Go forth, and Multiply!

Maths Club

Elliott Tjia
Base instincts

- What is a number base?
Base instincts

- What is a number base?
- What is our main number base?
Base instincts

- **What is a number base?**
- **What is our main number base?**
  - Ten (Decimal)
  - Digits used: 0,1,2,3,4,5,6,7,8,9
What is a number base?
What is our main number base?
  Ten (Decimal)
  Digits used: 0,1,2,3,4,5,6,7,8,9
A number base is just a representation of the same information, and doesn’t change the data itself.
One, Two, Many, Many-One,...

▶ How did people count?

Babylonians, base 60 counting system.

Mayans, base 20 - today is 13.0.0.3.4

Do we use any non-base ten counting?

Seconds in a minute, minutes in an hour, hours in a day
How did people count?

- Babylonians, base 60 counting system.
- Mayans, base 20 - today is 13.0.0.3.4

Do we use any non-base ten counting?

_seconds in a minute, minutes in an hour, hours in a day_
One, Two, Many, Many-One,...

- How did people count?
  - Babylonians, base 60 counting system.
  - Mayans, base 20 - today is 13.0.0.3.4

- Do we use any non-base ten counting?
  - Seconds in a minute, minutes in an hour, hours in a day
An On-off relationship with computers

- How to Computers count?
An On-off relationship with computers

- How to Computers count?
- Base 2 (Binary)
All your base are belong to us

- Problem: Every base is base 10

 Maths Club       Go forth, and Multiply!
All your base are belong to us

- Problem: Every base is base 10
- Notation for bases $34_5$
Problem: Every base is base 10
Notation for bases $34_5 = 19_{10}$
All your base are belong to us

- Problem: Every base is base 10
- Notation for bases $34_5 = 19_{10} = 10011_2$
Something doesn’t add up

- Addition and subtraction still work in the same fashion
- $33_7 - 12_7 =$
Something doesn’t add up

- Addition and subtraction still work in the same fashion
- \( 33_7 - 12_7 = 21_7 \)
- \( 23_5 + 14_5 = \)
Something doesn’t add up

- Addition and subtraction still work in the same fashion
- $33_7 - 12_7 = 21_7$
- $23_5 + 14_5 = 42_5$
Something doesn’t add up

- Addition and subtraction still work in the same fashion
- $33_7 - 12_7 = 21_7$
- $23_5 + 14_5 = 42_5$
- Question Sheet 1
My base is bigger than your base

- Hexadecimal is base 16
- $10_{10} = ??_{16}$
Hexadecimal is base 16

$10_{10} = ??_{16}$

Remembering that a base is defined by the number of unique digits used, base 16 can use the following digits:

$0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F$
Conversion between bases is easier if one base is an integer power of the other e.g. $16 = 2^4$
Conversion between bases is easier if one base is an integer power of the other e.g. $16 = 2^4$

- $3_{16} = 11_2$
- $A_{16} = 1010_2$
Conversion between bases is easier if one base is an integer power of the other e.g. $16 = 2^4$

- $3_{16} = 11_2$
- $A_{16} = 1010_2$
- $3A_{16} = 111010_2$
Dem bones

- Classical Algorithm
  - Napier’s bones
- Single Digit Additions, Multiplications, Shifts.
Quite a peasant experience

- In base 2, a multiplication by 2 is equivalent to a shift.
  - Peasant Multiplication
Quite a peasant experience

- In base 2, a multiplication by 2 is equivalent to a shift.
  - Peasant Multiplication
- Karatsuba Algorithm
Quite a peasant experience

- In base 2, a multiplication by 2 is equivalent to a shift.
  - Peasant Multiplication
- Karatsuba Algorithm
- Question Sheet 2
Jack Skellington would be proud

- Base 8 is Octal
- Base 10 is Decimal
Jack Skellington would be proud

- Base 8 is Octal
- Base 10 is Decimal
- OCT 31 = DEC 25

Maths Club | Go forth, and Multiply!
Jack Skellington would be proud

- Base 8 is Octal
- Base 10 is Decimal
- OCT 31 = DEC 25