Expressions

Expressions

- Combine values using operators and function calls
- Return a value of a known type (int, double, float, pointer)
- Example:
  - (3+4)/2 returns an integer value (3).
  - + and / are operators, 3, 4, 2 are operands.

Expressions

- An operator is something which takes one or more values and does something useful with those values to produce a result
- Each thing which is operated upon by an operator is called an operand
- Operation is the action which was carried out upon the operands by the operator

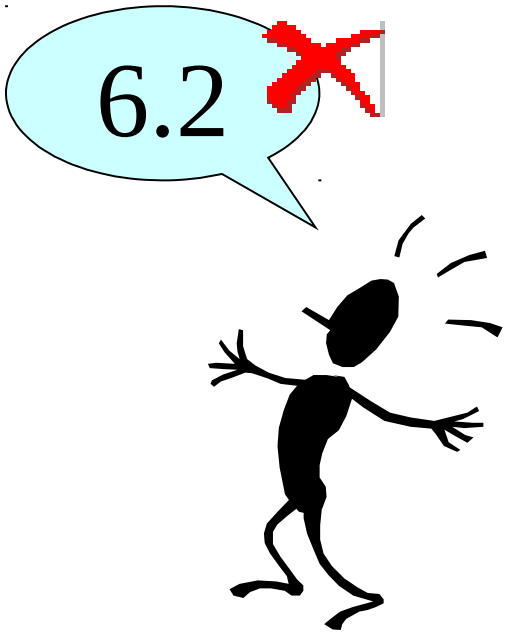
Arithmetic Expressions

- take arithmetic (numerical) values
- return an arithmetic (numerical) value
- Are composed using the following operators:
  - + (unary plus)
  - - (unary minus)
  - + (addition)
  - - (subtraction)
  - * (multiplication)
  - / (division or quotient)
  - % (modulus or remainder)

Example

```
1 + 2 * 3 - 4 / 5

= 1 + (2 * 3) - (4 / 5)
```



Example (con't)

```
1 + 2 * 3 - 4 / 5 =

1 + (2 * 3) - (4 / 5)
```

Divide two integers, the result is also an integer

Example (con't)

```
1 + 2 * 3 - 4 / 5 =

1 + (2 * 3) - (4 / 5)
```

```
= 0
```

Example (con't)

- Use a real number to create an expression that return a real value

```
1 + 2 * 3 - 4.0 / 5

= 1 + (2 * 3) - (4.0 / 5)

= 1 + 6 - 0.8

= 6.2
```

Comparison operators

- < (less than)
- <= (less than or equal)
- > (greater than)
- >= (greater than or equal)
- == (equal)
- != (in-equal)

Example

$1 + 2 < 3$

$= (1 + 2) < 3$

$= 3 < 3 = 0$

- Not to be confused between == and = (assignment)

Example

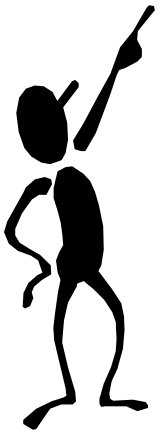
Prevent misconsideri ng as assign operator (=)

```
3 == 4 → 0

3 != 4 → 1

3 < 4 → 1

3 < 4 && 5 > 2 → 1
```



Logic

- A special data type that has only two values:
  - true
  - false
- It is used to create the select condition or the loop for an algorithm
- Boolean expression: is an expression that return only true/false

Use `int` as logic

- In C, logic values are represented by integer
  - 0 is false
  - any non-zero value is taken interpreted as true (often use 1)
- All expressions in C return a number
- A “true” logic expression will return 1, otherwise 0

Logic operators

- … is used to built logic expression
- && (and)
- || (or)
- ! (not)
- comparison (**==**, **!=**, **<**, **>**, **<=**, **>=**)

Example

(3 ==3) && (1+ 2) < 3

= 1 && (3 < 3)

= 1 && 0 = 0

Example

Prevent misconsideri ng as **and** bit (&)

Prevent misconsiderin g as **or** bit (|)

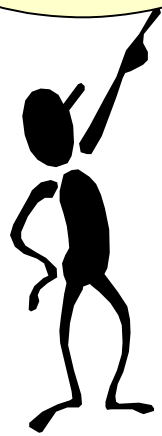
Prevent misconsiderin g as **reverse** bit (~)

```
5 && 4 → 1

1 || 4 → 1

! 0 → 1

! 0 || 0 && 2 → 1
```



Bit operators

An expression that only uses bit operators is not logic expression. Result of this expression is an integer.

& (and bit)
| (or bit)
~ (negation)
>> (shift right)
<< (shift left)

Bit operators

- Not to be confused with boolean operators: &&, ||, !
- Example:

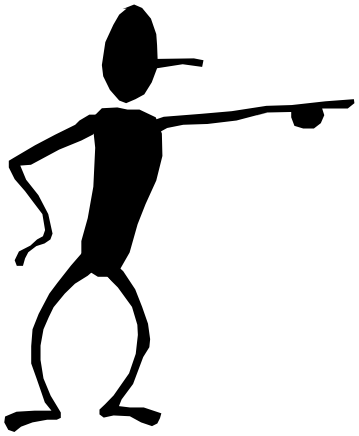
```
    5 = 101
&   4 = 100
 -------------
=   4 = 100
```

1 | 4 → ?

5 & (4 >> 1) → ?

Short-circuiting

- a complex Boolean expression is only evaluated as far as necessary



```
1 || 2

0 || 1 || 2
0 || 1 || (2 &&3)

1 && 0 && -1
```

Common errors

```
#include <stdio.h>

/* Common errors */

int main()
{
   int score;

   scanf("%d", &score);

   if ( score == 9 || 10 )
   {
      printf("Excellent\n");
   }
   return 0;
}
```

Return value is always 1

Return value is 0 or 1

Common errors (con’t)

```
#include <stdio.h>

/* Correct program */

int main()
{
   int score;

   scanf("%d", &score);

   if ( score == 9 || score == 10 )
   {
      printf(“Excellent\n");
   }
   return 0;
}
```

Common errors (con't)

```
#include <stdio.h>

/* Common errors */

int main()
{
   int score;

   scanf("%d", &score);

   if ( 8 <= score <= 10 )
   {
      printf("Good\n");
   }
   return 0;
}
```

Return value is always 1

Return value is 0 or 1

Common errors (con’t)

```
#include <stdio.h>

/* Correct program */

int main()
{
   int score;

   scanf("%d", &score);

   if ( 8 <= score && score <= 10 )
   {
      printf(“Good\n");
   }
   return 0;
}
```

Assignment expressions

- Assignment = is also an operator that returns the assignment value.
- This operator can be used to create an expression that return a value: result of the assignment is the right value of the expression
- Example:

  (x = 4) → 4

  (y = 0) → 0

  a = b = 5» a = (b = 5) » a = 5
- Can create an expression with a serie of assigment

  x = y = z = 4

Common errors (con't)

```
#include <stdio.h>

/* Common errors */

int main()
{
   int score;

   scanf("%d", &score);

   if (score = 9 || score = 10)
   {
      printf("Good!\n");
   }
   return 0;
}
```

Incorrect wrote as an assignment

Common errors (con't)

```
#include <stdio.h>

/* Probably the most common C error. */

int main()
{
   int score;

   scanf("%d", &score);

   if (score == 9 || score == 10)
   {
      printf("OK!\n");
   }
   return 0;
}
```

Some extend assignment operators

Operator	Example	Equal expression
+=	x += 5	x = x + 5
-=	x -= 5	x = x - 5
*=	x *= 5	x = x * 5
/=	x /= 5	x = x / 5
%=	x %= 5	x = x % 5

Increment, decrement operators

- ++ is the *increment* operator
- ++i is equivalent to i = i + 1
- -- is the *decrement* operator
- --j is equivalent to j = j - 1
- Two ways of writing: prefix (++i) and suffix (i++)
- They are different in return values of expressions. Example, if i = 5
  - Prefix return value after adding 1, (++i) → 6
  - Posfix return value before adding 1, (i++) → 5
  - In both cases, value of i increases by 1

Example

```
int i = 5;
++i;
printf("%d", i);
```

- Output: 6

Conditional Expressions

- … a ternary operator

  Condition ? Expr2 : Expr3

- Example:

```
int max,a,b;
…
max = ( a > b ) ? a : b;
```

Casting data type

- Assignment is only carried out in variables and values in the same data type
- C can automatically convert data type for assignment if this conversion **do not loose information**. Example, convert from int to float

```
int a;
float f;
f = a; /* OK */
a = f; /* not OK */
```

- In case of loosing information, casting data type is needed. Example, convert from float to int.

```
a = (int) f;
```

Precedences

- Unary operators (**!, -**)
- Multiply, divide (***, /, %***)
- Addition, subtraction (**+, -**)
- Comparison 1 (**<, <=, >, >=**)
- Comparison 2 (**==, !=**)
- And (**&&**)
- Or (**||**)

Example

- 7+5&&4<2+3-2/3||5>2+1
- (7+5)&&4<2+3-(2/3)||5>(2+1)
- 12&&4<(2+3-0)||(5>3)
- 12&&(4<5)||1
- (12&&1)||1
- 1||1 = 1

Exercise

- 3&&7+4/3-2>6+-3*10%2
- 2+3/5>6-10/2||3/7&&4
- (3<<1)&(4>>2)|5
- (1>4)&&(2||(3<4))

(**!**, **-**)
(*****, ***/***, **%**)
(**+**, **-**)
(**<**, **<=**, **>**, **>=**)
(**==**, **!=**)
And (**&&**)
Or (**||**)