1. **Sasha is looking at Olga, and Olga's looking at Andrew. Sasha has children, and Andrew does not. Is a person who has children looking at a person who does not have children? The answer options are "Yes", "No", "Cannot be determined". Explain your reasoning.**

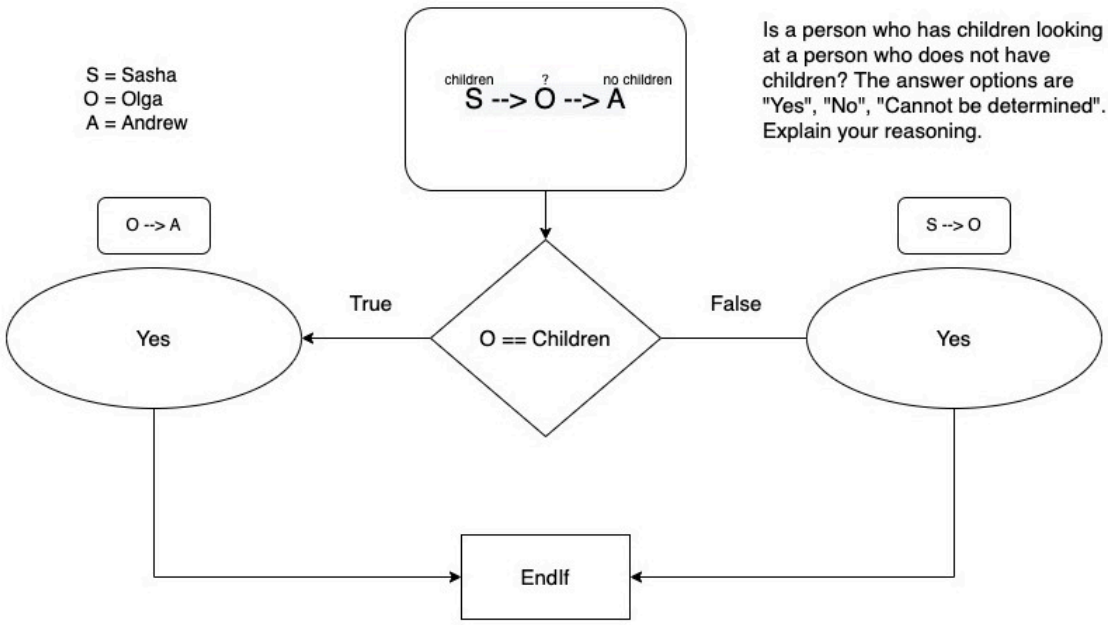
   Sasha (has children) -> Olga (unknown) -> Andrey (no children)
   There are only two options for Olga - have children and no children.

   Option 1. Olga "has children".
   The statement "Olga is looking at Andrei" corresponds to the statement "Person who has children looking at a person who does not have children"

   Option 2. Olga "does not have children".
   The statement "Sasha is looking at Olga" corresponds to the statement "Person, who has children looking at a person who does not have children"

   Thus, under both options, the statement "Person who has children looking at a person who does not have children" is true.

   Answer: YES



2. Assume that the company you work for is planning to start building houses in Antarctica in the next ten years. Your role is Technical Project Manager. A seminar will soon be organised with experts on issues related to this task. What would you like to clarify with them to start working on the project? Prepare a list of specific questions, answers to which you will need to start designing the houses and the required infrastructure.

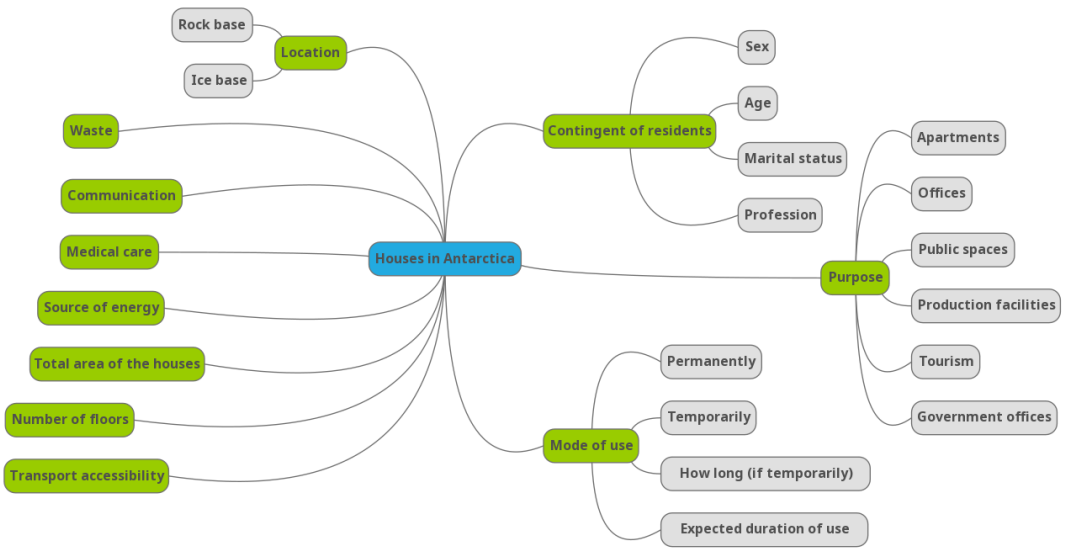
First you need to understand the purpose of the houses in Antarctica:

1. **Their purpose?** (apartments, offices, public spaces, production facilities, tourism, government offices, etc.)
2. **Contingent of residents?** (sex, age, marital status, occupation, criminality, etc.)
3. **Mode of use?** (permanently or temporarily, for how long - if temporarily, what is the total expected duration of use)

Having assessed the answers to these questions, it is possible to decide on the legal side of the project: the use of Antarctica is regulated by special international laws and the construction of houses may contradict them. And, therefore, impossible.

If the legal side is not an obstacle, the answers to these and subsequent questions will help to decide on the parameters of the houses and the procedure for their construction:

4. **Location - rock base or ice?**
5. **The total area of the houses?**
6. **What is the preferred number of storeys?**
7. **What means of transport can be used to deliver construction equipment, materials and structural elements?**
8. **What will be the source of energy for heating and electricity generation?**
9. **How can medical care be organised?**
10. **How can the disposal of technical and household waste, human waste (from a technical and legal point of view) be organised?**
11. **How would arrival/departure in normal and abnormal (emergency) situations be handled?**
12. **What means of communication with the mainland may be available?**



3. Estimate the number of mechanical weighing scales in operation in the Czech Republic. Nobody knows the exact number but try to estimate it as closely as possible. Explain your reasoning.

First, let's define the object of counting. A scale is a device for determining the mass of material objects.

(Note: Scales do not actually determine the mass, but the weight of a material object. Mass is related to the measured quantity (weight) by the conventional constant g=9.81... But this quantity is not a constant and there are many places on Earth where the constant g differs from the one taken as a constant. The principle of scales is to compare the force of gravity acting on a body with another force that we can measure. Mechanical scales use two forces for comparison:

The force of gravity acting on weights (objects with a predetermined weight) - we will call such scales HIRES;

The elastic force (e.g. in a spring), which is proportional to the elongation of the spring) - we will call such scales SPRING LOADED)

Next, let's define the place of storage/use of these scales. Based on the conditions of the problem, we need to determine the number of "working" scales. That is, the number of scales in use. However, it is not specified how often they should be used (daily? once a month? once a year?). This is important, as a significant number of mechanical scales may be in long-term storage and used very infrequently.

An important fact for this task:

Electronic scales are now the main scales produced and purchased. And the dramatic generation change from mechanical/electronic took place about 25 years ago. Thus, we need to look for scales purchased before 1995-2000 and in use (at least occasionally).

Now, let's look at where mechanical scales are stored/used:

Households

- spring changers

- floor spring for human weighing

- table spring kitchen scales

Shops

- counter spring-operated (with dial)

Markets

- counter weight

- counter spring kettlebells (with clock face)

Medical institutions

- Floor kettlebells for human weighing

- Floor-mounted human weighing spring kettlebells

We also believe that mechanical scales may be located in transport companies (weighing of cargo when accepting goods), agricultural organisations (weighing of fruits and vegetables), schools and kindergartens (for educational purposes), museums (for historical purposes) and many other places. However, the number of such places is insignificant compared to the four listed, and counting the weights in them would give a very small increase.

Let's move on to estimating the number of places where mechanical scales are stored/ used:

Households

Population of the Czech Republic for the year 2022 10.500.000

Number of flats/houses in the Czech Republic 4,600,000

Urban population - 75%, rural population - 25%.

It is possible to estimate the number of flats at 3,000,000, and the number of houses at 1,600,000 (on average more people live in a house than in a flat, and the rural population also lives in flats)

Let us estimate the share of households with mechanical scales (the estimate is of a heuristic, expert nature, based on life experience) and the number of scales available:

Spring-loaded spring-loaded (takes up little space, is rarely used, does not break down, keeps for decades):

*urban population - 20% * 3.000.000 = 600.000*

*rural population - 50% * 1.600.000 = 800.000*

Floor springs for human weighing (takes up little space, is used infrequently, breaks down rarely, can be stored for decades):

*urban population - 7% * 3.000.000 = 210.000*

*rural population - 10% * 1,600,000 = 160,000*

Spring kitchen floor units (take up space in the kitchen, are used infrequently, tend to be replaced by electronic ones)

*urban population - 5% * 3.000.000 = 150.000*

*rural population - 10% * 1,600,000 = 160,000*

Shops

The number of grocery shops in the Czech Republic with an area of up to 50 square metres is 5,500.

In medium and large shops, mechanical scales are unlikely to be available.

*Counter top spring-bottom scales (with a dial) - 7% * 5,500 * 1.8 (average number of scales in a shop) = 700*

Markets

Number of towns in the Czech Republic - 609

We estimate the number of food markets in the Czech Republic to be 1,000 (some towns have several, some have none at all)

*Bench-markets with a spring and bar scale (with a clock) - 7 per cent * 1,000 * 10 (average number of scales in the market) = 700*

*Counter top kettlebells - 1% * 1000 * 10 (average number of scales on the market) = 100*

Medical organisations

The number of doctors in the Czech Republic is estimated to be around 35,000
Let us assume that every fourth doctor owns a scale of which 20% are mechanical (10% with kettlebells and 10% with springs).

*Floor kettlebells for human weighing - 35,000 / 4 * 10% = 875*

*Floor spring scales for human weighing - 35,000 / 4 * 10% = 875*

TOTAL:
Our reasoning results in the following figures:
Households - 2,080,000
Trade (shops and markets) - 1.500
Health care - 1.750
Other - 1.000

All other sectors except households give a vanishingly small result of 0.2%. Thus, the validity of the final estimate depends on the following parameters: the percentage of households in the Czech Republic which own a spring balance, a floor spring scale and a kitchen spring scale. In order to refine this parameter, surveys in typical urban and rural localities should be conducted.

It seems that the estimate of 1.700.000 - 2.000.000 mechanical scales used occasionally seems to be very reliable.

4. Assume that the company you work for is making electric scooters. You are assigned to work on the safety of this future product. What safety tests will you perform?

First, let's define the object of the study. An electric scooter is a two-wheeled vehicle equipped with an electric motor and a battery for moving one or two people, standing or sitting.

Let us define the concept of safety. Safety, as an antonym for the word 'danger', involves the assessment of hazards and objects of harm. It seems that the safety/safety of a scooter has to be assessed in the following circumstances:

A. Scooter movement - danger to others
B. Scooter movement - danger to operator (driver and passenger)
C. Storing and charging the scooter - danger to others

Based on this, it is suggested that the following tests be conducted to assess safety:

1. **Crash test with a dummy** (driver, driver+passenger) and a stationary obstacle - at different speeds, with dummies of different weight. Assess damage to **dummy driver and passenger**, including scooter parts (type B)

2. **Crash test with dummy** (driver, driver+passenger) and dummy obstacle - at different speeds, with dummies of different weight. Assess damage to **pedestrian dummy** including scooter parts (Type A)

3. **Payload test** - how rider weight affects the technical condition of the scooter: breakage of body, wheels, other parts (Type B)

4. **Brake quality test** (type A and B):
- effect of driver's weight on braking distance
- Influence of weather conditions (rain, fog, dust, sand) on braking distance

5. **To check the quality of the lighting equipment** (type A and B)
- headlamp - shape of the light spot, brightness, range of detection of a pedestrian wearing cataphotos in the dark
- brake light and rear position lights - range of visibility at night

6. **Battery and charger reliability test** (type C):
- testing the charging process during under-voltage, over-voltage and over-voltage surges
- testing of charging process at low and high ambient temperatures
- testing charging process in very humid or rainy conditions
- testing the charging process in very dusty environments

7. **Carrying out of appliance fire safety tests** (type C):

- in accordance with current fire procedures, standards and regulations