COMMON NUMBER SYSTEMS

BINARY | BASE-2 | RADIX-2

$(0,1)_2$

1	0	1	0	1	1	0	1	

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1	0	1	0	1	1	0	1	

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	$\times$
1	0	1	0	1	1	0	1	
1×2^7	0×2^6	1×2^5	0×2^4	1×2^3	1×2^2	0×2^1	1×2^0	

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1	0	1	0	1	1	0	1	$\times$
1×2^7	0×2^6	1×2^5	0×2^4	1×2^3	1×2^2	0×2^1	1×2^0	$\sum$
								173

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	$\times$
3	0	3	0	2	1	3	1	
								Σ

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	$\times$
3	0	3	0	2	1	3	1	
3×2^7	0×2^6	3×2^5	0×2^4	2×2^3	1×2^2	3×2^1	1×2^0	$\sum$
								–

LET'S COUNT IN BINARY

OCTAL | BASE-8 | RADIX-8

$(0,1,2,3,4,5,6,7)_8$

3	0	3	0	2	1	3	1	

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	
3	0	3	0	2	1	3	1	

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	
3	0	3	0	2	1	3	1	$\times$
3×8^7	0×8^6	3×8^5	0×8^4	2×8^3	1×8^2	3×8^1	1×8^0	

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	$\times$
3	0	3	0	2	1	3	1	
3×8^7	0×8^6	3×8^5	0×8^4	2×8^3	1×8^2	3×8^1	1×8^0	$\sum$
								57,508,953

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	$\times$
3	0	A	0	9	1	3	1	
								Σ

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	$\times$
3	0	A	0	8	1	3	1	
3×8^7	0×8^6	$A\times8^5$	0×8^4	8×8^3	1×8^2	3×8^1	1×8^0	$\sum$
								-

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	$\times$
1	0	1	0	1	1	0	1	
1×8^7	0×8^6	1×8^5	0×8^4	1×8^3	1×8^2	0×8^1	1×8^0	$\sum$
								2,130,497

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	
1	0	1	0	1	1	0	1	
1×8^7	0×8^6	1×8^5	0×8^4	1×8^3	1×8^2	0×8^1	1×8^0	
								2,130,497

Radix-8
vs.
Radix-2

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1	0	1	0	1	1	0	1	
1×2^7	0×2^6	1×2^5	0×2^4	1×2^3	1×2^2	0×2^1	1×2^0	
								173

LET'S COUNT IN OCTAL

$(\quad\quad\quad\quad)_8$

DECIMAL | BASE-10 | RADIX-10

$(0,1,3,4,5,6,7,9)_{10}$

0123456789

٠١٢٣٤٥٦٧٨٩

I II III IV V VI VII VIII IX X

০১২৩৪৫৬৭৮৯

൦൧൨൩൪൫൬൭൮൯

๐๑๒๓๔๕๖๗๘๙

〇一二三四五六七八九

3	0	3	0	2	1	3	1	

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	
3	0	3	0	2	1	3	1	

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	
3	0	3	0	2	1	3	1	$\times$
3×10^7	0×10^6	3×10^5	0×10^4	2×10^3	1×10^2	3×10^1	1×10^0	

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	$\times$
3	0	3	0	2	1	3	1	
3×10^7	0×10^6	3×10^5	0×10^4	2×10^3	1×10^2	3×10^1	1×10^0	$\sum$
								30,302,131

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	$\times$
3	0	3	0	2	1	3	1	
3×10^7	0×10^6	3×10^5	0×10^4	2×10^3	1×10^2	3×10^1	1×10^0	$\sum$
								30,302,131

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	$\times$
1	0	1	0	1	1	0	1	
1×10^7	0×10^6	1×10^5	0×10^4	1×10^3	1×10^2	0×10^1	1×10^0	$\sum$
								10,101,101

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	
1	0	1	0	1	1	0	1	
1×10^7	0×10^6	1×10^5	0×10^4	1×10^3	1×10^2	0×10^1	1×10^0	
								10,101,101

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	
1	0	1	0	1	1	0	1	
1×8^7	0×8^6	1×8^5	0×8^4	1×8^3	1×8^2	0×8^1	1×8^0	
								2,130,497

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1	0	1	0	1	1	0	1	
1×2^7	0×2^6	1×2^5	0×2^4	1×2^3	1×2^2	0×2^1	1×2^0	
								173

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	
3	0	A	0	8	1	3	1	$\times$
								Σ

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	$\times$
3	0	A	0	8	1	3	1	
3×10^7	0×10^6	$A\times10^5$	0×10^4	8×10^3	1×10^2	3×10^1	1×10^0	$\sum$
								–

YOU KNOW HOW TO COUNT IN DECIMAL!

$(\quad\quad\quad\quad)_{10}$

HEXADECIMAL | BASE-16 | RADIX-16

$(0,1,3,4,5,6,7,9,A,B,C,D,E,F)_{16}$

16^7	16^6	16^5	16^4	16^3	16^2	16^1	16^0	
3	0	A	0	9	1	3	1	$\times$
								Σ

16^7	16^6	16^5	16^4	16^3	16^2	16^1	16^0	$\times$
3	0	A	0	9	1	3	1	
3×16^7	0×16^6	$A\times16^5$	0×16^4	9×16^3	1×16^2	3×16^1	1×16^0	$\sum$

16^7	16^6	16^5	16^4	16^3	16^2	16^1	16^0	$\times$
3	0	A	0	9	1	3	1	
3×16^7	0×16^6	$A \times 16^5$	0×16^4	9×16^3	1×16^2	3×16^1	1×16^0	$\sum$

$$A = (9 + 1) = (10)_{10}$$

16^7	16^6	16^5	16^4	16^3	16^2	16^1	16^0	$\times$
3	0	A	0	9	1	3	1	
3×16^7	0×16^6	$A\times16^5$	0×16^4	9×16^3	1×16^2	3×16^1	1×16^0	$\sum$
								815,829,297

$$A = (9 + 1) = (10)_{10}$$

$$
\begin{aligned}
1,2,3,4,5,6,7,8,9,A &= 9 + 1 = (10)_{10} \\
B &= A + 1 = (11)_{10} \\
C &= B + 1 = (12)_{10} \\
D &= C + 1 = (13)_{10} \\
E &= D + 1 = (14)_{10} \\
F &= E + 1 = (15)_{10}
\end{aligned}
$$

16^7	16^6	16^5	16^4	16^3	16^2	16^1	16^0	
1	0	1	0	1	1	0	1	$\times$
1×16^7	0×16^6	1×16^5	0×16^4	1×16^3	1×16^2	0×16^1	1×16^0	$\sum$
								269,488,385

16^7	16^6	16^5	16^4	16^3	16^2	16^1	16^0	
1	0	1	0	1	1	0	1	
1×16^7	0×16^6	1×16^5	0×16^4	1×16^3	1×16^2	0×16^1	1×16^0	
								269,488,385

10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0	
1	0	1	0	1	1	0	1	
1×10^7	0×10^6	1×10^5	0×10^4	1×10^3	1×10^2	0×10^1	1×10^0	
								10,101,101

8^7	8^6	8^5	8^4	8^3	8^2	8^1	8^0	
1	0	1	0	1	1	0	1	
1×8^7	0×8^6	1×8^5	0×8^4	1×8^3	1×8^2	0×8^1	1×8^0	
								2,130,497

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	
1	0	1	0	1	1	0	1	
1×2^7	0×2^6	1×2^5	0×2^4	1×2^3	1×2^2	0×2^1	1×2^0	
								173

LET’S COUNT IN BASE-16

BASE-64 | RADIX-64

$$(A,B,C, \ldots,Z, a,b,c,\ldots,z,0,1,2,\ldots,9,+,/)_{64}$$

BASE-64 | RADIX-64

$$(A,B,C,\ \ldots,Z,\ a,b,c,\ldots,z,0,1,2,\ldots,9,+,/)_{64}$$

1992: RFC 1341

MIME (MULTIPURPOSE INTERNET MAIL EXTENSIONS)

Mechanisms For Specifying And Describing The Format Of Internet Message Bodies

Digit	Value		Digit	Value		Digit	Value		Digit	Value
A	0		Q	16		g	32		w	48
B	1		R	17		h	33		x	49
C	2		S	18		i	34		y	50
D	3		T	19		j	35		z	51
E	4		U	20		k	36		0	52
F	5		V	21		l	37		1	53
G	6		W	22		m	38		2	54
H	7	→	X	23	→	n	39	→	3	55
I	8		Y	24		o	40		4	56
J	9		Z	25		p	41		5	57
K	10		a	26		q	42		6	58
L	11		b	27		r	43		7	59
M	12		c	28		s	44		8	60
N	13		d	29		t	45		9	61
O	14		e	30		u	46		+	62
P	15		f	31		v	47		/	63

3	a	A	/	d	1	H	+	

64^7	64^6	64^5	64^4	64^3	64^2	64^1	64^0	
3	a	A	/	d	1	H	+	$\times$
								$\sum$

Digit	Value
A	0
B	1
C	2
D	3
E	4
F	5
G	6
H	7
I	8
J	9
K	10
L	11
M	12
N	13
O	14
P	15

→

Digit	Value
Q	16
R	17
S	18
T	19
U	20
V	21
W	22
X	23
Y	24
Z	25
a	26
b	27
c	28
d	29
e	30
f	31

→

Digit	Value
g	32
h	33
i	34
j	35
k	36
l	37
m	38
n	39
o	40
p	41
q	42
r	43
s	44
t	45
u	46
v	47

→

Digit	Value
w	48
x	49
y	50
z	51
0	52
1	53
2	54
3	55
4	56
5	57
6	58
7	59
8	60
9	61
+	62
/	63

64^7	64^6	64^5	64^4	64^3	64^2	64^1	64^0	
3	a	A	/	d	1	H	+	$\times$
55×64^7	26×64^6	0×64^5	63×64^4	29×64^3	53×64^2	7×64^1	62×64^0	$\sum$

64^7	64^6	64^5	64^4	64^3	64^2	64^1	64^0	$\times$
3	a	A	/	d	1	H	+	
55 $\times 64^7$	26 $\times 64^6$	0 $\times 64^5$	63 $\times 64^4$	29 $\times 64^3$	53 $\times 64^2$	7 $\times 64^1$	62 $\times 64^0$	$\sum$
								243,680,329,290,238

Increment by 1 → Increment by AAAB

+				a	+	Z	/
Base-64				A	A	A	B

↓

+				a=26	+=62	Z=25	/=63
Base-64				A=0	A=0	A=0	B=1

						B=1	
+ Base-64				a=26	+=62	Z=25	/=63
				A=0	A=0	A=0	B=1
							A=0

$$\frac{64}{64} = 1\ r\ 0$$
$$= B\ r\ A$$

						B=1	
+ Base-64				a=26	+=62	Z=25	/=63
				A=0	A=0	A=0	B=1
				a	+	a=26	A=0

RADIX-R NUMBER SYSTEM

aka. Base-r Number System

Hossein's number system is not a Radix-r number system!

Let $(N)_r$ be a radix-r (base-r) number in a positional weighting number system, then

$$(N)_r = (d_{n-1}\, r^{n-1} + d_{n-2}\, r^{n-2} + \cdots + d_i\, r^i + \cdots + d_2\, r^2 + d_1\, r^1 + d_0 r^0)_{10}$$

where:

- r = radix (base)
- d_i = digit at position i, $0 \le d_i \le r - 1$
- r^i = weight (significance) of position i
- n = number of digits in N

Let $(N)_r$ be a radix-r (base-r) number in a positional weighting number system, then

$$(N)_r = (d_{n-1}\, r^{n-1} + d_{n-2}\, r^{n-2} + \cdots + d_i\, r^i + \cdots + d_2\, r^2 + d_1\, r^1 + d_0 r^0)_{10}$$

where:

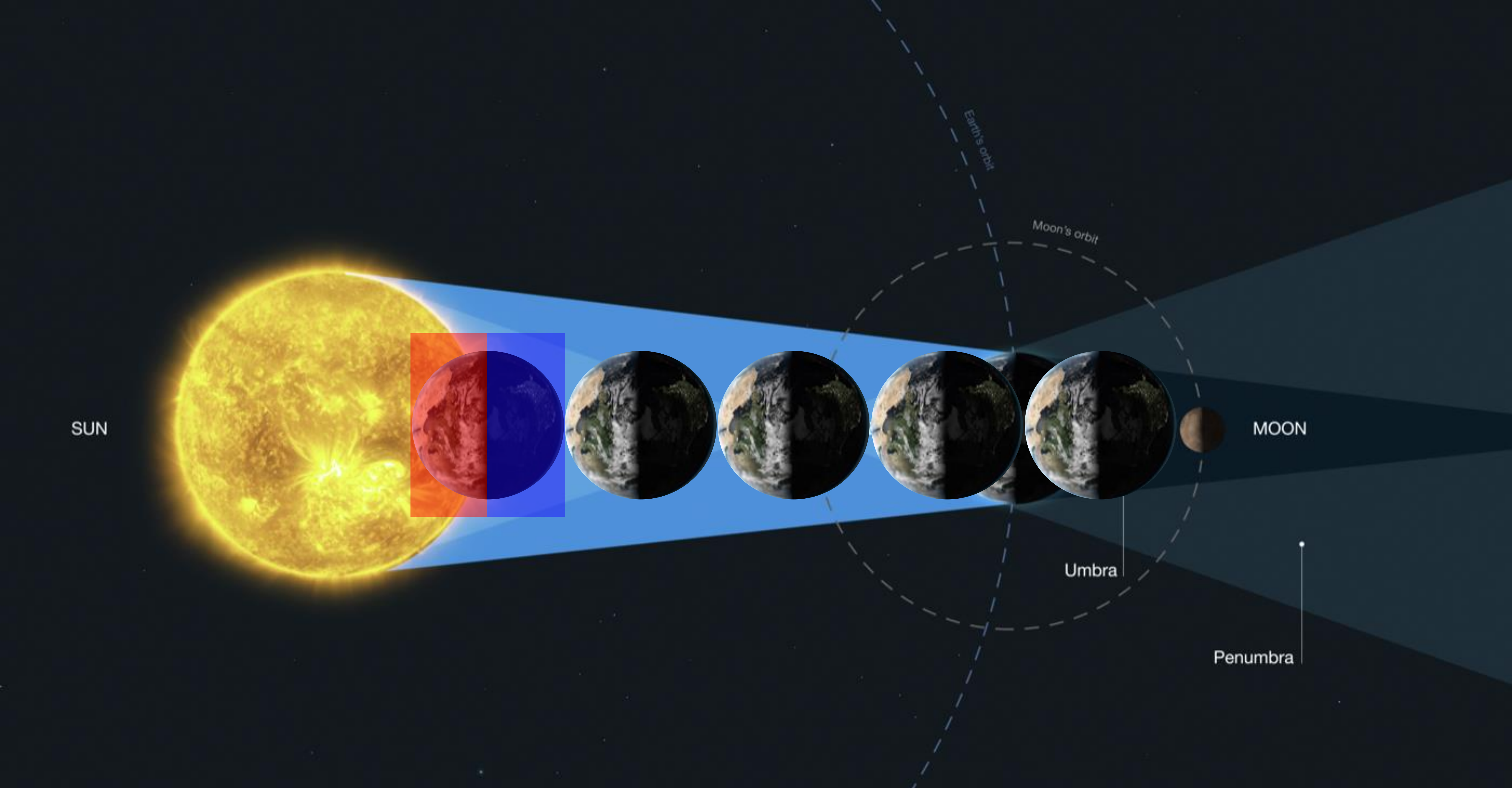
- r = radix (base)
- d_i = digit at position i, $0 \le d_i \le r - 1$
- r^i = weight (significance) of position i
- n = number of digits in N

Let $(N)_r$ be a radix-r (base-r) number in a positional weighting number system, then

Min	$= (0_{n-1}0_{n-2} \cdots 0_1 0_0)_r$	$= (0)_{10}$
Max	$= ((r-1)_{n-1}(r-1)_{n-2} \cdots (r-1)_1(r-1)_0)_r$	$= (r^n-1)_{10}$
Unit	$= (0_{n-1}0_{n-2} \cdots 0_1 1_0)_r$	$= (1)_{10}$

where:

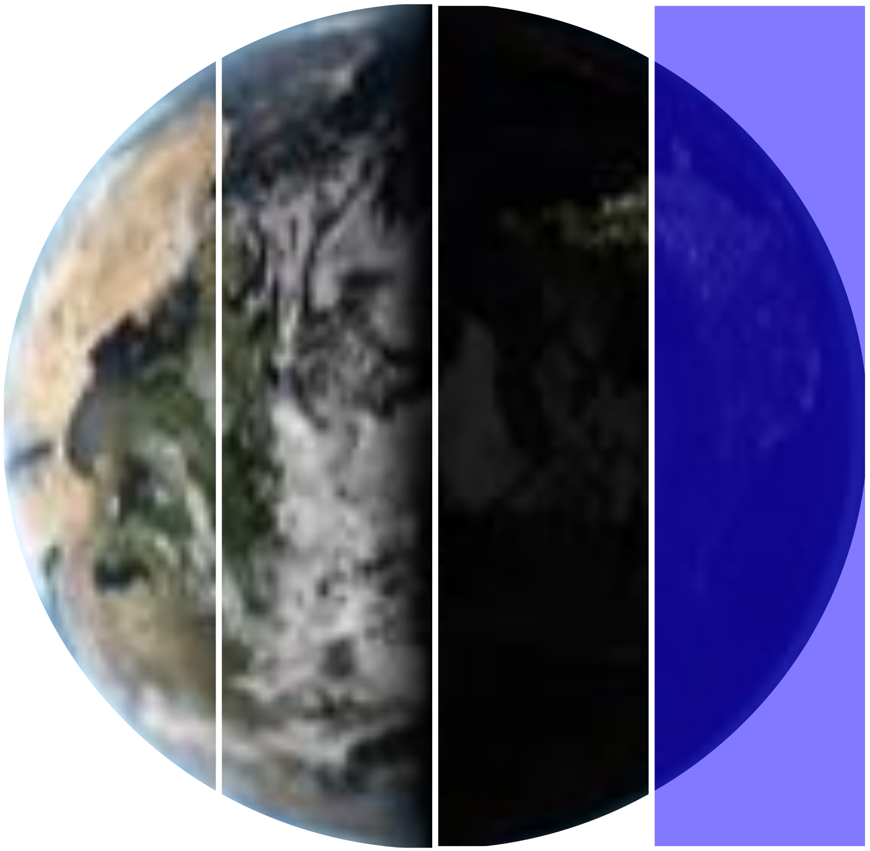
- r = radix (base)
- r^i = weight of position i
- n = number of digits in N



Moon's Distance to Sun: $(10.?)_4 = (4.5)_{10}$

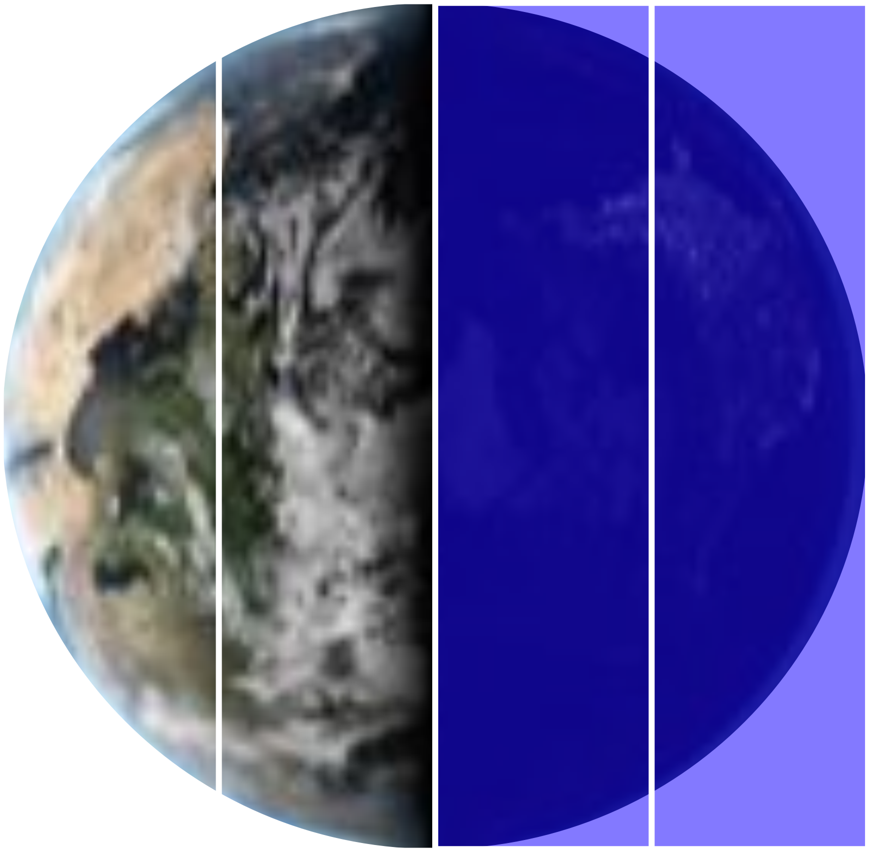
FRACTION

1 Earth

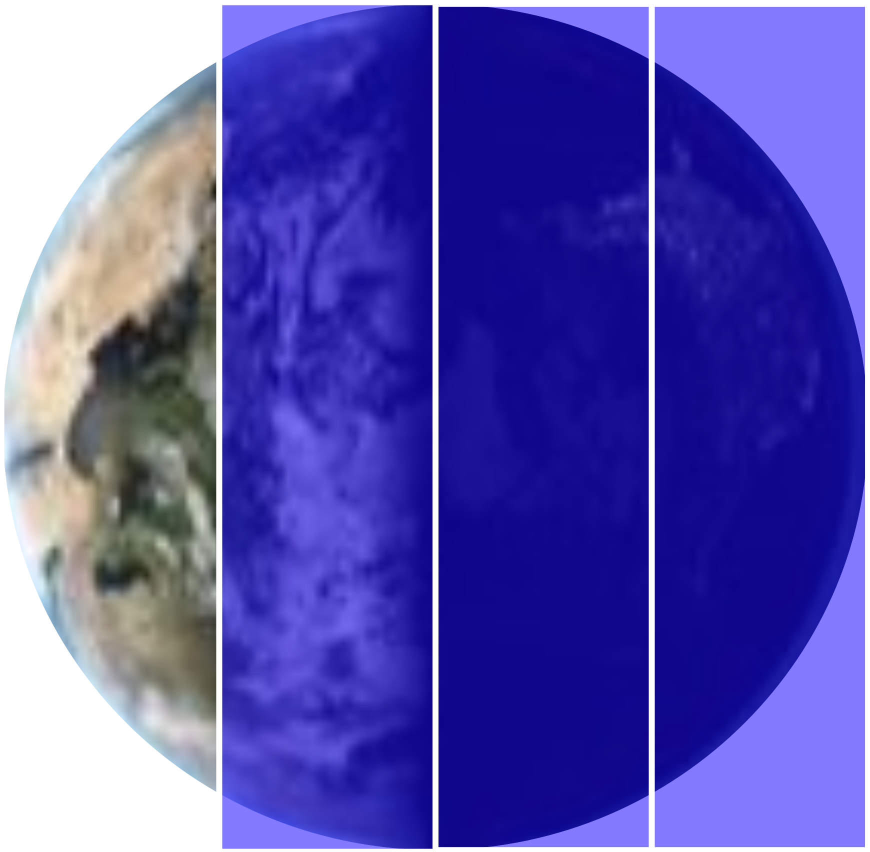


Fraction Point

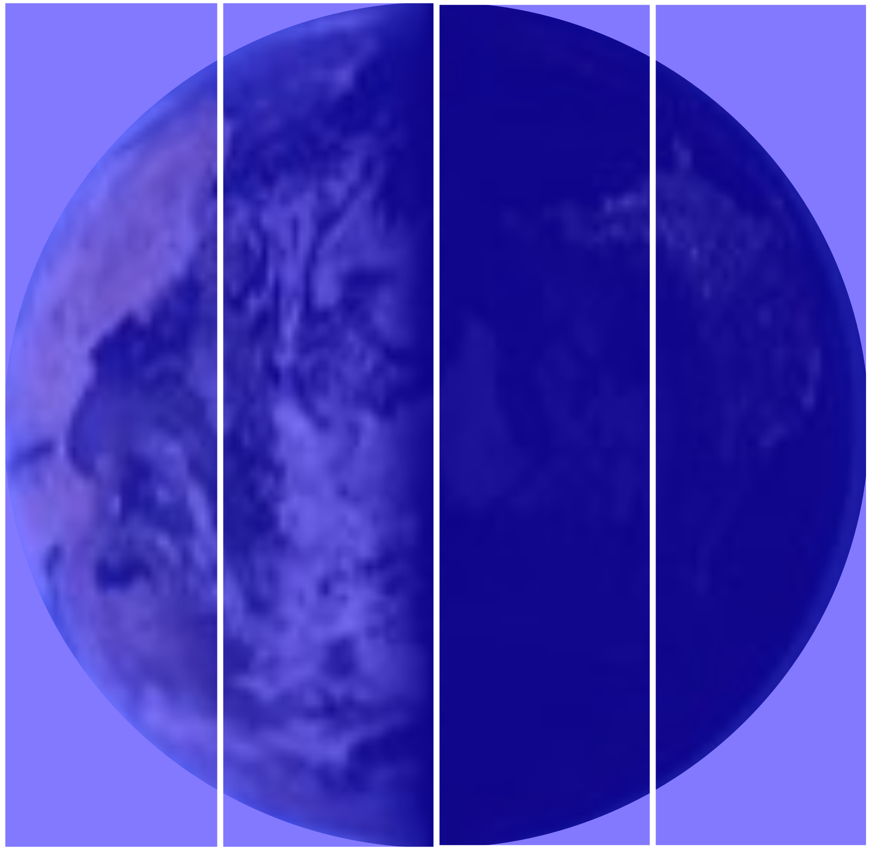
Radix-4 (Base-4) = 1/4 Earth = 4^{-1} Earth = $(.1)_4$



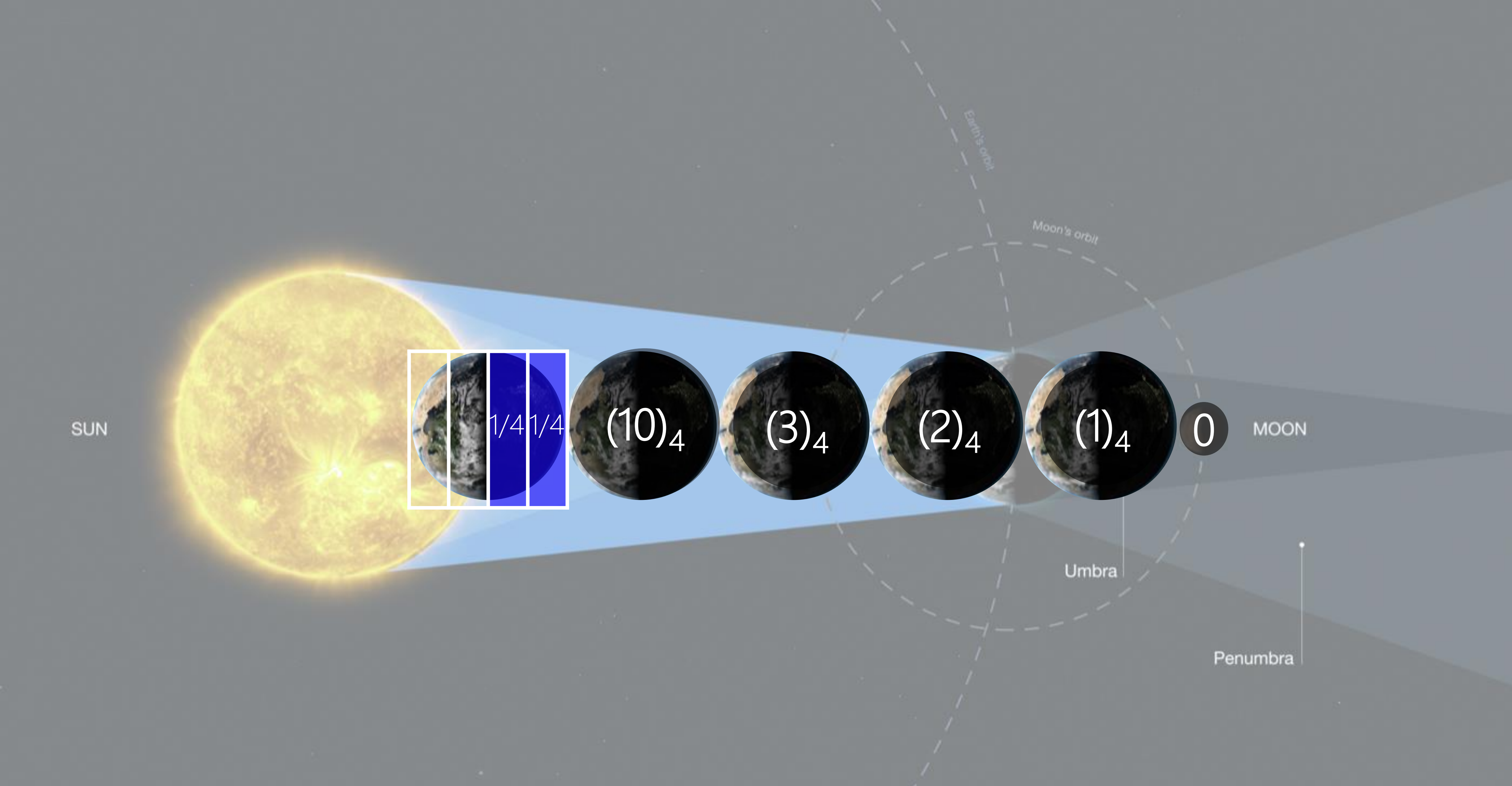
Radix-4 (Base-4) = 2 × 1/4 Earth = 2 × 4^{-1} Earth=$(.2)_4$



Radix-4 (Base-4) = $3 \times 1/4$ Earth = 3×4^{-1} Earth=$(.3)_4$

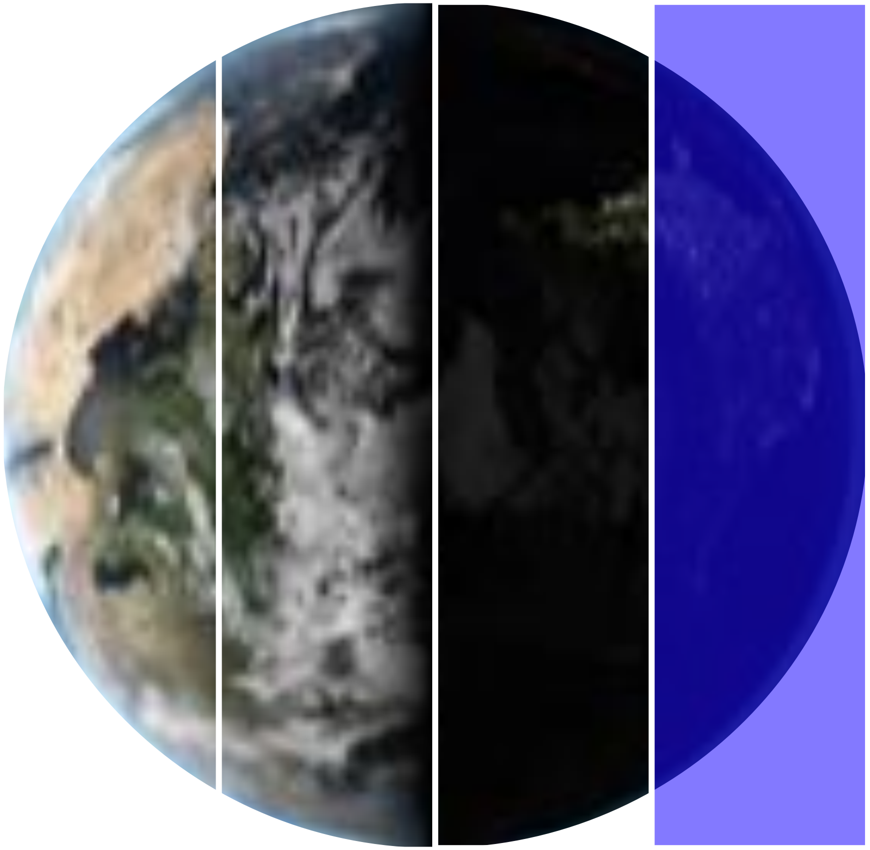


Radix-4 (Base-4) = 4 × 1/4 Earth = 4 × 4^{-1} Earth=$(1)_4$

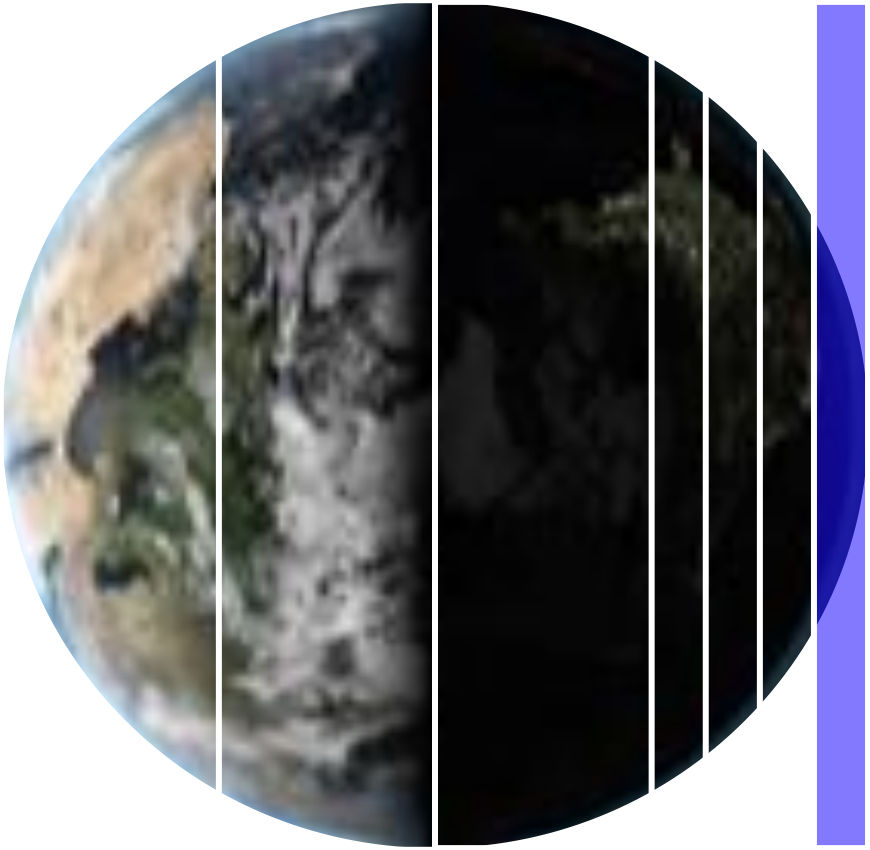


Moon's Distance to Sun in Radix-4: $(10.2)_4$

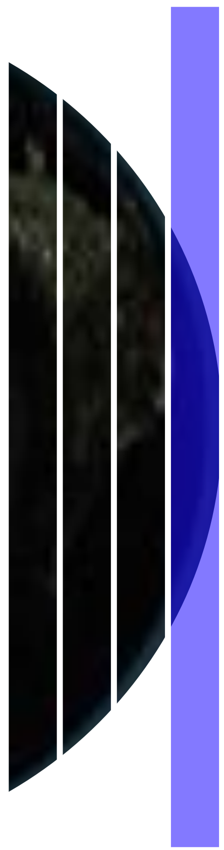
MORE PRECISION



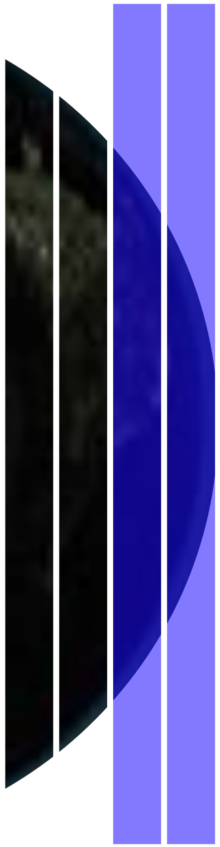
Radix-4 (Base-4) = 1/4 Earth = 4^{-1} Earth = $(.1)_4$



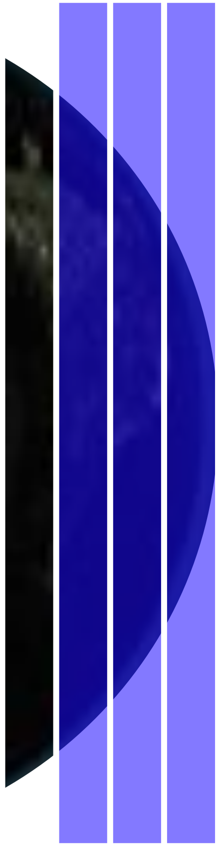
Radix-4 (Base-4) = (1/4)/4) Earth = 1/16 Earth = 4^{-2} Earth



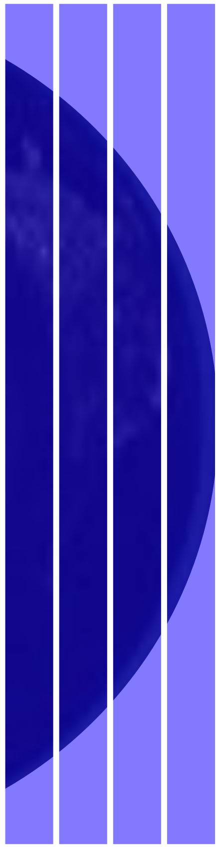
Radix-4 (Base-4) = 1/16 = 4^{-2} Earth = $(.01)_4$



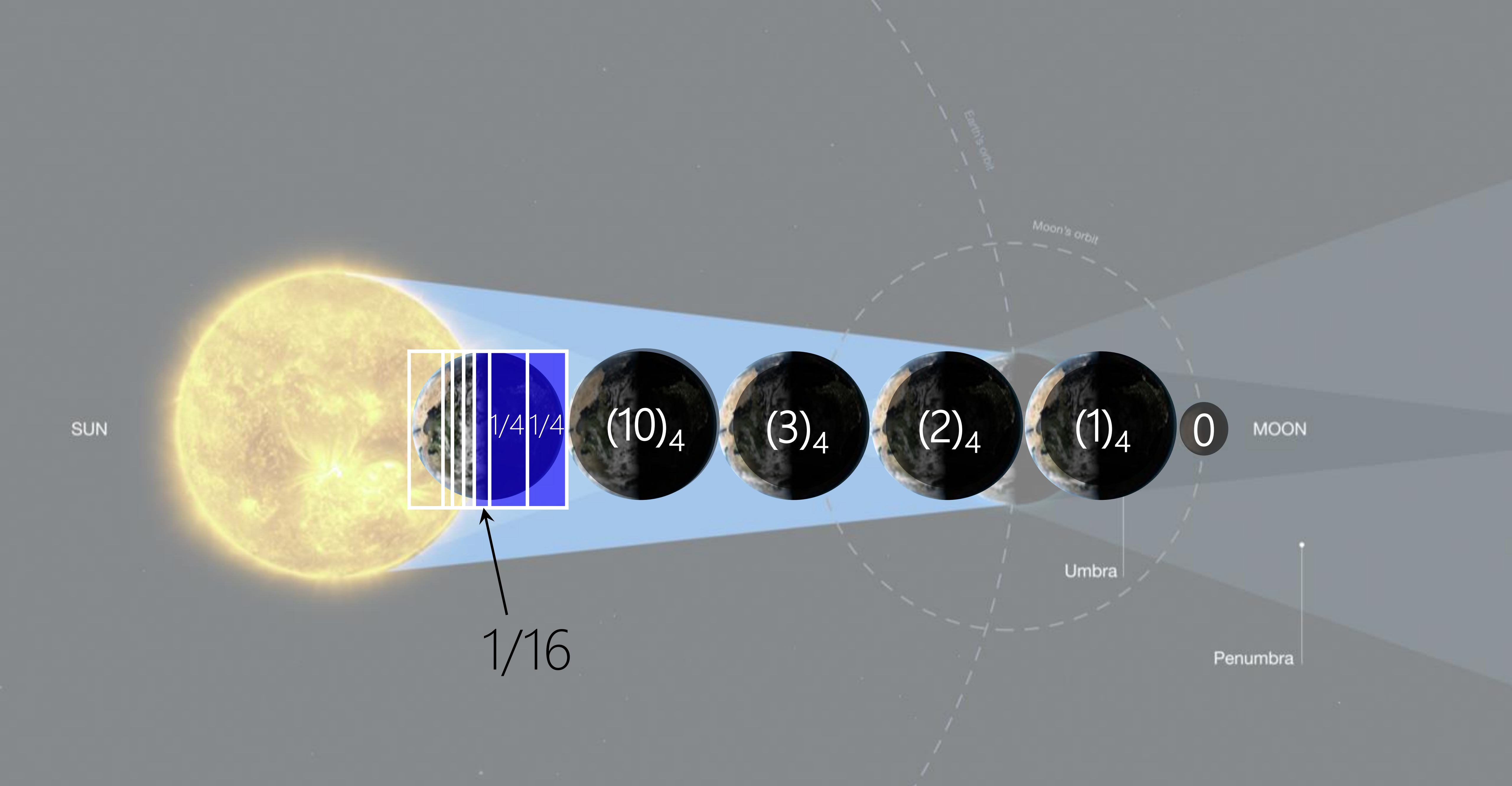
Radix-4 (Base-4) = $2 \times 1/16 = 2 \times 4^{-2}$ Earth = $(.02)_4$



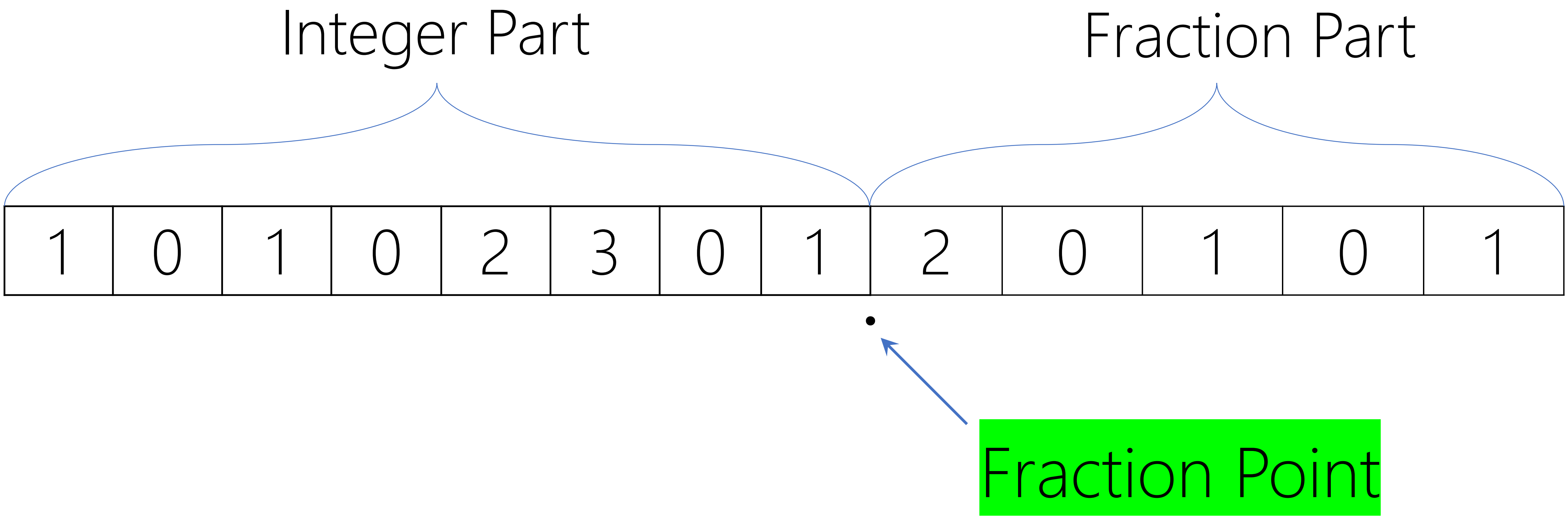
Radix-4 (Base-4) $= 3 \times 1/16 = 3 \times 4^{-2}$ Earth $= (.03)_4$



Radix-4 (Base-4) = $4 \times 1/16 = 4 \times 4^{-2}$ Earth = $(.1)_4$



Moon’s Distance to Sun in Radix-4: $(10.21)_4$


Integer Part
Fraction Part
1 0 1 0 2 3 0 1
2 0 1 0 1
Fraction Point

Integer Part | Fraction Part

4^7	4^6	4^5	4^4	4^3	4^2	4^1	4^0		4^{-1}	4^{-2}	4^{-3}	4^{-4}	4^{-5}
1	0	1	0	2	3	0	1	.	2	0	1	0	1

Integer Part Fraction Part

4^7	4^6	4^5	4^4	4^3	4^2	4^1	4^0		4^{-1}	4^{-2}	4^{-3}	4^{-4}	4^{-5}
1	0	1	0	2	3	0	1	$\times$.	2	0	1	0	1
1 ×16,384	0	1 ×1,024	0	2 ×64	3 ×16	0	1	$\sum$	$\frac{2}{4}$	0	$\frac{1}{64}$	0	$\frac{1}{1,024}$

Integer Part | Fraction Part

4^7	4^6	4^5	4^4	4^3	4^2	4^1	4^0		4^{-1}	4^{-2}	4^{-3}	4^{-4}	4^{-5}
1	0	1	0	2	3	0	1	× .	2	0	1	0	1
1 ×16,384	0	1 ×1,024	0	2 ×64	3 ×16	0	1	$\sum$	$\frac{2}{4}$	0	$\frac{1}{64}$	0	$\frac{1}{1{,}024}$
							17,584	.					

Integer Part									Fraction Part				
4^7	4^6	4^5	4^4	4^3	4^2	4^1	4^0	$\times$	4^{-1}	4^{-2}	4^{-3}	4^{-4}	4^{-5}
1	0	1	0	2	3	0	1	.	2	0	1	0	1
1 $\times$16,384	0	1 $\times$1,024	0	2 $\times$64	3 $\times$16	0	1	$\sum$	$\frac{2}{4}$	0	$\frac{1}{64}$	0	$\frac{1}{1{,}024}$
				17,584				.	5166015625				

Let $(N)_r$ be a radix-r (base-r) number in a positional weighting number system, then

$$(N)_r = (d_{n-1}\, r^{n-1} + \cdots + d_0 r^0 \,.\, d_{-1}\, r^{-1} + d_{-2}\, r^{-2} + \cdots + d_{-m}\, r^{-m})_{10}$$

Fraction Point

where:

r = radix (base)

d_i = digit at position i, $0 \le d_i \le r - 1$

r^i = weight of position i

n = number of digits in integer part of N

m = number of digits in fraction part of N

Let $(N)_r$ be a radix-r (base-r) number in a positional weighting number system, then

$$\text{Min} = (0_{n-1} \cdots 0_1 0_0 \,.\, 0_{-1} 0_{-2} \cdots 0_{-m-1} 0_{-m})_r = (0\,.\,0)_{10}$$

$$\text{Max} = ((r-1)_{n-1} \cdots (r-1)_0 \,.\, (r-1)_{-1}(r-1)_{-2} \cdots (r-1)_{-m-1}(r-1)_{-m})_r = (r^n\text{-}1\,.\,?\,)_{10}$$

$$\text{Unit} = (0_{n-1} \cdots 0_1 0_0 \,.\, 0_{-1} 0_{-2} \cdots 0_{-m-1} 1_{-m})_r = (r^{-m})_{10}$$

where:

- r = radix (base)
- r^i = weight of position i
- n = number of digits in integer part of N
- m = number of digits in fraction part of N

Lecture Assignment

PRACTICE RADIX-2

Radix-2								Radix-10
Integer (n=4)					Fraction (m=3)			
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Radix-2								Radix-10
Integer (n=4)					Fraction (m=3)			
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3}$ = 1/8 = 0.125
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3}$ = 1/4 = 0.25
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3}$ = 1/4 + 1/8 = 3/8 = 0.375
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3}$ = ½ = 0.5
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3}$ = 1/2 + 1/8 = 5/8 = 0.625
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3}$ = 1/2 + 1/4 = 3/4 = 0.75
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3}$ = 1/2 + 1/4 + 1/8 = 0.875
0	0	0	1	.	0	0	0	$1*2^0 + 0*2^{-1} + 0*2^{-2} + 0*2^{-3}$ = 1
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

What is the max in this system with these spaces?

Radix-2								Radix-10
Integer (n=4)					Fraction (m=3)			
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^0 + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

What is the max in this system with these spaces?

$(1111.111)_2 = (15.875)_{10}$

Radix-2								
Integer (n=4)					Fraction (m=3)			Radix-10
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

Radix-2								
Integer (n=4)					Fraction (m=3)			Radix-10
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Radix-2								Radix-10
Integer (n=4)					Fraction (m=3)			
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Solution?

Radix-2								
Integer (n=4)					Fraction (m=3)			Radix-10
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Solution?

A. More precision.

Radix-2								Radix-10
Integer (n=4)					Fraction (m=3)			
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Solution?

A. More precision.

A. More fraction positions.

Radix-2								
Integer (n=4)					Fraction (m=3)			Radix-10
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Solution?

A. More precision.

A. More fraction positions.

A. More in m!

Radix-2								
Integer (n=4)					Fraction (m=3)			Radix-10
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Solution?

A. More precision.

A. More fraction positions.

A. More in m! How much?

Radix-2								Radix-10
Integer (n=4)					Fraction (m=3)			
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Solution?
B. Find the closest number

Radix-2								
Integer (n=4)					Fraction (m=3)			Radix-10
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Solution?

B. Find the closest number

$(1.000)_2 = (1)_{10}$ => Error = 0.02

$(1.001)_2 = (1.125)_{10}$ => Error = 0.105

Radix-2								
Integer (n=4)					Fraction (m=3)			Radix-10
2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*2^{-3} = 1/8 = 0.125$
0	0	0	0	.	0	1	0	$1*2^{-2} + 0*2^{-3} = 1/4 = 0.25$
0	0	0	0	.	0	1	1	$1*2^{-2} + 1*2^{-3} = 1/4 + 1/8 = 3/8 = 0.375$
0	0	0	0	.	1	0	0	$1*2^{-1} + 0*2^{-2} + 0*2^{-3} = ½ = 0.5$
0	0	0	0	.	1	0	1	$1*2^{-1} + 0*2^{-2} + 1*2^{-3} = 1/2 + 1/8 = 5/8 = 0.625$
0	0	0	0	.	1	1	0	$1*2^{-1} + 1*2^{-2} + 0*2^{-3} = 1/2 + 1/4 = 3/4 = 0.75$
0	0	0	0	.	1	1	1	$1*2^{-1} + 1*2^{-2} + 1*2^{-3} = 1/2 + 1/4 + 1/8 = 0.875$
0	0	0	1	.	0	0	0	$1*2^{0} + 0*2^{-1} + 0*2^{-2} + 0*2^{-3} = 1$
0	0	0	1	.	0	0	1	1.125
0	0	0	1	.	0	1	0	1.25
0	0	0	1	.	0	1	1	1.375
0	0	0	1	.	1	0	0	1.5
0	0	0	1	.	1	0	1	1.625
0	0	0	1	.	1	1	0	1.75
0	0	0	1	.	1	1	1	1.875
0	0	1	0	.	0	0	0	2

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! The numbers in this system increments by 0.125 unit.

Solution?

B. Find the closest number

$(1.000)_2 = (1)_{10} => \text{Error} = 0.02$

$(1.001)_2 = (1.125)_{10} => \text{Error} = 0.105$

PRACTICE RADIX-4

Radix-4								
Integer (n=4)					Fraction (m=3)			Radix-10
4^3	4^2	4^1	4^0	.	4^{-1}	4^{-2}	4^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*4^{-3} = 1/64 = 0.015625$
0	0	0	0	.	0	0	2	$2*4^{-3} = 2/64 = 0.03125$
0	0	0	0	.	0	0	3	$3*4^{-3} = 3/64 = 0.046875$
0	0	0	0	.	0	1	0	$1*4^{-2} + 0*4^{-2} = 1/16 = 0.0625$
0	0	0	0	.	0	1	1	$1*4^{-2} + 1*4^{-2} = 1/16 + 1/64 = 0.078125$
0	0	0	0	.	0	1	2	$1*4^{-2} + 2*4^{-2} = 1/16 + 2/64 = 0.09375$
0	0	0	0	.	0	1	3	$1*4^{-2} + 3*4^{-2} = 1/16 + 3/64 = 0.109375$
0	0	0	0	.	0	2	0	$2*4^{-2} + 0*4^{-2} = 2/16 = 0.125$
…								
0	0	0	0	.	3	3	3	$3*4^{-1} + 3*4^{-2} + 3*4^{-3} = 0.984375$
0	0	0	1	.	0	0	0	1
…								
3	3	3	3	.	3	3	0	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 0*4^{-3} = ?$
3	3	3	3	.	3	3	1	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 1*4^{-3} = ?$
3	3	3	3	.	3	3	2	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 2*4^{-3} = ?$
3	3	3	3	.	3	3	3	255.984375

Radix-4								Radix-10
Integer (n=4)					Fraction (m=3)			
4^3	4^2	4^1	4^0	.	4^{-1}	4^{-2}	4^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*4^{-3} = 1/64 = 0.015625$
0	0	0	0	.	0	0	2	$2*4^{-3} = 2/64 = 0.03125$
0	0	0	0	.	0	0	3	$3*4^{-3} = 3/64 = 0.046875$
0	0	0	0	.	0	1	0	$1*4^{-2} + 0*4^{-2} = 1/16 = 0.0625$
0	0	0	0	.	0	1	1	$1*4^{-2} + 1*4^{-2} = 1/16 + 1/64 = 0.078125$
0	0	0	0	.	0	1	2	$1*4^{-2} + 2*4^{-2} = 1/16 + 2/64 = 0.09375$
0	0	0	0	.	0	1	3	$1*4^{-2} + 3*4^{-2} = 1/16 + 3/64 = 0.109375$
0	0	0	0	.	0	2	0	$2*4^{-2} + 0*4^{-2} = 2/16 = 0.125$
...								
0	0	0	0	.	3	3	3	$3*4^{-1} + 3*4^{-2} + 3*4^{-3} = 0.984375$
0	0	0	1	.	0	0	0	1
...								
3	3	3	3	.	3	3	0	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 0*4^{-3} = ?$
3	3	3	3	.	3	3	1	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 1*4^{-3} = ?$
3	3	3	3	.	3	3	2	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 2*4^{-3} = ?$
3	3	3	3	.	3	3	3	255.984375

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

Radix-4								
Integer (n=4)					Fraction (m=3)			Radix-10
4^3	4^2	4^1	4^0	.	4^{-1}	4^{-2}	4^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*4^{-3} = 1/64 = 0.015625$
0	0	0	0	.	0	0	2	$2*4^{-3} = 2/64 = 0.03125$
0	0	0	0	.	0	0	3	$3*4^{-3} = 3/64 = 0.046875$
0	0	0	0	.	0	1	0	$1*4^{-2} + 0*4^{-2} = 1/16 = 0.0625$
0	0	0	0	.	0	1	1	$1*4^{-2} + 1*4^{-2} = 1/16 + 1/64 = 0.078125$
0	0	0	0	.	0	1	2	$1*4^{-2} + 2*4^{-2} = 1/16 + 2/64 = 0.09375$
0	0	0	0	.	0	1	3	$1*4^{-2} + 3*4^{-2} = 1/16 + 3/64 = 0.109375$
0	0	0	0	.	0	2	0	$2*4^{-2} + 0*4^{-2} = 2/16 = 0.125$
				…				
0	0	0	0	.	3	3	3	$3*4^{-1} + 3*4^{-2} + 3*4^{-3} = 0.984375$
0	0	0	1	.	0	0	0	1
				…				
3	3	3	3	.	3	3	0	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 0*4^{-3} = ?$
3	3	3	3	.	3	3	1	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 1*4^{-3} = ?$
3	3	3	3	.	3	3	2	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 2*4^{-3} = ?$
3	3	3	3	.	3	3	3	255.984375

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! Why?

Radix-4								
Integer (n=4)					Fraction (m=3)			Radix-10
4^3	4^2	4^1	4^0	.	4^{-1}	4^{-2}	4^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*4^{-3} = 1/64 = 0.015625$
0	0	0	0	.	0	0	2	$2*4^{-3} = 2/64 = 0.03125$
0	0	0	0	.	0	0	3	$3*4^{-3} = 3/64 = 0.046875$
0	0	0	0	.	0	1	0	$1*4^{-2} + 0*4^{-2} = 1/16 = 0.0625$
0	0	0	0	.	0	1	1	$1*4^{-2} + 1*4^{-2} = 1/16 + 1/64 = 0.078125$
0	0	0	0	.	0	1	2	$1*4^{-2} + 2*4^{-2} = 1/16 + 2/64 = 0.09375$
0	0	0	0	.	0	1	3	$1*4^{-2} + 3*4^{-2} = 1/16 + 3/64 = 0.109375$
0	0	0	0	.	0	2	0	$2*4^{-2} + 0*4^{-2} = 2/16 = 0.125$
...								
0	0	0	0	.	3	3	3	$3*4^{-1} + 3*4^{-2} + 3*4^{-3} = 0.984375$
0	0	0	1	.	0	0	0	1
...								
3	3	3	3	.	3	3	0	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 0*4^{-3} = ?$
3	3	3	3	.	3	3	1	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 1*4^{-3} = ?$
3	3	3	3	.	3	3	2	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 2*4^{-3} = ?$
3	3	3	3	.	3	3	3	255.984375

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! Why?

Solution:

A. More in m

B. Find the closest number

Radix-4								
Integer (n=4)					Fraction (m=3)			Radix-10
4^3	4^2	4^1	4^0	.	4^{-1}	4^{-2}	4^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*4^{-3} = 1/64 = 0.015625$
0	0	0	0	.	0	0	2	$2*4^{-3} = 2/64 = 0.03125$
0	0	0	0	.	0	0	3	$3*4^{-3} = 3/64 = 0.046875$
0	0	0	0	.	0	1	0	$1*4^{-2} + 0*4^{-2} = 1/16 = 0.0625$
0	0	0	0	.	0	1	1	$1*4^{-2} + 1*4^{-2} = 1/16 + 1/64 = 0.078125$
0	0	0	0	.	0	1	2	$1*4^{-2} + 2*4^{-2} = 1/16 + 2/64 = 0.09375$
0	0	0	0	.	0	1	3	$1*4^{-2} + 3*4^{-2} = 1/16 + 3/64 = 0.109375$
0	0	0	0	.	0	2	0	$2*4^{-2} + 0*4^{-2} = 2/16 = 0.125$
				...				
0	0	0	0	.	3	3	3	$3*4^{-1} + 3*4^{-2} + 3*4^{-3} = 0.984375$
0	0	0	1	.	0	0	0	1
				...				
3	3	3	3	.	3	3	0	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 0*4^{-3} = ?$
3	3	3	3	.	3	3	1	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 1*4^{-3} = ?$
3	3	3	3	.	3	3	2	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 2*4^{-3} = ?$
3	3	3	3	.	3	3	3	255.984375

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! Why?

Solution:

A. More in m

B. Find the closest number

$(1.001)_4 = (1.015625)_{10}$ => Error = 0.004375

$(1.002)_4 = (1.03125)_{10}$ => Error = 0.01125

Radix-4								
Integer (n=4)					Fraction (m=3)			Radix-10
4^3	4^2	4^1	4^0	.	4^{-1}	4^{-2}	4^{-3}	
0	0	0	0	.	0	0	0	0
0	0	0	0	.	0	0	1	$1*4^{-3} = 1/64 = 0.015625$
0	0	0	0	.	0	0	2	$2*4^{-3} = 2/64 = 0.03125$
0	0	0	0	.	0	0	3	$3*4^{-3} = 3/64 = 0.046875$
0	0	0	0	.	0	1	0	$1*4^{-2} + 0*4^{-2} = 1/16 = 0.0625$
0	0	0	0	.	0	1	1	$1*4^{-2} + 1*4^{-2} = 1/16 + 1/64 = 0.078125$
0	0	0	0	.	0	1	2	$1*4^{-2} + 2*4^{-2} = 1/16 + 2/64 = 0.09375$
0	0	0	0	.	0	1	3	$1*4^{-2} + 3*4^{-2} = 1/16 + 3/64 = 0.109375$
0	0	0	0	.	0	2	0	$2*4^{-2} + 0*4^{-2} = 2/16 = 0.125$
...								
0	0	0	0	.	3	3	3	$3*4^{-1} + 3*4^{-2} + 3*4^{-3} = 0.984375$
0	0	0	1	.	0	0	0	1
...								
3	3	3	3	.	3	3	0	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 0*4^{-3}$ = ?
3	3	3	3	.	3	3	1	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 1*4^{-3}$ = ?
3	3	3	3	.	3	3	2	$3*4^3 + 3*4^2 + 3*4^1+3*4^0+3*4^{-1} + 3*4^{-2} + 2*4^{-3}$ = ?
3	3	3	3	.	3	3	3	255.984375

Is it possible to show the number $(1.02)_{10}$ in this system with these spaces?

No! Why?

Solution:

A. More in m

B. Find the closest number

$(1.001)_4 = (1.015625)_{10}$ => Error = 0.004375

$(1.002)_4 = (1.03125)_{10}$ => Error = 0.01125

PRACTICE RADIX-[8,10,16]

At Home