CS10003:
Programming & Data Structures

Dept. of Computer Science & Engineering
Indian Institute of Technology Kharagpur

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Iterations and Loops – contd.

An Example

```
int main() {
   int  fact, i;
   fact = 1;  i = 1;
   while  ( i<10 )    {  /* run loop –break when fact >100*/
    fact = fact * i;
    if ( fact > 100 )  {
        printf ("Factorial of %d  above 100", i);
        break;     /* break out of the while loop */
    }
    ++i;
   }
   return 0;
}
```

Test if a number is prime or not

```
int main() {
    int  n, i=2;
    scanf (“%d”, &n);
    while (i < n)  {
        if (n % i == 0)  {
            printf (“%d is not a prime \n”, n);
            break;
        }
        ++i;
    }
    if (i == n) printf (“%d is a prime \n”, n);
    return 0;
}
```

More efficient??

```
int main() {
     int  n, i = 2, flag = 0;
    double limit;
     scanf (“%d”, &n);
     limit = sqrt(n);
     while (i <= limit)  {
         if (n % i == 0)  {
              printf (“%d is not a prime \n”, n);
              flag = 1; break;
         }
         i = i + 1;
     }
     if (flag == 0) printf (“%d is a prime \n”, n);
    return 0;
}
```

continue Statement

continue

- Skips the remaining statements in the body of a while, for or do/while structure
  - Proceeds with the next iteration of the loop

```
while (expr)
      statement;

do {
    statements;
} while (expr);
```

- while and do/while
  - Loop-continuation test is evaluated immediately after the `continue` statement is executed

```
for ( expr1; expr2; expr3)
     statement;
```

- for structure
  - Increment expression is executed, then the loop-continuation test is evaluated.
  - *expr3* is evaluated, then *expr2* is evaluated.

An Example with **break** and **continue**

```
int main() {
    int fact = 1, i = 1;
    while  (1)  {
        fact = fact * i;
        ++i;
        if  ( i <=10 )
            continue;     /*not done yet! Go to loop for next iteration*/
        break;
    }
    return 0;
}
```

Some Loop Pitfalls

```
while (sum <= NUM) ;
      sum = sum+2;
```

```
for (i=0; i<=NUM; ++i);
      sum = sum+i;
```

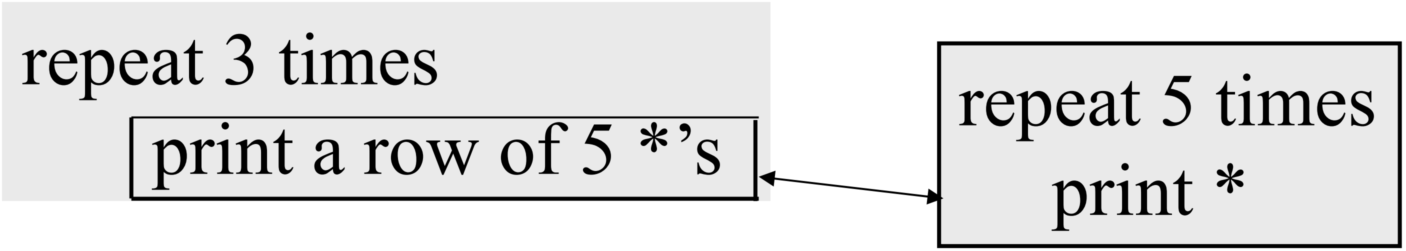
```
for (i=1; i!=10; i=i+2)
      sum = sum+i;
```

```
double x;
for (x=0.0; x<2.0; x=x+0.2)
      printf(“%.18f\n”, x);
```

Nested Loops: Printing a 2-D Figure

How would you print the following diagram?

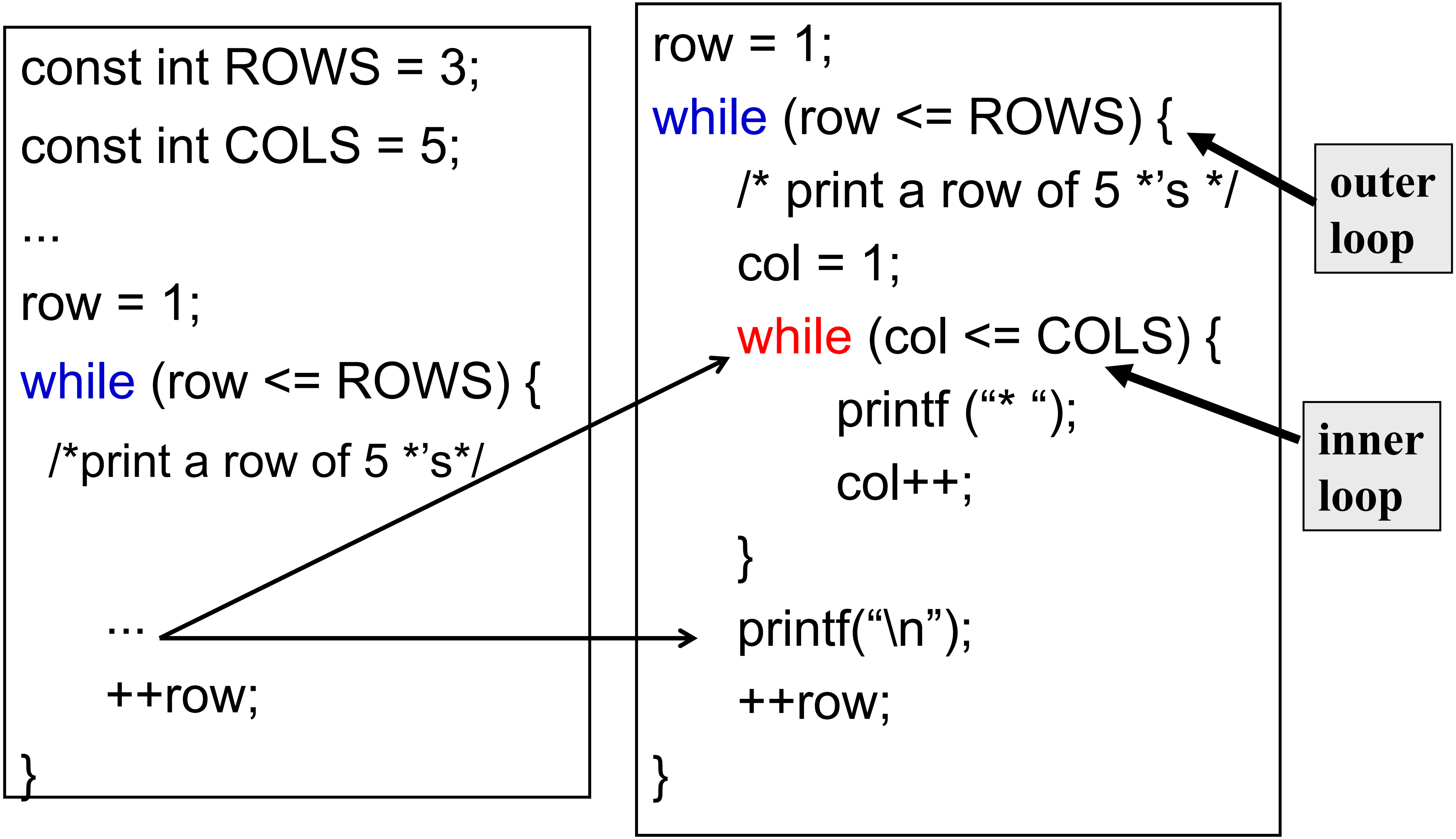
```
* * * * *

* * * * *

* * * * *
```



```
repeat 3 times
    print a row of 5 *'s
```

```
repeat 5 times
    print *
```

Nested Loops



```
const int ROWS = 3;
const int COLS = 5;
...
row = 1;
while (row <= ROWS) {
  /*print a row of 5 *’s*/


     ...
     ++row;
}
```

```
row = 1;
while (row <= ROWS) {
     /* print a row of 5 *’s */
     col = 1;
     while (col <= COLS) {
          printf (“* “);
          col++;
     }
     printf(“\n”);
     ++row;
}
```

2-D Figure: with for loop

Print

```
* * * * *

* * * * *

* * * * *
```

```
const int ROWS = 3;
const int COLS = 5;
....
for (row=1; row<=ROWS; ++row) {
    for (col=1; col<=COLS; ++col) {
        printf(“* ”);
    }
    printf(“\n”);
}
```

Another 2-D Figure

Print

```
*
* *
* * *
* * * *
* * * * *
```

```
const int ROWS = 5;
....
int row, col;
for (row=1; row<=ROWS; ++row) {
    for (col=1; col<=row; ++col) {
        printf(“* ”);
    }
    printf(“\n”);
}
```

Yet Another One

Print

```
* * * * *
 * * * *
  * * *
   * *
    *
```

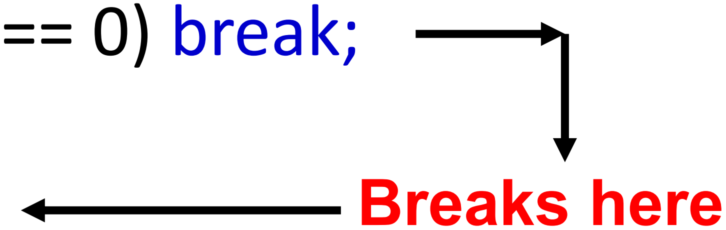
```
const int ROWS = 5;
....
int row, col;
for (row=0; row<ROWS; ++row)  {
    for (col=1; col<=row; ++col)
        printf("  ");
    for (col=1; col<=ROWS-row; ++col)
        printf("* ");
    printf ("\n");
}
```

break and continue with nested loops

For nested loops, break and continue are matched with the nearest loops (for, while, do-while)

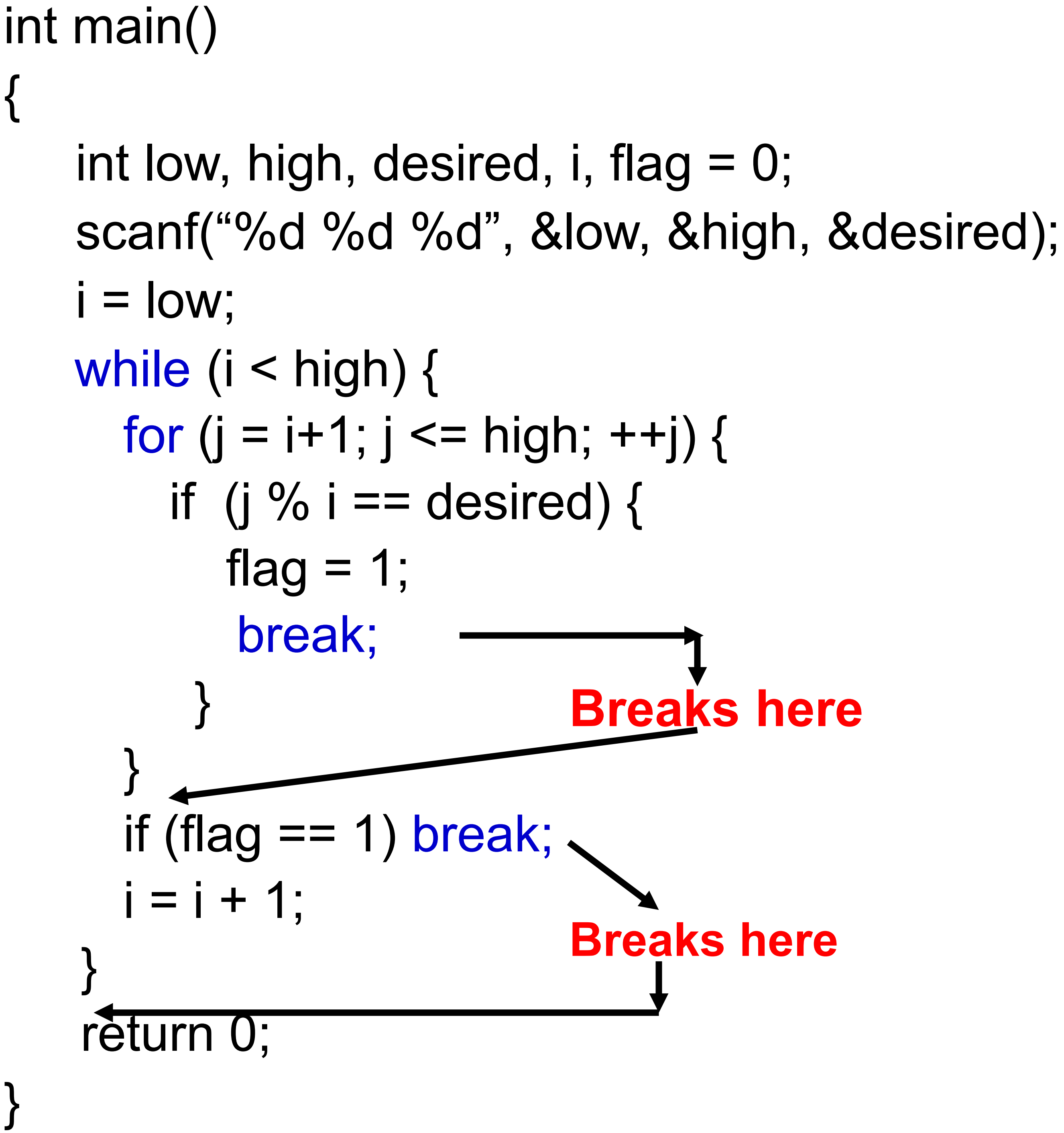
Example:

```
while (i < n) {
    for (k=1; k < m; ++k) {
      if  (k % i == 0) break;
    }
    i = i + 1;
  }
```



Breaks here

Example



```
int main()
{
    int low, high, desired, i, flag = 0;
    scanf("%d %d %d", &low, &high, &desired);
    i = low;
    while (i < high) {
      for (j = i+1; j <= high; ++j) {
        if  (j % i == desired) {
           flag = 1;
           break;
         }
      }
      if (flag == 1) break;
      i = i + 1;
    }
    return 0;
}
```

Breaks here

Breaks here

The comma operator

- Separates expressions
- Syntax

  expr-1, expr-2, …,expr-n

  where, expr-1, expr-2,… are all expressions
- Is itself an expression, which evaluates to the value of the last expression in the sequence
- Since all but last expression values are discarded, not of much general use
- But useful in for loops, by using side effects of the expressions

Example

- We can give several expressions separated by commas in place of expr1 and expr3 in a for loop to do multiple assignments for example

```
for  (fact=1, i=1; i<=10;++ i)
     fact = fact * i;

for (sum=0, i=1; i<=N; ++i)
     sum = sum + i * i;
```

Homework

Compute the following function given a value of x with the accuracy of 10^{-6}:

$$f(x)= 1-x^2/2! + x^4/4! – x^6/6! + \ldots..$$

You should not use any math library functions or C function to calculate factorial.

Computing standard deviation

The Steps

1. Read N
2. Read X_i
3. Compute Mean
4. Compute Standard Deviation

$$\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \mu)^2}$$

$$\mu = \frac{1}{N}\sum_{i=1}^{N} x_i$$

The Problem

Thank You!