

Lesson 2 - Introduction to C language

Logical Computational Thinking

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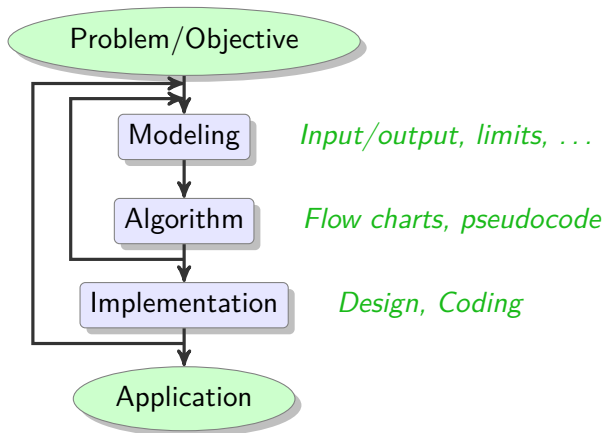
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10 September 2015

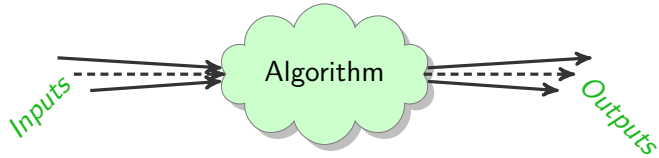


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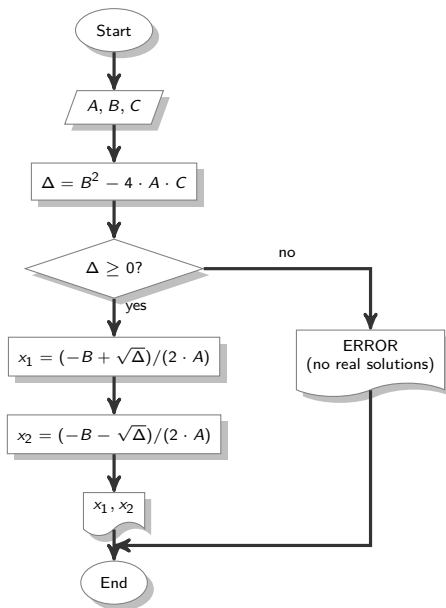
Review



Model



Algorithm



C language

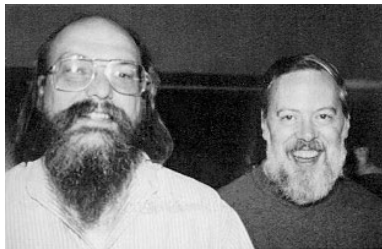


Figure: Ken Thompson and Dennis Ritchie

History

- ✓ The language **C** is developed in the 70's by Dennis Ritchie
- ✓ Along with the **Unix** system, created by Ken Thompson and Dennis Ritchie in the same years

Basics

Blocks

```
1  {  
2      ...  
3  }
```

- ✓ Good practice to **indent** the code to the right every time a block is open, and to the left when is closed.

Comments

```
1  //Single line comment  
2  
3  /* Multiple  
4  lines  
5  comments */
```

Main and libraries

Libraries

```
1  #include<stdio.h>
2  #include<math.h>
```

- ✓ For including code defined elsewhere.
- ✓ Can be custom libraries or standard libraries like:
 - `stdio.h` stands for *ST*andard *I*ntput *O*utput and provide basic interface with the terminal;
 - `math.h` provide some useful mathematical functions, like `pow` and `sqrt` .
- ✓ The `#include` directives must be write on top of the source file (before the main)

Main

- ✓ Is the entry point for the program.

```
1  int main(void) {  
2      ...  
3      return 0;  
4  }
```

or

```
1  int main(int argc, char *argv[]) {  
2      ...  
3      return 0;  
4  }
```


Example

hello_world.c

```
1 //Compile it with gcc hello_world.c -o  
    ↪ hello_world  
2  
3 #include<stdio.h> //library for input/output  
4  
5 int main(void) { //begin of main  
6     printf("Hello_world!\n"); //output of  
    ↪ string  
7     return 0;  
8 }
```

Variables

Initialization

```
1  int var1;                //default initial value
2  float var2 = 3.1415;    //custom initial value
3  int var3, var4, var5;   //multiple initialization
```

- ✓ C is **case sensitive**, `int` \neq `Int` \neq `INT` .
- ✓ Allowed names can contains `[A-Z,a-z,0-9,_]` , cannot begin with a number.
- ✓ Good practices are: to use **camel case** or `_` for composed words, and to start with **lower case**. I.e. `camelCaseExample` .
- ✓ Also when possible define variables on method begin.

Variables

Assignment

```
1 var1 = 42;
```

- ✓ Is possible to use also **expressions** on the right of =
- ✓ Also with other variables or the same variable.

```
1 var3 = var4 + var5;  
2 var3 = var3 - 1;
```

Variable types

Integer

type	size	min value	max value
char	1 byte	-128	127
short	2 bytes	-32,768	32,767
int	4 bytes	-2,147,483,648	2,147,483,647
long	8 bytes	-9,223,372,036,854,775,808	9,223,372,036,854,775,807
unsigned char	1 byte	0	255
unsigned short	2 bytes	0	65,535
unsigned int	4 bytes	0	4,294,967,295
unsigned long	8 bytes	0	18,446,744,073,709,551,615

✓ char is used also for the characters of the **ascii** table.

Variable types

Floating point

type	size	min value	max value	epsilon
float	4 bytes	$1.175494e^{-38}$	$3.402823e^{38}$	$1.192093e^{-07}$
double	8 bytes	$2.225074e^{-308}$	$1.797693e^{308}$	$2.220446e^{-16}$
long double	16 bytes	$3.362103e^{-4932}$	$1.189731e^{4932}$	$1.084202e^{-19}$

Boolean

- ✓ Is possible to use the type `bool`, and the values `true` and `false`.
- ✓ You need to add `#include<stdbool.h>`.
- ✓ Not really useful because you can use any integer type with the values:
 - 0 for false;
 - $\neq 0$ for true.

Operators (in priority order)

Arithmetic

1. `*` , `/` , `%` ;
2. `+` , `-` ;

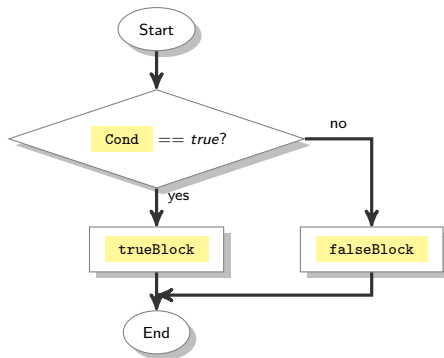
Logic

2. `!` ;
3. `<` , `>` , `<=` , `>=`
4. `==` , `!=` ;
5. `&&` ;
6. `||` ;

✓ Is possible to change order with `(` and `)` , i.e.:

```
1 (a+b)*c
```

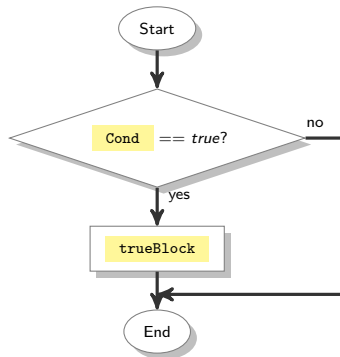
Selections



```
1  if(cond) {  
2    trueBlock;  
3  } else {  
4    falseBlock;  
5  }
```

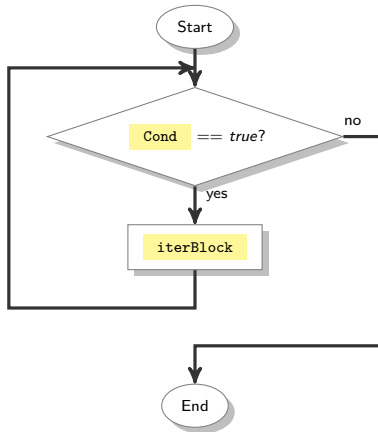
Selections

The `else` block is optional.



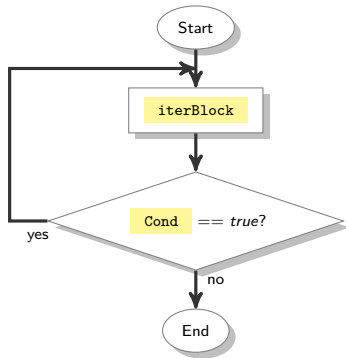
```
1  if(cond) {  
2    trueBlock;  
3  }
```


While iteration



```
1 while(cond) {  
2     iterBlock;  
3 }
```

Do-while iteration



```
1  do {  
2    iterBlock;  
3  } while(cond);
```

For iteration

```
1  for(iniz; cond; oper) {  
2      iterBlock;  
3  }
```

is equivalent to:

```
1  iniz;  
2  while(cond) {  
3      iterBlock;  
4      oper;  
5  }
```

For iteration example

forTest.c

```
1  #include <stdio.h>
2
3  int main(void) {
4      int i; //initialize var
5
6      //iterate from i=1 while i<=42
7      //incrementing i on each loop
8      for(i = 1; i <= 42; i++) {
9          printf("*"); //print an *
10     }
11     printf("\n");
12
13     return 0;
14 }
```

User input/output

Output: `printf`

```
printf(format, var1, var2, ...);
```

- ✓ `format` is a string that contains the text to be sent to output
- ✓ the format string can contain special chars using `\`
 - `\\` , `\"` , `\%` , `\n` (for new line)
- ✓ the format string can contain special **format specifiers**
 - for each specifier is necessary a corresponding variable `var`
 - the output string will be integrated with the value of the variables

Input: `scanf`

```
scanf(format, &var);
```

- ✓ `format` is a string with only one **format specifier**
- ✓ `var` is a variable name (remember to add the special char `&`)
- ✓ the input will be saved inside `var`

format specifiers

- ✓ for each **data type** corresponds a **format specifier**
- ✓ a format specifier is `%[length][specifier]`

Length	Specifier		
	d	u	f (e for $m10^n$)
(none)	int	unsigned int	float / double
hh	char	unsigned char	
h	short	unsigned short	
l	long	unsigned long	
L			long double

For example:

- ✓ `%d` for `int`
- ✓ `%hu` for `unsigned short`
- ✓ `%Le` for `long double` (expressed in scientific notation)

printfScanfExample.c

```
1  #include<stdio.h>
2
3  int main(void) {
4      float floatVar;
5      long longVar;
6      printf("Input\\output\\ndemonstration\\n\\n");
7      printf("Insert a rational number: ");
8      scanf("%f", &floatVar);
9      printf("Insert a long integer: ");
10     scanf("%ld", &longVar);
11     printf("Rational is: %f; integer is: %ld\\n",
12           ↪ floatVar, longVar);
13     return 0;
14 }
```

```
1 $ gcc printfScanfExample.c -o example
2 $ ./example
3 Input\output
4 demonstration
5
6 Insert a rational number: 12.34
7 Insert a long integer: 123456
8 Rational is: 12.340000; integer is: 123456
9 $
```