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**CMP 305L - Data Structures and Algorithms Lab**

**Lab. Assignment 7 – Recursion**

***Objectives:***

* Understand Recursion
* Develop functions using tail recursion

**Note:**

***Pre Lab:*** Ex 1, 2 and 3

***Lab*:** Ex 4,5 and 6

***Exercise 1:***

Write a function to calculate harmonic series using tail recursion:

F(n) = 1 + {1 \over 2} + {1 \over 3} + {1 \over 4} + {1 \over 5} + \cdots = \sum_{n=1}^\infty {1 \over n}.

**Exercise 2**

Write and test a function that prints nth Fibonacci number using tail recursion.

**Exercise 3**

Write a recursive function that returns the reverse of a number.

**Exercise 4**

Implement a recursive function *PI(n*) that calculates *π*with *n*terms, as per the series given below. Write two versions: (a) *without* accumulator and (b) *with accumulator.* Note that you need first to derive a proper recurrence formula, then implement it.

**π = 3** +

**Exercise 5**

Write a recursive function that checks if the array is a palindrome or not.

**Exercise 6**

Write a function that searches for an item in the array using tail recursion. Use binary search.

In the main, declare an array of integers and test the function.

// Exercise 1:

// Write a function to calculate harmonic series using tail recursion:

// F(n) = 1+1/2 +1/3+1/4+1/5

// Exercise 2

// Write and test a function that prints nth Fibonacci number using tail recursion.

// Exercise 3

// Write a recursive function that returns the reverse of a number.

#include<iostream>

using namespace std;

// harmonic series Question 1

float sum(float n)

{

if (n < 2)return 1;

else return 1 / n + (sum(n - 1));

}

// Question 2 Fibonacci

int fib(int n)

{

if (n <= 1)

return n;

return fib(n-1) + fib(n-2);

}

// Question 3 print reverse number

int reverseNumber(int num)

{

static int result = 0;

static int base = 1;

if (num > 0) {

reverseNumber(num / 10);

result += (num % 10) \* base;

base \*= 10;

}

return result;

}

// Exercise 4

// Implement a recursive function PI(n) that calculates π with n terms, as per the

// series given below. Write two versions: (a) without accumulator and (b) with accumulator.

// Note that you need first to derive a proper recurrence formula, the it.

// π = 3 + 4/(2 x 3 x 4)- 4/(4 x 5 x 6)+4/(6 x 7 x 8)- 4/(8 x 9 x 10)+⋯

double PI(int n )

{if(n == 1){return 3;}

if(n % 2 ==1 ){return (-4.0/((2\*n-2)\* (2\*n-1)\* (2\*n)))+PI(n-1);}

else if(n % 2 ==0 ){return (4.0/((2\*n-2)\* (2\*n-1)\* (2\*n)))+PI(n-1);}

}

// Exercise 5

// Write a recursive function that checks if the array is a palindrome or not.

bool palin(int ary[], int start , int end)

{

if(ary[start]!= ary[end]) return false;

if(start>=end) return true;

return palin(ary, start+1 , end-1);

//[1][2][3][3][2][1]

}

// Exercise 6

// Write a function that searches for an item in the array using tail recursion. Use binary search.

// In the main, declare an array of integers and test the function.

bool binarySerch( int ary[], int start , int end ,int find)

{

int mid =(start+end)/2;

if(ary[mid]==find){return true;}

else if(start> end){return false;}

else if(find>ary[mid]){

return binarySerch( ary, mid+1 , end , find);}

else if(find<ary[mid]){

return binarySerch( ary, start , mid-1 , find);}

}

int main()

{

//arrays used for testing

cout<<"-----------Printing the arrays used for testing:--------"<<endl;

int arr[6];

arr[0]=1; arr[1]=2; arr[2]=4; arr[3]=4; arr[4]=2; arr[5]=1;

for (int i =0; i<6;i++)

{

cout<<arr[i]<<" ";

}

cout<<endl;

int axx[6];

for (int i =0; i<6;i++)

{

axx[i]=i+2 ;

cout<<axx[i]<<" ";

}

cout<<endl;

cout<<"--------------------------------------"<<endl;

//end of arrays used for testing

cout<<"------calculate PI--------- "<<endl;

cout<< PI(4)<<endl;

cout<<"------is the array a palindrome?--------- "<<endl;

cout<<palin(arr, 0, 5)<<endl;

cout<<"------is element in array?--------- "<<endl;

cout<<binarySerch(axx, 0, 5,5)<<endl;

cout<<"------harmonic series--------- "<<endl;

cout<< sum(10)<<endl;

cout<<"------ nth Fibonacci--------- "<<endl;

cout<< fib(9)<<endl;

cout<<"------reverse of a number--------- "<<endl;

cout<< reverseNumber(746209)<<endl;

return 0;

}

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