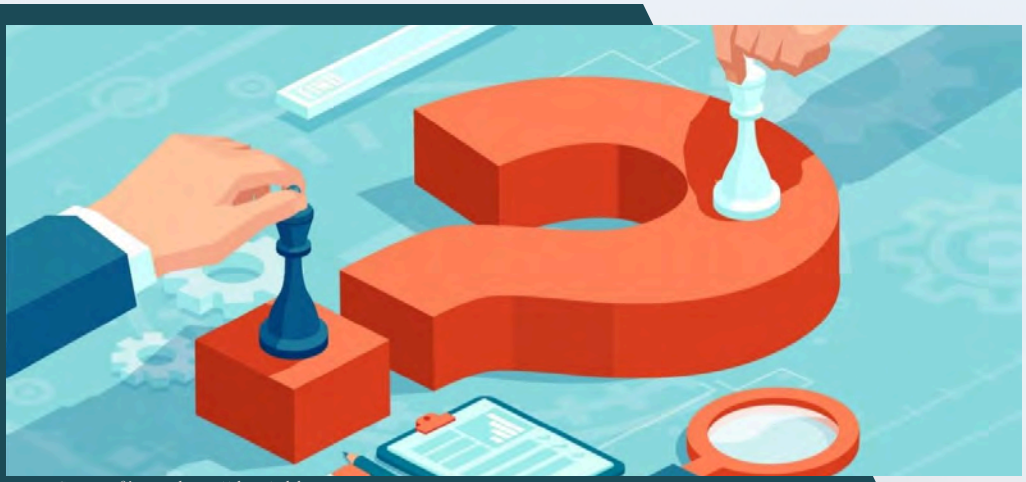
ISSUE 5, JUNE 2024

CONVERGENCE

The Annual E-Newsletter of the Department of Mathematics, Maitreyi College

WHAT'S INSIDE THIS ISSUE:



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"PLAYING TO WIN: AN INSIGHT INTO GAME THEORY"

"Game theory says that the true source of uncertainty lies in the intentions of others."

- Peter L. Bernstein

Ever wondered if we act rational, then most of our life decisions become an application of game theory ! Game here refers to any interaction between multiple people, known as players, in which each person's payoff is affected by the decisions made by the opponent. This contrasts with the traditional grasp of a game, which typically involves fun and competition. Henceforth, game theory is a systematic study of strategic interactions among rational individuals. Examples include an investment game, a game of poker, voting, auctioning, and more. The first mathematical formulation of game theory was provided by John Von Neumann, a Mathematician and Physicist, and Oskar Morgenstern, an Economist, in their book entitled “Theory of Games and Economics Behaviour”, published in the year 1944. The interdependence of players strategies is the basic essence of Game Theory. Its relevance can be as normal as the owner of a store deciding prices of products to drivers steering in heavy .

The tendency of an individual to have some gain at the expense of others may result in not getting an optimal outcome. This dilemma was devised by the American Mathematicians Merrill Flood and Melvin Dresher to enhance strategic thinking during the cold war between the USA and USSR in 1950. Later on, game theorist Alvin Tucker provided a framework in terms of imprisonment and termed it a “Prisoner’s Dilemma”. Consider the scenario of two players being accused criminals who face a choice: to stay silent or testify against their partner. The best outcome, staying silent, results in the lowest combined prison time. However, the temptation to testify for a lighter sentence leads both to betray each other, resulting in harsher punishments. Another famous example of Prisoner's Dilemma from economics is the “Tragedy of the Commons”. It refers to the problem of consuming resources available for all, like water and minerals, in excess by an individual for self convenience that may lead to depletion of the resources.

The application of game theory to the auction of radio frequencies by the U.S government was a landmark moment. It showcased how theoretical insights could translate into tangible, real-world benefits, in this case, maximizing revenue for the government and taxpayers. Beyond auctions, game theory has proven to be a powerful tool with applications in economics, politics, biology, and even everyday decision-making scenarios. Poker, on the other hand, is a natural fit for game theory, as the choice of when and how much to bet depends on your own cards, as well as the cards of your opponents. Evolutionary game theory in biology opens up another expansive realm. The Monty Hall problem is another classic, when it comes down to the final decision on the game show, with doors representing chance and a car hidden among goats. It's a simple scenario, with three doors, two with goats, and one with a fancy car. Yet, the twist lies in the host's revelation of a goat behind one of the unchosen doors. The player is then asked to stick with their initial choice, or opt for the other remaining door. The theory says one should ! Despite one's initial choice, there's a 2/3 chance the car hides behind the unchosen doors. It's an intriguing dilemma that embodies the quirky nature of choices.

The pivotal field of research in game theory is to establish the state of Nash equilibrium, named in the honour of Mathematician John Nash. In Nash equilibrium, a player has no gain in changing only his strategy while assuming others' decision as fixed and hence has no incentive to betray the opponent. It refers to the state where every player wins and achieves the desired outcome. Game Theory offers deep insights in making good strategic decisions in our life. Keep questioning, keep exploring, and may your strategies always lead you to success !

-By Neha Budhani (2nd year) and Ms. Rimpi (Assistant Professor, Department of Mathematics)

FIELDS MEDAL WINNER

MANJUL BHARGAVA

Manjul Bhargava is currently a Professor of Mathematics at Princeton University, the Stieltjes Professor of Number Theory at Leiden University, and also holds professorships at the Tata Institute of Fundamental Research (TIFR), the Indian Institute of Technology (IIT) Bombay, and the University of Hyderabad. He is one of the youngest professors of Mathematics in Princeton University and his extraordinary creativity and taste for simple problems has led him to become the first Indian origin (born in Canada) Mathematician to have won the highest mathematics honour award, the Fields Medal in 2014.

He was born on August 8, 1974 in Ontario, Canada. His father was a chemist and his mother who was then a mathematics professor at Hofstra University introduced Bhargava to mathematical insights at an early age. From early childhood, he used to play around with mathematics, do puzzles, ask his mom for nice suggestions that would be fun for him. He was brought up in New York and completed his schooling with an 'A' grade.

He loved mathematics but he didn't like the way mathematics was taught in school and so he used to find his own ways to make mathematics fun. He also loved to read his grandfather's mathematics books from ancient India. He then graduated with the degree of B.A. from Harvard University in 1996. He went to Princeton for a Hertz Fellowship and received the doctorate under Andrew Wiles, the one who solved Fermat's last theorem, from the renowned Princeton University itself.

His journey in mathematics begins very early starting from the age of seven when he created and solved a problem of algebra on his own. Apart from mathematics he is a professional musician. He understands numbers as a craft (finds position in space) and not just a mere sequence, making him a specialist of number theory. He has made great efforts towards understanding the range of possible solutions to equations known as elliptical curves, which were unsolved for more than a century. He is profoundly known for his contributions in Algebra too. Bhargava read the monumental Disquisitiones Arithmeticae, a book about Number Theory by Carl Friedrich Gauss, which he considers an inspiration. Gauss developed his inventive composition law, which gives a method for composing two binary quadratic forms to obtain a third one. Bhargava, while playing with a Rubik's cube, found a simple, visual way to obtain the law. He then discovered 13 new composition laws for higher-degree polynomials. Until Bhargava's work, no one realised that other composition laws existed for polynomials of higher degree. All these works and many more embarked his way to the Fields medal. He has won various other prestigious awards for his work including Padma Bhushan (2015), Infosys Prize (2012), Fermat Prize (2011), Cole Prize (2008), Morgan Prize(1996) and many more.

He pronounces that "Mathematics plays a very important role in our society". He believes that pure and applied mathematics have no real distinction. He also suggests that there must be funding of basic science research, especially in India so that young minds take up research in future to discover practical applications. He credits sanskrit rhythms, poetry and music to have built his interests in maths.

Credits:
Sketch - Tannu Sharma (2nd year)
Article - Neha Budhani (2nd year)

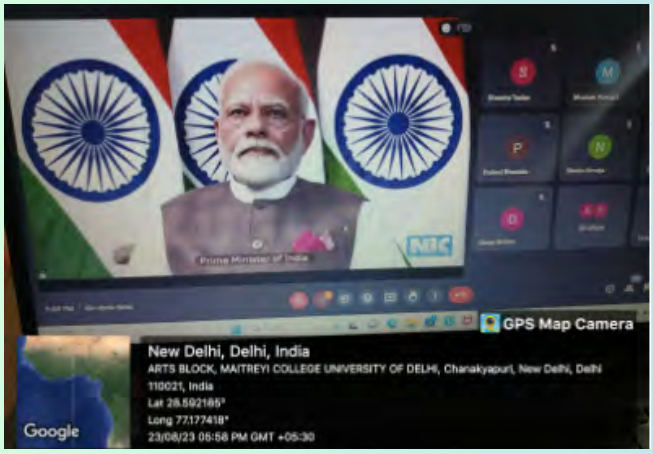
DEPARTMENTAL NEWS

DEPARTMENTAL ORIENTATION

On **August 17, 2023**, the Department held an orientation for the 2023-27 batch. Led by the Teacher-in-charge Dr. Geetan Manchanda, the event introduced new students to the department's goals, curriculum, and future activities. Seniors shared their experiences, and faculty answered questions about courses and electives. The program included an interactive workshop to help students transition smoothly and ended with a "Bucket list" game and refreshments, leaving attendees with a positive impression.

ALUMNAE SERIES

On **August 18, 2023**, the Department held an engaging session with alumna Ms. Hansa Malhotra, attended by 27 students and faculty members. After a welcome from third-year student Ms. Amrita Upadhyay and a presentation from Dr. Geetan Manchanda, Ms. Malhotra discussed her academic and professional journey, emphasizing the importance of seizing opportunities and seeking mentors. She offered career advice and highlighted other successful alumni. Ms. Priyanka Sahni expressed gratitude for Ms. Malhotra's mentorship offer, and Dr. Manchanda praised her motivational talk. The session ended with Ms. Malhotra connecting with students and sharing valuable insights.



LIVE STREAMING OF CHANDRAYAAN 3

The Department organized an live streaming session for the Chandrayaan-3 landing on the Lunar surface on August 23, 2023, which attracted 76 virtual participants, including students and staff. The event, hosted by Aarushi Seth and Padmadev Mishra, featured detailed commentary on Indian Space Research Organization ISRO's lunar missions, including Chandrayaan-1 and Chandrayaan-2, before focusing on the Chandrayaan-3 project. During the landing, Prime Minister Shri Narendra Modi congratulated Team ISRO on the successful landing on South-pole of the Moon, becoming the first country to achieve this feet. Nisha Choudhary expressed gratitude to participants on behalf of Gradient , the Department Society followed by a quiz conducted by Shweta Yadav.

SEMINAR ON CAREER IN MATHEMATICS

On **April 18, 2024**, the Department hosted a seminar "Career in Mathematics," with Prof. Gurpreet Singh Tuteja, Joint Dean of Students' Welfare, University of Delhi as the guest speaker. The session was hosted by Akshita and Neha, Gradient's President and Vice President, respectively. It began with a lamp lighting ceremony. Prof. Gurpreet assessed the career interest of students through an online test based on six principles: realistic, investigative, artistic, social, entrepreneurial, and conventional. He showed how these factors correspond to suitable job paths. This interactive seminar covered a variety of mathematical career paths, including teaching, actuarial science, and data analysis. The session was well-received, with students gaining great insights and help for their future career plans.

TALK ON MEDITATION

The Department, in collaboration with Science of Spirituality organized a talk on meditation on **October 3, 2023.** The speaker of the session, Ms. Seema Charla, a dedicated speaker with 25 years of service at Science of Spirituality gave talk on “Win the Game of Life through Meditation”. Students enriched themselves with a Meditation exercise guided by the speaker and experienced the life-changing benefits of Meditation. The event coordinator, Dr. Neetu Arneja, expressed gratitude and exchanged tokens of appreciation.

SEMINAR ON BLOCKCHAIN

On **October 6, 2023**, the Department at hosted a seminar on Blockchain Technology by Dr. Girish Mishra from the Scientific Analysis Group, DRDO, Metcalfe House. The title of the talk was "Application of Blockchain Technology and its Security Aspects.". The seminar began with a cordial greeting from Akshita Singh, President of the Department Society and Jyotsna Nigam co-hosted the event. Dr. Mishra delivered a well-structured talk that highlighted the importance of blockchain technology and its mathematical roots. He elaborated on cryptocurrency, Bitcoins, and network decentralization, involving students in conversations and addressed issues with traditional monetary systems. Dr. Khushboo Bussi, the event coordinator, expressed gratitude to Dr. Mishra, and Dr. Geetan Manchanda handed a memento as a token of respect, capping off the wonderful event.

WORKSHOP ON CYBER SECURITY AND DIGITAL HYGIENE

On **October 26, 2023**, the Department hosted a lecture on "Cyber Security and Digital Hygiene" with Prof. Charru Malhotra from the Indian Institute of Public Administration, New Delhi. Prof. Malhotra discussed the definitions and relevance of cybersecurity and digital hygiene, as well as his own personal experiences and practical precautions. The presentation was dynamic, with interesting topics and a useful Question-Answer session. Ms. Rajni Gupta and Dr. Geetan Manchanda presented Prof. Malhotra with a planter, after which Ms. Mamta Godara, session coordinator, gave a vote of gratitude.

WORKSHOP ON BALANCING TECHNOLOGY AND WELL-BEING

On **November 8, 2023**, the Department held a session titled "Balancing Technology and Well-Being". Speakers at the event were Dr. Sandip Chatterjee, Shiv Rao Challa, Arjun Naidu, and Ms. Pragya Malik. The first session’s talks were focused on e-waste and its effects by Dr. Chatterjee and Mr. Challa. Dr. Geetan Manchanda handed planters to the speakers, who then received a vote of gratitude from Ms. Mamta Godara. Ms. Pragya Malik and Mr. Arjun Naidu led the second session, which focused on Yoga and healthy living. Ms. Rajni Gupta and Dr. Geetan Manchanda expressed a gesture of appreciation at the end of the interactive session, and Dr. Shivani Yadav thanked everyone in her closing note.

SHORT TERM COURSE

During **October 23 - November 22, 2023**, the Department hosted a 30-hours Online Certificate Course titled "Building Mathematical Skills: Logic, Reasoning & Aptitude 2.0". The course, designed to improve students' mathematical skills for competitive exams and corporate placements, had 21 modules, six of which were new additions. The course was registered by 96 students from various prestigious colleges across the nation. The course was inaugurated by the respected Principal, Prof. Haritma Chopra. Dr. Neelima Ohri, the course co-ordinator compend the session and introduced the participants with course detail. The course consisted of daily e-content and live sessions led by Department teachers. The course ended with a final test on November 26th, followed by a Valedictory Session on December 18, 2023. Dr. Geetan Manchanda, the Course Convenor, offered the vote of appreciation, indicating the successful completion of the course. This was a tremendous achievement for both participants and organizers.

EDUCATIONAL TRIP

On **May 1, 2024**, the Department organized an educational trip to the National Science Museum, providing students with an enriching educational experience. They walked around informative exhibits including the Energy Ball and Kugal Fountain, learned about human biology and prehistoric life, and watched a 3D marine life show. The Fun Science Gallery included accommodate hands-on exhibitions, whilst the Heritage Gallery offered historical perspectives on India's scientific and mathematical advances. The trip was both educational and pleasant, invoking interest in science and mathematics among the youngsters.

FAREWELL

The Department bid a heartfelt farewell to the batch of 2021-24 on **May 9, 2024**. The event was a poignant occasion as students and faculty gathered to shower good wishes to the departing members of the department. The respected Principal, Prof. Haritma Chopra gave valuable suggestion ending with the key takeaway for everyone, “Dont react, respond!”.

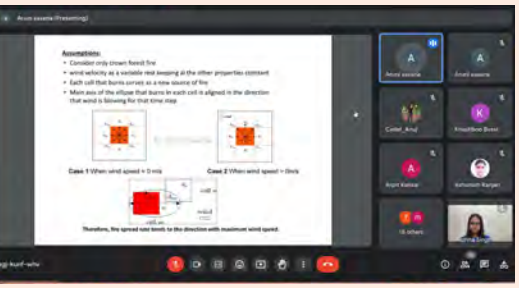
The farewell began with a warm welcome. The students reminisced about shared experiences and acknowledging the contributions of the faculty members as well as college in shaping their lives. There were heartfelt expressions of gratitude and well-wishes for their future endeavours.

As part of the farewell, students and colleagues shared anecdotes and memories, celebrating the friendships and mentorship cultivated within the department. A touching slideshow showcased the memorable moments from their journey in the college.

The event concluded with a symbolic gesture of presenting tokens of appreciation and personalised messages to the departing members, symbolising the lasting impact they've had on the department. Overall, the farewell was a poignant reminder of the bonds formed within the students and faculty members and was a celebration of the journey shared by all.

AVGAAHAN

The Round-1 event Math-e-logic had a strong participation, with 302 people initially enrolled. In this preliminary round, 185 candidates exhibited their abilities. Out of them, 25 candidates advanced to the final round, which was a poster-making competition with the theme ”Maths and Nature Intertwine”. The events held from **February 22- March 1, 2024** drew participants from 52 different colleges and institutes, demonstrating the extensive interest and participation among educational institutions. Furthermore, the competition demonstrated an amazing multidisciplinary reach, with 16 disciplines represented outside of the core department, indicating the broad appeal and usefulness of mathematical and logical talents across other fields of study.



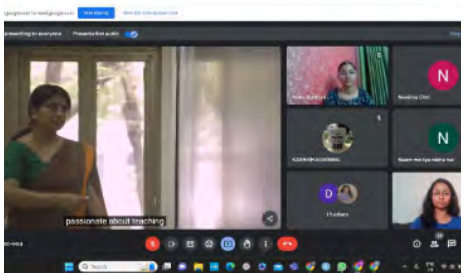
NATIONAL MATHEMATICS WEEK

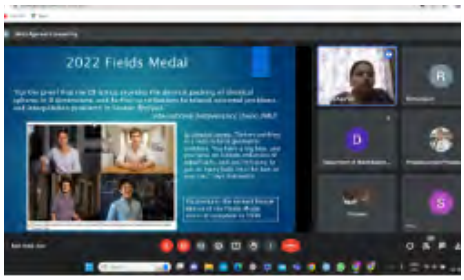
The Department, in collaboration with Shiksha Sanskriti Uthaan Nyas, Delhi, celebrated National Mathematics Week from **19th to 23rd December, 2023** to inspire and remind our present generation about the importance of Mathematics and Srinivasa Ramanujan's contributions in the field of mathematics.

- **On December 19, 2023**, a quiz on the movie "Ramanujan" had participants watch the film beforehand. It consisted of two rounds: an online quiz with 20 multiple-choice questions via Google Forms and a live quiz on Google Meet with additional video clip-based questions. Pamulapati Manasa of Maitreyi College won first place, and Jagdeesh of BHU finished second.
- **On December 20, 2023**, the "Mathematical Insights Showcase: PowerPoint Presentation" event featured eight participants from different colleges and universities, addressing diverse mathematical topics. Yukta Agarwal from Guru Gobind Singh Indraprastha University clinched the first prize with her presentation titled "A Simple Open Problem in Mathematics: Collatz Conjecture."
- On **December 21, 2023**, the "Art Integration Activity: Poster Presentation" event featured visually striking posters illustrating intricate mathematical concepts, promoting interdisciplinary learning and visual communication. Akshita Singh from Maitreyi College won first place with "Symmetry in Groups: Indian Art," while Priya Sharma, also from Maitreyi College, secured second place with "Symmetry in Group Theory."
- On **December 22, 2023**, Dr. Amit Kulshrestha from IISER Mohali discussed Srinivasa Ramanujan's life, focusing on his remarkable contributions to number theory, unique mathematical discoveries, collaborations with renowned Mathematicians, and enduring influence on the field of mathematics.
- On **December 23, 2023**, Dr. Rakesh Bhatia, National Coordinator of Vedic Mathematics at Shiksha Sanskriti Utthan Nyas in Delhi, introduced the simplicity and efficiency of Vedic Mathematics through innovative formulas and practical demonstrations. Attendees engaged in a lively Q&A session to explore its applications further.

INTERNATIONAL WOMEN IN MATHEMATICS DAY, MAY 12 INITIATIVE

To inspire women everywhere to celebrate their achievments in Mathematics, the Department organized various events on the occasion of International Women in Mathematics Day, May 12 Initiative. The day is in honour of Maryam Mirzakhani, the only women to win the Fields Medal.





- On **June 6th, 2023**, a symposium on International Women in the Department, presented by Dr. Nikita Agarwal. The session began with a welcome by Ms. Shivangi Pandit, and Dr. Aprit Kansal introduced Dr. Nikita Agarwal, who discussed Maryam Mirzakhani's significant contributions to geometry and dynamical systems, focusing on her work on Riemann surfaces and their moduli spaces.
- On **June 9th, 2023**, a virtual screening of "Journeys of Women in Mathematics," followed by an online quiz. The event highlighted the experiences of pioneering female mathematicians. Ms. Shivangi Pandit and Ms. Neha Budhani hosted the screening. Afterward, nine students participated in the quiz, with winners Udita Anand, Rishika Khatri, and Jyotsna Nigam receiving e-certificates and social media mentions.
- On **June 13th, 2023**, the second lecture of the symposium by Dr. Olena Vaneeva. Dr. Aprit Kansal introduced Dr. Vaneeva. Dr. Vaneeva discussed the lives and achievements of renowned female mathematicians, their career challenges, and their breakthroughs, including the mathematician whom Albert Einstein considered the greatest genius.
- On **June 14th, 2023**, a Modern Mathematician Art competition. Students from various departments participated. Participants drew famous women mathematicians from G-20 countries using mathematical shapes and introduced their chosen mathematicians.
- On **June 15th, 2023**, the third lecture of the symposium was by Prof. Geeta Arora. Prof. Arora discussed the benefits of Vedic mathematics, demonstrated rapid calculation techniques, and engaged students with puzzles. The lecture covered tricks for squaring numbers ending in 5, multiplying numbers with specific digit patterns, and quickly finding products involving 11 and series of 9s.

ABSCISSA

2024

ABSCISSA, the departmental fest held on March 15, 2024, commenced with an introductory address by Prof. Ajay Kumar from the University of Delhi. The event opened with a traditional lamp-lighting ceremony, followed by Prof. Kumar's engaging discussion on continuity and uniform continuity, sparking enthusiastic participation from students. Akshita Singh and Neha Budhani hosted the event, ensuring it was both informative and interactive.

The "Mathematics Relay" event followed, with 15 teams representing various colleges. Participants faced relay-based challenges over four rounds, with the quickest teams advancing. Team Invictus from Deshbandhu College won first place, while Team Equinox from Daulat Ram College finished second. The event emphasized the value of teamwork and collaborative problem solving.

The "Cosplay" event added a creative component by involving participants dressed as notable mathematicians and scientists. Kishan Kumar of Sri Aurobindo College received first place for his rendition of Albert Einstein. This event encouraged people to be creative, express themselves, and develop community.

The "Mock CID" event allowed participants to simulate criminal investigations based on the TV show "CID." Team Infinity from Ram Lal Anand College won first position, followed by Team Equation from Maitreyi College in second. The event focused on problem-solving abilities, critical thinking, and teamwork in a realistic scenario.

The series ended with a "Open Mic" event, which provided a venue for music, poetry, comedy, and other performances. Participants from several colleges demonstrated their talents, encouraging creativity and community involvement. The event series emphasized the Department's dedication to holistic student development and interdisciplinary learning.

Game Theory in International Relations, Trade and Politics

The game theory is directly related to real events and the possible solutions that can be offered. In other words, game theory has helped researchers to study problems in a rigorous and balanced manner. The conclusions clarified by game theory have often gone beyond the scope of economic analysis, and it has also significantly contributed to political science, international relations, and social theory

In today's political, cultural, and economic climate, game theory has become a coveted asset in the game of political and economic gamesmanship because of its overwhelmingly strong indications of mathematical certainties. .

Furthermore few real life examples and case studies of game theory are:

1) Prisoner's dilemma in nuclear arms race

The question presented by the description of Principle III of the Arm Race Competition, asking "Is the arms race beneficial for the individual participants?" is because the game does not contain external rules; the competition of the arms race benefits each superpower. Indeed, it is only when Russia and the United States are in complete security, thanks to nuclear weapons, that the arms race ends! Finally, since medium-short retention are authorized and benefit only potential aggressors, leading Russia, which was then "the potential aggressor", never could favor this option.

In the nuclear arms race, both superpowers have two options: either to restrain their own development of weapons or to be deceived by the other's construction of weapons. It is the essence of the Prisoner's dilemma. The rule of the de-escalation game, equitably accepted by all the participants, is very similar to the de-escalation game between two countries which play the Prisoner's dilemma. The history of the whole de-escalation could be interpreted without difficulties as a sequence of correspondences between the two superpowers and Russia.

2) Game theory in trade:

The same principle applies in other dynamic concepts to trade policy making such as, for example, Viner's or Meade's reformulation of the terms-of-trade theory. Results are the same as well if countries are more symmetric and choose quantity rather than trade policy instruments. This is true for policy variables such as the chosen amount of trade, Foreign Direct Investment (FDI), or non-cooperative environmental policies in order to attract markets through comparative advantages. Dynamic games have been studied in systems where public memory could be invoked. In that case, countries can credibly promise to, when provoked, retaliate in response to some actions. Public memory happens in world trade law. If you start a dispute, you can only invoke "escape clause", "safeguard", or "anti-dumping & countervailing" measures against a single trading partner if that country has acted in anger against you, or when for the purpose of Voice of Customer (VOC), process of capturing and analyzing the feedback and preferences of customers regarding a product or service.

Researchers have been increasingly applying game theory to international trade, not least in trade negotiations. We give an overview of the field. We start with static applications. The simplest is the well-known tariff-setting game. This is often used to test different ideas in other models, such as whether bilateral trade agreements can improve world welfare under certain conditions. Duopolistic competition is the most popular "backward induction" example. One of the ideas behind concepts such as Nash equilibrium is that of "mutual consistency". If being tough triggers your rival's toughness, then isn't it better to be conciliatory in the first place? If you do, however, isn't it better for your rival to become tough? But if your rival anticipates that you'll think this way, then he will take a conciliatory stand himself, which would then lead you to change your tough position. And so on. After some time, you reach an agreement.

3) Complex game tree in politics:

We turn to politics for an illustration of a slightly more complex game tree. A mock of American politics says that Congress likes more expenditures and chairpersons try to cut down the bloated budgets that Congress passes. Of course, chairpersons have their own likes and dislikes among similar expenditures and would like to cut only the bones they dislike. To do so, they would like to have the power to cut out specific particulars from the budget, or a line-item prescription. At first sight, it would feel that having the freedom to blackball the corridor of a bill can only increase the chairman's power and no way yield him any worse issues. Yet the chairman may be better off without this tool. The point is that the actuality of a line-item prescription will impact Congress's strategies in passing bills. A simple game actually showed this. It involves the system of backward logic in a game tree to a veritably trivial game(Charlie Brown) and extended it to a slightly more complicated game(the line-item proscription) The general principle remains applicable, no matter how complicated the game may be.

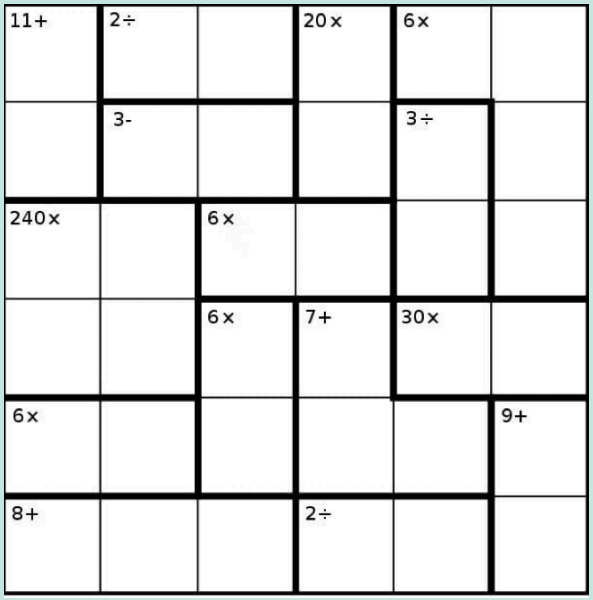
Between the two axes lie numerous relatively complex games that are played in business, politics, and everyday life. Two approaches can be used for these. Computer programs are available to construct trees and predict results. alternately, numerous games of moderate complexity can be answered by the sense of tree analysis, without drawing the tree explicitly. We illustrate this using a game that was played in a television show that's about games, where each player tries to" outplay, outsmart, and outlive" the others.

Therefore, game theory is an essential asset in areas of the social, political and economic importance.

-By Rajan Kaur (2nd year)

MIND LAB 5.0

KEN-KEN



Rules for ken-ken

1. The numbers you use in a Ken-Ken puzzle depends on the size of the puzzle grid. A 4 x 4 grid means you use the numbers 1, 2, 3 and 4. In this 6 x 6 grid, use the numbers 1 to 6.
2. No numbers may repeat in any row or column. (Every allowable number must appear in every row and column.)
3. You must fill that "cage" (region bounded by a heavy border) with numbers (in any order) that reach the target using the specified arithmetic operation. Numbers repeat within a cage, if needed, as long as they do not repeat within a single row or column.

For Answers Scan the QR KEN-KEN

CRACK THE CODE

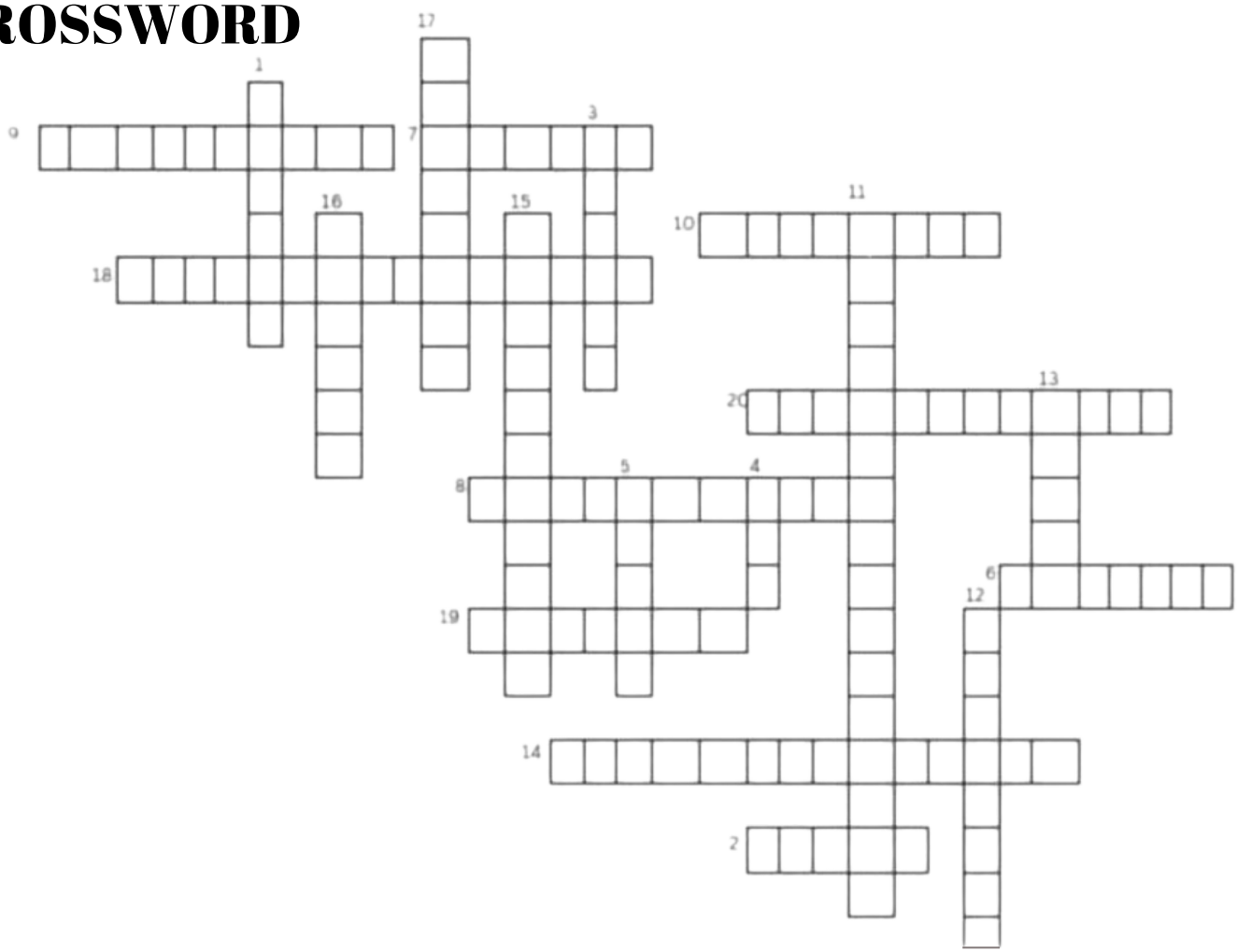
Can you crack the 4 digit number lock code?

TWO DIGITS ARE RIGHT, BUT BOTH ARE IN WRONG PLACE	8 9 5 1
TWO DIGITS ARE RIGHT, ONE IS IN RIGHT PLACE, 2ND IN WRONG PLACE	2 1 6 9
TWO DIGITS ARE RIGHT, ONE IS IN RIGHT PLACE, 2ND IN WRONG PLACE	3 6 9 4
TWO DIGITS ARE RIGHT, ONE IS IN RIGHT PLACE, 2ND IN WRONG PLACE	4 7 2 1
THREE DIGITS ARE RIGHT, BUT ALL ARE IN WRONG PLACE	1 2 3 7

ENTER THE CODE

For Answers Scan the QR CRACK THE CODE

CROSSWORD



Across:-

2.Popular card game often played with a standard deck and jokers, involving melding sets and runs of cards. (5 letters).
6.Imitating others' actions or behaviors without adding originality or innovation. (7 letters)
7.Puzzle game where players must fill a grid with digits so that every row, column, and subgrid contains all of the digits from 1 to 9. (6 letters)
8.Mathematical puzzle involving arranging a set of numbers in a specific order so that each row, column, and diagonal adds up to the same sum. (5+6 letters)
9. Field of study that analyzes strategic interactions between rational decision-makers. (4+6 letters)
10. A board game where players buy properties and charge rent to opponents, with the goal of bankrupting them. (8 letters)
14. Father of game theory (14 letters)
18. A situation where no player could gain by changing their own strategy. (4+11 letters)
19. Player one's gain is equivalent to player two's loss, with the result that the net improvement in benefit of the game is zero. (3+4 letters)
20. Table that contains the options that are available to players of a game. (6+6 letters)

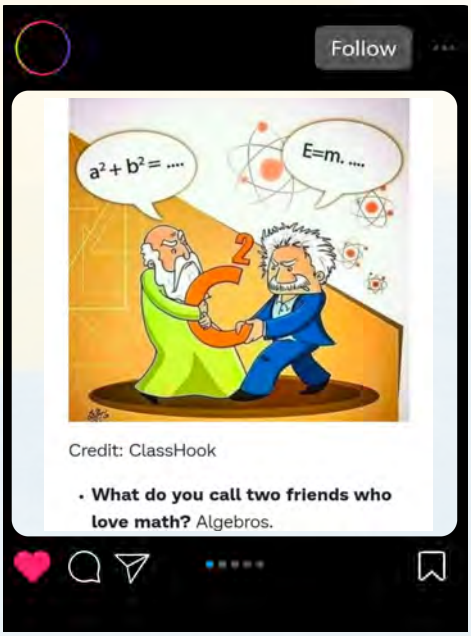
Down:-

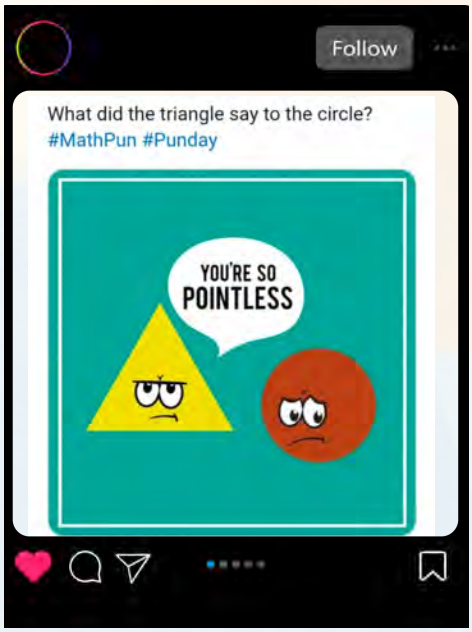
1. Mathematical game where players strategically place numbers on a grid and the numbers in outlined "cages" produce a specific result using given operations:(6 letters)
3. Grid-based puzzle game where players fill in cells with numbers, aiming to meet specified sum totals of rows and columns.(6 letters)
4. Colorful card game where players race to be the first to empty their hand by matching colors or numbers, often causing wild twists with special action cards. (3 letters)
5. A game of kings and queens, knights and bishops, where every move counts towards the ultimate objective: checkmate.(5 letters)
11. Classic game theory problem about cooperation and betrayal. (9+7 letters)
12. Word-building game where players strategically place letter tiles on a board to earnpoints, challenging opponents' vocabulary skills. (8 letters)
13. A word association game where players try to guess a word based on clues provided by their teammates. (5 letters)
15. Apart from World Champion, the highest title a chess player can attain. (11 letters)
16. India's youngest grandmaster. (6 letters)
17. In chess moving the king two squares toward a rook on the same rank and then moving the rook to the square that the king passed over. (8 letters)

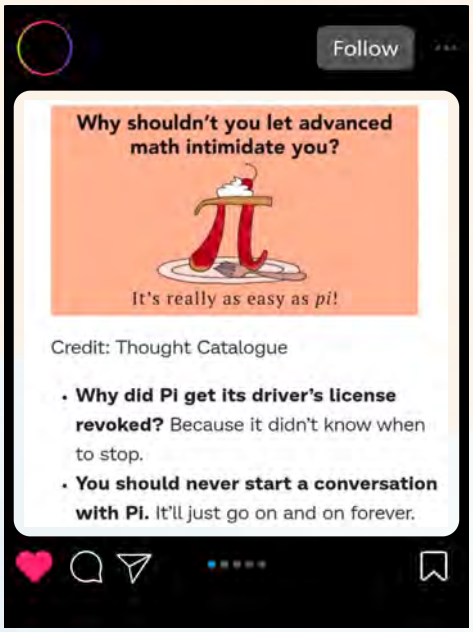
For Answers Scan the QR

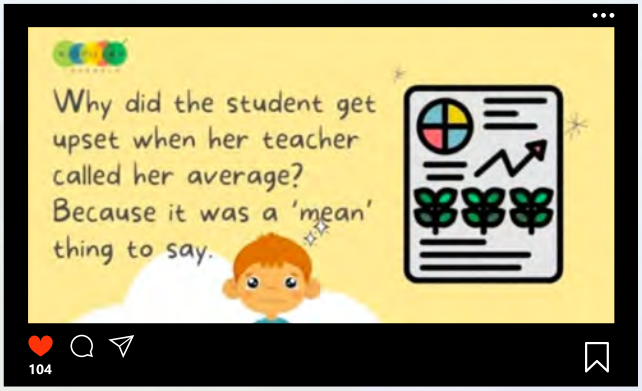
Credits: Samiksha, Shweta and Manshi (2nd year)

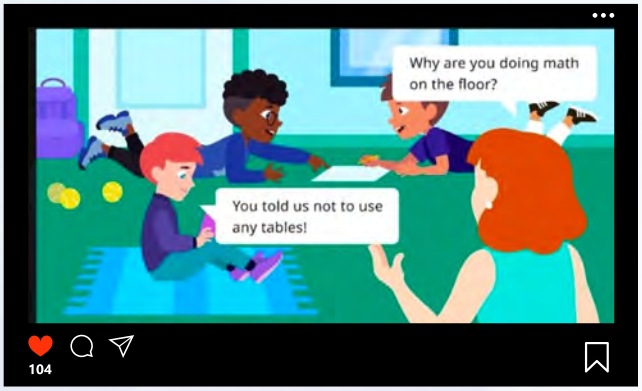
MEME CORNER











- What's a math teacher's favourite kind of tree? **Geometry**
- Why wasn't the geometry teacher at school ? **Because she sprained her angle**
- I had an argument with a 90 degree angle. **It turns out it was right**
- What shape is usually waiting for you inside the starbucks ? **A line**
- What do geometry teachers' have for decorating their floors? **Area rugs**
- What do mathematicians do after a snowstorm? **Make snow angles**
- Why did the mathematician spill all of his food in the oven ? **The directions said, "Put it in the oven at 180 degree"**

Credits: Samiksha, Shweta and Manshi (2nd year)

OUR ALUMNI

Dr. Anju Kumari

Batch 2009-12
Assistant Professor
Shyama Prasad Mukherjee College for Women

Maitreyi College played an important role in shaping my career. The teachers at Maitreyi College inspired me in Mathematics and provided me with a solid foundation in the subject, which helped me greatly in my further studies and research. Additionally, the guidance from the faculty created a supportive learning environment that fostered growth and confidence in me.

Kiran

Batch 2020-23

I completed my B.Sc. in Mathematics with honors from Maitreyi College in 2023 and am now pursuing an M.Sc. in Mathematics from IIT Delhi, having cracked the IIT JAM exam. Through this journey, I learned that the true pleasure lies not in the destination but in the journey itself. I focused on self-study, seeking help from teachers, Unacademy lectures, and YouTube to clear my doubts. This preparation taught me the immense value of time management. Key lessons from my IIT JAM preparation include:

- Results speak louder than efforts.
- Stop worrying about looks and style; no one cares.
- Maintain friendships; you'll need them for those cherished tea and samosa breaks.
- Don't broadcast your IIT JAM preparation unless you're ready for criticism.
- Every day counts; even the Sun and Moon don't take holidays.
- Keep going, whether you succeed or become a great guide.

Shivangi Pandit

Batch 2020-23

My journey felt like a short-term course on "Building a New Me" with hands-on experiences. As an introvert, I aspired to be approachable and confident in engaging with anyone. College was my chance to transform. Starting online, I gathered the courage to run for Class Representative (CR), which became a turning point. I interacted with classmates, students from different courses, juniors, seniors, and teachers, learning much about people and myself.

Inspired by my seniors, I became Vice president and then President of Gradient department. Every task, from asking teachers about classes to co-hosting events, collecting sponsorships, and organizing a successful departmental fest, was a first for me. This journey was made possible by my supportive friends, guiding seniors, encouraging juniors, dedicated teachers, and Maitreyi's nurturing environment. I never imagined I'd become who I am today. This "course" was a huge success, and Maitreyi gifted me with the "New Me."

Neha Nautiyal

Batch 2020-23

As a kid, I imagined college would be all fun and exploration. Joining Maitreyi College, however, was an eye-opener about the real world.

The experience was like a roller coaster, involving various competitions and college societies. Being in a girls' college provided a supportive environment with great friends and understanding teachers, pushing me beyond my comfort zone. I showcased my skills in extracurricular activities and learned valuable multitasking, task delegation, and time management skills. Maitreyi's atmosphere bridged my hard work and success, even with half my journey online. The faculty excelled not only in teaching but also in fostering a positive environment that encouraged new ideas and growth. I'm grateful for the experiences and supportive community at Maitreyi. Now, as a proud graduate, I feel confident showcasing my abilities. Proud to be a Maitreyian!

OUR ACHIEVER

The Department congratulates

MANVI CHAUDHARY

B.Sc. (Hons.) Mathematics
(2018-21)

for securing Rank 48 in

UPPSC 2023

EX- FACULTY COLUMN

"Though physically separated from Maitreyi, the memories encoded within the recesses of my mind persisted as constants in the mathematical equation of life, immutable and unchanging."

DR. ARPIT KANSAL

In the hallowed halls of Maitreyi College, my journey as a guest faculty in the realm of mathematics began, akin to the commencement of an elegant mathematical proof. Each moment within those sacred confines unfolded like the steps of a well-structured theorem, leading me inexorably towards enlightenment.

Maitreyi, with its infinite array of teaching methodologies and pedagogical strategies, resembled a mathematical function, continuously iterating towards the optimal solution of educational excellence. Through the harmonious convergence of lectures, workshops, and mathematical dialogues, the ambiance reverberated with the dynamic resonance of mathematical discourse, reminiscent of the convergence process within an operator sequence towards a profound limit.

Yet, beyond the rigid confines of academic discourse, Maitreyi revealed itself as a fertile ground for the cultivation of mathematical friendships, akin to the establishment of mathematical congruence between like-minded individuals. Each interaction, each exchange of ideas, served as the variables in a grand equation, yielding solutions of camaraderie and mutual growth.

As the variables of time and opportunity intertwined within the mathematical framework of fate, I found myself yearning for an infinite limit, a scenario where the derivative of my tenure at Maitreyi approached zero, signifying an infinitesimal amount of time spent away from its embrace.

Though physically separated from Maitreyi, the memories encoded within the recesses of my mind persisted as constants in the mathematical equation of life, immutable and unchanging. For in the realm of mathematics, as in life, it is not the quantity of time spent, but the quality of the interactions and the profundity of the lessons learned that truly matter.
And so, as I bid adieu to Maitreyi College, I extend my heartfelt gratitude to the entire department of mathematics, especially Rajni Ma'am and Geetan Ma'am, for their unwavering support and guidance. Let the symbol of summation encapsulate the totality of my experiences, each moment, each memory, converging towards a singular truth: that the essence of Maitreyi, and the warmth of its faculty, shall forever remain an integral part of my mathematical journey.

DR. ASHOK KUMAR

Maitreyi College stands as a beacon of academic excellence and holistic education, nestled in the heart of Delhi. From its inception, the college has been committed to nurturing young minds, empowering them with knowledge, and instilling in them the values of integrity, compassion, and social responsibility.

In Maitreyi Garden, the flowers bloom with a kaleidoscope of colors, each petal a testament to the garden's vibrant life force. From the delicate elegance of roses to the cheerful charm of marigolds, a diverse array of blooms adorns the landscape, weaving together a tapestry of natural beauty.

"In Maitreyi Garden, the flowers bloom with a kaleidoscope of colors, each petal a testament to the garden's vibrant life force. From the delicate elegance of roses to the cheerful charm of marigolds, a diverse array of blooms adorns the landscape, weaving together a tapestry of natural beauty."

The Department of Mathematics at Maitreyi College is a haven for those passionate about the beauty and precision of numbers, equations, and mathematical concepts.

My colleagues in the Department were not just coworkers; they are mentors, collaborators, and friends. Each member brings their unique expertise and perspective to the table, enriching our collective understanding and creating a supportive environment for both students and faculty alike.

Reflecting on my time at Maitreyi College, I am filled with gratitude for the experiences shared, the connections made, and the knowledge imparted. It is a place where time seems to stand still yet rushes by in a whirlwind of intellectual stimulation and personal fulfillment. As I bid farewell to this cherished chapter, I carry with me the memories of a journey enriched by the spirit of Maitreyi College.

MOVIE REVIEW

"Journeys of Women in Mathematics"

"You must be brave if you are a woman because in order to get a seat, you have to fight" quotes Aminatou Pecha in the film "Journeys of Women in Mathematics", a 20-minutes duration short film produced by the International Mathematical Union (IMU) Committee for Women in 2018. The film sheds light on the life of women mathematicians around the world described in the words of these women themselves, who struggled to get the recognition they have accomplished.

The first part of the movie shows three women mathematicians, telling their journey from their respective institutes and countries. It featured Neela Natraj from India, Aminatou Pecha from Cameroon and Carolina Araujo from Brazil. Neela Natraj is the first woman Head of Department of Mathematics at Indian Institute of Technology (IIT) Bombay, India. She has received the 'Excellence in Teaching' award thrice from the IIT Bombay for her profound skills in teaching. Aminatou Pecha is a researcher and also a member of 'The Cameroon Women in Mathematics Association', which is a non-profit association to encourage and support women who want to pursue a career in mathematics. Carolina Araujo is the only permanent researcher at the Institute of Pure and Applied Mathematics, Brazil. These three women shared their thrilling journeys which are full of hurdles. The movie shows how these women have supported and uplifted other women around them along with taking care of their families as well.

The second part of the movie shows various women sharing their fields of research and perspective as a women mathematician. It was shot at the "World Meeting for Women in Mathematics, 2018". It includes interviews of six women in mathematics, Salome Martinez (Chile), Alicia Dickenstein (Argentina), Maria Eulalia Vares (Brazil) as well as Natalia Garcia (Mexico), Jaqueline Godoy Mesquita (Brazil) and Carolina Neira Jiménez (Colombia). The movie also showcased some scenes from the 'Mariyam Mirzakhani Memorial Exhibition' towards the end.

In my opinion, this movie does not only show the successes of women mathematicians but also reflects their resilience and determination to reach their goals. Owing to the pioneer work and contributions made by women in the field of mathematics, the movie highlights the gender gap as well. I agree with Carolina's stance that there is an unbalanced gender gap in Mathematics. It's a call to action for lesser inclusivity and equivalency in the community, recognizing the heritage of changemakers like Mariyam Mirzakhani while inspiring unborn generations of women mathematicians.

I would like to end this review with a beautiful quote by Mariyam Mirzakhani "I don't think that everyone should become a mathematician. But I do believe that many students don't give mathematics a real chance."

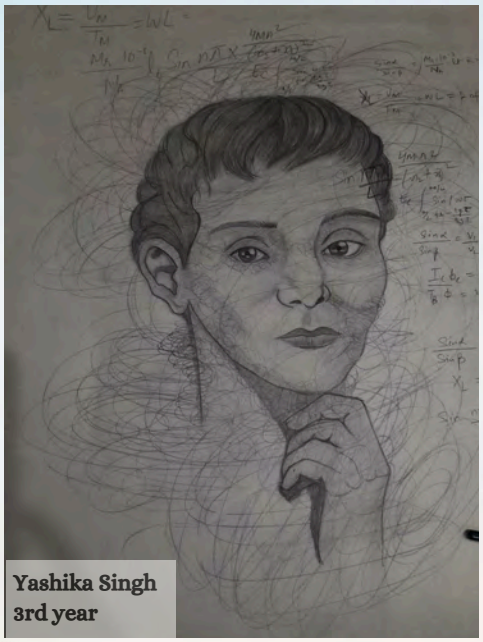
NOTE: This movie was virtually screened during the celebration of "International Women in Mathematics Day, May 12 Initiative" to highlight the experience of pioneering female mathematicians.

-By Rajan Kaur
(2nd Year)

ARTFUL FRAMES

Akshita Singh
3rd year

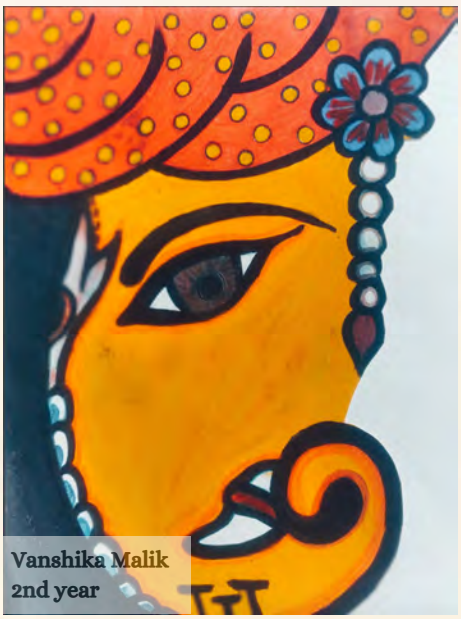
Taniya Singh
2nd year



Yashika Singh
3rd year

Sanya Malhotra
1st year

Sneha Gupta
3rd year



Vanshika Malik
2nd year

Neha Budhani
2nd year

Sneha Gupta
3rd year

THROUGH THE LENS

Sanya Malhotra
1st year

Vishwesh Tiwari
3rd year

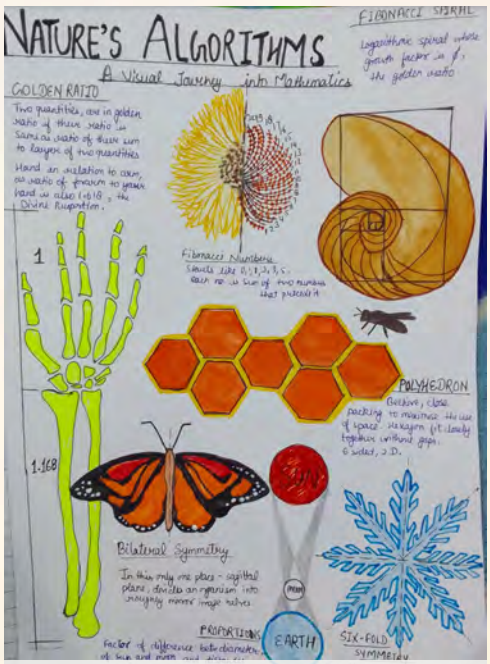
Vishwesh Tiwari
3rd year

Akshita Singh
3rd year

Sakshi Kalsania
1st year

AVGAAHAN WINNERS MATHOLOGY 2024

Neha Budhani (2nd year)
Maitreyi College (1st Position)



Srishty Gupta (2nd year)
Sri Venkateswara College (2nd Position)

POETRY FRAGMENT

मानव का सफ़र

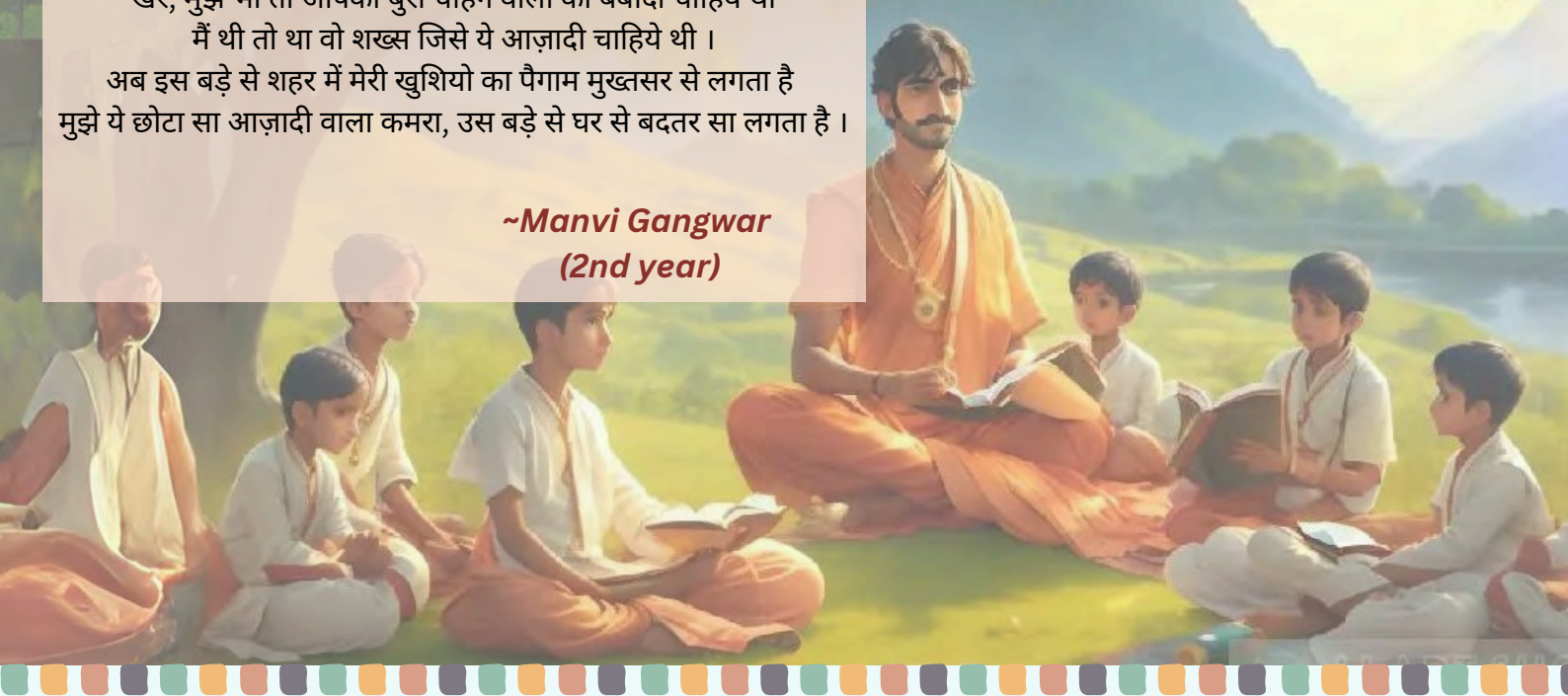
इस अनजान शहर में कोई भी मुझे अनु नाम से नही बुलाता है
माँ, इस नए शहर में तुम्हारा आँचल बहुत याद आता है
अब की तरह वहाँ पैसो को तराज़ू में तोलना नही पड़ता था
जब मैं घर पे था, तब किसी चीज़ के लिए बोलना नही पड़ता था
याद आता है जब हम तुम्हारे पाँव छूते थे और तुम हमे आशीर्वाद देती थी
कोई दे या न दे, पर तुम हमेशा हमारा साथ देती थी
और जब क्लास में फर्स्ट आते थे, तो दफ्तर के बाद पापा से हमारी तारीफ भी किया करती थी
भले ही बचा लो गलतियों पे पापा के सामने, पर अकेले में डांट भी दिया करती थी
और अब इस शहर में कोई भी मुझे अपना कंधा मजबूत नही देता
मैं रात को कितना भी पढ़ लूं , कोई आकर मुझे दूध नही देता
और अगर मनपसंद का खाना न हो हॉस्टल में, तो कोई मनाने भी नही आता
अगर देर रात तक जागूँ , तो पापा आपकी तरह कोई डांटकर सुलाने भी नही आता
पता नही ज़िन्दगी के इस पड़ाव पे कैसा मजबूर हो गया हूं मैं
आप दोनों के लिए, आप दोनों से ही दूर हो गया हूं मैं
बचपन मे सोचता था कि अकेला रहूंगा तो ऐश-ओ-आराम सारा कर लूंगा
तब लगता था महज़ 1000 रुपये में महीने भर का गुजारा कर लूगा
आज भी जैसे ही छुट्टियां पड़ती है, चेहरा घर की ओर मुड़ जाता है
पैसा कितना भी सम्भालके खर्च कर, पापा पलक झपकते ही उड़ जाता है
खैर, मुझे भी तो आपका बुरा चाहने वालो की बर्बादी चाहिये थी
मैं थी तो था वो शख्स जिसे ये आज़ादी चाहिये थी ।
अब इस बड़े से शहर में मेरी खुशियो का पैगाम मुख्तसर से लगता है
मुझे ये छोटा सा आज़ादी वाला कमरा, उस बड़े से घर से बदतर सा लगता है ।

~Manvi Gangwar
(2nd year)

We all grew up

From calling khichdi a patient's food to cooking and eating it happily just to save time
We all grew up.
From crying for 1 mark to not crying even after failing in exam, accepting it and working hard again
We all grew up.
From taking every small problem serious to taking every problem casual as they are variable and smiling at them
We all grew up.
From faking tears so that parents don't scold you to hiding real tears so that parents don't question you
We all grew up

~Manviya Rawat
(3rd year)



RESEARCH FUNDAMENTALS

According to the Oxford English dictionary, research is defined as the process of studying something carefully and discovering new facts about it. Researching a topic is going to be an important part of one's professional life as well. Under the National Education Policy (NEP), all students have research as a part of their curriculum.

Research involves an in-depth understanding of the topic. The first step of starting a research is to identify what topic you want to work on. The topic must adhere to the guidelines given and must be interesting for you then thoroughly search on the topic for collecting sufficient information for your project. You can start collecting information by going through various journals, periodicals, and books available in the campus library or even use the library's electronic database. One of the many ways to check the credibility of the resource we are using is to look at the authors credentials and to use a source which is "peer reviewed." In a peer reviewed journal, several other experts would have reviewed the authors work to ensure that the conclusion presented is valid.

Keep making notes of the resources. This may include URLs of the websites you are using, page number of books where you found relevant information and important keywords. Create a rough draft for organizing your ideas in a rough manner for better understanding of presenting your information and make changes until you feel that your final product is ready. To cite the corresponding resources is an essential part of any research paper. Not citing the source is plagiarism and is unethical. There are many softwares available for plagiarism check.

DrillBit:
This is a plagiarism detection software which is widely used in academics. This is provided for detection of originality of writing of researchers. DrillBit can also be integrated with google classroom, blackboard, brightspace and schoology. Presently our University is using the DrillBit software for plagiarism detection.

Listed here below are some of the key resources for simplifying the research work.

MathSciNet:
MathSciNet is an online bibliographic database created by the American Mathematical Society. It contains all the contents of Mathematical Reviews along with an extensive author database, citation and links to original articles.

Google Scholar:
Google scholar is a product of Google through which we can access academic resources and literature.

ArXiv.org:
In ArXiv you can see the latest work done by authors in your fields. Articles in arXiv need not be peer reviewed. It is a repository which is open access and contains pre-prints and post-prints that are made available by the authors themselves.

ResearchGate:
ResearchGate is a social networking site for Scientists and Researchers to share papers, ask questions and find collaborators.

MathOverflow:
This allows users to ask questions,submit answers, and rate both, all while getting merit points for their activities.

Mendeley:
Using this, We can store and organise and research all your references from just one library.

Open Math Notes/ NPTEL:
This provides e-learning through online web and video courses streams.

Zotero:
Zotero is a reference management tool that helps researchers collect relevant data from various pdfs, newspapers, websites, and journals. It is highly compatible with various word processors including google docs and ms word and helps the author manage citation and bibliographies.

Trello:
Trello helps a researcher organise his/her ideas using interactive interfaces. These interfaces can be used in multiple ways which include assigning tasks, creating lists, linking files as well as assigning due dates for these tasks. One can see the entire research process in a single trello board.

E-Library:
The University of Delhi provides access to about 1.5 lacs e-books and other digital resources. Besides these, e- journals are also available.

Research at Maitreyi College
Maitreyi College provides a platform Centre For Research (CFR) to nurture research amongst faculty and students at the under-graduate level. The major research programmes carried out by the centre are the following:

- Summer Internship Programme (SIP)
- Annual Research Programme (ARP)
- The Annual International Conference Equinox under the aegis of Vantage: Journal of Thematic Analysis
- Special Lectures and Training Workshops
- Vocal for Local

-By Udita Anand (2nd year), Tannu Sharma (2nd year)

OUR SUPPORT SYSTEM

Prof. Haritma Chopra
Principal, Maitreyi College

Left to right: **Mr. Ravi Kumar Meena, Mr. Monu Kumar, Mr. Nitin Sharma, Dr. Neetu Arneja, Ms. Rajni Gupta, Dr. Geetan Manchanda, Ms. Priyanka Sahni, Dr. Varsha Chauhan, Ms. Rimpi, Dr. Neelima Ohri, Dr. Simran Kaur, Dr. Archana Paradkar, Mr. Sandeep Kumar, Mr. Saurav Kumar.**

EDITORIAL TEAM

Neha Budhani

Rajan Kaur

Jyotsna

Samiksha

Tannu

Udita

Special Mention:

Ritika, Taniya Singh, Keshvi Kapoor, Shweta Yadav, Manshi, Urvashi Pareek

EDITOR'S MESSAGE

Dear Readers,

I am honoured to present the special version- 5th edition of our Departmental E-Newsletter, 'Convergence'. Each edition of Convergence sets out to bring the wonderful world of mathematics closer to all of our readers by crossing disciplinary barriers. I'd want to express my deepest gratitude to our honourable Principal, **Prof. Haritma Chopra**, for her unwavering encouragement and support in pushing us towards greatness. My heartfelt thanks also goes to **Dr. Geetan Manchanda**, Head of the Department, for her unwavering guidance and assistance during this journey.

A note of appreciation to the **Faculty Editorial Board, Dr. Archana Paradkar**, **Dr. Neelima Ohri**, and **Ms. Rimpi,** for their unwavering devotion, inventiveness, and essential insights. Their collaborative efforts have helped shape this newsletter into a valuable resource. Working with such a brilliant and dedicated team has been a rewarding experience, and I am genuinely thankful for their efforts and dedication. I'd also like to thank everyone who believed in us and contributed their work for publication.

"Pure mathematics is, in its way, the poetry of logical ideas." - Albert Einstein

We hope this year's diverse range of content will ignite your mathematical curiosity and highlight the dynamism and creativity of our department. I hope the intriguing realm of game theory catches your attention through this newsletter.

Happy Reading..

-Akshita Singh
(3rd year)