

# EECS 10: Computational Methods in Electrical and Computer Engineering

## Lecture 8

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## Lecture 8: Overview

- Keywords in C
- Counters
  - Augmented Assignment Operators
  - Increment and Decrement Operators
- Repetition Statements
  - `while` loop
- Counter-controlled repetition
  - Example `Average.c`
- Sentinel-controlled repetition
  - Example `Average2.c`

## Keywords in C

- List of keywords in ANSI-C

- auto
- break
- case
- char
- const
- continue
- default
- do
- double
- else
- enum
- extern
- float
- for
- goto
- if
- int
- long
- register
- return
- short
- signed
- sizeof
- static
- struct
- switch
- typedef
- union
- unsigned
- void
- volatile
- while

- These keywords are reserved!
- These cannot be used as identifiers.
- More keywords are reserved for C++

## Augmented Assignment Operators

- Assignment operator: =
  - evaluates right-hand side
  - assigns result to left-hand side
- Augmented assignment operators: +=, \*=, ...
  - evaluates right-hand side as temporary result
  - applies operation to left-hand side and temporary result
  - assigns result of operation to left-hand side
- Example: Counter
  - `int c = 0; /* counter starting from 0 */`
  - `c = c + 1; /* counting by regular assignment */`
  - `c += 1; /* counting by augmented assignment */`
- Augmented assignment operators:
  - +=, -=, \*=, /=, %=, <<=, >>=, |=, &&=

## Increment and Decrement Operators

- Counting in steps of one
  - increment (add 1)
  - decrement (subtract 1)
- C provides special operators
  - increment operator: ++
    - `count++` post-increment (`count += 1`)
    - `++count` pre-increment (`count += 1`)
  - decrement operator: --
    - `count--` post-decrement (`count -= 1`)
    - `--count` pre-increment (`count -= 1`)
  - *pre-* increment/decrement
    - value returned is the incremented/decremented (new) value
  - *post-* increment/decrement
    - value returned is the original (old) value

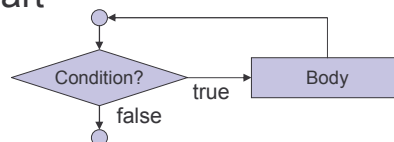
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## Repetition Statements

- Repetition (aka. iteration, loop)
  - repeated execution of a block of statements
  - counter-controlled
    - counter determines number of repetitions (often predefined at compile time)
  - sentinel-controlled
    - sentinel condition determines number of repetitions (usually determined at run time)
- Control flow chart



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## Repetition Statements

- **while** loop
  - Control flow statement for repetition (iteration)
    - Repeats execution depending on a specified condition
  - Example:
 

```
int product = 2;
while (product < 1000)
{ product *= 2; }
printf("Product is %d", product);
```
  - Syntax: **while** construct consists of
    - keyword `while`
    - condition expression evaluated to true or false
    - body statement block
  - Semantics: the body is repeatedly executed as long as the condition evaluates to true
    - the condition is evaluated at the *beginning* of each loop

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## Example Program

- Average of values: **Average.c** (part 1/3)

```
/* Average.c: compute the average of a set of numbers */
/*
/* author: Rainer Doemer */
/*
/* modifications: */
/* 10/10/04 RD initial version */

#include <stdio.h>

/* main function */

int main(void)
{
    /* variable definitions */
    int counter;
    double value;
    double total;
    double average;
    ...
}
```

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## Example Program

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

```
...  
  
/* input and computation section */  
counter = 1;  
total = 0.0;  
while (counter <= 10)  
{ printf("Please enter value %d: ", counter);  
  scanf("%lf", &value);  
  total += value;  
  counter++;  
} /* elihw */  
  
/* computation section */  
average = total / 10.0;  
  
...
```

## Example Program

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

```
...  
  
/* output section */  
printf("The average is %f.\n", average);  
  
/* exit */  
return 0;  
} /* end of main */  
  
/* EOF */
```

## Example Program

- Example session: `Average.c`

```
% vi Average.c
% gcc Average.c -o Average -Wall -ansi
% Average
Please enter value 1: 23
Please enter value 2: 25
Please enter value 3: 17
Please enter value 4: 18.6
Please enter value 5: 50.8
Please enter value 6: 33.3
Please enter value 7: 12
Please enter value 8: 42
Please enter value 9: 42.2
Please enter value 10: 34
The average is 29.790000.
%
```

## Repetition Statements

- Explicit control flow in loops
  - `break` statement
    - exits the innermost loop
  - `continue` statement
    - jump back to the beginning of the innermost loop

- Example:

```
int i = 0;
int s = 0;
while (1)          /* "endless" loop */
{
    i++;
    if (i > 10)
        { break; } /* exit the loop */
    if (i % 2 == 1)
        { continue; } /* next iteration */
    s += i;
} /* elihw */
printf("%d", s);
```

## Example Program

- Average of values: `Average2.c` (part 1/3)

```

/* Average2.c: compute the average of a set of numbers */
/*
/* author: Rainer Doemer
/*
/*
/* modifications:
/* 10/10/04 RD sentinel controlled loop
/* 10/10/04 RD initial version

#include <stdio.h>

/* main function */

int main(void)
{
    /* variable definitions */
    int counter;
    double value;
    double total;
    double average;
    ...

```

## Example Program

- Average of values: `Average2.c` (part 2/3)

```

...

/* input and computation section */
counter = 0;
total = 0.0;
while (1)
{ printf("Please enter a value (or -1 to quit): ");
  scanf("%lf", &value);
  if (value == -1.0)
  { break;
  } /* fi */
  total += value;
  counter++;
} /* elihw */

...

```

## Example Program

- Average of values: `Average2.c` (part 3/3)

```

...

/* computation and output section */
printf("%d values entered.\n", counter);
if (counter >= 1)
{ average = total / (double)counter;
  printf("The average is %f.\n", average);
} /* fi */

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

/* EOF */

```

## Example Program

- Example session: `Average2.c`

```

% vi Average2.c
% gcc Average2.c -o Average2 -Wall -ansi
% Average2
Please enter a value (or -1 to quit): 2
Please enter a value (or -1 to quit): 3
Please enter a value (or -1 to quit): 4
Please enter a value (or -1 to quit): 5
Please enter a value (or -1 to quit): -1
4 values entered.
The average is 3.500000.
% Average2
Please enter a value (or -1 to quit): -1
0 values entered.
%

```