EECS 10: Computational Methods in Electrical and Computer Engineering
Lecture 11

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Lecture 11: Overview

- Think!
- Structured Programming
  - Control flow charts
  - Sequential statements
  - Conditional statements
    - `if` statement
    - `if-else` statement
    - `switch` statement
  - Repetition statements
    - `while` loop
    - `do-while` loop
    - `for` loop
  - Example `Interest.c`

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Programming == Thinking

- Programming ...
  - ... is *not* a mechanic procedure!
  - ... requires *thinking*!
- Program ...
  - ... *writing* requires an *intelligent human being*!
  - ... *execution* can be done by a *dumb machine*.
- General programming steps:
  1. Understand the problem
  2. Define the input and output data
  3. Develop the algorithm (e.g. use pseudo code)
  4. Define the control flow (e.g. use control flow charts)
  5. Write the program in programming language
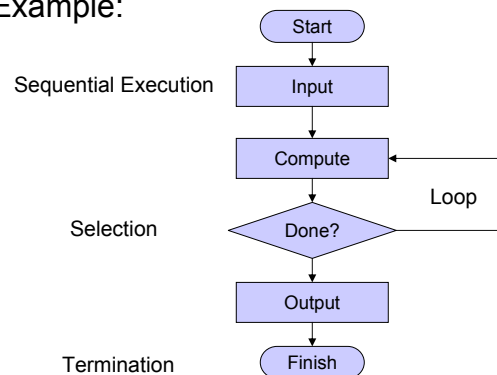 6. Test and debug the program

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Structured Programming

- Control flow charts
  - Graphical representation of program control flow
  - Example:

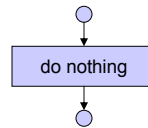EECS10: Computational Methods in ECE, Lecture 11   (c) 2009 R. Doemer   4

Structured Programming

- Empty statement blocks
  - empty compound statement
  - does nothing (no operation, no-op)
  - Example: Flow chart:

```
{
 /* nothing */

}
```

do nothing
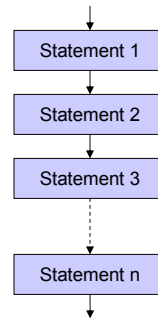
Structured Programming

- Sequential execution in C
  - Statement blocks: *Compound statements*
  - Sequence of statements grouped by braces: **{ }**
- Example: Flow chart:

```
{
  /* statement 1 */

  /* statement 2 */

  /* statement 3 */

  /* ... */

  /* statement n */
}
```

Statement 1
Statement 2
Statement 3
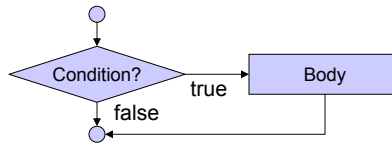Statement n

Structured Programming

- Selection: **if** statement
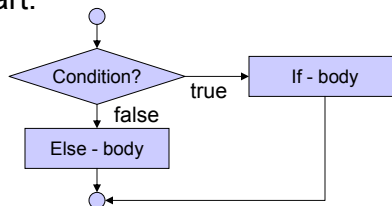 - Flow chart:

  - Example:

```
if (grade >= 60)
   { printf("You passed.");
    } /* fi */
```

Structured Programming

- Selection: **if-else** statement
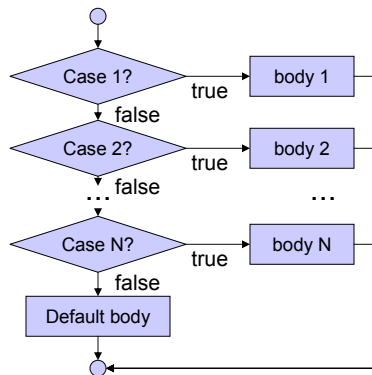 - Flow chart:

  - Example:

```
if (grade >= 60)
   { printf("You passed.");
    } /* fi */
else
   { printf("You failed.");
    } /* esle */
```

Structured Programming

- Selection: **switch** statement
  - Flow chart: Example:


```
switch(LetterGrade)
{ case 'A':
   { printf("Excellent!");
     break; }
  case 'B':
  case 'C':
  case 'D':
   { printf("Passed.");
     break; }
  case 'F':
   { printf("Failed!");
     break; }
  default:
   { printf("Invalid grade!");
     break; }
} /* hctiws */
```

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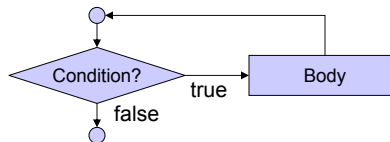
Structured Programming

- Repetition: **while** loop
  - Flow chart:

  - Example:

```
int product = 2;
while (product < 1000)
   { product *= 2;
    } /* elihw */
```

  - Note:
    - The condition is evaluated at the *beginning* of each loop!

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Structured Programming

- Repetition: **do-while** loop
  - Flow chart:
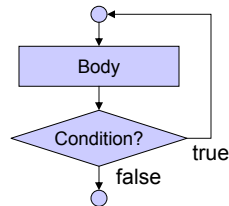
  - Example:

```
int product = 2;
do { product *= 2;
   } while (product < 1000);
```

  - Note:
    - The condition is evaluated at the *end* of each loop!

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Structured Programming

- Repetition: **for** loop
  - Flow chart:
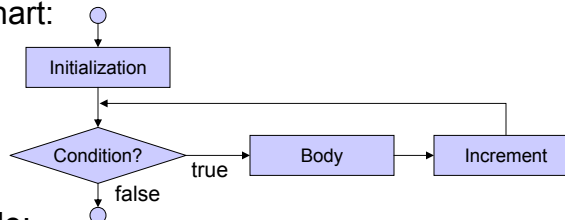
  - Example:

```
for(i = 0; i < 10; i++)
   { printf("i = %d\n", i);
    } /* rof */
```

  - Syntax:
    - **for(initialization; condition; increment)**
      body

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Example Program

- Compound interest: **Interest.c**
- Assignment:
  - Write a program that calculates the interest accumulated in a savings account. Given an initial deposit amount and an annual percentage rate (APR), compute the yearly interest earned and the resulting balance, for a period of ten years.
  - The output should be listed in a table as follows:

```
Interest for year  1 is $   45.00, total balance is $ 1045.00.
Interest for year  2 is $   47.02, total balance is $ 1092.03.
Interest for year  3 is $   49.14, total balance is $ 1141.17.
...
```

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Example Program

- Compound interest: **Interest.c**
- Assignment:
  - Write a program that calculates the interest accumulated in a savings account. Given an initial deposit amount and an annual percentage rate (APR), compute the yearly interest earned and the resulting balance, for a period of ten years.
- Step 1: Understand the problem
  - What is given?
    - deposit amount, annual percentage rate
  - What is asked for?
    - yearly interest, resulting balance
  - How do we compute what is asked for?
    - *interest = amount * APR/100*
    - *balance = amount + interest*

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Example Program

- Compound interest: **Interest.c**
- Assignment:
  – Write a program that calculates the interest accumulated in a savings account. Given an initial deposit amount and an annual percentage rate (APR), compute the yearly interest earned and the resulting balance, for a period of ten years.
- Step 2: Define the input and output data
  – Input:
    - Initial deposit amount: floating point value, **amount**
    - Annual percentage rate: floating point value, **rate**
  – Output:
    - Current year: integral value, **year**
    - Interest earned: floating point value, **interest**
    - Resulting balance: floating point value, **balance**

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Example Program

- Compound interest: **Interest.c**
- Assignment:
  – Write a program that calculates the interest accumulated in a savings account. Given an initial deposit amount and an annual percentage rate (APR), compute the yearly interest earned and the resulting balance, for a period of ten years.
- Step 3: Develop the algorithm
  – First, input **amount** and **rate**
  – Next, compute **interest** on the **amount** for the year
  – Next, compute new **balance** at the end of the year
  – Then, print **year**, **interest** and **balance** in tabular format
  – Finally, set the **amount** to the new **balance**
  – Repeat the previous 4 steps for 10 years
  – Done!

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Example Program

- Compound interest: **Interest.c**
- Assignment:
  - Write a program that calculates the interest accumulated in a savings account. Given an initial deposit amount and an annual percentage rate (APR), compute the yearly interest earned and the resulting balance, for a period of ten years.
- Step 4: Define the control flow
  - First, input **amount** and **rate**
  - Repeat for 10 years:
    - Compute **interest** on the **amount** for the year
    - Compute new **balance** at the end of the year
    - Print **year**, **interest** and **balance** in tabular format
    - Set the **amount** to the new **balance**
  - Done!

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Example Program

- Compound interest: **Interest.c**
- Assignment:
  - Write a program that calculates the interest accumulated in a savings account. Given an initial deposit amount and an annual percentage rate (APR), compute the yearly interest earned and the resulting balance, for a period of ten years.
- Step 5: Write the program in programming language

```
double amount;        double rate;        int year;

double interest;      double balance;

printf("Please enter the initial amount in $: ");
scanf("%lf", &amount);

printf("Please enter the interest rate in %% : ");
scanf("%lf", &rate);
```
etc.

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Example Program

- Compound interest: **Interest.c** (part 1/2)

```
/* Interest.c: compound interest on savings account   */
/* author: Rainer Doemer                               */
/* modifications:                                      */
/* 10/18/06 RD  distinguish amount and balance         */
/* 10/19/04 RD  initial version                        */

#include <stdio.h>

/* main function */

int main(void)
{
   /* variable definitions */
   double amount, balance, rate, interest;
   int    year;

   /* input section */
   printf("Please enter the initial amount in $: ");
   scanf("%lf", &amount);
   printf("Please enter the interest rate in %% : ");
   scanf("%lf", &rate);
...
```

Example Program

- Compound interest: **Interest.c** (part 2/2)

```
...

   /* computation and output section */
   for(year = 1; year <= 10; year++)
      { interest = amount * (rate/100.0);
        balance = amount + interest;
        printf("Interest for year %2d is $%8.2f,"
               " total balance is $%8.2f.\n",
               year, interest, balance);
        amount = balance;
      } /* rof */

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

/* EOF */
```

Example Program

- Compound interest: **Interest.c**
- Assignment:
  - Write a program that calculates the interest accumulated in a savings account. Given an initial deposit amount and an annual percentage rate (APR), compute the yearly interest earned and the resulting balance, for a period of ten years.
- Step 6: Test (and debug) the program
  - see next slide!

Example Program

- Example session: **Interest.c**

```
% vi Interest.c
% gcc Interest.c -o Interest -Wall -ansi
% Interest
Please enter the initial amount in $: 1500
Please enter the interest rate in % : 1.5
Interest for year  1 is $   22.50, total balance is $ 1522.50.
Interest for year  2 is $   22.84, total balance is $ 1545.34.
Interest for year  3 is $   23.18, total balance is $ 1568.52.
Interest for year  4 is $   23.53, total balance is $ 1592.05.
Interest for year  5 is $   23.88, total balance is $ 1615.93.
Interest for year  6 is $   24.24, total balance is $ 1640.16.
Interest for year  7 is $   24.60, total balance is $ 1664.77.
Interest for year  8 is $   24.97, total balance is $ 1689.74.
Interest for year  9 is $   25.35, total balance is $ 1715.08.
Interest for year 10 is $   25.73, total balance is $ 1740.81.
%
```