



第5章 循环控制

——程序调试



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本节要讨论的主要问题

- 何为Bug？何为Debug？
- 程序中常见的出错原因有哪些？
- 常用的程序调试方法有哪些？



Bug与Debug

何谓Bug?



何谓Debug?



程序中常见的出错原因

编译
错误

语法错误 (Syntax Error)

链接
错误

缺少包含文件、或者包含文件的路径错误等

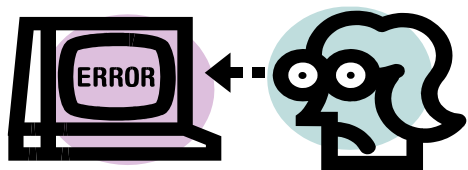
运行时
错误

运行结果与预期不一致
程序无法正常运行

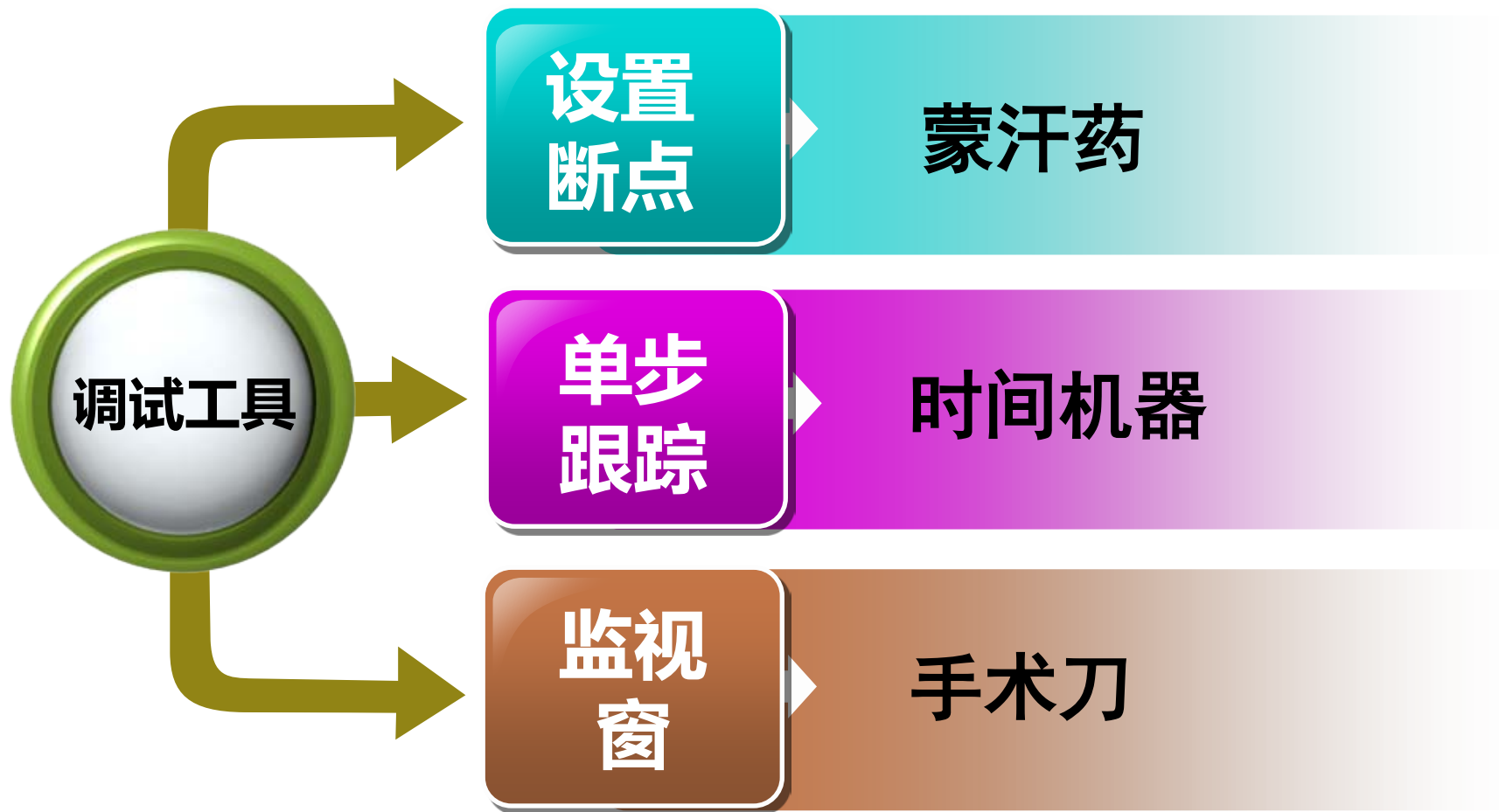
编译
错误

链接
错误

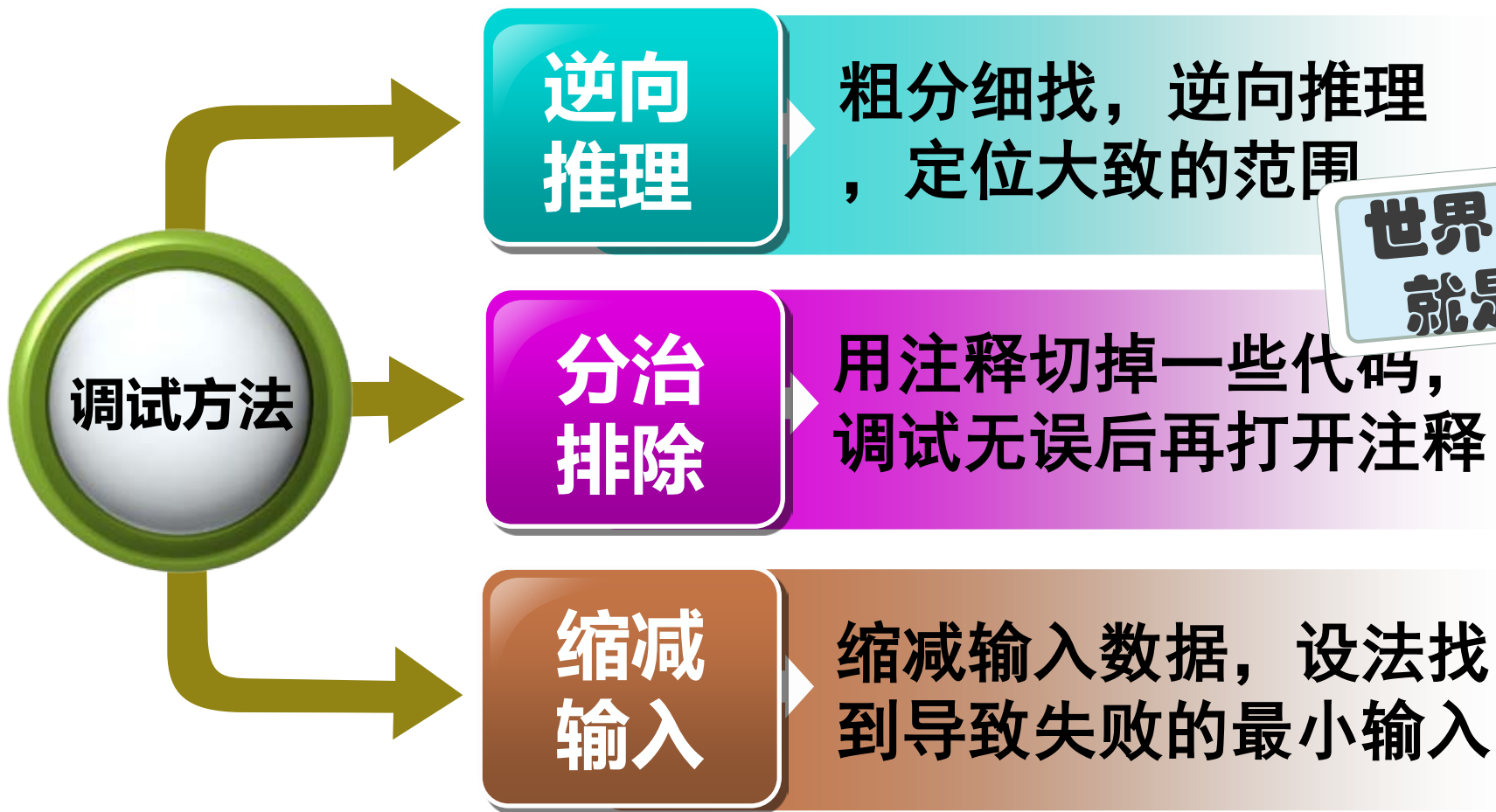
运行时
错误



调试工具



调试方法



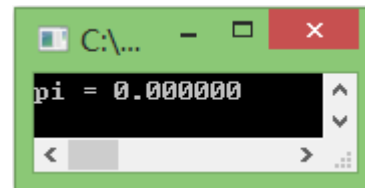
世界上最好的调试工具
就是那些有经验的人



计算 π 的值

- 利用 $\frac{\pi}{2} = \frac{2}{1} \times \frac{2}{3} \times \frac{4}{3} \times \frac{4}{5} \times \frac{6}{5} \times \frac{6}{7} \times \dots$ 前100项之积，计算 π 的值

```
#include <stdio.h>
int main()
{
    float term, result;
    int n;
    for (n=2; n<=100; n=n+2)
    {
        term = (n * n) / ((n - 1) * (n + 1));
        result = result * term;
    }
    printf("pi = %f\n", 2 * result);
    return 0;
}
```

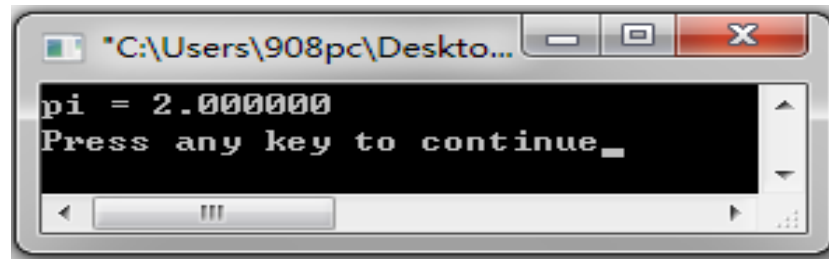


VC6.0和CB下运行不显示任何警告信息

程序改错

- 利用 $\frac{\pi}{2} = \frac{2}{1} \times \frac{2}{3} \times \frac{4}{3} \times \frac{4}{5} \times \frac{6}{5} \times \frac{6}{7} \times \dots$ 前100项之积，计算 π 的值

```
#include <stdio.h>
int main()
{
    float term, result = 1;
    int n;
    for (n=2; n<=100; n=n+2)
    {
        term = (n * n) / ((n - 1) * (n + 1));
        result = result * term;
    }
    printf("pi = %f\n", 2 * result);
    return 0;
}
```

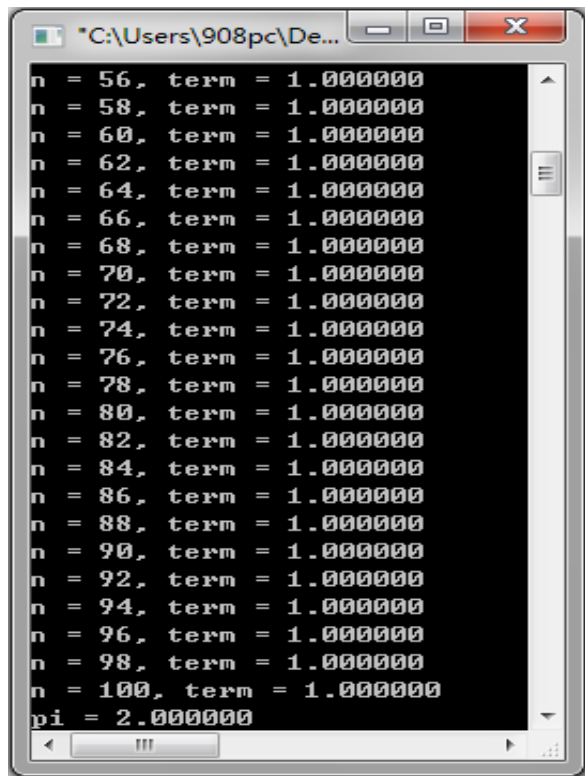


VC6.0和CB下运行不显示任何警告信息

程序改错

- 利用 $\frac{\pi}{2} = \frac{2}{1} \times \frac{2}{3} \times \frac{4}{3} \times \frac{4}{5} \times \frac{6}{5} \times \frac{6}{7} \times \dots$ 前100项之积，计算 π 的值

```
#include <stdio.h>
int main()
{
    float term, result = 1;
    int n;
    for (n=2; n<=100; n=n+2)
    {
        term = (n * n) / ((n - 1) * (n + 1));
        printf("n = %d, term = %f\n", n, term);
        result = result * term;
    }
    printf("pi = %f\n", 2 * result);
    return 0;
}
```



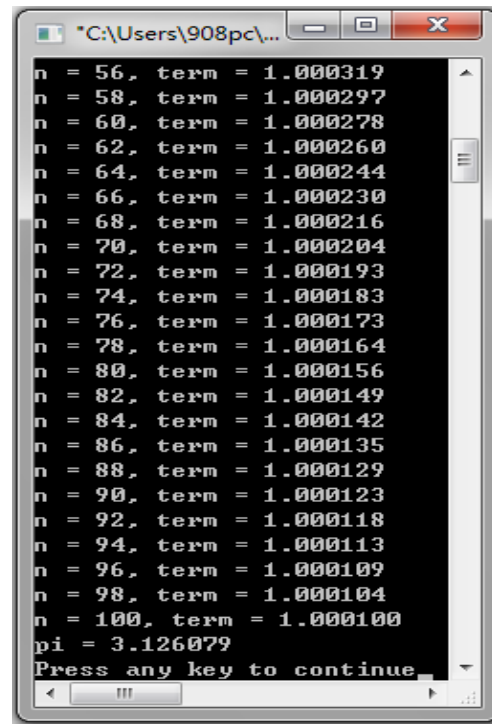
```
n = 56, term = 1.000000
n = 58, term = 1.000000
n = 60, term = 1.000000
n = 62, term = 1.000000
n = 64, term = 1.000000
n = 66, term = 1.000000
n = 68, term = 1.000000
n = 70, term = 1.000000
n = 72, term = 1.000000
n = 74, term = 1.000000
n = 76, term = 1.000000
n = 78, term = 1.000000
n = 80, term = 1.000000
n = 82, term = 1.000000
n = 84, term = 1.000000
n = 86, term = 1.000000
n = 88, term = 1.000000
n = 90, term = 1.000000
n = 92, term = 1.000000
n = 94, term = 1.000000
n = 96, term = 1.000000
n = 98, term = 1.000000
n = 100, term = 1.000000
pi = 2.000000
```

插入打印语句，打印中间结果信息

程序改错

- 利用 $\frac{\pi}{2} = \frac{2}{1} \times \frac{2}{3} \times \frac{4}{3} \times \frac{4}{5} \times \frac{6}{5} \times \frac{6}{7} \times \dots$ 前100项之积，计算 π 的值

```
#include <stdio.h>
int main()
{
    float term, result = 1;
    int n;
    for (n=2; n<=100; n=n+2)
    {
        term = (float)(n * n) / ((n - 1) * (n + 1));
        printf("n = %d, term = %f\n", n, term);
        result = result * term;
    }
    printf("pi = %f\n", 2 * result);
    return 0;
}
```



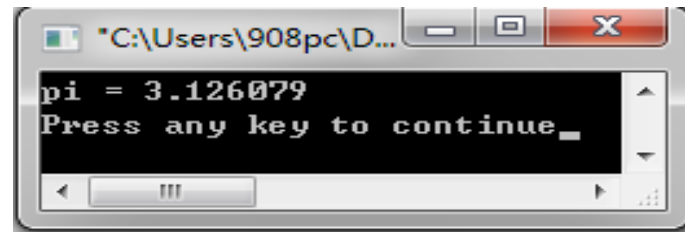
```
n = 56, term = 1.000319
n = 58, term = 1.000297
n = 60, term = 1.000278
n = 62, term = 1.000260
n = 64, term = 1.000244
n = 66, term = 1.000230
n = 68, term = 1.000216
n = 70, term = 1.000204
n = 72, term = 1.000193
n = 74, term = 1.000183
n = 76, term = 1.000173
n = 78, term = 1.000164
n = 80, term = 1.000156
n = 82, term = 1.000149
n = 84, term = 1.000142
n = 86, term = 1.000135
n = 88, term = 1.000129
n = 90, term = 1.000123
n = 92, term = 1.000118
n = 94, term = 1.000113
n = 96, term = 1.000109
n = 98, term = 1.000104
n = 100, term = 1.000100
pi = 3.126079
Press any key to continue
```

程序改错

- 利用 $\frac{\pi}{2} = \frac{2}{1} \times \frac{2}{3} \times \frac{4}{3} \times \frac{4}{5} \times \frac{6}{5} \times \frac{6}{7} \times \dots$ 前100项之积，计算 π 的值

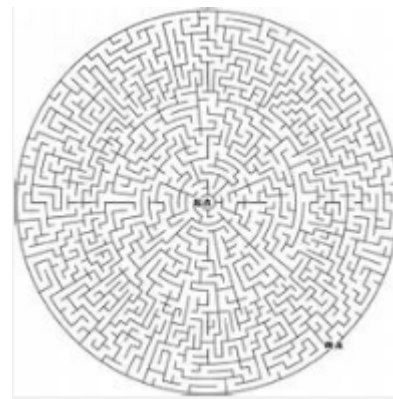
```
#include <stdio.h>
int main()
{
    float term, result = 1;
    int n;
    for (n=2; n<=100; n=n+2)
    {
        term = (float)(n * n) / ((n - 1) * (n + 1));

        result = result * term;
    }
    printf("pi = %f\n", 2 * result);
    return 0;
}
```



韩信点兵

```
#include <stdio.h>
int main()
{
    int x = 1, find = 0;
    while (!find);
    {
        if (x%5==1 && x%6==5 && x%7==4 && x%11==10)
        {
            printf("x = %d\n", x);
            find = 1;
            x++;
        }
    }
    return 0;
}
```



错在哪里？



韩信点兵

```
#include <stdio.h>
int main()
{
    int x = 1, find = 0;
    printf("before while\n");
    while (!find);
    {
        if (x%5==1 && x%6==5 && x%7==4 && x%11==10)
        {
            printf("x = %d\n", x);
            find = 1;
            x++;
        }
        printf("in while\n");
    }
    return 0;
}
```

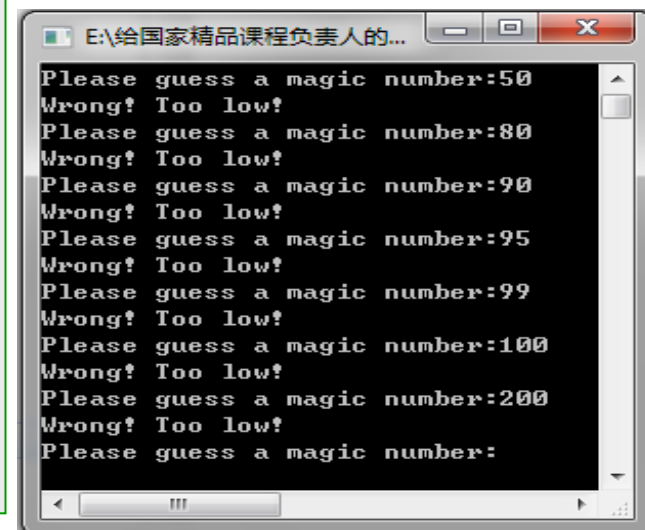
错在哪里?



```
#include <stdlib.h>
#include <stdio.h>
#include <time.h>
int main()
{
    int magic, guess, counter;
    srand(time(NULL));
    magic = rand() % 100 + 1;
    counter = 0;
    do{
        printf("Please guess a magic number:");
        scanf("%d", &guess);
        counter++;
        if (guess > magic)
            printf("Wrong! Too low!\n");
        else if (guess < magic)
            printf("Wrong! Too high!\n");
        else
            printf("Right!\n");
    }while (guess != magic);
    printf("counter = %d \n", counter);
    return 0;
}
```

直到猜对为止

错在哪里?



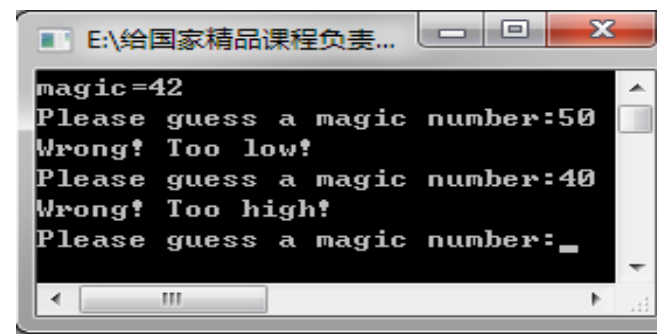
```
E:\给国家精品课程负责人的...
Please guess a magic number:50
Wrong! Too low!
Please guess a magic number:80
Wrong! Too low!
Please guess a magic number:90
Wrong! Too low!
Please guess a magic number:95
Wrong! Too low!
Please guess a magic number:99
Wrong! Too low!
Please guess a magic number:100
Wrong! Too low!
Please guess a magic number:200
Wrong! Too low!
Please guess a magic number:
```



```
#include <stdlib.h>
#include <stdio.h>
#include <time.h>
int main()
{
    int magic, guess, counter;
    srand(time(NULL));
    magic = rand() % 100 + 1;
    printf("magic=%d\n", magic);
    counter = 0;
    do{
        printf("Please guess a magic number:");
        scanf("%d", &guess);
        counter++;
        if (guess > magic)
            printf("Wrong! Too low!\n");
        else if (guess < magic)
            printf("Wrong! Too high!\n");
        else
            printf("Right!\n");
    }while (guess != magic);
    printf("counter = %d \n", counter);
    return 0;
}
```

直到猜对为止

插入打印语句



讨论题

- 从键盘任意输入两个符号各异的整数，直到输入的两个整数满足要求为止，然后打印这两个数。请通过测试找出下面这个程序存在的问题，并给出解决的方法。

```
#include <stdio.h>
int main()
{
    int x1, x2;
    do{
        printf("Input x1, x2:");
        scanf("%d,%d", &x1, &x2);
    }while (x1 * x2 > 0);
    printf("x1=%d,x2=%d\n", x1, x2);
    return 0;
}
```



讨论题

```
#include <stdio.h>
#include <math.h>
int main()
{
    int n, i;
    printf("Input n:");
    scanf("%d", &n);
    for (i=2; i<=sqrt(n); i++)
    {
        if (n % i == 0)
        {
            printf("No!\n");
        }
    }
    printf("Yes!\n");
    return 0;
}
```

- 从键盘任意输入一个正整数，编程判断它是否是素数，若是素数，输出“**Yes!**”，否则输出“**No!**”。
- 已知负数、0和1都不是素数。
- 请找出程序的错误并改正之。



