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
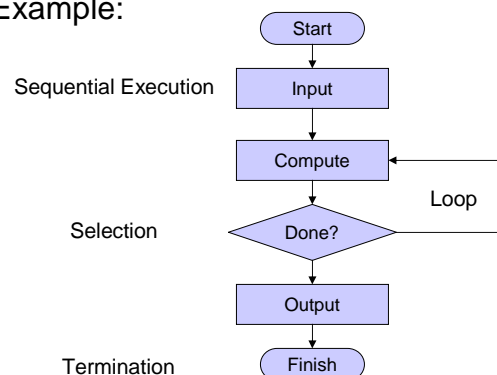 6. Test and debug the program

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Structured Programming

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

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Structured Programming

- Sequential execution in C
  - Statement blocks: *Compound statements*
  - Sequence of statements grouped by braces: { }
- Example: Flow chart:
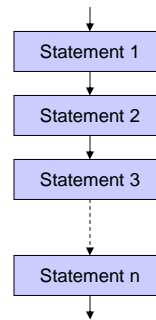
```
{
  /* statement 1 */

  /* statement 2 */

  /* statement 3 */

  /* ... */

  /* statement n */
}
```

Statement 1
Statement 2
Statement 3
Statement n

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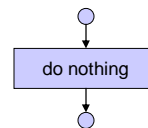# Structured Programming

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

```
{
  /* nothing */
}
```

do nothing

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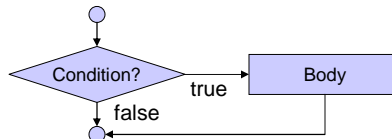
Structured Programming

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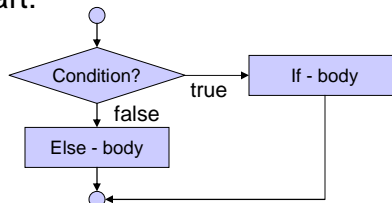 - Flow chart:

  - Example:

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

Structured Programming

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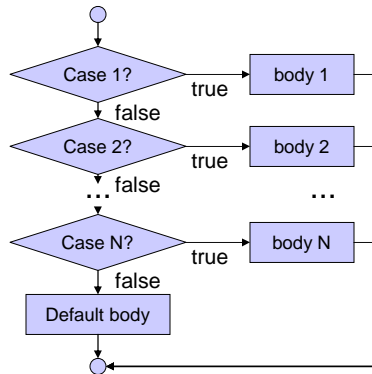 - Flow chart:

  - 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 */
```
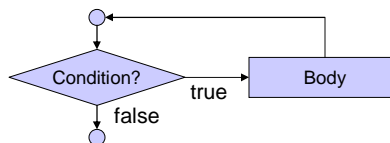
Structured Programming

- 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!

Structured Programming

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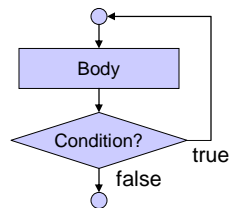
  - Example:

```
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:
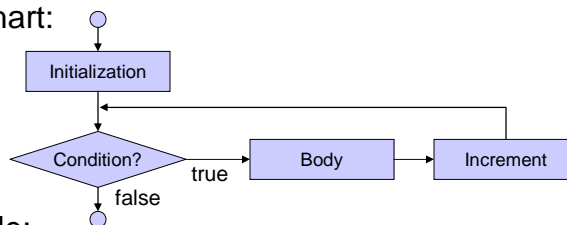
  - Example:

```
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.

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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

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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:
    - Yearly interest earned: floating point value, "interest"
    - Yearly resulting balance: floating point value, "balance"
      Note: "balance" becomes next year's "amount"!

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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"
  - Next, compute new "balance"
  - Print "interest" and "balance" on screen
  - Repeat last 3 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:
    - Next, compute "interest"
    - Next, compute new "balance"
    - Print "interest" and "balance" on screen
  - 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;

double interest;        int    year;

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:                                      */
/* 10/19/04 RD  initial version                        */

#include <stdio.h>

/* main function */

int main(void)
{
   /* variable definitions */
   double amount, 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);
...
```

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Example Program

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

```
...

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

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

/* EOF */
```

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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 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.
%
```