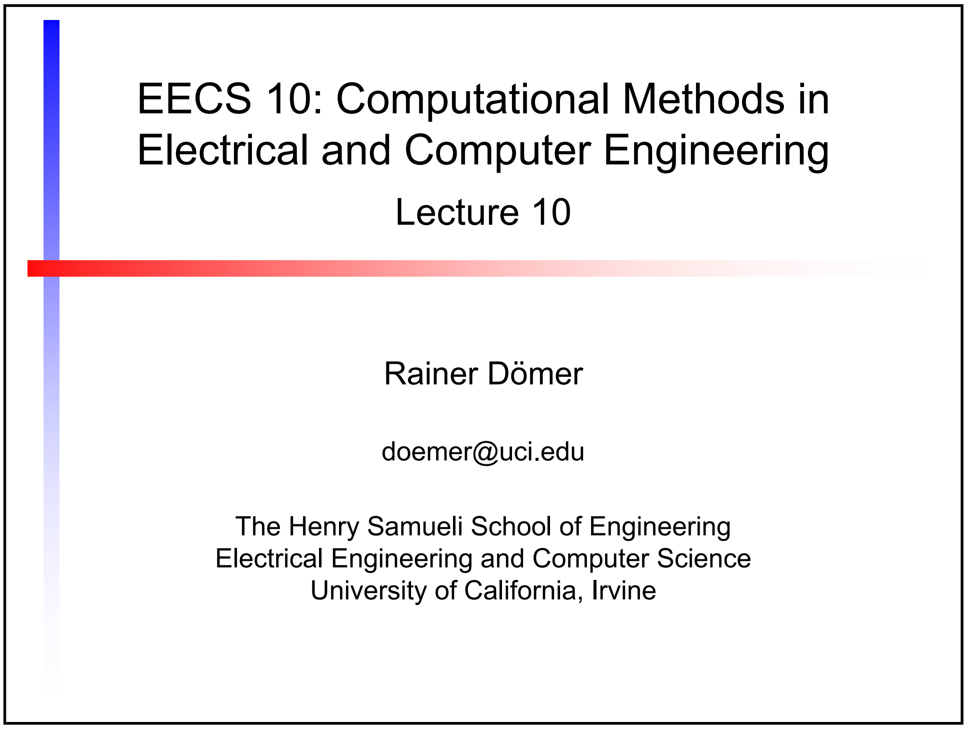

EECS 10: Computational Methods in Electrical and Computer Engineering

Lecture 10

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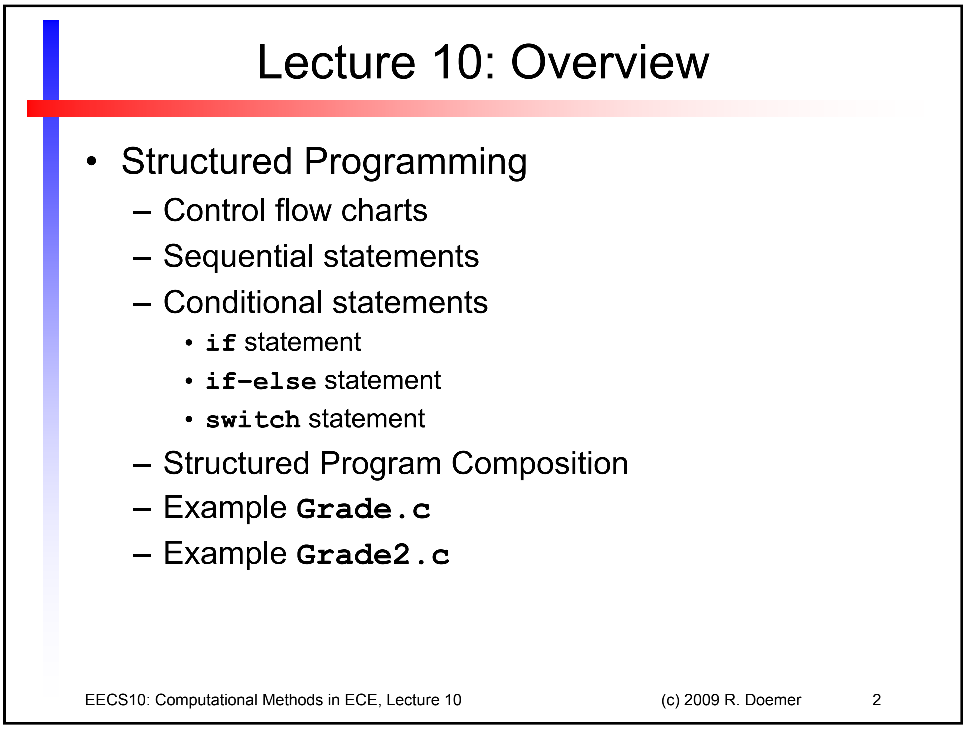
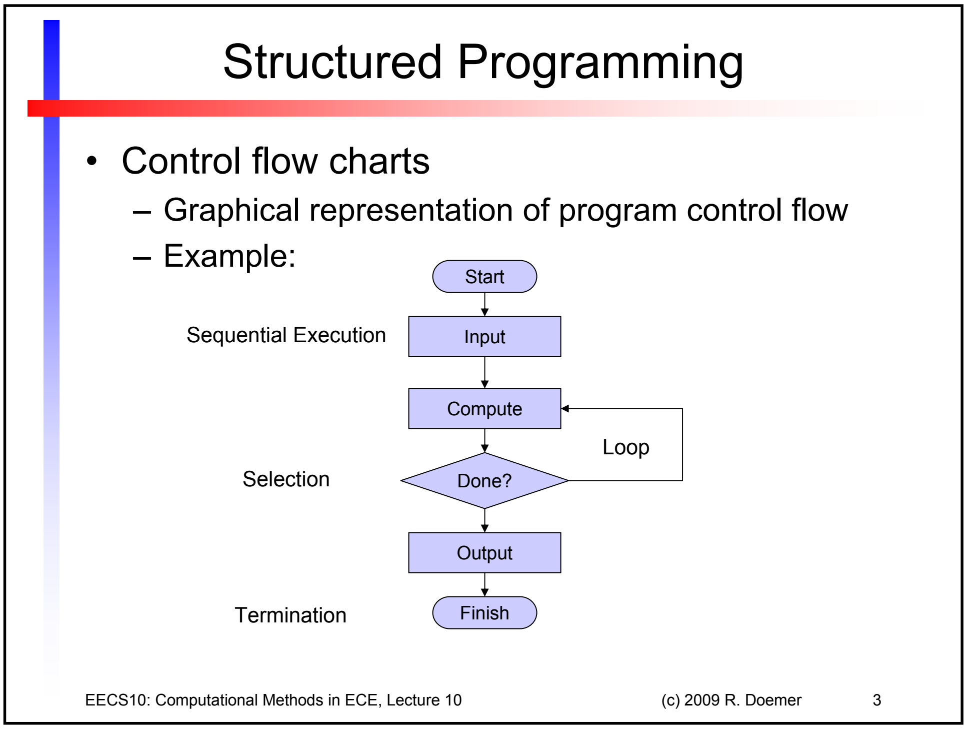


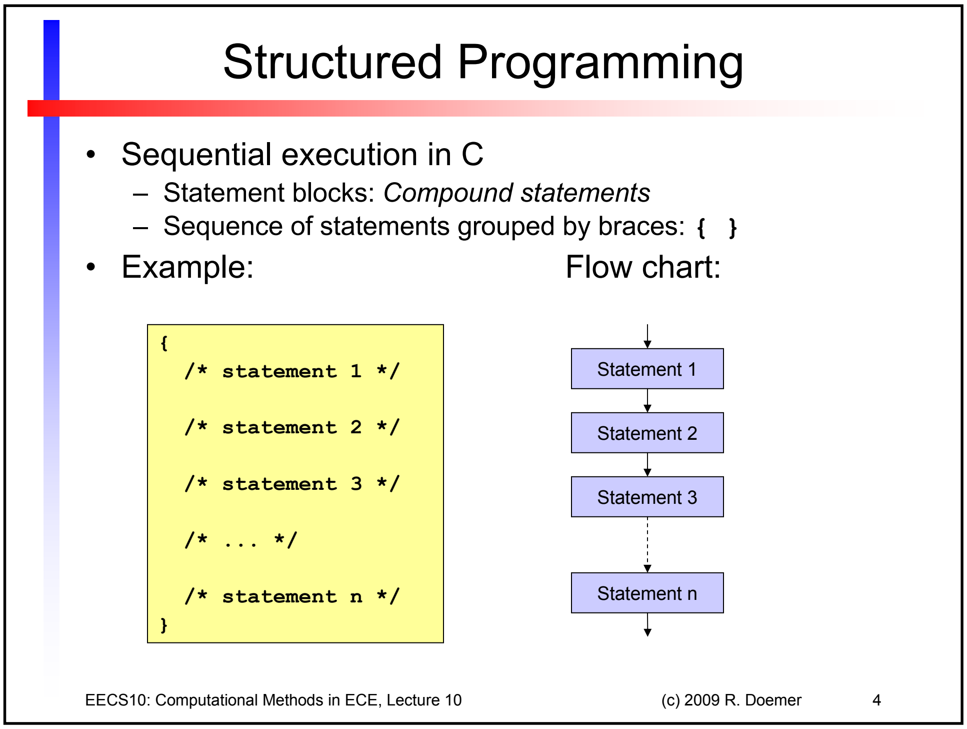
Lecture 10: Overview

- Structured Programming
  - Control flow charts
  - Sequential statements
  - Conditional statements
    - **`if`** statement
    - **`if-else`** statement
    - **`switch`** statement
  - Structured Program Composition
  - Example **`Grade.c`**
  - Example **`Grade2.c`**



Structured Programming

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

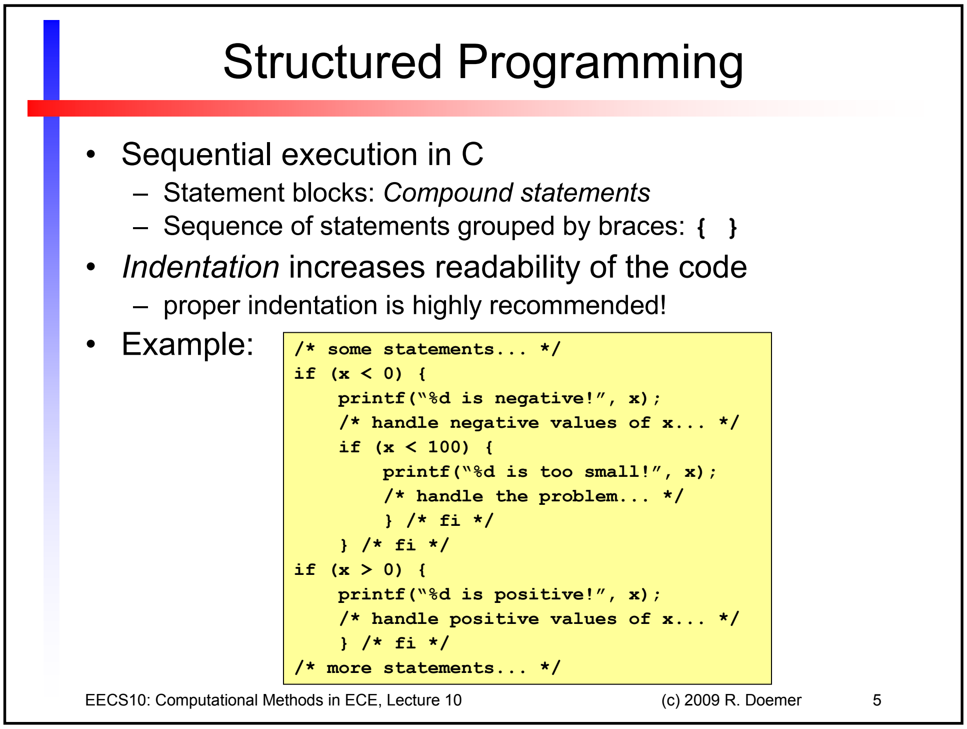


Structured Programming

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

```
{
  /* statement 1 */

  /* statement 2 */

  /* statement 3 */

  /* ... */

  /* statement n */
}
```

Flow chart:



Structured Programming

- Sequential execution in C
  - Statement blocks: *Compound statements*
  - Sequence of statements grouped by braces: **{ }**
- *Indentation* increases readability of the code
  - proper indentation is highly recommended!
- Example:

```
/* some statements... */
if (x < 0) {
    printf(“%d is negative!”, x);
    /* handle negative values of x... */
    if (x < 100) {
        printf(“%d is too small!”, x);
        /* handle the problem... */
        } /* fi */
    } /* fi */
if (x > 0) {
    printf(“%d is positive!”, x);
    /* handle positive values of x... */
    } /* fi */
/* more statements... */
```

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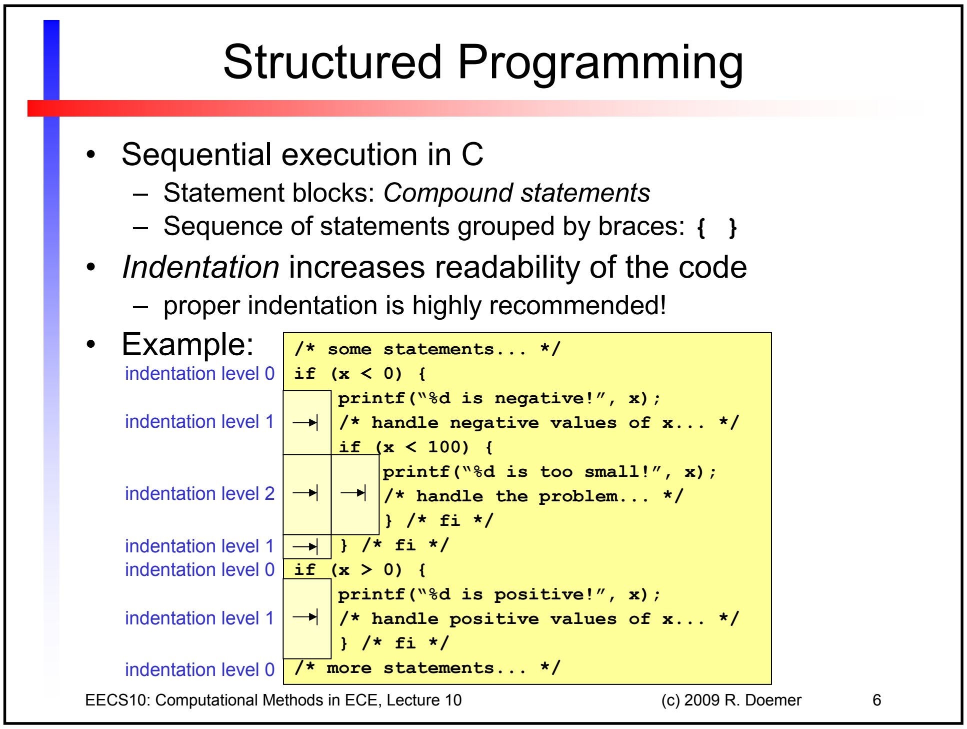

Structured Programming

- Sequential execution in C
  - Statement blocks: *Compound statements*
  - Sequence of statements grouped by braces: **{ }**
- *Indentation* increases readability of the code
  - proper indentation is highly recommended!
- Example:

```
                     /* some statements... */
indentation level 0  if (x < 0) {
                         printf(“%d is negative!”, x);
indentation level 1  →|  /* handle negative values of x... */
                         if (x < 100) {
                             printf(“%d is too small!”, x);
indentation level 2  →|  →|  /* handle the problem... */
                             } /* fi */
indentation level 1  →|  } /* fi */
indentation level 0  if (x > 0) {
                         printf(“%d is positive!”, x);
indentation level 1  →|  /* handle positive values of x... */
                         } /* fi */
indentation level 0  /* more statements... */
```

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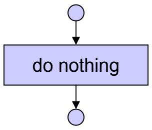
Structured Programming

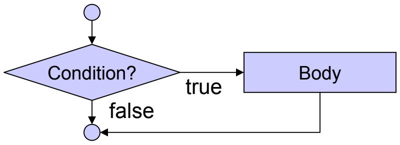
- Empty statement blocks
  - empty compound statement
  - does nothing (no operation, no-op)
  - Example: Flow chart:

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



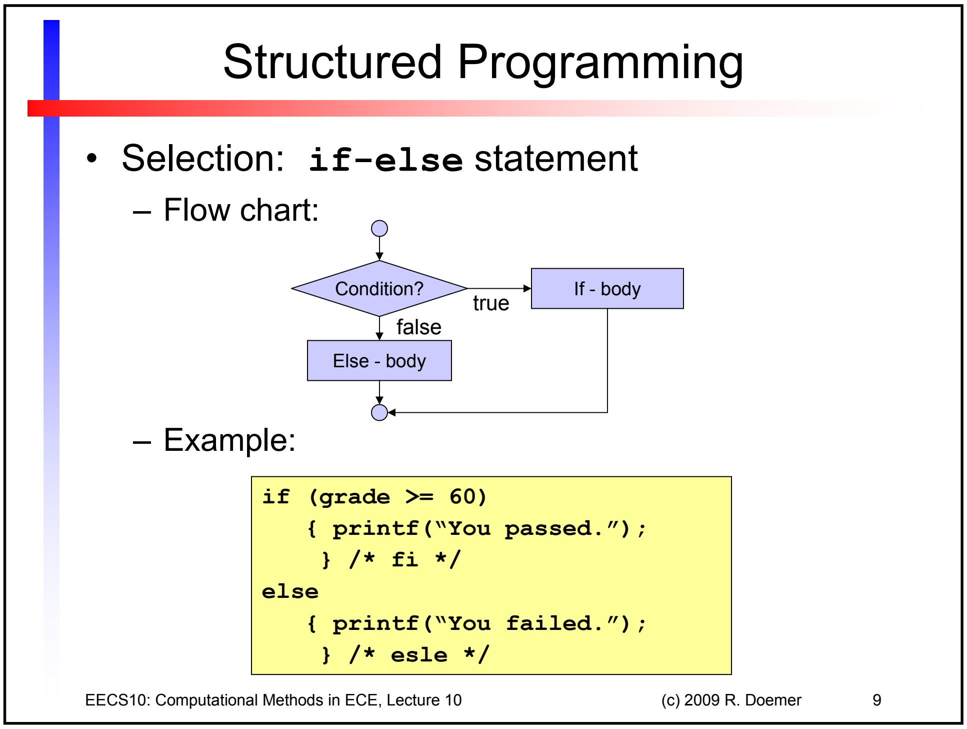
Structured Programming

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



  - Example:

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



Structured Programming

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

Condition?
true
If - body
false
Else - body

  - Example:

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

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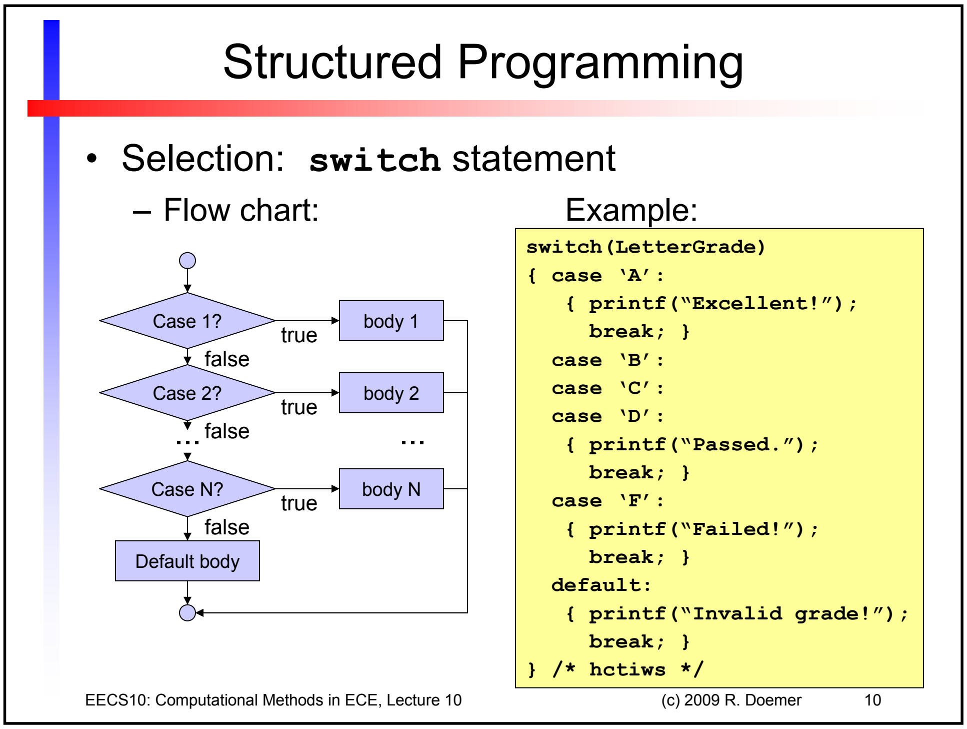

Structured Programming

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

Case 1?
true
body 1
false
Case 2?
true
body 2
false
…
…
Case N?
true
body N
false
Default body

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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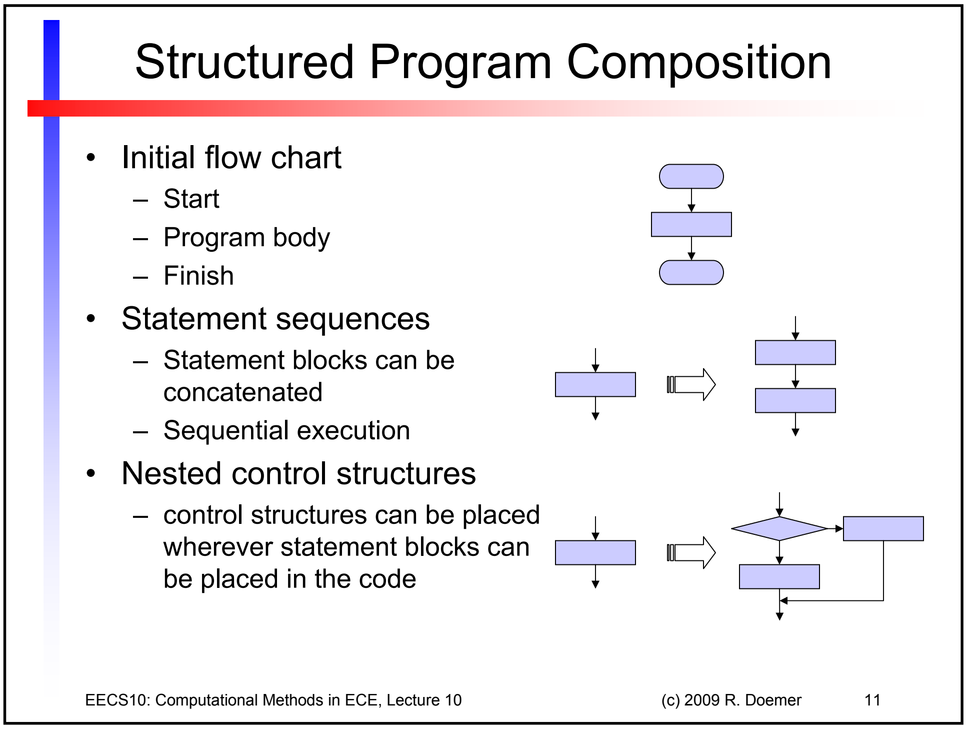
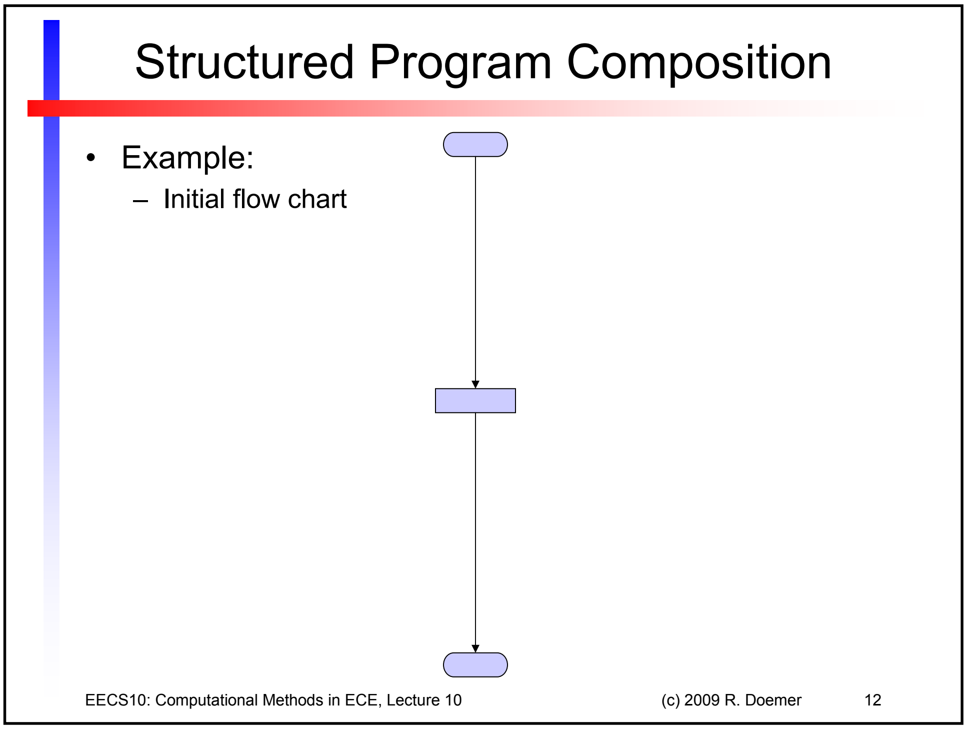


Structured Program Composition

- Initial flow chart
  - Start
  - Program body
  - Finish
- Statement sequences
  - Statement blocks can be concatenated
  - Sequential execution
- Nested control structures
  - control structures can be placed wherever statement blocks can be placed in the code

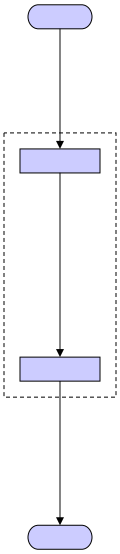


Structured Program Composition

- Example:
  - Initial flow chart

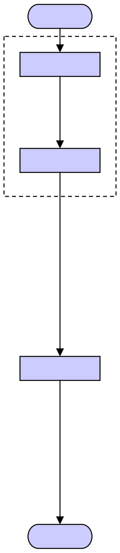
Structured Program Composition

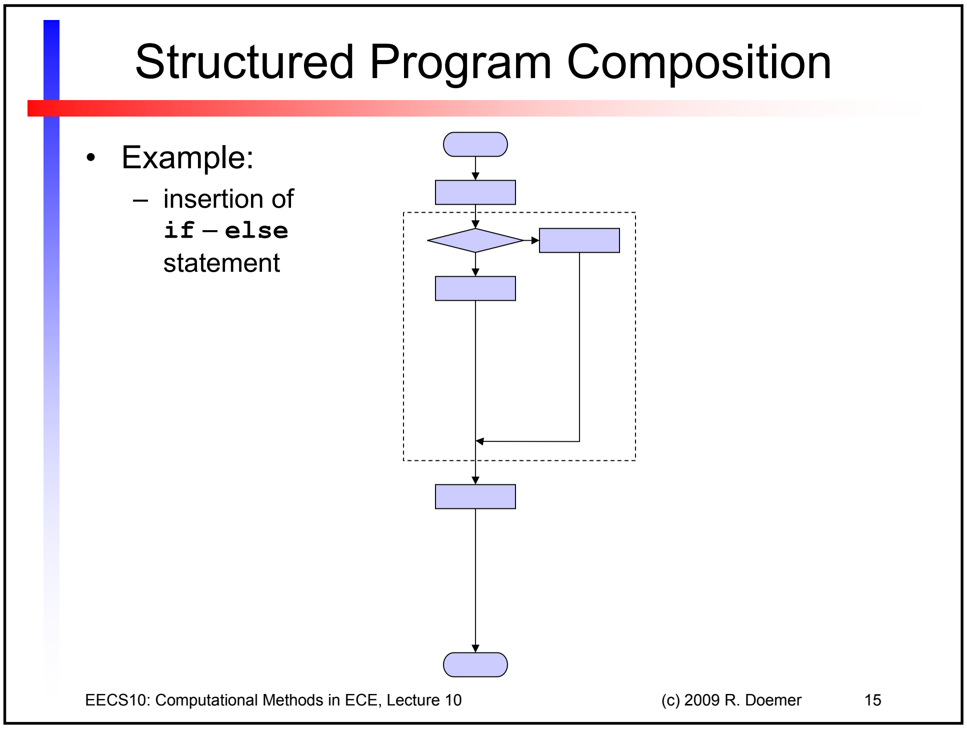
- Example:
  - Sequential composition



Structured Program Composition

- Example:
  - insertion of another sequential statement





Structured Program Composition

- Example:
  - insertion of **`if – else`** statement

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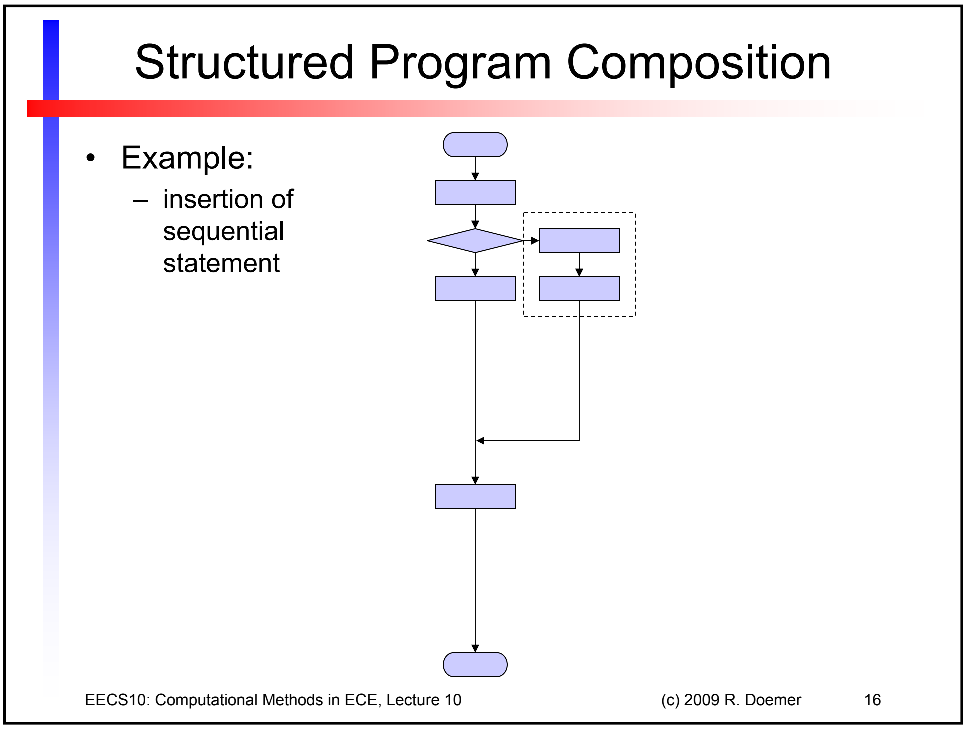

Structured Program Composition

- Example:
  - insertion of sequential statement

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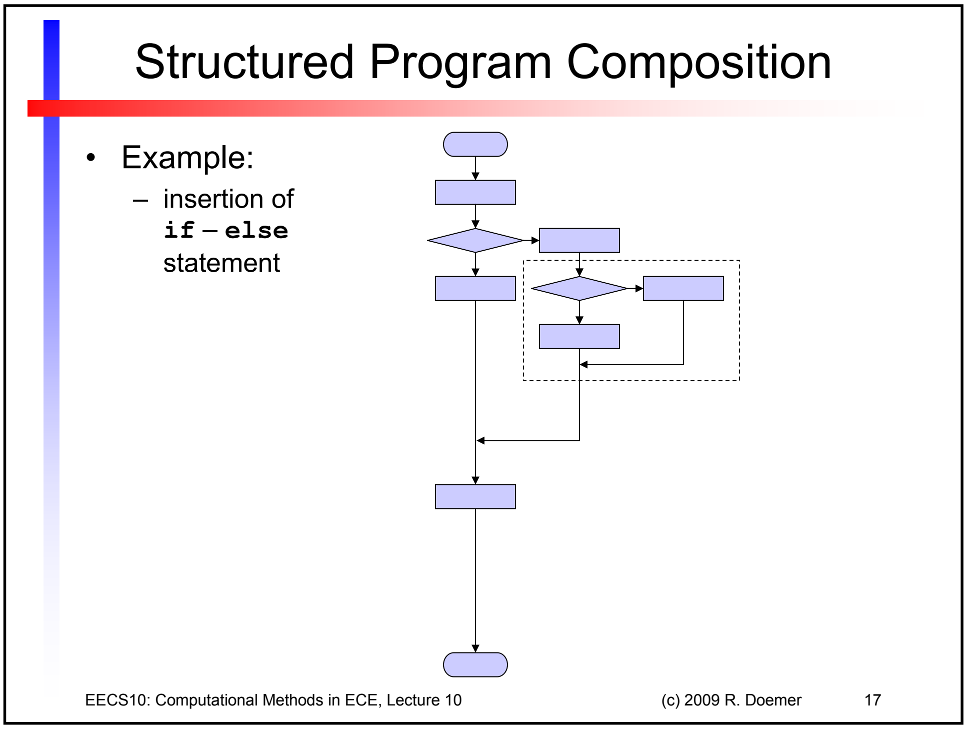
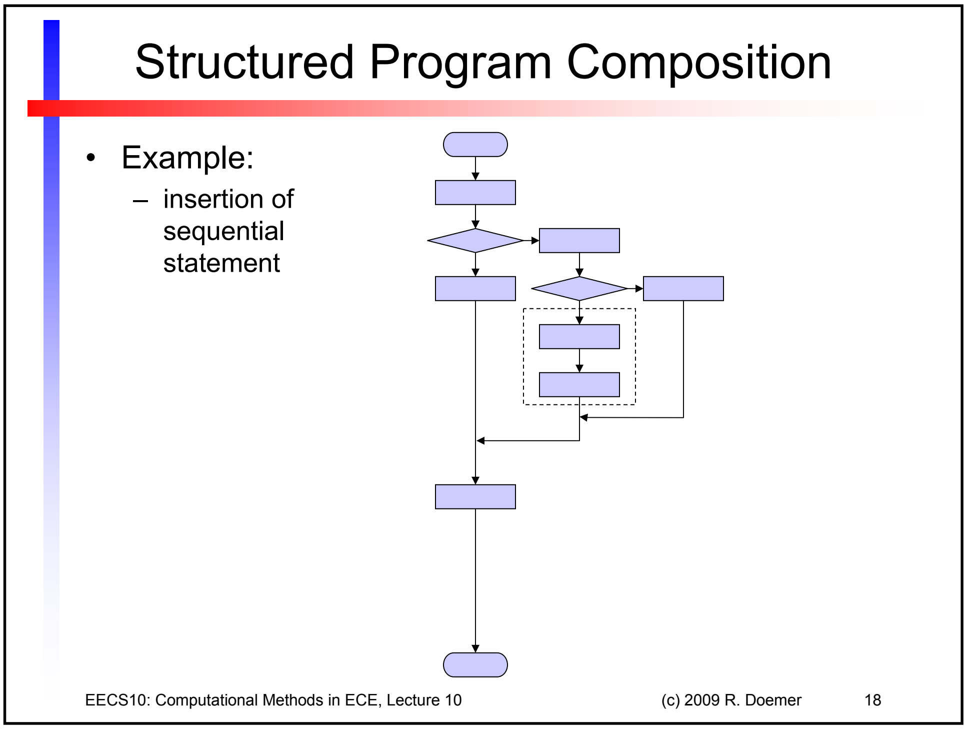


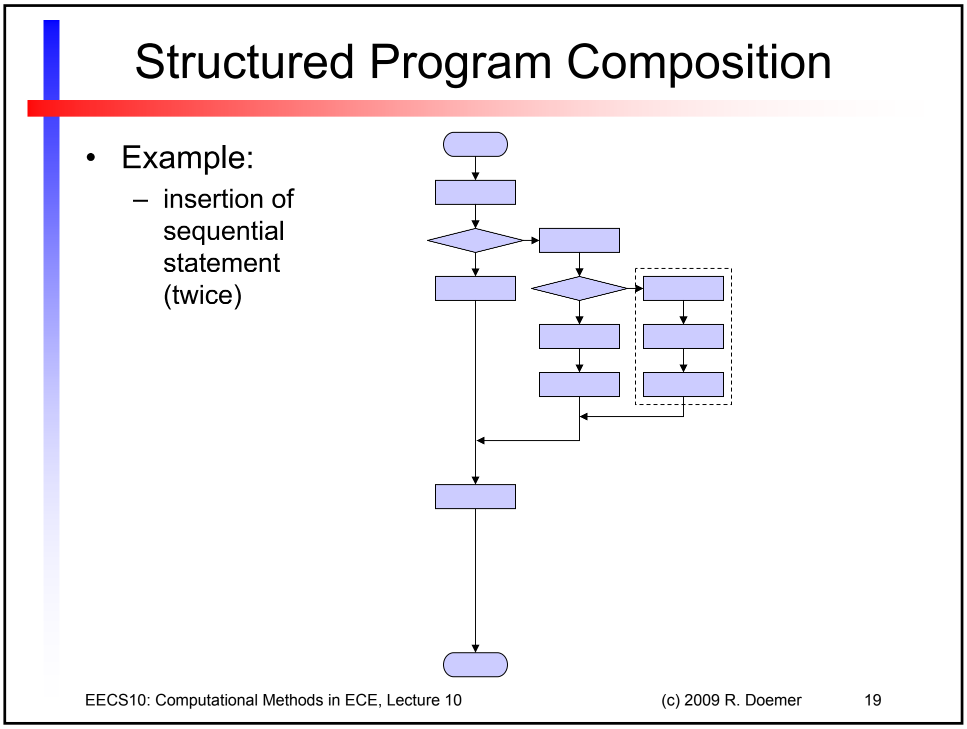
Structured Program Composition

- Example:
  - insertion of `if – else` statement



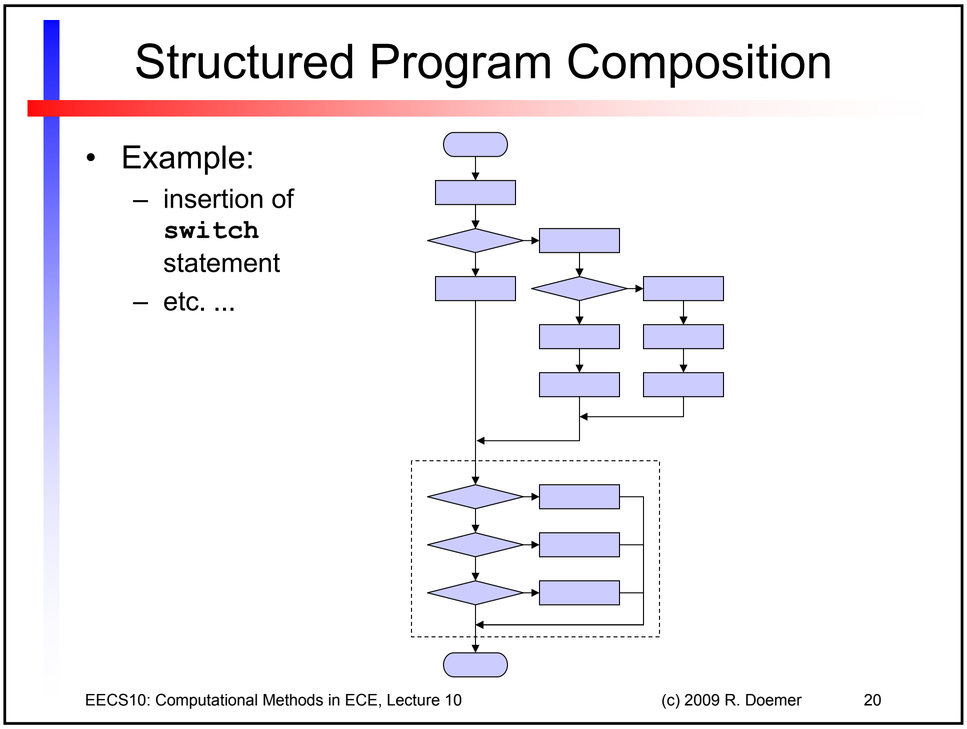
Structured Program Composition

- Example:
  - insertion of sequential statement



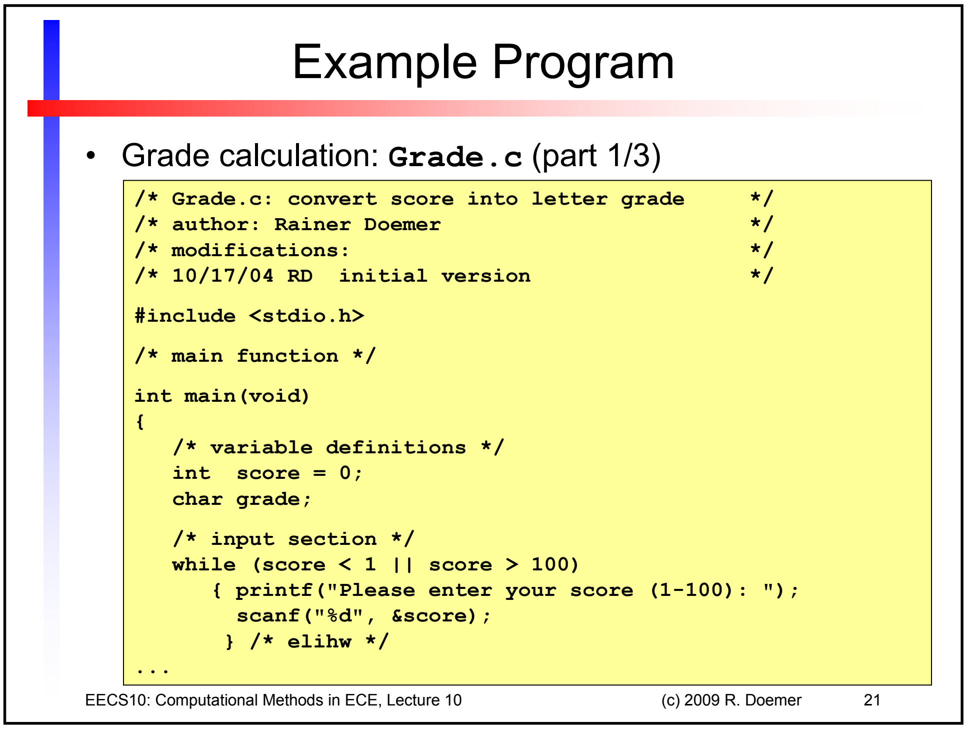
Structured Program Composition

- Example:
  - insertion of sequential statement (twice)



Structured Program Composition

- Example:
  - insertion of **switch** statement
  - etc. ...



Example Program

- Grade calculation: **`Grade.c`** (part 1/3)

```
/* Grade.c: convert score into letter grade     */
/* author: Rainer Doemer                        */
/* modifications:                               */
/* 10/17/04 RD  initial version                 */

#include <stdio.h>

/* main function */

int main(void)
{
   /* variable definitions */
   int  score = 0;
   char grade;

   /* input section */
   while (score < 1 || score > 100)
      { printf("Please enter your score (1-100): ");
        scanf("%d", &score);
       } /* elihw */
...
```

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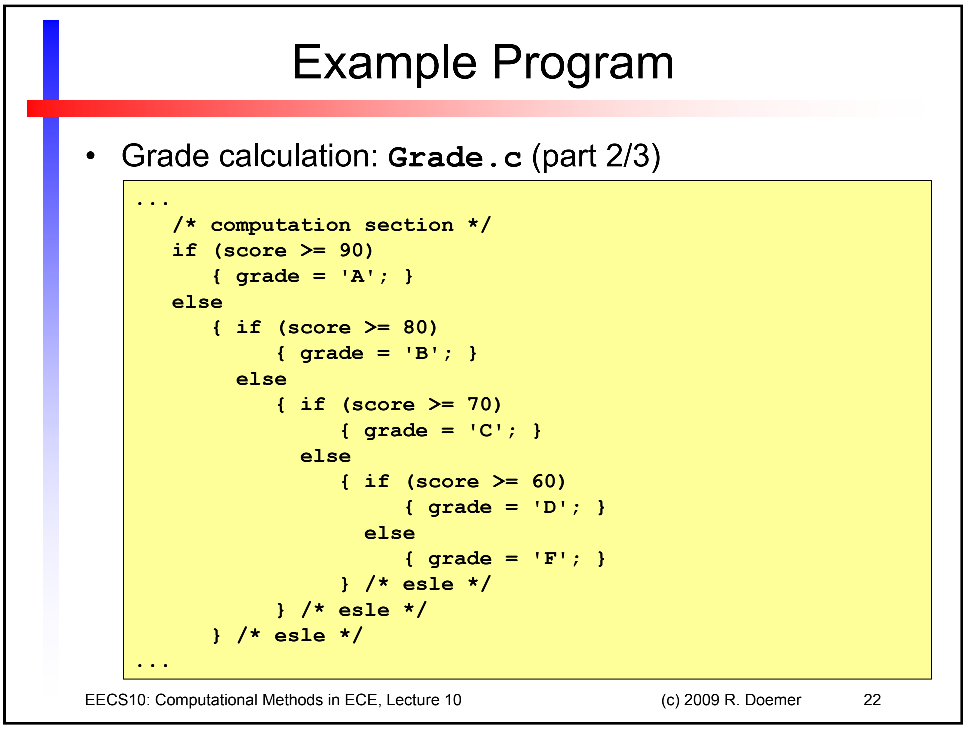

Example Program

- Grade calculation: **`Grade.c`** (part 2/3)

```
...
   /* computation section */
   if (score >= 90)
      { grade = 'A'; }
   else
      { if (score >= 80)
           { grade = 'B'; }
        else
           { if (score >= 70)
                { grade = 'C'; }
             else
                { if (score >= 60)
                     { grade = 'D'; }
                  else
                     { grade = 'F'; }
                } /* esle */
           } /* esle */
      } /* esle */
...
```

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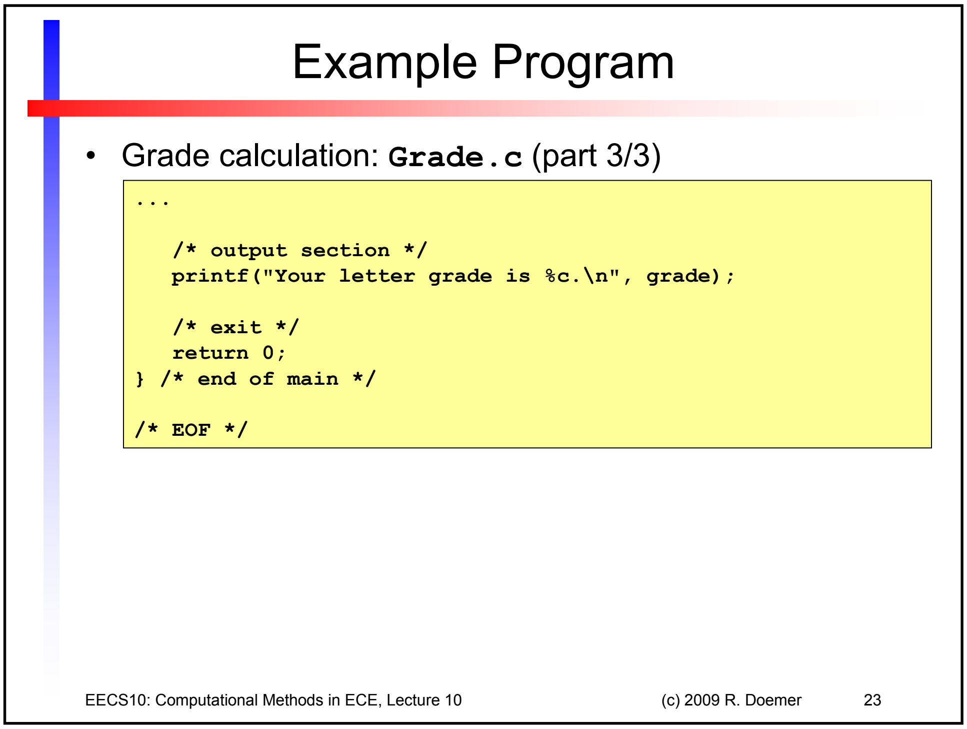
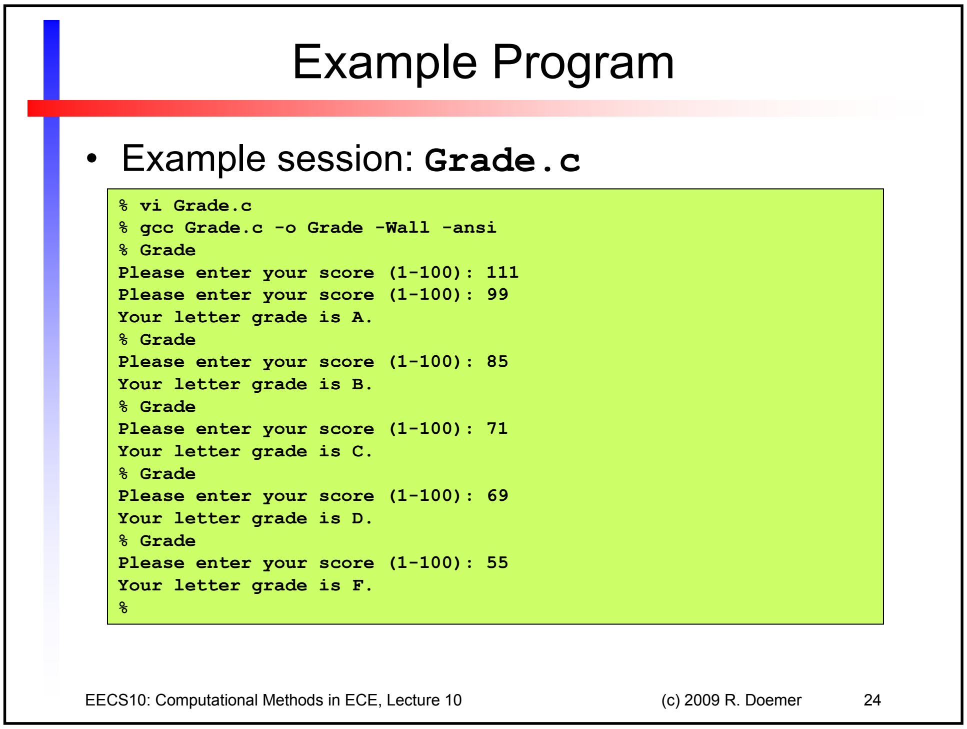


Example Program

- Grade calculation: **`Grade.c`** (part 3/3)

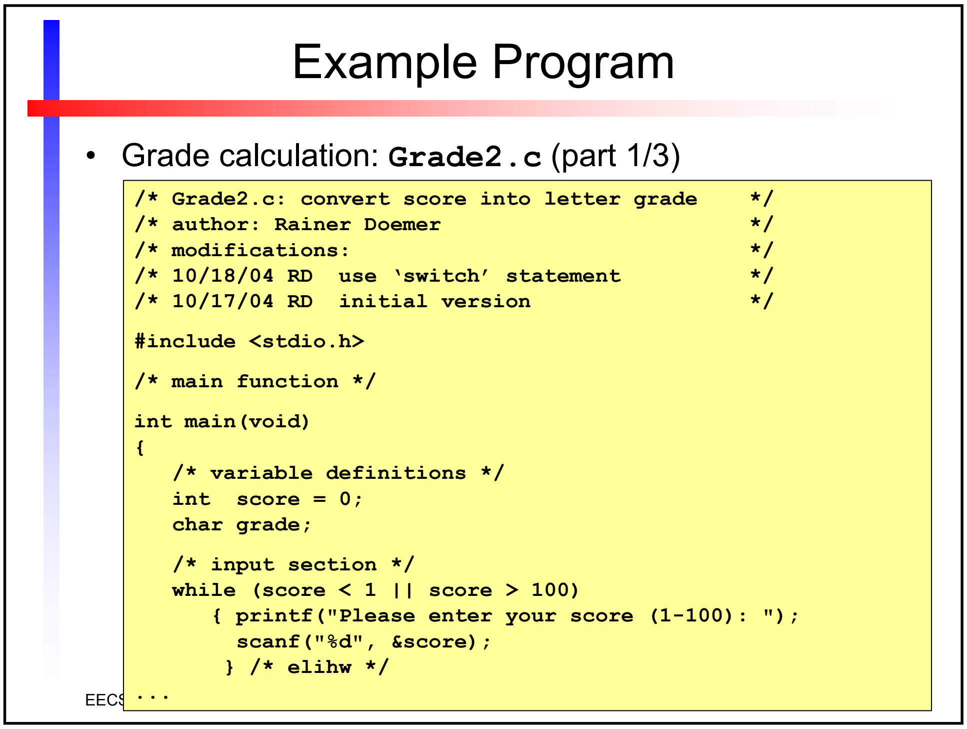
```
...

   /* output section */
   printf("Your letter grade is %c.\n", grade);

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

/* EOF */
```



Example Program

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

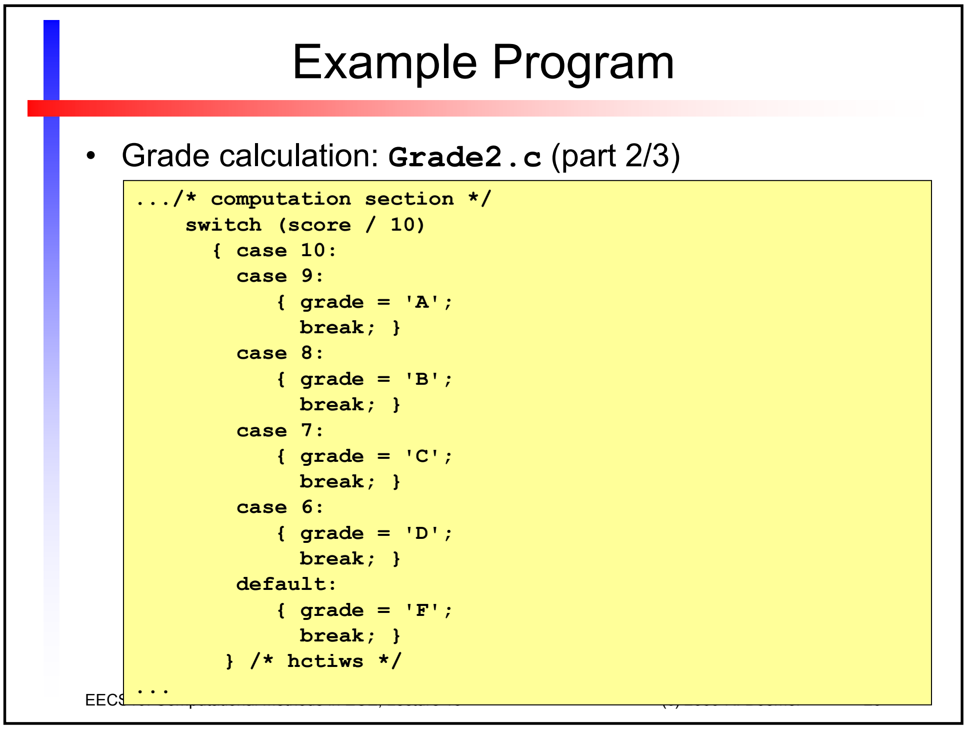
```
% vi Grade.c
% gcc Grade.c -o Grade -Wall -ansi
% Grade
Please enter your score (1-100): 111
Please enter your score (1-100): 99
Your letter grade is A.
% Grade
Please enter your score (1-100): 85
Your letter grade is B.
% Grade
Please enter your score (1-100): 71
Your letter grade is C.
% Grade
Please enter your score (1-100): 69
Your letter grade is D.
% Grade
Please enter your score (1-100): 55
Your letter grade is F.
%
```



Example Program

- Grade calculation: **`Grade2.c`** (part 1/3)

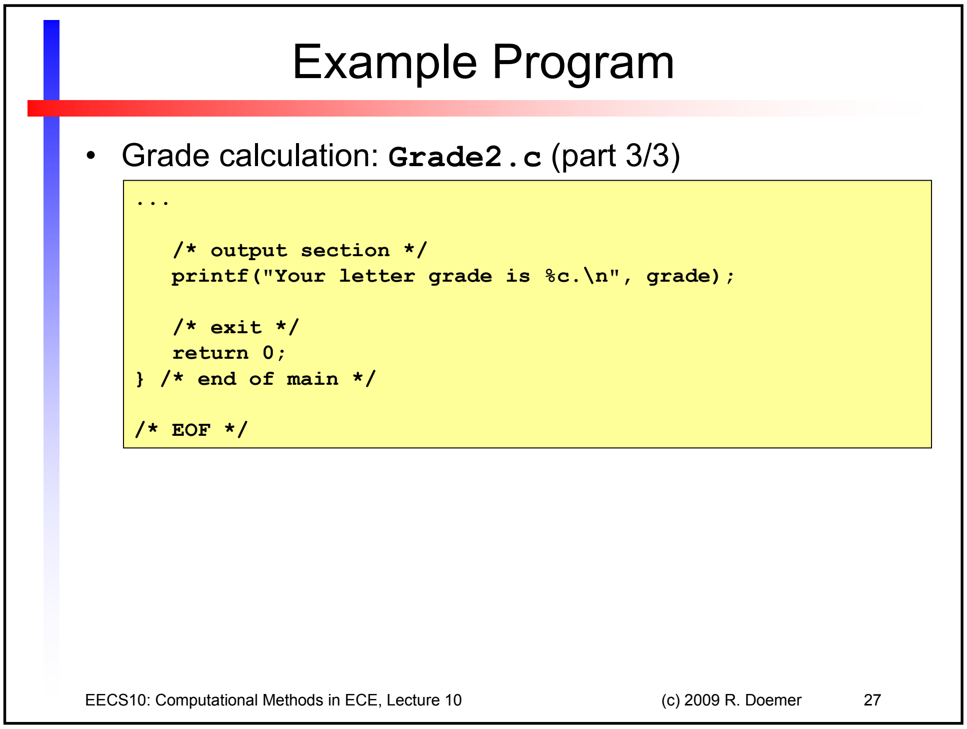
```
/* Grade2.c: convert score into letter grade    */
/* author: Rainer Doemer                        */
/* modifications:                               */
/* 10/18/04 RD  use ‘switch’ statement          */
/* 10/17/04 RD  initial version                 */

#include <stdio.h>

/* main function */

int main(void)
{
   /* variable definitions */
   int  score = 0;
   char grade;

   /* input section */
   while (score < 1 || score > 100)
      { printf("Please enter your score (1-100): ");
        scanf("%d", &score);
       } /* elihw */
...
```



Example Program

- Grade calculation: **`Grade2.c`** (part 2/3)

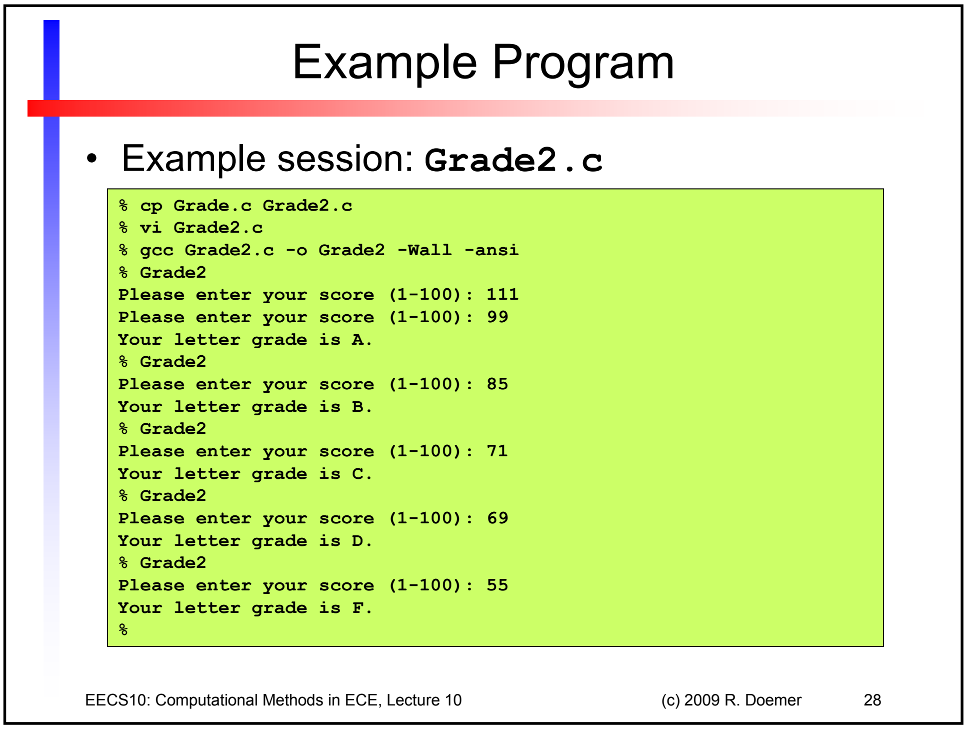
```
.../* computation section */
    switch (score / 10)
      { case 10:
        case 9:
           { grade = 'A';
             break; }
        case 8:
           { grade = 'B';
             break; }
        case 7:
           { grade = 'C';
             break; }
        case 6:
           { grade = 'D';
             break; }
        default:
           { grade = 'F';
             break; }
       } /* hctiws */
...
```



Example Program

- Grade calculation: **`Grade2.c`** (part 3/3)

```
...

   /* output section */
   printf("Your letter grade is %c.\n", grade);

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

/* EOF */
```



Example Program

- Example session: **`Grade2.c`**

```
% cp Grade.c Grade2.c
% vi Grade2.c
% gcc Grade2.c -o Grade2 -Wall -ansi
% Grade2
Please enter your score (1-100): 111
Please enter your score (1-100): 99
Your letter grade is A.
% Grade2
Please enter your score (1-100): 85
Your letter grade is B.
% Grade2
Please enter your score (1-100): 71
Your letter grade is C.
% Grade2
Please enter your score (1-100): 69
Your letter grade is D.
% Grade2
Please enter your score (1-100): 55
Your letter grade is F.
%
```