Revolution in Technology -'Blessing or Misfortune' for University Engineering Students

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Abstract—Advancement in technology no doubt have made human's life comfortable and convenient. But this revolution in technology at one end has proved to be a blessing to humans and at other end has become a misfortune for university engineering students in form of 'code-plagiarism'. Students are often caught in incidences of copying software codes from internet which are given to them as lab assignment in programming labs. Student's take undue advantage of this blessings that technology has provided to humans to avoid tireless and time-consuming manual efforts just for sake of convenience. But Student's forget in this stage of life only rigorous practice would make them perfect and would help them develop their own coding logic. With increase in innovations and inventions that technology is giving every day, it gives opportunities to socially inspired students to hide beneath different technological advancements. They hide their act of copying software codes in programming labs of universities by using different technological innovations like Bluetooth, What-Sapp, Hike, Facebook, other instant messengers and social networks. This prevents students from developing logical and analytical skills. Universities are becoming more concerned in this regard. To cope up with such challenges in our education system the undertaken research provides an opportunities to universities to integrate with their norms a 'code-plagiarism evaluation cum prevention model'. This model works will not only provide opportunity to faculty to smartly detect hidden activities of students of code-plagiarism in labs but will also suggest suitable prevention measures to overcome curse of code-plagiarism in programming labs. Digital era university students may opt code-plagiarism and hiding at the same time, using smart technologies such as Hike, Bluetooth etc. It is easily feasible for faculty members to trace these behavior of students using SCEPM model. SCEPM is a complete incremental learning evaluation cum prevention system integrated using Genetic Algorithm (GA), Multi-Level Cohort Analysis (MCA), various machine learning clustering algorithms like K-Means etc., which any university can implement easily with objectives like to trace / remove / predict code-plagiarism in programming labs of university. (Abstract)

Keywords- Code-Plagiarism, Similarity Index, Hidden Layers, Footprints, Attractiveness, Optimization (key words)

I. INTRODUCTION

Plagiarism can occur in anywhere in everyday field especially with proliferation of digital resources on Internet and advent of social networks like What-Sapp, Hike, Skype, Facebook, Line, We-Chat and non-social networks like Bluetooth, SMS etc. Similarly increasing incidences of code-plagiarism can be easily observed among students these days in programming labs of universities. This in turn affects students problem solving and logical coding skills which affects their competency in software industries in future. Basically students try to use one or more of the social or non-social networks as hidden layers to exchange their cloned lab assignments among themselves in their batch and smartly hide their act of cloning from lab instructor and faculty using either of the hidden layers. In spite of exchanging cloned lab assignment over university mails or

other personal mails which can be easily caught by faculty and in turn can make them punishable for breaking academic laws. They try to use some personal social or non-social networks as means of hiding their act of code-plagiarism and exchange cloned code which is punishable as per university academic norms and defined laws against code-plagiarism. The key motivation behind undertaken research study is to propose a solution to such challenges of code-plagiarism in universities programming labs.

This research proposes a 'Smart Code-Plagiarism Evaluation cum Prevention Model' (*SCEPM*). This model provides faculties with opportunities to smartly detect smart copying cases of code-plagiarism of students in programming labs. As well as recommend an appropriate prevention measure to prevent such actions of code-plagiarism of students in university labs. Hence the model works in two phases – Phase I: Code-Plagiarism Detection Phase then Phase II: Code-Plagiarism Prevention Phase. This model also provides opportunities to faculty members and universities to understand smart act of copying or cloning of codes by students in programming labs and implement a code-plagiarism prevention measure smartly to improvise student's cloned behavior of software codes in labs. Prevention is only possible by universities by proposing and formulating different laws against code-plagiarism based on close observation of students hiding behavior using various technological means. Our article takes place at intersection of various domains as shown in Fig. 1 where focus of our paper is mainly on 'Social and Non-Social Hidden Layers' problem domain as highlighted in figure as well. Fig.2 gives a generalized view of SCEPM model.

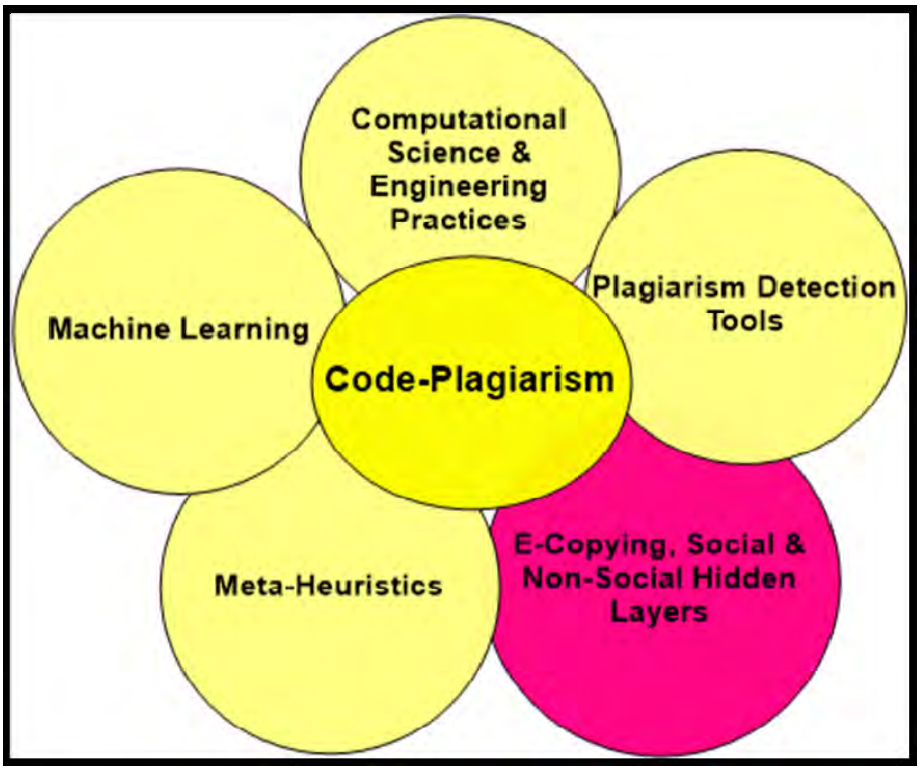

Fig.1 Intersection of different Domains

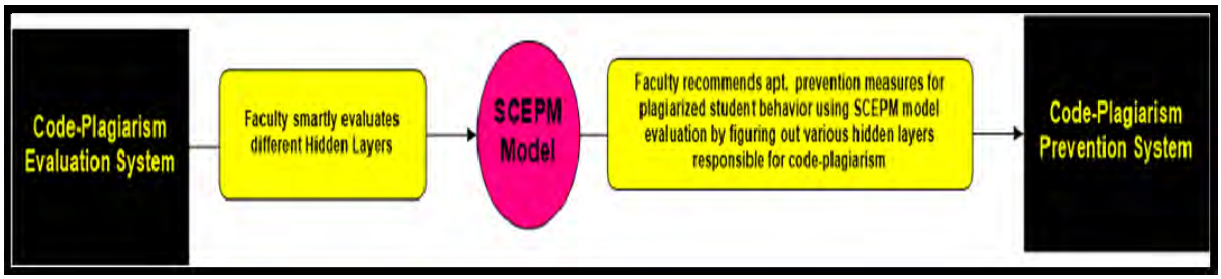

Fig.2 SCEPM Generalized Model

II. SCEPM MODEL PROCEDURE

Algorithm for Smart Code-Plagiarism Evaluation cum Prevention Model (*SCEPM*) for socially-inspired Meta-Cohorts i.e. students:

A. Phase I: Code-Plagiarism Evaluation Phase

1. **Hawk Eye – Code-Plagiarism Detection System:** This system proposed initially in undertaken research can be used to detect level of code-plagiarism in submitted lab assignment.
2. **Smart Evaluation of submitted Lab-Assignment:** This code-plagiarism detection system can be smartly used to evaluate and analyze different possible layers being used by students to exchange cloned code and hide their act of copying from lab instructor. This analysis can be based on following social characteristics of students:
   - **a.) Dynamic Environment**
   - **b.) Incremental Clustering Rules**
   - **c.) Means of Communication**
3. **Faculty Recommendations Formulation to prevent Code-Plagiarism:** Based on possible analysis of different forms of hidden layers being used by students to smartly clone their code and then exchange among them, faculty can suggest suitable recommendation to be followed in lab from next turn to prevent increasing number of plagiarized lab-assignment.

B. Phase II: Code-Plagiarism Prevention Phase

1. **Initialization of Student Cohorts (SC):** Based on detected level of plagiarized code students can be categorized into different student cohorts.
2. **Faculty Recommendation Cohorts (FC) Initialization:** Then faculty cohorts can be formulated based on detected level of plagiarism in submitted lab-assignment by particular student cohort category.
3. **Mapping SC to FC:** Each student cohort can be mapped to faculty cohort using either of mapping:
   a) ***Direct Mapping****:* Mapping based on single attribute i.e. similarity index/detected level of plagiarism in submitted lab-assignment.
   b) ***Offset Mapping****:* Mapping based on multiple attributes i.e. student behavioral characteristics.
4. **University Laws Cohorts (UC) Initialization**: University Laws cohorts can be formulated against each category/level of code-plagiarism.
5. **Design University Incremental Learning Curve (ILC):** At end of every year an incremental learning curve can be designed by University to understand rate of increase-decrease in code-plagiarism.

III. DIFFERENT FORMS OF HIDDEN LAYERS

Now the hidden layers [24] can be broadly classified into three major categories:

*A. **E-Copying (Code-plagiarism) – 'Smart High-Tech Methods of copying using Advance Digital Networks'***

Technological Advancements and expanding digital networks gives opportunities to university students use many high tech methods like to name a few are discussed in detail below.

- **I. Spy Kits (Earpieces, signals, MP3 Files):** Many software firms like IGIS electronics etc. are shipping these days' e-gadgets like invisible earpieces that can be connected to MP3 player or associate who can help students in copying codes. These kits include invisible micro earpieces, SOS silent beeper button to communicate with someone and a means to connect to Bluetooth cell phone and microphone.
- **II. Bluetooth Pens:** Companies like Amazon offers a Bluetooth pens that appears like normal ball point pens that can help in two way conversation almost hands free. It connects to mobile device and relays information from phone to an earpiece. One can talk to associate on other end through pen's concealed microphone.
- **III. Image editing Software's:** Proficient imaging software's like Adobe Photoshop can be used to edit different kind of original and innocent content and stuff's. Hence students may use such software to conceal the identity of original content.
- **IV. Storing Data on Calculators:** Some calculators work very well as storage device to hold text, formulas or even pictures. Such storage devices can also serve the purpose of exchanging code logic among other batch mates in labs.
- **V. Smartphones Camera to take snaps:** Smartphones cameras these days are the most frequent means for storing and exchanging data in form of image among other students.
- **VI. Hacking Computer Data to steal Transcript:** Many hacking software's like 'key-loggers' etc. are available these days to manipulate the already existing data available on computer by stealing

administrator/ other user's computer login credentials. Hence students can use such software's to alter their grades from 'C' to 'A'.

VII. **Group Collaboration and Wireless Communication:** Group-Collaborations are the means which are often encouraged by faculty in a class for healthy discussions and to increase levels of student centered learning. But our smart digital era students use these traditional methods like hand signals, eye contact or more tech-savvy means of group collaboration as signals for exchanging and copying information. Similarly wireless devices like earpieces and sets, mobile phones also serve as possible means of communication for exchanging and copying lab-assignments in programming labs.

VIII. **Paying Third Party Sources to Pass:** This may not be tech-savvy way of copying but is used these days frequently to pay to third party sources to develop code and complete the assigned lab-assignment this way given by faculty to students in programming labs.

IX. **Invisible Ink:** An invisible ink pen are frequently used to write and exchange secret messages which can include logic for developing the code. This invisible ink is visible only under LED light that's mostly placed on lid of invisible ink pen.

X. **Watch Hack:** Watch hack is a software that transfers printouts based notes from desktop to your wrist watch. For transparency a printing paper is required as label. Hence this software can use some editing software's and printers for copying and also helps in keeping the secret/ spirit of copying and exchanging lab-assignments in programming labs among a batch of students.

B. Non-Social Network Based Hidden Layers (i.e. Without Internet Connectivity)

These are mainly the Hidden Layers which can be used without internet connection. These hidden layers include Bluetooth, SMS, MMS etc.

I. **Bluetooth** – Non-Social networks like Bluetooth has following advantages and limitations:

Advantages

- ✓ Cheap and Easy to install
- ✓ Wireless and requires no internet connectivity
- ✓ Free to use if installed in device
- ✓ Makes connection to different devices convenient

Limitations

- ✓ Allows only short distance/range communication
- ✓ At a time can connect at most two devices only
- ✓ Can lose connection easily in some situations

II. **SMS -** Non-Social networks like SMS [24] has following advantages and limitations:

Advantages

- ✓ Allows mobile phone devices to exchange short text messages.
- ✓ Good means to communicate or keep everyone in touch especially when far
- ✓ Saves time in sending message
- ✓ Can be sent to large set of people simultaneously
- ✓ Cost-effective and no internet connection required or data charges incurred

Limitations

- ✓ Only short messages can be sent across devices
- ✓ Not very good means of communication for formal messages
- ✓ Needs good typing speed.
- ✓ Short Character Limit

III. **MMS -** Non-Social networks like MMS has following advantages and limitations:

Advantages

- ✓ Allows sending text messages longer than 16o characters in length that SMS is unable to send.
- ✓ Allows large amount of rich multimedia data to send across.

Limitations

- ✓ Device Compatibility problem may occur.
- ✓ Slow to send to large group of people as large amount of data is being transferred across network.

C. Social Network Based Hidden Layers (i.e. With Internet Connectivity)

These are the Hidden Layers which require good internet connection either in form of LAN or WiFi or Mobile Internet. These hidden layers mainly include the most popular being Whatsapp, Hike, Facebook Messenger, Line, WeChat, GTalk, personal E-Mails, Lync etc.

I. **Instant Messengers** – Social networks like Whatsapp, hike, Line, WeChat etc. other instant messengers has following advantages and limitations:

Advantages

- ✓ No other charges applicable except for good Internet connectivity
- ✓ Instantly send messages to anyone anywhere in world
- ✓ Can send messages to group of people at same time
- ✓ Many IM's also support free calls only require good internet connection, no other charges
- ✓ Supports sharing of information/media of different formats
- ✓ Supports automatic connection to everyone based on your phone contact list

Limitations

- ✓ Only smartphones can support IM's
- ✓ Good Internet connectivity/support required to send messages across
- ✓ Saves files/content by default, so privacy or easily tracked threat
- ✓ Requires regular updates to use latest/new features/add-ons
- ✓ Require proper account creation or one time login to use

IV. PHASE- I CODE-PLAGIARISM EVALUATION

This phase comprises of **Hawk Eye [1]: Code-Plagiarism Detection System** that can be used for evaluation of submitted lab-assignment. This Hawk Eye Code-Plagiarism Detection system flow can be improvised a little bit for smart evaluation of submitted lab assignment using SCEPM model. Based on evaluation done by faculty suitable recommendation measures can be taken by faculty to prevent increasing incidences of code-plagiarism among digital era smart students. Fig. 3 gives modified flow of activities for existing designed Hawk Eye system.

Each socially inspired student is characterized by following social characteristics:

1. **Dynamic Environment:** A student would always seek for most safe, secure and attractive hidden layer to hide his act of cloning of software codes by using a secure means which can hide his act of copying and exchanging code and being catch for his act by faculty.
2. **Incremental Clustering Rules:** The movement of social student is inspired from following aggregation/group/cluster formation rules. This rule is based on interaction between them and with environment.

a) **Safest Hidden Layer –** Students are attracted more too hidden layer where safety quality of layer is more because it protects them from getting caught in labs by faculty. Like non-social networks Bluetooth, SMS etc. can serve this purpose where no internet (university LAN or WiFi) connectivity required hence it leaves no footprints/traces of their cloning of code and then exchanging cloned code among them.

b) **Same Family Attraction –** Choice of exchange of cloned code among students could also be inspired by fact that students of same caste/family has more chances of being more closer/good friends compared to other counter parts. Thus more chances of exchange among such students.

c) **Security Factor (SF) –** Students who exchange code initially have less chances of getting caught compared to students who exchange in end/last. As students who exchange cloned codes initially get their lab-assignments reviewed by faculty in beginning hence lesser are the chances that faculty label submitted assignment as plagiarized/cloned.

3. **Means of Communication:** Every student perceives the best behavior from set of behavior available among their batch. Based on it student improvises his behavior and adapt to existing conditions. Various factors in environment can influence a student behavior like more new innovations in technology like social networks – Whatsapp, Hike etc. Other factors are like ease of exchange, convenience, speed, charges etc. using social networks also matters and influence a student behavior.

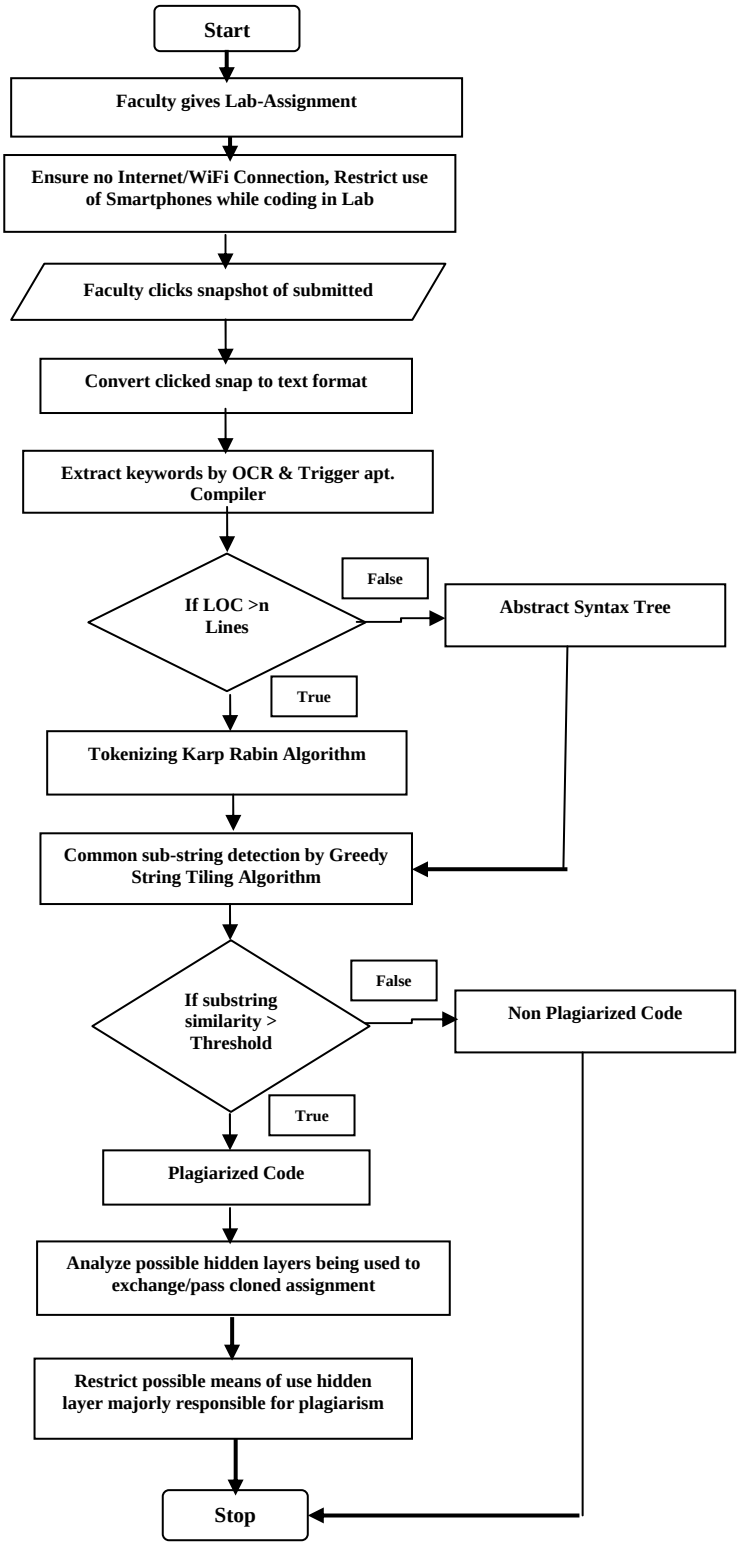

Fig. 3. Part-I: Flowchart for Smart Code-Plagiarism Detection System – 'Hawk Eye'

Note: Threshold value defined/set for 'n' in above flowchart is 100 in our undertaken research as per other set constraints and development environment

V. DETECTION OF STUDENT ATTRACTIVENESS TO CODE-PLAGIARISM DUE TO PRESENCE OF HIDDEN LAYERS

A student is characterized by following three main social characteristics as discussed below. These characteristics form the mere reason for attractiveness of university students to code based plagiarism in

programming labs due to advancements in technology in form of various forms of hidden layers like hike, Bluetooth etc. as discussed in details section III.

a.) Dynamic Environment
b.) Incremental Clustering Rules
- Safest Hidden Layer (SH_L)
- Same Family Attraction (F_A)
- Security Factor (S_F)

c.) Means of Communication

This characteristic of attractiveness (A) can be expressed in form of below mathematical expression:

If

$\mathbf{S_{Ci}}$ - Number of student cohorts

$\mathbf{H_{Li}}$ – Number of available Hidden Layers

Attractiveness (A) = α * $\mathbf{SH_L}$ ($\mathbf{S_{Ci}}$, H_{Li}) + $\boldsymbol{\beta}$ * $\mathbf{F_A}$ ($\mathbf{S_{Ci}}$, H_{Li}) + $\boldsymbol{\gamma}$ * $\mathbf{S_F}$ ($\mathbf{S_{Ci}}$, H_{Li})

Where

$\boldsymbol{\alpha, \beta, \gamma}$: Minor Weight Adjustments

From above expression it is clearly visible that students are attracted to code-plagiarism which primarily depends on these attributes i.e.

- Safest Hidden Layer (SH_L),
- Same Family Attraction (F_A), and

Security Factor (S_F)

VI. PHASE- II CODE-PLAGIARISM PREVENTION

After Phase I, Phase II comes into play which comprises of following steps:-

1. **Initialization of Student Cohorts [18]** $\mathbf{S_C}$ - Students can be categorized into different cohort categories based on level and different categories/ cases of code-plagiarism (i.e. attribute, token or Structure/functionality based code-plagiarism) behavior exhibited by a student in submitted lab assignment. These cases has already been validated using Genetic Algorithm (GA) as visible in Fig.4 and cross-validated using Multi-level Cohort Analysis (MCA) procedure which shows plot of convergence or saturation for different behaviors of students in fig. 5. These procedures has proved to be most appropriate means to validate and optimize different cases of code-plagiarism from range of cases.

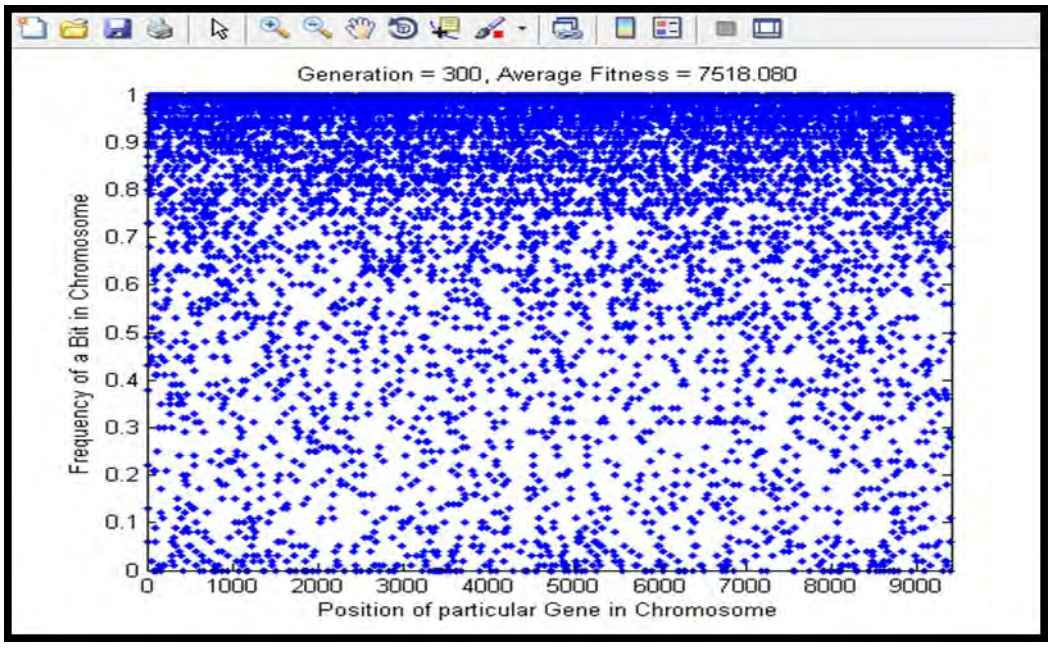

Fig. 4 GA Computation to validate cases of code-plagiarism by calculating average fitness value of student population over successive generations [Outcome as per our Research]

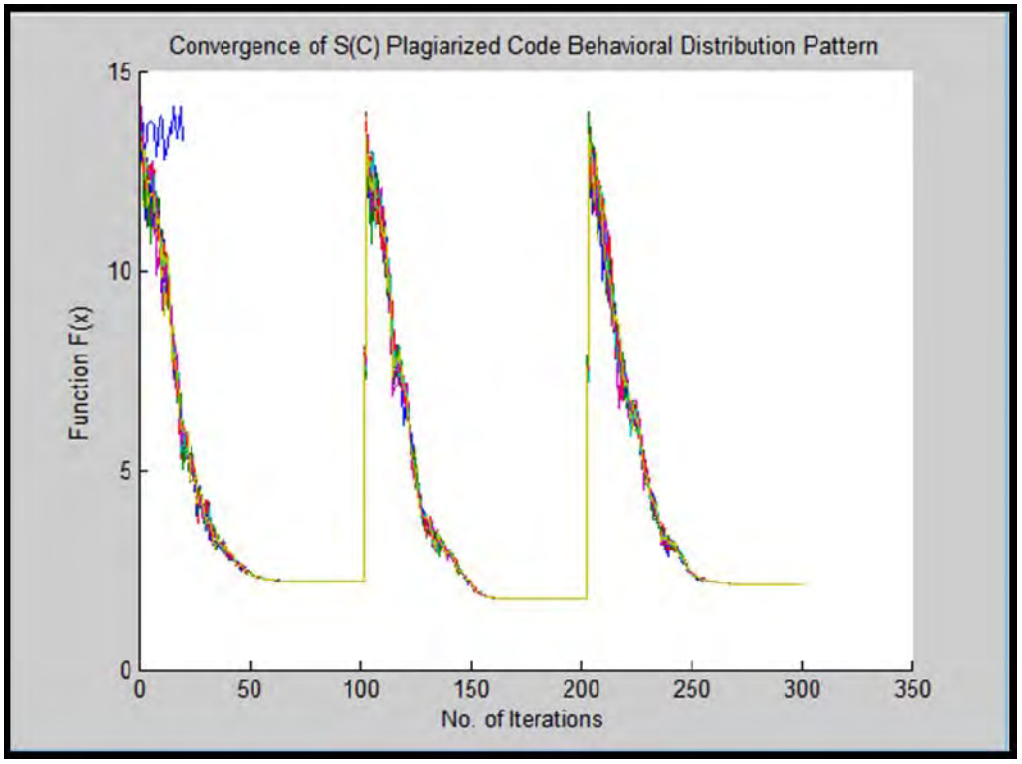

Fig. 5. MCA Algorithm Convergence Solution Plot for different cases of Code Plagiarism Case [Outcome of our Research]

2. **Initialization of Faculty Recommendation Cohorts F_C –** Based on different S_C ranging from low to high level code-plagiarism corresponding type of recommendation measures for different S_C can formulated by faculty as per their experience and expertise. These recommendations can be exchanged among faculties over period of time and can be revised/updated in every semester to deal with entirely different set of behavioral characteristics of a new batch of students every year.

3. **Mapping of S_C to F_C using either of two:-**

a.) **Direct Mapping –** As the name suggests this mapping is based on single parameter i.e. similarity threshold value between student-faculty cohorts. Similarity threshold value is detected percentage of code-plagiarism from Hawk Eye system.

b.) **Offset Mapping –** Offset mapping is used when mapping involves more than one parameter like student behavioral characteristics can be used as a parameter for offset mapping. Based on different behavioral distribution pattern of students suitable recommendations can be taken by faculty cohorts.

4. **University Laws Cohorts Formulation:** Different layers of laws can be formulated by universities according to different categories of student cohorts. These laws of cohorts can take advantage of paid services of social and professional networks like LinkedIn and Facebook. Like LinkedIn paid account services include benefits of seeing more profile information of someone not in your contact through advanced searches or performing a reference check on someone etc. These services can help universities to keep a check on social activities of their students and take suitable recommendations timely to prevent increasing incidences of code-plagiarism.

5. **University Incremental Learning Curve [19] IL_C to realize effectiveness of *UCPM*-** An Incrementally evolving learning curve over successive years can be designed/formulated by university as visible in below Fig. 6 to see the trend/rate of growth of code-plagiarism with successive batch of students every year and thus realize effectiveness of model in preventing code-plagiarism. Fig.4 shows plot for rate of code-plagiarism for two different semesters in 2015 and 2016.

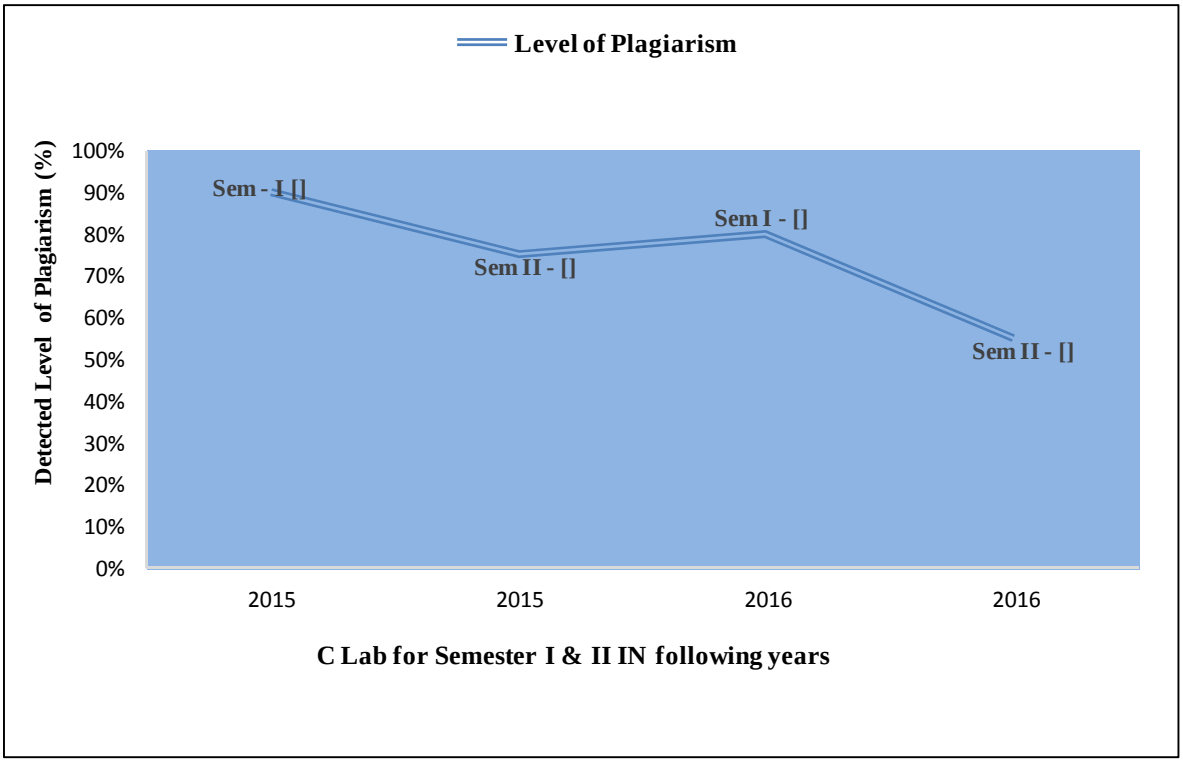

Fig.6 University Incremental Learning Curve

VII. CONCLUSION

A computationally intelligent scientific, smart, incrementally evolving, generalized model like *SCEPM* is required by any university for careful evaluation cum prevention for increasing incidences of code-plagiarism. A model which not only smartly detects plagiarized cases but also smartly analyze various possible contributors to incidences of code-plagiarism. This model considers the most important social characteristic of student i.e. attractiveness into account to evaluate different incidences of code-plagiarism in a batch by looking for different possible hidden layers that are responsible for code-plagiarism and conceal student's act of copying codes. Thus in turn suitable recommendation measures can be taken by faculty to prevent such cases. Hence it is proved in our research work that SCEPM model is useful and helpful for faculty and university to understand different possible forms of hidden layers that are used as shelter by students to hide their activities of copying. And based on a careful and detailed analysis of students social behavior suitable laws can be designed by faculty members and universities to prevent growing cases of code-plagiarism in programming labs among students in different universities.

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International Conferences: 16

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