Please Note

These pdf slides are configured for viewing on a computer screen.

Viewing them on hand-held devices may be difficult as they require a "slideshow" mode.

Do not try to print them out as there are many more pages than the number of slides listed at the bottom right of each screen.

Apologies for any inconvenience.

Numbers and Fractions

Numeracy Workshop

geoff.coates@uwa.edu.au

STUDYSmarter
Learning, Language and Research Skills

Introduction

These slides are designed to help you calculate with different types of numbers and fractions.

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Counting Numbers

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What if you have no children or lose all your sheep?

Then we need a new number, **zero**, which we write as 0.

Types of Numbers

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The Whole Numbers: $\{0, 1, 2, 3, 4, 5, \ldots\}$

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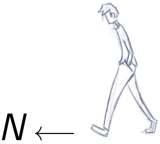

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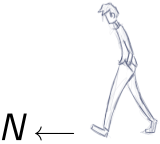

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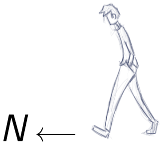

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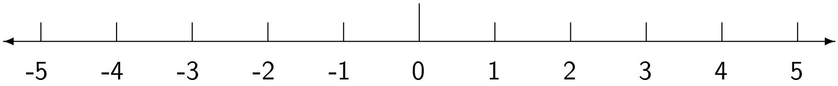
The Number Line

Integers sit nicely on **the number line.**



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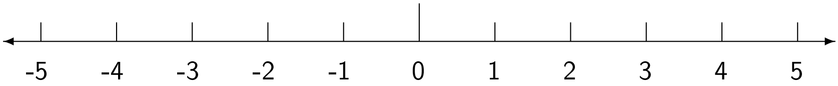

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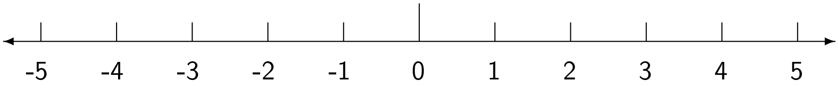

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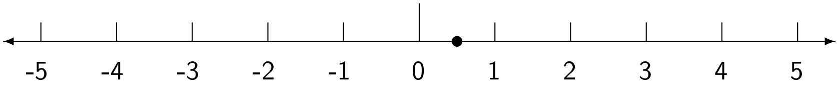

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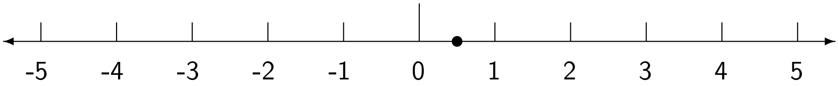

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When the **numerator** (top line) is smaller than the **denominator** (bottom line) we call this a **proper fraction**.

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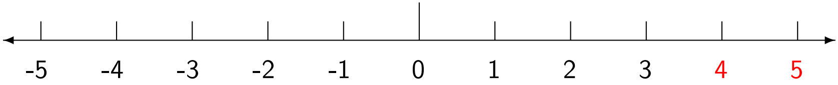

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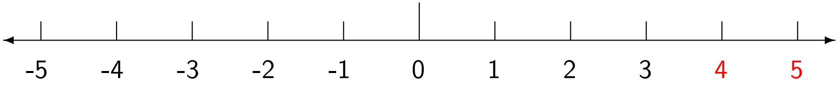

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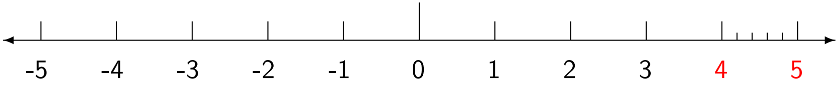

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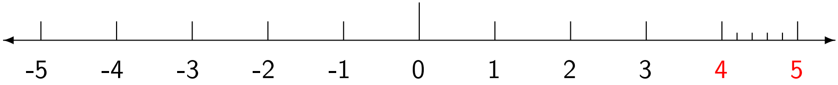

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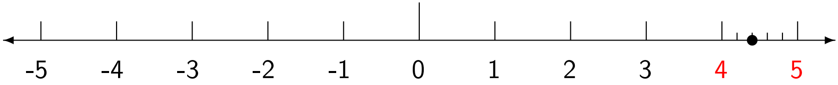

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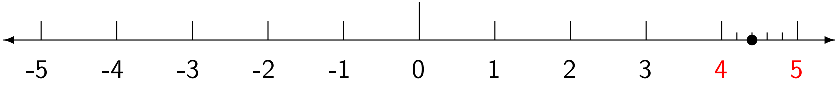

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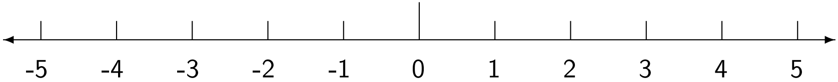
Now, starting at 4, move right along two of these fifths.

We call $4\frac{2}{5}$ a **mixed numeral**, as it is the **sum** of an integer and a proper fraction.

Fractions

Here are some more examples of mixed numerals.



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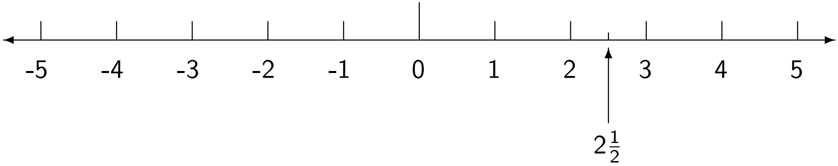

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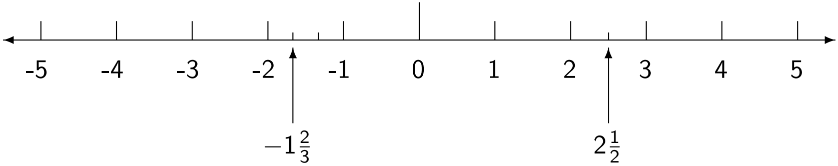

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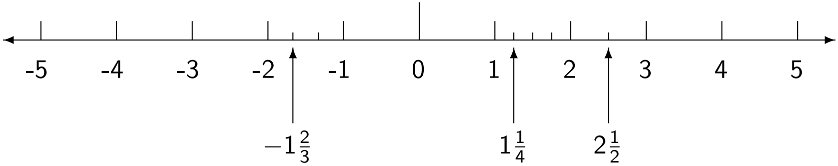

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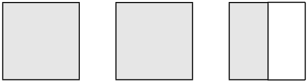

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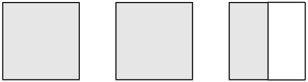

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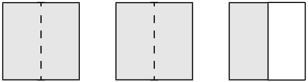

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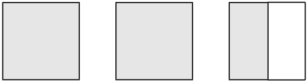

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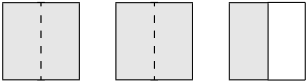

$$2\frac{1}{2} = \frac{5}{2}$$

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The combination of all rational and irrational numbers is the set of **real numbers**.

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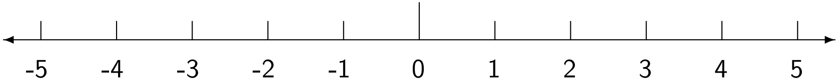
Real numbers can all be placed on a number line:



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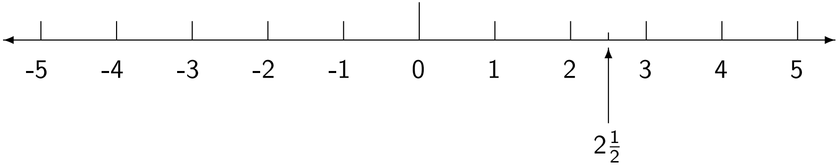

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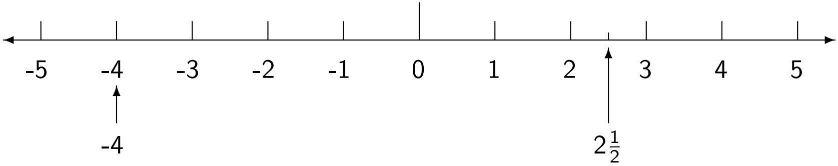

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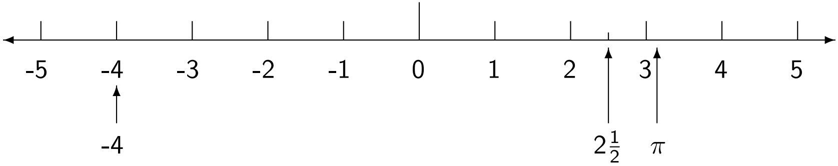

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Real Numbers: {Rational Numbers, Irrational Numbers}

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Addition is a commutative operation because the order does not matter.

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$$
\begin{aligned}
4 + 9 &= 13 \\
9 + 4 &= 13
\end{aligned}
$$

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$$\begin{aligned} 4+9 &= 13 \\ 9+4 &= 13 \end{aligned} \qquad \begin{aligned} 3\times 6 &= 18 \\ 6\times 3 &= 18 \end{aligned}$$

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Rules for Dividing Negatives

negative ÷ negative = positive

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$$\begin{aligned} -10 \div -2 &= 5 \\ 16 \div -2 &= -8 \\ -20 \div 4 &= -5 \end{aligned}$$

Indices (Powers)

Indices provide a short way of representing repeated multiplication of a fixed number.

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Instead of writing $3 \times 3 \times 3 \times 3$ we may write 3^4, and we say "three to the power of four".

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$$
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& \underbrace{-3 \times -3} && \times \text{-3} \\
= & \quad 9 && \times \text{-3} \\
= & \quad \text{-27}
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$$

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$$\text{negative}^3 = \text{negative}$$

Indices (Powers)

There is a pattern here.

$\text{negative}^{\text{even}} =$

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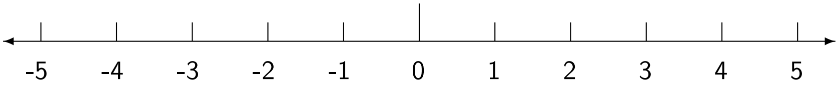
Calculating with the Number Line

Use the number line to find $1-3+5$.



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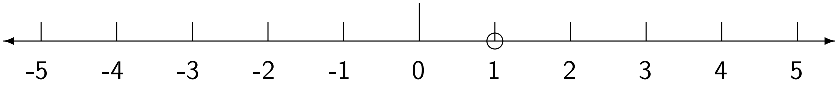

We start at 1,

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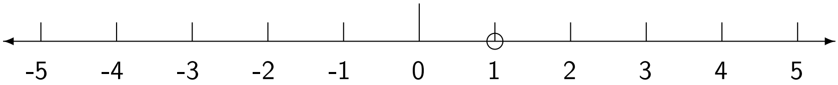

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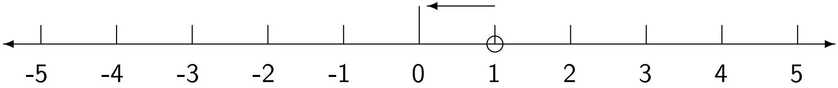

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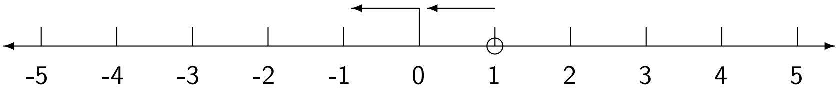

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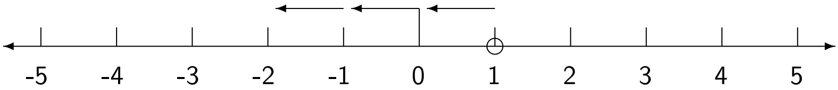

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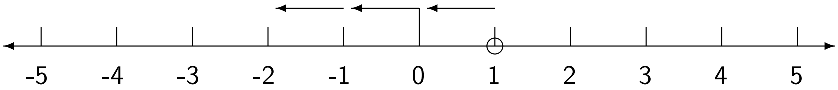

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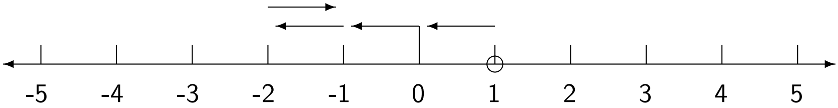

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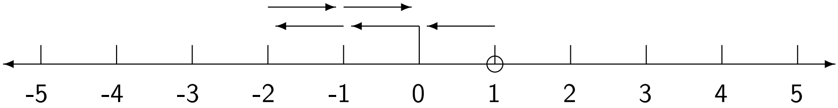

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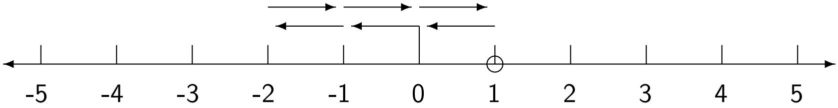

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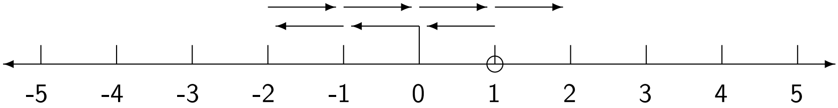

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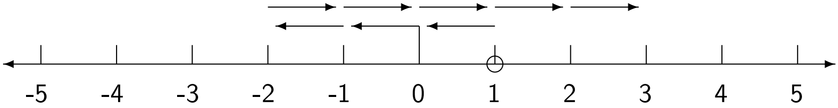

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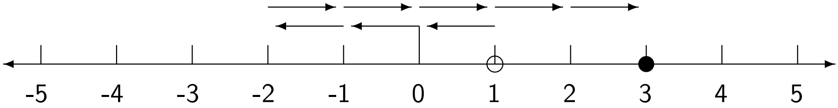

We start at 1, then move 3 *left*, then 5 *right*.

The answer is 3.

Rule for Subtracting Negatives

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$$\begin{aligned} & 5-(-3) \\ = \; & 5+3 \\ = \; & 8 \end{aligned} \qquad \begin{aligned} & 6--4 \\ = \; & 6+4 \\ = \; & 10 \end{aligned} \qquad \begin{aligned} & -2-(-3) \\ = \; & -2+3 \\ = \; & 1 \end{aligned}$$

Combined Calculations

What if we are asked to calculate $4 \times 3 + 8 \div 2 - 3 \times 1$?

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We do the calculation step by step in this order.

Combined Calculations: Example

Use BIMDAS to calculate: $4 \times 3 + 8 \div 2 - 3 \times 1$

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→ Now when we get to A/S, just do it the way we did with our number line.

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$$= \quad 12 \quad + \quad 4 \quad - \quad 3$$

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The answer is 13.

Combined Calculations: Example

Use BIMDAS to calculate: $3^2 \times -2 + (6 - 8 \div 2) - 3 \times (1 - 3)$

This looks fairly horrible. We use the step by step process of BIMDAS.

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$$\begin{aligned} & 3^2 \times -2 + (6 - \underbrace{8 \div 2}) - 3\times (\underbrace{1 - 3}) \\ = \; & 3^2 \times -2 + \quad (6 - 4) \quad - 3\times \quad (-2) \end{aligned}$$

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We can now drop the brackets:

$$3^2 \times -2 + 2 - 3 \times -2$$

Combined Calculations: Example

$$3^2 \times -2 + 2 - 3 \times -2$$

Combined Calculations: Example

$$3^2 \times -2 + 2 - 3 \times -2$$

$\rightarrow$ I (Indices) is next.

$$3^2 \times -2 + 2 - 3 \times -2$$

Combined Calculations: Example

$$3^2 \times -2 + 2 - 3 \times -2$$

$\rightarrow$ I (Indices) is next.

$$\begin{aligned} & 3^2 \times -2 + 2 - 3 \times -2 \\ = & \ 9 \times -2 + 2 - 3 \times -2 \end{aligned}$$

Combined Calculations: Example

$$3^2 \times -2 + 2 - 3 \times -2$$

→ I (Indices) is next.

$$\begin{aligned} & 3^2 \times -2 + 2 - 3 \times -2 \\ = \ & 9 \times -2 + 2 - 3 \times -2 \end{aligned}$$

→ D/M are next.

$$\underbrace{9 \times -2} + 2 - \underbrace{3 \times -2}$$

Combined Calculations: Example

$$3^2 \times -2 + 2 - 3 \times -2$$

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$$\begin{aligned} & 3^2 \times -2 + 2 - 3 \times -2 \\ = \ & 9 \times -2 + 2 - 3 \times -2 \end{aligned}$$

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$$\begin{aligned} & \underbrace{9 \times -2} + 2 - \underbrace{3 \times -2} \\ = \ & \quad -18 \quad + 2 - \quad -6 \end{aligned}$$

Combined Calculations: Example

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$$\begin{aligned} & \underbrace{9 \times -2} + 2 - \underbrace{3 \times -2} \\ = & \quad -18 \quad + 2 - \quad -6 \end{aligned}$$

→ A/S are last.

The answer is -10

Fractions with Negatives

Negatives in fractions are free to move around as follows

$$\frac{-10}{2} = \frac{10}{-2} = -\frac{10}{2}$$

Fractions with Negatives

Negatives in fractions are free to move around as follows

$$\frac{-10}{2} = \frac{10}{-2} = -\frac{10}{2}$$

Remember that fraction bars represent division so, if both the numerator and denominator are negative, the result is positive:

$$\frac{-10}{-2} = \frac{10}{2}$$

Multiplying Fractions

Multiplying fractions is as easy as multiplying integers. We just **multiply the numerators together**, and **multiply the denominators together** as follows:

$$\frac{2}{5} \times \frac{3}{2} = \frac{6}{10}$$

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$$\frac{-3}{7} \times \frac{2}{-5} = \frac{-6}{-35} = \frac{6}{35}$$

Dividing Fractions

Dividing fractions is as easy as multiplying them. We **change the division sign to a multiplication sign** by **inverting the fraction** we are dividing by.

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$$\frac{2}{6} \div \frac{1}{4}$$

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$$
\begin{aligned}
& \frac{2}{6} \div \frac{1}{4} \\
= \quad & \frac{2}{6} \times \frac{4}{1}
\end{aligned}
$$

Dividing Fractions

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$$\begin{aligned} & \frac{2}{6} \div \frac{1}{4} \\ = \quad & \frac{2}{6} \times \frac{4}{1} \\ = \quad & \frac{8}{6} \end{aligned}$$

Dividing Fractions

$$\frac{3}{4} \div 2$$

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$$\frac{3}{4} \div 2$$

$$= \quad \frac{3}{4} \div \frac{2}{1}$$

Dividing Fractions

$$
\begin{aligned}
& \frac{3}{4} \div 2 \\
= \quad & \frac{3}{4} \div \frac{2}{1} \\
= \quad & \frac{3}{4} \times \frac{1}{2}
\end{aligned}
$$

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$$
\begin{aligned}
& \frac{3}{4} \div 2 \\
= \quad & \frac{3}{4} \div \frac{2}{1} \\
= \quad & \frac{3}{4} \times \frac{1}{2} \\
= \quad & \frac{3}{8}
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$$

Equivalent Fractions

Earlier, we saw that

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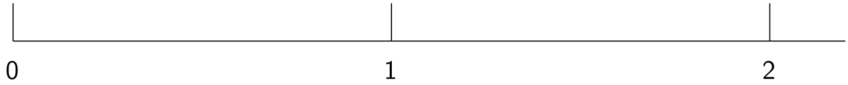

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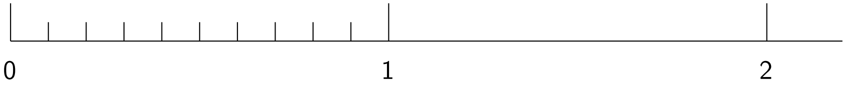

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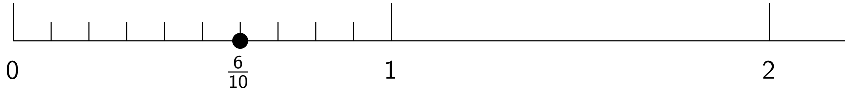

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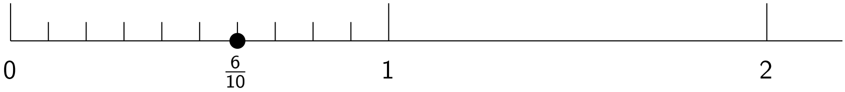

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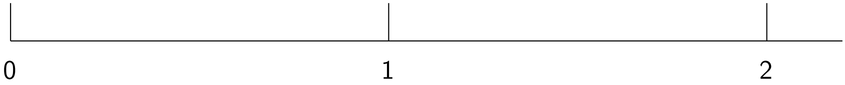

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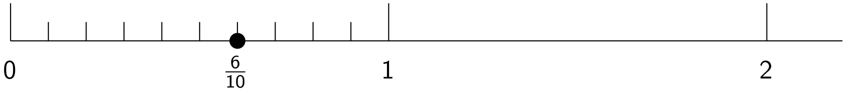

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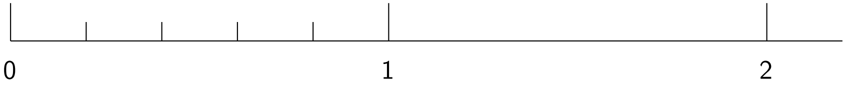

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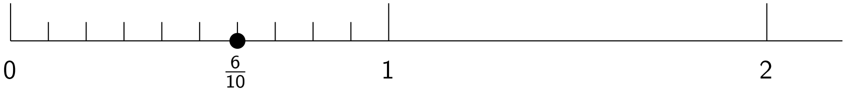

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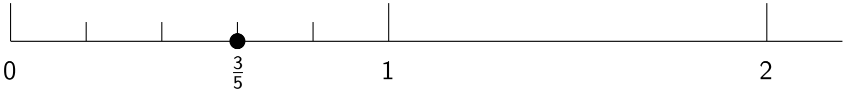

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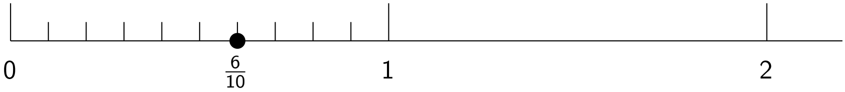

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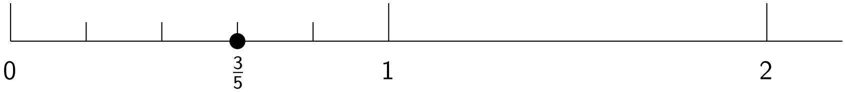

$$\frac{6}{10} = \frac{3}{5}$$

These are **equivalent fractions**. We say that $\frac{3}{5}$ is the **simplest form**.

Equivalent Fractions

$$\frac{12}{30} = \frac{12 \div 2}{30 \div 2} =$$

Equivalent Fractions

$$\frac{12}{30} = \frac{12 \div 2}{30 \div 2} = \frac{6}{15}$$

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Is this the simplest form?

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Is this the simplest form?
Yes, because no whole number divides into both 2 and 5.

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Is this the simplest form?
Yes, because no whole number divides into both 2 and 5.

Note that we have effectively divided both sides by 6:

$$\frac{12}{30} = \frac{12 \div 6}{30 \div 6} = \frac{2}{5}$$

Equivalent Fractions

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Is this the simplest form?
Yes, because no whole number divides into both 2 and 5.

Note that we have effectively divided both sides by 6:

$$\frac{12}{30} = \frac{12 \div 6}{30 \div 6} = \frac{2}{5}$$

6 is the **greatest common divisor** of 12 and 30. (More on this topic at the end.)

Adding and Subtracting Fractions

Addition and subtraction with fractions is easy if we are adding or subtracting fractions with the same denominators.

$$\frac{4}{5} + \frac{3}{5}$$

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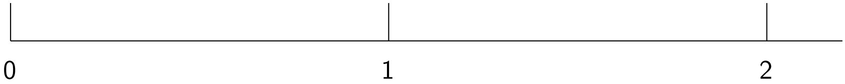

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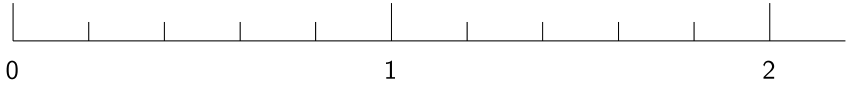

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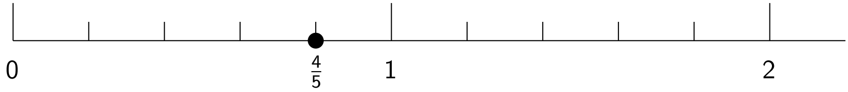

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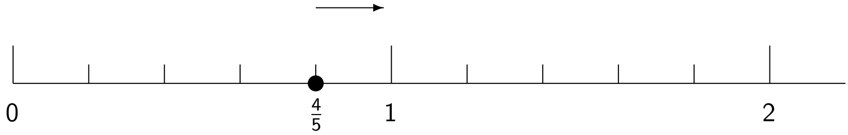

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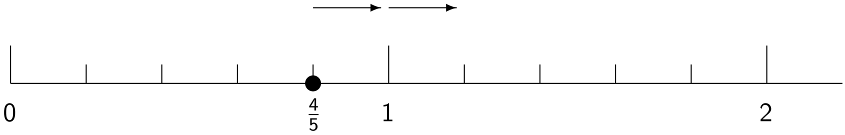

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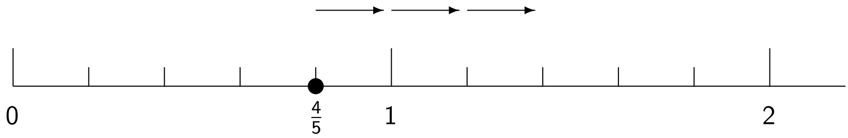

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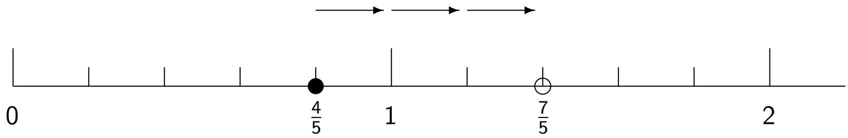

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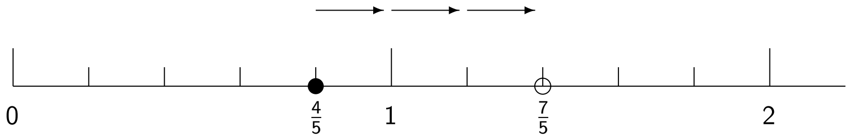

$$\begin{aligned} & \frac{4}{5} + \frac{3}{5} \\ = \quad & \frac{4+3}{5} \\ = \quad & \frac{7}{5} \end{aligned}$$

Adding and Subtracting Fractions

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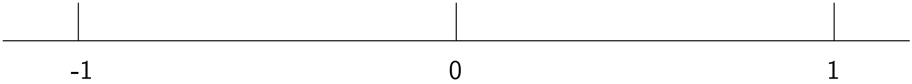

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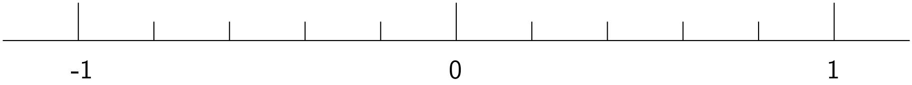

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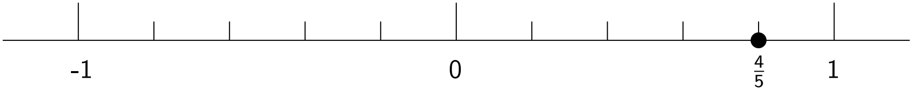

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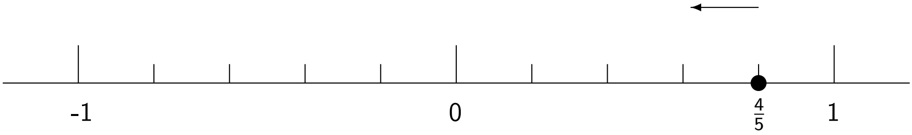

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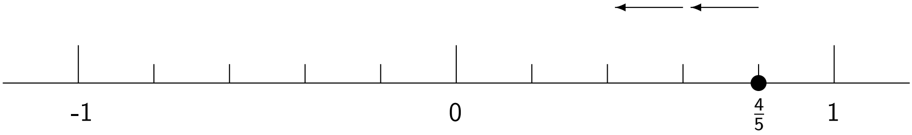

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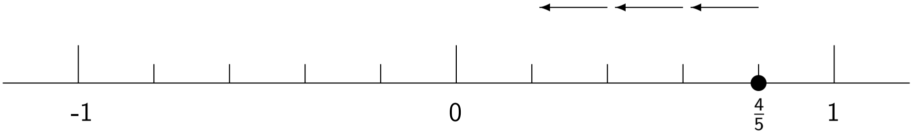

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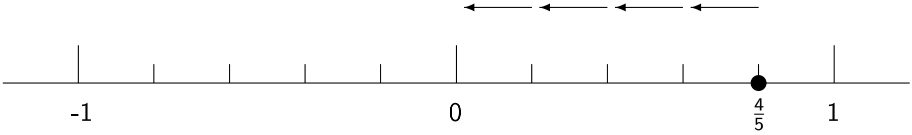

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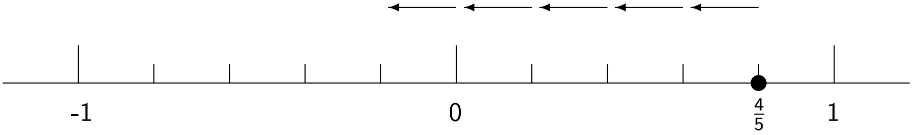

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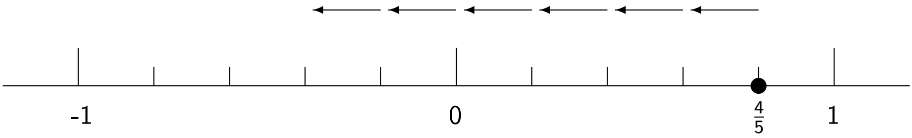

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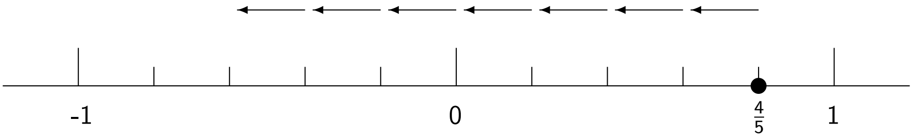

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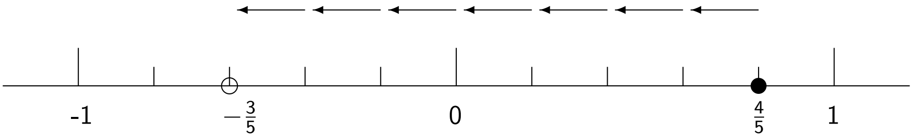

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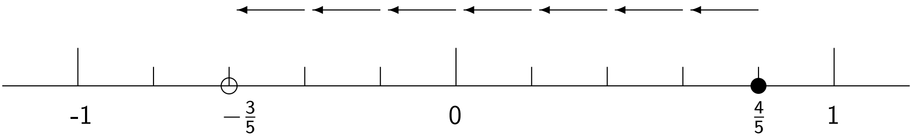

$$\begin{aligned} & \frac{4}{5} - \frac{7}{5} \\ = \quad & \frac{4-7}{5} \\ = \quad & \frac{-3}{5} \end{aligned}$$

Adding and Subtracting Fractions

What if we were asked to find $\frac{1}{6} + \frac{3}{8}$?

Adding and Subtracting Fractions

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This is harder, as the denominators are different...

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One option is to multiply the denominators together to create a common denominator:

$$\frac{1\times 8}{6\times 8} + \frac{3\times 6}{8\times 6}$$

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This is harder, as the denominators are different...

One option is to multiply the denominators together to create a common denominator:

$$\frac{1\times 8}{6\times 8} + \frac{3\times 6}{8\times 6}$$

$$= \frac{8}{48} + \frac{18}{48}$$

Adding and Subtracting Fractions

What if we were asked to find $\frac{1}{6} + \frac{3}{8}$?

This is harder, as the denominators are different...

One option is to multiply the denominators together to create a common denominator:

$$
\begin{aligned}
& \frac{1\times 8}{6\times 8} + \frac{3\times 6}{8\times 6} \\
= \quad & \frac{8}{48} + \frac{18}{48} \\
= \quad & \frac{8+18}{48} \\
= \quad & \frac{26}{48}
\end{aligned}
$$

Adding and Subtracting Fractions

$$\frac{26}{48}$$

Adding and Subtracting Fractions

$$
\begin{aligned}
& \frac{26}{48} \\
= \quad & \frac{26 \div 2}{48 \div 2} \\
= \quad & \frac{13}{24}
\end{aligned}
$$

Adding and Subtracting Fractions

$$
\begin{aligned}
& \frac{26}{48} \\
= \quad & \frac{26 \div 2}{48 \div 2} \\
= \quad & \frac{13}{24} \text{ in simplest form}
\end{aligned}
$$

Adding and Subtracting Fractions

Note that 24 would also work as a common denominator:

$$\frac{1\times 4}{6\times 4}+\frac{3\times 3}{8\times 3}$$

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24 is the **lowest common multiple** of 6 and 8. (More on this topic at the end.)

More examples and notes

The following slides contain more information and examples about

Equivalent Fractions
Reducing fractions to simplest form
Adding and subtracting fractions
Greatest common divisor (GCD)
Least common multiple (LCM)

Equivalent Fractions: Examples

$$\frac{1}{3} = \frac{3}{9} \text{ (multiply the top and bottom by 3)}$$

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$$\frac{4}{5} = \frac{28}{35} \text{ (multiply the top and bottom by 7)}$$

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We can also go backwards, by dividing the top and bottom by the same thing.

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$$\frac{4}{5} = \frac{28}{35} \text{ (multiply the top and bottom by 7)}$$

We can also go backwards, by dividing the top and bottom by the same thing.

$$\frac{10}{20} = \frac{5}{10} \text{ (divide the top and bottom by 2)}$$

Equivalent Fractions: Examples

$$\frac{1}{3} = \frac{3}{9} \text{ (multiply the top and bottom by 3)}$$

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We can also go backwards, by dividing the top and bottom by the same thing.

$$\frac{10}{20} = \frac{5}{10} \text{ (divide the top and bottom by 2)}$$

$$\frac{5}{10} = \frac{1}{2} \text{ (divide the top and bottom by 5)}$$

Divisors

The divisors (factors) of an integer are all the numbers which you can divide that integer by to get another integer.

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What are the divisors of 10?

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The divisors (factors) of an integer are all the numbers which you can divide that integer by to get another integer.

What are the divisors of 10?

$$\begin{aligned} 10 \div 1 &= 10 \\ 10 \div 2 &= 5 \\ 10 \div 5 &= 2 \\ 10 \div 10 &= 1 \end{aligned}$$

The divisors of 10 are 1, 2, 5, and 10.

Greatest Common Divisor GCD

Given two integers, we can ask if they have any common divisors. Of more interest, what is the largest divisor they have in common? We call this the **greatest common divisor** (GCD).

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The greatest common divisor of 45 and 60 is **15**.

Simplifying Fractions: Examples

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\begin{aligned}
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= \quad & \frac{7}{21} + \frac{12}{21} \\
= \quad & \frac{7 + 12}{21} \\
= \quad & \frac{19}{21}
\end{aligned}
$$

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The multiples of 5 are 5, 10, 15, 20, 25, 30, ...

Least Common Multiple LCM

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The least common multiple of 4 and 5 is **20**.

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