

Subject: PRF192- PFC

Workshop 03

Objectives:

- (1) Practicing skills at analyzing and implementing programs using user-defined functions.
- (2) Making familiar with some basic algorithms

Grading 10 programs, 1 mark/program

Program 1:

Objectives	Practice implementing simple functions
Related knowledge	<p>Definition: A prime is positive integer that is greater than 1 and it is the multiple of 1 and itself only.</p> <p>Theorem: The integer n is a prime if and only if $n > 1$ and it can not be divided by all integers from 2 to $\lfloor \text{square root of } n \rfloor$.</p> <p>Use the library math.h to get the function sqrt(double) for getting the square root of a positive number.</p>
Problem	Write a C that will accept a positive integer n, $n \geq 2$ then print out primes between 2 and n.
Analysis <i>Nouns:</i> <i>positive integer</i> $\rightarrow \text{int } n$	<p>Suggested algorithm (logical order of verbs)</p> <p>Begin</p> <p style="padding-left: 20px;">Do {</p> <p style="padding-left: 40px;">Accept n;</p> <p style="padding-left: 20px;">}</p> <p style="padding-left: 20px;">While ($n < 2$);</p> <p style="padding-left: 20px;">For ($i = 2$ to n)</p> <p style="padding-left: 40px;">If (i is a prime) Print out i; \rightarrow Function int prime (int i)</p> <p>End</p>
Algorithm for checking whether an integer is a prime or not	<pre> int prime(int n) { int m = sqrt(n); /* m: square root of n */ int i; /* variable having value from 2 to m */ if (n<2) return 0; /* Condition 1 is not satisfied */ for (i=2; i<=m; i++) /* checking the second condition */ if (n%i==0) return 0; /* n is divided by i \rightarrow n is not a prime */ return 1; /* n is a prime */ } </pre>

Program 2:

Objectives	Practice implementing simple functions
Related knowledge	Leap year (y): $(y \% 400 == 0 \parallel (y \% 4 == 0 \ \&\& \ y \% 100 != 0))$
Problem	Write a C program that will accept data of a day then print out whether they are valid or not.
Analysis <i>Data of a day</i>	<p>Suggested algorithm (logical order of verbs)</p> <p>Begin</p>

→ int d, m, y	Accept d, m, y If (valid(d,m,y)) print out "valid date" Else print out "invalid date" End
Algorithm for checking whether a date is valid or not	<pre> int validDate (int d, int m, int y) { int maxd = 31; /*max day of months 1, 3, 5, 7, 8, 10, 12 */ /* basic checking */ if (d<1 d>31 m<1 m>12) return 0; /* update maxd of a month */ if (m==4 m==6 m==9 m==11) maxd=30; else if (m==2) { /* leap year? */ if (y%400==0 (y%4==0 && y%100!=0) maxd=29; else maxd=28; } return d<=maxd; } </pre>

Program 3:

Objectives	Practice implementing simple functions
Related knowledge	A point p is in a circle if the distance from the center to p is less than the radius.
Problem	Write a C program that will accept a point and a circle having the center is (0,0) then print out the relative position of this point with the circle.
Analysis Nouns: A point → double x,y A circle → double r Relative position → int result → -1: (x,y) is out of the circle → 0: (x,y) is on the circle → 1: (x,y) is in the circle	Suggested algorithm (logical order of verbs) Begin Accept x, y; Do { Accept r; } While(r<0); result = getRelPos(x,y,r); if (result ==1) Print out "The point is in the circle"; else if (result==0) Print out "The point is on the circle"; else Print out "The point is out of the circle"; End
Algorithm for getting relative position of a point with a circle	<pre> int getRelPos (double x, double y, double r) { double d2=x*x + y*y; /* d²= x²+ y² */ double r2= r*r; /* r²*/ if (d2<r2) return 1 ; /* d²<r² →the point is in the circle */ else if (d2==r2) return 0 ; /* d²=r² →the point is on the circle */ return -1 ; /* d²> r² →the point is out of the circle */ } </pre>

Program 4:

Objectives	Practice implementing simple functions
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Related knowledge	$n! = 1*2*3*...*n$
Problem	Write a C program that will accept a positive integer then print out its factorial.
Analysis A positive integer → int n	Suggested algorithm (logical order of verbs) Begin Do { Accept n; } While (n<0); Print out factorial(n); End.
Algorithm for Computing factorial of an integer	<pre>double factorial (int n) { double p=1; int i; for (i=2; i<=n; i++) p *= i; return p; }</pre>

Program 5:

Objectives	Practice implementing simple functions
Related knowledge	Fibonacci sequence: 1 1 2 3 5 8 13 21 34 ... Two first numbers: 1 Others: Its value is the sum of 2 previous numbers
Problem	Write a C program that will print out the value at the n th position in Fibonacci sequence.
Analysis A position → int n	Suggested algorithm (logical order of verbs) Begin Do { Accept n; } While (n<1); Print out fibo(n); End.
Algorithm for Computing the nth value of the Fibonacci sequence	<pre>double fibo (int n) { int t1=1, t2=1, f=1, i ; for (i= 3, i<=n; i++) { f= t1 + t2; t1= t2; t2=f; } return f; }</pre>

How to compute the nth value of the Fibonacci sequence

Position 1	2	3	4	5	6	7	8	9	10
1	1	2	3	5	8	13	21	34	55
T1	T2	F							
	T1	T2	F						

		T1	T2	F					
			T1	T2	F				
				T1	T2	F			
					T1	T2	F		
						T1	T2	F	...

Program 6:

Objectives	Practice implementing simple functions
Related knowledge	
Problem	Write a C program that will accept a positive integer then print out whether it is an element of the Fibonacci sequence or not.
Analysis An integer \rightarrow int n	Suggested algorithm (logical order of verbs) Begin Do { Accept n; } While (n<1); If (isFibonacci(n)==1) Print out "It is a Fibonacci element." Else print out "It is not a Fibonacci element." End
Algorithm for Checking whether an integer is a element of the Fibonacci sequence or not	int isFibonacci (int n) { int t1=1, t2=1, f=1; if (n==1) return 1; /* n belongs to the Fibonacci sequence*/ while (f<n) /* Find out the Fibo number f to n */ { f= t1 + t2; t1=t2; t2=f; } return n==f; /* if n==f \rightarrow n is Fibo element \rightarrow return 1 */ }

Program 7:

Objectives	Practice implementing simple functions
Related knowledge	Getting the rightmost digit of the integer n: $n\%10$
Problem	Write a C program that will carry out some times. In each time, a nonnegative integer is accepted then print out the sum of its decimal digits. The program will terminate when its value of accepted number is negative.
Analysis Sum \rightarrow int S=0 Accepted integer \rightarrow int n	Suggested algorithm (logical order of verbs) Begin Do { Accept n; If (n>=0) { S = sumDigits(n); Print out S; } } While (n>=0);

	End
Algorithm for Computing sum of digits of a nonnegative integer	<pre> int sumDigits (int n) { int sum=0; /* initialize sum of digits */ Do { int remainder = n%10 ; /* Get a digit at unit position */ n = n/10; sum += remainder; } while (n>0); return sum; } </pre>

Program 8:

Objectives	Practice implementing simple functions
Related knowledge	<p>Making a real number from its integral part and its fraction (its fraction must be positive). Example : 32 25 → 32.25 25 → 0.25 → 32+0.25= 32.25 Example -51 139 → -51.139 139 → 0.139 → -51- 0.139= -51.139</p> <p>double makeDouble(int ipart, int fraction) { double d_f= fraction; while (d_f >=1) d_f = d_f/10; /* create the fraction <1 */ if (ipart<0) return ipart – d_f; /* case -51 – 0.139 */ return ipart + d_f ; /* case 32 + 0.25 */ }</p>
Problem	Write a C program that will accept the integral part and fraction of a real number then print out the this real number.
Analysis Integral part → int ipart Fraction → int fraction Real number → double value	<p>Suggested algorithm (logical order of verbs) Begin Accept ipart; Do { Accept fraction; } While fraction<0; value= makeDouble(ipart,fraction); Print out value; End</p>

Program 9:

Objectives	Practice implementing simple functions																
Related knowledge	<p>Find out the greatest common divisor (gcd) and least common multiple (lcm) of two positive integers: <i>Find out gcd of a and b</i></p> <table><tr><td>a</td><td>b</td><td>a</td><td>b</td></tr><tr><td>14</td><td>21</td><td>13</td><td>8</td></tr><tr><td>14</td><td>7</td><td>5</td><td>8</td></tr><tr><td>7</td><td>7</td><td>5</td><td>3</td></tr></table>	a	b	a	b	14	21	13	8	14	7	5	8	7	7	5	3
a	b	a	b														
14	21	13	8														
14	7	5	8														
7	7	5	3														

	<pre> 2 3 2 1 1 1 int gcd(int a, int b) { while (a != b) if a>b then a -=b; else b -= a; return a; } int lcm (int a, int b) { return a*b/ gcd(a,b); } </pre>
Problem	Write a C program that will accept two positive integers then print out their greatest common divisor and least common multiple.
Analysis Two integers → int a, b gcd → int d lcm → int m	Suggested algorithm (logical order of verbs) Begin Do { Accept a, b; } While (a<=0 OR b <=0); d = gcd(a,b); m = lcm (a.b); Print out d; Print out m; End

Program 10:

Objectives	Practice implementing simple functions
Related knowledge	<p>Print out the minimum and the maximum digits of a nonnegative integer</p> <p>Example: n= 10293 → Print out 9, 0</p> <pre> void printMinMaxDigits(int n) { int digit; /* Variable for extracting 1 digit */ int min, max ; /* Result variables */ digit = n% 10; /* get the first rightmost digit: 3 */ n=n/10; /* 1029, the remainder needs to proceed after*/ min=max=remainder; /* initialize results */ while (n>0) { digit = n%10; /* Get the next digit */ n=n/10; if (min > remainder) min=remainder; /* update results */ if (max < remainder) max=remainder; } Print out min, max; } </pre>
Problem	Write a C program that will accept a non-negative integer then print out its minimum and maximum digits.

Analysis Noun: A integer → int n	Suggested algorithm (logical order of verbs) Begin Do { Accept n; printMinMaxDigits(n); } While (n<0); End
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