EECS 22: Advanced C Programming

Lecture 10

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Lecture 10: Overview

- Course Administration
  - Midterm course evaluation
- Midterm Course Review
  - Syntax and semantics of C programs
  - Types, expressions, statements, functions
  - Recursion, modules, Makefile, debugging
- Practice
  - Review Quiz
  - Programming Problem

Course Administration

- Midterm Course Evaluation
  - One week, starting this Sunday!
  - Sunday, Oct. 28, noon – Sunday, Nov. 4, noon
  - Online via EEE Evaluation application
- Feedback from students to instructors
  - Completely voluntary
  - Completely anonymous
  - Very valuable
    - Help to improve this class!
- Mandatory Final Course Evaluation
  - expected for week 10 (TBA)

Midterm Course Review

- L1: Introduction, course setup, Linux
- L2: Tokens, basic types, operators, formatted I/O
- L3: Control-flow statements, conditionals, loops
- L4: Arrays, accesses, pass by value/reference
- L5: Functions, call graph, stack, recursion
- L6: Scope, variable lifetime, storage classes
- L7: Compiler components, translation units
- L8: Make, Makefile, rules, targets and dependencies
- L9: Assertions, debugging, GDB/DDD commands

Quiz: Question 21

- Which of the following variable declarations is valid in ANSI-C?
  (Check all that apply! 2 pts.)
  a) `double xyz;`
  b) `double x, y, z;`
  c) `double x = 1.0;`
  d) `double x = 1.1, y = 2.2, z = 3.3;`
  e) `double x,y,z = 1.0,2.0,3.0;`

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  e) `double x,y,z = 1.0,2.0,3.0;`

Quiz: Question 22

- Which of the following data types has the largest range of representable numbers?
  a) `char`
  b) `short int`
  c) `long long int`
  d) `unsigned int`
  e) `signed long int`

Quiz: Question 22

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Quiz: Question 23

- Which of the following data types can store the greatest value?
  a) `long int`
  b) `long long int`
  c) `unsigned long long int`
  d) `float`
  e) `double`

Quiz: Question 23

- Which of the following data types can store the greatest value?
  a) `long int`
  b) `long long int`
  c) `unsigned long long int`
  d) `float`
  e) `double`

Quiz: Question 24

- Assuming that **x** is a variable of type **int**, which values of **x** satisfy the following condition?

```
x % 2 == 1
```

a) no value
b) any value
c) any value less than **2**
d) any odd value
e) any even value

Quiz: Question 24

- Assuming that **x** is a variable of type **int**, which values of **x** satisfy the following condition?

```
x % 2 == 1
```

a) no value
b) any value
c) any value less than **2**
d) any odd value
e) any even value

Quiz: Question 25

- Assume that **x** is an integer in the range of 1 through 10 inclusively. Which of the following expressions can be used as a test for **x** being an even number?
  (Check all that apply! 2 pts.)

a) `x % 2 == 0`
b) `x / 2 > 1`
c) `x % 2 == 1`
d) `x / 2 * 2 == x`
e) `x==2 || x==4 || x==6 || x==8 || x==10`

Quiz: Question 25

- Assume that **x** is an integer in the range of 1 through 10 inclusively. Which of the following expressions can be used as a test for **x** being an even number?
  (Check all that apply! 2 pts.)

a) `x % 2 == 0`
b) `x / 2 > 1`
c) `x % 2 == 1`
d) `x / 2 * 2 == x`
e) `x==2 || x==4 || x==6 || x==8 || x==10`

Quiz: Question 26

- Given the following function **g**, what is the result of **g(85)**?

a) **'A'**
b) **'B'**
c) **'C'**
d) **'D'**
e) **'F'**

```
char g(int n)
{
  switch(n/10)
  { case 10:
    case  9: return('A');
    case  8: return('B');
    case  7: return('C');
    case  6: return('D');
    default: return('F');
   }
}
```


Quiz: Question 26

- Given the following function **g**, what is the result of **g(85)**?

a) **'A'**
b) **'B'**
c) **'C'**
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    case  6: return('D');
    default: return('F');
   }
}
```

Quiz: Question 27

- What is the value of **x** after the following code fragment is executed?

```
int x = 0;
for(x = 1; x <= 10; x++)
   {  }
```

a) **0**
b) **1**
c) **9**
d) **10**
e) **11**

Quiz: Question 27

- What is the value of **x** after the following code fragment is executed?

```
int x = 0;
for(x = 1; x <= 10; x++)
   {  }
```

a) **0**
b) **1**
c) **9**
d) **10**
e) **11**

Quiz: Question 28

- Given the following program fragment, what is printed when it gets executed?

a) nothing
b) **0**
c) **10**
d) **20**
e) **30**

```
int i = 1;
int s = 0;
while (1)
  { i++;
    if (i >= 10)
       { break; }
    if (i % 2 == 1)
       { continue; }
    s += i;
   }
printf("%d", s);
```


Quiz: Question 28

- Given the following program fragment, what is printed when it gets executed?

a) nothing
b) **0**
c) **10**
d) **20**
e) **30**

```
int i = 1;
int s = 0;
while (1)
  { i++;
    if (i >= 10)
       { break; }
    if (i % 2 == 1)
       { continue; }
    s += i;
   }
printf("%d", s);
```

Quiz: Question 29

- Given the following code fragment, which of the following statements are true? (Check all that apply!)

```
double f(int x);
void g(int x, int y)
{
  int z;

  z = f(x) + 2*y;
  return z;
}
```

a) Function **f** is declared.
b) Function **g** calls function **f**
c) Variable **z** is a local variable of function **g**
d) Function **g** is declared and defined.
e) **y** is a parameter of function **g**.

Quiz: Question 29

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```
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a) Function **f** is declared.
b) Function **g** calls function **f**
c) Variable **z** is a local variable of function **g**
d) Function **g** is declared and defined.
e) **y** is a parameter of function **g**.

Quiz: Question 30

- Given the following program fragment, what is the value of **`g(2,f(3,4))`**?

a) **8**
b) **9**
c) **10**
d) **11**
e) **12**

```
int x = 7;

int f(int x, int y)
{
  return x + y;
}

int g(int x, int y)
{
  return f(y, x);
}
```


Quiz: Question 30

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a) **8**
b) **9**
c) **10**
d) **11**
e) **12**

```
int x = 7;

int f(int x, int y)
{
  return x + y;
}

int g(int x, int y)
{
  return f(y, x);
}
```

Programming Problem

- Task:
  - Write a program than calculates the square root of a positive number entered by the user
- Instructions:
  - Write a main module (file **`Main.c`**) that prompts the user for a value and prints the calculated square root
  - Write a square root module (files **`sqrt.c`** and **`sqrt.h`**) which implements a function with the signature **`double sqrt(double)`**
  - Write a corresponding **`Makefile`** to compile the program
- Hint:
  - Use a binary search algorithm to calculate the square root (see next page)

Binary Search Algorithm For Square Root

- Approximation Algorithm:
  - Input: positive real number N
  - Output: square root of N
  - Approximate the square root by use of a range $\{L, R\}$, where $L \le sqrt(N) \le R$
  - Start with the range $\{0, N\}$
  - Calculate the middle of the range $M = L + (R-L)/2$
  - If the square root of N lies in the lower half of the range, use $\{L, M\}$ as new range; otherwise use $\{M, R\}$
  - Repeat the bisection until the range is smaller than $1*10^{-5}$
  - Output M
- Hint:
  - $L \le sqrt(N) \le R \Leftrightarrow L*L \le N \le R*R$