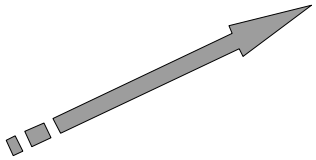
Lecture 7



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Making Decisions

- This lecture is about program "branching", where different actions can occur depending upon the state of data.
- The simplest of which is the conditional expression or query-colon ?:
- C has a conditional operator, ?: which is used in the form

  expr1 ? expr2 : expr3

  boolean expression ? if true : if false
- Remember that in C, non-zero means true, zero means false. If expr1 is true, the value of the expression is that of expr2; if expr1 is false then it is that of expr3

Conditional Expression cont

- Because this is an expression, we can use it on the RHS of an assignment, eg.

  `y=(x>=7)?5:(17-x);`
- So
  - if x is 19, y is 5
  - if x is 2, y is 15
- As the ?: can make code a little difficult to read it is best for short expressions

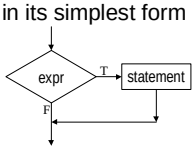
```
/* Example: conditional expressions */

#include <stdio.h>

main()
{
  int n, m, abs, max;

  printf("Enter a positive or negative integer: ");
  scanf("%i", &n);

  printf("\nYou entered %i.\n", n);
  abs = n < 0 ? -n : n;
  printf("Its absolute value is %i.\n", abs);

  printf("\nEnter two integers (e.g. 1 2): ");
  scanf("%i %i", &n, &m);

  printf("\nYou entered %i and %i.\n", n, m);
  max = n > m ? n : m;
  printf("%i is the larger value.\n", max);
}
```

If Statements

- The if statement is the bread and butter of most programmers across many languages
- C provides an if statement, in its simplest form

```
if (expr)
  statement;
```

e.g.
```
if (x==3)
    y++;
```



- if expr evaluates to true (non zero), statement is executed; if not, statement is skipped.

If Statements

- Note that if several statements are to be executed, they must be grouped together to form a block, using braces {}
- e.g.

```
if (x==3){
   y++;
   z*=37;
}
```

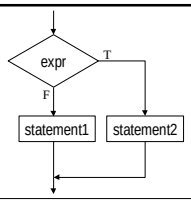
```
/* Example: simple if statement */

#include <stdio.h>

main()
{
  int n;

  printf("Enter an integer: ");
  scanf("%i", &n);

  printf("\nYou entered %i", n);

  if (n >= 0)
    printf(", which isn't negative.\n");
}
```

If Statements

- As with the conditional operator, its possible to have two branches

```
if (expr)
   statement1;
else
   statement2;
```

- Again, statement1 and statement2 can be blocks

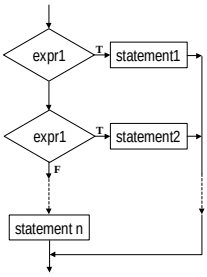



```
/* Example: if...else statement */

#include <stdio.h>

main()
{
  int n;

  printf("Enter an integer: ");
  scanf("%i", &n);

  printf("\nYou entered %i", n);

  if (n >= 0)
    printf(", which isn't
negative.\n");
  else
    printf(", which is negative.\n");
}
```

If Statements

- What if we wish to have a 3-way (or more) choice ?
- We can use a "nested" if…else statement
- Nested basically means one inside another

```
if (expr1)
   statement1;
else
   if (expr2)
      statement2;
      ⋮
   else
      statement n;
```



nestedif.c
if1.bug
if2.bug

```
/* Example: nested if...else statements */

#include <stdio.h>

main()
{
  int n;

  printf("Enter an integer: ");
  scanf("%i", &n);

  printf("\nYou entered %i", n);

  if (n > 0)
    printf(", which is positive.\n");
  else if (n < 0)
    printf(", which is negative.\n");
  else
    printf(", which is neither positive nor negative.\n");
}
```

```
/* BUG ZONE!!!
Example: if...else statement */

#include <stdio.h>

main()
{
  int lucky;

  printf("Enter your lucky number: ");
  scanf("%i", &lucky);

  if (lucky = 7)  /* BUG */
    printf("Your lucky number is %i, same as mine!\n", lucky);
  else
    printf("Your lucky number is %i\n", lucky);
}
```

```
/* BUG ZONE!!!
Example: if statement */

#include <stdio.h>

main()
{
  int dialled = 123;

  printf("You dialled %i\n", dialled);

  if (dialled == 999);  /* BUG */
    puts("Emergency services.");
    puts("Which service do you require?");  /* BUG */
    puts("Police, ambulance, fire or coastguard?");
}
```

Logical Operators

- Consider the following

  "I only attend lectures on Monday at 10 or on Thursday at 10, otherwise I say in bed"

- This could be described by a rather complicated flow diagram involving four "if" boxes:

Logical Operators

- This would make an equally complicated C program. Fortunately C provides three logical operators to get around this.

  && - AND, | | - OR and ! - NOT

  a&&b means both a and b must be true for the result to be true

  a||b means either a or b (or both) must be true for the result to be true

  !a means a must be false for the result to be true

  && has higher precedence than ||

- So we could code it as

```
if (( day==MON || day==TUE ) && time==10)
   go_to_lecture();
else
   stay_in_bed();
```

- Sometimes `if(a==0)` is written `if(!a)`

leapyear.c

```
/* Example: determining leap years */

#include <stdio.h>

main()
{

  /* A leap year is one that is divisible by 4, but not
  divisible by 100. Overriding that, a year divisible
  by 400 is a leap year. */

  int year, leap, div4, div100, div400;

  printf("Enter a year (e.g. 1996): ");
  scanf("%i", &year);

  div4 = year % 4 == 0; /* true if divisible by 4 */
                  /* Could also write  div 4 = !(year % 4) */
  div100 = year % 100 == 0;
  div400 = year % 400 == 0;

  leap = (div4 && !div100) || div400;

  /* Could also write  leap = div4 && !(div100 && !div400); */

  if (leap)
    puts("This is a leap year");
  else
    puts("This is not a leap year");
}
```

Switch Statements

- C provides a statement for multiple choices, based on the value of an integer variable:

```
switch (integer_expression){
     case value1:
       statement(s);
       break;
     case value2:
       statement(s);
       break;
       ⋮
     case value n;
       statement(s);
       break;
     default :
       statement(s);
}
```

- break causes the program to jump to the end of the switch statement

switch.c

```
/* Example: switch statement */

#include <stdio.h>

main()
{
  int d;

  printf("Enter a number from 1 to 9: ");
  scanf("%i", &d);
  putchar('\n');

  switch (d)
  {
    case 1:
      puts("A stitch in time saves nine.");
      break;

    case 2:
    case 6:
    case 9:
      puts("Handsome is as handsome does.");
      break;

    case 3:
      puts("Too many cooks spoil the broth.");
      break;

    case 4:
    case 7:
      puts("Pride comes before a fall.");
      break;

    case 5:
    case 8:
      puts("Many hands make light work.");
      break;

    default:
      puts("Very clever. Try again.");
  }
}
```

switch2.c

```
/* Example: switch statement without breaks */

#include <stdio.h>

main()
{
  int v;

  printf("Enter a number from 1 to 10: ");
  scanf("%i", &v);
  putchar('\n');

  if (v < 1 || v > 10)
  {
    puts("Very clever. I'll use 10.\n");
    v = 10;
  }

  switch (v)
  {
    case 10: puts("Ten...");
    case  9: puts("Nine...");
    case  8: puts("Eight...");
    case  7: puts("Seven...");
    case  6: puts("Six...");
    case  5: puts("Five...");
    case  4: puts("Four...");
    case  3: puts("Three...");
    case  2: puts("Two...");
    case  1: puts("One...");
             puts("ZERO!!");
  }
}
```