KING'S MATHS SCHOOL

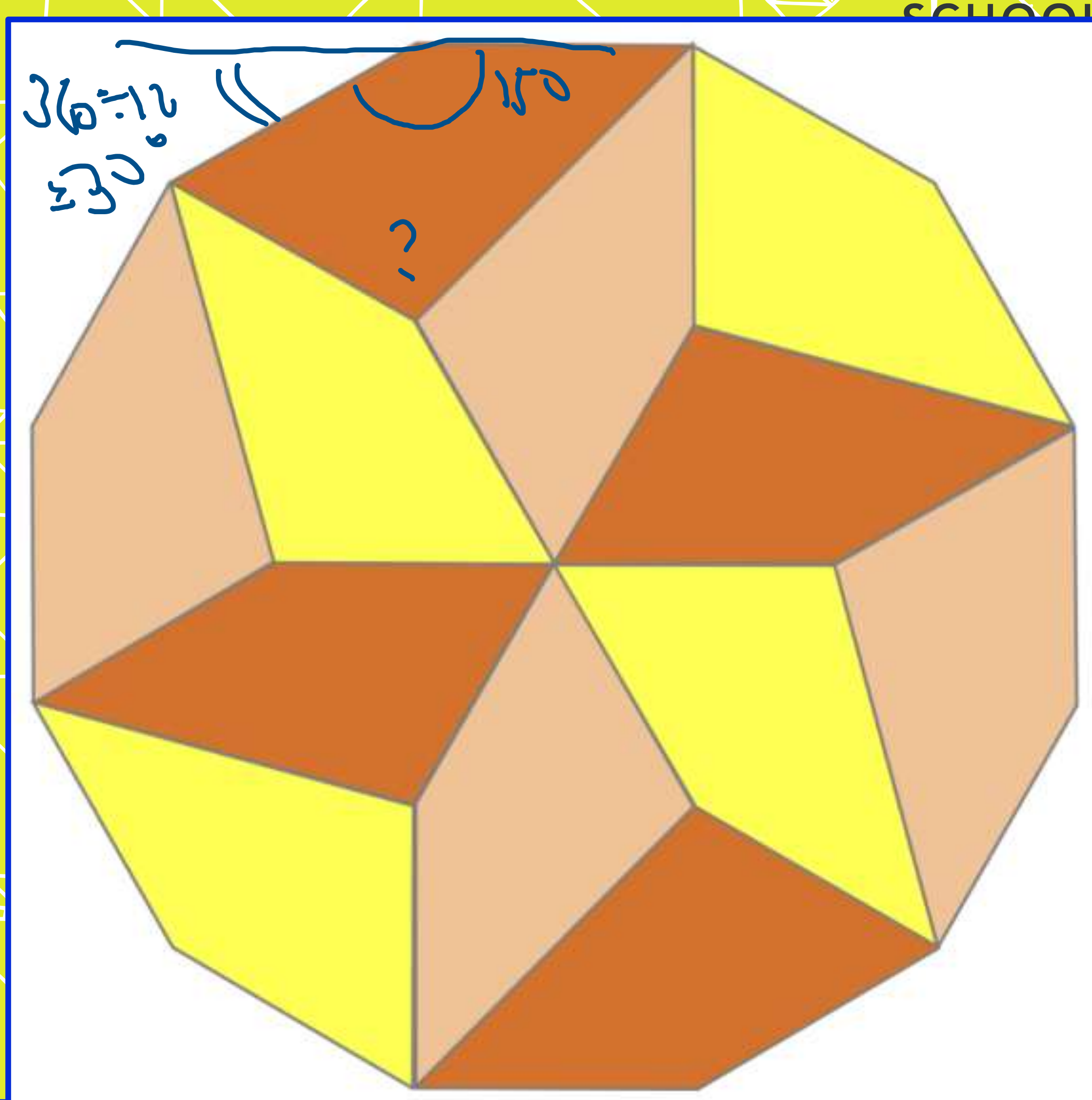
Welcome to GCSE 7+
Tuesday 13 April 2021

Session 8: Probability

A puzzle to ponder

12 congruent quadrilaterals make a regular dodecagon.

What are the values of the interior angles of the quadrilateral?



Keep GCSE 7+ safe for everyone

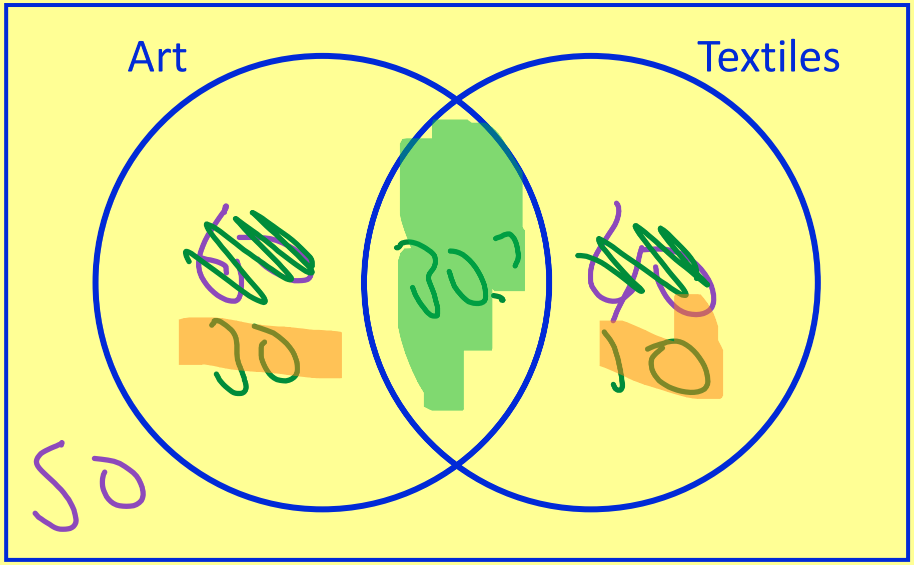
KING'S MATHS SCHOOL

- **Do not <u>ASK</u>** anyone for **their** personal contact details: email, 'phone number, social media name, Instagram address etc.
- **Do not <u>GIVE</u>** anyone **your** personal contact details: email, 'phone number, social media name, Instagram address etc.
- If **anyone** asks you, in the Chat or directly, for your personal contact details, or
- If you read in the Chat, or if you overhear, **anyone** asking for or giving out personal contact details, or
- If you have any concerns about the welfare/wellbeing of any participant, including yourself, then you must **as soon as possible**
    - email the Head teacher dan.abramson@kcl.ac.uk or text him 07902 911144 and say what your concern is,
    - or email kclmsoutreach@kcl.ac.uk and ask Dan to contact you.

Venn should I draw boxes not circles?

KING'S MATHS SCHOOL

- There are 120 students in Year 11. 40 students study Textiles. 60 students study Art. 50 students study neither Textiles nor Art.



All Year 11 120 ✓

Venn should I draw boxes not circles?

KING'S MATHS SCHOOL

- There are 120 students in Year 11. 40 students study Textiles. 60 students study Art. 50 students study neither Textiles nor Art.

	Art Yes	Art No	
Textiles Yes	30 +	10 =	40
Textiles No	30 +	50	80
	60	60	120

Two-way table

Venn should I draw boxes not circles?

KING'S MATHS SCHOOL

- There are 120 students in Year 11. 40 students study Textiles. 60 students study Art. 50 students study neither Textiles nor Art.

When you choose **any** student at random,

- P(studies Art) = $\frac{60}{120} = \frac{1}{2}$
- P(studies both) = $\frac{30}{120} = \frac{1}{4}$

	Art Yes	Art No	
Textiles Yes	30	10	40
Textiles No	30	50	80
	60	60	120

Two-way table

Venn should I draw boxes not circles?

KING'S MATHS SCHOOL

- There are 120 students in Year 11. 40 students study Textiles. 60 students study Art. 50 students study neither Textiles nor Art.

When you choose a **Textiles** student at random,

- P(studies Art) = $\frac{30}{40}$
- P(studies both) = $\frac{30}{40}$

	Art Yes	Art No	
Textiles Yes	30	10	40
Textiles No	30	50	80
	60	60	120

Two-way table

Venn should I draw boxes not circles?

KING'S MATHS SCHOOL

- In Year 11 some students study History, some study Geography, and some study neither. When a student is chosen at random,
  - P(they study History) = $\frac{2}{3}$
  - P(they study Geography) = $\frac{3}{5}$
  - P(they study neither) = $\frac{1}{10}$
- Work out P(they study both)

$$\boxed{\frac{2}{3} \times \frac{3}{5} \neq \frac{11}{30}}$$

	H✓	H✗	
G✓	$\frac{11}{30}$	$\frac{7}{30}$	$\frac{3}{5}$
G✗	$\frac{3}{10}$	$\frac{1}{10}$	$\frac{2}{5}$
	$\frac{2}{3}$	$\frac{1}{3}$	$\boxed{1}$

Venn should I draw boxes not circles?

KING'S MATHS SCHOOL

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  - P(they study History) = $\frac{2}{3}$
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- Work out P(they study both)

	H Yes	H No	
G Yes			
G No			

Venn should I draw boxes not circles?

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  - P(they study History) = $\frac{2}{3}$
  - P(they study Geography) = $\frac{3}{5}$
  - P(they study neither) = $\frac{1}{10}$
- Work out P(they study both) = $\frac{11}{30}$

	H Yes	H No	
G Yes	$\frac{11}{30}$	$\frac{7}{30}$	$\frac{3}{5}$
G No	$\frac{3}{10}$	$\frac{1}{10}$	$\frac{2}{5}$
	$\frac{2}{3}$	$\frac{1}{3}$	1

Venn should I draw boxes not circles?

- In Year 11 some students study History, some study Geography, and some study neither. When a **History** student is chosen at random,
  - P(they study both) =

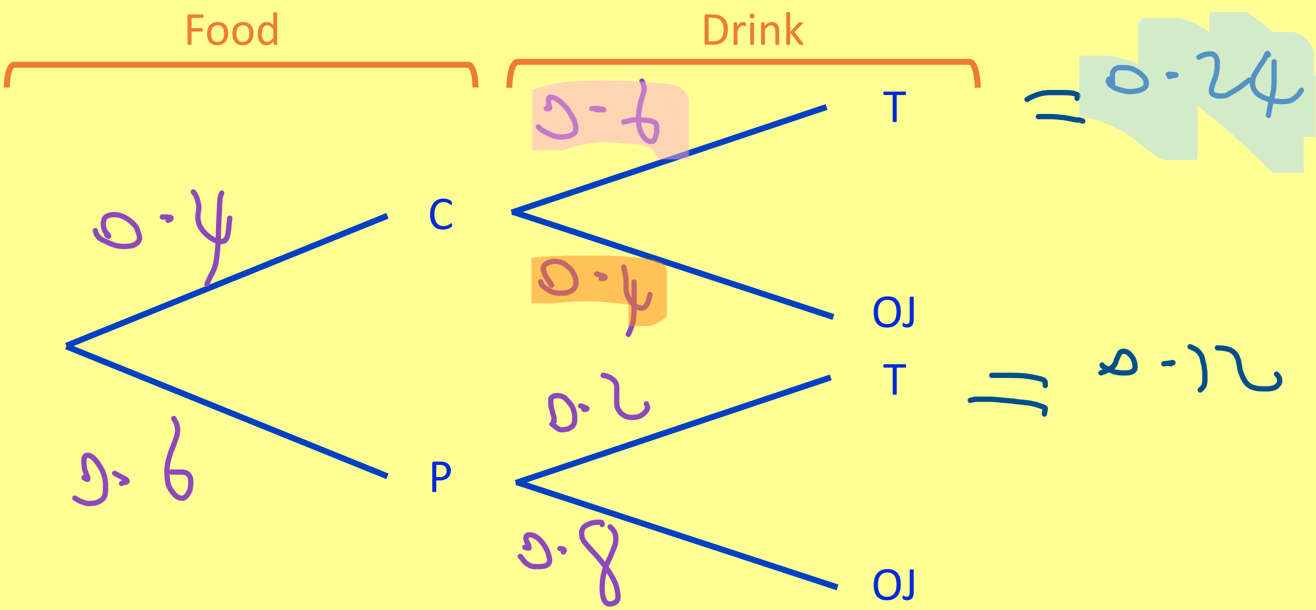
$$= \frac{\frac{11}{30}}{\frac{2}{3}} = \frac{11}{20}$$

$$= \frac{11}{30} \times \frac{3}{2}$$

	H Yes	H No	
G Yes	$\frac{11}{30}$	$\frac{7}{30}$	$\frac{3}{5}$
G No	$\frac{3}{10}$	$\frac{1}{10}$	$\frac{2}{5}$
	$\frac{2}{3}$	$\frac{1}{3}$	1

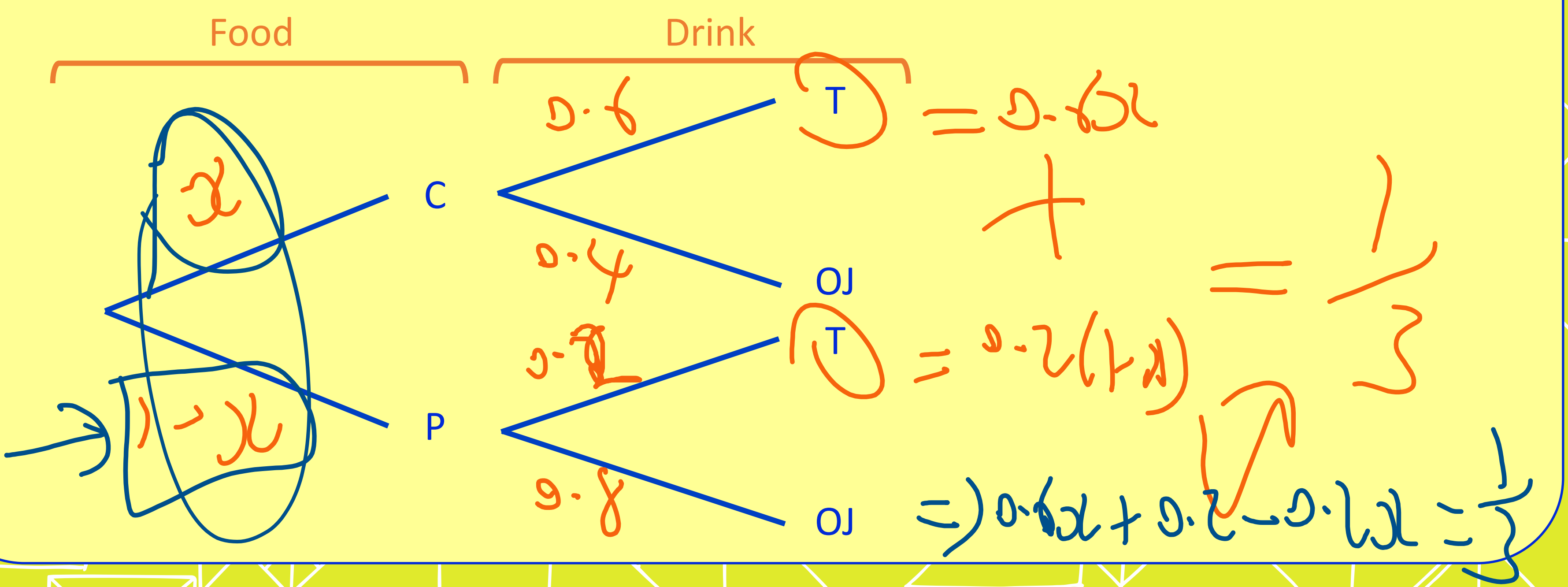
Venn a tree diagram is better

- The probability that I have cereals for breakfast is 0.4, and porridge with probability 0.6. With cereals I drink either tea (probability 0.6) or orange juice (probability 0.4); with porridge these probabilities are 0.2 or 0.8.
- What is the (overall) probability that I drink tea? P(tea) = 0.36



Venn a tree diagram is better

- For breakfast I always have either cereals or porridge. With cereals I drink either tea (probability 0.6) or orange juice (probability 0.4); with porridge these probabilities are 0.2 or 0.8. I notice that in the long term I drink tea $\frac{1}{3}$ of the time.
- What is the long-term average ratio "cereals : porridge"?



Venn a tree diagram is better

- *I have cereals for breakfast with probability 0.4, and porridge with probability 0.6. With cereals I drink either tea (probability 0.6) or orange juice (probability 0.4); with porridge these probabilities are 0.2 or 0.8.*
- We know that the (overall) probability I drink tea = 0.36

	Cereals Yes	Cereals No	
Tea Yes	0.24	0.12	0.36
Tea No	0.16	0.48	0.64
	0.4	0.6	1

Venn a tree diagram is better

- *I have cereals for breakfast with probability 0.4, and porridge with probability 0.6. With cereals I drink either tea (probability 0.6) or orange juice (probability 0.4); with porridge these probabilities are 0.2 or 0.8.*
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	0.4	0.6	

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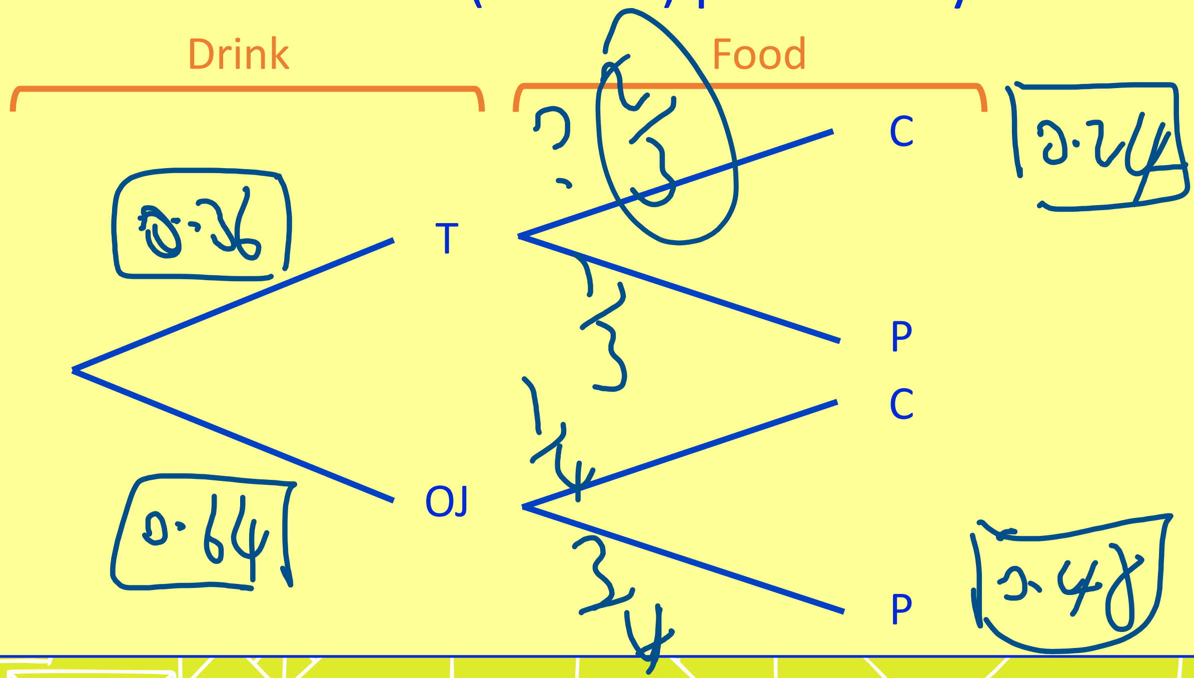

Imaginary trees

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- There are three different flavours of packets of crisps in a box. There are 4 pickled onion packets, 5 salt & vinegar packets and 6 ready-salted packets.
- I take two(!) packets at random, one after the other.
- Work out the probability my **TWO!** packets are the same flavour.

$$= \frac{4}{15} \times \frac{3}{14} + \frac{5}{15} \times \frac{4}{14} + \frac{6}{15} \times \frac{5}{14}$$

$$= \frac{12 + 20 + 30}{210} = \frac{42}{210} = \frac{1}{5}$$

Imaginary trees

KING'S MATHS SCHOOL

- There are 5 red pens, 3 blue pens and 2 green pens in a box.
- Mr Abramson takes a pen at random from the box and gives it to me. He then selects another pen from the box for himself.
- Work out the probability that he and I now have two **different**-coloured pens.

"not same"

$$1 - \left(\frac{5}{10} \times \frac{4}{9} + \frac{3}{10} \times \frac{2}{9} + \frac{2}{10} \times \frac{1}{9} \right)$$

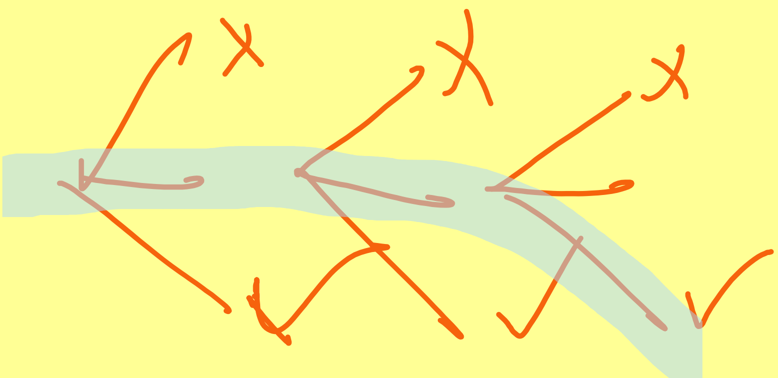
$= \_\_\_\_\_$

Imaginary trees

KING'S MATHS SCHOOL

- You and I play a game. Each 'round', P(you win) = 0.3 and P(we draw) = 0.1. The game stops when somebody wins.
- What is the probability that I win in the third round?

"DDW"



$\boxed{0.1 \times 0.1 \times 0.6}$

$= 0.006$

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- You and I play a game. Each 'round', P(you win) = 0.3 and P(we draw) = 0.1. The game stops when somebody wins.
- What is the probability that I win eventually?

$P(\text{I win}) = 0.6$

$= 0.6 + 0.1 \times 0.6 + 0.1 \times 0.1 \times 0.6 + \ldots$

$= 0.6 + 0.06 + 0.006 + 0.0006 + \ldots$

$= 0.\overline{6} = \frac{2}{3}$

2 : 1

In praise of John Venn

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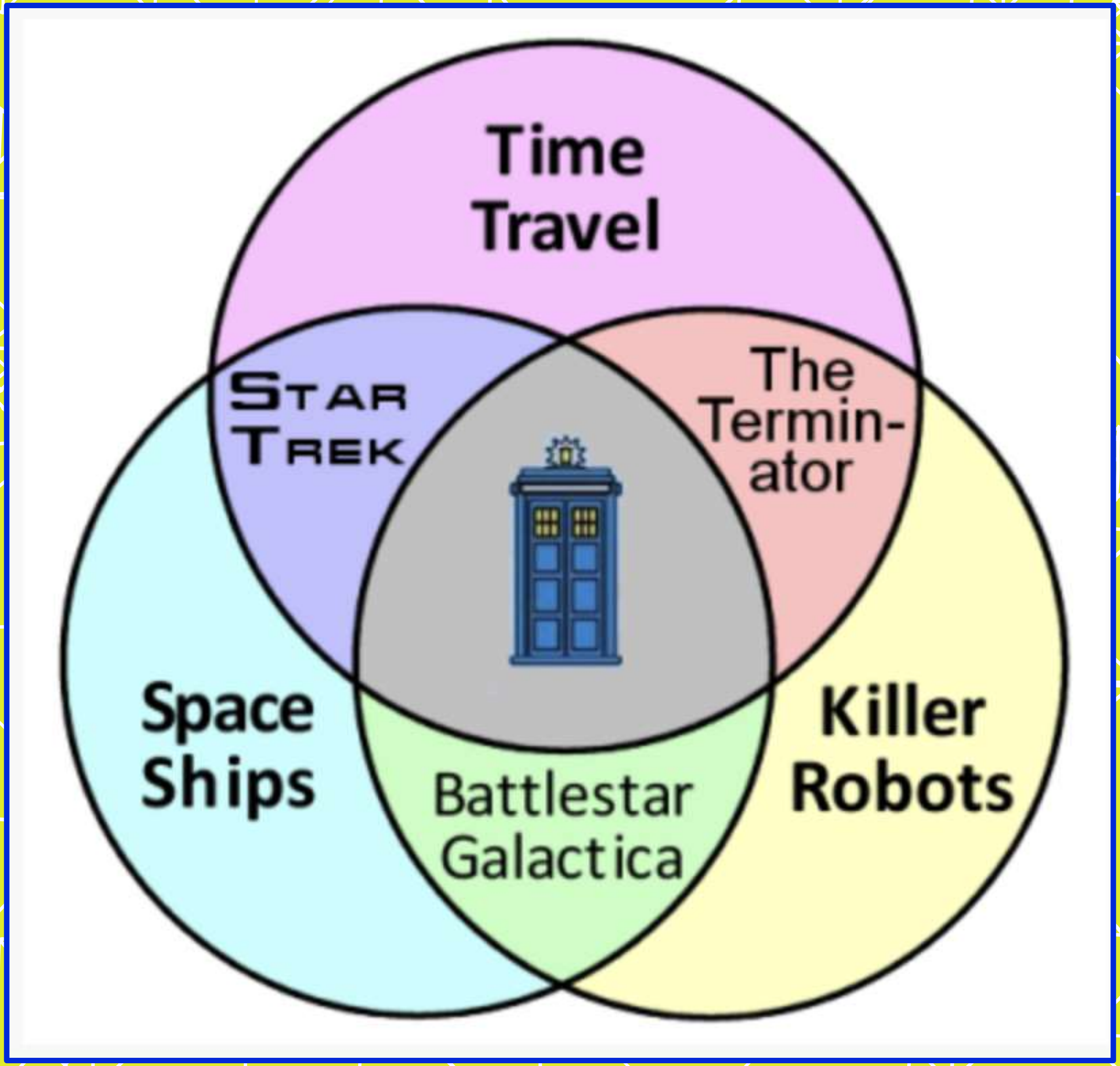
Time Travel
Star Trek
The Termin-ator
Space Ships
Battlestar Galactica
Killer Robots