Overview of C

Computer Science Department

Comp 1310

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Motivation

```
//C program for area of circle     Comment
#include <stdio.h> // standard header file (contains printf and scanf )
#define PI  3.141   //we use define for creating constant
int main()                  // int, float , and return   (reserved words)
{
    float r, a;   //  r, a are variables
   printf("Please enter the radius: ");  //standard identifier
   scanf("%f", &r);    //standard identifier
   a = PI * r * r;      //  = , *,{, }  special symbols
   printf("%f\n", a); // standard identifier
   return 0;
}
```

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Preprocessor directives

- #include
  - gives a program access to a library
- <stdio.h>
  - standard header file
  - contains information about standard input and output functions such as scanf and printf

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Preprocessor directives

- #include <stdio.h>
  - notify the preprocessor that some names used in the program are found in <stdio.h>
- #define
  - using only data values that never change should be given names

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Preprocessor directives

- Constant macro
  - a name that is replaced by a particular constant value

EX:

#define PI 3.141593

constant macro constant value

#define MAX_LENGTH 100

Comment

- Two types:
  - One-line comment //
  - Multiple-line comment /* */

Examples:

```
// This is a one-line comment

/* Hello, this is
   multiple-line comment*/
```

Variable declarations and data types

- Variable: a name associated with a memory cell whose value can change.

Examples:

sum , x ,y , result,…..

Variable declarations and data types

1. A variable must consist only of letters, digits, and underscores.
2. A variable cannot begin with a digit.
3. A C reserved word cannot be used as a user variable.
4. A variable defined in a C standard library should not be redefined.

Reserved Words : A word that has special meaning in C

for example: int, float, double, char , return ,…etc

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Variable declarations and data types

Syntax Display for Declarations:

Syntax :

- int *variable_list*;
- float *variable_list;*
- double *variable_list;*
- char *variable_list;*

- Examples :
  - int count, large;
  - float ans; or float ans=4.2;
  - double x, y, z; or double x=1.2,y=3.6,z=8.9;
  - char first_initial;

Variable declarations and data types

Data types:

- int (16 bit)
- float (32 bit)
- double (64 bit)

a real number has an integral part and a fractional part that are separated by a decimal point

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Variable declarations and data types

Data types:

- char (8 bit)
  - represent an individual character value
  - include a letter, a digit, a special symbol
  - ex. ‘A’ ‘z’ ‘2’ ‘9’ ‘ * ’ ‘ : ’ ‘ ” ’ ‘ ‘

Variable declarations and data types

Invalid variables names

Invalid identifier	Reason Invalid
1Letter	begins with a digit
double	reserved word
int	reserved word
TWO*FOUR	character * not allowed
joe's	character ' not allowed

To remove the ambiguity

Reserved Words	Standard Identifiers	User-Define Identifiers
int	printf	KMS_PER_MILE
void	scanf	miles
float		kms
double		sum
return		sum

NOTE: <u>Sum</u>, <u>sum</u>, <u>SUM</u> are viewed by the compiler as different identifiers

Placeholders in format strings

Placeholder	Variable Type	Function Use
%c	char	printf / scanf
%d	int	printf / scanf
%f	float	printf / scanf
%f	double	printf
%lf	double	scanf

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Placeholders in format strings

```
int  sum ;
float a, r ;
double num;
```

let sum=2

a=3.2 , r=5,2

num= 76.2232

- printf (“The area is %f”, a);
- scanf(“ %f ”,&r);
- printf (“the result is %d”, sum);
- scanf (“%lf”,& num);
- printf (“the number is %f”, num)

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Arithmetic expressions.

Arithmetic Operator	Meaning	Examples
+	addition	5 + 2 is 7
-	subtraction	5 - 2 is 3
*	multiplication	5 * 2 is 10
/	division	5 / 2 is 2
%	Remainder or Mod	5 % 2 is 1

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Arithmetic expressions.

Results of / and % operations

2 / 15 = 0

16 / 3 = 5

4 / 0 undefined

2 % 5 = 2

5 % 4 = 1

15 % 0 undefined

int / int = int

12/3= 4 , 9/8=1

int/float =float , float/int=float

float/float=float

9/8.0=1.125000

9.0/8=1.125000

9.0/8.0=1.125000

Arithmetic expressions.

- Example:

```
double k,m;
 k= 9/6;
 m=9/6.0;

 printf("k=%f \nm= %f", k,m);
```

Output:

k=1.000000
m=1.500000

Arithmetic expressions.

Precedence Rules:

- ()
- * / %
- + -

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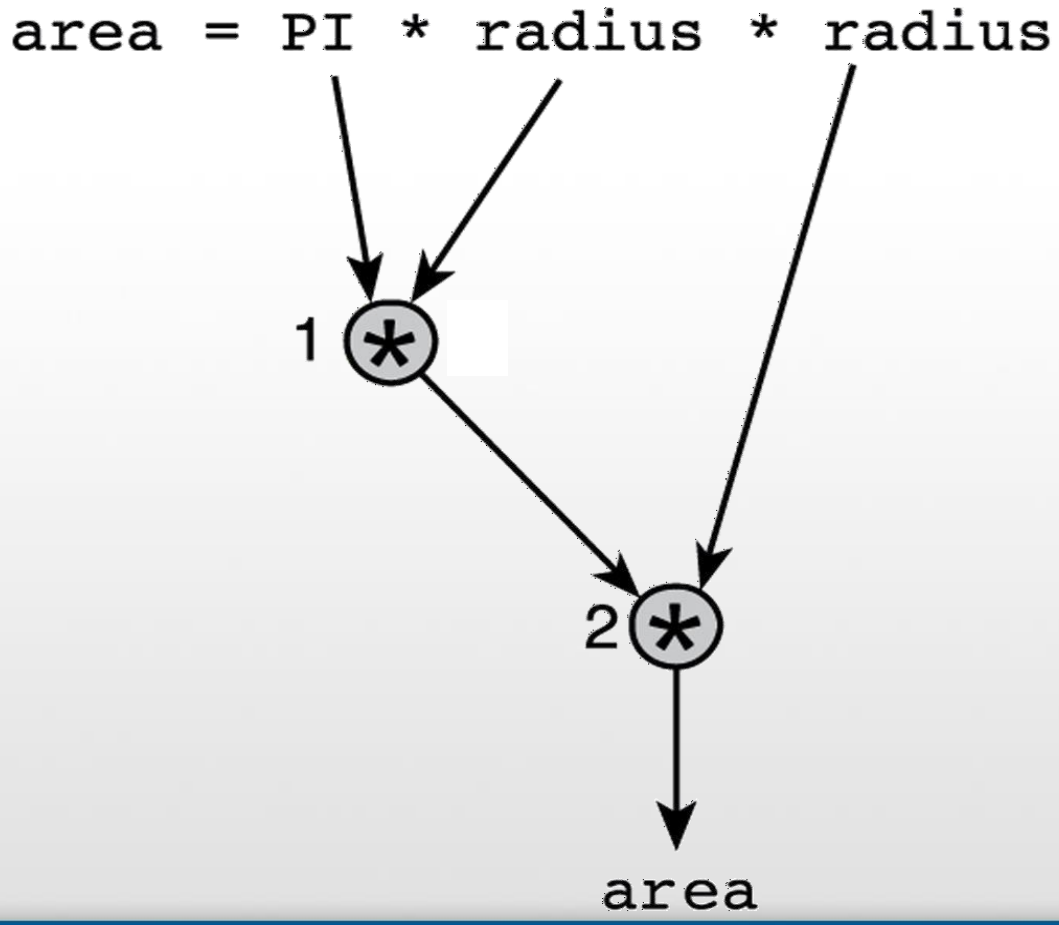
Arithmetic expressions.

Example 1 : Evaluate area = PI * radius * radius



Arithmetic expressions.

Example 1 : Evaluate area = PI * radius * radius

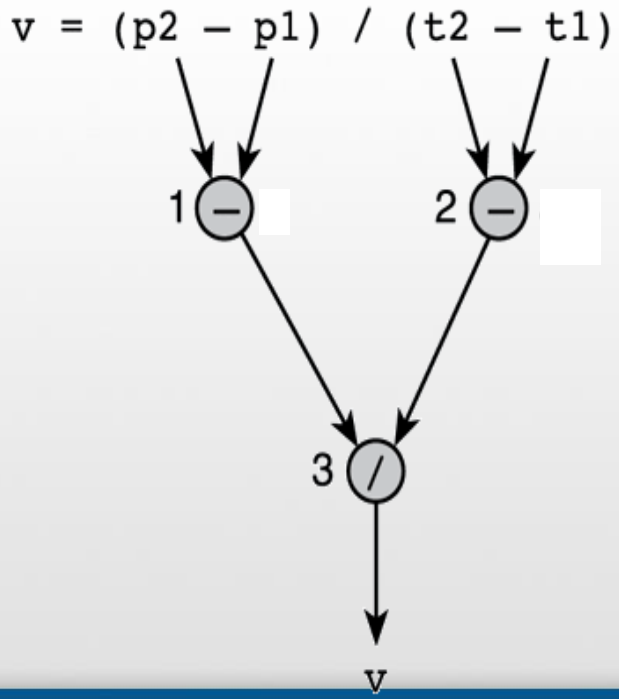
Let PI= 3.14159 , radius=2.0

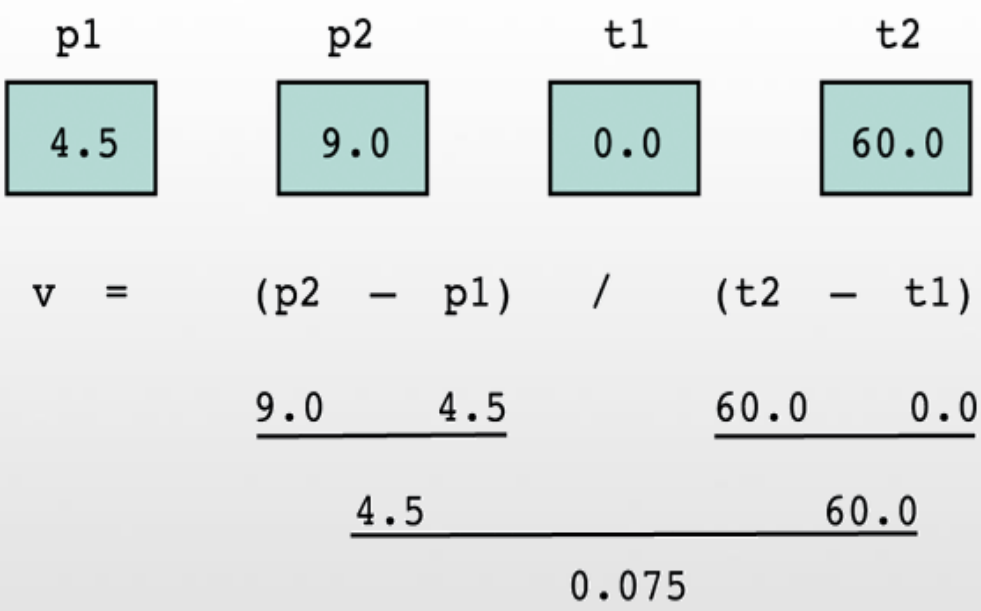
```
area     =      PI     *    radius    *    radius
            3.14159          2.0            2.0
            ------------------------
                  6.28318
                  ------------------------------
                                12.56636
```

Arithmetic expressions.

Example 1 : Evaluate $v = \dfrac{p2-p1}{t2-t1}$

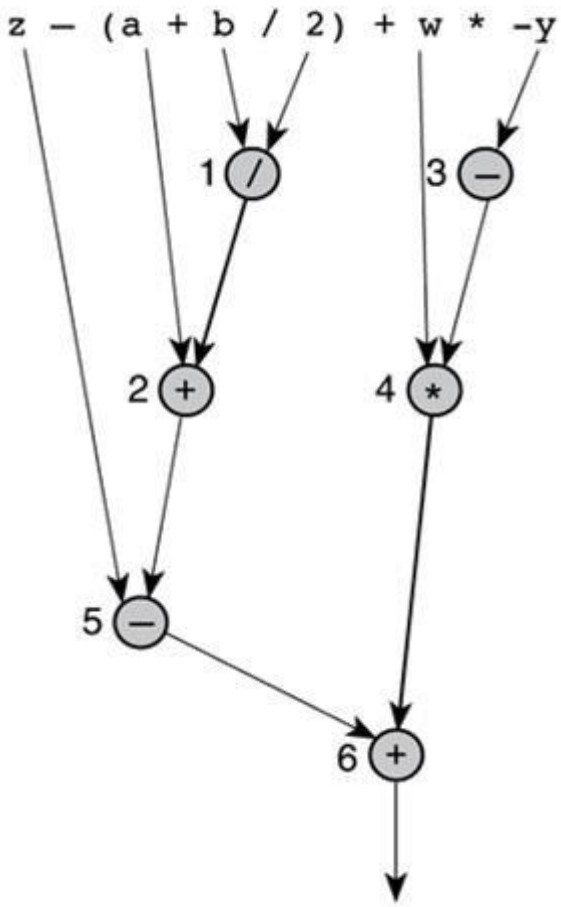
let P1=4.5 ,P2=9.0, t1=0.0, t2=60.0

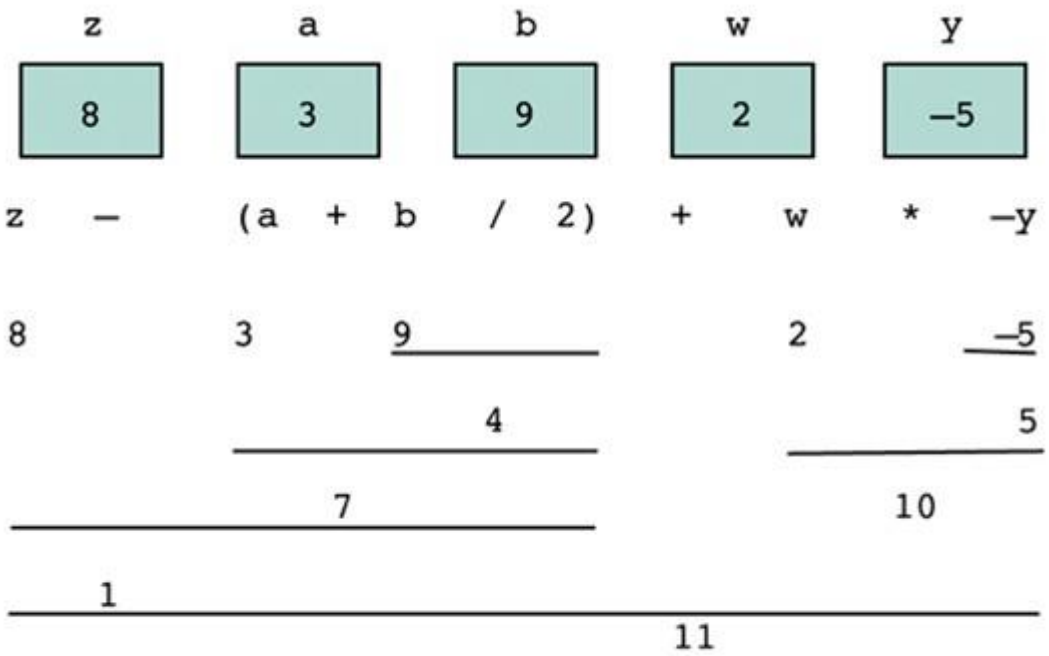




Arithmetic expressions.

Example 1 : Evaluate z - (a + b / 2) + w * - y





Arithmetic expressions.

Mathematical Formula as C Expression

Mathematical Formula	C Expression
b^2-4ac	b * b - 4 * a * c
a + b - c	a + b - c
$\frac{a+b}{c+d}$	(a + b) / (c + d)
$\frac{1}{1+x^2}$	1 / (1 + x * x)
a x -(b + c)	a * -(b + c)

Arithmetic expressions.

Example:

Write a complete C program that prompts the user to enter the radius of a circle and displays the circumference. Circumference=2 πr

```
#include <stdio.h>
#define PI 3.14159
int main(void)
 {
     double radius, circum;
     printf("Please enter radius of circle> ");
     scanf("%lf", &radius);
     circum = 2 * PI * radius;
     printf("The circumference is %.2f.\n", circum);
     return 0;
 }
```

Formatting output

int x= 4678, y=3 , z=19

1. printf (“%d %d %d”, x,y,z)

Output

4678 3 19

2. printf (“%7d %5d %6d”, x,y,z)

Output

4678 3 19

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Formatting output

- float x=56.2757 y=2.3849 z=114.2 ;

  printf (“%8.3f%-7.2f%7.4f”,x,y,z);

  ▒▒ 56.276 **2.38** ▒▒▒ **114.2000**

- double a= 38.56, b= 201.117;

  printf("Is it%6.1f%9.4f", a, b);

  Is▒ **it** ▒▒ 38.6 ▒ **201.1170**

- float x=333.256;

  printf("%0.2f",x);

  333.26

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Formatting output (Practice)

Value	Format	Displayed Output		Value	Format	Displayed Output
234	%4d	▒234		-234	%4d	-234
234	%5d	▒▒234		-234	%5d	▒-234
234	%6d	▒▒▒234		-234	%6d	▒▒-234
234	%1d	234		-234	%2d	-234

Formatting output (Practice)

Value	Format	Displayed Output	Value	Format	Displayed Output
3.14159	%5.2f	▒3.14	3.14159	%4.2f	3.14
3.14159	%3.2f	3.14	3.14159	%5.1f	▒▒▒3.1
3.14159	%5.3f	3.142	3.14159	%8.5f	▒3.14159
.1234	%4.2f	0.12	-.006	%4.2f	-0.01
-.006	%8.3f	▒▒▒-0.006	-.006	%8.5f	-0.00600
-.006	%.3f	-0.006	-3.14159	%.4f	-3.1416

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Extra Exercises

1. Which of the following identifiers are (a) C reserved words, (b) standard identifiers, (c) conventionally used as constant macro names, (d) other valid identifiers, and (e) invalid identifiers?

void	MAX_ENTRIES	double	time	G	Sue's
return	printf	xyz123	part#2	"char"	#insert
this_is_a_long_one					

2. Do a step-by-step evaluation of the expressions that follow if the value of celsius is 38.1 and salary is 38450.00 .

- 1.8 * Celsius + 32.0
- (salary - 5000.00) * 0.20 + 1425.00

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Extra Exercises

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return	printf	xyz123	part#2	"char"	#insert
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2. Do a step-by-step evaluation of the expressions that follow if the value of celsius is 38.1 and salary is 38450.00 .

- 1.8 * Celsius + 32.0
- (salary - 5000.00) * 0.20 + 1425.00

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Example

- Write a program to reverse any two digits number? (check slide 15, Algorithm lecture)

```
#include <stdio.h>
int main()
{
    int num;
    int rem;
    int rev;
    int tens;
    printf("Please enter two digits number");
    scanf ("%d",&num);
    tens= num / 10;
    rem=num % 10;
    rev= rem * 10;
    rev= rev+ tens;
    printf ("the result is %d", rev);
    return 0;
}
```

Common programming errors

- Syntax Errors

  - is a mistake in the syntax.

Ex:

- missing semicolon
- undeclared variable
- last comment is not closed because of blank in */ close-comment sequence

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Common programming errors

- Logic Errors
  - an error caused by following an incorrect algorithm.

Ex:

sum = x-y (minus instead of plus)

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Common programming errors

- Run-Time Errors
  - an attempt to perform an invalid operation, detected during program execution.

Ex:

result= x / 0 (undefined)

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Common programming errors (Practice)

A Program with a syntax errors

```
221 /* Converts distances from miles to kilometers. */
222
223 #include <stdio.h>          /* printf, scanf definitions    */
266 #define KMS_PER_MILE 1.609 /* conversion constant          */
267
268 int
269 main(void)
270 {
271       double kms
272
273       /* Get the distance in miles. */
274       printf("Enter the distance in miles> ");
***** Semicolon added at the end of the previous source line

275       scanf("%lf", &miles);
***** Identifier "miles" is not declared within this scope
***** Invalid operand of address-of operator

276
277       /* Convert the distance to kilometers. */
278       kms = KMS_PER_MILE * miles;
***** Identifier "miles" is not declared within this scope

279
280       /* Display the distance in kilometers. * /
281       printf("That equals %f kilometers.\n", kms);
282
283       return (0);
284 }
***** Unexpected end-of-file encountered in a comment
***** "}" inserted before end-of-file
```

Common programming errors (Practice)

A Program with a run-time error

```
111 #include <stdio.h>
262
263 int
264 main(void)
265 {
266         int     first, second;
267         double temp, ans;
268
269         printf("Enter two integers> ");
270         scanf("%d%d", &first, &second);
271         temp = second / first;
272         ans = first / temp;
273         printf("The result is %.3f\n", ans);
274
275         return (0);
276 }

Enter two integers> 14 3
Arithmetic fault, divide by zero at line 272 of routine main
```

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Type conversion through casts

- type cast
  - converting an expression to a different type by writing the desired type in parentheses in front of the expression
- Example 1: n = (int)(9 * 0.5);

  The value of n is 4

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Type conversion through casts

Using Cast

```c
#include <stdio.h>
int main()
{
    int sum = 17, count = 5;
    double mean;
    mean = (double) sum / count;
    printf("Value of mean : %f\n", mean );
    return 0;
}
```

Value of mean : 3.400000

Without Cast

integer division would cause the loss of the fractional part of the mean

```c
#include <stdio.h>
int main()
{
    int sum = 17, count = 5;
    double mean;
    mean = sum / count;
    printf("Value of mean : %f\n", mean );
    return 0;
}
```

Value of mean : 3.000000

Find more examples: http://www.tutorialspoint.com/cprogramming/c_type_casting.htm

Escape sequences

Escape Sequence causes the program to escape from the normal interpretation of a string, so that the next character is recognized as having a special meaning. The back slash "****" character is called the "**Escape Character**".

The escape sequence includes the following:
\n => new line
\t => tab
\r => carriage return
\" => double quotations
\\ => back slash etc.

Extra Exercises

1) **What will be the output of the printf statement**
   printf("hello\ryou");

2) **Evaluate the following formulas:**
   - 7 - 15 / 4
   - 6 * 5 / 10
   - 2 - 4 * 3 + 26 / 2

3) **Find the value of x after applying the casting**
   - **x= (double) (r/t) , r=10, t=3**
   - **x= (double) r/t , r=10, t=3**
   - **x= r/(double)t , r=10, t=3**

Question?

“Success is the sum of small efforts, repeated day in and day out.”
Robert Collier

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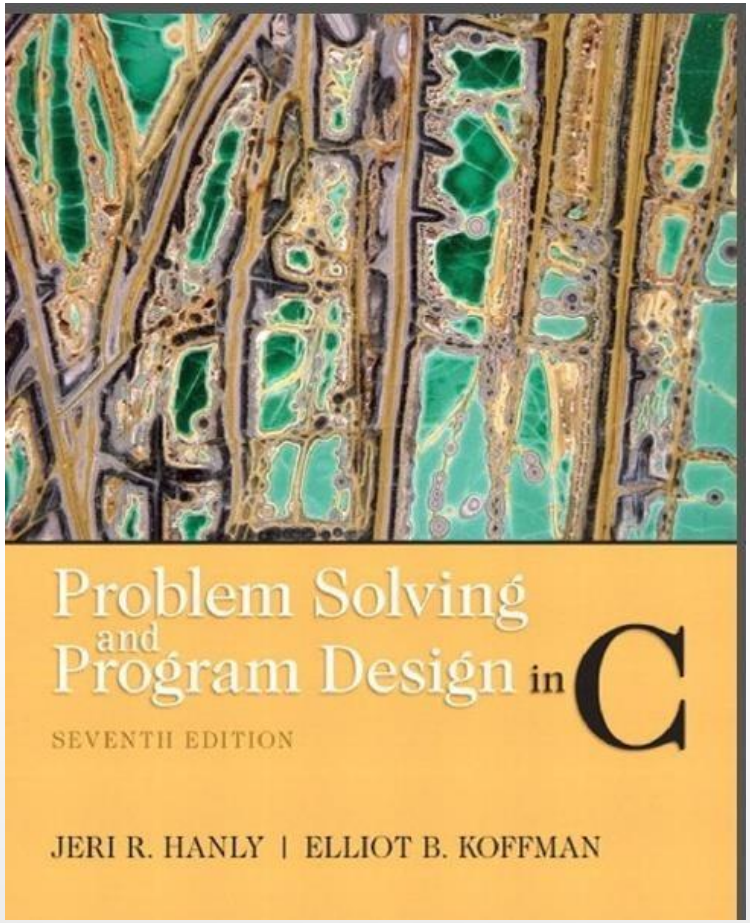

Reference: *Problem Solving & Program Design in C*

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