Ik heb steeds mijn antwoorden vetgedrukt, soms is dit niet heel duidelijk, maar ik mag niet markeren binnenin wiskundige vergelijkingen van Libreoffice. Hopelijk is alles wel duidelijk genoeg.

Oefening 1:

a. $(10110111100)_2\, 0+0+4+8+16+32+0+128+256+1024=\mathbf{1468_{10}}$

b. $(3A6E)_{16}=14+6*16+10*16^2+3*16^3=\mathbf{14958_{10}}$

c. $(1110000011010)_2=0+2+0+8+16+1024+2048+4096=\mathbf{7194_{10}}$

d. $(164)_8=64+6*8+4=\mathbf{116_{10}}$

e. $(1004)_6=6^3+4=\mathbf{220_{10}}$

Oefening 2:

a. $(11101011)_{2(two's\,complement)}=-\overline{11101011-1}=-00010101=-(1+4+16)=\mathbf{-21_{10}}$

b. Allemaal 1 = $\mathbf{-1_{10}}$

c. $(0.213)_4=0+\frac{2}{4}+\frac{1}{16}+\frac{3}{64}=\mathbf{0.609375_{10}}$

d. $(0.987)_{15}=0+\frac{9}{15}+\frac{8}{15^2}+\frac{7}{15^3}=\mathbf{0.637629629\ldots_{10}}$

Oefening 3:

a. $(2021)_{10}=\begin{array}{r|l} 2021 & 1 \\ 1010 & 0 \\ 505 & 1 \\ 252 & 0 \\ 126 & 0 \\ 63 & 1 \\ 31 & 1 \\ 15 & 1 \\ 7 & 1 \\ 3 & 1 \\ 1 & 1 \end{array}=\mathbf{11111100101_2}$

b. $(666)_8=6*8^2+6*8+6=438_{10}=\begin{array}{r|l} 438 & 0 \\ 219 & 1 \\ 109 & 1 \\ 54 & 0 \\ 27 & 1 \\ 13 & 1 \\ 6 & 0 \\ 3 & 1 \\ 1 & 1 \end{array}=\mathbf{110110110_2}$

c. $(1BD7)_{16}\overset{elk\,teken\,afzonderlijk}{=}0001\,1011\,1101\,0111=\mathbf{1101111010111_2}$

d. $(7.75)_{10}=\begin{array}{r|l} 7 & 1 \\ 3 & 1 \\ 1 & 1 \\ \hline 0{,}75 & 1 \\ 1{,}5 & 1 \\ {,}5 & 0 \end{array}=\mathbf{111.11_2}$

e. $(AD14)_{16}\overset{zie\,3.c.}{=}\mathbf{1010110100010100_2}$

Oefening 4:

a. $(-104)_{10} = - \begin{array}{r|l} 104 & 0 \\ 52 & 0 \\ 26 & 0 \\ 13 & 1 \\ 6 & 0 \\ 3 & 1 \\ 1 & 1 \end{array} = -1101000_2 =$

$\overset{signed\ magnitude}{=} \mathbf{101101000_2} \left(: positieve\ getal, maar\ eerst\ 0\ voor + of\ 1\ voor -\right)$

$\overset{once\ complement}{=} \mathbf{110010111_2} \left(: signed\ magnitude, maar\ alle\ bits\ behalve\ de\ sign\ zijn\ geflipt\right)$

$\overset{two's\ complement}{=} \mathbf{110011000_2} \left(: once\ complement + 1\right)$

$\overset{excess\ 128}{=} \mathbf{000011000_2} \left(: positieve\ getal + 128\right)$

b. $(-69)_{10} = \begin{array}{r|l} 69 & 1 \\ 34 & 0 \\ 17 & 1 \\ 8 & 0 \\ 4 & 0 \\ 2 & 0 \\ 1 & 1 \end{array} = -1000101_2$

$\overset{signed\ magnitude}{=} \mathbf{101000101_2}$

$\overset{once\ complement}{=} \mathbf{110111010_2}$

$\overset{two's\ complement}{=} \mathbf{110111011_2}$

$\overset{excess\ 128}{=} \mathbf{000111011_2}$

c. $(-128)_{10} = 2^7 = 10000000_2$

$\overset{signed\ magnitude}{=} \mathbf{110000000_2}$

$\overset{one's\ complement}{=} \mathbf{101111111_2}$

$\overset{two's\ complement}{=} \mathbf{110000000_2}$

$\overset{excess-128}{=} \mathbf{000000000_2}$

d. $(-3D)_{16} = -(00)111101_2$

$\overset{signed\ magnitude}{=} \mathbf{100111101_2}$

$\overset{one's\ complement}{=} \mathbf{111000010_2}$

$\overset{two's\ complement}{=} \mathbf{111000011_2}$

$\overset{excess-128}{=} \mathbf{001000011_2}$

<u>Oefening 5:</u>

a. $(0\ 10001110\ 00111010000000000000000)_{IEEE-754}$, elk stuk afzonderlijk 0, $128+8+4+2=142$,

$\frac{1}{8}+\frac{1}{16}+\frac{1}{32}+\frac{1}{128}=0.2265625$

$=+(eerste\ bit\ 0, positief)\, 2^{142-127=15} (exponent\ is\ excess\ 127) \cdot 1.2265625 (leading\ 1, want\ normaal\ getal)$

$= \mathbf{2^{15} \cdot 1.2265625_{10}}$

b. $(1\ 00111100\ 10110000000000000000000)_{IEEE-754} = -2^{(4+8+16+32)-127} \cdot \left(1+\frac{1}{2}+\frac{1}{8}+\frac{1}{16}\right) = \mathbf{-2^{-67} \cdot 1.6875}$

c. $(0\ 11111111\ 00000000000000000000000)_{IEEE-754} = \boldsymbol{+\infty (speciaal\ geval)}$

d.

$(0\ 00000000\ 00101011100000000000000)_{IEEE-754} = 2^{-126} (subnormal : speciaal\ getal) \cdot \left(\frac{1}{8}+\frac{1}{32}+\frac{1}{128}+\frac{1}{256}+\frac{1}{512}\right)$

$= \mathbf{2^{-126} \cdot 0.169921875_{10}} (leading\ 0, door\ subnormaliteit)$

e. $(1\ 00010100\ 11100110000000000000000)_{IEEE-754} = -2^{(4+16)-127} \cdot \left(1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\frac{1}{64}+\frac{1}{128}\right)$

$= \mathbf{-2^{-107} \cdot 1.8984375_{10}}$

f. $(0\,11111111\,11010100010001010100010)_{IEEE-754} \boldsymbol{= + NaN}\,(\textit{speciaal geval})$

g. $(0\,00001011\,01101000000000000000000)_{IEEE-754} = 2^{(1+2+8)-127} \cdot \left(1 + \frac{1}{4} + \frac{1}{8} + \frac{1}{32}\right)$

$= \mathbf{2^{-116} \cdot 1.40625_{10}}$

<u>Oefening 6:</u>

a. $(2078.25)_{10} = \begin{array}{r|l} 2078 & 0 \\ 1039 & 1 \\ 519 & 1 \\ 259 & 1 \\ 129 & 1 \\ 64 & 0 \\ 32 & 0 \\ 16 & 0 \\ 8 & 0 \\ 4 & 0 \\ 2 & 0 \\ 1 & 1 \end{array} + 0.01 = (100000011110.01)_2 = (1.0000001111001) \cdot 2^{11}$

$= 0\ (127+11)_{10}\ (0000\ 0011\ 1100\ 1000\ 0000\ 000)$: $\begin{array}{r|l} 138 & 0 \\ 69 & 1 \\ 34 & 0 \\ 17 & 1 \\ 8 & 0 \\ 4 & 0 \\ 2 & 0 \\ 1 & 1 \end{array}$

$\mathbf{= (0\,1000\,1010\,0000\,0011\,1100\,1000\,0000\,000)_{IEEE\,754}}$

b. $(2010)_{10} = \begin{array}{r|l} 2010 & 0 \\ 1005 & 1 \\ 502 & 0 \\ 251 & 1 \\ 125 & 1 \\ 62 & 0 \\ 31 & 1 \\ 15 & 1 \\ 7 & 1 \\ 3 & 1 \\ 1 & 1 \end{array} = (1.1111011010)_2 \cdot 2^{10} = 0\,(127+10)_{10}\,(1111\,0110\,100...)_2$: $\begin{array}{r|l} 137 & 1 \\ 68 & 0 \\ 34 & 0 \\ 17 & 1 \\ 8 & 0 \\ 4 & 0 \\ 2 & 0 \\ 1 & 1 \end{array}$

$\mathbf{= (0\,1000\,1001\,1111\,0110\,1000\,0000\,0000\,000)_{IEEE\,754}}$

c. NaN $\mathbf{= (0\,1111\,1111\,1000\,0000\,0000\,0000\,0000\,000)_{IEEE\,754}}$

d. $(-42.666)_{10} = \begin{array}{r|l} 42 & 0 \\ 21 & 1 \\ 10 & 0 \\ 5 & 1 \\ 2 & 0 \\ 1 & 1 \end{array} + 0. \begin{array}{r|l} 0.332 & 1 \\ 0.664 & 0 \\ 0.328 & 1 \\ 0.656 & 0 \\ 0.312 & 1 \\ 0.624 & 0 \\ 0.248 & 1 \\ 0.496 & 0 \\ 0.992 & 0 \\ 0.984 & 1 \\ 0.968 & 1 \\ 0.936 & 1 \\ 0.872 & 1 \\ 0.744 & 1 \\ 0.488 & 1 \\ 0.976 & 0 \\ 0.952 & 1 \\ 0.904 & 1 \\ 0.808 & 1 \\ 0.616 & 1 \\ 0.232 & 1 \\ 0.464 & 0 \\ 0.928 & 0 \end{array} = 1\,(1.01010101010100111111100)_2 \cdot 2^5$

$\mathbf{= (1\,1000\,0100\,0101\,0101\,0101\,0011\,1111\,100)_{IEEE\,754}}$

e. $\mathbf{+}\infty = \mathbf{(0\,1111\,1111\,0000\,0000\,0000\,0000\,0000\,000)_{IEEE\,754}}$

f. $\mathbf{+}0 = \mathbf{(0\,0000\,0000\,0000\,0000\,0000\,0000\,0000\,000)_{IEEE\,754}}$

g. $(1.11)_2 \cdot 2^{-129} = \mathbf{(0\,0000\,0000\,0011\,1000\,0000\,0000\,0000\,000)_{IEEE\,754}}$

h. $(333.666)_{10} = \begin{array}{r|l} 333 & 1 \\ 166 & 0 \\ 83 & 1 \\ 41 & 1 \\ 20 & 1 \\ 10 & 0 \\ 5 & 1 \\ 2 & 0 \\ 1 & 1 \end{array} + 0. = \begin{array}{r|l} 0.332 & 1 \\ 0.664 & 0 \\ 0.328 & 1 \\ 0.656 & 0 \\ 0.312 & 1 \\ 0.624 & 0 \\ 0.248 & 1 \\ 0.496 & 0 \\ 0.992 & 0 \\ 0.984 & 1 \\ 0.968 & 1 \\ 0.936 & 1 \\ 0.872 & 1 \\ 0.744 & 1 \\ 0.488 & 1 \\ 0.976 & 0 \\ 0.952 & 1 \\ 0.904 & 1 \\ 0.808 & 1 \\ 0.616 & 1 \\ 0.232 & 1 \\ 0.464 & 0 \\ 0.928 & 0 \end{array} 0\,(8+127)_{10}\,(01001101101010100111111)$: $\begin{array}{r|l} 135 & 1 \\ 67 & 1 \\ 33 & 1 \\ 16 & 0 \\ 8 & 0 \\ 4 & 0 \\ 2 & 0 \\ 1 & 1 \end{array}$

$\mathbf{= (0\,1000\,0111\,0100\,1101\,1010\,1010\,0111\,111)_{IEEE\,754}}$

<u>Oefening 7:</u>

a. $(x)_{2:sign\,bit}(xxxxx)_{2:exponent}(xxx)_{8:mantissa}$
5 bit 2’s complement, 32 voorstelbare getallen [-16,15]
$\Rightarrow$**Excess 16**

b. $(-142)_{10} = \begin{array}{r|l} 142 & 0 \\ 71 & 1 \\ 35 & 1 \\ 17 & 1 \\ 8 & 0 \\ 4 & 0 \\ 2 & 0 \\ 1 & 1 \end{array} : -1000\,1110 = -0.010001110 \cdot 8^3 = 1(3+16)_{10}(216)_8 : \begin{array}{r|l} 19 & 1 \\ 9 & 1 \\ 4 & 0 \\ 2 & 0 \\ 1 & 1 \end{array} = 1(10011)_2(216)_8$

$\mathbf{= 1\,10011\,010\,001\,110}$

c. De grootst mogelijke fout is wanneer de exponent maximaal is (15), en is dus $\mathbf{\frac{(0.001)_8 \cdot (2^{15})_{10}}{2}}$, de grootst mogelijke afstand tussen 2 opeenvolgende getallen, gedeeld door 2.
d. De kleinst mogelijke afstand tussen 2 opeenvolgende getallen is wanneer de exponent minimaal is (-16) en is dus $\mathbf{(0.001)_8 \cdot (2^{-16})}$

<u>Oefening 8: Pythoncode</u>

```python
from files import *
# a, lees het bestand in als utf-8
inputbestand = read_file("input.txt", en=UTF_8).splitlines()

# b, schrijf het bestand weg als utf-16
write_file("text_in_UTF_16.txt", "".join(inputbestand), en=UTF_16)

# c, maak de nieuwe variabele code_points, en schrijf die weg naar het bestand
code_points = []
for line in inputbestand:
    # Voor elke lijn, voeg die toe als codepoints aan de code_points lijst
    for char in line:
        code_points.append(f"{ord(char):04X}")
    code_points.append("")  # Dit stelt een nieuwe lijn voor

# Schrijf de code_points naar een bestand, met spaties er tussen
write_file("code_points.txt", " ".join(code_points), en=UTF_8)

# d, en nu nog naar HTML
html_content = []
for code_point in code_points:
    if code_point == "":  # Dit stelde een nieuwe lijn voor, dus vervang die door een <br>
        html_content.append("<br>")
    else:
        html_content.append(f"&#x{code_point};")
write_html_file("text_in_HTML.html", "".join(html_content))
print("Done :)")
```