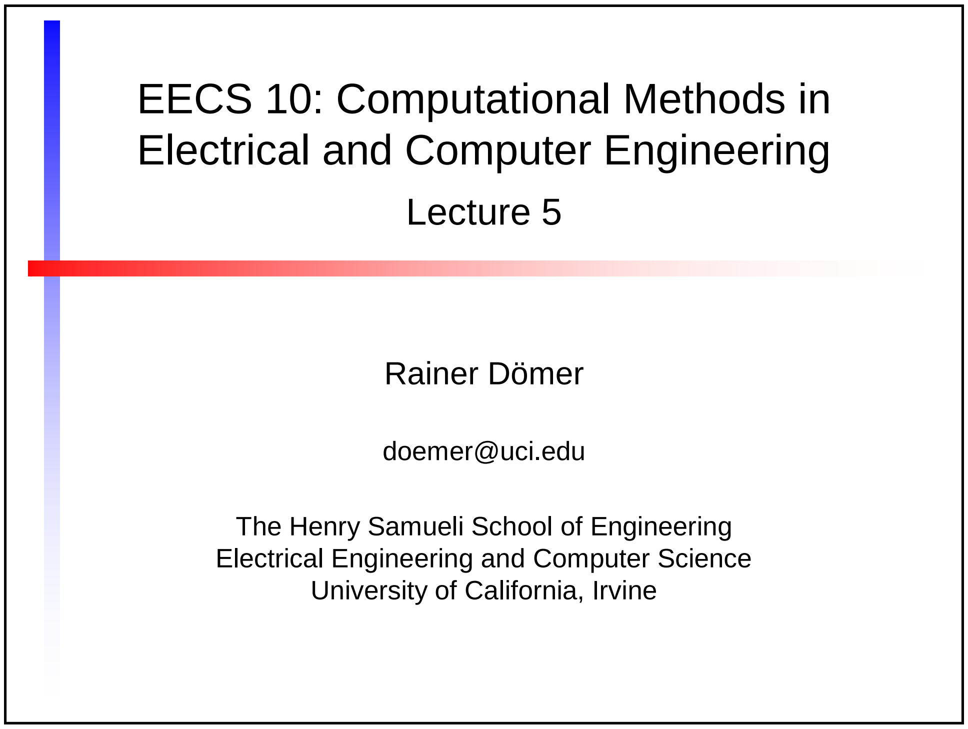


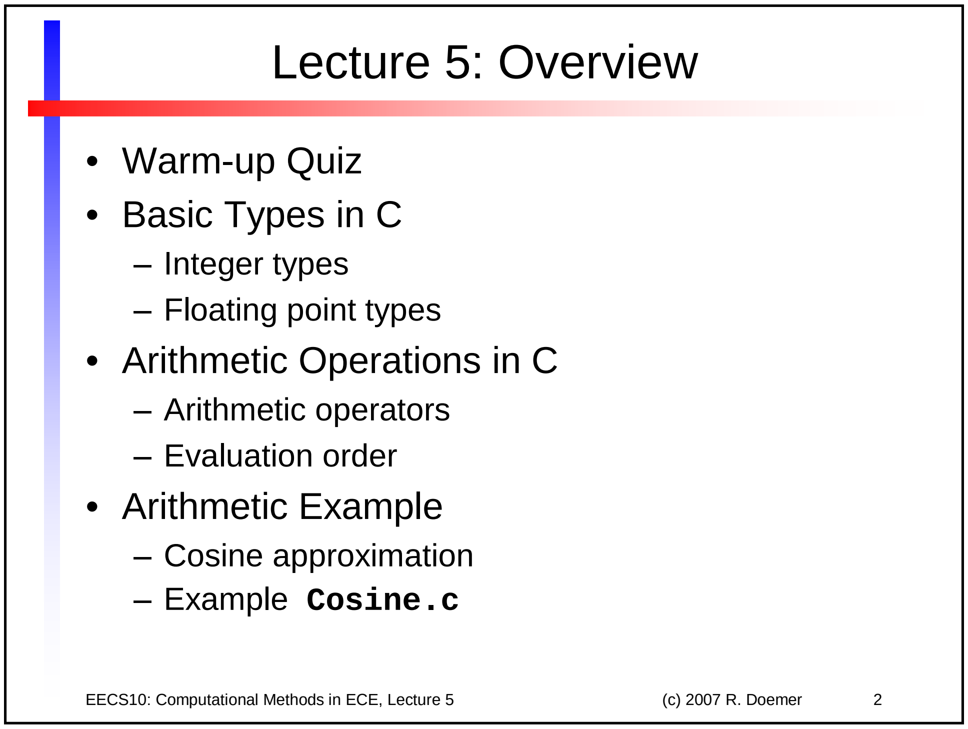
EECS 10: Computational Methods in Electrical and Computer Engineering

Lecture 5

Rainer Dömer

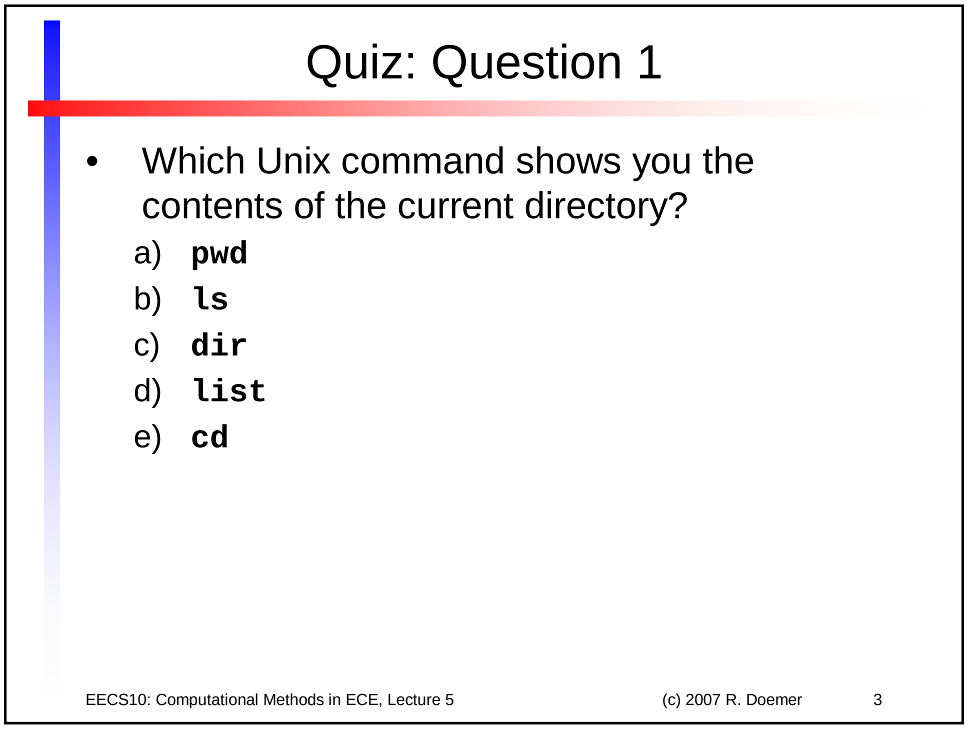
doemer@uci.edu

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



Lecture 5: Overview

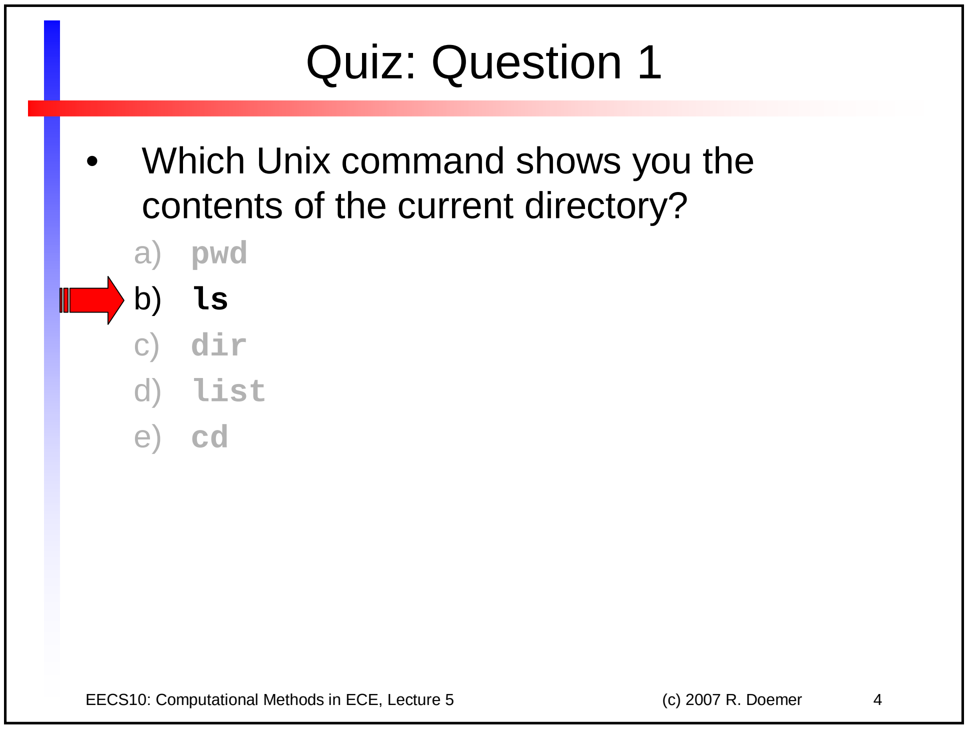
- Warm-up Quiz
- Basic Types in C
  - Integer types
  - Floating point types
- Arithmetic Operations in C
  - Arithmetic operators
  - Evaluation order
- Arithmetic Example
  - Cosine approximation
  - Example **`Cosine.c`**



Quiz: Question 1

- Which Unix command shows you the contents of the current directory?
  a) **`pwd`**
  b) **`ls`**
  c) **`dir`**
  d) **`list`**
  e) **`cd`**

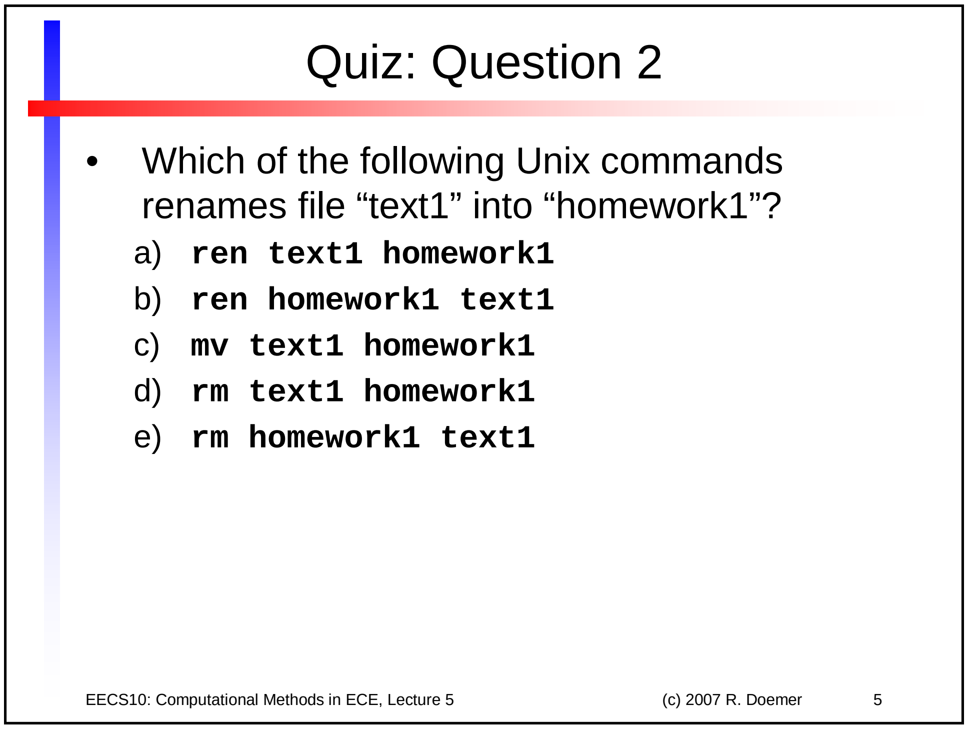
EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 3



Quiz: Question 1

- Which Unix command shows you the contents of the current directory?
  a) **`pwd`**
  [✓ b) **`ls`**]
  c) **`dir`**
  d) **`list`**
  e) **`cd`**

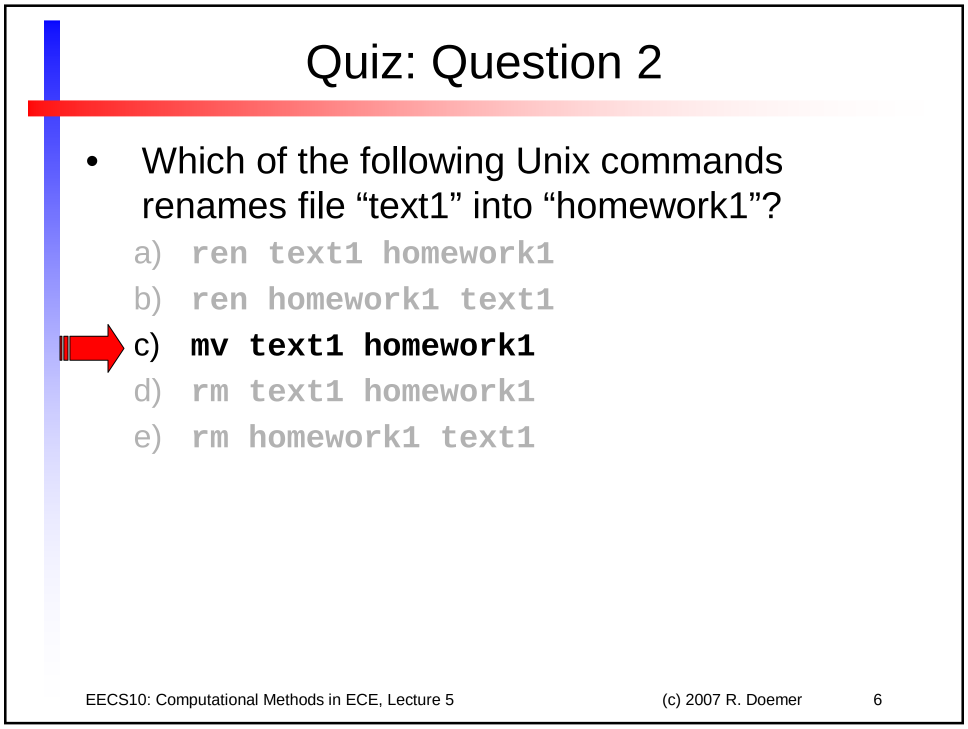
EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 4



Quiz: Question 2

- Which of the following Unix commands renames file “text1” into “homework1”?
  a) **`ren text1 homework1`**
  b) **`ren homework1 text1`**
  c) **`mv text1 homework1`**
  d) **`rm text1 homework1`**
  e) **`rm homework1 text1`**

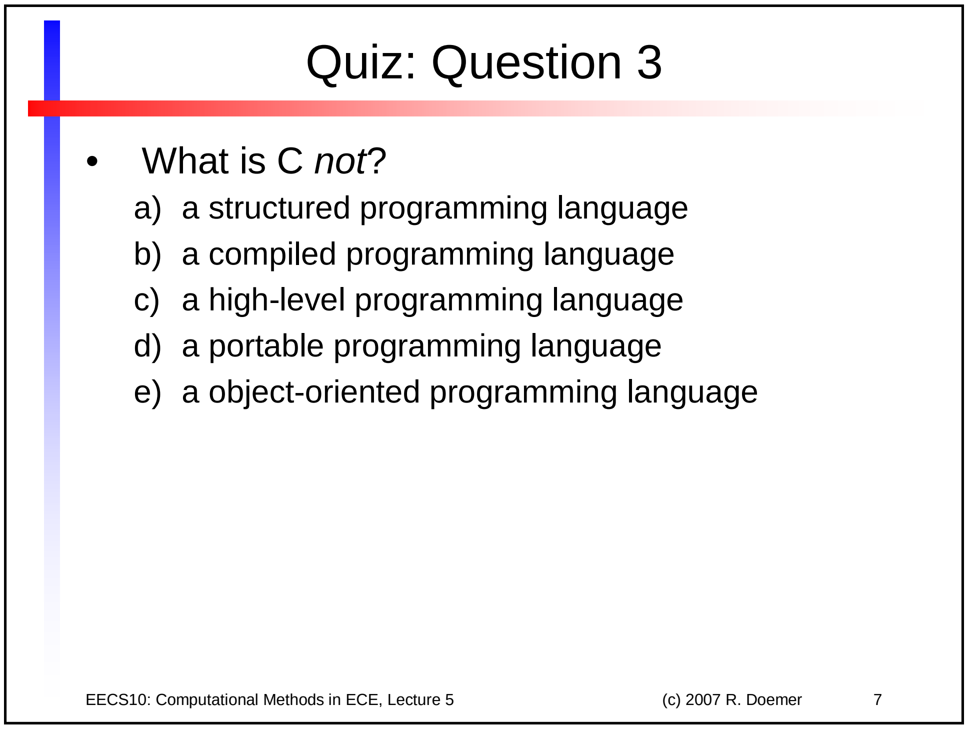
EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 5



Quiz: Question 2

- Which of the following Unix commands renames file “text1” into “homework1”?
  a) **`ren text1 homework1`**
  b) **`ren homework1 text1`**
  [✓ c) **`mv text1 homework1`**]
  d) **`rm text1 homework1`**
  e) **`rm homework1 text1`**

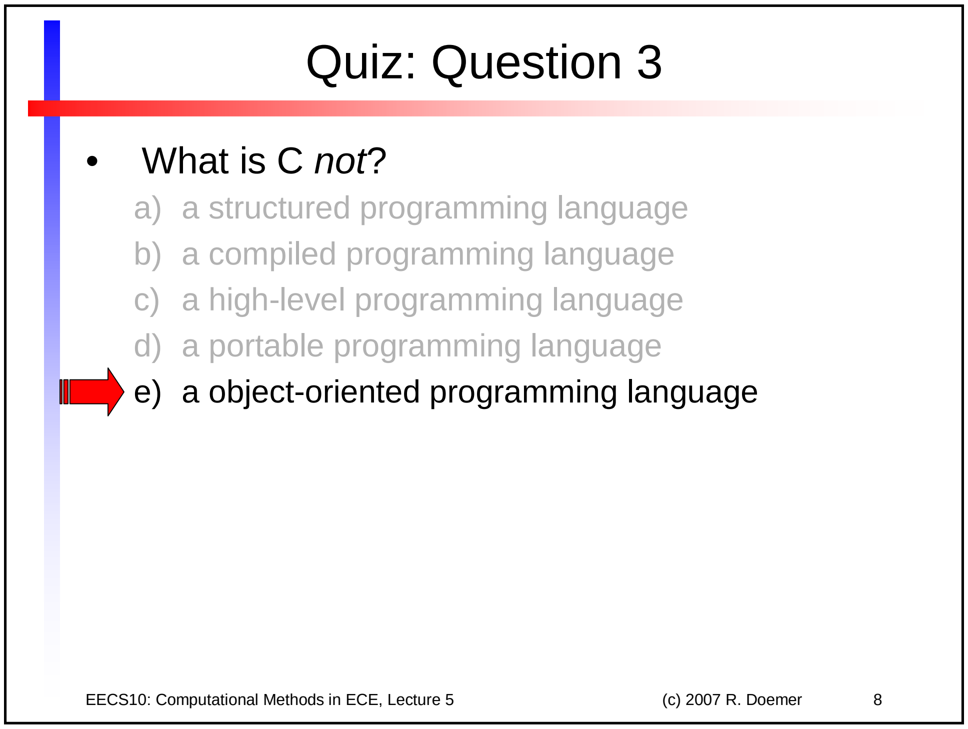
EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 6



Quiz: Question 3

- What is C *not*?
  a) a structured programming language
  b) a compiled programming language
  c) a high-level programming language
  d) a portable programming language
  e) a object-oriented programming language

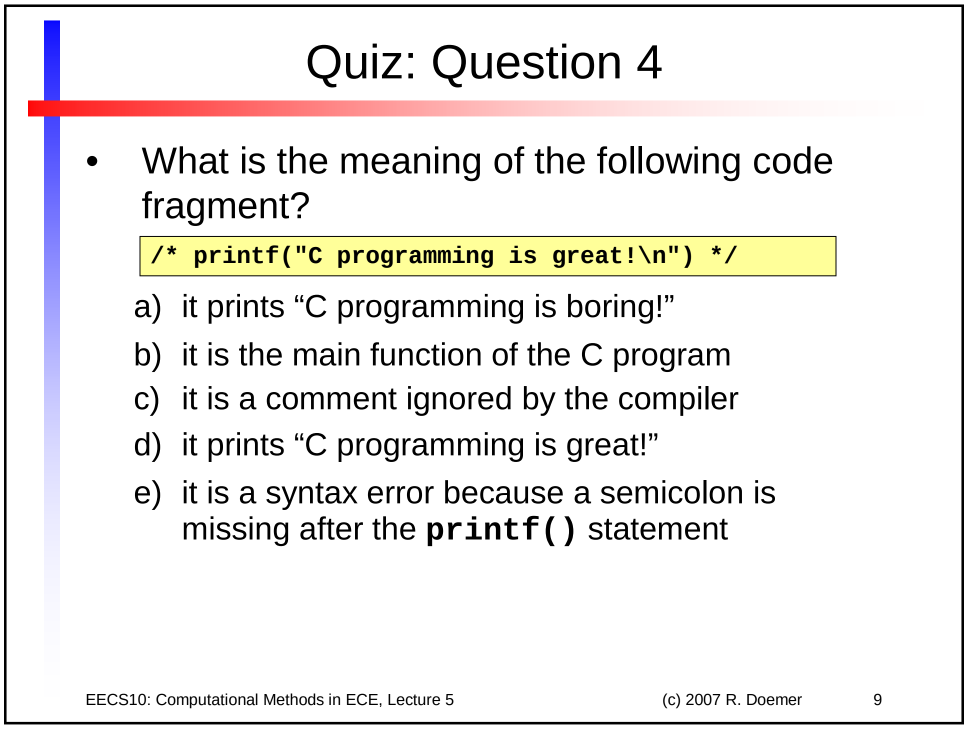
EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 7



Quiz: Question 3

- What is C *not*?
  a) a structured programming language
  b) a compiled programming language
  c) a high-level programming language
  d) a portable programming language
  [✓ e) a object-oriented programming language]

EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 8

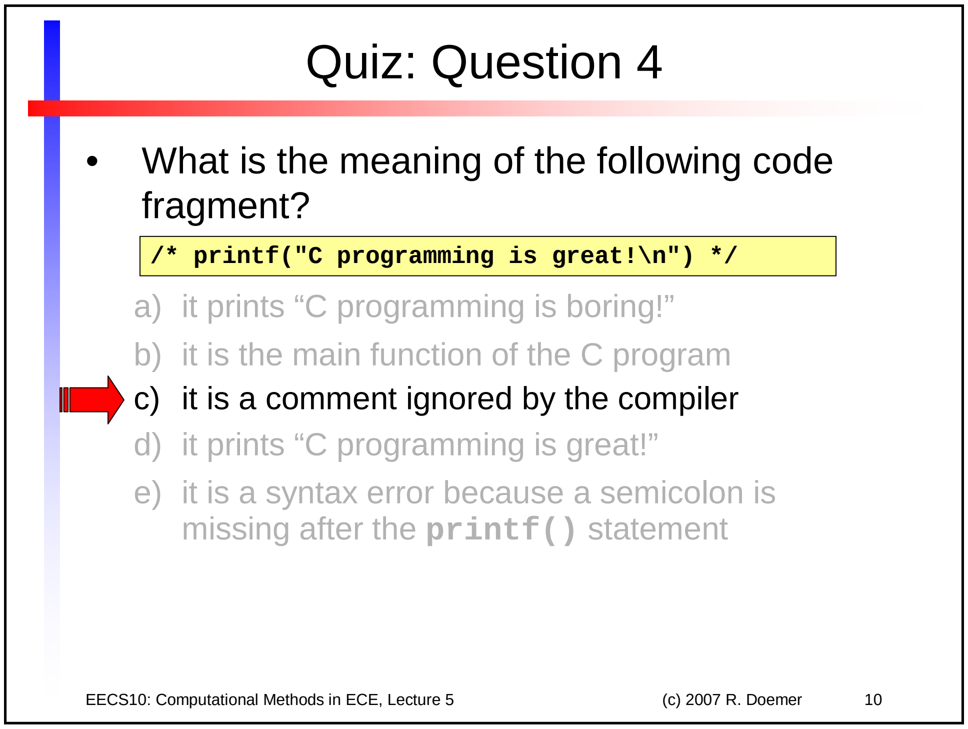


Quiz: Question 4

- What is the meaning of the following code fragment?

```
/* printf("C programming is great!\n") */
```

a) it prints “C programming is boring!”
b) it is the main function of the C program
c) it is a comment ignored by the compiler
d) it prints “C programming is great!”
e) it is a syntax error because a semicolon is missing after the **`printf()`** statement

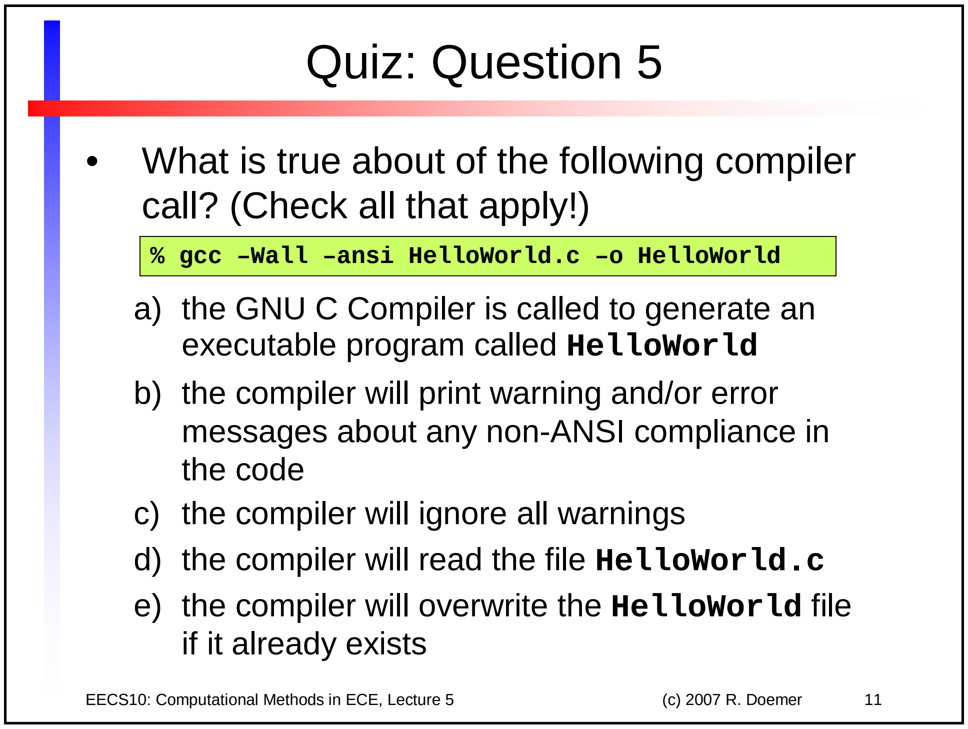


Quiz: Question 4

- What is the meaning of the following code fragment?

```
/* printf("C programming is great!\n") */
```

a) it prints “C programming is boring!”
b) it is the main function of the C program
[✓ c) it is a comment ignored by the compiler]
d) it prints “C programming is great!”
e) it is a syntax error because a semicolon is missing after the **`printf()`** statement



Quiz: Question 5

- What is true about of the following compiler call? (Check all that apply!)

```
% gcc -Wall -ansi HelloWorld.c -o HelloWorld
```

a) the GNU C Compiler is called to generate an executable program called **`HelloWorld`**

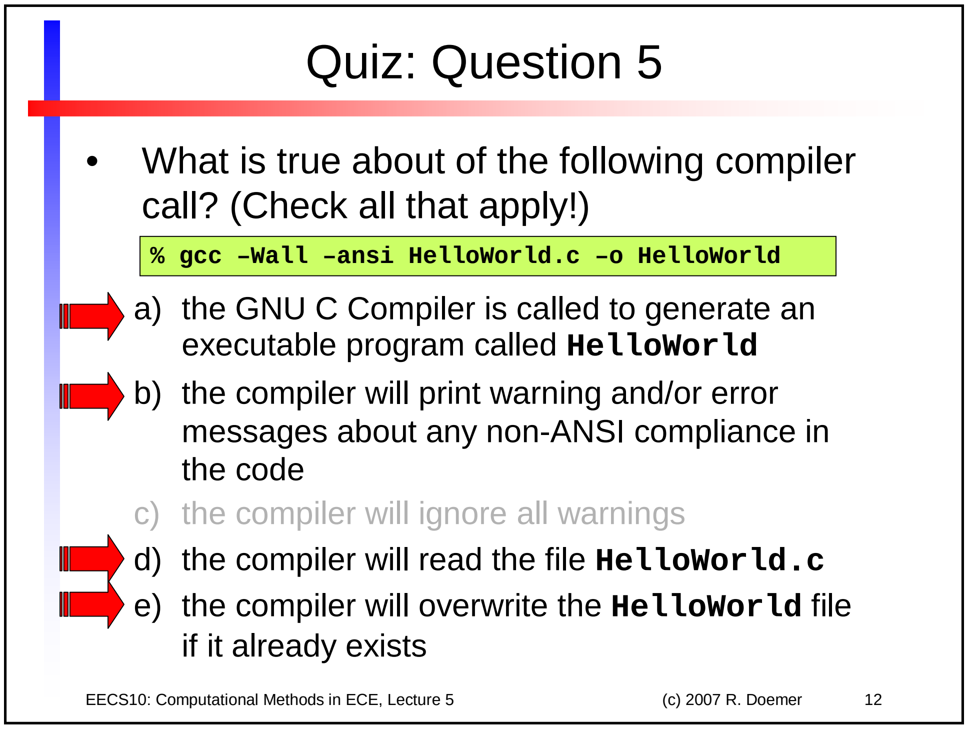
b) the compiler will print warning and/or error messages about any non-ANSI compliance in the code

c) the compiler will ignore all warnings

d) the compiler will read the file **`HelloWorld.c`**

e) the compiler will overwrite the **`HelloWorld`** file if it already exists

EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 11



Quiz: Question 5

- What is true about of the following compiler call? (Check all that apply!)

```
% gcc -Wall -ansi HelloWorld.c -o HelloWorld
```

[✓ a)] the GNU C Compiler is called to generate an executable program called **`HelloWorld`**

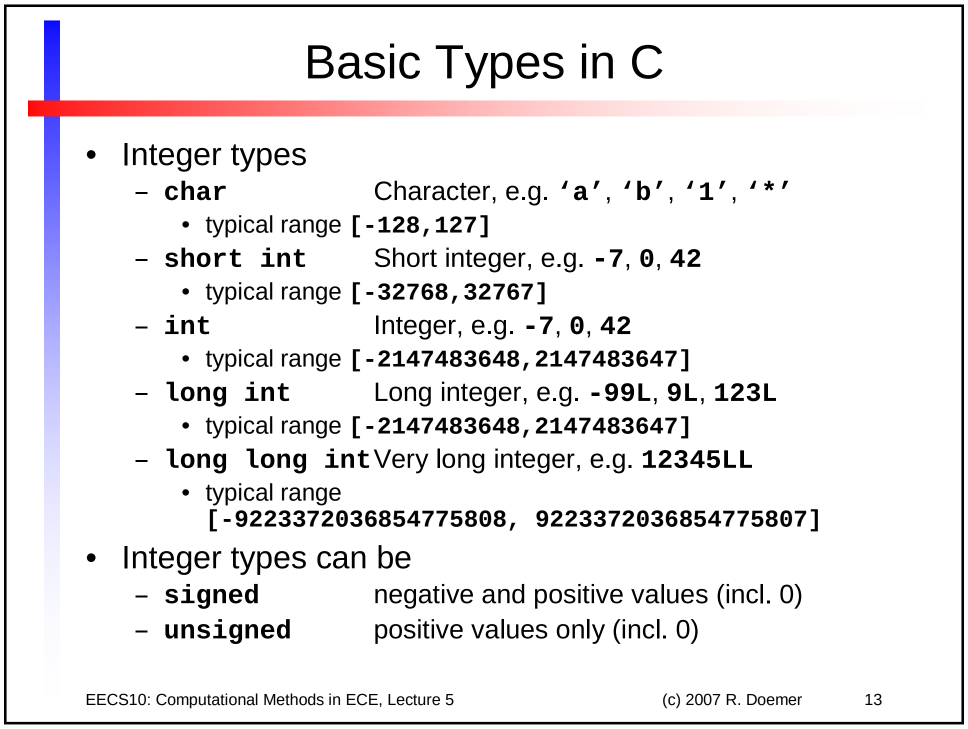
[✓ b)] the compiler will print warning and/or error messages about any non-ANSI compliance in the code

c) the compiler will ignore all warnings

[✓ d)] the compiler will read the file **`HelloWorld.c`**

[✓ e)] the compiler will overwrite the **`HelloWorld`** file if it already exists

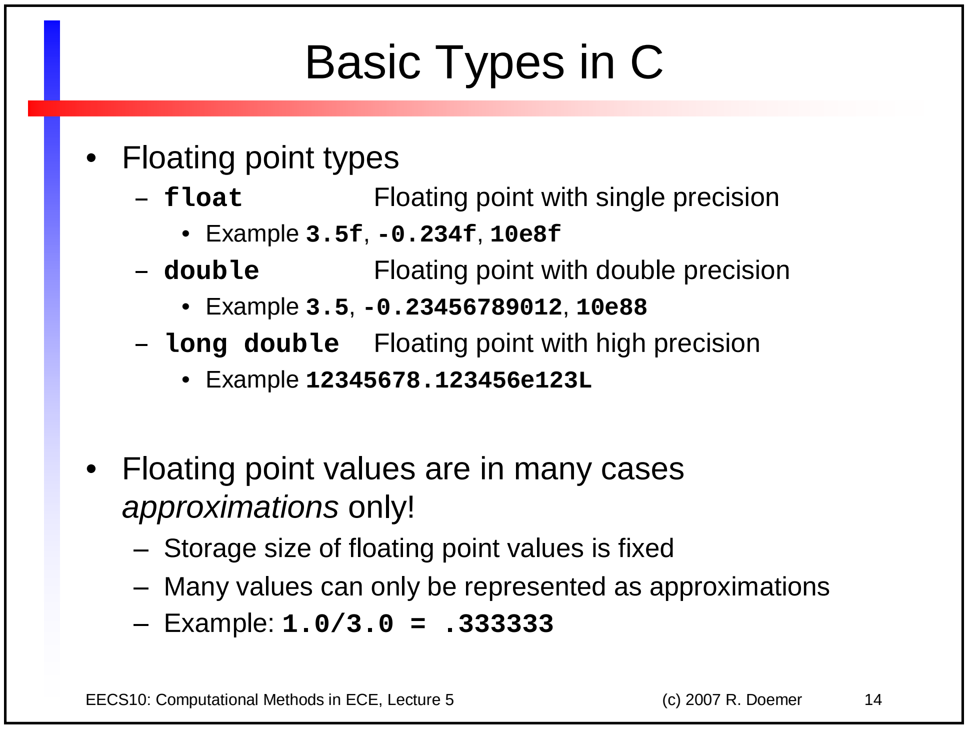
EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 12



Basic Types in C

- Integer types
  - **`char`** Character, e.g. **`'a'`**, **`'b'`**, **`'1'`**, **`'*'`**
    - typical range **`[-128,127]`**
  - **`short int`** Short integer, e.g. **`-7`**, **`0`**, **`42`**
    - typical range **`[-32768,32767]`**
  - **`int`** Integer, e.g. **`-7`**, **`0`**, **`42`**
    - typical range **`[-2147483648,2147483647]`**
  - **`long int`** Long integer, e.g. **`-99L`**, **`9L`**, **`123L`**
    - typical range **`[-2147483648,2147483647]`**
  - **`long long int`** Very long integer, e.g. **`12345LL`**
    - typical range **`[-9223372036854775808, 9223372036854775807]`**
- Integer types can be
  - **`signed`** negative and positive values (incl. 0)
  - **`unsigned`** positive values only (incl. 0)

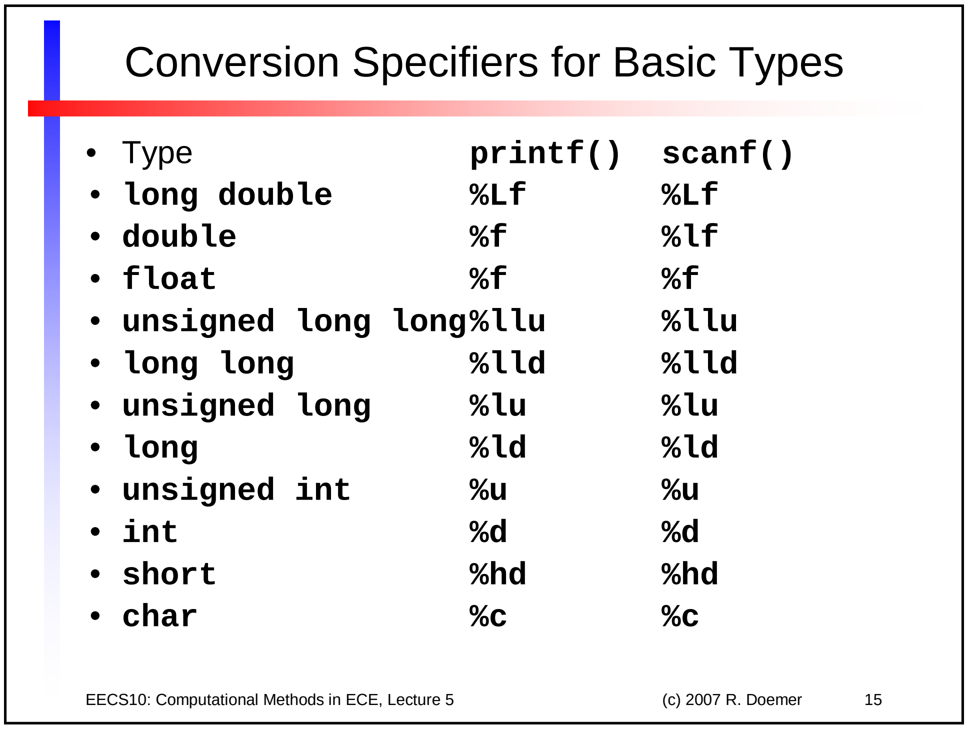
EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 13



Basic Types in C

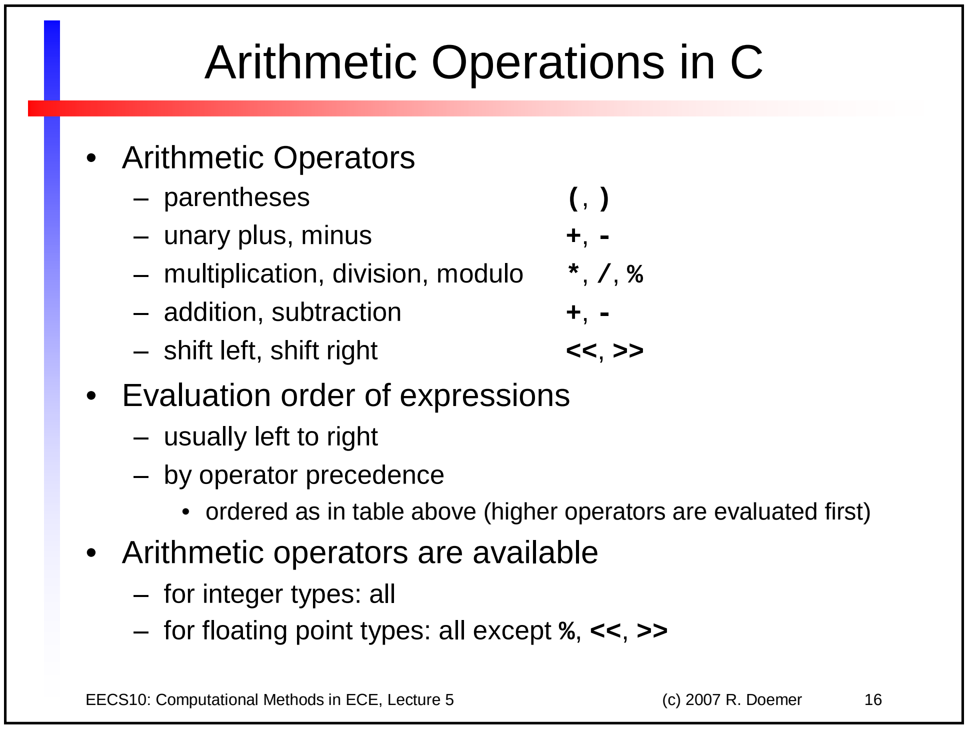
- Floating point types
  - **`float`** Floating point with single precision
    - Example **`3.5f`**, **`-0.234f`**, **`10e8f`**
  - **`double`** Floating point with double precision
    - Example **`3.5`**, **`-0.23456789012`**, **`10e88`**
  - **`long double`** Floating point with high precision
    - Example **`12345678.123456e123L`**
- Floating point values are in many cases *approximations* only!
  - Storage size of floating point values is fixed
  - Many values can only be represented as approximations
  - Example: **`1.0/3.0 = .333333`**

EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 14



Conversion Specifiers for Basic Types

Type	`printf()`	`scanf()`
`long double`	**`%Lf`**	**`%Lf`**
`double`	**`%f`**	**`%lf`**
`float`	**`%f`**	**`%f`**
`unsigned long long`	**`%llu`**	**`%llu`**
`long long`	**`%lld`**	**`%lld`**
`unsigned long`	**`%lu`**	**`%lu`**
`long`	**`%ld`**	**`%ld`**
`unsigned int`	**`%u`**	**`%u`**
`int`	**`%d`**	**`%d`**
`short`	**`%hd`**	**`%hd`**
`char`	**`%c`**	**`%c`**

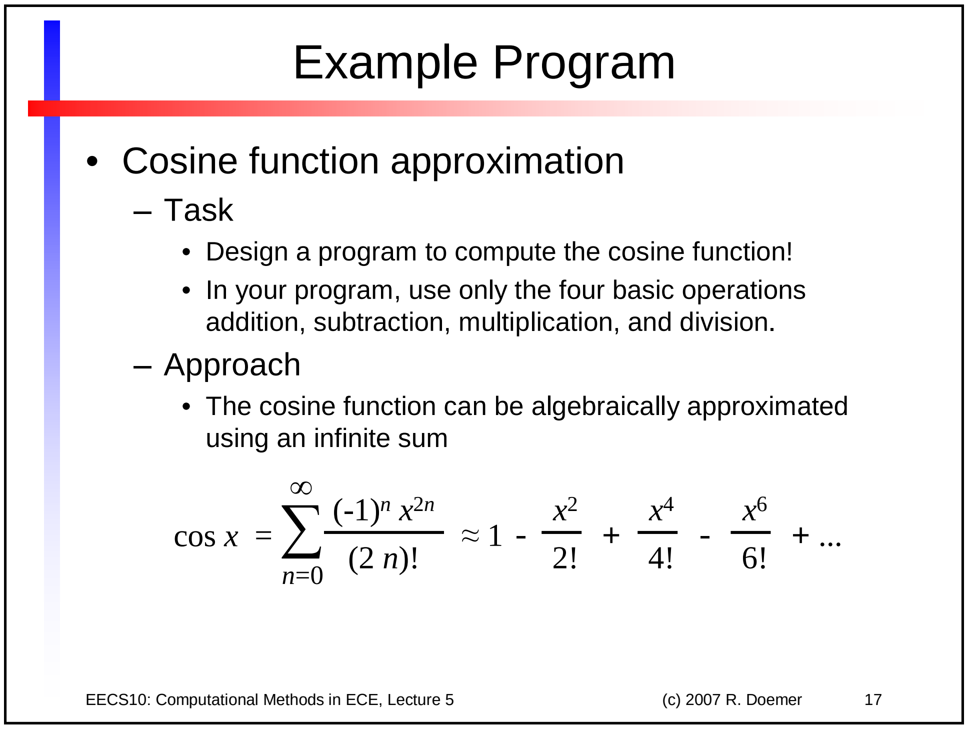


Arithmetic Operations in C

- Arithmetic Operators

– parentheses	**`(`**, **`)`**
– unary plus, minus	**`+`**, **`-`**
– multiplication, division, modulo	**`*`**, **`/`**, **`%`**
– addition, subtraction	**`+`**, **`-`**
– shift left, shift right	**`<<`**, **`>>`**

- Evaluation order of expressions
  - usually left to right
  - by operator precedence
    - ordered as in table above (higher operators are evaluated first)
- Arithmetic operators are available
  - for integer types: all
  - for floating point types: all except **`%`**, **`<<`**, **`>>`**

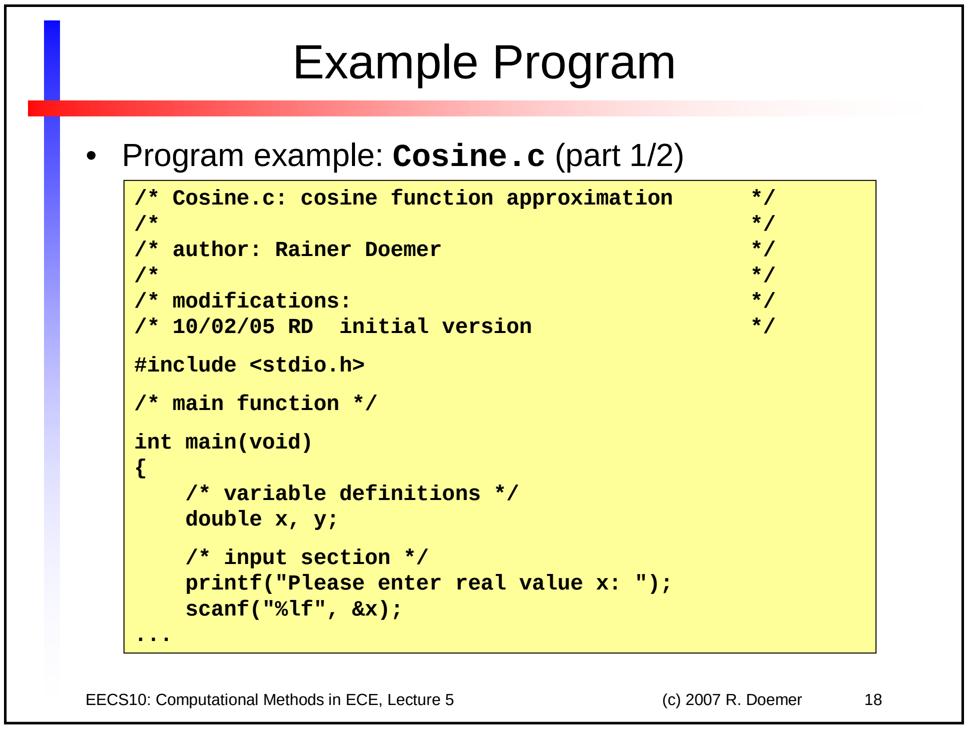


Example Program

- Cosine function approximation
  - Task
    - Design a program to compute the cosine function!
    - In your program, use only the four basic operations addition, subtraction, multiplication, and division.
  - Approach
    - The cosine function can be algebraically approximated using an infinite sum

$$\cos x = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{(2n)!} \approx 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \ldots$$

EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 17



Example Program

- Program example: **`Cosine.c`** (part 1/2)

```
/* Cosine.c: cosine function approximation      */
/*                                              */
/* author: Rainer Doemer                        */
/*                                              */
/* modifications:                               */
/* 10/02/05 RD  initial version                 */

#include <stdio.h>

/* main function */

int main(void)
{
    /* variable definitions */
    double x, y;

    /* input section */
    printf("Please enter real value x: ");
    scanf("%lf", &x);
...
```

EECS10: Computational Methods in ECE, Lecture 5 (c) 2007 R. Doemer 18

Example Program

- Program example: **`Cosine.c`** (part 2/2)

```
...

    /* computation section */
    y = 1 - (x*x)/(2.0*1.0)
          + (x*x*x*x)/(4.0*3.0*2.0*1.0)
          - (x*x*x*x*x*x)/(6.0*5.0*4.0*3.0*2.0*1.0);

    /* output section */
    printf("cos(%f) is approximately %f\n", x, y);

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

/* EOF */
```

Example Program

- Example session: **`Cosine.c`**

```
% vi Arithmetic.c
% vi Cosine.c
% gcc -Wall -ansi Cosine.c -o Cosine
% Cosine
Please enter real value x: 0.0
cos(0.000000) is approximately 1.000000
% Cosine
Please enter real value x: 0.1
cos(0.100000) is approximately 0.995004
% Cosine
Please enter real value x: 1.57079
cos(1.570790) is approximately -0.000888
% Cosine
Please enter real value x: 3.1415927
cos(3.141593) is approximately -1.211353
%
```