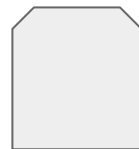
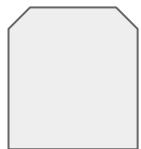
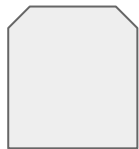
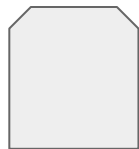
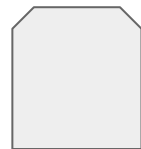
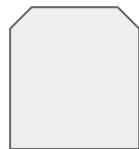
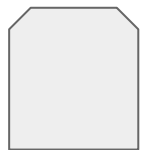
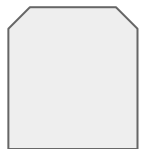


HOW HARD IS IT TO SOLVE THIS?

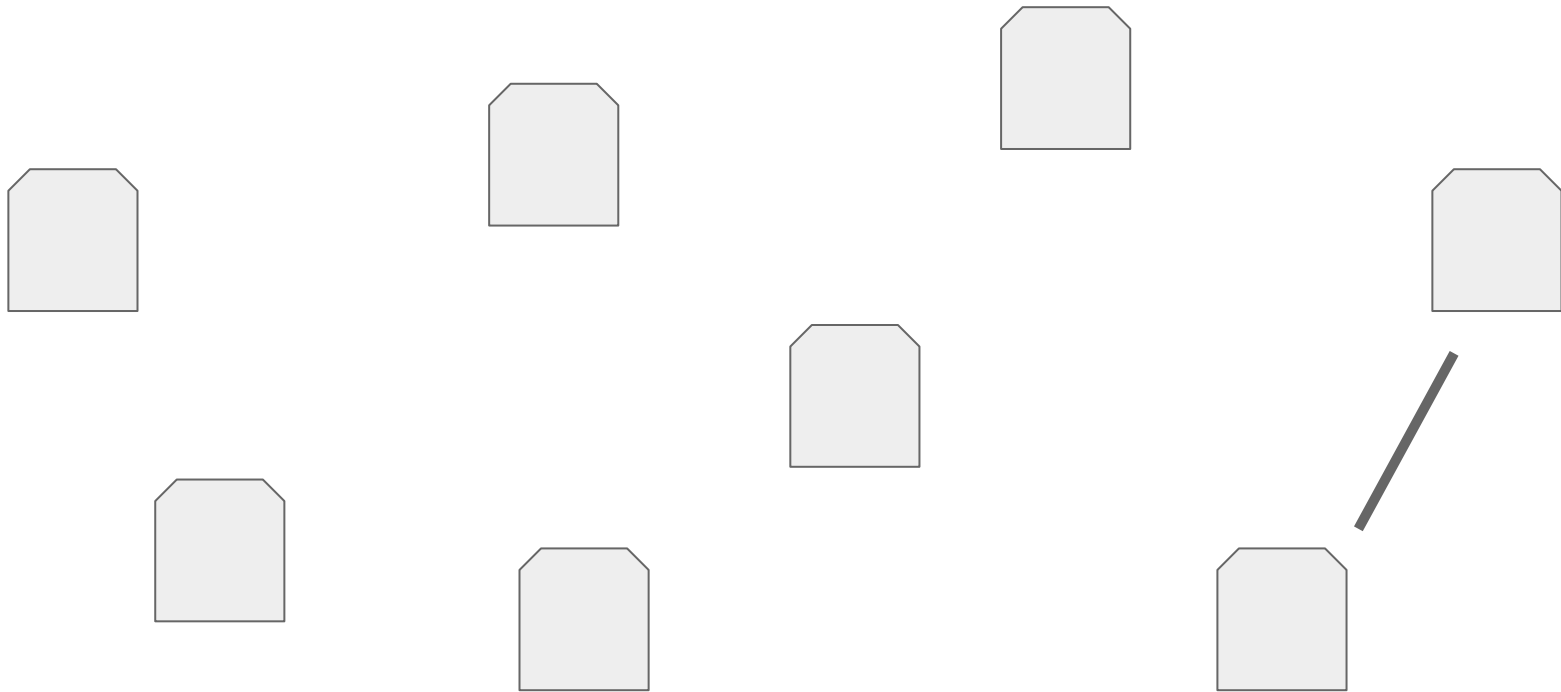
Prerona Chatterjee

NISER Bhubaneswar

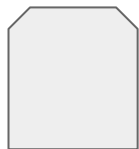
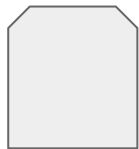
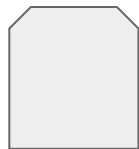
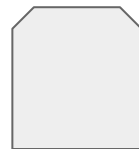
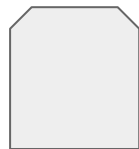
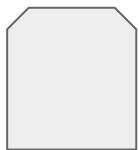
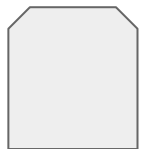
CONNECTING VILLAGES



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- If yes, how?
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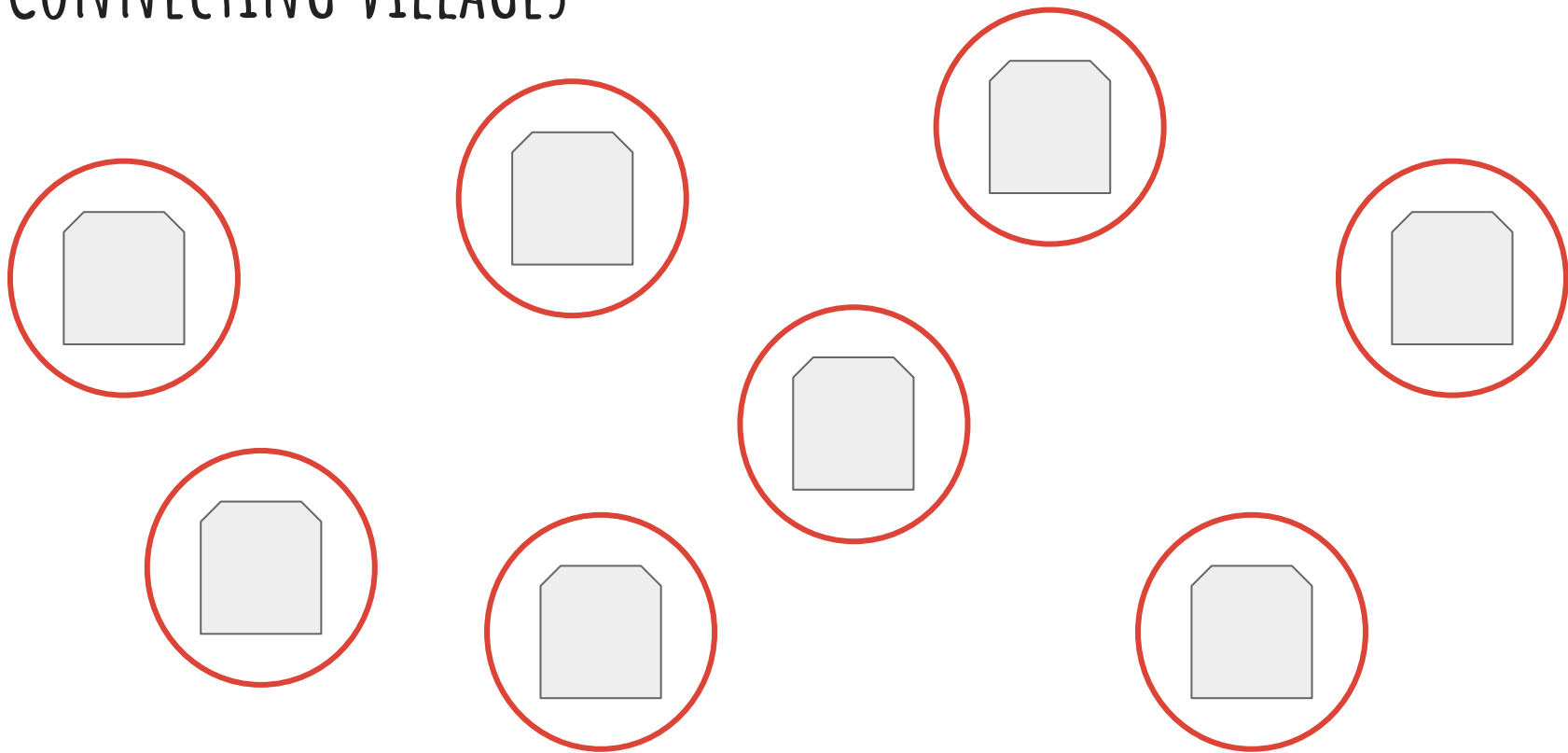
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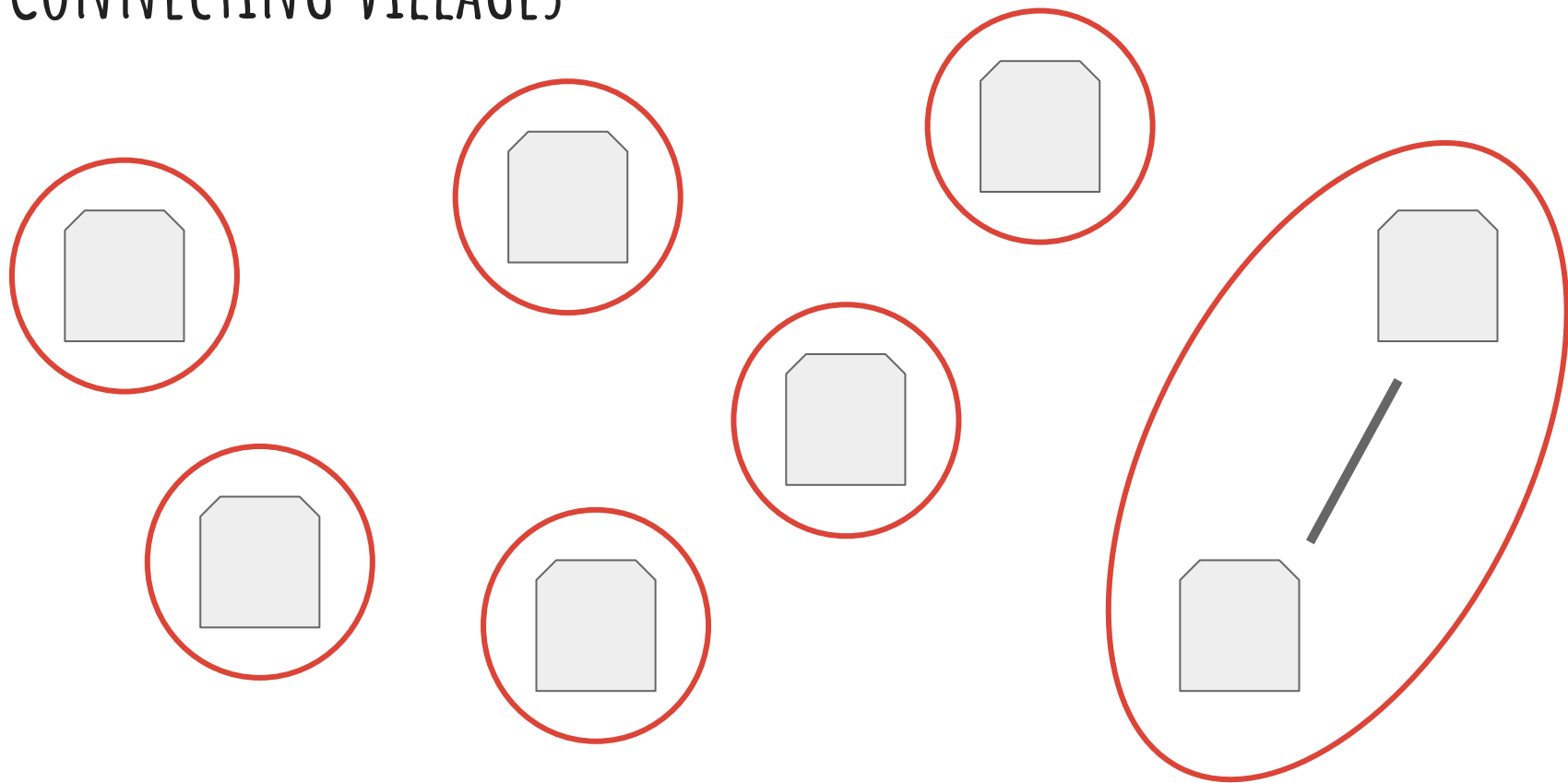
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₹70,000 is enough. But is it necessary?

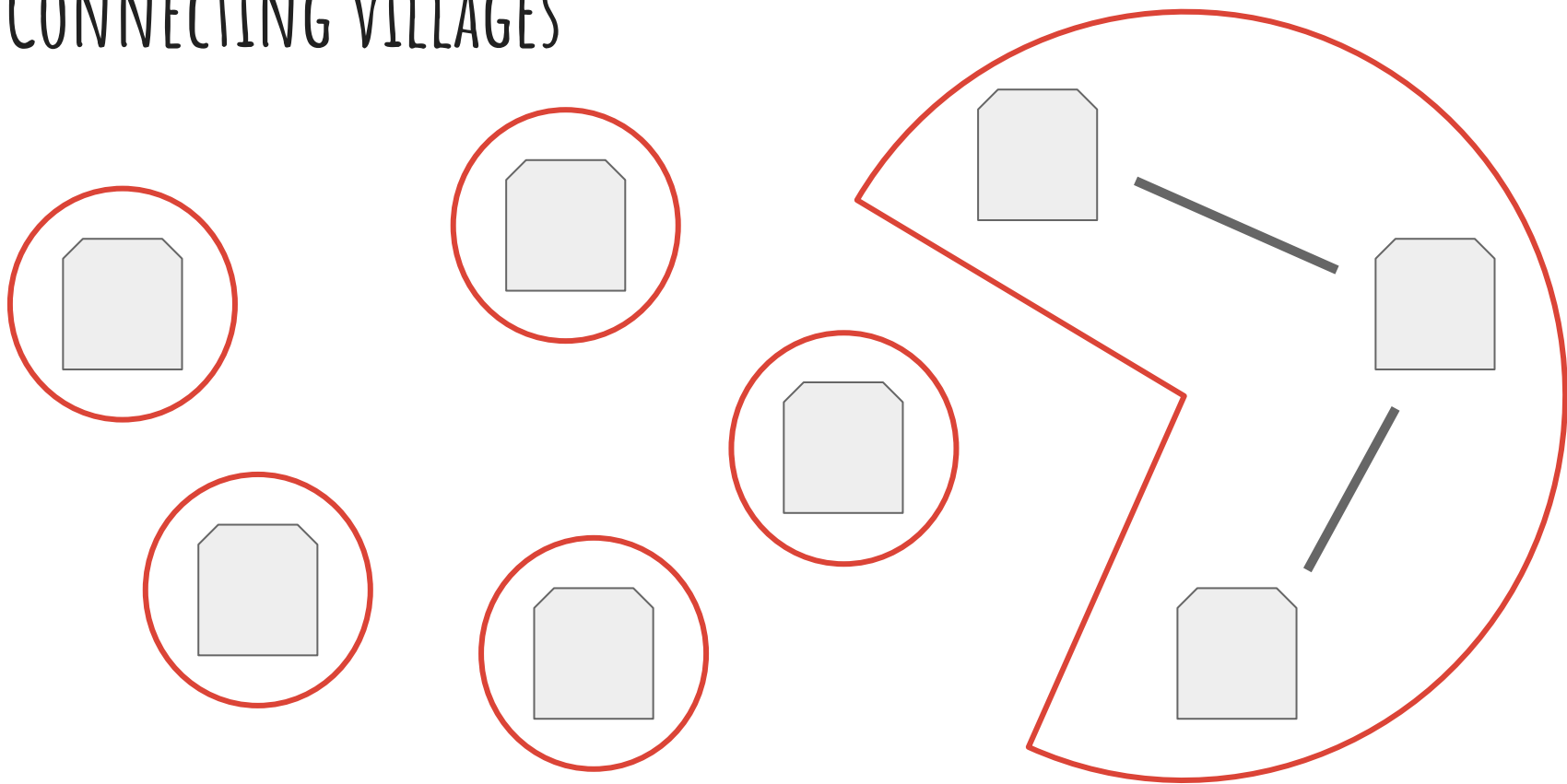
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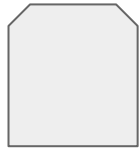
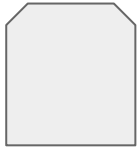
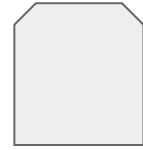
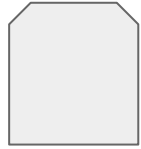
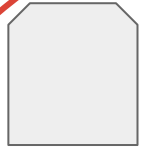
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₹70,000 is indeed necessary.

HOW IS PROVING
THAT SOMETHING IS
HARD HELPFUL?

KNOWING THE LIMITATIONS

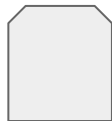
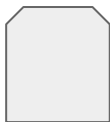
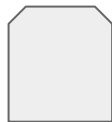
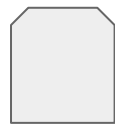
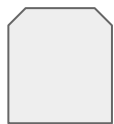
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KNOWING THE LIMITATIONS

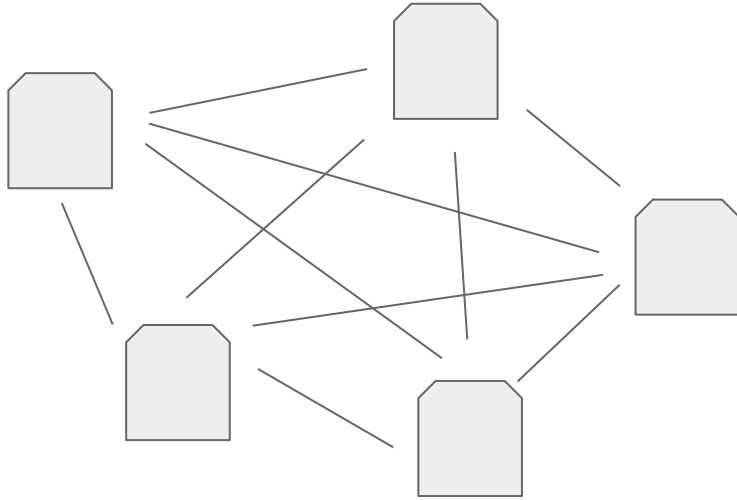
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THE TRAVELLING SALESPERSON

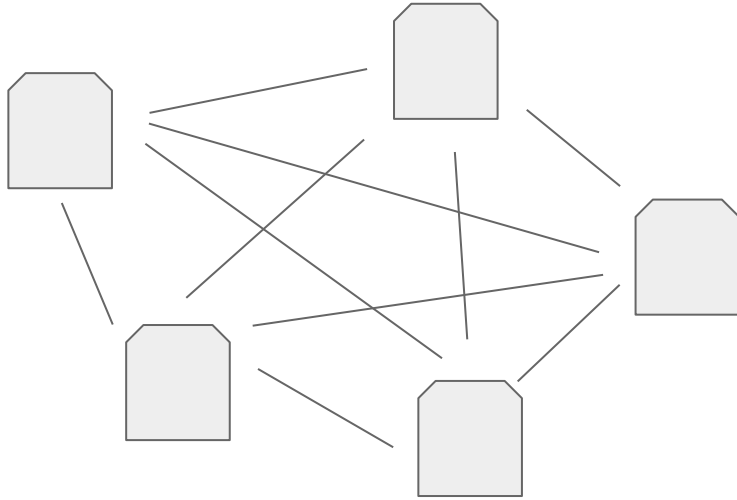


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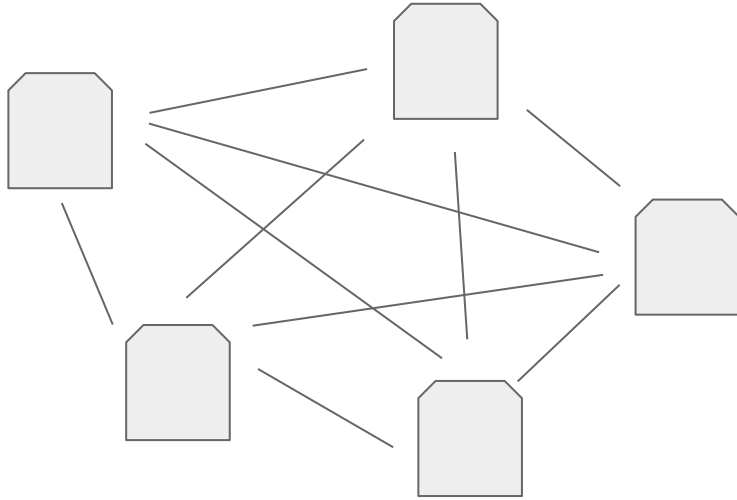
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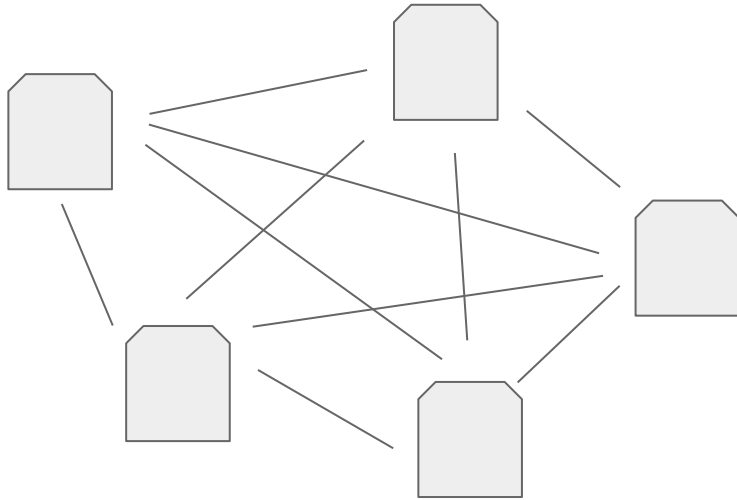
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- All the villages are connected to each other by a direct road.
- Different (direct) roads are of different lengths.
- Salesperson wants to visit each village exactly once and return to the village they started from.
- Find the route which minimises the distance.

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APPROXIMATION ALGORITHMS

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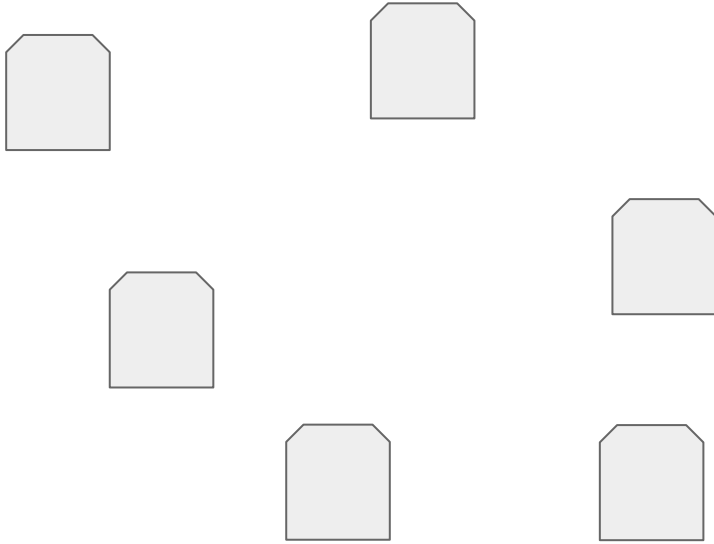
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KNOWING THE LIMITATIONS

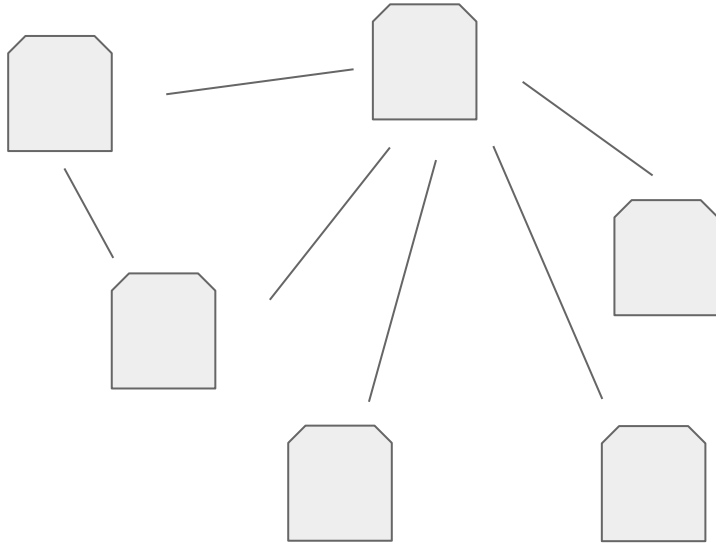
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K-VERTEX COVER

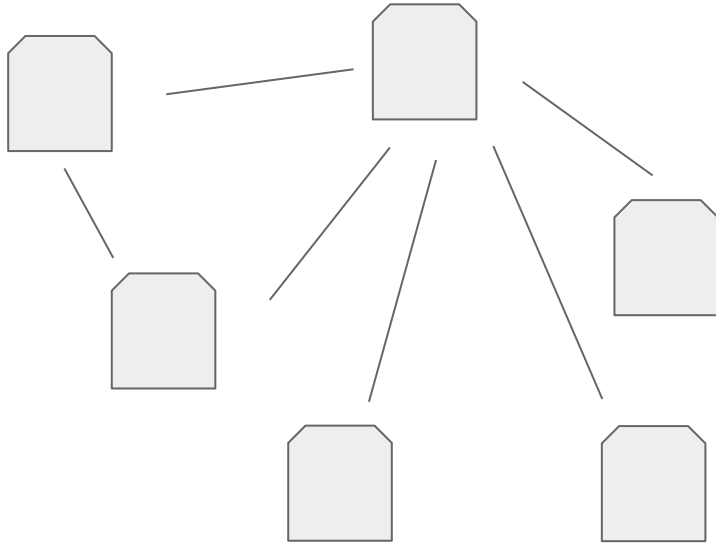


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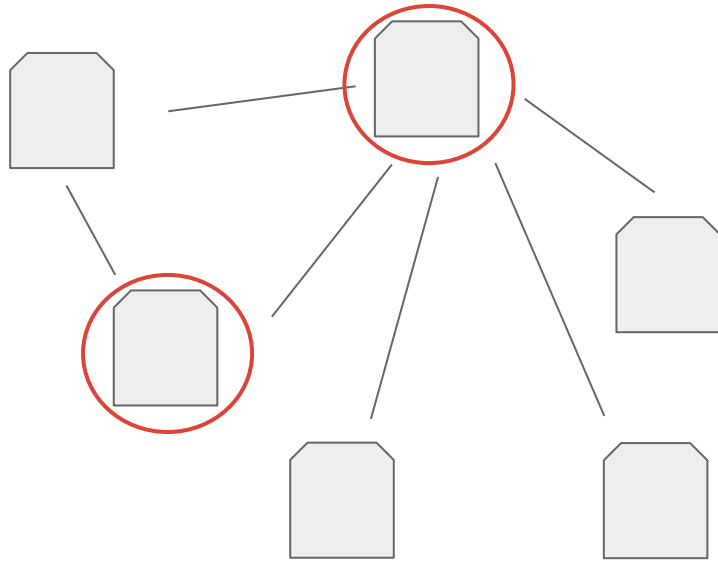
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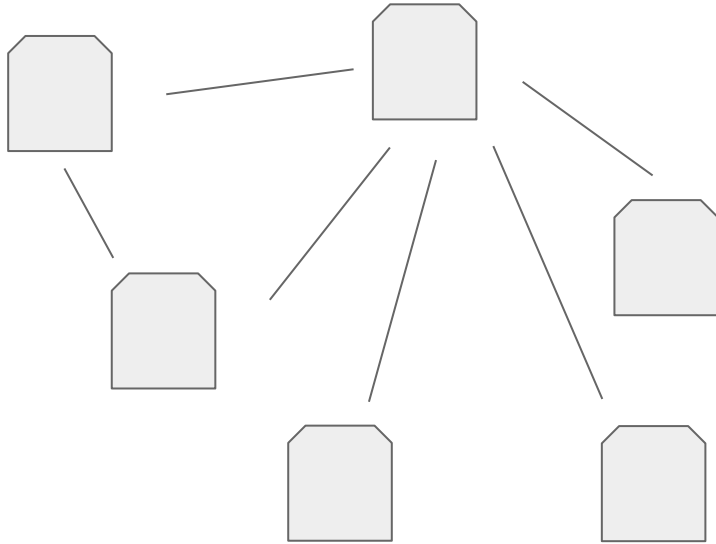
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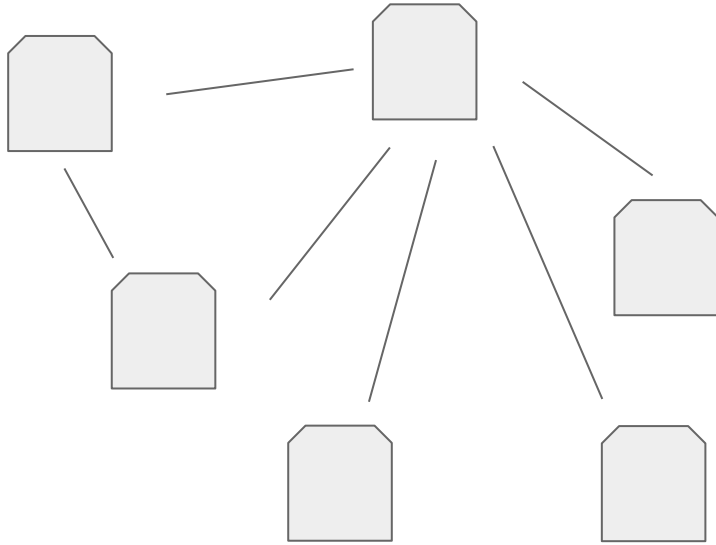
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- Want to place police stations in some villages so that each road is guarded by some police station.
- For a given k , find out if it is possible to do this with only k police stations. Output the villages they should be constructed in.

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PARAMETERISED ALGORITHMS

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As a group, you want to find the sum of the numbers selected by your members, WITHOUT ANY OF YOU FINDING OUT THE NUMBERS SELECTED BY THE OTHERS.

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- A5 does the same and tells the sum to A1.

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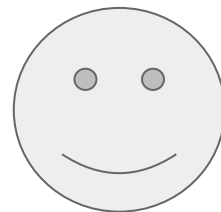
Check: No one gets to know anything apart from their own number and the sum of the numbers because of the randomness added at the beginning.

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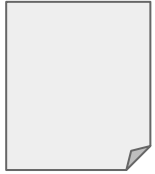
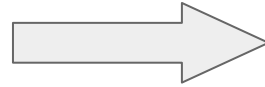
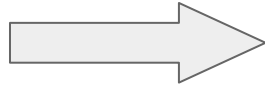
SENDING SECRET MESSAGES



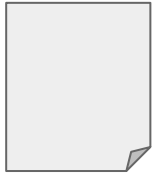
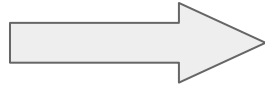
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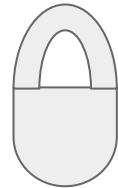
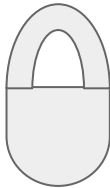
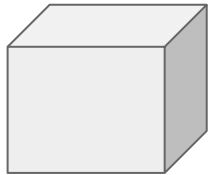
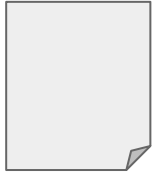
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This protocol is secure assuming B does not have any equipment to break the lock.

KNOWING THE LIMITATIONS

CRYPTOGRAPHY

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DIFFIE-HELMAN KEY EXCHANGE

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CRYPTOGRAPHY

Study of techniques for secure communication in the presence of adversarial behavior.

DIFFIE-HELMAN KEY EXCHANGE



F : EASY TO COMPUTE BUT
HARD TO INVERT FUNCTION

KNOWING THE LIMITATIONS

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$$G : \text{FUNC. S.T. } G(X, F(Y)) = G(Y, F(X))$$

THEORETICAL
COMPUTER
SCIENCE

- A PROBLEM THAT NEEDS TO BE SOLVED.

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- A MATHEMATICAL MODEL THAT DESCRIBES THE ABILITIES/RESTRICTIONS OF THE SOLVER.

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STUDY THE AMOUNT OF RESOURCES NEEDED BY
THE MODEL TO SOLVE THE PROBLEM.

I AM MORE INTERESTED IN
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- Finding factors of a given number.
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I AM MORE INTERESTED IN UNDERSTANDING THE MODEL

- Communication models.
 - two-party/multi-party
 - compromised channels/uncompromised channels
 - broadcast/point-to-point
- Computers (a.k.a Turing machines)
- Quantum Computers.
- Circuits.
- Proof Systems.
- Prover-Verifier Games.
-

ALGEBRAIC
COMPLEXITY THEORY

UNDERSTANDING THE COMPLEXITY OF ALGEBRAIC PROBLEMS

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- Finding factors of a given number/polynomial.
- Computing the determinant of a matrix.
- Multiplying two numbers/polynomials/matrices.
- Finding out if a given set of vectors are linearly independent.
- Finding an annihilator for a given set of polynomials.
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UNDERSTANDING THE COMPLEXITY OF ALGEBRAIC PROBLEMS

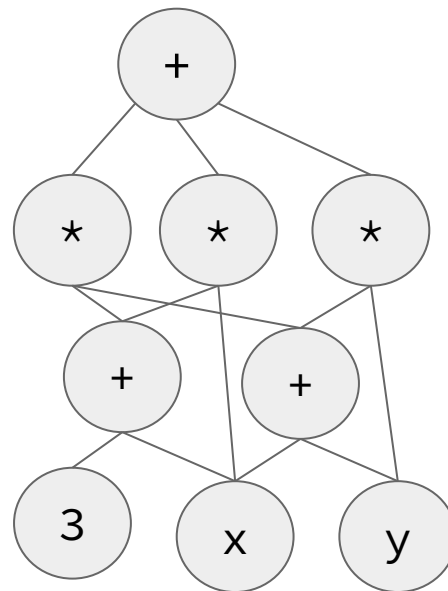
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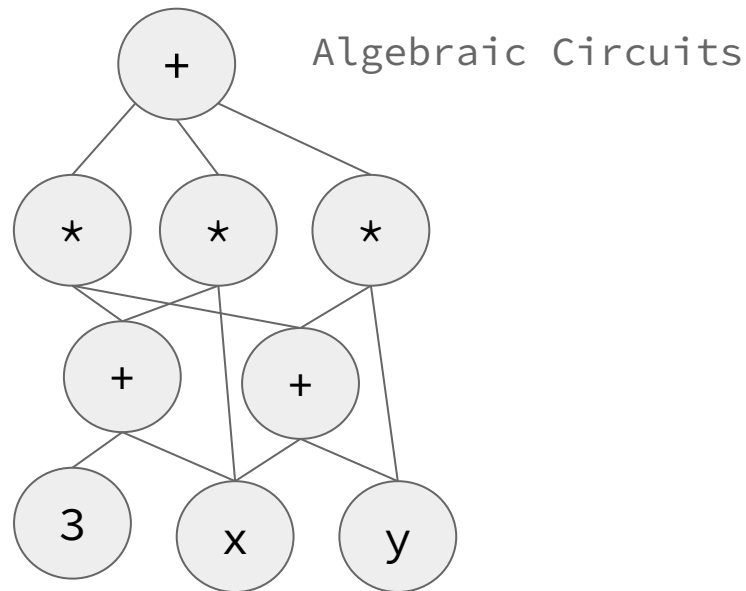
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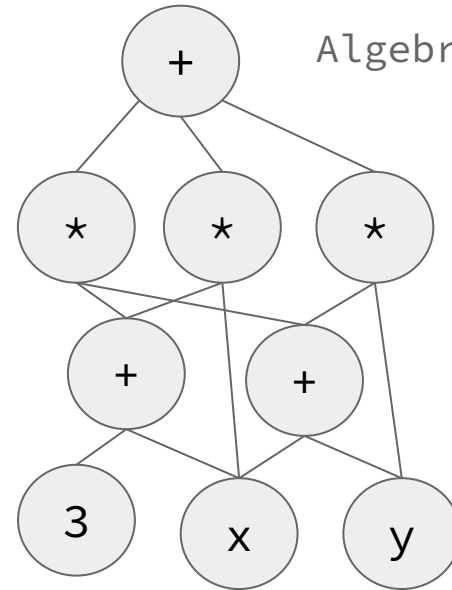
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UNDERSTANDING THE POWER OF ALGEBRAIC MODELS



Algebraic Circuits

- Algebraic Formulas
- Algebraic Branching Programs
- BSS Model

SCOS @ NISER

Secure Multiparty Computation

Secure multiparty computation (MPC) is a cryptographic protocol that **allows multiple parties to jointly compute a function** of their inputs while revealing as little as possible about those inputs.

Some of the applications of MPC are **online auctions, voting** etc.



Data Clustering

Data clustering is the process of **grouping data points together based on their similarities**. Clustering is an unsupervised learning technique.

Application of data clustering includes **market segmentation, image segmentation, anomaly detection** and many more.

Algorithm Design

Algorithm Design refers to developing efficient algorithms to **solve computational problems and analysing their complexity**.

The aim is to devise algorithms that optimize time and space complexities, addressing challenges in various domains like **optimization, cryptography, artificial intelligence**, and more.

Machine Learning

Machine Learning (ML) is a type of artificial intelligence (AI) that allows software applications to become more accurate in **predicting outcomes without being explicitly programmed to do so**.

Application of Machine learning includes **healthcare, natural language processing, recommendation systems**.

Complexity Theory

Complexity Theory is the study of different **computational models**.

Research in this area focuses on understanding the **power and limitations** of objects that model **real-world machines** with varied restrictions. Knowing the limitations of a model helps us devise **secure protocols** against them.

THANK YOU !

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