

PRUF – CW Language Application in Creative Literature

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Abstract - Agatha Christie, one of the world famous Mystery novel writer, dedicated her life to literature and referred as Master of Suspense's and Twist's. This study mainly depicts the nature and sweetness of the mathematical logic in the field of literature, and also reveals the true nature, meticulous style of Agatha Christie's novels. The purpose of this paper is to study how Mathematics can be applied in the world of creative literature, and how 'mathematical' logic plays a vital role in solving mysteries. This paper carries several research works which includes the classification of Classical logics; Fuzzy logics; examining the nuances and main suspect behind the murder. I strengthened this study by interlinking both Mathematics and literature. Also this paper discusses the nature of murder mystery novels and also narrates how the suspense's plays a vital role in Agatha's novels. Theoretical fuzzy Logic explanation and practical logic application for solving these mysteries are explained with particular case studies.

I. INTRODUCTION

Many of the high intellectual literary persons linked their works with Mathematics and produce humour and also enrich their identity in the field of Mathematics. The Symbolic Logic of Murder by John Reese "adjusts Boolean algebra, of an admittedly elementary order, to the requirements of popular fiction." The truth behind the mystery murder is related to negations, unions and intersections. In a moving story of a mathematical child-genius, the young Archimedes, Aldous Huxley combines a loving proficiency in music with an extraordinary ability in mathematics.

In "female mathematical geniuses", Mark Clifton portrays about Star and Bright. Star, a three-year old child, invents a Moebius strip and also figures out a way to teleport herself into 4-dimensional space and to travel backwards and forwards in time. Other female geniuses have been subjects of two plays, Arcadia by Tom Stoppard, and Proof by David Auburn. The Moebius strip is a popular focus of number of stories. For instance, in the humorous story, Paul Bunyan Versus the Conveyor Belt, uranium mine workers Paul Bunyan and Ford Fordsen use a mile long and four feet wide conveyor belt to transport the ore. The belt is a Moebius strip with one twist. Needing to lengthen the belt, they argue with Loud Mouth Johnson about the result of cutting it lengthwise down the middle. Later the need to lengthen the belt again leads to a new argument. In War and Peace, Tolstoy uses mathematics to bolster his theory of history. Tolstoy's theory is that history needs to be analyzed mathematically and statistically and not as discrete incidents, but (in a reference to calculus) as a continual process, where causes are shown in a regressive process, a kind of infinite sum of infinitesimal quantities. In addition, Tolstoy provides an example of the use of ratio and linear equations to

clarify how the disadvantaged (such as the Russians) can win battles against more advantaged (such as the French) if they have enough spirit and energy. Ratio and proportion can be used to relate the power of an army to its spirit. Many poems and limericks express appreciation, understanding, love, or fear of mathematics from a variety of different perspectives. Umar Gayyam, a poet known for love poems is basically a mathematician. Poems and limericks are often humorous.

The content of a poem may relate to the subject matter, or the associated pedagogy, it may be about a mathematician, or a mathematician's life. For instance, Jo Anne Growney's poem, "A Mathematician's Nightmare", seems on the surface level to be about decision-making in pricing and shopping, but it is an excellent depiction for a student or lay reader of the Collatz Conjecture, a famous unsolved problem. This paper also examine and depicts the nature of murder mystery, and more commonly it discusses the meticulous and mysterious style of Agatha Christie. Mystery fiction is a novel or short story in which a detective either professional or amateur investigates and solves a crime mystery. Crime fiction is the literary genre that fictionalises crimes, their detection, criminals and their motives. The term "mystery fiction" may sometimes be limited to the subset of detective stories in which the emphasis is on the puzzle/suspense element and its logical solution, in contrast to hardboiled detective stories, which focus on action and gritty realism. This paper deals with the suspenses developed in the Agatha Christie Mystery novels. Mystery fiction can be divided into numerous categories, among them the "traditional mystery", "legal thriller", "medical thriller", "Cozy mystery", "police procedural", and "hardboiled" mystery are the popular and major types. Usually the literary person employ whodunit format in their works. It is one of the common form of detective fiction. It features a complex, plot-driven story in which the reader is provided with clues from which the identity of the perpetrator of the crime may be deduced before the solution is revealed at the end of the book. In Knox's words, a detective story, "must have as its main interest the unravelling of a mystery; a mystery whose elements are clearly presented to the reader at an early stage in the proceedings, and whose nature is such as to arouse curiosity, a curiosity which is gratified at the end." A majority of detective stories follow the "whodunit" format. The events of the crime and the subsequent events of the investigation are presented in the fiction so that the reader is only provided with clues, from which the identity of the perpetrator of the crime may be deduced. The real truth is not revealed until the final pages of the book.

A. Mysterious Agatha and her meticulous Styles

- Plot- The arrangement of dramatic incidents or the story of the play's actions.

- Subtext - The meanings beneath the text usually revealed through oral delivery of the text or the actions of the person speaking the text.
- Exposition - That part of the play that reveals what has happened before, exposing theme, characters, and previous events.
- Climax - The culminating event of a series of events; the point of highest dramatic tension; the decisive turning point of the action.
- Crisis - A decisive state of things, the turning point at which something must soon terminate or suffer a material change; a crucial situation whose outcome decides which consequences will follow.
- Denouement - Unknotting or unraveling of the main dramatic complication of the plot, producing the final outcome.
- Foreshadowing - An event that predicts future outcomes often through symbolic objects, actions or sayings.
- Symbolism - Investing objects with non-intrinsic meanings.
- Red Herrings - A term derived from the practice of drawing a smoked herring across a trail to confuse hunting dogs; later became known as something that distracts attention from the real issue.

Christie's stories are also known for their taut atmosphere and strong psychological suspense, developed from the deliberately slow pace of her prose. Almost all of Christie's books are whodunits, focusing on the British middle and upper classes. According to Agatha, expressed through Poirot's words, the culprits had committed crimes with a well planned execution plan and undoubtable escape mechanisms. The crimes were not committed due to an impulsive, emotional outburst. Some characters take revenge after many years. Usually, the detective either stumbles across the murder or is called upon by an old acquaintance, who is somehow involved. Gradually, the detective interrogates each suspect, examines the scene of the crime and makes a note of each clue and then finally sum up all the clues as he discovers the murderer. Very often, the detective makes journey by train or car, in the process of investigation. Then, about halfway through, or sometimes even during the final act, one of the suspects usually dies, often because they have inadvertently deduced the killer's identity and need silencing. In her novels, like "Death Comes as the End" and "And Then There Were None", there are multiple victims. Finally, the detective organises a meeting of all the suspects and slowly denounces the guilty, exposing several unrelated secrets along the way, sometimes over the course of thirty or so pages. The murders are often extremely ingenious, involving some convoluted piece of deception.

II. PRINCIPLES USED

A. Fuzzy Logic

A fundamental contribution of fuzzy logic is a methodology for 'computing with words(CW)'. This method is termed as PRUF – CW language (Possibilistic Relational Universal Fuzzy – Computing with words language) and widely accepted as Fuzzy Subsets. The notion of computing with words (CW) has recently emerged instead of computers. Basically computers manipulate numbers but humans communicate with words. For example they derive approximate reasoning conclusions

expressed in words, from observations and facts, the premises, that are expressed in a natural language. Fuzzy sets and techniques provide a methodology for computing with words which mimics human reasoning.

Zadeh presented a meaning representation language called PRUF('Possibilistic Relational Universal Fuzzy') explains, some imprecision that is intrinsic in natural language, is possibilistic rather than probabilistic in nature. There are different ways of looking at fuzzy logic, and when studying approximate reasoning in natural languages, one may consider linguistic truth values (Eg. More or less true, not very true, absolutely false) expressed by fuzzy sets of the unit interval [0,1]. Fuzzy logic and probabilistic logic are mathematically similar, both have truth values ranging between 0 and 1, but conceptually distinct, owing to different interpretations. Fuzzy logic corresponds to "degrees of truth", while probabilistic logic corresponds to "probability, likelihood"; as these differ, fuzzy logic and probabilistic logic yield different models of the same real-world situations. The fundamental difference between classical propositions and fuzzy propositions is in the range of their truth values. While each classical proposition is required to be either true or false, the truth or falsity of fuzzy proposition is a matter of degree. Assuming that Truth and Falsity are expressed by values 1 and 0, respectively, the degree of truth of each fuzzy proposition is expressed by a number in the unit interval [0,1]. Here are some basic fuzzy type of classification, based on the method which mimics human reasoning. This part of the paper deals with the brief structure of Christie's mystery works and also it deals with the Fuzzy concept, in finding out the killer. The statements are categorized according to their importance and denoted by the membership degree.

a) Unconditional and unqualified proposition

"The temperature is high" is one of very suitable example for this proposition. Here the statement doesn't have any conditions in it and it also doesn't denote any qualification of the linguistic variable.

b) Unconditional and qualified proposition

"The temperature is high is very true" is one of the suitable example for this proposition. Here the statement doesn't have any conditionals in it, but the proposition is qualified by denoting the proposition with qualified linguistic term "very high".

c) Conditional and unqualified proposition

"If the temperature is high, then it is hot" is one of the suitable example for this kind of proposition. Here the statement had the condition "IF", but it doesn't have any qualified linguistic terms to add the quality to the given proposition.

d) Conditional and qualified proposition

"If the temperature is high, then it is hot is true" is one of the suitable example for this kind of proposition. Here the statement had both the conditional "IF" and the qualified linguistic term "true" to add quality to this proposition.

B. Fuzzy Subset

Let E be the universal set, let x be an element of E. then the fuzzy subset A of E, (A of E) is a set of ordered

pairs. $A = \{(x | \mu_A(x))\}$, for all $x \in E$. Where $\mu_A(x)$ is the grade (or) degree of membership of x in A . $\mu_A(x)$ takes the value from the membership set $M = [0,1]$ and $\mu_A(x)$ is the membership function or characteristic function.

C. Projection of a Fuzzy Relation

a) First Projection

The membership function, $\mu_R^{(1)}(x) = \bigvee_y \mu_R(x, y)$ is called the first projection.

b) Second Projection

The membership function, $\mu_R^{(2)}(x) = \bigvee_x \mu_R(x, y)$ is called the second projection.

c) Global Projection

The second projection of the first projection (or) the first projection of the second projection is called the Global Projection of the fuzzy relation, and it will denoted by, $h(R)$

$$(i.e.,) h(R) = \bigvee_x \bigvee_y \mu_R(x, y) \quad (or) \quad h(R) = \bigvee_y \bigvee_x \mu_R(x, y)$$

d) Normal Projection

If Global Projection of the fuzzy relation is 1, then the relation is said to be Normal.

e) Subnormal Projection

If Global Projection of the fuzzy relation is <1 then the relation is said to be Subnormal.

III. DESCRIPTION OF WORKS

. The following are the predictions that we had from our work.

- To predict the time interval
- To predict the similarities (symmetric property, left right discrepancy)
- To predict the exact plot
- To predict the impersonating, false clues
- To predict the suspense behind all the murder
- To predict the red-herring (false clues leads to false conclusion)
- To know about the character
- To know about the repetitions (usually words, sentences)
- To predict the sequences, order
- To predict the contradictions

The following were the two different case studies.

A. The Hollow

The story begins as Henrietta, Henry, and Lady Angkatell prepare for some regular weekend trip to The Hollow, their home outside of London. The three had invited Christow's family to join them for the weekend. They had also invited Midge Harvey, cousin of Henrietta for their weekend gathering. Edward Angkatell, son of lady angkatell, was also to join them to celebrate the weekend. In the story we find two more person namely Hercule Poirot and The Hollywood Actress Veronica Craye who reach the cottage for weekend. Veronica Craye who was engaged to John Christow ten years before had come for her weekend enjoyment. All were engaged in the evening party which was arranged in Lady Angkatell cottage. After a few days, all gathered for a talk to relax themselves. Veronica Craye, suddenly entered into the party hall and asked for a matchbox. She was surprised to find John Christow there. She invited John to her cottage once the party gets over after the dinner. John accepted her invitation and went to her cottage. All those who were in the party, noticed John reaching Veronica Craye's cottage. Gerda was present in the group. Christow returned to the room by 3.00 o'clock on the next day morning. Gerda had noticed his return. Gerda had noticed his return. Next day morning John went to Veronica cottage. She forced John to marry her and leave Gerda. But John Christow strongly refused her saying that, Gerda is more important to him and he wants to live with her only. Later he left Veronica's cottage and reached near the pool which has been located near to the Lady Angkatell's cottage. There John was shot dead.

a) Similarities and Suspense's

The family members were trying to hide Gerda from the crime. The following are the miss leading arguments that has been played by the family members. The statements made by them includes such as;

- Guns are fired regularly in Act II and left in unusual places.
- Lady Angkatell makes misleading comments, making many believe she is the killer.
- Gudgeon exhibits odd behavior and Doris accuses him of the murder.
- Lady Angkatell appears to defend him, drawing even greater attention to Gudgeon and then to herself.
- Edward claims that John said nothing when he died, while everyone else heard him saying, "Henrietta!" Veronica displays suspiciously threatening behaviour before and after the murder.
- Sir Henry suggests to Midge that Edward has proposed to her to deflect suspicion from himself.

Table-1

Suspect	Blaming	Hearing the final word "Henrietta"	Misleading Comments	Love proposal	Anger due to the John's act at night and his late arrival	Symbolism And Hatchet missing.
Gerda	0.8	1	0.9	1	1	1
Edward	0	0	0	1	0	0
Henrietta	0	1	0.9	0	0.5	0.75
Angkatell	0.8	1	0.75	0	0.5	0.5
Gudgeon	0	1	0.25	0	0	0
Veronica	0.8	1	0.9	1	1	0

Table-2

	Statements in degree. (e.g. 10% as 0.1)
Statements Misdirected	
Veronica craves tries to blame Gerda	0.8
Gerda blames Veronica	0.8
Henrietta defends Gerda and Angkatell	0.75
Edward – Midge love proposal	0.25
Midge suspecting Edward's proposal	0.5
Henrietta gets Gerda the confess	0.8
John's final word "Henrietta"	1
Guns are left in unusual places	0.8
Gerda's anger due to John's Act	1
Hatchet in Gerda's room	0.8
Symbolism by Henrietta	0.5

Table-3

Linguistic Terms	Degree
Unimportant	0
Very Less important	0.1
Less important	0.25
Partially true and unimportant	0.5
Partially true and Important	0.75
Important	0.8
Very important	0.9
Very much important	1

And then we allot membership degree for those linguistic terms such as;

Now it is the time to find whose involvement is more when the murder takes place. To find this, we use Fuzzy Membership. These are the observations made by us when studying the novel. And we give the membership degree according to their importance. We apply Max-Min composition to fix the murderer.

B. After The Funeral

Richard Abernethie was the eldest of seven. His young brother is Timothy Abernethie and his young sister was Cora Abernethie. Richard Abernethie is a wealthy person but affected by a serious disease. Doctor examined Richard's health and sug-

gested that his condition was too bad. So Richard wanted to divide his wealth with his blood relations. Richard also had a nephew and two nieces. Richard wanted to divide his wealth into six portions and the six members he quoted in his will are, Timothy Abernethie, Cora, his nephew George, then two nieces, and the last portion is for his brother Leo's widow. One day Richard was found dead in his sleep. But Cora argued that his death was not natural and it was a crime. But doctor's reports said that it was a sudden demise, it was an unexpected one and it was a natural death. It caused some doubt among the family members. Mr. Entwistle, Richard's family lawyer, read Richard's will in the Enderby Hall, where all the family members were present and the wealth has been shared by six of his fami-

ly members. For four of them the portion was directly given as properties and the remaining two, the young sister and brother of Richard, had a lifetime income from his wealth. The house of Richard and the things owned by him were kept for auction. The auction would take place later. But after the funeral, the next day Cora was found dead, brutally murdered in sleep by repeated blows with a Hatchet. Motive of the murder was not obvious. One possible motive is to suppress anything that Richard might have told Cora about his suspicions that he was being poisoned. These had been overheard by her paid companion, the timid Miss Gilchrist. Then Mr. Entwhistle asked Hercule Poirot to take over the case and find the murderer. Poirot employed an old friend, Mr. Goby, to investigate the family. Mr. Goby, a most resourceful man, collected number of reasons for the family members who were in desperate need for the money from Richard Abernethie's estate. None of the family members could be cleared of suspicion. Poirot warned Entwhistle that Miss Gilchrist may herself be a target for the murderer. The Inspector Mr. Goby and Hercule Poirot shared information as they gathered. Mr. Goby focused on people in the area of Cora's rented cottage. Poirot focused on the Abernethie family, and a number of red herrings come to light.

- a) The statements which misdirected the investigations are
 - Rosamund Shane, one of the nieces, is a beautiful but determined woman who seems to have something to hide (which turns out to be her husband's infidelity and her own pregnancy).
 - Susan's husband, Gregory, is a dispensing chemist who had been responsible for deliberately administering a nonlethal overdose to an awkward customer. In a surprising twist, he confesses to the murder of Richard Abernethie at the end. He possesses a psychological complex to perish people. Timothy Abernethie, an unpleasant man preoccupied with his own health perhaps to gain attention, might have murdered Cora, along with his country tweed, strong, healthy wife, Maude.
 - Even the gentle Helen Abernethie left Enderby to fetch her things from her London flat upon agreeing to stay longer at Enderby.
 - In short, all the family had been alone on the day Cora was murdered, for enough time to reach the rented cottage and commit the murder.

b) Impersonification

Cora had never come to the funeral at all. It was Miss Gilchrist, who disguised herself as Cora as part of a complicated plot for her own gain, leaving Cora home asleep from a sedative in her

Table-5

Suspect	Anxiety about future	Cora's Identity	Cora's Mannerism	Cora's Habitual Activity	MAX(y) First projection
Rosamund	0.5	0.25	0	0	0.5
Gregory	0.75	0.25	0	0	0.75
Miss. Gilchrist	1	1	1	1	1
Helen Abernethie	0	0.5	0.5	0	0.5
MAX(x) Second projection	1	1	1	1	1 Normal projection

tea. She wished to plant the idea that Richard's death had been a murder. Therefore when Cora herself was murdered, it would seem that the alleged murderer had struck again. None of the family had seen Cora for over 20 years, due to the ill feeling caused at the time of her marriage. Miss Gilchrist had successfully copied her mannerisms, well enough to fool those who had known her as adults. The flaw in her portrayal of Cora was spotted by Helen Abernethie. Miss Gilchrist had rehearsed a characteristic turn of the head in a mirror, where the reflection is a reverse of reality. When she came to the house after the funeral, she turned her head to the left, not to the right. Helen had had the feeling that something was wrong when Cora had made her startling statement, but took some days and a timely conversation among the young cousins to realize precisely what it was.

c) Left – Right Symmetric Property

The left right discrepancy in the mirror reflection helped to solve the mystery. The criminal Miss. Gilchrist came to a family gathering, impersonating an aunt of the family who is supposed to be returning after a long time. The aunt had a peculiar gesture of bending her head to the right, while talking. The criminal practised this gesture and used it. But as she practised in front of a mirror, she had bend her head to the left and was finally caught.

d) Fuzzy Applications

The most suspected happenings are,
 Shane Rosamund –Pregnancy due to sexual relationship with her husband
 Gregory (husband of Susan) – Chemist – overdose given to Richard
 Miss. Gilchrist – took poison in the cake
 Helen Abernethie – Doubted in mannerism

e) Fuzzy Criterion

Linguistic Terms-Having read the novel in detail and fuzzy membership tools are applied. First, membership values are given arbitrarily, to some linguistic variables,

Table-4

Linguistic Variable	Linguistic values
Never	0
Sometime yes	0.25
Yes	0.5
Often	0.75
Very often	1

V. RESULT

Based on the above membership table and applying first and second projections, it is clear that Miss Gilchrist should be the Culprit. Her involvement is more that of others and Helen's doubt is all about Miss. Gilchrist and her gesture and impersonating as Cora.

VI. CONCLUSION

The mystery plots of Agatha Christie may look simple at the outset, but it is more complex. Agatha Christie's work contains innumerable logical statements and she attracts the

reader by her plots, characterization, and the 'Twists'. Through the character of Hercule Poirot, she unfolds the truth hidden by different actions, words and events. The reader who cracks the mystery after reading her stories are considered to be a bit of 'genius' in them.

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