JURUSAN TEKNOLOGI INFORMASI

Critical Thinking & Problem Solving Course
06. Advanced Problem Solving Techniques

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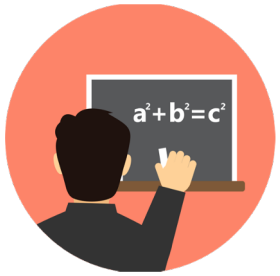
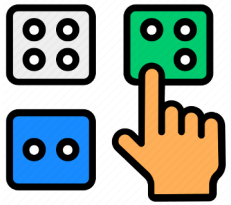
Discussion Topic

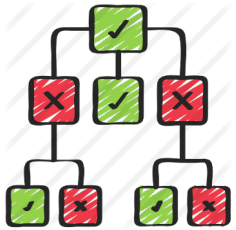


Mathematical Methods

Graphical Methods



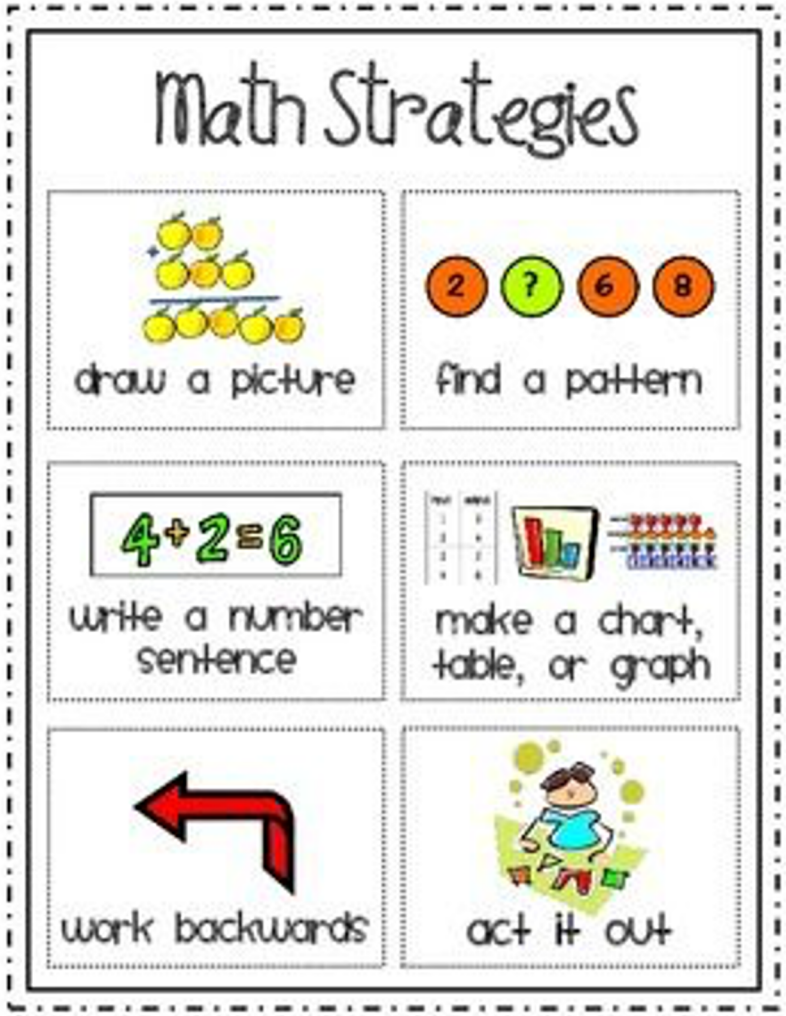
Probability



Decision Trees

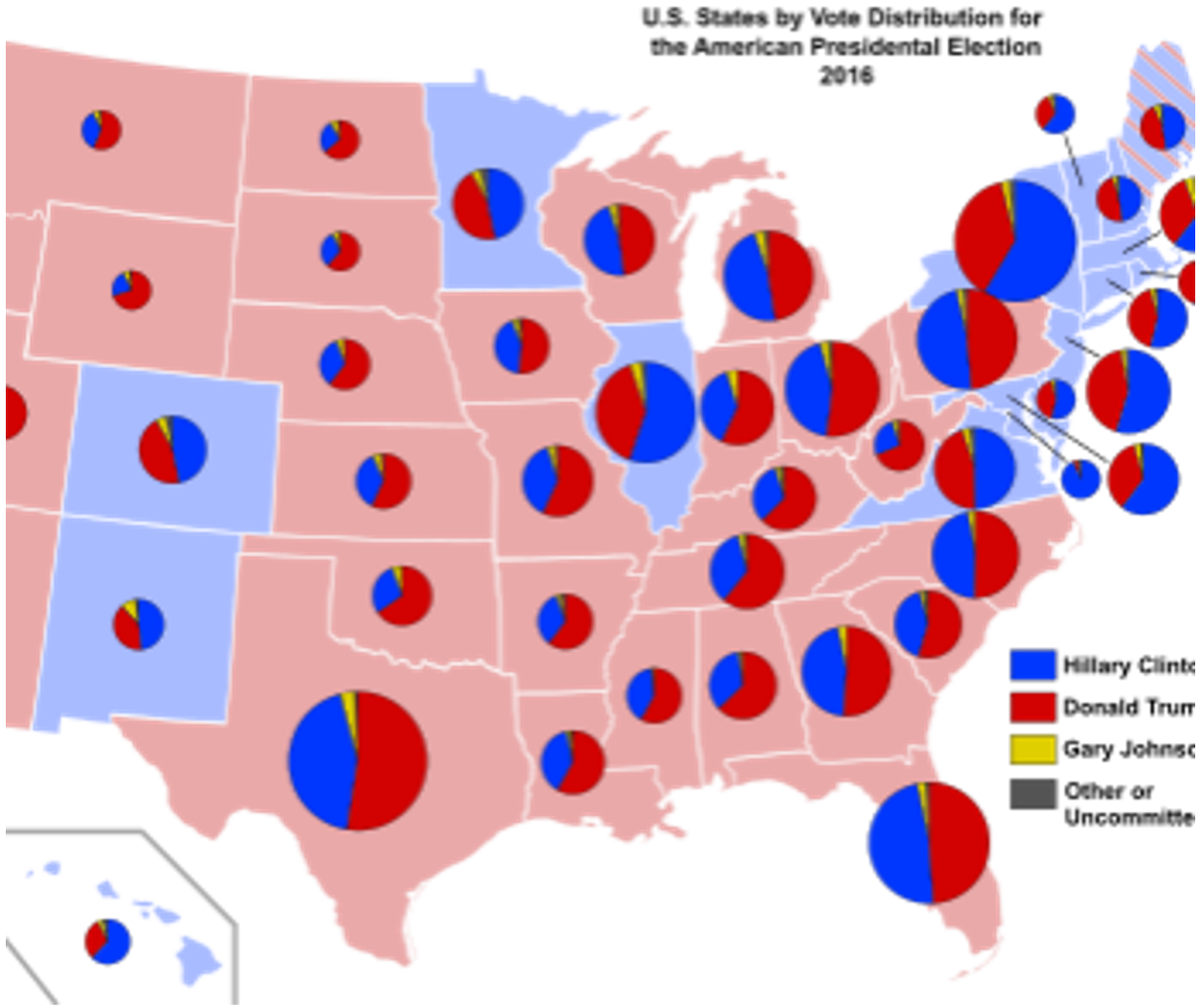
Mathematical Methods

- **Some types** of **questions can be answered** in an **easier** way **by** using **mathematical techniques**.
- In particular, **simple algebra can be used to provide clear problem statements**, which can **then be solved by standard mathematical methods.**
- **Although** these **techniques are beyond the elementary methods we have used so far**, they are dealt with in the early stages of secondary education, **and most candidates for thinking skills examinations** will have some knowledge and skill in these areas.



Percentages

- Most people understand simple percentages:
  - When a **candidate gets 33% of the vote** in an election, it's easy enough to understand that this means **about 1/3 of the electorate voted** for them.
  - This become little more complicated when we try to multiply or divide percentages or handle percentages over 100.
  - However, there is a very easy way to work around this to make it easier to understand.
  - In the example above, Suppose only 60% of those eligible to vote actually vote in the election. What percentage of the total number of eligible candidates earned?



Percentages

- It's easier not to use than a percentage to do it. we need to understand that 33% is 1/3 and 60% is 3/5
- Then multiply the proportion: 1/3 x 3/5 = 1/5 or 20% of the answer.

- Another example:
  - If the city's population is now 120% from 10 years ago which was 50,000,
  - then the current population is 1.2 × 50,000, or 60,000. Again we have to convert percentage to ratio to do the calculation.

Algebra

Consider the problem below.

A ferry is moving at 20 km/hr downstream but only 15 km/hr upstream. The journey between the two cities takes 5 hours longer going up than coming down. How far are the two cities?

Algebra

If the distance between the two cities is x km, then we get:

•Upstream time = x/15 hours;

Downstream time = x/20 hours

So, since the difference between these times is 5 hours:

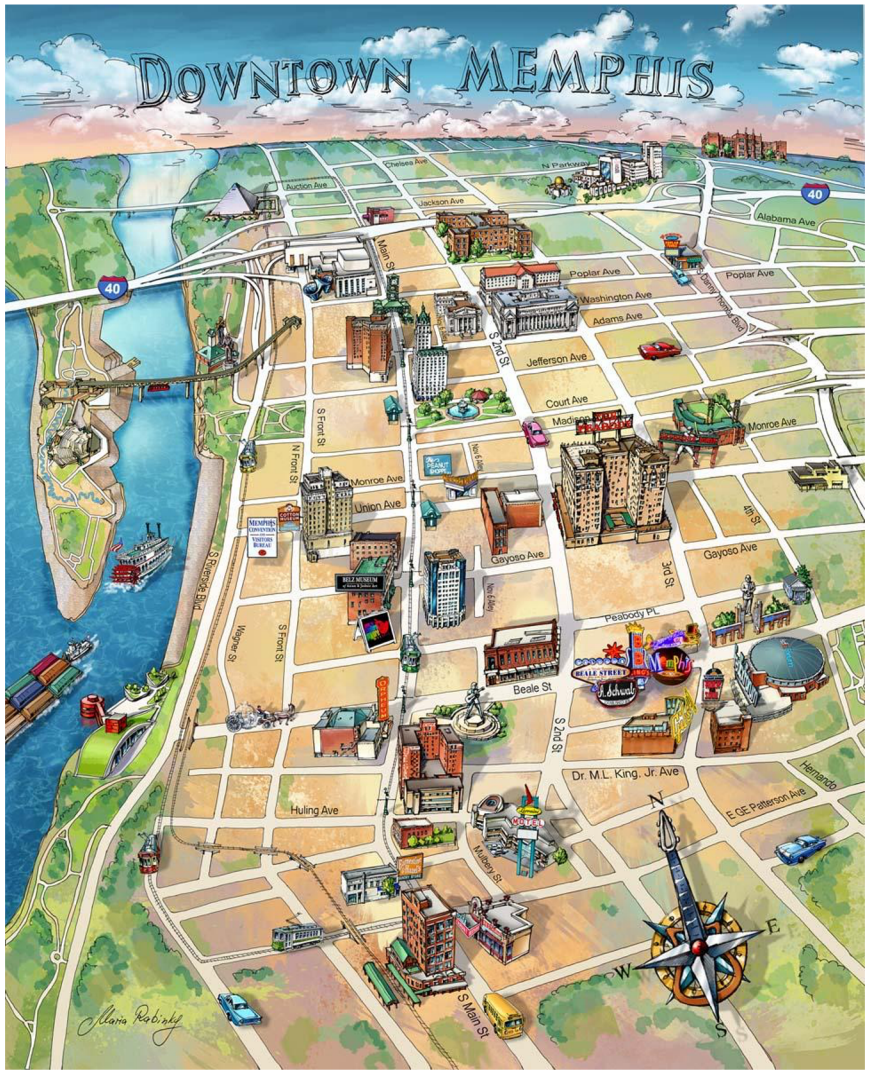
x/15- x/20 =5 multiply both sides by 60

•4x-3x = 300

So x, the distance between cities, is 300 km.

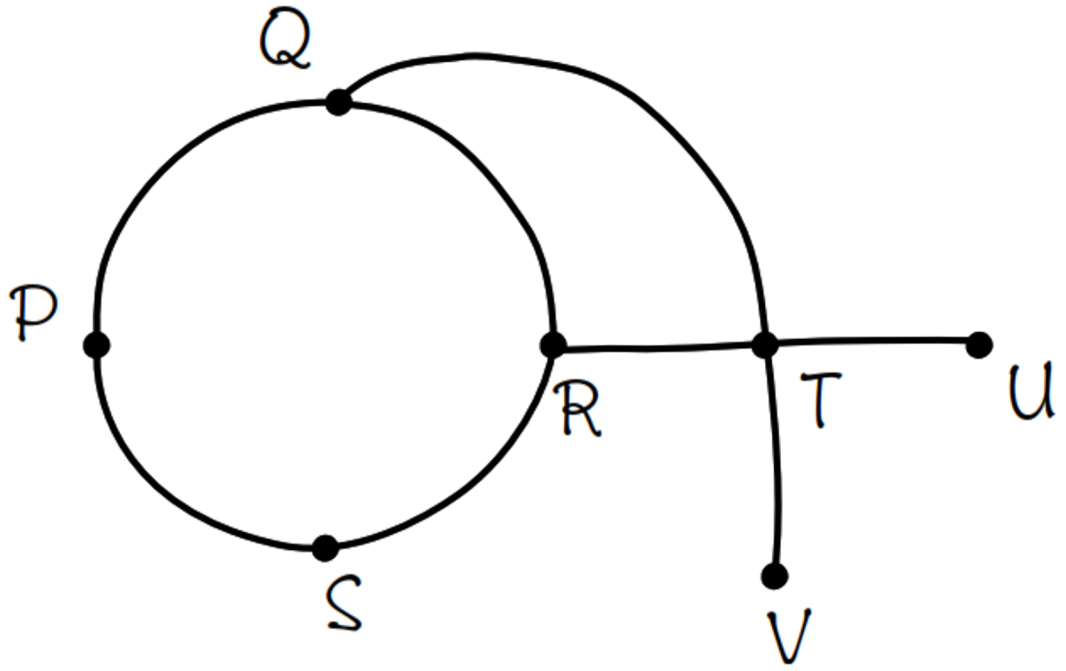
Graphical Methods

- It is often useful to **draw a simple picture when trying to analyze a problem**. This can be a map, diagram or sketch graph.
- Examples of using images/graphics
- The town of Perros is connected to Queenston then to Ramwich and finally to Sandsend and back to Perros by a circular bus service. Ramwich has a bus service to Upperhouse via Tempsfield. Queenstown has a bus service to Ventham via Tempsfield.
- Orla is visiting the area and wants to see all these cities start and end in Perros. What is the smallest number of stages (i.e. travel from one city to the next) he can take to make the journey?
- A 7
- B 8
- C 9
- D 10



Graphical Methods

- It would be very difficult to answer this question without some kind of picture.
- A sketch of the city and bus services is shown on the right.



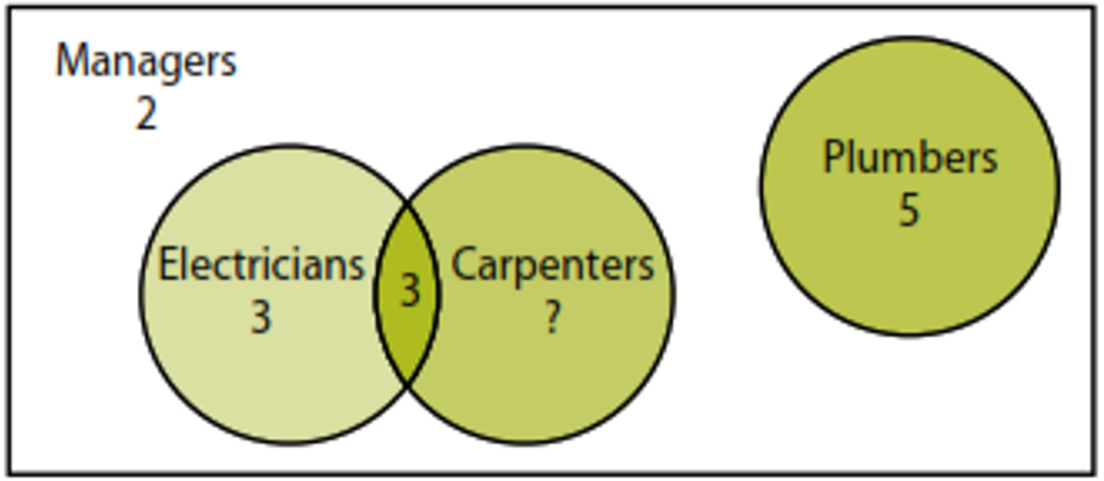
- To reach the minimum number of stages, a shortcut between Q and T must be taken either on the exit or on the way back (but not both because we need to visit R).
- It is possible to do both, but both will result in the same number of stages. One minimum route is: P-Q-T-U-T-V-T-R-S-The answer is C, 9 stages.

Graphical Methods

- A general household repair business has 15 workers.
- Two are managers and have no special skills.
- Five plumbers and does no other work.
- There were six electricians and a number of carpenters.
- Of these, three can work as electricians or carpenters.
- How many carpenters but not electricians?

Venn Diagram

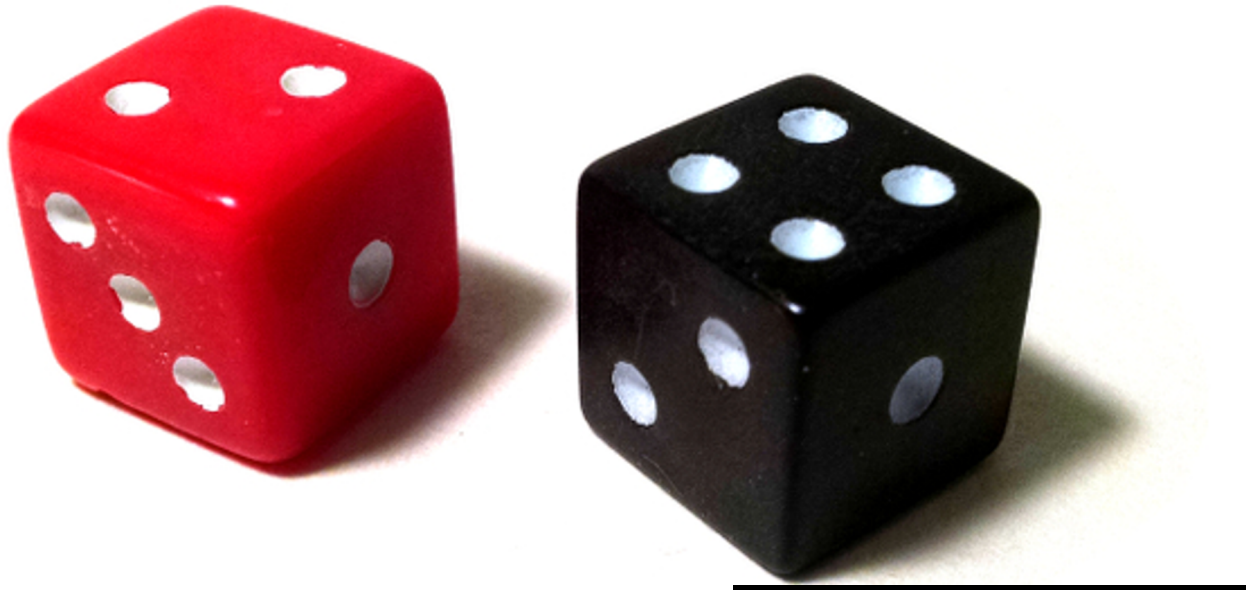
- Since neither plumber is an electrician or a carpenter, their area does not intersect with the other two.
- The entire outer box represents 15 workers.
- The '2' shown in the diagram outside the circle represents two managers who do not fit into any of the other categories.
- 5 plumbers are shown in their circle. The intersection between electricians and carpenters represents 3 that fall into both categories.
- Since there are 6 electricians, there must be 3 who are not carpenters either.
- So now there are 13 workers identified.
- so the remainder, 2, should be carpenters but not electricians.



Probability

Chance or probability is a way of expressing knowledge or belief that an event will occur or has occurred.

This concept has been more rigorously formulated in mathematics, and has subsequently been used more widely in not only mathematics or statistics, but also finance, science and philosophy.



Probability Problem

- The activity below is a probability problem with a few tweaks that make it more than just a simple math calculation.
- At the village fair there is a game of chance involving the toss of two dice. The dice are normal, numbered 1 through 6. One is red and one is blue. The number on the red dice is multiplied by 10 and added to the number on the blue dice to produce a two-digit number. (So, if red is 2 and blue is 4, your score is 24.)
- You win a prize if you score more than 42. What are the chances of winning?

Probability Problem

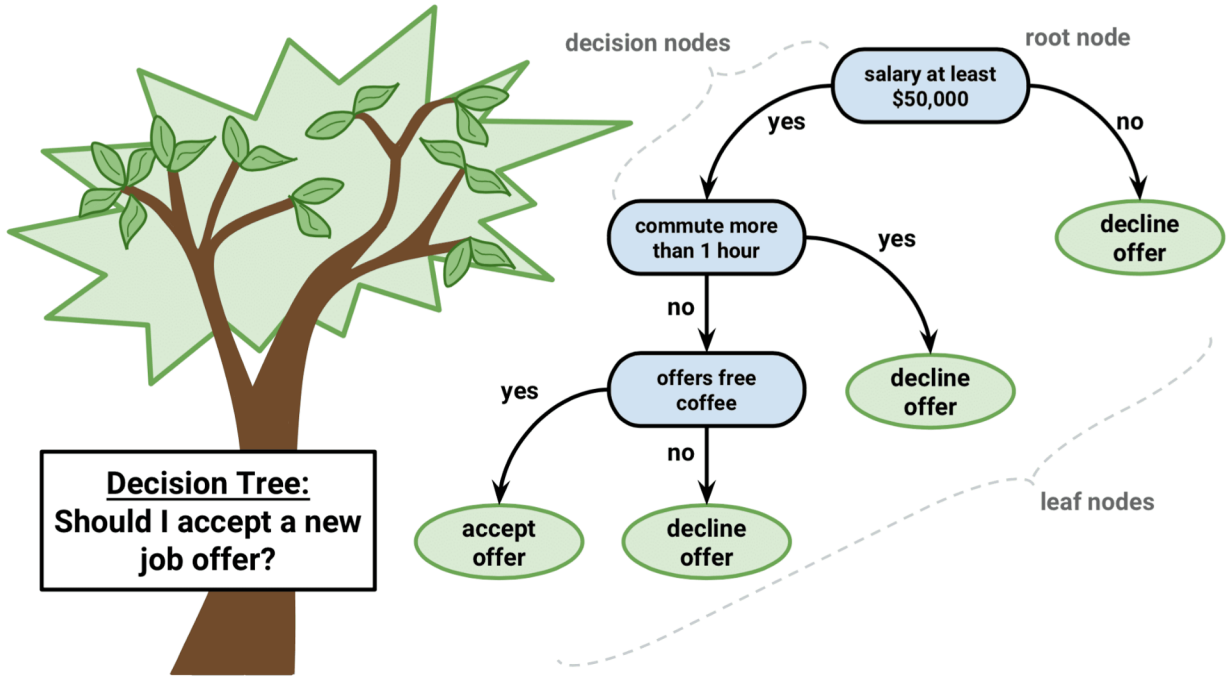
- There are 36 (6 × 6) possible throws in all.
- If the red die shows 1, 2 or 3, whatever the blue dcie shows, you lose (18 rolls).
- If the red dice shows 5 or 6, whatever the blue dice shows, you win (12 rolls).
- This leaves 6 possible rolls with the red dice showing 4: You lose with these 2 (blue 1 and 2)
- and you win by 4 (blue 3, 4, 5 or 6).
- So the number of ways to win is 12 + 4 = 16 of 36. (The number of ways to lose is 18 + 2 = 20 of 36.) So the chance of winning is 16/36 = 4/9
- 4/9 x 100 = 44,4%

Decission Trees

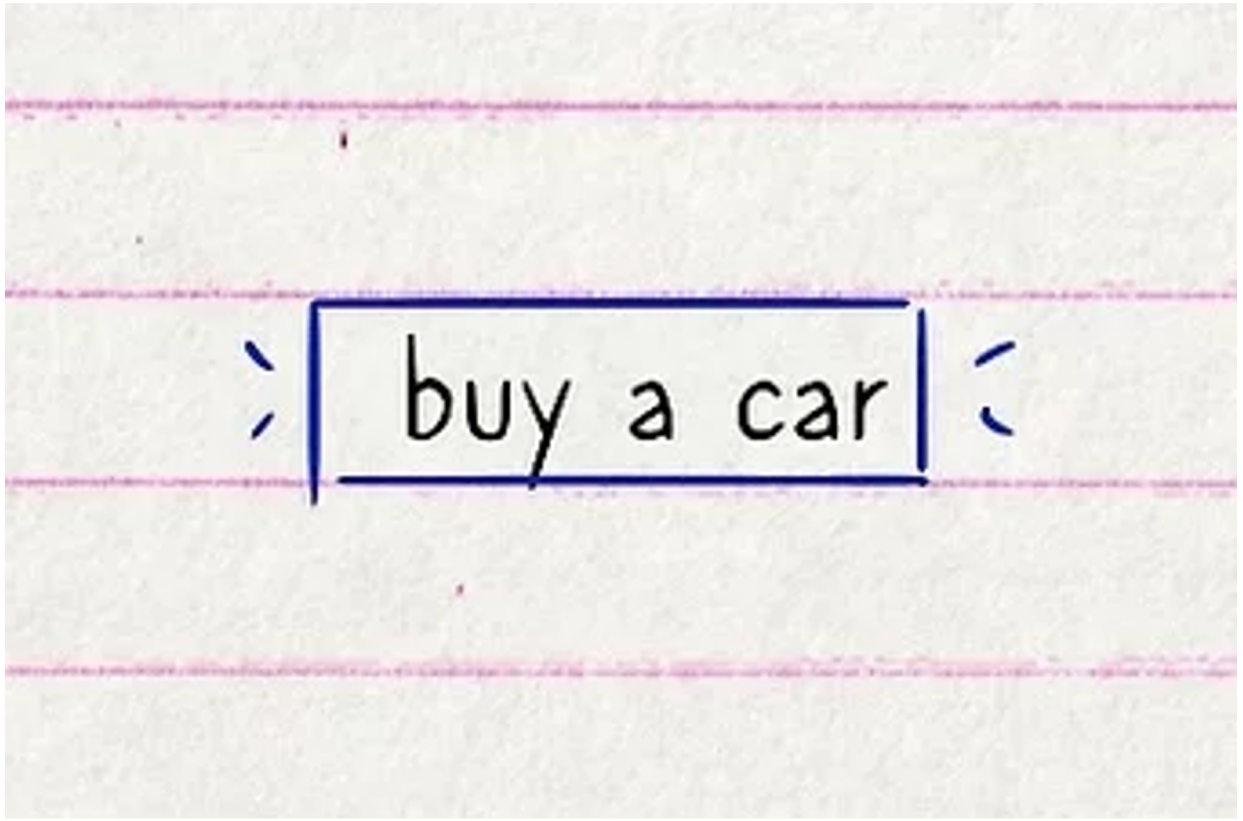
Everyone certainly wants an appropriate and efficient decision making, including a company. For this reason, many companies need a medium such as Business Intelligence to assist in making the right decisions.

However, this would be meaningless without the concept of a decision tree. Decision tree is one of the most popular classification methods, because it is easy for humans to interpret. Decision tree is a predictive model using a tree structure or hierarchical structure.

The concept of a decision tree is to convert data into a decision tree and decision rules. The main benefit of using a decision tree is its ability to break down complex decision-making processes into simpler ones, so that decision-makers will better interpret solutions to problems.



How to Make a Decision Trees



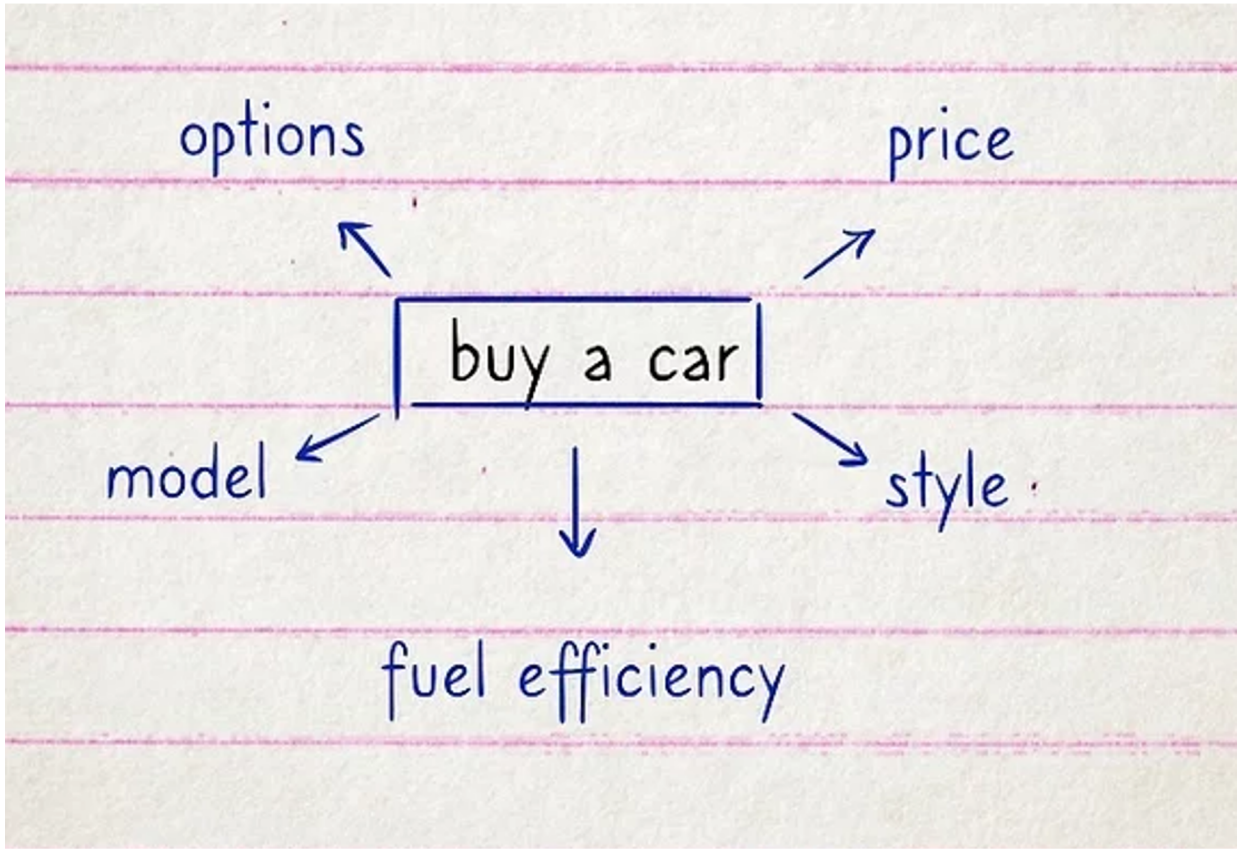
You can follow these steps when creating a decision tree:

1 Identify the main decisions you want to make

Before you start, you need to find the main heading of the decision tree which is the problem you want to solve. For example, your main problem is what kind of car should you buy.

Focus on only one problem or decision so you don't get confused and a decision can be made clearly.

How to Make a Decision Trees



You can follow these steps when creating a decision tree:

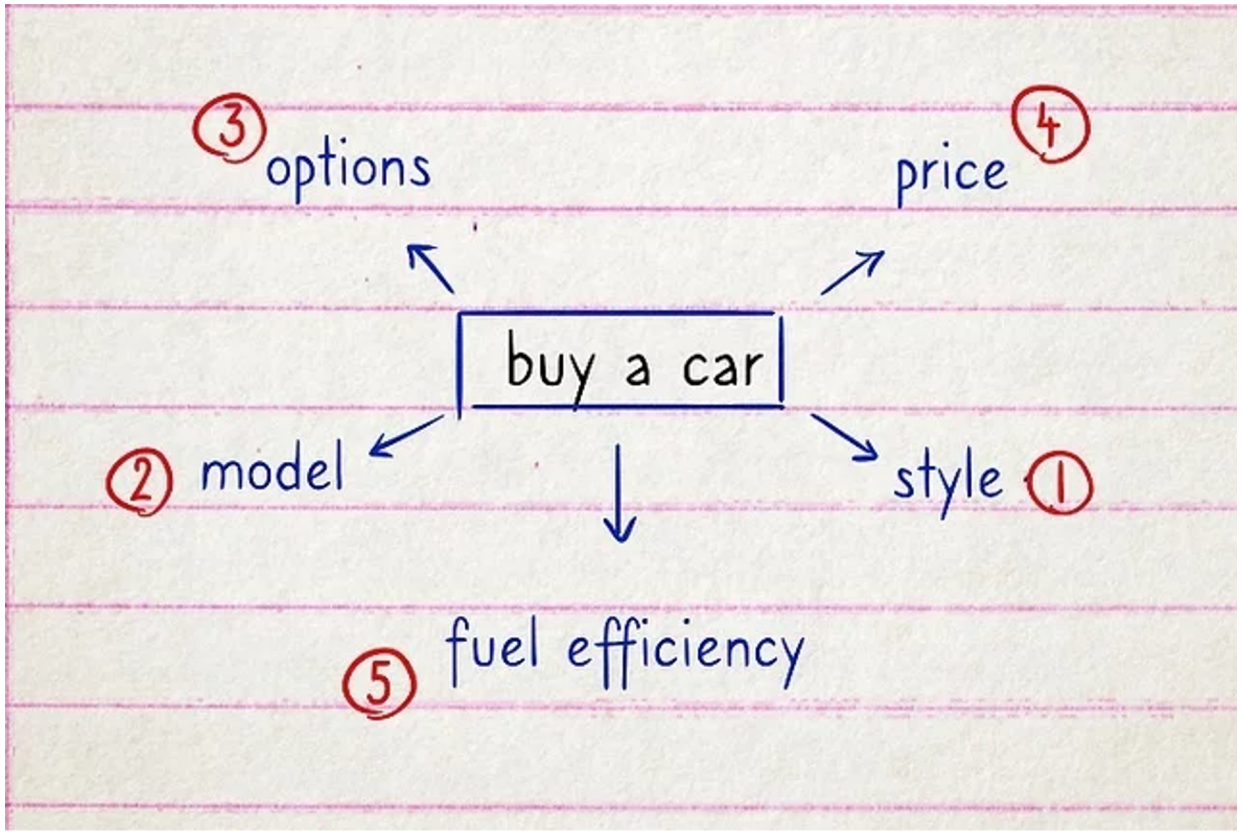
2 Brainstorm.

Brainstorming can help you come up with new ideas.

List each variable associated with the decision that the decision tree wants to help.

Write it down on a piece of paper. For example, if you are making a decision tree to buy a car, your variables would be “price”, “model”, “gas efficient”, “style” and “option”.

How to Make a Decision Trees



You can follow these steps when creating a decision tree:

3 Determine the priority of the variables you write down.

Find out what sections are most important to you and list them in order (from most important to least important).

One way of understanding this is to make a graphical representation of the major decisions versus the components needed to make the decisions.

Major decisions are placed in the middle (organizational problems that affect the quality of work), while the components of the problem will branch from the main problem in the middle. Thus, buying a car is the biggest issue, while price and model are the factors that influence the final decision.

How to Make a Decision Tree

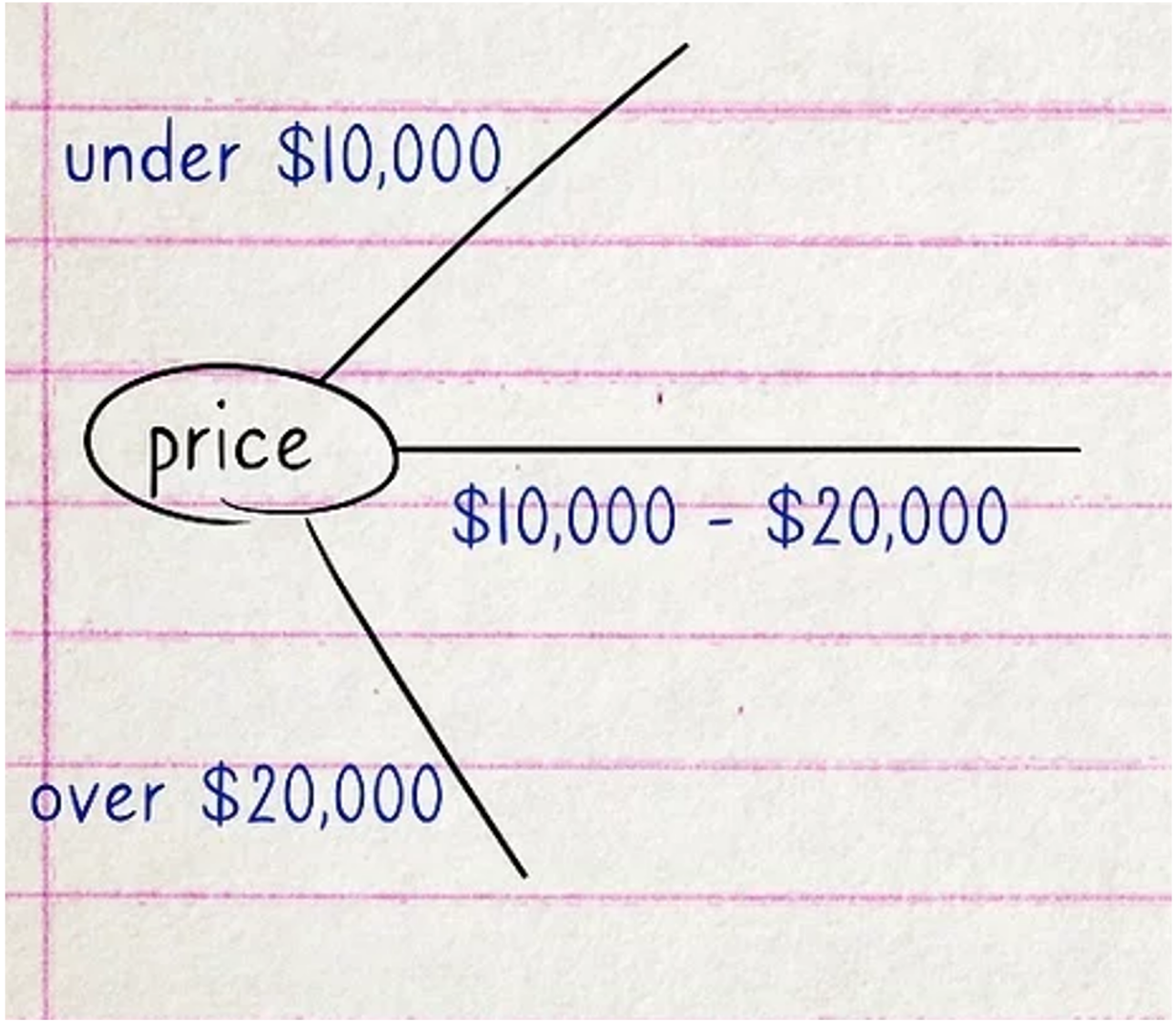
Draw a circle.

Start a decision tree by drawing a circle or square, on one side of the paper. Give labels to represent the most important variables in the decision tree

Draw a line.

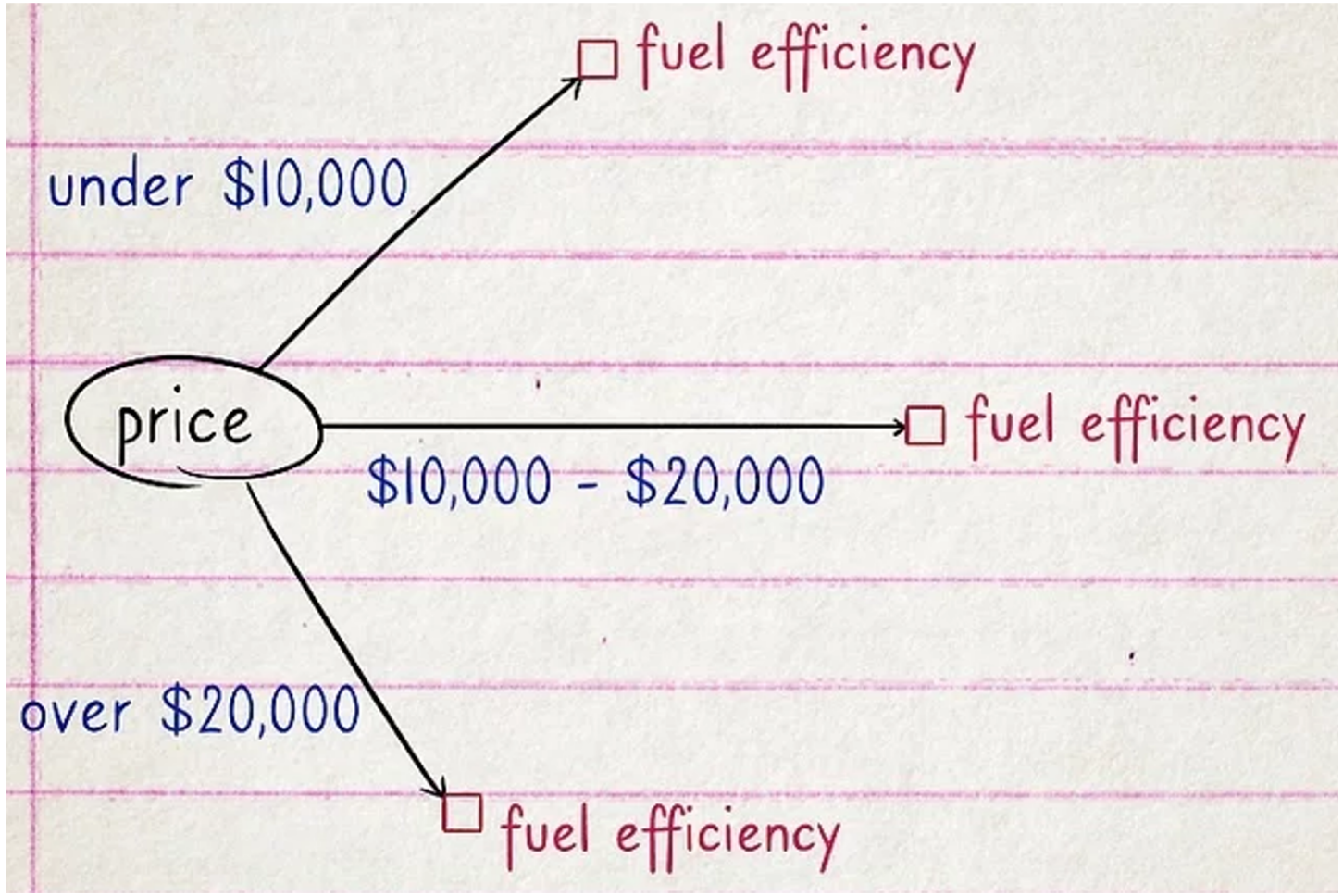
Make a minimum of 2 lines and a maximum of 4 lines leading out of the first variable. Label each line to represent the option or range of options that the variable derives from.

For example, from the "price" circle, make three arrows labeled "under 100 million", "100 million to 200 million", and "over 200 million" respectively.

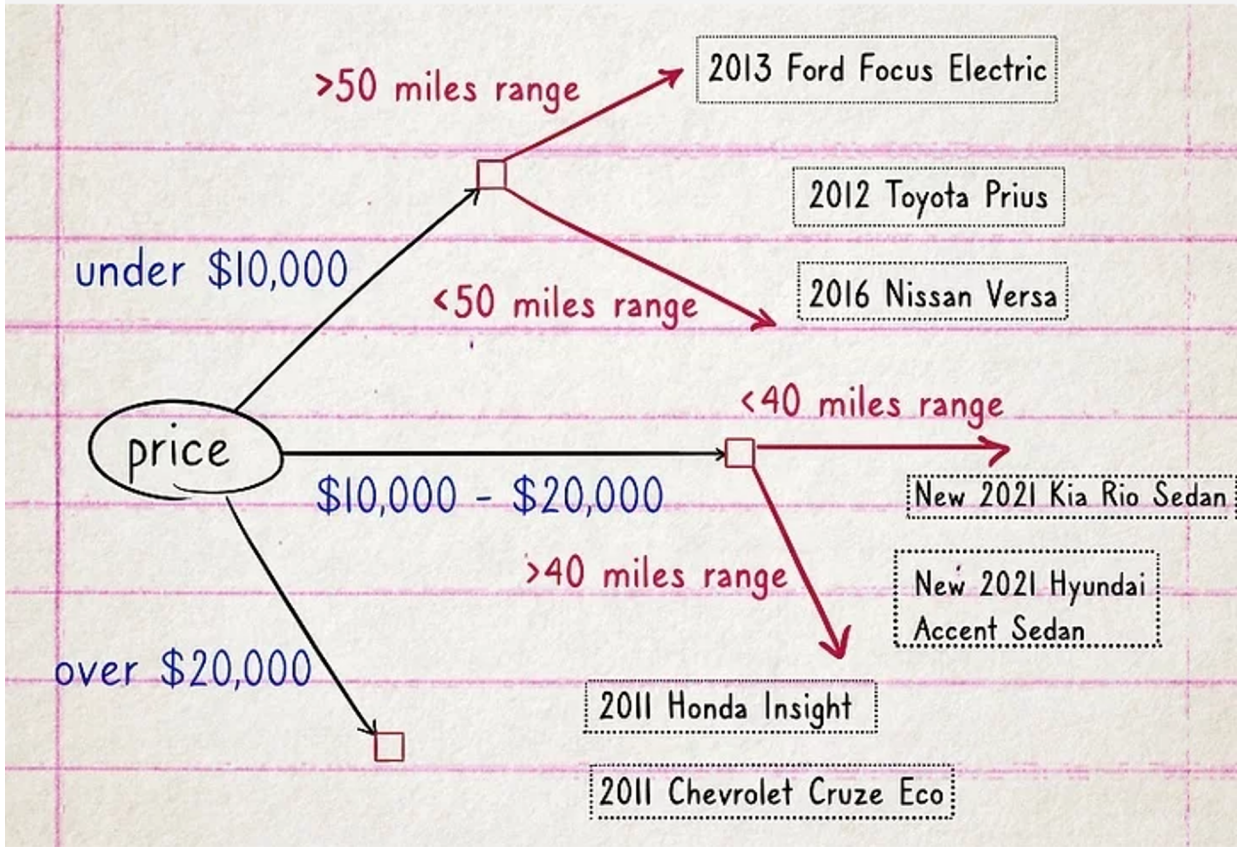


How to Make a Decision Trees

- Draw a circle or square at the end of each line.
- This circle or square represents the next priority of your variable list. Draw a line coming out of each of these circles that represents the next option.
- Usually, each box/circle contains special options that differ based on the parameters selected from the first decision.
- For example, each box will be labeled “fuel efficient”. Since cheap cars usually have low gas mileage, the 2-4 options that fall out of the “gas efficient” circle will represent different ranges.



How to Make a Decision Trees



- Continue adding squares/circles and lines.
- Keep adding flowcharts until you reach the end of your decision matrix.
- Usually you will encounter additional variables when working on a decision tree.
- Sometimes, this variable is applied to only 1 “branch” in the decision tree. However, sometimes variables can be applied across all branches.

Other types of decisission trees

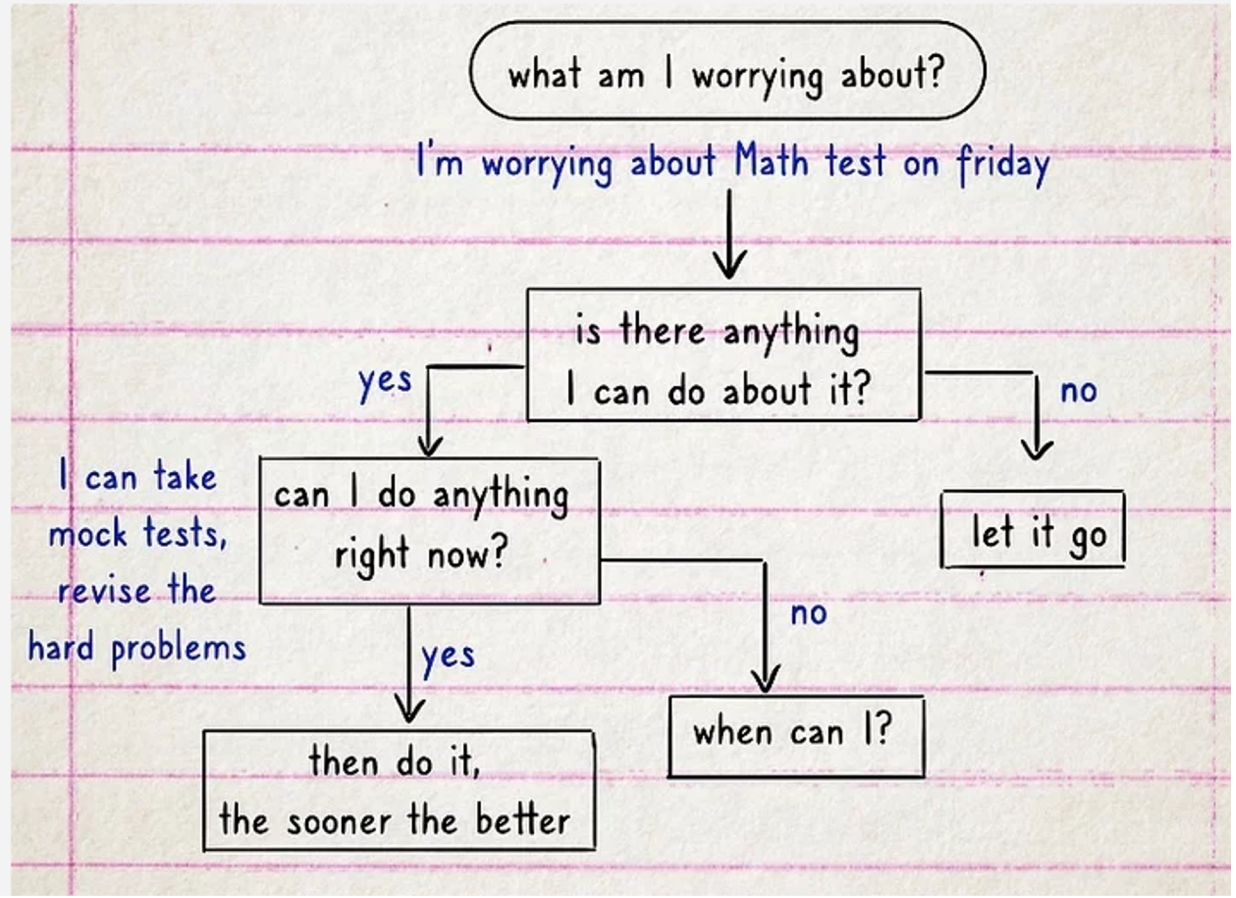
The decision tree also helps you identify the type of worry you have, turn the worry into a manageable problem, and decide when the worry is safe enough to be 'let go'.

There are two kinds of things that are not worth worrying about, things that can be acted upon and things that can't be acted upon.

Use the decision tree to examine any of your concerns. If the concern cannot be acted upon, then you can let go of the worry.

sIf the concern can be acted upon, you can develop a plan to address the problem. You don't have to worry anymore because you already have a plan.

If worry comes back again, you can tell yourself that you have a plan so you don't have to worry



Any Question

exercise

Combination Problems Mathematical, Probability and Decision Trees

There are two ways I go to work, both involve a two-part journey.

- I can cycle to the bus stop; it usually takes 5 minutes, or 15 minutes if the railroad crossing is closed on the road, which happens on 10%of occasions.
- A bus takes an average of 5 minutes to arrive. I took the first bus, which may have been a slow bus that took 30 minutes or a fast bus that took 15 minutes. Chances of I get a slow bus is 20%.
- Or, I could drive to the Park and Ride parking lot.
- Driving normally takes 15 minutes, but about half the time there is a traffic jam and it takes 20 minutes.
- When I get to Park and Ride, sometimes I get the bus right away, but there's a 60% chance I'll have to wait 10 minutes for the next bus.
- The bus took 10 minutes to take me to work.

1 What is my shortest time to start work?

2 On average, what is my best option for going to work and how much time do I need?

3 What is the probability that the first trip option takes 40 minutes or more?