

DISCRETE MATHEMATICS 2019/20

SEMINAR ASSIGNMENTS

SEMINARS 1 & 2

Tiene que haber una forma mejor.

List of exercises	L.E. 1	L.E. 3	L.E. 4
Group 1.1	8, 9	8, 9	10
Group 1.2	8	2, 3, 8	10
Group 1.3	12	8, 9 , 17	8
Group 1.4	10	11, 13, 17	8
Group 2.1	8	3, 13, 5	10
Group 2.2	2, 9	10, 6	9
Group 2.3	12	2 8, 17	8
Group 2.4	10	8 11, 17	6

→ Oct 30

→ Oct 30

→ November 13

- Due date: October 9
- Presentation date: October 9 & 23

SEMINARS 3, 4, 5 & 6

• RISE OF THE PLANET OF THE APES:

- Assigned to: Groups 1.1 and 2.1
- Due date: October 30
- Presentation date: November 6

• THE OXFORD MURDERS:

- Assigned to: Groups 1.2 and 2.2
- Due date: November 13
- Presentation date: November 20

• CRIMINAL MINDS:

- Assigned to: Groups 1.3 and 2.3
- Due date: November 27
- Presentation date: December 4

• FUTURAMA:

- Assigned to: Groups 1.4 and 2.4
- Due date: December 11
- Presentation date: December 18

DISCRETE MATHEMATICS 2019/20

SEMINAR GROUPS

SEMINAR 1

GROUP 1.1

BERISTAIN, MAIALEN
CORRES, BEGOÑA
ETXEBERRIA, LOREA

GROUP 1.2

BENARAN, AITOR
CLEMENTE, ALBA
ORUE, AIDA

GROUP 1.3

CAMPILLO, IRENE
DEL AMO, JULIO
INNERARITY, JAVIER

GROUP 1.4

ARRIOLA, ANDER
BIKANDI, MARTIN
CAMPANDEGUI, GORKA
MARTINEZ, GORKA

SEMINAR 2

GROUP 2.1

ERRASTI, NURIA
OTXANDORENA, XALBADOR
ZABALO, ZURINE

GROUP 2.2

CHOCARRO, ANDER
PEREZ, JOSU
SALVADOR, DAVID

GROUP 2.3

CID, GARBINE
MORO, LEIRE
RAMON, AMAIA
RODRIGUEZ, CLAUDIA

GROUP 2.4

ABAITUA, LUIS
MARTINEZ, MIKEL
SAGASTABEITIA, GONTZAL
SENA, INIGO

RISE OF THE PLANET OF THE APES



In the film “Rise of the planet of the apes” a scientist is testing a viral-based drug on chimpanzees to find a cure for Alzheimer's disease. The drug is given to chimps, greatly increasing their intelligence. In order to test their intellectual capability, the Tower of Hanoi game is used. The Tower of Hanoi (also called the Tower of Brahma or Lucas' Tower, and sometimes pluralized) is a mathematical game or puzzle. It consists of three rods, and a number of disks of different sizes which can slide onto any rod. The puzzle starts with the disks in a neat stack in ascending order of size on one rod, the smallest at the top, thus making a conical shape. The objective of the puzzle is to move the entire stack to another rod, obeying the

following simple rules:

- 1 Only one disk can be moved at a time.
- 2 Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack.
- 3 No disk may be placed on top of a smaller disk.



TASKS:

1. a) Find the moves for a tower with 2, 3 and 4 disks.
b) How can you use the strategy for a tower with k disks in order to make decisions for a tower of $k+1$ disks?

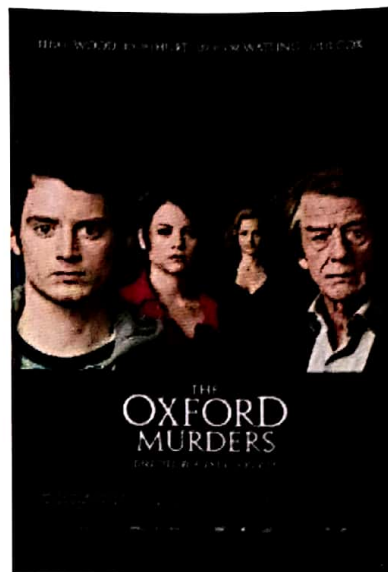
2. What is the minimum number of moves required to solve a Tower of Hanoi puzzle with n disks?
3. How many times is the biggest disk moved? And the next one in size? In what direction?
4. What is the matter with the smallest disks? How often are disks 2, 3, 4, ... moved? In what direction?
5. The tetrahedral numbers a_1, a_2, a_3 , and a_4 are: 1, 4, 10, 20.
 - a) Find a_5, a_6, a_7 and a_8 .
 - b) Find their recurrence relation.
 - c) Find their generating function.
 - d) Give an explicit expression for the general term of the sequence.
 - e) Verify with the previous expression the first values of the sequence.



THE OXFORD MURDERS

"The Oxford Murders" is a 2008 film directed by Álex de la Iglesia. This thriller film is adapted from the novel "Crímenes imperceptibles" by Argentine mathematician and writer Guillermo Martínez, winner of the Planeta Argentina Prize 2003. He gained a PhD in mathematical logic at the University of Buenos Aires. After his degree in Argentina, he worked for two years in a postdoctoral position at the Mathematical Institute, Oxford.

In 1993, Martin (Elijah Wood), a US student at the University of Oxford, wants Arthur Seldom (John Hurt) as his thesis supervisor. He idolises Seldom and has learned all about him. He takes accommodation in Oxford at the house of Mrs. Eagleton (Anna Massey), an old friend of Seldom. Also in the house is her daughter, Beth (Julie Cox), who is her full-time caregiver, which she resents bitterly. After a lecture the two men enter the house together and find Martin's landlady murdered. Seldom tells the police that he had received a note with his friend's address marked as "the first of a series". As Seldom is an authority on logical series, he argues that a serial killer is using murder as a way to challenge his intelligence. It appears that the serial killer can be stopped only if somebody can decode the next symbol in the sequence. Martin is joined by Seldom on the quest to solve the cryptic clues.

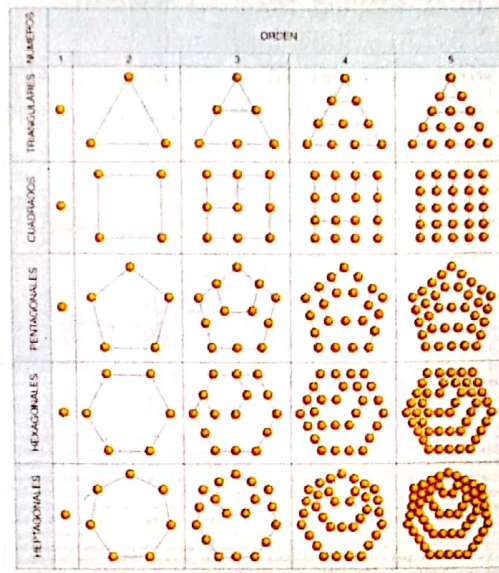


In chapter 24 of the book a clue is given through a phone call: "The fourth of the sequence is the Tetraktys. Ten points in the blind triangle". The Tetraktys and the triangular numbers, in general, were very important to the Pythagoreans. Among the many relationships of numbers that have fascinated man are those that suggest (or were derived from) the arrangement of points representing numbers into series of geometrical figures. Such numbers, known as figurate or polygonal numbers, appeared in 15th-century arithmetic books and were probably known to the ancient Chinese; but they were of especial interest to the ancient Greek mathematicians. To the Pythagoreans (c. 500 bc), numbers were of paramount significance; everything could be explained by numbers, and numbers were invested with specific characteristics and personalities. Among other properties of numbers, the Pythagoreans recognized that numbers had "shapes." Thus, the triangular numbers were visualized as points or dots arranged in the shape of a triangle.

TASKS:

1. Give the definition of the triangular numbers and the first numbers of the sequence.
2. Give (and explain) the formulas for the triangular numbers:
 - a) The explicit formula.
 - b) The recurrence formula.
 - c) Some properties.
3. Prove that triangular numbers cannot finish by 2, 4, 7 or 9.

4. Analyze the following statement: "If you take eight times a triangular number and afterwards you add one, it turns out a square".
5. Polygonal numbers: A polygonal number is a number represented as dots or pebbles arranged in the shape of a regular polygon.



- Obtain the explicit formulas for the square, pentagonal and hexagonal numbers as well as the formula for any polygonal number.
- Obtain the recurrence relationship for the polygonal numbers.
- Find some properties about these sequences of numbers.

