IS12 - Introduction to Programming

Lecture 11: While Loop

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Expressions again

- Expression: something that has a value
- Types of expressions we know
  - Literal constants: `33` or `3.14`
  - Variables: `count`
  - Simple - two *operands* and *operator*: `3 + 5`
  - Complex: `(count - (44 - 12) / 7) * num`
- Some expressions have side effect

```
x = 0 /* = is an operator! */
printf("Hello, World!\n")
```

From expressions to statements

- Statement: *expression with a semicolon*

```
33;
3+5;
x = 0;
x = y = 0; /* x = (y = 0); */
printf("Hello, World!\n");
```

- A statement makes sense if an expression in the statement has some side effect

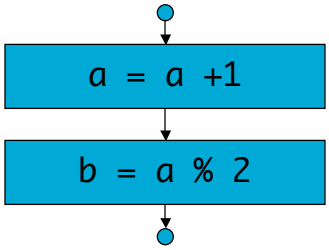
Block and Sequential Execution

- Block: { …..}
  - A group of statements
  - Statements are sequentially executed
  - Syntactically equivalent to a statement
- Example:

```
{
   a = a +1;
   b = a % 2;
}
```

Block and Sequential Execution

- Flowcharts are used to show the control flow inside the program
- Sequential execution inside a block means that the control (over the processor) flows downwards from statement to next statement



Blocks and Variables

- A block in C can start with a declaration of variables (just as the whole function)
- The scope of these variables is within this block - they can't be used outside of the block
- If variables with the same name exist outside of the block, they will be shadowed by the local block variables and not visible within the block

- Example:

```
int main() {
  int a, b;
   {
     int a;
     a = a +1;
     b = a % 2;
   }
}
```

While Loop

```
while (expression)
  loopstatement

nextstatement
```

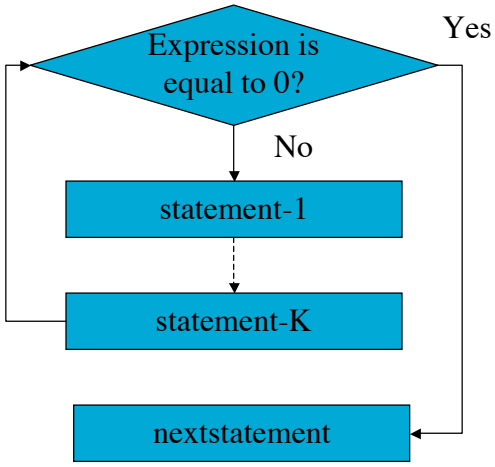
- If expression is not 0 (true) - dive into the loop
- If expression is 0 (false) - skip to nextstatement
- I.e, while expression is true, do the loop

While Loop with a Block

```
while (expression) {
   statement-1
   ...
   statement-K
}
nextstatement
```

- If expression is not 0 - dive into the loop
- If expression is 0 - skip to nextstatement
- I.e, while expression is not 0, do the loop

Flowchart of the While Loop



Example: Countdown (1)

```
/* Example 1: counting to zero
   Course IS0012
   Author: Peter Brusilovsky */
#include <stdio.h>
void main()
{
   int counter = 5; /* setting the counter */

   printf("Start counting...\n");
   while (counter) {

        printf("%d\n" , counter);

        counter = counter - 1;
   }
   printf("Fire!\n");
}
```

Increment Expressions

- Post-Increment: num++
  - Side effect: num is incremented
    - same as `num = num + 1`
  - Value: the value *before* increment
    - same as `num`
- Pre-Increment: ++num
  - Side effect: num is incremented
    - same as `num = num + 1`
  - Value: the value *after* increment
    - same as `num + 1`

Decrement Expressions

- Post-Decrement: num--
  - Side effect: num is decremented
    - same as `num = num - 1`
  - Value: the value *before* decrement
    - same as `num`
- Pre-Decrement: --num
  - Side effect: num is decremented
    - same as `num = num - 1`
  - Value: the value *after* decrement
    - same as `num - 1`

Some New Operations

- Special assignment expressions

```
result = result + 100; ➔ result += 100;
result = result - 100; ➔ result -= 100;
result = result % 100; ➔ result %= 100;
result = result * 100; ➔ result *= 100;
result = result / 100; ➔ result /= 100;
```

- As every expression it has a value
  - The value after assignment
- The side effect is the assignment

Example: Countdown (2)

```
/* Example 2 - counting to zero
   Author: Peter Brusilovsky 9/12/00 */
#include <stdio.h>
#define HOW_MANY 5

void main()
{
   int counter = HOW_MANY; /* setting the counter */

   printf("Start counting...\n");
   while (counter)
        printf("%d\n" , counter--);

   printf("Fire!\n");
}
```

Example: Interest over Years

```
void main() {
   int years; /* years the capital stays in bank */
   float interest_rate; /* interest rate in percents */
   float capital; /* capital in dollars */

   printf("Startup capital ($$$.cc): ");
   scanf("%f",&capital);
   printf("Interest rate in percents (xx.xx): ");
   scanf("%f",&interest_rate);
   printf("How many years? ");
   scanf("%d", &years);
   while (years) {
        capital += capital * interest_rate / 100;
        --years;
   }
   printf("New capital %9.2f\n", capital);
}
```

Before Next Lecture:

- Do reading assignment
  - Perry: Chapter 10; Chapter 14 (First reading)
- Run Classroom Examples
- Check yourself by working with QuizPACK and WADEIn systems
- Explore alternative readings with Knowledge Sea
- Do your homework (HW5)