Introduction to Programming and Computational Physics

Lecture 3

Operators
Selection

Operators

`double` **`sqrt`**`(double)` (-> math.h, math.c)

output input

arithmetic operators (basic C library)

`int` **`+`**`(int,int)`	`float` **`+`**`(float,float)`
`int` **`/`**`(int,int)`	`float` **`/`**`(float,float)`
`void` **`=`**`(&int,int)`	`void` **`=`**`(&float,float)`

what if…

`int a; float b;`

`float c = a+b;`

usually `a` is promoted to float and `+(float,float)` called

Increment and decrement operators

n++
++n
} The same as **n=n+1**

++(&int)

n--
--n
} The same as **n=n-1**

The expression ++n increments n *before* its value is used, while n++ increments n *after* its value has been used.

If n is 5, then

x = ++n sets x to 6 but,

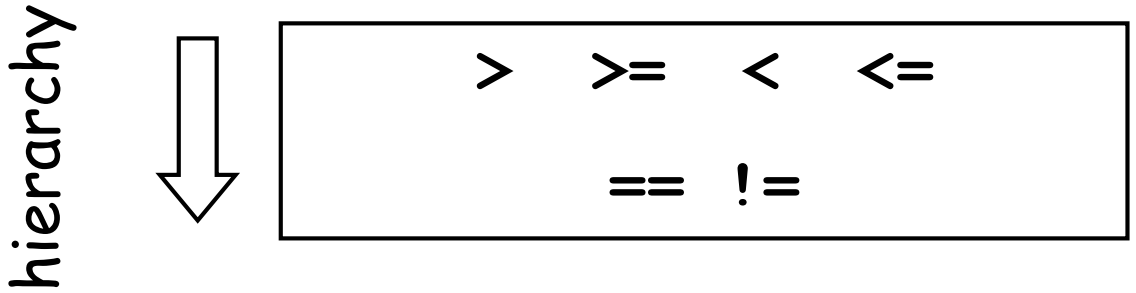
x = n++ sets x to 5

In both cases n becomes 6

Assignment operators

`x+=2`	The same as `x=x+2`
`x-=y`	The same as `x=x-y`
`x*=y+1`	The same as `x=x*(y+1)`
`x/=y`	The same as `x=x/y`

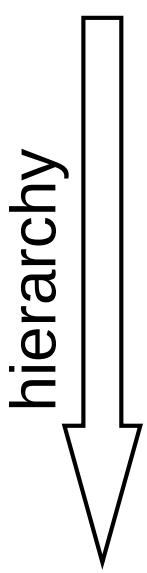
Relational operators



The result can be “true” or “false” and the returned value is 1 (true) or 0 (false) `int >(int,int)`

```
int a = 10, b = 20;

int r1 = a<b;   // r1 takes value 1

int r2 = a>b;   // r2 takes value 0

int r3 = a==b;  // r3 takes value 0

int r4 = a!=b;  // r4 takes value 1
```

Relational and logical operators



`!` **(NOT)**	`int !(int)`
`>` `>=` `<` `<=`	} relational
`==` `!=`	} relational
`&&` **(AND)**	`int &&(int,int)`
`||` **(OR)**	`int ||(int,int)`

The value "0" is assumed as false, any other value as true.

```
int a = 0, b = 10;
int r1 = a&&b;   // r1 takes value 0
int r2 = a||b;   // r2 takes value 1
int r3 = !b;     // r3 takes value 0
int r4 = !!b;    // r4 takes value 1
int r5 = a<=b||!b          int r5 = ((a<=b)||(!b))
```

Truth table

Ex1	Ex2	Ex1&&Ex2	Ex1||Ex2	!Ex1
F	F	F	F	T
F	T	F	T	T
T	F	F	T	F
T	T	T	T	F

Conditional structures

The C language has two conditional structures:

- **if - else (…else if)**
- **switch**

if – else

```
if (a>b) printf("%f is greater than %f",a,b);
```

Brackets are not needed for a single statement but probably helpful to avoid mistakes.

```
if (a>b)  //no semicolon here!!
{
   printf("%f is greater than %f",a,b);
   …
}
```

Combining relational and logical operators…

```
if (a<b&&b<c) …          if((a<b)&&(b<c))…
```

if – else

```
if (a>b)
{
    max_ab = a;
    printf("a is the maximum and its value is %f",a);
}
else
{
   max_ab = b;
   printf("b is the maximum and its value is %f",b);
}
```

if – else

```
if (a=b)
     printf("a and b are the same");
else
     printf("a and b are different");
```

WRONG !!!

It will execute the statement if b is not zero

```
if (a==b)
     printf("a and b are the same");
else
     printf("a and b are different");
```

CORRECT !!!

if – else (nested)

```
if (n > 0)
  if (a > b)
    z = a;
  else
    z = b;
```

```
if (n > 0)
{
  if (a > b)
  z = a;
}
else
  z = b;
```

Because the **else** part of an **if-else** is optional, there is an ambiguity when an **else** is omitted in a nested **if** sequence.
The C language associates the **else** to the closest **if**.
The usage of additional { } could be anyway suggested to avoid confusion

if – else … else if

When the number of alternatives is bigger than 2 the if-else can be extended by using the else if option

The expressions are evaluated in sequence. The last else is optional

```
if (expression)
  statement;
else if (expression)
  statement;
else if (expression)
  statement;
else
  statement;
```

```
if (n>0)
  printf("n is positive");
else if (n==0)
  printf("n is null");
else
  printf("n is negative");
```

Switch

```
switch(expression)
{
    case const1 :
    statement ;
    …
    break;
    case const2 :
    statement ;
    …
    break;
    default :
    statement ;
    …
}
```

The expression must be an integer or a char

The (optional) **break** command brings outside the **switch** block

The statements following the (optional) **default** command are executed when none of the **case** is fulfilled

Switch

```
#include <stdio.h>

int main()
{
  int x;
  printf("\nEnter a number between zero and three: ");
  scanf("%d",&x);

  switch(x)
  {
    case 0:
      printf("you wrote zero\n\n");
      break;
    case 1:
      printf("you wrote one\n\n");
      break;
    case 2:
      printf("you wrote two\n\n");
      break;
    case 3:
      printf("you wrote three\n\n");
      break;
    default:
      printf("your number is not between zero and three\n\n");
      break;
  }
  return 0;
}
```