# CHAPTER 2

# GETTING COMFORTABLE WITH C

# **Sample Output –** intrate

```
Interest Rate:       6.00%
Starting Balance: 5000.00$

Year     Balance
   1   $ 5300.00
   2   $ 5618.00
   3   $ 5955.08
   4   $ 6312.38
   5   $ 6691.13
   6   $ 7092.60
   7   $ 7518.15
```

# intrate.c

(Figure 2.1 – Page 20)

```
/*
 * Generate a table showing interest accumulation.
 */
#include <stdio.h>

#define PRINCIPAL  5000.00                /* start with $5000 */
#define INTRATE       0.06                /* interest rate of 6% */
#define PERIOD        7                   /* over 7-year period */

main()
{
  double balance;                         /* balance at year's end */
  int    year;                            /* year of period */

  printf("Interest Rate:    %7.2f%%\n", INTRATE * 100);
  printf("Starting Balance: %7.2f$\n\n", PRINCIPAL);
  printf("Year     Balance\n");
  balance = PRINCIPAL;
  year = 1;
  while (year <= PERIOD)
  {
    balance = balance + balance * INTRATE;
    printf("%4i   $ %7.2f\n", year, balance);
    year = year + 1;
  }
  return 0;                               /* assume program worked! */
}
```

# oops.c

(Figure 2.2 – Page 23)

```
/*
 * Generate a table showing interest accumulation.
 */
#include <stdio.h>

#define PRINCIPAL  5000.00                /* start with $5000 */
#define INTRATE       0.06                /* interest rate of 6% */
#define PERIOD        7                   /* over 7-year period */

main()
{
  double balance;                         /* balance at year's end */
  int    year;                            /* year of period */

  printf("Interest Rate:    %7.2f%%\n", INTRATE * 100)
  printf("Starting Balance: %7.2f$\n\n", PRINCIPAL);
  printf("Year     Balance\n");
  year = 1;
  while (year <= PERIOD)
  {
    balance = balance + balance * INTRATE;
    printf("%4i   $ %7.2f\n", year, balance);
    year := year + 1;
  }
  return 0;                               /* assume program worked! */
}
```

# **Compiler Errors –** oops

```
Compiling oops.c:

Error oops.c 16: Statement missing ; in main
Warning oops.c 21: Possible use of 'balance' before definition in main
Warning oops.c 21: Possible use of 'balance' before definition in main
Error oops.c 23: Expression syntax in main

*** 2 errors in Compile ***
```

# **Buggy Output** – oops

```
Interest Rate:       6.00%
Starting Balance: 5000.00$

Year     Balance
   1   $    0.00
   2   $    0.00
   3   $    0.00
   4   $    0.00
   5   $    0.00
   6   $    0.00
   7   $    0.00
```

# intrate2.c

(Figure 2.4 – Page 24)

```
/*
 * Generate a table showing interest accumulation.
 */
#include <stdio.h>

#define PRINCIPAL  5000.00                  /* start with $5000 */
#define INTRATE       0.06                  /* interest rate of 6% */
#define PERIOD        7                     /* over 7-year period */

main()
{
  double balance;                           /* balance at year's end */
  int    year;                              /* year of period */

  printf("Interest Rate:    %7.2f%%\n", INTRATE * 100);
  printf("Starting Balance: %7.2f$\n\n", PRINCIPAL);
  printf("Year     Balance\n");
  balance = PRINCIPAL;
  for (year = 1; year <= PERIOD; year = year + 1)
  {
    balance = balance + balance * INTRATE;
    printf("%4i   $ %7.2f\n", year, balance);
  }
  return 0;                                 /* assume program worked! */
}
```

# **Sample I/O –** intrate3

```
Enter interest rate, principal and period: .04 1000 7
Interest Rate:       4.00%
Starting Balance: 1000.00$

Year     Balance
   1   $ 1040.00
   2   $ 1081.60
   3   $ 1124.86
   4   $ 1169.86
   5   $ 1216.65
   6   $ 1265.32
   7   $ 1315.93
```

# intrate3.c

(Figure 2.5 – Page 26)

```
/*
 * Generate a table showing interest accumulation.  Now the user
 * provides the initial interest rate, balance, and principal.
 */
#include <stdio.h>

main()
{
  double intrate;                        /* interest rate */
  double balance;                        /* balance at year's end */
  int    year;                           /* year of period */
  int    period;                         /* length of period */

  printf("Enter interest rate, principal, and period: ");
  scanf("%lf %lf %i", &intrate, &balance, &period);
  printf("Interest Rate:    %7.2f%%\n", intrate * 100);
  printf("Starting Balance: %7.2f$\n\n", balance);
  printf("Year     Balance\n");
  for (year = 1; year <= period; year = year + 1)
  {
    balance = balance + balance * intrate;
    printf("%4i   $ %7.2f\n", year, balance);
  }
  return 0;                              /* assume program worked! */
}
```

# **Sample I/O –** grade

```
Enter score: 87
Hooray!  A 87 means you passed!
```

---

```
Enter score: 50
Too bad!  A 50 means you failed!
```

---

```
Enter score: 70
Hooray!  A 70 means you passed!
```

---

```
Enter score: 69
Too bad!  A 69 means you failed!
```

# grade.c

(Not In Text)

```
/*
 * Simple program to determine whether a grade is passing.
 */
#include <stdio.h>

#define PASSING 70                  /* minimum passing score */

main()
{
  int score;                        /* score on test */

  printf("Enter score: ");
  scanf("%i", &score);
  if (score >= PASSING)
    printf("Hooray!  A %i means you passed!\n", score);
  else
    printf("Too bad!  A %i means you failed!\n", score);
}
```

# **Sample I/O –** intrate4

```
Enter interest rate, principal, and period: alex
Error: Expected three numeric input values.
```

# intrate4.c

(Figure 2.6 – Page 28)

```
/*
 * A new version of our interest computing program that verifies
 * it received the expected input values.
 */
#include <stdio.h>

main()
{
  double intrate;                          /* interest rate */
  double balance;                          /* balance at year's end */
  int    year;                             /* year of period */
  int    period;                           /* length of period */
  int    status;                           /* did program fail? */

  printf("Enter interest rate, principal, and period: ");
  if (scanf("%lf %lf %i", &intrate, &balance, &period) != 3)
  {
    printf("Error: Expected three numeric input values.\n");
    status = 1;                            /* record program failed */
  }
  else
  {
    printf("Interest Rate:    %7.2f%%\n", intrate * 100);
    printf("Starting Balance: %7.2f$\n\n", balance);
    printf("Year     Balance\n");
    for (year = 1; year <= period; year = year + 1)
    {
      balance = balance + balance * intrate;
      printf("%4i   $ %7.2f\n", year, balance);
    }
    status = 0;                            /* record program success */
  }
  return status;                           /* return program status */
}
```

# **Sample I/O –** avg

```
95.6
Read value: 95.600000
87.5
Read value: 87.500000
71.5
Read value: 71.500000
82.6
Read value: 82.600000
57.9
Read value: 57.900000
91.4
Read value: 91.400000
68.6
Read value: 68.600000
73.5
Read value: 73.500000
98.6
Read value: 98.600000
control-d
The average of the 9 input values is 80.800000.
```

---

```
90.0
Read value: 90.000000
80.0
Read value: 80.000000
oops
The average of the 2 input values is 85.000000.
```

# avg.c

(Not In Text)

```
/*
 * Simple program to print average of its input values.
 */
#include <stdio.h>

main()
{
  double sum_so_far;            /* total of all values read */
  double next_value;            /* next value read */
  int values_read_so_far;       /* count of all values read */

  sum_so_far = 0.0;
  values_read_so_far = 0;
  while (scanf("%lf", &next_value) == 1)
  {
    printf("Read value: %f\n", next_value);
    values_read_so_far = values_read_so_far + 1;
    sum_so_far = sum_so_far + next_value;
  }
  printf("The average of the %i input values is %f.\n",
          values_read_so_far,
          sum_so_far / values_read_so_far);
  return 0;
}
```

# **Sample I/O –** avg2

```
56.7
Read score: 56.700000
That's a failing score!
86.7
Read score: 86.700000
That's a passing score!
70.5
Read score: 70.500000
That's a passing score!
69.5
Read score: 69.500000
That's a failing score!
control-d
The average of the 4 input values is 70.850000.
```

---

```
60.0
Read score: 60.000000
That's a failing score!
80.0
Read score: 80.000000
That's a passing score!
garbage
Warning: Hit error before end of input
The average of the 2 input values is 70.000000.
```

---

```
control-d
No scores were read in successfully.
```

# avg2.c
(Not In Text)

```
/*
 * Improved program to print average of its input values.  Also
 * determines whether each grade is passing or failing.
 */
#include <stdio.h>

#define PASSING 70               /* passing score */

main()
{
  double sum_so_far;             /* total of all values read */
  double next_value;             /* next value read */
  int values_read_so_far;        /* count of all values read */
  int n;                         /* number of values read */

  sum_so_far = 0.0;
  values_read_so_far = 0;
  n = scanf("%lf", &next_value);
  while (n == 1)
  {
    printf("Read score: %f\n", next_value);
    if (next_value >= PASSING)
      printf("That's a passing score!\n");
    else
      printf("That's a failing score!\n");
    values_read_so_far = values_read_so_far + 1;
    sum_so_far = sum_so_far + next_value;
    n = scanf("%lf", &next_value);
  }
  if (n != EOF)
    printf("Warning: Hit error before end of input\n");
  if (values_read_so_far != 0)
    printf("The average of the %i input values is %f.\n",
            values_read_so_far,
            sum_so_far / values_read_so_far);
  else
    printf("No scores were read in successfully.\n");
  return 0;
}
```

# **Sample I/O –** intrate5

```
Enter interest rate, principal, and period:  0.04 1000.00 4
Interest Rate:       4.00%
Starting Balance: 1000.00$

Year     Balance
   1   $ 1040.00
   2   $ 1081.60
   3   $ 1124.86
   4   $ 1169.86

Enter interest rate, principal, and period:  0.05 2000.00 4
Interest Rate:       5.00%
Starting Balance: 2000.00$

Year     Balance
   1   $ 2100.00
   2   $ 2205.00
   3   $ 2315.25
   4   $ 2431.01

Enter interest rate, principal, and period:  control-d
```

# intrate5.c

(Figure 2.7 – Page 30)

```
/*
 * An interest rate program that repeatedly reads input values.
 */
#include <stdio.h>

main()
{
  double intrate;                    /* interest rate */
  double balance;                    /* balance at year's end */
  int    year;                       /* year of period */
  int    period;                     /* length of period */
  int    status;                     /* did program fail? */
  int    n;                          /* number of values read */

  printf("Enter interest rate, principal, and period: ");
  while ((n = scanf("%lf %lf %i", &intrate, &balance, &period)) == 3)
  {
    printf("Interest Rate:    %7.2f%%\n", intrate * 100);
    printf("Starting Balance: %7.2f$\n\n", balance);
    printf("Year     Balance\n");
    for (year = 1; year <= period; year = year + 1)
    {
      balance = balance + balance * intrate;
      printf("%4i   $ %7.2f\n", year, balance);
    }
    printf("\nEnter interest rate, principal, and period: ");
  }
  if (n != EOF)
  {
    printf("Error: Expected three numeric input values.\n");
    status = 1;
  }
  else
    status = 0;
  return status;                     /* return program status */
}
```

# **Sample I/O –** stars2

```
40
****************************************
20
********************
10
**********
50
**************************************************
30
******************************
```

# stars2.c
(Not In Text)

```
/*
 * Print rows of stars corresponding to input values.
 */
#include <stdio.h>

main()
{
  int  next_value;
  void write_stars(int how_many);

  while (scanf("%i", &next_value) == 1)
  {
    write_stars(next_value);
    printf("\n");
  }
  return 0;
}

void write_stars(int how_many)
{
  int stars;              /* stars written */

  for (stars = 0; stars < how_many; stars = stars + 1)
    printf("*");
}
```

# **Sample I/O –** boxes

```
7 7
*******
*******
*******
*******
*******
*******
*******
3 50
**************************************************
**************************************************
**************************************************
4 6
******
******
******
******
```

# boxes.c

(Not In Text)

```
/*
 * Print boxes of stars corresponding to input values.
 */
#include <stdio.h>

main()
{
  int  next_height;        /* height of next box */
  int  next_width;         /* width of next box */
  void write_box(int height, int width);

  while (scanf("%i %i", &next_height, &next_width) == 2)
    write_box(next_height, next_width);
  return 0;
}

void write_box(int height, int width)
{
  int lines;               /* lines of stars written */
  void write_stars(int how_many);

  for (lines = 0; lines < height; lines = lines + 1)
  {
    write_stars(width);
    printf("\n");
  }
}

void write_stars(int how_many)
{
  int stars;               /* stars written */

  for (stars = 0; stars < how_many; stars = stars + 1)
    printf("*");
}
```

# **Sample I/O –** intrate6

```
Enter interest rate, principal, and period: .04 1000 7
Interest Rate:       4.00%
Starting Balance: 1000.00$

Year     Balance
   1   $ 1040.74
   2   $ 1083.14
   3   $ 1127.27
   4   $ 1173.20
   5   $ 1221.00
   6   $ 1270.74
   7   $ 1322.51
```

# intrate6.c

(Figure 2.8 – Page 32)

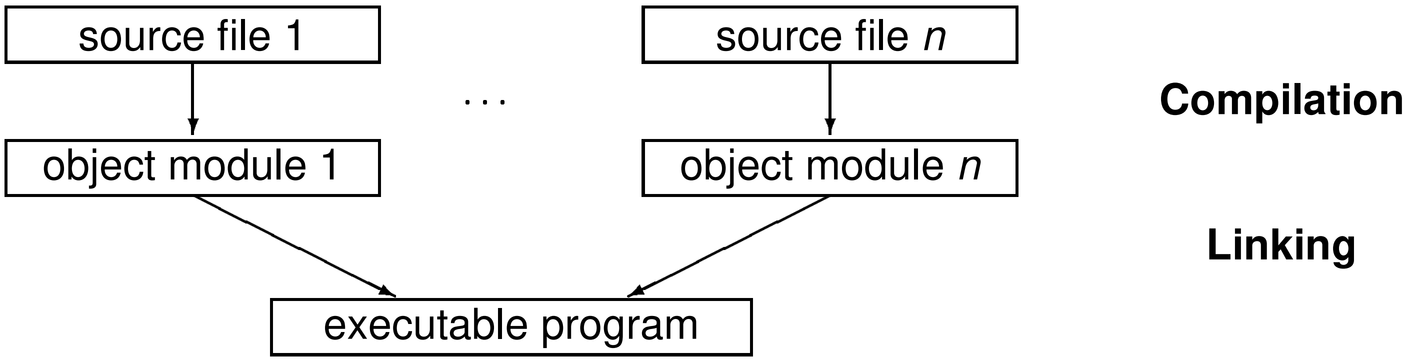
```
/*
 * A new version of our interest rate program that compounds
 * interest monthly, rather than yearly.
 */
#include <stdio.h>

main()
{
  void    display_values(double yrly_pct, double start_bal);
  double  year_end_balance(double intrate, double monthly_bal);

  int     period;                       /* length of period */
  int     year;                         /* year of period */
  double  balance;                      /* balance at end of year */
  double  intrate;                      /* interest rate */

  printf("Enter interest rate, principal, and period: ");
  scanf("%lf %lf %i", &intrate, &balance, &period);
  display_values(intrate * 100, balance);
  printf("Year     Balance\n");
  for (year = 1; year <= period; year = year + 1)
  {
    balance = year_end_balance(intrate, balance);
    printf("%4i   $ %7.2f\n", year, balance);
  }
  return 0;                             /* assume program succeeded */
}
```

# intrate6.c

(Figure 2.8 – Page 32)

```
/* Print the initial interest rate and starting balance */

void display_values(double yrly_pct, double start_bal)
{
  printf("Interest Rate:    %7.2f%%\n", yrly_pct);
  printf("Starting Balance: %7.2f$\n\n", start_bal);
}

/* Compute a year's ending balance, compounding interest monthly */

double year_end_balance(double intrate, double monthly_bal)
{
  int     month;                          /* current month */
  double  monthly_intrate;                /* % interest per month */

  monthly_intrate = intrate / 12;
  for (month = 0; month < 12; month = month + 1)
    monthly_bal = monthly_bal * monthly_intrate + monthly_bal;
  return monthly_bal;
}
```

# SEPARATE COMPILATION



# irmain.c

(Figure 2.10 – Page 37)

```
/*
 * The main program of our separately compilable interest rate program.
 */
#include <stdio.h>

main()
{
  void    display_values(double yrly_pct, double start_bal);
  double  year_end_balance(double intrate, double monthly_bal);

  int     period;                      /* length of period */
  int     year;                        /* year of period */
  double  balance;                     /* balance at end of year */
  double  intrate;                     /* interest rate */

  printf("Enter interest rate, principal, and period: ");
  scanf("%lf %lf %i", &intrate, &balance, &period);
  display_values(intrate * 100, balance);
  printf("Year     Balance\n");
  for (year = 1; year <= period; year = year + 1)
  {
    balance = year_end_balance(intrate, balance);
    printf("%4i   $ %7.2f\n", year, balance);
  }
  return 0;                             /* assume program succeeded */
}
```

# irfuncs.c

(Figure 2.11 – Page 38)

```
/*
 * The functions for our separately compilable interest rate program.
 *   display_values - print initial interest rate and starting balance.
 *   year_end_balance - compute year's ending balance, compounding
 *     interest monthly.
 */
#include <stdio.h>

void display_values(double yrly_pct, double start_bal)
{
  printf("Interest Rate:    %7.2f%%\n", yrly_pct);
  printf("Starting Balance: %7.2f$\n\n", start_bal);
}

double year_end_balance(double intrate, double monthly_bal)
{
  int     month;
  double  monthly_intrate;

  monthly_intrate = intrate / 12;
  for (month = 0; month < 12; month = month + 1)
    monthly_bal = monthly_bal * monthly_intrate + monthly_bal;
  return monthly_bal;
}
```

# SEPARATE COMPILATION ON UNIX

- Use the *-c* command to *cc* to compile a source file without linking.

  *cc -c irmain.c*
  *cc -c irfuncs.c*

- By default, this creates an object module with a suffix of *.o* rather than *.c*.

- Use the *cc* command to link the object modules together.

  *cc -o ir irmain.o irfuncs.o*

- To run the program, simply type the executable's name.

  *ir*

- On some systems you may have to add extra options (such as *-Aa*) to request an ANSI C compilation.

  *cc -Aa -c irmain.c*
  *cc -Aa -c irfuncs.c*

# **Sample I/O –** intrate7

```
Enter interest rate, principal, and period:  .05 1000 5

Interest Rate:       5.00%
Starting Balance: 1000.00$

Year   Balance
   1   $ 1051.16
   2   $ 1104.94
   3   $ 1161.47
   4   $ 1220.90
   5   $ 1283.36
Enter interest rate, principal, and period:  .03 5000 8

Interest Rate:       3.00%
Starting Balance: 5000.00$

Year   Balance
   1   $ 5152.08
   2   $ 5308.79
   3   $ 5470.26
   4   $ 5636.64
   5   $ 5808.08
   6   $ 5984.74
   7   $ 6166.77
   8   $ 6354.34
Enter interest rate, principal, and period:  control-d
```

# intrate7.c

(Not In Text)

```
/*
 * A final version of our interest rate program that both
 * repeatedly reads values and makes use of a set of functions.
 */
#include <stdio.h>

main()
{
  double intrate;                        /* interest rate */
  double balance;                        /* balance at year's end */
  int    period;                         /* length of period */
  int    n;                              /* number of values read */
  void   print_balances(double intrate, double balance, int period);

  printf("Enter interest rate, principal, and period: ");
  while ((n = scanf("%lf %lf %i", &intrate, &balance, &period)) == 3)
  {
    print_balances(intrate, balance, period);
    printf("\nEnter interest rate, principal, and period: ");
  }
  if (n == EOF)
    printf("\n");
  else
    printf("I expected three values.  I quit!\n");
  return 0;
}

void print_balances(double intrate, double balance, int period)
{
  int    year;
  void   display_values(double yrly_pct, double start_bal);
  double year_end_balance(double intrate, double monthly_bal);

  display_values(intrate * 100, balance);
  printf("Year   Balance\n");
  for (year = 1; year <= period; year = year + 1)
    printf("%4i   $ %7.2f\n",
           year, balance = year_end_balance(intrate, balance));
}
```

# REMINDERS

- Do not take compiler warning messages lightly.
- Remember to precede any variables passed to **`scanf`** with an **`&`**.
- Make sure to parenthesize any assignment you embed in a larger expression.
- Changes to a function's parameters do not affect its arguments.
- Make sure to provide a prototype for every function you call.

# CHAPTER SUMMARY

- C provides the **`while`** and **`for`** looping constructs. The **`while`** repeatedly tests an expression and, if it's true, executes the body of the loop. The **`for`** allows us to initialize a variable before going through the loop and to update it each time we finish executing the loop body.

- C provides a variety of operators for doing comparisons (**`==`**, **`!=`**, **`<`**, **`<=`**, **`>`**, **`>=`**) and taking an address (**`&`**).

- We perform formatted input with the predefined **`scanf`** function.

  **`scanf("`***format string*`", ` *address-1*`, ` *address-2*`, ` ...**`)`**

- We make decisions using the **`if`** statement.

- We can define our own functions by providing the function's return value, parameters, and statements to be executed when the program is called.

- We can divide our programs into multiple source files, compile them separately, and then link the resulting object modules together.