Chapter 2

Overview of C

Figure 2.1 C Language Elements in Miles-to-Kilometers Conversion Program

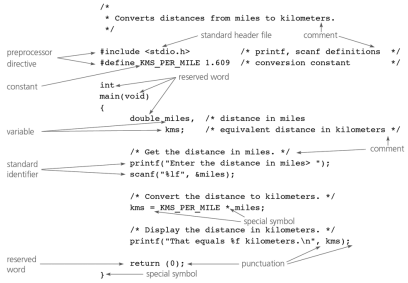

Figure 2.2 Memory(a) Before and (b) After Execution of a Program

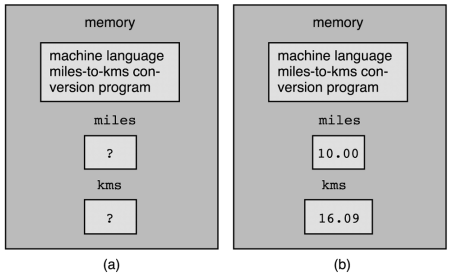

Figure 2.3 Effect of kms = KMS_PER_MILE * miles;

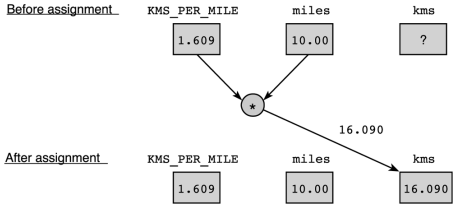

Figure 2.4 Effect of sum = sum + item;

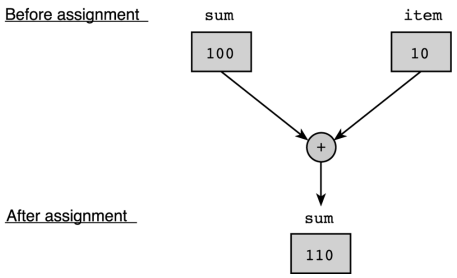

Figure 2.5 Effect of scanf("%lf", &miles);

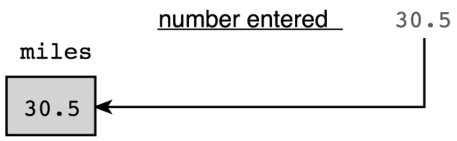

Figure 2.6 Scanning Data Line Bob

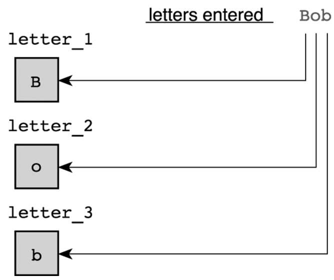

Figure 2.7 General Form of a C Program

preprocessor directives
main function heading
{
declarations
executable statements
}

Figure 2.8 Evaluation Tree for
area = PI * radius * radius;

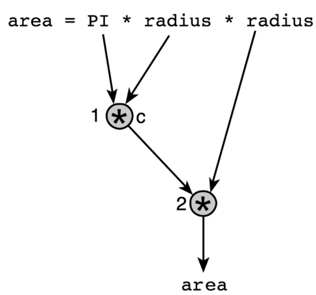

Figure 2.9 Step-by-Step Expression Evaluation

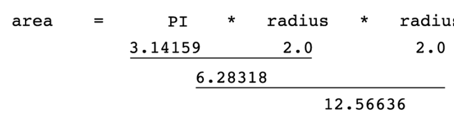

Figure 2.10 Evaluation Tree and Evaluation for v = (p2 - p1) / (t2 - t1);

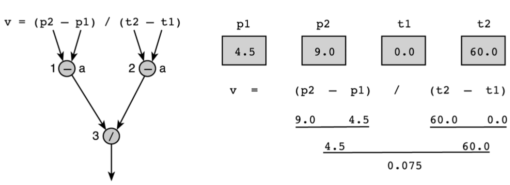

Figure 2.11 Evaluation Tree and Evaluation for z - (a + b / 2) + w * -y

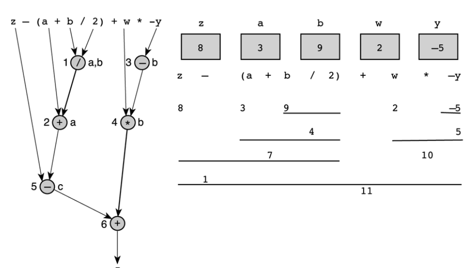

Figure 2.12 Finding the Value of Coins

```
/*
 * Determines the value of a collection of coins.
 */
#include <stdio.h>
int
main(void)
{
    char first, middle, last; /* input - 3 initials          */
    int pennies, nickels;  /* input - count of each coin type */
    int dimes, quarters;   /* input - count of each coin type */
    int change;            /* output - change amount       */
    int dollars;           /* output - dollar amount       */
    int total_cents;       /* total cents

    /* Get and display the customer's initials. */
    printf("Type in 3 initials and press return> ");
    scanf("%c%c%c", &first, &middle, &last);
    printf("Hello %c%c%c, let's see what your coins are worth.\n",
           first, middle, last);

    /* Get the count of each kind of coin. */
    printf("Number of quarters> ");
```

(continued)

Figure 2.12 Finding the Value of Coins (cont'd)

```
    scanf("%d", &quarters);
    printf("Number of dimes   > ");
    scanf("%d", &dimes);
    printf("Number of nickels > ");
    scanf("%d", &nickels);
    printf("Number of pennies > ");
    scanf("%d", &pennies);

    /* Compute the total value in cents. */
    total_cents = 25 * quarters + 10 * dimes +
                  5 * nickels + pennies;

    /* Find the value in dollars and change. */
    dollars = total_cents / 100;
    change = total_cents % 100;

    /* Display the value in dollars and change. */
    printf("\nYour coins are worth %d dollars and %d cents.\n",
           dollars, change);

    return (0);
}
```

```
Type in 3 initials and press return> BMC
Hello BMC, let's see what your coins are worth.
Number of quarters> 8
Number of dimes   > 20
Number of nickels > 30
Number of pennies > 77

Your coins are worth 6 dollars and 27 cents.
```


Figure 2.13 Batch Version of Miles-to-Kilometers Conversion Program

```
/* Converts distances from miles to kilometers.    */

#include <stdio.h>    /* printf, scanf definitions */
#define KMS_PER_MILE 1.609 /* conversion constant  */

int
main(void)
{
      double miles,  /* distance in miles                                */
             kms;    /* equivalent distance in kilometers                */

      /* Get and echo the distance in miles. */
      scanf("%lf", &miles);
      printf("The distance in miles is %.2f.\n", miles);

      /* Convert the distance to kilometers. */
      kms = KMS_PER_MILE * miles;

      /* Display the distance in kilometers. */
      printf("That equals %.2f kilometers.\n", kms);

      return (0);
}
```

```
The distance in miles is 112.00.
That equals 180.21 kilometers.
```


Figure 2.14 Miles-to-Kilometers Conversion Program with Named Files

```
/* Converts distances from miles to kilometers.    */

#include <stdio.h>    /* printf, scanf, fprint, fscanf, fopen, fcloes
                         definitions                                  */
#define KMS_PER_MILE 1.609 /* conversion constant  */

int
main(void)
{
      double miles, /* distance in miles                                */
             kms;   /* equivalent distance in kilometers                */
      FILE  *inp,  /* pointer to input file                            */
            *outp; /* pointer to output file                           */

      /* Open the input and output files.   */
      inp = fopen("b:distance.dat", "r");
      outp = fopen("b:distance.out", "w");

      /* Get and echo the distance in miles. */
      fscanf(inp, "%lf", &miles);
      fprintf(outp, "The distance in miles is %.2f.\n", miles);

      /* Convert the distance to kilometers. */
      kms = KMS_PER_MILE * miles;

      /* Display the distance in kilometers. */
      fprintf(outp, "That equals %.2f kilometers.\n", kms);

      /* Close files. */
      fclose(inp);
      fclose(outp);

      return (0);
}
```

Contents of input file distance.dat

```
112.0
```

Contents of output file distance.out

```
The distance in miles is 112.00.
That equals 180.21 kilometers.
```


Figure 2.15 Compiler Listing of a Program with Syntax Errors

```
221 /* Converts distances from miles to kilometers. */
222
223 #include <stdio.h>        /* printf, scanf definitions   */
266 #define KMS_PER_MILE 1.609 /* conversion constant         */
267
268 int
269 main(void)
270 {
271       double kms
272
273       /* Get the distance in miles. */
274       printf("Enter the distance in miles> ");
***** Semicolon added at the end of the previous source line

275       scanf("%lf", &miles);
***** Identifier "miles" is not declared within this scope
***** Invalid operand of address-of operator

276
277       /* Convert the distance to kilometers. */
278       kms = KMS_PER_MILE * miles;
***** Identifier "miles" is not declared within this scope

279
280       /* Display the distance in kilometers. * /
281       printf("That equals %f kilometers.\n", kms);
282
283       return (0);
284 }
***** Unexpected end-of-file encountered in a comment
***** "}" inserted before end-of-file
```


Figure 2.16 A Program with a Run-Time Error

```
111 #include <stdio.h>
262
263 int
264 main(void)
265 {
266       int    first, second;
267       double temp, ans;
268
269       printf("Enter two integers> ");
270       scanf("%d%d", &first, &second);
271       temp = second / first;
272       ans = first / temp;
273       printf("The result is %.3f\n", ans);
274
275       return (0);
276 }

Enter two integers> 14 3
Arithmetic fault, divide by zero at line 272 of routine main
```

Figure 2.17 Revised Start of main Function for Coin Evaluation

```
1.  int
2.  main(void)
3.  {
4.        char first, middle, last; /* input - 3 initials           */
5.        int pennies, nickels;  /* input - count of each coin type */
6.        int dimes, quarters;   /* input - count of each coin type */
7.        int change;            /* output - change amount          */
8.        int dollars;           /* output - dollar amount          */
9.        int total_cents;       /* total cents                     */
10.       int year;              /* current year                    */
11.
12.       /* Get the current year.                                  */
13.       printf("Enter the current year and press return> ");
14.       scanf("%d", &year);
15.
16.       /* Get the program user's initials.                       */
17.       printf("Type in 3 initials and press return> ");
18.       scanf("%c%c%c", &first, &middle, &last);
19.       printf("Hello %c%c%c, let's check your coins' value in %d.\n",
20.             first, middle, last, year);
21.       ...
```


Figure 2.18 A Program That Produces Incorrect Results Due to & Omission

```
1.  #include <stdio.h>
2.
3.  int
4.  main(void)
5.  {
6.        int    first, second, sum;
7.
8.        printf("Enter two integers> ");
9.        scanf("%d%d", first, second); /* ERROR!! should be  &first, &second */
10.       sum = first + second;
11.       printf("%d + %d = %d\n", first, second, sum);
12.
13.       return (0);
14. }

Enter two integers> 14  3
5971289 + 5971297 = 11942586
```