Ⅰ. Single Choices (20 points)

1、Which of the following data types has a typical range of 0 to 2^{32}-1?

A. unsigned short　　B. int

C. unsigned int　　D. short int

2、Which one of the following is NOT a valid identifier in C++?

A. positive　　B. __123　　C. 2no　　D. rear

3、Which of the following is a valid input statement?

A. cin >> a;　　B. cin << a;　　C. a << cin;　　D. a >> cin;

4、Which of the following statements sends a newline character to the standard output device?

A. cout << endl　　B. cout << '\0';　　C. cout << '\line';　　D. cout << '\n';

5、Consider the following statements.

```
int a = 10;
const int * p = &a;
```

Which of the following is illegal?

A. cout << p ++ ;　　B. cout << (*p) ++ ;　　C. cout << ++ a;　　D. A, B and C above

6、How many times will the following loop print hello?

```
int i = 1;
while ( i ++ <= 28 ){
    cout << "hello";
    if (i % 2 == 0 || i % 3 == 0) i *= 2;
 }
```

A. 4　　B. 5　　C. 6　　D. An infinite number of times.

7、Which line of the following code contains syntax error?

```
class Rectangle{          //  line 1
    unsigned int w;       //  line 2
    Rectangle():w(3);     //  line 3
}                         //  line 4
```

A. 3　　B. 4　　C. 3 and 4　　D. None

8、In C++, a function prototype is?

A. a declaration but not a definition　　B. a definition but not a declaration

C. neither a declaration nor a definition　　D. both a declaration and a definition

9、If int a = 2021, which of the following statement will print out 2022?

A. cout << a ++;　B. cout << ++ a;　　C. cout<< a%2022;　D. cout<< (2022==a);

10、Which of the following options is NOT a return type for a function in c++?

A. int::　　B. int　　C. int *　　D. void

Ⅱ.What is the output of the following C++ program? (42points)

1、

```
#include <iostream>
using namespace std;
int main(){
    int a = 2021, b = 3;
    cout << "The number is: ";
    switch (a % b) {
    case 1: cout << "one ";
    case 2: cout << "two ";
    case 3: cout << "three ";
    default: cout << "*";
    }
    return 0;
}
```

2、
```
#include <iostream>
using namespace std;
int main(){
    using namespace std;
    char a[6];
    for(char c = 'A'; c < 'G'; c ++)
        a[c-'A'] = c;
    int n = 2021, r = n % 16;
    cout << r << '-';
    n /= 16;    r = n % 15;
    cout << ((r > 9) ? a[r-10]: r) << '-';
    n /= 15;    r = n % 14;
    cout << ((r > 9) ? a[r-10]: r);
    return 0;
}
```

3、
```
#include <iostream>
using namespace std;
void swap(int, int);
int main(){
    int x(20), y(21);
    swap(x, y);
    cout << "(x, y): " << x << ", " << y ;
    return 0;
}
void swap(int a, int b){
    int t = a + b;
    a = t - a; b = t - a;
    cout << "(a, b): " << a << ", " << b << "---";
}
```

4、
```
#include <iostream>
using namespace std;
int main(){
    char cstr1[] = {"Hello"};
    char cstr2[] = {"C-+"};
    char * pCstr2 = cstr2;
    cout << cstr1 << ',' << cstr1[1] << ',' << *(cstr1+4) << ',';
    cout << *pCstr2; pCstr2 += 2;
    cout << *pCstr2 << pCstr2 - cstr2;
    return 0;
}
```

5、
```
#include <iostream>
#include <string>
using namespace std;
int main(){
    string a[2][4]={"Tian ", "landed on ", "Ren ", "Wen ",
                    "has ", "Hao ", "love ", "Mars."};
    cout<<a[0][0]<< a[0][3];
    cout<<*(a[1]+1) << *(a[1]);
    cout<<*(*a+1)<<*(*(a+1)+3);
    return 0;
}
```

6、
```
#include <iostream>
using namespace std;
void func(int x, int &y){
    x = x + y;
    y = x % 4;
    cout << x << " " << y << ",";
}
```

```
int main(){
    int x = 8, y = 6;
    func(x, y);
    cout << x << " " << y << ",";
    func(x, x);
    cout << x << " " << y << " ";
    return 0;
}
```

7、

```
#include <iostream>
using namespace std;
class A{
public:
    virtual char toString(){return 'A';}
    void toDoubleString(){ cout << "AA ";}
};
class B:public A{
public:
    char toString(){return 'B';}
    void toDoubleString(){ cout << "BB ";}
};
void func(A& obj){
    cout << obj.toString() << " ";
}
int main(){
    A a; B b;
    a. toDoubleString(); b. toDoubleString();
    func(a);    func(b);
    return 0;
}
```

Ⅲ.Fill the vacant position in the program. (8points)

The following class is a stack holds the int type values. A stack is a data structure that holds data in a last-in, first-out fashion. Please fill the vacant of the program. Note that : top function gets the last integer; pop function deletes the last integer; the first and last integers are stored in s[0] and s[size-1] respectively.

```
#include <iostream>
using namespace std;
class StackOfInteger{
public:
    StackOfInteger(int capacity){
        ____1____ = capacity;
        size = 0;
        s = new int[capacity];
    }
    ~StackOfInteger();
    ____2____
    int top(){
        if (size) return ____3____;
        else return -1;
    }
    void pop(){  ____4____ }
    void print(){
        cout << "capacity: " << capacity << ", " << "size: " << size << "\n";
        for(int i = 0; i < size; i ++)
            cout << s[i] << ' ';
        cout << "\n";
    }
    int * s;
    int capacity, size;
};
```

```
void StackOfInteger::push(int value){
    if(size == capacity){
        int * tmpS = new int[capacity*2];
        for(int i = 0; i < size; i ++) tmpS[i] = s[i];
        _____5_____
        s = tmpS;
        _____6_____;
    }
    _____7_____
}
StackOfInteger::~StackOfInteger(){ _____5_____ }

int main(){
    _____8_____ ss(4);
    for(int i = 1; i < 5; i ++) ss.push(i);
    ss.print();
    ss.push(16);    ss.print();
    ss.push(7);     ss.pop();    ss.print();
    return 0;
}
```

Sample Output

```
capacity: 4, size: 4
1 2 3 4
capacity: 8, size: 5
1 2 3 4 16
capacity: 8, size: 5
1 2 3 4 16
```

Ⅳ. Programming Problems (30 points)

1. Write a program by using a recursive function getSeriesValue to compute the following series:

$$s(n) = \frac{1}{1} + \frac{2}{3} + \frac{3}{6} + \frac{4}{10} + \frac{5}{15} + \cdots + \frac{n}{1+2+\cdots+n}$$

The function header of getSeriesValue is:
double getSeriesValue (int n)

Input

The input contains exactly one positive integer n, $1 \le n \le 10^4$.

Output

The output one line contains the result value of *s(n)*. Please use "cout" directly, no need to consider how many decimal digits to keep**.**

Sample 1:
Please input n: 1
1

Sample 2:
Please input n: -3
Invalid n!

Sample 3:
Please input n: 4
2.56667

Sample 4:
Please input n: 435
11.312

2. Write a program to determine whether a binary number B is a prime number, 10≤B≤ 11111111111111111111111111111111(total of 31 one).

Input

The first line of the input is the number of test cases T (1≤n≤100). Then some test cases followed, each test case contains a binary number. Note that all the input binary numbers are integers and larger than zero.

Output

You should output one line for each test case. For each line, print out a sentence with an enter character. The output sentence could be: "B is a prime number." or "B is NOT a prime number." according to whether B is a prime number.

Sample Input

2

111

101101

Sample Output

111 is a prime number.

101101 is NOT a prime number.

3. Write a program to print out a triangle tree according to the user input. A triangle tree contains at least one layer; each layer size must be larger than all the layer sizes above. We use a double-size m "*" to represent a layer with size m and use "-" to represent a blank. If the layer size is 2, the corresponding layer should start with some "-" then followed by four "*" then follower by some "-". We decide the number of "-" by the following rules: the layer with maximum size has no "-". The sum of "-" and"*" are the same for all layers.

Input

The first line is the number of test cases T (1≤n≤100). Then some test cases followed, each test case contains a line of an integer N (the tree has N layers, N≤64), and then N line integers of layer sizes M_i (from layer one to layer N, M_i≤100).

Output

Output the corresponding triangle tree. If the input layer size is less than or equal to the last layer size, print out "The input number should be larger than "+current maximum layer size.

Sample:

(user input)2

(user input)3

(user input)1

(user input)2

(user input)3

(output)--**--

(output)-****-

(output)******

(user input)4

(user input)2

(user input)3

(user input)1

(output)The input number should be larger than 3.

(user input)5

(output)---****---

(output)--******--

(output)**********

Ⅰ. Answer：

1	2	3	4	5	6	7	8	9	10
C	D	A	D	B	C	C	A	B	A

Ⅱ. Answer：

1、 The number is: two three * The number is: 1 分 two: 2 分 three *: 各 1 分，共 2 分 输出格式: 1 分（书写在一行内）	2、 5-6-8 5-: 2 分 6-: 2 分 8: 2 分
3、 (a, b): 21, 20---(x, y): 20, 21 (a, b) 和 ---: 1 分 21, 20: 2 分 (x, y): 1 分 20, 21: 2 分	4 Hello,e,o,C+2 Hello, : 1 分 e, : 1 分 o, : 1 分 C+2:各 1 分，共 3 分
5、 Tian Wen Hao has landed on Mars. Tian Wen Hao has Mars.每个单词 1 分 Landed on: 1 分	6、 14 2,8 2,16 0,0 2 14 2: 1 分 8 2: 2 分 16 0: 1 分 0 2: 2 分
7、 AA BB A B AA BB: 各 2 分 A B: 各 1 分	

Ⅲ. Answer：

（1） this->capacity （2） void push(int);

（3） s[size-1] （4） if (size) size --;

（5） delete [] s; （6） capacity *= 2;

（7） s[size++] = value; （8） StackOfInteger

Ⅳ. Programming Problems

1.

```
#include <iostream>
using namespace std;
int sum(int n){
    if (n % 2 == 0)
        return n / 2 * (1 + n);
    else return (1 + n) / 2 * n;
    // --- or --- //
    // int sum = 0;
    // for(int i = 1; i <= n; i ++)
    //         sum += i;
    // return sum;
}
double getSeriesValue(int n){
    if (n == 1) return 1.0;
    else return double(n)/sum(n) + getSeriesValue(n - 1);
}
int main(){
    int n;
    cin >> n;
    if(n < 1 or n > 10000)
        cout << "Invalid n!" << endl;
    else
        cout << getSeriesValue(n) << endl;
    return 0;
}
```

2.

```
#include <iostream>
#include <string>
using namespace std;

bool isPrime(int n){
	if (n == 2 || n == 3) return true;
	for(int i = 2; i < n/2 + 1; i ++){
		if (n % i == 0) return false;
	}
	return true;
}

int bin2dec(string bin){
	int base = 1;
	int res = 0;
	for(int i = 0; i < bin.size(); i ++){
		res += (bin[bin.size() - 1 - i]-'0') * base;
		base *= 2;
	}
	return res;
}

int main(){
	int c;
	cin >> c;
	for(int i = 0; i < c; i ++){
		string bin;
		cin >> bin;
		cout << bin << " is" << (isPrime(bin2dec(bin))?"":" NOT") << " a prime number." <<
endl;
	}
	return 0;

}
```

3.

```
#include <iostream>
#include <string>
using namespace std;

int a[64];
int main(){
	int caseNumber;
	cin >> caseNumber;
	int n, m;
	for(int i = 0; i < caseNumber; i ++){
		cin >> n;
		int max = -1, cnt = 0;
		for(int j = 0; j < n; j ++){
			cin >> m;
			if (m > max){
				max = m; a[cnt] = m;
				cnt ++;
			}
			else
				cout << "Next input number should be larger than " << max << endl;
		}
		for(int j = 0; j < cnt; j ++){
			for(int k = 0; k < max-a[j]; k ++)
				cout << "-";
			for(int k = 0; k < a[j]; k ++)
				cout << "**";
			for(int k = 0; k < max-a[j]; k ++)
				cout << "-";
			cout << endl;
		}
	}
	return 0;

}
```