|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| a | b | C | D | e | f | g | h | i | j | k | M |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |

BCD 555 = 0101 0101 0101

UTF - 8

|  |  |  |  |
| --- | --- | --- | --- |
| 1st point | Last point | # of bytes | Byte 1 |
| 0000 | 007F | 1 | 0xxxxxxx |
| 0080 | 07FF | 2 | 110xxxxx |
| 0800 | FFFF | 3 | 1110xxxx |
| 10000 | 1FFFFF | 4 | 11110xxx |

|  |  |  |
| --- | --- | --- |
| Byte 2 | Byte 3 | Byte 4 |
|  |  |  |
| 10xxxxxx |  |  |
| 10xxxxxx | 10xxxxxx |  |
| 10xxxxxx | 10xxxxxx | 10xxxxxx |

UTF – 16

Code points from U+010000 to U+10FFFF

–0x010000 is subtracted from the code point, leaving a 20-bit number in the range 0x00000 to 0xFFFFF.

–The top ten bits (a number in the range 0x0000 to 0x03FF) are added to 0xD800 to give the first 16-bit code unit or *high surrogate*, which will be in the range 0xD800..0xDBFF.

|  |  |  |  |
| --- | --- | --- | --- |
| 99.75 to Decimal 32 | | | |
| Sign | Combi | Exp | Mantissa |
| 0 | 01000 | 10 0011 | 000 000 1 001 101 1111 101 |

–The low ten bits (also in the range 0x0000 to 0x03FF) are added to 0xDC00 to give the second 16-bit code unit or *low surrogate*, which will be in the range 0xDC00..0xDFFF.

UTF – 32 = Represent as is.

Length of Field

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Format | Single Precision | Double Pre | Decimal32 | Decimal64 |
| Length | 32 | 64 | 32 | 64 |
| Sign | 1 | 1 | 1 | 2 |
| Exp. | 8 | 11 | 6 | 8 |
| Mantissa | 23 | 52 | 20 | 50 |
| Total Mantissa in digits | N/A | N/A | 7 | 16 |
| Combi. | N/A | N/A | 5 | 5 |
| Bias | 127 | 1023 | 101 | 398 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 1.011 + 0.0011111 | | With GSR | G | S | R |
| Operand1 | 1.10 | 1.01 | 1 | 0 | 1 |
| Operand2 | 0.10 | 0.00 | 1 | 1 | 1 |
| Sum | 1.11 | 1.10 | 0 | 1 | 1 |
| Sum rounded off | 1.10 | | | | |

|  |  |  |
| --- | --- | --- |
| Decimal | 16-bit Unsigned integer binary | 16-bit 2’s complement binary |
| +130 | 0000 0000 1000 0010 | 0000 0000 1000 0010 |
| -130 | n/a | 1111 1111 0111 110 |
| +32767 | 0111 1111 1111 1111 | 0111 1111 1111 1111 |
| -32767 | n/a |  |
| +65535 | 1111 1111 1111 1111 | N/A |
| -10000 | n/a |  |

32768 16384 8192 4096 2048 1024 512 256 128 64 32 16 8 4 2 1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Densely Packed Decimal | | | | |
| aei | pqr | stu | v | wxy |
| 000 | Bcd | Fgh | 0 | Jkm |
| 001 | Bcd | Fgh | 1 | 00m |
| 010 | Bcd | Jkh | 1 | 01m |
| 011 | Bcd | 10h | 1 | 11m |
| 100 | Jkd | Fgh | 1 | 10m |
| 101 | Fgd | 01h | 1 | 11m |
| 110 | Jkd | 00h | 1 | 11m |
| 111 | 00d | 11h | 1 | 11m |

Directed Rounding

–Round towards 0: also known as truncation

–Round towards +infinity: also known as rounding up or ceiling

–Round towards –infinity: also known as round down or floor

Rounding to nearest

–Round to nearest, ties to even

–Round to nearest, ties away from zero

Round to nearest, ties to even

Rounds to the nearest value

If the number falls midway it is rounded to the nearest value with an even (zero) least significant bit

|  |  |  |
| --- | --- | --- |
| +99.75 to single precision | | |
| Sign | Exp. | Mantissa |
| 0 | 1000 0101 | 1000 11110….0 |

|  |  |  |
| --- | --- | --- |
| -110011.11 to double precision | | |
| Sign | Exp. | Mantissa |
| 1 | 100 0000 0101 | 100011110….0 |

|  |  |  |  |
| --- | --- | --- | --- |
| Floating point rounding | | | |
| 0.7783 | 3 sig. | 2 sig. | 1 sig |
| Truncate | 0.77 | 0.7 | 0 |
| Round - up | 0.78 | 0.8 | 1 |
| Round - down | 0.77 | 0.7 | 0 |
| Round even | 0.78 | 0.8 | 1 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Round up to 3 significant bits. | | | | |
|  | Truncate | R. up | R. down | R. even |
| 0.1101 | 0.11 | 1.00 | 0.11 | 0.11 |
| 0.1110 | 0.11 | 1.00 | 0.11 | 0.10 |
| 0.1111 | 0.11 | 1.00 | 0.11 | 1.11 |

|  |  |  |
| --- | --- | --- |
| Unicode | U+03A3 | U+240F1 |
| UTF – 8 | 1100 1110 1010 0011 | 1111 0000 1010 0100 1000 0011 1011 0001 |
| UTF – 16 | 0000 0011 1010 0011 | 1101 1000 0101 0000 1101 1100 1111 0001 |
| UTF - 32 | 0000 0000 0000 0000 0000 0011 1010 0011 | 0000 0010 0100 0000 1111 0001 |

|  |  |  |
| --- | --- | --- |
| 16 – bit binary | Decimal signed | Decimal unsigned |
| 00001 0001 0001 0001 |  |  |
| 1000 1000 1000 1000 |  |  |