# Some Numeration Systems of the World

Egyptian, Roman, Chinese, Babylonian and Mayan

*Text – Chapter 4 – Sections 1, 2*

## Early Egyptian

EARLY EGYPTIAN SYMBOLS

| Number | Symbol | Description |
|---|---|---|
| 1 (or $10^0$) | | straight vertical line |
| 10 (or $10^1$) | | heel bone |
| 100 (or $10^2$) | | scroll |
| 1000 (or $10^3$) | | lotus flower |
| 10,000 (or $10^4$) | | bent line |
| 100,000 (or $10^5$) | | burbot fish |
| 1,000,000 (or $10^6$) | | man in astonishment |

*No in-class assignment problem*

## Early Egyptian - continued

- Need to know about this system
  - Base 10
  - Simple or additive system
  - Base symbols on the previous slide
  - Order of symbols not important
  - Evaluate by adding the values of all of the symbols

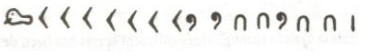
*No in-class assignment problem*

## Interpreting an Early Egyptian Numeral

- The number of men in astonishment, if any – the first digit of the number
- The number of tadpoles – the second digit of the number
- The number of bent fingers – the next digit of the number
- Continue up the chart. If one of the symbols is not present place a zero

*In-class Assignment 18 - 1*

## The Translation of an Egyptian Numeral



No men in astonishment
1 tadpole - 1
7 pointing fingers – 7
No lotus flowers – 0
3 scrolls – 3
4 heel bones - 4
1 staff - 1

170,341

*In-class Assignment 18 - 1*

## 2,345,023 Written as an Egyptian Numeral

- Symbols can be drawn in any order – even on different lines.
- Need
  - 2 men in astonishment
  - 3 tadpoles
  - 4 pointing fingers
  - 5 lotus flowers
  - 2 heel bones
  - 3 staffs

*In-class Assignment 18 - 2*

## Roman Numerals

- Need to know
  - Modified additive system - used subtraction
  - Base 10 – with sub base of 5
  - Order important
- Start at the left - add each numeral unless its value is less than the numeral to its right. If it is, subtract its value from the value of the numeral to its right.

| Roman numerals | I | V | X | L | C | D | M |
|---|---|---|---|---|---|---|---|
| Hindu–Arabic numerals | 1 | 5 | 10 | 50 | 100 | 500 | 1000 |

*No in-class assignment problem*

## Interpreting a Roman Numeral

MMCDXLVII

- 1000 +1000 = 2000 MM
- 500 – 100 = 400 CD
  - 100 < 500 - subtract
- 50 −10 = 40 XL
  - 10 < 50 – subtract
- 5 + 1 + 1 = 7 VII
- 2,447

*In-class Assignment 18 - 3*

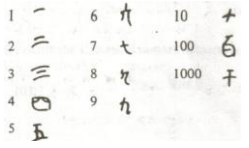
## Writing a Roman Numeral for 2,939

- Determine the largest symbol needed M.
  - MM = 2000
- Since 900 = 1000 − 100 subtract C from M by placing the C to the left of M.
  - CM = 900
- XXX = 30
- Since 9 = 10 − 1 subtract I from X by placing the I to the left of the X.
- 2,939 = MMCMXXXIX

*In-class Assignment 18 - 4*

## Traditional Chinese Numeration System

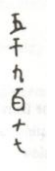
- Need to know
  - Modified multiplicative system
    - Order important, Written vertically, Omitted the multiplier one,
      Omitted the base symbol one unless necessary
  - Base 10




--- Multipliers ------ -- -Base symbols --

*No in-class assignment problem*

## Interpreting a Chinese Numeral

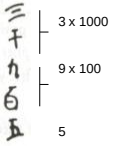


- Start at top.
  - Multiplier 5 followed by 1000
    5 x 1000 = 5000
  - Multiplier 9 followed by 100
    9 x 100 = 900
  - No multiplier so 1 x 10 = 10
  - Multiplier 7 and no base so 7
  - The numeral represents 5917

*In-Class Assignment 18 - 5*

## Write a Chinese Numeral for 3,905

1. 3000 is multiplier 3 times base symbol 100
2. 900 is multiplier 9 times base symbol 100
3. No tens .
4. 5 is the multiplier 1 but no base symbol for 1.




*In-class Assignment 18 - 6*

## The Babylonian Numeration System

- Need to know
  - Positional numeration system
  - Base 60 – need powers of 60
  - Only two symbols – 
  - No zero
  - Positions separated by gaps

*No in-class assignment problem*

## A Babylonian Numeral for 3,746

- $60^0 = 1$
- $60^1 = 60$
- $60^2 = 3600$
- $60^3 = 216000$
- Need 3 positions

3600 60 1

$3600\overline{)3746}\ 1$ remainder $146$

$60\overline{)146}\ 2$ remainder $26$

*In-class Assignment 18 - 7*

## To Write a Babylonian Numeral

- Determine the highest power of 60 that is less than or equal to the number to be written.
- Then proceed as in the other systems by dividing the number to be written by that power.
- Divide the remainder by the next highest power of the base and so on

*No in-class assignment problem*

## Write 4685 in the Babylonian System

- $60^2$ is the highest power → 3 positions

$3600\overline{)4689}\ 1$ remainder $1089$

$60\overline{)1089}\ 18$ remainder $5$

- 1 x 3600
- 18 x 60
- 9 x 1

## The Mayan Numeration System

- Need to know
  - A modified positional system
  - A modified base of 20
    - $20^2 = 400$ - the system use 360
  - Vertically written – highest position value at top
  - Had a zero or place holder
  - Used combinations of bars for “5”s and dots for “1”s.

*No in-class assignment problem*

## Position Values for the Mayan System

$20 \times 7200 = 144000$
$20 \times 360 = 7200$
$20 \times 18 = 360$
$20^1 - 20$
$20^0 = 1$

4 x 7200 = 28800

15 x 360 = 5400

0 x 20 = 0

18 x 1 = 18

The numeral is 34218

*In-class Assignment 18 - 9*

## Writing a Mayan Numeral for 8,451

- Need 4 positions
- Highest place value 7200



$$7200\overline{)8451}\quad 1 \qquad -7200 \qquad 1251$$

$$360\overline{)1251}\quad 3 \qquad -1080 \qquad 171$$

$$20\overline{)171}\quad 8 \qquad -160 \qquad 11$$