Computers work with numbers, but decimal numbers are not convenient for computers.

Decimal number:

(base ten)

hundreds	tens	ones
2	8	5

$= 2\times10^2 + 8\times10^1 + 5\times10^0$

$= 200 + 80 + 5$

Binary number:

(base two)

fours	twos	ones
1	0	1

$= 1\times2^2 + 0\times2^1 + 1\times2^0$

$= 4 + 0 + 1 = 5$ (decimal)

Converting Binary to Decimal

1. Write place values below each binary digit.
2. Sum the place values below each 1 in the binary number.

Example:

binary number:	0	1	1	0	1	0	1	1
place values:	128	64	32	16	8	4	2	1

decimal number: 64 + 32 + 8 + 2 + 1 = 107

Converting Binary to Decimal

1. Write place values below each binary digit.
2. Sum the place values below each 1 in the binary number.

Convert the following binary numbers to decimal:

10101	101100
decimal: 21	44

Hexadecimal Numbers

Since binary numbers are cumbersome for humans, computer scientists often convert binary to **hexadecimal numbers**.

Hexadecimal number:

(base sixteen)

$= 2\times16^2 + 8\times16^1 + 5\times16^0$

$= 2\times256 + 8\times16 + 5\times1$

$= 512 + 128 + 5$

$= 645$ (decimal)

Hexadecimal Numbers

Hexadecimal (hex) numbers require sixteen digits:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F

To convert from hex to decimal:

1. Write the place value below each hex digit.
2. Multiply each digit by its place value, and add the products.

Example:

hex number:	2	C	E
place values:	256	16	1

decimal number: $2\times256 + 12\times16 + 14\times1 = 718$

Hexadecimal Numbers

To convert from hex to decimal:

1. Write the place value below each hex digit.
2. Multiply each digit by its place value, and add the products.

Convert the following hex numbers to decimal:

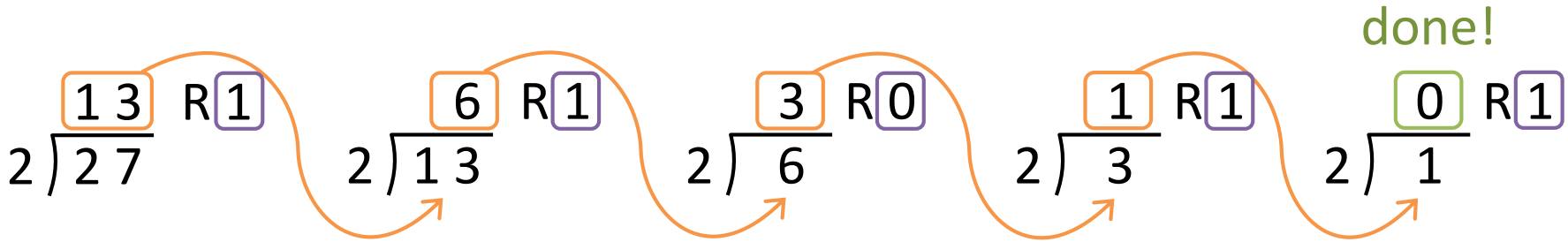
A 2	1 2 B
decimal: 162	299

Converting Decimal to Any Base

1. Divide the decimal number by the new base.
2. The remainder is the next digit to write down (right to left).
3. If the quotient is zero, you are done. If not, go to step 1 and use the quotient as the new number to divide.

Algorithm

Example: convert decimal 27 to binary



decimal 27 = binary 1 1 0 1 1

Converting Decimal to Any Base

1. Divide the decimal number by the new base.
2. The remainder is the next digit to write down (right to left).
3. If the quotient is zero, you are done. If not, go to step 1 and use the quotient as the new number to divide.

Algorithm

Time for some practice!

Visit the course web site: **cs125.mlwright.org**

Download the file **number_practice.pdf**

This file contains practice problems, which we will work on in small groups.

Remember:

This is a kind, inclusive, failure-tolerant class.