How to Convert Unsigned Decimal to Binary

Method 1: Using the Powers of 2

- The powers of 2 means(2^0,2^1, 2^2, 2^3, 2^4, etc.)
- 1,2,4,8,16,32,64,128,256, etc.

Step 1: Find the power of 2 that is less than or equal to the number you want to convert
- If the number I wanted to convert is 35 then the power of 2 I would need is 32
- If the number I wanted to convert is 234 then the power of 2 I would need is 128

Step 2: Write down the power of 2 you are using and all of the lesser powers of 2
- Example: the number chosen is 186

Step 3: Convert
- Your initial number is the number that you are trying to convert(in this case 186)
- Your current power of 2 is the highest power of 2 you have written
- Write down 1 if the number is divisible by the power of 2
- Write down 0 if the number is not divisible by the power of 2
- Then subtract your current number by the current power of 2 (this is your new current number)
- Then go down to the next lowest power of 2(this is your new current power of 2)
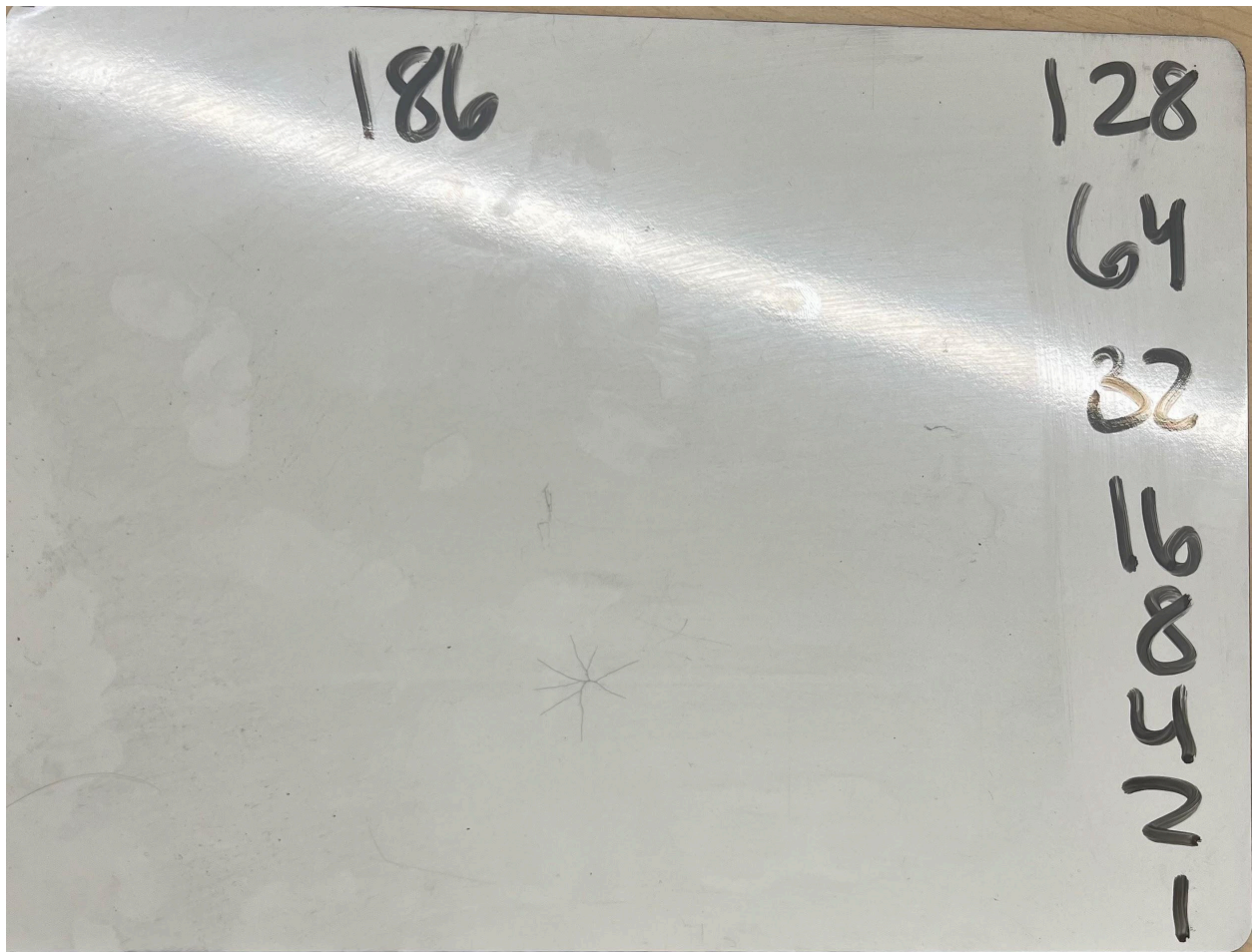
Example: convert 186 to binary
Step 1: Find your power of 2

- In this case the power of 2 that is less then or equal to 186 is 128

Step 2: write down the power of 2 and all of the lesser powers of 2
- Now we write down all of the lesser powers of 2

186

128
64
32
16
8
4
2
1

Step 3: Convert

- Our current power 128 can go into 186 so write 1
- Then subtract our current power(128) from the current number(186)
- This is result(58) is now our current number
- Our new current power is 64
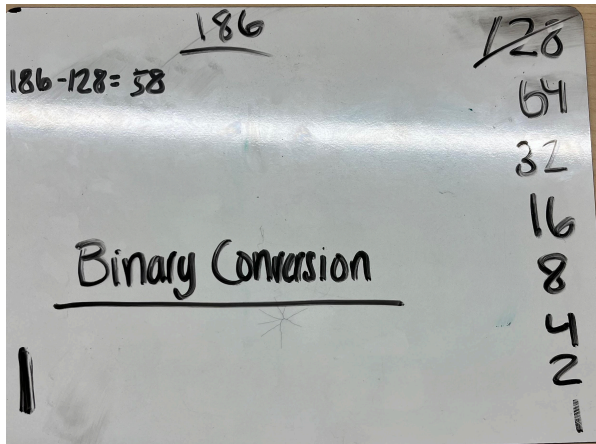
- Our current power 64 cannot go into 58 so write 0
- No need to subtract so our current number stays at 58
- Our current power is now 32
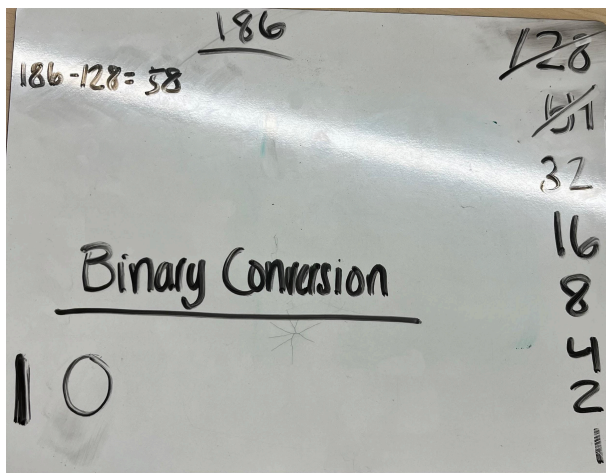
- Our current power 32 can go into our current number 58 so write 1
- Subtract 32 from 58 which is 26 and this is our new current number
- Our current power is now 16

186

186 - 128 = 58 - 32 = 26

128
64
32
16
8
4
2

Binary Conversion

1 0 1

- Our current power 16 can go into our current number 26 so write 1
- Subtract 16 from 26 which is 10 and this is our new current number
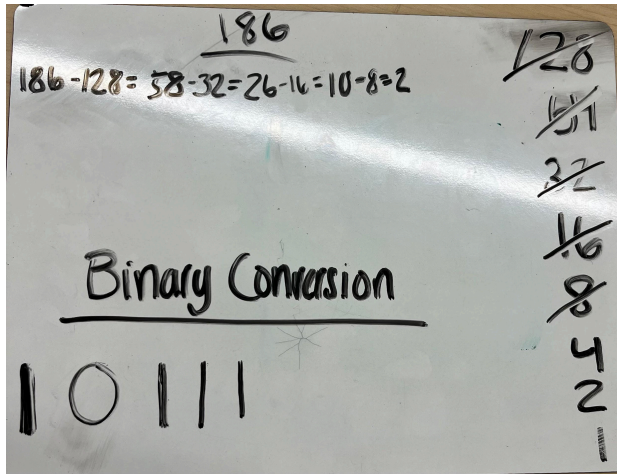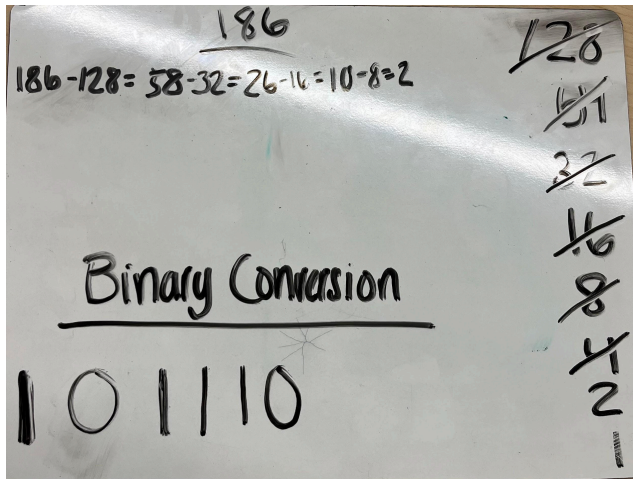- Our current power is now 8

186

186 - 128 = 58 - 32 = 26 - 16 = 10

128
64
32
16
8
4
2

Binary Conversion

1 0 1 1

- Our current power 8 can go into our current number 10 so write 1
- Subtract 8 from 10 which is 2 and this our new current number
- Our current power is now 4

186

186-128= 58-32=26-16=10-8=2

128
64
32
16
8
4
2

Binary Conversion

1 0 1 1 1

- Our current power 4 cannot go into our current number of 2 so write 0
- No need to subtract
- Our current power is now 2

186

186-128= 58-32=26-16=10-8=2

128
64
32
16
8
4
2

Binary Conversion

1 0 1 1 0

- Our current power 2 can go into our current number 2 so write 1
- Subtract 2 from 2 which is 0 and this our new current number
- Our current power is now 1
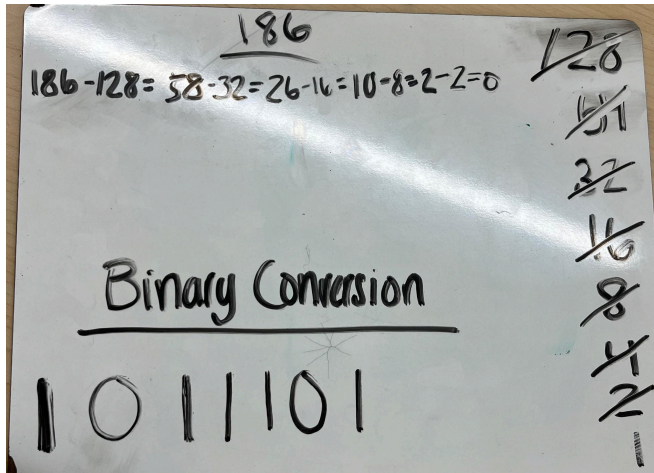
- Our current power 1 cannot go into 0 so write 0
- No need to subtract
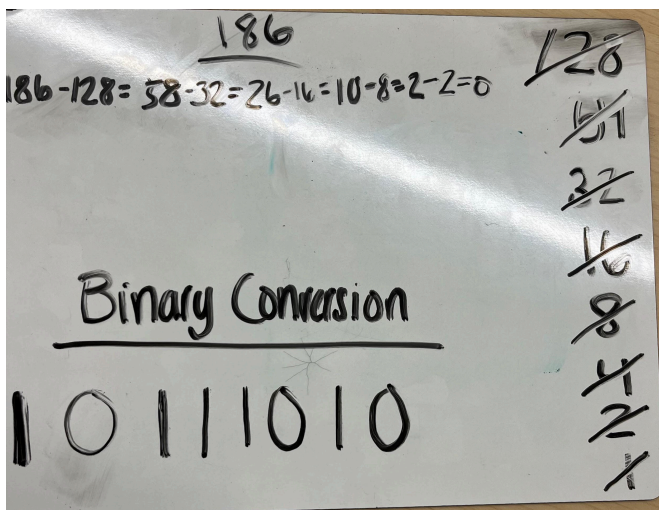
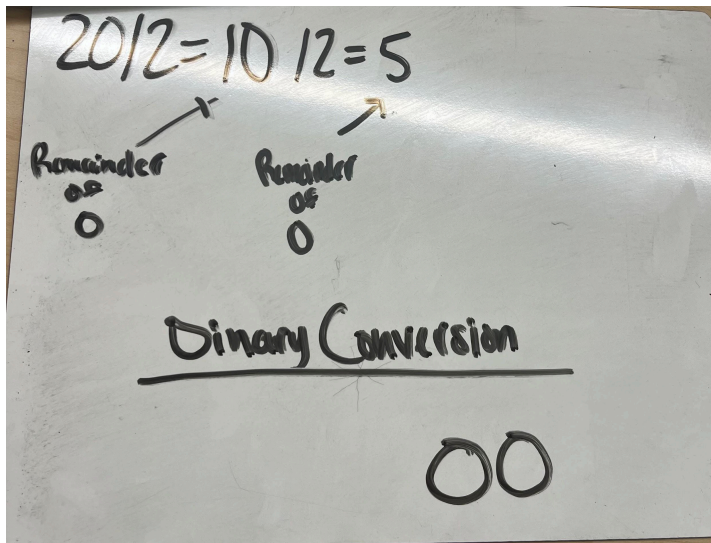- All done

Method 2: Dividing by 2 and tracking the Remainder
- **Step1: Find the number you want to convert**
- **Step2: Divide by 2**
- **Step3: If there is a remainder write 1, if there is not write 0**
- **KEY STEP: when writing the binary conversion go from right to left**
- **Continue these steps until you cannot divide any more**
- **This method is better for smaller numbers but is time consuming for converting larger decimal numbers**

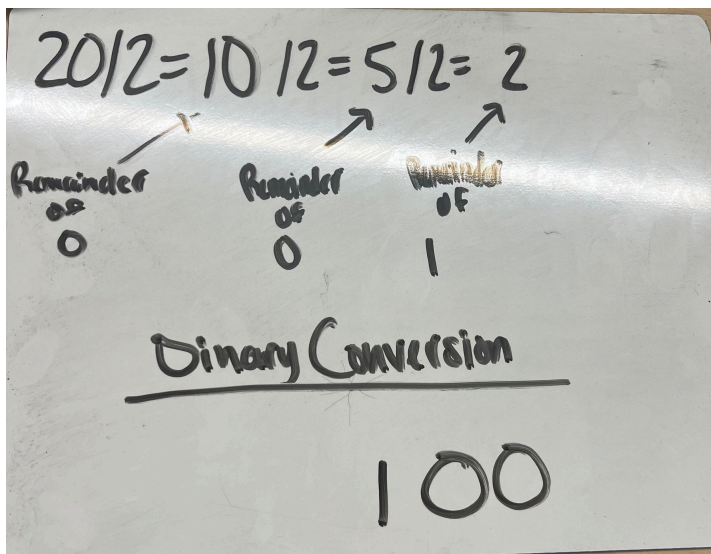**Example: Convert 20 into binary using the divide by 2 method:**
- divide 20 by 2
- This gives us 10 with zero remainder so write down 0
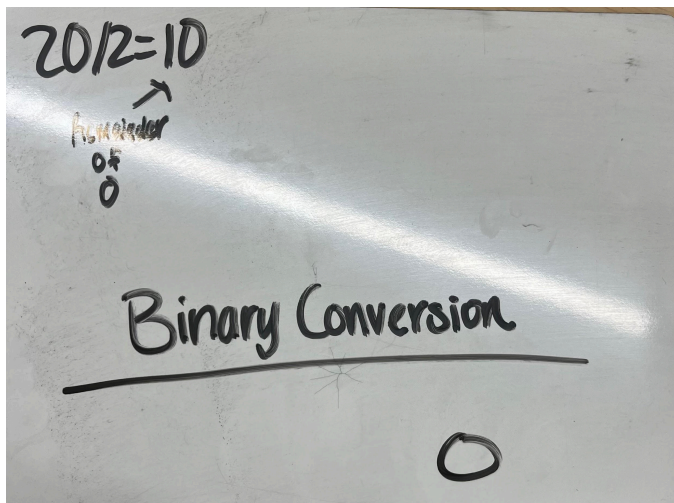
- Divide 10 by 2
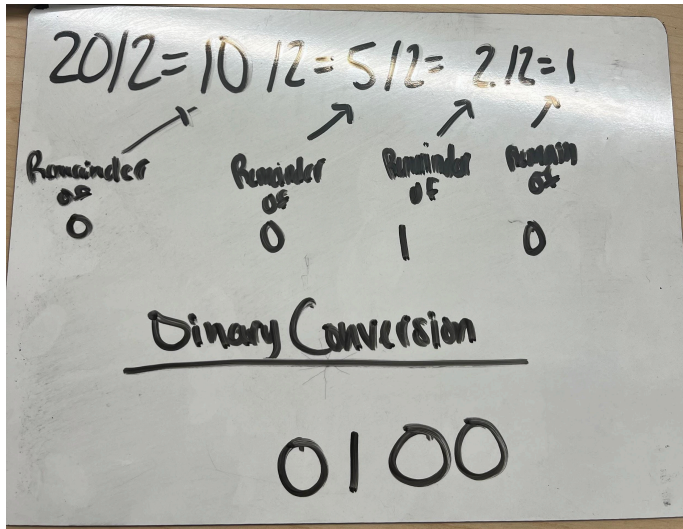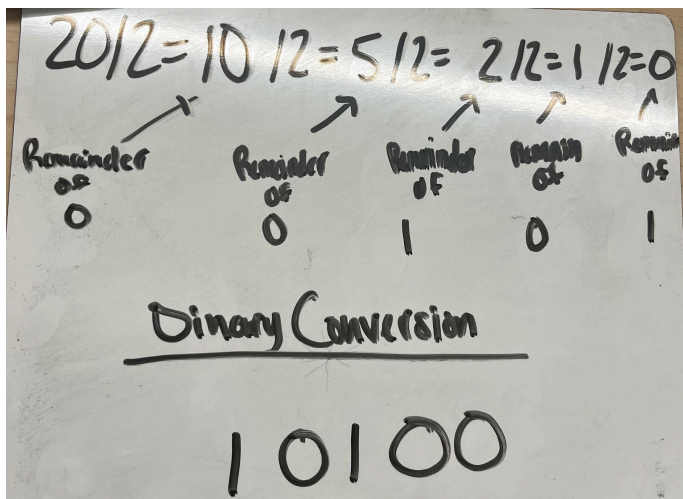- This gives us 5 with zero remainder so write 0

$20/2 = 10 \; /2 = 5$

Remainder of 0

Remainder of 0

Binary Conversion

00

- Divide 5 by 2
- This gives us 2 with a remainder of 1 so write 1

$20/2 = 10 \; /2 = 5 \; /2 = 2$

Remainder of 0

Remainder of 0

Remainder of 1

Binary Conversion

100

- Divide 2 by 2
- This gives us 1 with a remainder of 0 so write 0

20/2=10 /2=5/2= 2./2=1

Remainder of 0   Remainder of 0   Remainder of 1   Remainder of 0

Dinary Conversion

0100

- Divide 1 by 2
- This gives us 0 with a remainder of 1 so write 1

20/2=10 /2=5/2= 2/2=1 /2=0

Remainder of 0   Remainder of 0   Remainder of 1   Remainder of 0   Remainder of 1

Dinary Conversion

10100

- All done