Greater than
>=	Greater than or equal to
<	Less than
<=	Less than or equal to

Logical data type

Relational operators:

Operation	Result
3<4	True (1)
3<=4	True (1)
3==4	False (0)
3>3	False (0)
4<=4	True (1)
‘A’<‘B’	True (1)
‘a’<‘B’	False (0)
0==sin(pi)	False (0)
abs(0-sin(pi))<1.0e-14	True (1)

Logical data type

Logic operators: operators with one or two logical operands that yield a logical result.

Operator	Operation
&	Logical AND
&&	Logical AND with shortcut
|	Logical inclusive OR
||	Logical inclusive OR with shortcut
xor	Logical exclusive OR
~	Logical not

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Truth tables for logic operators.

A	B	A & B	A && B	A | B	A || B	xor (A,B)	~A
F	F	F	F	F	F	F	T
F	T	F	F	T	T	T	T
T	F	F	F	T	T	T	F
T	T	T	T	T	T	F	F

xor: "one or the other but not neither nor both"

Hierarchy of operations.

The order in which the operators are evaluated.

1. Arithmetic operators
2. Relational operators (==,>,…) (left to right)
3. ~ operators
4. & and && operators (left to right)
5. |, ||, and xor operators (left to right)

Hierarchy of arithmetic operators

Operations at a higher level are evaluated before operations at lower levels.

1. Parentheses starting form the innermost and working outward
2. Exponentials (left to right)
3. Multiplications and divisions (left to right)
4. Additions and subtractions (left to right)

Hierarchy of arithmetic operators

Distance travel by an object starting from rest and subjected to a constant acceleration

$$d = \frac{1}{2} a t^2$$

accel = 4
time = 10

Distance = 0.5*accel*time^2   = ?
Distance = (0.5*accel*(time^2) = ?
Distance = (0.5*accel*time)^2 = ?

Hierarchy of arithmetic operators

2^3^2=?
(2^3)^2=?
2^(3^2)=?

How will you enter the following equation into MATLAB?

$$\alpha_2 = \frac{(a+b)c^{a/b}}{a-b}$$

$$a = 4, b = 2, c = 2$$

$$\alpha_2 = ?$$

Hierarchy of arithmetic operators

$$\alpha_2 = \frac{(a+b)c^{a/b}}{a-b}$$

$$a = 4, b = 2, c = 2$$
$$\alpha_2 = ?$$

```
alpha_2    = ((a+b)*c^(a/b))/(a-b)   ?

alpha_2    =  (a+b)*c^a/b/a-b         ?

alpha_2    =  ((a+b)*(c^a/b))/(a-b)   ?
```

```
(4>1)*(-2<0)  =  ?

4>1*-2<0      =  ?

~(2*3^2/2*3/9/3+1>=5/(3*realmax)+2)     =     ?
```

floor, fix, mod, rem, ceil and round commands

floor: Round towards minus infinity

floor(4.2) = 4
floor(4.9) =4
floor(-0.2)=-1
floor(10/3)= **?**
floor(10/-3)=**?**
floor(-10/3)= **?**

fix: Rounds towards 0

fix(4.2) = 4
fix(4.9) =4
fix(-0.2)=0
fix(10/3)= **?**
fix(10/-3)=**?**
fix(-10/3)= **?**

floor, fix, mod, rem, ceil and round commands

mod: modulus after division

M = mod(X,Y) if Y ~= 0, returns X - n.*Y
 where n = floor(X./Y)
By convention, mod(X,0) is X

mod(13,2)=1	13 = 2*6 + 1
mod(2,13)=2	2 = 13*0 + 2
mod(10,0)=10	10 = 0*n + 1
mod(13.34,2)=1.34	13.24 = 2*6 + 1.34
mod(5,-2)=-1	5=-2*-3+ (-1)
mod(-5,2)=1	-5=2*-3+1
mod(0,20)=?	
mod(-20,5)=?	
mod(-20,6)=?	

floor, fix, mod, rem, ceil and round commands

rem: Remainder after division

R = rem(X,Y) if Y ~= 0, returns X - n.*Y
where n = fix(X./Y)
By convention, rem(X,0) is NaN

rem(13,2)=1	13 = 2*6 + 1
rem (2,13)=2	2 = 13*0 + 2
rem (10,0)=NaN	
rem(13.34,2)=1.34	13.24 = 2*6 + 1.34
rem(5,-2)=1	5=-2*-2+1
rem(-5,2)=-1	-5=2*-2+ (-1)
rem(0,20)=?	
rem(-20,5)=?	
rem(-20,6)=?	

floor, fix, mod, rem, ceil and round commands

As long as operands X and Y are of the same sign, the statement rem(X,Y) returns the same result as does mod(X,Y).

mod(11,2) = rem(11,2) = 1
mod(-11,-2) = rem(-11,-2) = 1

However, for positive X and Y:

rem(-X,Y) = mod(-X,Y)-Y
rem(-5,2)=-1=mod(-5,2)-2=1-2=-1

floor, fix, mod, rem, ceil and round commands

ceil: Round toward infinity

ceil(4.2) = 5
ceil(4.9) =5
ceil(-0.2)=0
ceil(10/3)= **?**
ceil(10/-3)=**?**
ceil(-10/3)= **?**

round: Round to nearest integer

round(4.5) = 5
round(4.9) =5
round(-4.5)=-5
round(-0.2)=0
round(10/3)= **?**
round(10/-3)=**?**
round(-10/3)= **?**