PROBLEMS

1. Convert the following numbers to binary: 1984, 4000, 8192.

2. What is 1001101001 (binary) in decimal? In octal? In hexadecimal?

3. Which of the following are valid hexadecimal numbers? BED, CAB, DEAD, DECADE, ACCEDED, BAG, DAD.

4. Express the decimal number 100 in all radices from 2 to 9.

5. How many different positive integers can be expressed in k digits using radix r numbers?

6. Most people can only count to 10 on their fingers; however, computer scientists can do better. If you regard each finger as one binary bit, with finger extended as 1 and finger touching palm as 0, how high can you count using both hands? With both hands and both feet? Now use both hands and both feet, with the big toe on your left foot as a sign bit for two's complement numbers. What is the range of expressible numbers?

7. Perform the following calculations on 8-bit two's complement numbers.

$$\begin{array}{r} 00101101 \\ +\underline{01101111} \end{array} \qquad \begin{array}{r} 11111111 \\ +\underline{11111111} \end{array} \qquad \begin{array}{r} 00000000 \\ -\underline{11111111} \end{array} \qquad \begin{array}{r} 11110111 \\ -\underline{11110111} \end{array}$$

8. Repeat the calculation of the preceding problem but now in one's complement.

9. Consider the following addition problems for 3-bit binary numbers in two's complement. For each sum, state
   a. Whether the sign bit of the result is 1.
   b. Whether the low-order 3 bits are 0.
   c. Whether an overflow occurred.

$$\begin{array}{r} 000 \\ +\underline{001} \end{array} \qquad \begin{array}{r} 000 \\ +\underline{111} \end{array} \qquad \begin{array}{r} 111 \\ +\underline{110} \end{array} \qquad \begin{array}{r} 100 \\ +\underline{111} \end{array} \qquad \begin{array}{r} 100 \\ +\underline{100} \end{array}$$

10. Signed decimal numbers consisting of n digits can be represented in $n + 1$ digits without a sign. Positive numbers have 0 as the leftmost digit. Negative numbers are formed by subtracting each digit from 9. Thus the negative of 014725 is 985274. Such numbers are called nine's complement numbers and are analogous to one's complement binary numbers. Express the following as three-digit nine's complement numbers: 6, −2, 100, −14, −1, 0.

11. Determine the rule for addition of nine's complement numbers and then perform the following additions.

$$\begin{array}{r} 0001 \\ +\underline{9999} \end{array} \qquad \begin{array}{r} 0001 \\ +\underline{9998} \end{array} \qquad \begin{array}{r} 9997 \\ +\underline{9996} \end{array} \qquad \begin{array}{r} 9241 \\ +\underline{0802} \end{array}$$

12. Ten's complement is analogous to two's complement. A ten's complement negative number is formed by adding 1 to the corresponding nine's complement number, ignoring the carry. What is the rule for ten's complement addition?

13. Construct the multiplication tables for radix 3 numbers.

14. Multiply 0111 and 0011 in binary.