College Guild
PO Box 696, Brunswick, Maine 04011

Logic, Puzzles, and Games

Unit 1 of 6

Logic

Welcome to the College Guild course Logic, Puzzles, and Games.

Guidelines for all College Guild courses:
1. **Answer all the questions in bold print, and use black or blue ink or dark pencil if possible.** After we receive and review your completed Unit, we will send you feedback from your reader along with your original work and the next Unit. You don't need to return the questions – it saves us both postage.
2. There is **no specific deadline** to complete any Unit, but we would get concerned if we hadn't heard back from you after two months.
3. Remember how often the mail service loses things. **If you don't hear back from us within two months, please write to ensure we received your Unit** and sent out the next one.
4. Several questions ask you to **draw/sketch** something...please TRY these! It does not matter if you think you are a terrible artist; even stick figures are fine with us.

Overview: When we think through a problem and make a sound decision we benefit from our time spent struggling to reach a desired outcome. Additionally we get an emotional charge from solving a problem, whether we are in competition with others or just ourselves. These rewards are the reason that puzzles and games have thrived throughout civilization. In these units you will have to analyze, struggle, adjust, and discover, en route to reaching an answer. Just as with any learning experience, making mistakes is all part of the process of gaining skills and wisdom to use on future challenges. There is an art to problem solving.

In the opening unit we will examine five different types of logical thinking and set your mind loose on problems that will let you practice each of them. See this as an opportunity to expand your mind as well as become a more confident problem solver. Try not to be intimidated by these questions, but instead see them as a challenge that could have you stuck at times or completely. **"Doing your best is a process of trying to do your best." - Singer/song writer Townes Van Zandt.**

Glossary of Terms: In order of appearance

Logic - Thinking that is practiced in a clear way resulting in a correct answer, or best answer.
Fractal - A mathematical shape that contains an endless repeatable pattern.
Recursion- A process that contains in it a repetition of the same process, again and again.
Midpoint- The point that separates a side or segment into two equal pieces.
Deductive Reasoning- A logical process that leads to a correct conclusion based on one or more true statements.

Patience and Persistence
"It always seems impossible until it's done." —Nelson Mandela

To be effective in solving a problem, especially one that requires a lot of thought, you have to be patient. Even people who consider themselves a steady thinker can lose their patience depending on the circumstances. A bad night's sleep, a pressing deadline, being hungry, or daily stressors can cloud our judgment, making us unfocused or frustrated. Practicing patience is one way to become more patient. To complicate matters, our modern world is filled with convenience, eliminating the opportunity for patience to develop otherwise.

Being able to digest a problem slowly and steadily is just the start. We also need to have the drive to keep pushing ourselves. Being persistent begins with the belief that you can succeed. Ways to improve our confidence and drive include: reflecting on our hard earned accomplishments, finding inspiration in the example of others, or simply by embracing a quote that reminds us to carry on. The American inventor Thomas Edison, famously stated, "I have not failed 10,000 times. I have not failed once. I have succeeded in proving that those 10,000 ways will not work. When I have eliminated all the ways that will not work, I will find the way that will work."

1. Write about a role model of yours that demonstrated patience and persistence. Describe what they did to display these qualities and why they inspire you. If you would rather you could instead write about something that you accomplished that gives you pride because of the hard work that it took to achieve it.

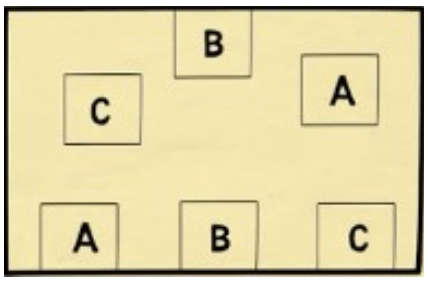
2. Tell us a quote that you know of that inspires you. It could be by a famous person or someone that you know. If you don't have one in particular in mind, then inspire us with some advice of your own.

3. Solve the following three problems:

a. **Arithmetic:** Javier bought a pair of sneakers and a pair of socks for $110. The sneakers cost one-hundred dollars more than the socks. How much did the sneakers cost? (Hint: The sneakers were not one-hundred dollars.)

b. **Geometry:** What is the greatest number of pieces of pizza you can get by cutting a circular pizza with four straight cuts? The pieces do not have to be the same size. Show your solution with a picture of a circle sliced up with four straight cuts.

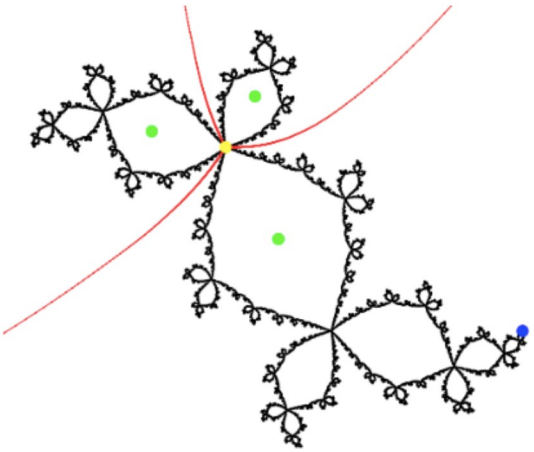
c. **Network Theory:** Connect the matching letters without crossing paths with your other connections. You must stay in the rectangle.



4. Write a few sentences describing your reaction to working on the last three questions. What sort of emotions did you experience?

5. If you did give up on any of the four questions, go back and try some more. Tell us if you were successful the second time through. (You might be surprised to learn that we are intentionally not providing you with the answers.)

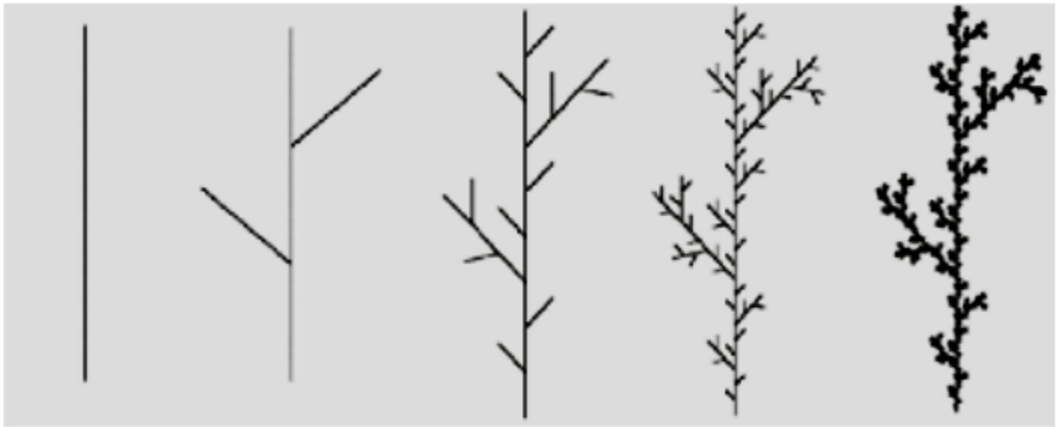
Pattern Recognition
"Clouds are not spheres, mountains are not cones, and bark is not smooth nor does lightning travel in a straight line." -Benoit Mandelbrot



Making sense of our world arguably comes down to one skill that evolution has prepared brains very well for, pattern recognition, the ability to detect sequences. Whether it is a fish recognizing what pattern of a coral reef offers the best habitat, or a person anticipating another's emotions, we flourish when we are successful making predictions based on the sequences we identify.

In 1980, Polish mathematician Benoit Mandelbrout delighted the academic community by unveiling his computer generated images which he called **fractals**. These futuristic designs have a fractured or broken look to them that repeat in an endless pattern. Fractals at first had only artistic value, but in a few short years were being used to assist in tasks including: making medical diagnosis, designing better antennas for cellular phones, and understanding how ice is formed. Above you see one of Mandelbrout's fractal designs.

His access to the latest IBM computers allowed him to apply a mathematical concept called **recursion** to develop these fantastic and original patterns. Recursion is a process which, when followed, leads to a point where the process repeats. He of course did not invent this concept, it's found in the natural world as shown in the figure below of an artistic sequence that leads to a drawing of a branch. Notice from left to right how each segment from the previous picture gets two diagonal lines, making the final image more full and realistic. You might say that "the rule" for drawing a branch is, "Keep on adding two diagonal lines each time, with the higher one to the right.



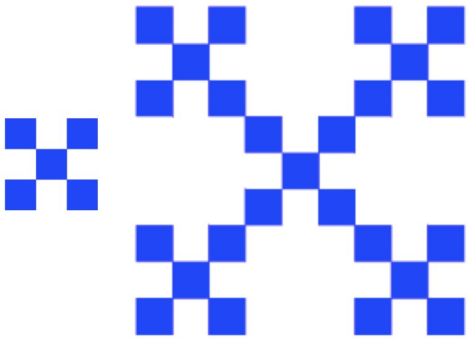
Start With **End With**

6. Follow "the rule" to duplicate the final picture of a branch. Do this a few times if you wish to make a forest scene.

7. Follow "the rule" for each of the following starter pictures below and build up to a finished drawing like above.

a. **Rule: "Draw in a smaller triangle each time by connecting the midpoints of every triangle you see." A midpoint is a point on a side that splits the side into two equal pieces. (Be sure to start with a big triangle to begin.)**

b. **Rule: "Attach a pattern of five squares to each of the outermost squares" (Start with a small design here as it will fill up the page quickly.)**



c. **Rule: "Add the two numbers above to get the next number underneath, also always begin and end a row with the number 1" You can start by copying the list of original numbers below. Try to get at least 8 rows.**

Row 1	**1**
Row 2	**1 1**
Row 3	**1 2 1**
Row 4	**1 3 3 1**
Row 5	**1 4 6 4 1**

<u>Let's Shake On It:</u> The handshake has been a symbol of peace for thousands of years, with its origins dating back to ancient Greece. We shake with our right hands, likely because for the majority of people the right hand is our dominant hand. Did you know that boy scouts shake with their left hands? This is believed to have originated from a meeting between Robert Baden-Powell, the founder of the Boy Scouts, and the Ashanti of West Africa. To the Ashanti warriors, offering a left hand to others symbolized putting down the hand that held their shields. This gesture of friendship and trust made an impression on Baden-Powell, which he incorporated as part of the scout culture. Now, let's use handshakes as a chance to practice some patient problem solving. Notice how the following questions slowly build up to a greater number. Sometimes looking at a simpler version of a question can give us insight on how to do ones that

are more complicated.

8. A room has three people. Al, Bo, and Cal. Determine the total number of handshakes necessary so that each person shakes hands with everyone.

9. A fourth person, Dee, enters the room. Determine the total number of handshakes that are now necessary so that each person shakes hands with everyone. Explain how you determined your answer. You might find that drawing a picture will help in your explanation.

10. A fifth person, Eli, enters the room. Determine the number of handshakes needed.

11. A sixth person, Flo enters. Determine the number of handshakes needed.

12. Write a story that involves shaking hands as an important part of the story. It could be fiction or non-fiction. For an added challenge, make your story comical.

You might not have realized it, but the answers questions 7-10 are all found in your answer to question 7c. You will find them on a diagonal line in the formation of the rows of numbers. Find them right now before you continue. The formation of numbers in question 6c is called **Pascal's Triangle**. It is a useful mathematical list that can help us solve a variety of math problems such as expanding a binomial in algebra:

$$(x + y)^4 = 1x^4 + 4x^3y + 6x^2y^2 + 4xy^3 + 1y^4$$

13. Use the patterns in Pascal's Triangle to determine the total number of handshakes necessary so that each person shakes hands with everyone if there are eight people in the room. Show this by adding rows to your answer in 7c.

Experience and Creativity

"Good decisions come from experience. Experience comes from bad decisions." -Mark Twain

So far, each of the puzzles you've worked on have had only one answer. However, not every puzzle is as clear cut. Logical conclusions can often be one of many correct answers. Puzzles like this allow you to develop several "correct" answers depending on your experience and creativity.. Now let's look at some puzzles that will give you a chance to think and perhaps debate the best solution.

Lost at Sea: You have chartered a yacht with three friends, for a trip of a lifetime across the Atlantic Ocean. Because none of you have any sailing experience, you have hired an experienced sailor. Tragically on the second night a fire on the ship takes the sailor's life and now the ship is sinking. Your location is unclear because vital navigational and radio equipment were damaged in the fire. Your best estimate is that you are many hundreds of miles from the nearest landfall. You and your three friends have managed to save a four-man rubber lifeboat, a box of matches, and these fifteen items.

1. pair of binoculars
2. bedsheet
3. roll of aluminum foil
4. seven gallon(25 Liters) container filled with water

5. six cans of pinto beans
6. acoustic guitar
7. box of 15 plastic garbage bags
8. gas can filled with approximately 2 gallons of gas
9. net that is 8 feet by 10 feet
10. battery powered radio
11. fifteen feet of rope
12. Duct tape, one roll
13. family sized bag of skittles
14. can of shark repellant
15. complete first aid kit

14. Rank the items above from 1 (most important) to 15 (least important) for your survival from the scenario described above. You can do this ranking on your own or discuss this with other people.

15. Explain your top three choices and your bottom three choices. What made each of them important or not important.

16. Write a story with at least two paragraphs that brings to life this survival story. In the story describe how some of the items helped or didn't help.

Deductive Reasoning

"When you have eliminated the impossible, whatever remains, however improbable, must be the truth." Sign of the Four -Sir Arthur Conan Doyle

In 1979 British engineer Micheal Cairney took fifteen days to set up nearly seventeen-hundred dominoes. Known as the World Domino Spectacular, the domino fall included over thirty stunts such as bridges, spirals, rocket launching, flag waving, and most comically dialing a phone to place a call to Guiness Book of Records notifying them that a new world record had been set. The chain reaction of the dominos tumbling into one another is a perfect way to visualize our next concept.

From the dawn of civilization, mankind has accumulated truth to collect more truth. This type of thinking is called **deductive reasoning**. We establish facts that must be true, which lead to conclusions that also must be true, which leads again to more and more truth. Imagine these truths as dominoes, colliding with one another, making more and more tumble over. Some examples of deductive logic at work include establishing facts in geometry, predicting results of scientific experiments,

writing an essay to convince somebody that you are correct, and both writing and correcting computer programs. Deductive reasoning can be studied by examining both correct and incorrect pathways of thought. The following examples provide you with one of each along with an explanation. Examples like these are used in puzzle books, are used to determine reasoning skills in children, job interviews to determine a candidates' qualifications, and the elderly to assess their mental well being.

Correct Deductive Reasoning
Truth: All insects have exactly six legs.
Truth: A spider has eight legs.
Conclusion: A spider is not an insect.
Explanation: A spider has too many legs to be an insect.

Incorrect Deductive Reasoning
Truth: If it rains then the street gets wet.
Truth: It is not raining.
Conclusion: The street is not wet.
Explanation: The street could be wet for another reason, maybe a car wash.

17. For each of the following examples determine if the conclusion is true or false or if there is not enough information and most importantly explain your answer.

EXAMPLE A
Truth: All elephants have trunks..
Truth: All animals with trunks are mammals.
Truth: All elephants are animals.
Conclusion: All elephants are mammals

EXAMPLE B
Truth: The aquarium has more goldfish than angelfish.
Truth: There are more angelfish in the aquarium than there are neon tetras
Conclusion: The aquarium contains more goldfish than neon tetras.

EXAMPLE C
Truth: I chipped a tooth eating popcorn a year ago.
Truth: A friend offers me popcorn.
Conclusion: I will not eat the popcorn because I will chip another tooth.

EXAMPLE D
Truth: King's novel is longer than the book Patterson wrote, but shorter than Baldwin's novel.
Truth: Alvarez's novel is shorter than Baldwin's book, but longer than King's.
Conclusion: Patterson's book is shorter than Alvarez's.

EXAMPLE E
Truth: All potatoes have eyes.
Truth: All corn has hair.
Truth: Julia has eyes and hair.

Conclusion: Julia is a potato and corn.

EXAMPLE F
Truth: On days when coffee sales are high the restaurant sells less ice cream cones.
Conclusion: To sell more ice cream the restaurant should stop selling coffee.

18. Five sports cars are all in a row. The Lamborghini is positioned to the right of the Porsche but is not positioned next to the Camaro. The Camaro is positioned next to the Ferrari, which has the Lamborghani on its left side. The Mustang is positioned furthest from the Camaro. Which car does not have a car to the left of it?

19. Write your own example where deductive reasoning is used to reach a conclusion. Make your example or examples as difficult as you like.

Self-Reflection Exercise

20. What was the most interesting thing you learned about Unit 1 Logic?

21. How do the lessons of Unit 1 Logic apply to your own life?

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Remember: First names only & please let us know if your address changes

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https://commons.wikimedia.org/wiki/File:Domino_--_2021_--_6759.jpg

https://commons.wikimedia.org/wiki/File:Drawing,_Design_for_a_Fountain,_1795_(CH_18125803).jpg