

**Definition** For  $b$  an integer greater than 1 and  $n$  a positive integer, the **base  $b$  expansion of  $n$**  is

$$(a_{k-1} \cdots a_1 a_0)_b$$

where  $k$  is a positive integer,  $a_0, a_1, \dots, a_{k-1}$  are nonnegative integers less than  $b$ ,  $a_{k-1} \neq 0$ , and

$$n = \sum_{i=0}^{k-1} a_i b^i$$

Notice: *The base  $b$  expansion of a positive integer  $n$  is a string over the alphabet  $\{x \in \mathbb{N} \mid x < b\}$  whose leftmost character is nonzero.*

| Base $b$                 | Collection of possible coefficients in base $b$ expansion of a positive integer  |
|--------------------------|--|
| Binary ( $b = 2$ )       | $\{0, 1\}$   |
| Ternary ( $b = 3$ )      | $\{0, 1, 2\}$  |
| Octal ( $b = 8$ )        | $\{0, 1, 2, 3, 4, 5, 6, 7\}$   |
| Decimal ( $b = 10$ )     | $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$   |
| Hexadecimal ( $b = 16$ ) | $\{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F\}$<br>letter coefficient symbols represent numerical values $(A)_{16} = (10)_{10}$<br>$(B)_{16} = (11)_{10}$ $(C)_{16} = (12)_{10}$ $(D)_{16} = (13)_{10}$ $(E)_{16} = (14)_{10}$ $(F)_{16} = (15)_{10}$ |