

### Unicode

- Unicode was developed for international use → Because ASCII did not have enough characters
- Unicode uses 2<sup>16</sup> characters (that's 65,000!)
- The first 256 (28) characters correspond to ASCII
- Not all of the codes have been used so UNICODE can be expanded

### Numbers & the Machine

- We think in decimal (Base 10)
- o Computers use Binary (Base 2) 0's & 1's
- We need to be able to convert from decimal to binary
- Since Binary numbers get long fast...
  - Eg (10000001) = 129
  - It is easier for us to convert from binary to octal or hexadecimal equivalents
    - lue ightarrow than from binary to decimal
  - It is easier to convert to binary from oct and hex numbers
    - lacktriangle ightarrow than from decimal to binary

## The Decimal System

- o Brought to us by the Hindus (400 A.D.)
- They Arabs picked up on it in (800 A.D.)
- And Europeans discovered it in (1200 A.D.)
- It is a great system because
  - It is easy to deal with large quantities with relatively few symbols
  - It is easy to carry and borrow
  - The decimal systems makes use of 10 digits (0-9)
  - These symbols have a "place value" or "positional concept" which allow us to represent any whole number
  - $\bullet$  The term digit (relates to fingers and toes)  $\Rightarrow$  we have 10 so thi system makes sense to us

# Positional concept

- Position MATTERS
  - 352 in decimal
  - = 300 + 50 + 2
  - $= 3 \times 10^2 + 5 \times 10^1 + 2 \times 10^0$
  - The position determines the power in which we raise the base
  - 10 = ten because we use base 10
     If we used base 2, 10 would = 2
- Base (AKA Radix)

#### Positional Notation

#### Rules for Positional Notation:

- 1. The number of distinct symbols equals the base (in base 10 they are 0,1,2,3,4,5,6,7,8,9)
- 2. The largest value represented by 1 symbol is one less than the base

(for base 10 this is 9)

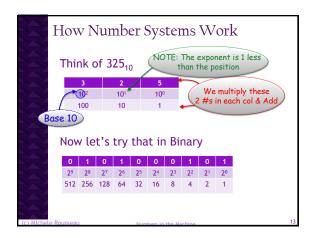
3. Each value of a number is multiplied by the base raised to the appropriate power relative to its position

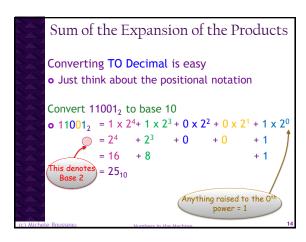
(e.g.  $352 = 3 \times 10^2 + 5 \times 10^1 + 2 \times 10^0$ )

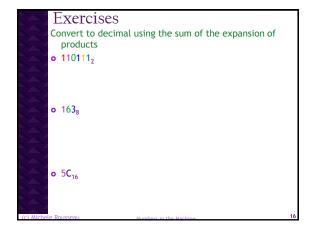
4. The symbols 10 represents the base

(for base 10 this is ten)

	Decimal	Binary	Octal	Hexadecimal
	0	0	0	0
	1	1	1	1
	2	10	2	2
	3	11	3	3
	4	100	4	4
	5	101	5	5
	6	110	6	6
	7	111	7	7
	8	1000	10	8
	9	1001	11	9
	10	1010	12	А
	11	1011	13	В
	12	1100	14	С
	13	1101	15	D
	14	1110	16	E
	15	1111	17	F
	16	10000	20	10
(c) Michele Roi	usseau	Numbers in	the Machine	

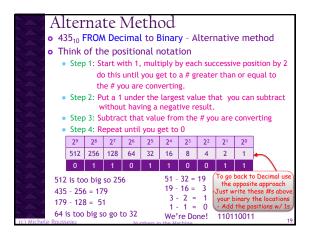


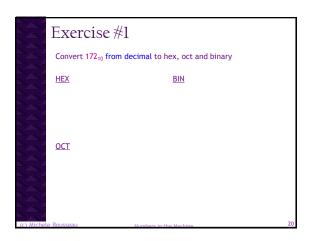




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Dibble Dabble
    To convert FROM decimal to any base we use the "dibble-dabble"
   method to
     ■ DIBBI F-DABBI F
       →Use successive divisions by the base
       → Keep track of the remainder
    Convert 35<sub>10</sub> to binary
    35/2 - 17 -- remainder 1 (least significant bit)
    17)2 = 8 -- remainder 1
                                            Read from
     8/2 = 4 -- remainder 0
                                            the bottom
     4/2 = 2 -- remainder 0
                                            Un
     2/2 = 1 -- remainder 0
     1/2 = 0 -- remainder 1 (most significant bit)
     Thus, 35_{10} = 100011_2
You can use the same method for Octal or Hexidecimal
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```
Dibble Dabble Oct & Hex
o 435<sub>10</sub> Decimal to Octal
   • Dibble - Dabble Method
                                          Read from
    435 / 8 = 54 - REMAINDER 3
                                          the bottom
      54 / 8 = 6 - REMAINDER 6
       6 / 8 = 0 - REMAINDER 6
   Reverse the numbers 435_{10} = 663_8
o 435<sub>10</sub> Decimal to Hex
   • Dibble - Dabble Method
                                           Read from
    435 / 16 = 27 - REMAINDER 3
                                           the bottom
      27 / 16 = 1 - REMAINDER 11 = B
                                           Up
      1 / 16 = 0 - REMAINDER 1
   Reverse the numbers 435_{10} = 1B3_{16}
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Exercise #2

Convert 201<sub>10</sub> from decimal to hex, oct and binary

HEX

OCT
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Addition Base 10

    Process of Adding

 Step 1: Add the two digits in the first position.
         Check if the solution is greater than or equal to the base.
         If not then just write down the solution. You're done.
 Otherwise go to step 2.
 Step 2: Carry 1.
         Subtract the base from the solution found in step one.
         Write this down - this is your solution for that position.
 Step 3: Add 1 to the position to the left.
 Step 4: Repeat this for all positions.
                    9+2=11 - this is > 9 (base -1), so we have to carry
    Base 10 Add the carry too 11-10=1 write down 1 & add 1 to the
                                position to the left.
       19910
                    9+2+1=12 - this is > 9 so we have to carry.
                                    12-10=2 so write down 1 & add 1 to
     +2210
                                    the position on the left
       221,0
                     1+1=2 Not > 9 so no carry
```

```
Addition Bases 8 & 2
o Same as in Base 10 except you carry when you
   reach the base #
   Base 8
                              9 is greater than 7(base-1) → CARRY
      ^{1\,1}_{162_8}
                              9-8 = 1 (solution -base) - write down 1
                             Add 1 to the next position
     + 47<sub>8</sub>
              6+4+1=11 11>7, so 11-8=3, We write down 3.
      2318
                              carry the 1
              1 + 1 = 2
     Base 2
      1001, 1+1=2
                           2>1 → carry.
                               so 2-2= 0 - write down 0, carry1
    +1011<sub>2</sub> 0+1+1=2
                           Same as above
               1+0=1
                           No Carry
     10100<sub>2</sub>
               1+1=1
                           2>1 \rightarrow again, 2-2=0, write 0 & Carry the 1
```

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Addition Base 16
o Same as in Base 10 except you carry when you reach the base # (in
   this case if the # > 15)
• Note in Base 16 we count 0-9 just like in decimal then we
   represent 10 with an A, 11=B, 12=C, 13=D, 14=E, 15=F
      AE9_{16} 9 + 7 = 16
                               16 is greater than 16(base-1) → CARRY
                   The Base 16 - 16 = 0 (solution-base) \rightarrow write 0
     + 6716
                               Add 1 to the next position
      B50.
              E+ 6 + 1 = 21 21 > 15, so 21 - 16 = 5,
                                  We write 5 carry the 1
               A + 1 = 11
                                11=B, so we write B
      FFA_{16} A+9 = 19
                                19>15 → carry,
                                  so 19-16= 3 - write down 3, carry 1
    +A9<sub>16</sub>
              F + A + 1 =
               15+10+1=26
                               26>15 → carry,
    10A3 <sub>16</sub>
                                  so 26-16=10 - write down A, carry 1
               F+1 = 16
                               16>15, 16-16=0, so 0, carry 1
```

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Exercises

• Same as in Base 10 except you carry when you reach the base #

Base 8

Base 16

125<sub>8</sub>

F9E<sub>16</sub>

+72<sub>8</sub>

+71<sub>16</sub>

Base 2

11011<sub>2</sub>

+1001<sub>2</sub>

**COMichele Rousseau*

**Mumbers in the Marking**

25
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Subtraction Base 10

    Basic Process of Subtraction

 Step 1: Check the two digits in the first position to see if you have to
            borrow. If not then just subtract. If so, go to step 2.
 Step 2: Borrowing 1 – if the position on the left > 0.
            Subtract 1 from the position to the left.
            Add the base to the current position and subtract.
 Step 3: If the position on the left = 0.
            Then borrow from the next position.
 Step 4: Repeat this for all positions.
           9
1/0 10
                         -2<0 , so we have to borrow. The position on the left
         2 0 1<sub>10</sub>
                         (the 10s) = 0 so we have to borrow the base from the position to the left (the hundreds).

* Remember to borrow we subtract 1 and borrow the bas
           2310
                         In this case, we borrow from the 100s, so 2-1=1, give 10 to the 10s position. Borrow again so 10-1=9, and
         1 7 8<sub>10</sub>
     add the base (10 to the ones position).

Borrowed So now we have 10+1-3 =8
                     1-0 = 1
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Subtraction Base 16

Same as in Base 10 except you borrow the base (in this case 16)

Again, note in Base 16 we count 0-9 just like in decimal then we represent 10 with an A, 11=B, 12=C, 13=D, 14=E, 15=F

13 16 9-A=

A \not \in 9_{16} 9-10=-1 Need to Borrow.

Subtract 1 from the position to the left (E-1=D)

Add the base, 16+9-A=16+9-10=15=F

9 7 F 16 D-6=13-6=7-Don't need to borrow

A-1=10-1=9

16

A-C=10-12=-2 Need to borrow,

50 F-1=E,

16+A-C=16+10-12=14=E

Need to borrow,

50 F-1=E,

16+A-C=16+10-12=14=E

Need to borrow,

50 F-1=E

16+E-F=16+14-15=15=F

E-2=14-2=12=C
```

• Same as in Base 10 except you borrow when you reach the base

Base 8

551<sub>8</sub>

F 0 3<sub>16</sub>

- 12<sub>8</sub>

- 1 A<sub>16</sub>

Base 2

1001<sub>2</sub>

- 101<sub>2</sub>

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For More Help

http://www.saddleback.edu/faculty/lperez/
algebra2go/compsci/index.html

+ Additional links online
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