

Numeration Systems

3 Theoretical Systems

Text – Chapter 4 – Sections 1, 2

Simple or Additive System

- Must have a base and symbols for powers of the base.
- The order of the symbols is not important.
- Evaluate by adding the values of each symbol in the numeral.
- Let's use base 6.

No in-class assignment problem

Base 6 Powers and Symbols

Powers	Symbols
• $6^0 = 1$	/
• $6^1 = 6$	^
• $6^2 = 36$	^^
• $6^3 = 216$	^^^
• $6^4 = 1296$	^^^^

In-class Assignment 17 - 1

Interpret the Additive Numeral Base 6

/ ^^ / / ^ ^^ /

$$1 + 216 + 6 + 1 + 1 + 6 + 36 + 1$$
$$= 268$$

In-class Assignment 17 - 1

Write a Base 6 Additive Numeral

- Find the highest power of the base that is less than or equal to the given number.
- Divide the given number by that power.
- Write the symbol for the power as many times as the quotient.
- Divide the remainder by the next lower power.
- Continue in this manner.

No in-class assignment problem

947 as a Base 6 Additive Numeral

$$\begin{array}{r} 4 \\ 216 \overline{)947} \\ \underline{-868} \\ 79 \\ 6 \overline{)79} \\ \underline{-6} \\ 1 \end{array}$$

$$\begin{array}{r} 2 \\ 36 \overline{)79} \\ \underline{-72} \\ 7 \end{array}$$

4 of ^^

2 of ^

1 of ^

1 of /

○ These symbols in any order.




In-class Assignment 17 - 2

Multiplicative Numeration System

- Need a base and symbols for powers of the base. Use base 6 symbols from slide 3
- Need multipliers – use circles with dots to represent how many of that base symbol
- Pairs of symbols – multipliers and base symbol
- Order of pairs not important
- Evaluate by multiplying the pairs and adding the results

No in-class assignment problem

Interpret the Multiplicative Numeral
Base 6

 \wedge  \wedge  \wedge

$(4 \times 6) + (1 \times 216) + (2 \times 36)$
 $= 312$

In-class assignment 17 - 3

Write a Base 6 Multiplicative Numeral

- Find the highest power of the base that is less than or equal to the given number.
- Continue as in writing an additive numeral but use a base symbol only once preceded by a multiplier with the number of dots representing how many of the symbols there should be.

No in-class assignment problem

957 as a Base 6 Multiplicative Numeral

$\begin{array}{r} 216 \overline{)957} \\ \underline{-864} \\ 93 \end{array}$	$\begin{array}{r} 36 \overline{)93} \\ \underline{-72} \\ 21 \end{array}$	○ 4 of \wedge
$\begin{array}{r} 6 \overline{)21} \\ \underline{-18} \\ 3 \end{array}$		○ 2 of \wedge
		○ 3 of \wedge
		○ 3 of /

In-class Assignment 17 - 3

Another Numeral for 957 (Base 6)

 \wedge  /  \wedge  \wedge

Note: The pairs can be in any order

In-class Assignment 17 - 3

Positional (Place-Value) System

- Need a base but no base symbols
- Multipliers in valued positions
 - Highest power at the extreme left
 - Lowest power at the extreme right
- Order very important
- Need a place holder (zero)
- Evaluate by multiplying the multiplier (face value) and the value of the position (place value).

No in-class assignment problem

Evaluate A Base 6 Positional Numeral



There are 3 multipliers.
The position values from
left to right are 6^2 (36),
 6^1 (6) and 6^0 (1).

- 3 times 36 = 108
- 4 times 6 = 24
- 3 times 1 = 3
- The numeral represents 135

In-class Assignment 17 - 5

Write the Base 6 Positional Numeral

- Decide on the highest power of 6 that is less than or equal to the number you are representing.
- Proceed as in the simple and multiplicative procedures.
- Write a multiplier with the proper number of dots for the highest power first then the next and so on.

No in-class assignment problem

782 as a Positional Numeral (Base 6)

3

216 $\overline{)782}$

- 648

134

3

36 $\overline{)134}$

- 109

25

4

6 $\overline{)25}$

- 24

1

Four powers - 4 multipliers

pv - 216

36

6

1

••

••••

•••

•

In-class Assignment 17 - 6