

# EECS 10: Computational Methods in Electrical and Computer Engineering

## Lecture 7

Rainer Dömer

doemer@uci.edu

The Henry Samueli School of Engineering  
Electrical Engineering and Computer Science  
University of California, Irvine

## Lecture 7: Overview

- Warm-up Quiz
- Comparison of Values
  - Relational Operators
  - Logical Operators
  - Conditional Operator
- Conditional Statements
  - `if` statement
- Conditional Programming
  - Example `comparison.c`

## Quiz: Question 11

- What is the value of the integer  $x$  after the following statement?


```
x = 2 << 8 >> 2;
```

- a) 256
- b) **Syntax Error!**
- c) 128
- d) 512
- e) 20000000

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- a) 256
- b) **Syntax Error!**
-  c) **128**
- d) 512
- e) 20000000

## Quiz: Question 12

- Which of the following constants is of type `double`?  
(Check all that apply!)
  - a) `42`
  - b) `4.2`
  - c) `4e2`
  - d) `4E2`
  - e) `42f`

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## Quiz: Question 12

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  - d) `4E2`
  - e) `42f`

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### Quiz: Question 13

- What is the result type of the following expression?


```
1 - 23 * (4.5f / 67L) - (short)89
```

- a) `short int`
- b) `int`
- c) `long int`
- d) `float`
- e) `double`

### Quiz: Question 13

- What is the result type of the following expression?

```
1 - 23 * (4.5f / 67L) - (short)89
```

- a) `short int`
- b) `int`
- c) `long int`
-  d) `float`
- e) `double`

## Quiz: Question 14

- What is the value of  $x$  after the following code segment?


```
int    i = 10;  
double d = 0.5;  
long   x;  
  
x = i/3.0 + d;
```

- a) 3.333333
- b) 3
- c) 3.833333
- d) 0.333333
- e) 3.5

## Quiz: Question 14

- What is the value of  $x$  after the following code segment?

```
int    i = 10;  
double d = 0.5;  
long   x;  
  
x = i/3.0 + d;
```

- a) 3.333333
-  b) 3
- c) 3.833333
- d) 0.333333
- e) 3.5

## Quiz: Question 15

- Given the following code fragment,

```
double x;  
double y;  
  
x = (int)(y + 0.5);
```

which of the following statements is true?  
(Check all that apply!)

- a) for  $y=3.0$ ,  $x$  is set to 3.5
- b) for  $y=3.0$ ,  $x$  is set to 3.0
- c) for  $y=3.2$ ,  $x$  is set to 3.0
- d) for  $y=3.9$ ,  $x$  is set to 3.0
- e) for  $y=3.9$ ,  $x$  is set to 4.0

## Quiz: Question 15

- Given the following code fragment,

```
double x;  
double y;  
  
x = (int)(y + 0.5);
```

which of the following statements is true?  
(Check all that apply!)

- a) for  $y=3.0$ ,  $x$  is set to 3.5
- b) for  $y=3.0$ ,  $x$  is set to 3.0
- c) for  $y=3.2$ ,  $x$  is set to 3.0
- d) for  $y=3.9$ ,  $x$  is set to 3.0
- e) for  $y=3.9$ ,  $x$  is set to 4.0

## Comparison of Values

- Relational Operators
  - direct comparison of two values
  - Boolean result: truth value, true or false
- Logical Operators
  - Operations on Boolean values
- Conditional Operator
  - Conditional evaluation of expressions

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## Relational Operators

- Comparison operations
  - $<$  less than
  - $>$  greater than
  - $<=$  less than or equal to
  - $>=$  greater than or equal to
  - $==$  equal to (remember,  $=$  means assignment!)
  - $!=$  not equal to
- Comparison is defined for all basic types
  - integer (e.g.  $5 < 6$ )
  - floating point (e.g.  $7.0 < 7e1$ )
- Result type is Boolean, but represented as integer
  - false 0
  - true 1 (or any other value *not* equal to zero)

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## Logical Operators

- Operation on Boolean/truth values

- ! "not" logical negation
- && "and" logical and
- || "or" logical or

- Truth table:

x	y	!x	x && y	x    y
0	0	1	0	0
0	1	1	0	1
1	0	0	0	1
1	1	0	1	1

- Argument and result types are Boolean, but represented as integer
  - false 0
  - true 1 (or any other value *not* equal to zero)

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## Conditional Operator

- Conditional evaluation of values in expressions
- Question-mark operator:  
***test ? true-value : false-value***
  - evaluates the *test*
  - if *test* is true, then the result is *true-value*
  - otherwise, the result is *false-value*
- Examples:
  - $(4 < 5) ? (42) : (4+8)$  evaluates to 42
  - $(2==1+2) ? (x) : (y)$  evaluates to *y*
  - $(x < 0) ? (-x) : (x)$  evaluates to **abs(x)**

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## Operator Evaluation Order

- Associativity: left to right or right to left
- Precedence: group-wise, top to bottom
  - parentheses ( , ) n/a
  - unary plus, minus, negation +, -, ! right to left
  - type casting ( *typename* ) right to left
  - multiplication, division, modulo \*, /, % left to right
  - addition, subtraction +, - left to right
  - shift left, shift right <<, >> left to right
  - relational operators <, <=, >=, > left to right
  - equality ==, != left to right
  - logical and && left to right
  - logical or || left to right
  - conditional operator ?: left to right
  - assignment operator = right to left

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## Conditional Statements

- **if** statement
  - Control flow statement for decision making
    - Changes control flow depending on a specified condition
  - Example:
    - `if (x < 0)`  
`{ printf("%d is negative", x); }`
    - `if (x >= 0)`  
`{ printf("%d is positive", x); }`
  - Syntax: **if** construct consists of
    - Keyword `if`
    - Condition expression evaluated to true or false
    - Body statement block
  - Semantics:
    - Body is executed *only if* the condition evaluates to true

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## Example Program

- Comparison of values: `Comparison.c` (part 1/3)

```

/* Comparison.c: arithmetic comparisons          */
/*                                              */
/* author: Rainer Doemer                      */
/*                                              */
/* modifications:                             */
/* 10/07/04 RD  initial version              */
/*                                              */

#include <stdio.h>

/* main function */

int main(void)
{
    /* variable definitions */
    int a, b;

    ...

```

## Example Program

- Comparison of values: `Comparison.c` (part 2/3)

```

...
/* input section */
printf("Please enter a value for integer a: ");
scanf("%d", &a);
printf("Please enter a value for integer b: ");
scanf("%d", &b);

/* computation and output section */
if (a == b)
{ printf("%d is equal to %d.\n", a, b);
  } /* fi */
if (a != b)
{ printf("%d is not equal to %d.\n", a, b);
  } /* fi */
if (a < b)
{ printf("%d is less than %d.\n", a, b);
  } /* fi */
...

```

## Example Program

- Comparison of values: `Comparison.c` (part 3/3)

```

...
if (a > b)
{ printf("%d is greater than %d.\n", a, b);
} /* fi */
if (a <= b)
{ printf("%d is less than or equal to %d.\n", a, b);
} /* fi */
if (a >= b)
{ printf("%d is greater than or equal to %d.\n", a, b);
} /* fi */

/* exit */
return 0;
} /* end of main */

/* EOF */

```

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## Example Program

- Example session: `Comparison.c`

```

% vi Comparison.c
% gcc -Wall -ansi Comparison.c -o Comparison
% Comparison
Please enter a value for integer a: 42
Please enter a value for integer b: 56
42 is not equal to 56.
42 is less than 56.
42 is less than or equal to 56.
% Comparison
Please enter a value for integer a: 6
Please enter a value for integer b: 6
6 is equal to 6.
6 is less than or equal to 6.
6 is greater than or equal to 6.
% Comparison
Please enter a value for integer a: 77
Please enter a value for integer b: 6
77 is not equal to 6.
%

```

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