Conditional Execution

- many problems require executing statements only in some circumstances
  e.g read two integers and print largest one
- sometimes called control flow, branching or conditional execution
- The C if Statement can do this.
The if Statement

```c
if (expression) {
    statement1;
    statement2;
    ....
}
```

- **statement1, statement2, ...** are executed if **expression** is non-zero.
- **statement1, statement2, ...** are **NOT** executed if **expression** is zero.
- There is no “boolean” type in C.
  0 is regarded as “FALSE”
  anything non-zero is regarded as “TRUE”
The else keyword

```java
if (expression) {
    statement1;
    statement2;
    ....
} else {
    statement3;
    statement4;
    ....
}
```

- **statement1, statement2, ...** are executed if `expression` is non-zero.
- **statement3, statement4, ...** are executed if `expression` is zero.
Multiple `if` statements can be chained together:

```c
int a, b;

printf("Please enter two numbers, a and b: ");
scanf("%d %d", &a, &b);

if (a > b) {
    printf("a is greater than b\n");
} else if (a < b) {
    printf("a is less than b\n");
} else {
    printf("a is equal to b\n");
}
```
C has the usual operators to compare numbers:

>   greater than
>=  greater than or equal to
<   less than
<=  less than or equal to
!=  not equal to
==  equal to

• Be careful comparing doubles for equality using == or !=
• Remember doubles are approximations.
Relational Operators

- Many languages have a separate type for true & false.
- C just uses numbers.
- C convention is zero is false, other numbers true.
- relational operators return:
  - the int 0 for false
  - the int 1 for true
- For example:
  - $5 > 4 \mapsto 1$
  - $5 \geq 4 \mapsto 1$
  - $5 < 4 \mapsto 0$
  - $5 \leq 4 \mapsto 0$
  - $5 \neq 4 \mapsto 1$
  - $5 == 4 \mapsto 0$
Logical Operators

- C has logical operators: `&&` `||` `!`
- Logical operators allow us to combine comparisons, eg:
  
  \[
  \text{mark} > 0 \land \text{mark} < 100
  \]

- Logical operators return:
  - the int `0` for false
  - the int `1` for true

- `&&` is the **and** operator - true if both operands are true
  \[
  2 > 0 \land 2 < 10 \rightarrow 1 \land 1 \rightarrow 1
  \]

- `||` is the **or** operator - true if either operand is true
  \[
  24 > 42 \lor 2 < 10 \rightarrow 0 \lor 1 \lor 1
  \]

- `!` is the **not** operator - true iff its operands is false
  \[
  !(24 > 42) \rightarrow !0 \rightarrow 1
  \]
Logical Operators - Conditional evaluation

- The C operator `&&` `||` have a useful property.
- They always evaluate their left-hand side first.
- They only evaluate their right-hand side if needed.
- `&&` will not evaluate right-hand side if left-hand side is false (zero).
- `||` will not evaluate right-hand side if left-hand side is true (non-zero).
- For example we can write
  
  ```
  x != 0 && y/x > 2
  ```

  without risking division by zero.
Unary Negation operator

The unary negation operator converts a non-zero operand into 0 and 0 into 1. For example,

```c
if (!(height <= 130 && width <= 240)) {
    printf("Envelope too large!\n");
}
```

.. is the same as ..

```c
if (height > 130 || width > 240) {
    printf("Envelope too large!\n");
}
```