Number Systems

*Learning Objectives:*

* *To be able to explain where each type of number may be used by a computer or in a program*
* *To be able to explain where real numbers and integers may be used in a computer program*
* *To be able to explain what each type of number is and to know the difference between real numbers and integers*

**Integer:** Any whole number (no fractional portion)

**Rational Number:** A number that can be expressed as a fraction (a.k.a. a *quotient*)

**Irrational Number:** A number that *cannot* be expressed as a fraction, e.g. π, φ, *e*

**Real Number:** Any positive or negative number

**Ordinal Number:** A number to specify a position in a list, e.g. first, second, third

**CNC** (Computer Numerical Control): The manner in which a computer converts and interprets numbers, e.g. converting a CAD design to numbers for a 3D printer

*1. What are the defining features of…*

1. *…natural numbers?*

Whole number, above 0

1. *…integers?*

Whole number

1. *…rational numbers?*

Can be expressed as a fraction

1. *…irrational numbers?*

*Can’t* be expressed as a fraction

1. …real numbers?

Any positive or negative number

*2. Why is it important for programmers to distinguish between the different types of number?*

So the computer knows how much memory to set aside for the number when stored, as well as indicating what the number will be used for to other programmers.

*3. Use an example to explain the difference between an ordinal number and a cardinal number.*

Let’s think of an array – to reference the *first* (ordinal number) item in the array, you use *index 0* (cardinal number).

*4. Prove that all integers are rational numbers*

Any integer is a whole number, meaning that if it were in a simplified fraction, its denominator would be 1 – because it can be written in a fraction, it must be rational.

*5. Why does dividing a number by 0 not result in a value of 0?*

Any number divided by 0 is mathematically undefined, so when used in a program, it would either return some kind of NaN or undefined value, or throw an exception.