## 4.1 The Decimal System

Decimal The decimal system, also called base-ten, refers to a number system in which the number

The word “decimal” 10 is used as the base. The origin of this system probably goes back to the number of fincomes to us from the

Latin word 'decimus,' gers on human hands that were used as counting or calculation aids.

meaning ten.

The numbers of the decimal system are called decimal numbers. The ten known digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 are used for their notation; these digits are called decimal digits. In other parts of the world, different characters are sometimes used for this purpose, but—as the name of the system already suggests—there are always ten of them. with m, n ∈ ℕ and di ∈ {0, ±., 9}dmd, m−−n ≤ i ≤ m1…d1d0 ·d. −1d−2…d−n

Any number in the decimal system can be expressed in the form

power of ten highest index furthest The index right at the end.i indicates the importance of the respective digit 10i. The digits are written directly left at the beginning and the digit with the lowest index after each other, with the digit di. The value of each digit is add−mn with the furthest

decimal places. In German-speaking countries, the comma is used as a separator betweenThe places with the digits before and i ≥ 0 are called pre-decimal places and the places after the decimal point. In the English-speaking world, a periodi < 0 are called postcorresponding to the weight of each digit. For this purpose, the digits before the decimalments from dThe value instead of a comma is used for this. To notate integers without decimal places, i.e., ele-point are multiplied by powers of ten with non-negative exponents and the digits −1 . d−n and the separating period and writes, for example, instead of 5.0, simply 5.z of each decimal number in the decimal system is the sum of powers of base 10ℤ, the digits dm . d0 are sufficient. In this case, one usually omits the digitsafter the

decimal point by powers of ten with negative exponents and summed up. The value of each decimal number can thus be calculated as follows:Example: Decimal system z = ± i =∑m−nzi ·10i

5=5·10=5·1 0

723=7·10=7·100+2·10+3·1=700+20+335=3·101 +6·10=3·10+5·1=30+52=5+2·1001 +9·10+5·101 +3·10−0 1 +5·100 −2

46.95=4·10=4·10+6·1+9·0.1+5·0.01=40+6+0.9+0.05−3.5===−−− 3·103·1+3+0.50 +5·105·0.1 −1 1,234.567=1·10=1000+200+30+4+0.5+0.06+0.007=1·1000+2·100+3·10+4·1+5·0.1+6·0.01+7·0.0013 +2·102 +3·101 +4·100 +5·10−1 +6·10−2 +7·10−3

To indicate that a number is expressed in a particular number system, a subscript index is often used which indicates the base number of that system. The notation 123410 means, for example, that it is the number 1234 in the decimal system. This information is important because the value of the number can be completely different in other number systems. The value of a number is always given as a decimal number, because this is the number system in which we calculate daily. Therefore, please note that the number 1234 only actually has the value 1234 in the decimal system! In other number systems the value of this number is different, as we will see below. Thus, it is always necessary to distinguish between the representation of a number and its actual value. Since most of the numbers we calculate with are decimal numbers, we will often omit the index for these in the following if it is clear from the context in which we work and there is no risk of misunderstanding. Unless otherwise explicitly stated, all numbers without a base are always decimal numbers in the following.