# STUDY GENIE: NOTE SHARING APPLICATION

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## ABSTRACT

Note-taking is essential for student to excel in his academic career. Some students tend to write concepts more clearly in their notes. In this project we are allowing students to view and share their notes with peers, where students can go through notes they like and save it to their notes page. Cheat sheets preparation is something that helps students perform better in exams. However, there are no guiding principles for creating cheat sheet and using it achieve superior results in exams. The traditional method of creating cheat sheets is tedious and time consuming, furthermore, neglects to catch student's concentration for cheat sheet preparation. In this project an improvement and utilization of web based cheat sheet creation application, Study Genie, and how it helped students. Evaluation performed on a set of students showed results that are emphatically correlated with exam execution, it showed significant difference on students who used the tool versus students who used traditional methods. Study Genie can be viewed as a tool to integrate, share and communicate students notes among peers thus facilitating a smoother note taking and cheat sheet preparation

## Keywords

Adaptive Web, Open User Modelling, Open Social User Modelling, User Profiling, Web Application, Cheat Sheet, Notes, Content Filtering, Conference Publications

## 1. INTRODUCTION

Student's taking notes, preparing cheat sheets are practices to note down concepts, prepare, study for an exam. They might miss out on some classes or loss of concentration during class can result in note being not complete. Cheat sheets are documents that help students in exams by writing material or formulae that is complex thereby aiding then in exam preparation.

Currently, there are several web-based and application based note taking systems such as Google Docs, sheets, keep, Microsoft word etc. However, none of these facilitate note sharing publicly and privately or cheat sheet creation. In current project we are exploring using a web-based tool for note taking and cheat sheet creation and how it improves performance in exams. We developed and deployed a web application Study Genie for students use, we also used feedback systems to monitor and log user's activity on the website to provide them feedback.

In this project, we built an adaptive system that answers the questions: how students collaborating on notes can improve the quality of notes available for a course and how cheat sheet creation on the fly helps students in exam preparation and performance. Our hypothesis is that having a vast resource of notes with feedback system helps in determining good notes to choose from, it also facilitates creation of cheat sheets from good notes and multiple versions of cheat sheets to choose from thereby helping students create cheat sheets in a non-tedious manner.

Our Adaptive support on study genie application is a web system that allows students to share public/private notes, assemble cheat sheets, form study groups (collaborative notes). The goal is to push students organize domain knowledge and facilitate exam preparation. The application is an adaptive system, that provides personalized information to the user based on his/her preferences

## 2. Motivation

Note taking and cheat sheet creation helps students to excel in academic career. Cheat sheets help students in exams by writing material or formulae that is complex thereby aiding then in exam preparation, they help students with metacognition and exam performance. Note taking, sharing and cheat sheet creation facilitate exam preparation, decrease tension, anxiety, stress related to exam caused due to lack of proper preparation guides. They also help student to concentrate on understanding the concepts rather than memorizing complex material or formulae (Song and Thuente, 2015).

The lack of guide lines for creating cheat sheets that give best performance in exam and the task of preparing cheat sheets being exhaustive, students cannot afford to spend time in creating multiple variations of cheat sheets to select the best among them. analyzing enormous amounts of hand-written cheat sheets is typically very time consuming (Hsiao, 2016).

Therefore, there is a requirement to have a web based application that helps students create notes, share them, create cheat sheets on the fly and analyze and pick the best among created cheat sheets. So, we developed a web based application that helps students to both create, share and collaborate with notes and creating cheat sheets on the fly.

## 3. System Design

The application allows users to create and view notes. The user can later use these notes along with notes made public other users

and create cheat sheets. The user has an option to join or a form a study. The system presents changes the content on user home page and study group page adaptively. User can upvote, downvote or favorite any notes which is used as explicit data for adaptive content presentation.

## 3.1 Architectural Design

The application employs MERN Stack to provide the necessary functionality i.e.; a MongoDB server for database storage, Express for web framework, React.js for frontend user interface rendering and Node.js provides the platform for Express to perform route handling.

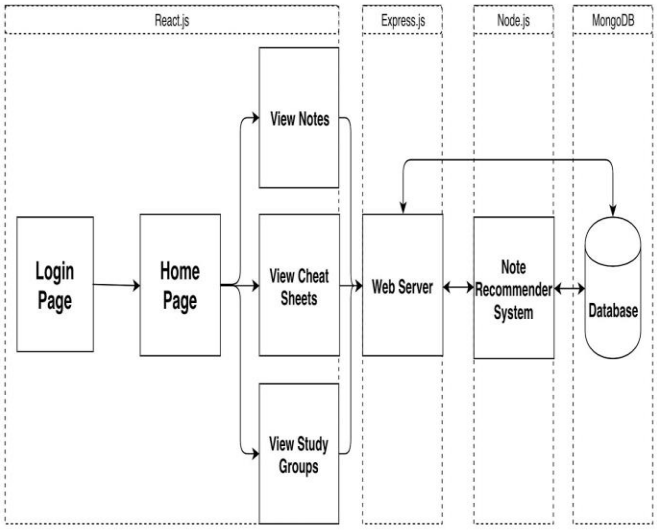


**Figure 3.1:** Overview of the architectural design

When the user logins into the system using a web browser, the Express, web server framework, responds with the corresponding web page and React code required for adaptive presentation of the notes and cheat sheets suggested by the recommendation system using the data stored in the database.

## 3.2 Data Description

MongoDB is used to store the data of this application. Below is the data architecture that is being followed. We maintain separate tables for user info, notes, cheat sheet and groups. Each note has a minimum of one tag and that is stored in "Tags table". Upvotes, downvotes and favorites are mapped to UserId and NoteId in different tables. Three tables are associated with groups.

## 3.3 Data Architecture

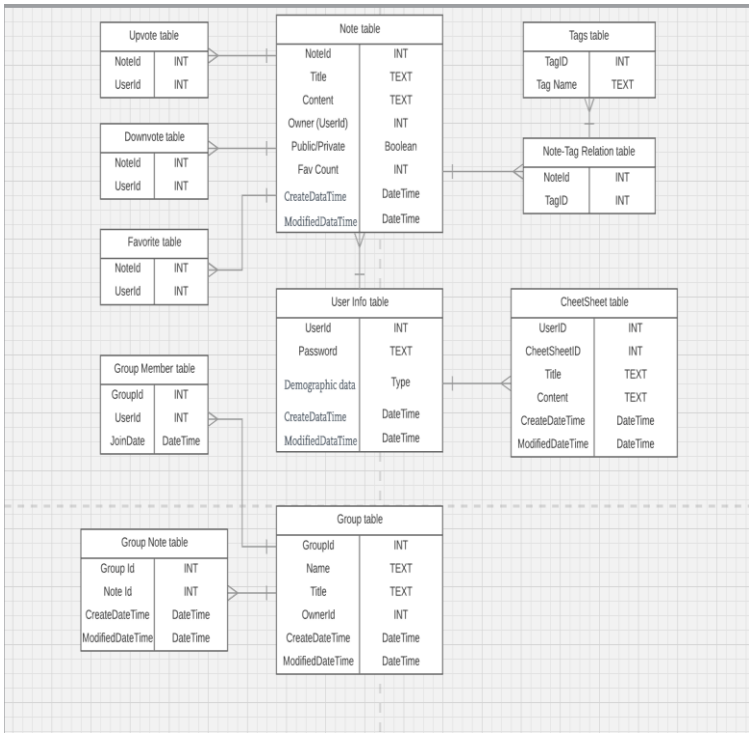


**Figure 3.2:** Database structure

## 3.4 Human Interface Design

We want to keep the user interface simple and minimalist to make sure the user has a clean experience. The users of the applications are typically students. They take notes and browse through notes in typically very high stress situation. Therefore, it is important that the user interface is straightforward and systematic.

Every user is present with a homepage which contains all the recommended/new notes she/he has access to. These notes are condensed and arranged along a grid. She/he can also access MyNotes page to access her/his own notes. This page organizes and manages her own notes. She/he can also view her/his activity upon going to User profile page. Cheat sheet page lets you create and manage cheat sheets. Also, each study group will have its own page that displays all the contents of that group.

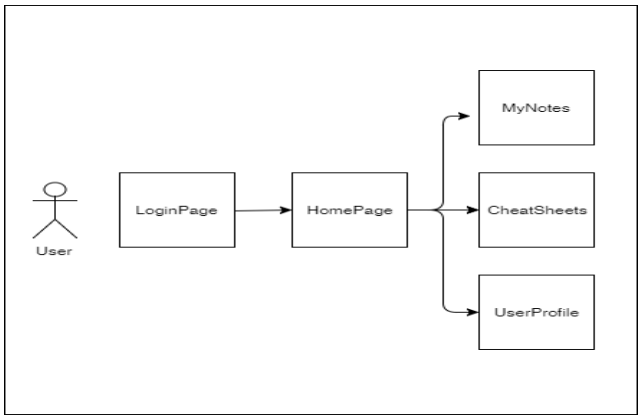


**Figure 3.3:** User Interaction design

User interaction design depicts how a user interfaces with the Study Genie web application. The user logs into the system by providing valid credentials. User then gets to see her/his homepage, from homepage he can navigate to Mynotes where she/he can see their own notes, user can also navigate to Cheat Sheets page where she/can create cheat sheets on the fly using public/private notes. User can also navigate to UserProfile page

## 4. Methodology

In this section, we will be discussing the methodology, stating how our designed approach can solve the research problems: how students collaborating on notes can improve the quality of notes available for a course and how cheat sheet creation on the fly helps students in exam preparation and performance.

### 4.1 Study Genie Home Page

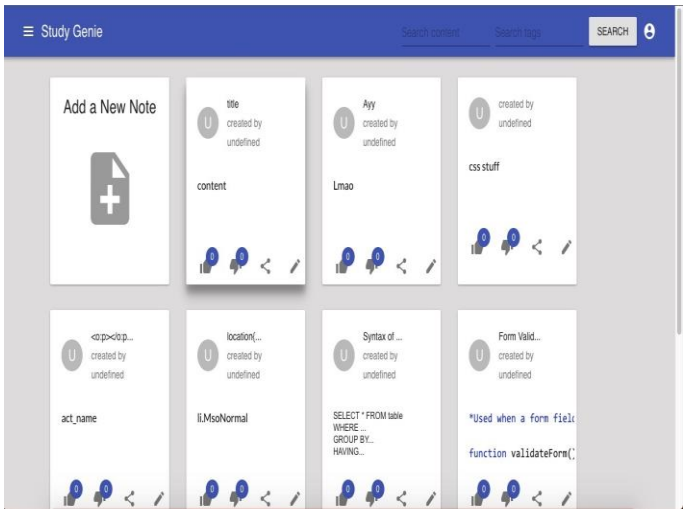


**Figure 4.1:** Homepage

Study Genie is a web application developed with MERN stack. The home page shows the notes of interest of the individual user. The notes typed into will be stored as cards, on clicking the cards the user can view the content and can edit if it is her/his notes or public notes. The notecards can contain text such as class notes, formulae or code snippets.

The content on the home page is generated using adaptive note recommender which uses the users search content and search tags, do elastic search on it (content based recommendation) and returns notes relevant to the user. As an example, if a user searches for Java 6 times, python 3 times, CSS 1 time, the notes returned to the user on logging in or refreshing the home page will contain notes in the ratio of their searches. So, if 20 notes are returned to populate homepage 12 would be Java, 6 of Python and 2 of CSS.

The app has four main screens: the home page, MyNotes page, Profile page, MyCheatSheets page

MyNotes page contain the notes the user created on his own. Note creation is done by clicking on the Add a New Note button and typing in Title and content and choosing the tags from pre-determined tag list. Also note creation requires at least one tag to be chosen for a note.

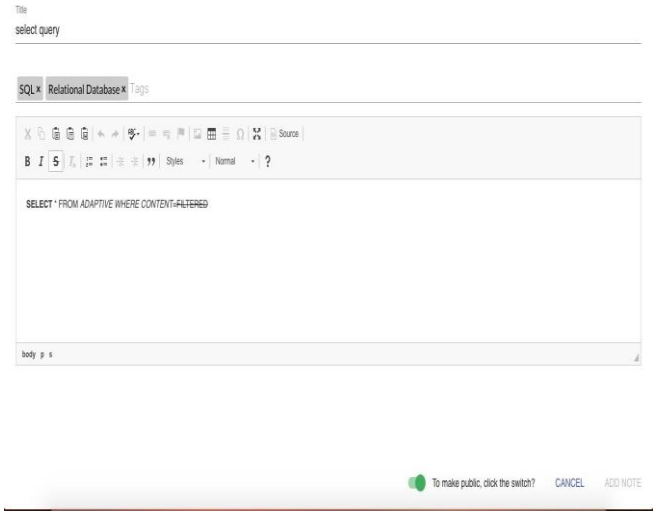


**Figure 4.2:** Note creation page

As we can see in the above figure, while creating a note we are letting the user keep it public or as private notes. If the users share their notes with other users, then it is available to all of them. They can search for public notes and view it on homepage as in Figure 4.1, also by taking explicit feedback using upvotes and downvotes and implicit feedback the time spent on a note, we are determining the best notes for a topic to be displayed. User can get the top-rated notes and compare it with their notes, to edit or correct their notes.

Also, the availability of public notes removes the problem of not having notes to prepare and perform on an exam. It removes the stress caused during exams or normal study caused due to lack of proper notes for the topics. In this way we are answering the question how students collaborating on notes can improve the quality of notes available for a course.

### 4.3 User Profile and Activity visualization

On clicking the user icon from the home page redirects to user profile page, the user profile page contains user details such as his username, mailId, notes created by the user, count of users public and private notes and cheat sheets created by the user.

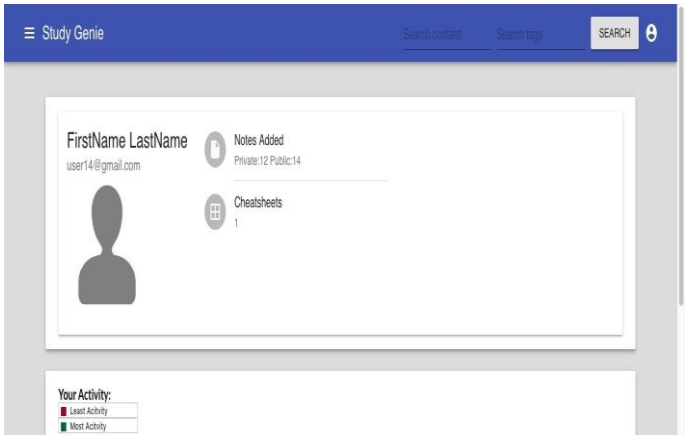


**Figure 4.3:** User Profile Page

The user activity visualization shows both users personal activity based on date on the website and on clicking a date the user can

view the Open User Modelling visualization that shows what percentage of the tags of each topic he viewed on that date. It lets user to decide whether he must read notes/ skip notes containing tags of the topic. The following visualization shows the same

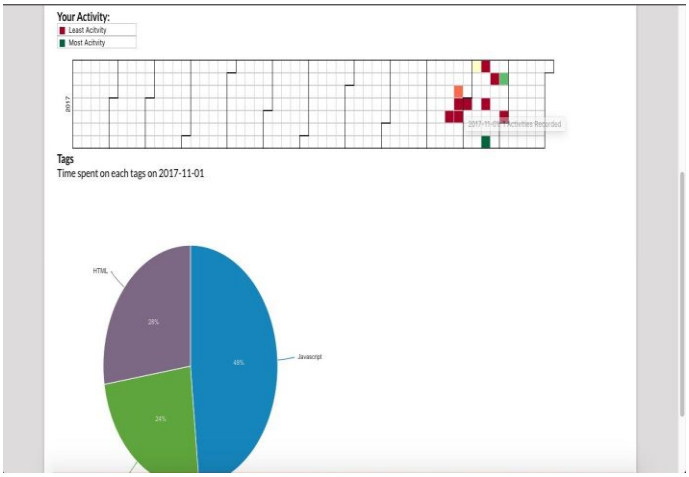


**Figure 4.4:** User Activity Visualization

The following visualization shows the Open Social User visualization for all the tags in the system. While writing a note user must choose at least one tag, the following figure 4.5 shows the co-occurrence relation among the tags i.e. how frequently for a note they appeared together. The width of the line connecting the circles (tags names) indicate their co-occurrence score, the thicker the line more times those tags appeared together in notes, thinner line implies those tags did not appear together frequently in notes. If there is no line between two tags it says there are no notes where they were chosen together

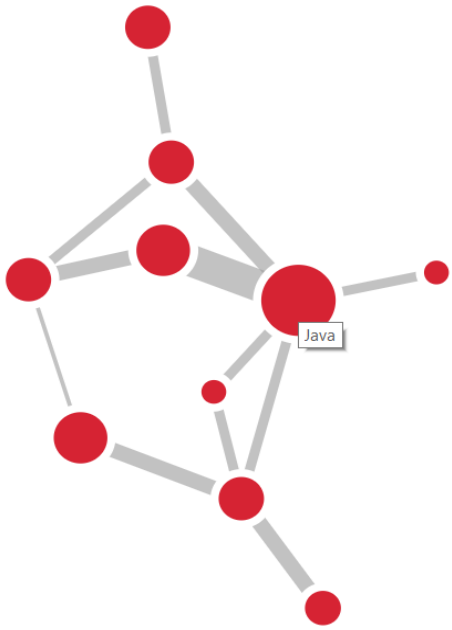


**Figure 4.5:** Network showing relation of tags

## 4.4 MyCheatSheets Page

On clicking on the drawer button on the left top and clicking on MyCheatSheets navigates us to cheat sheets page where we can create cheat sheets on the fly. The cheat sheet page contains a search bar where user can search for a note and copy its content on to the cheat sheet. For editing the cheat sheets, the user can delete content on the cheat sheet.

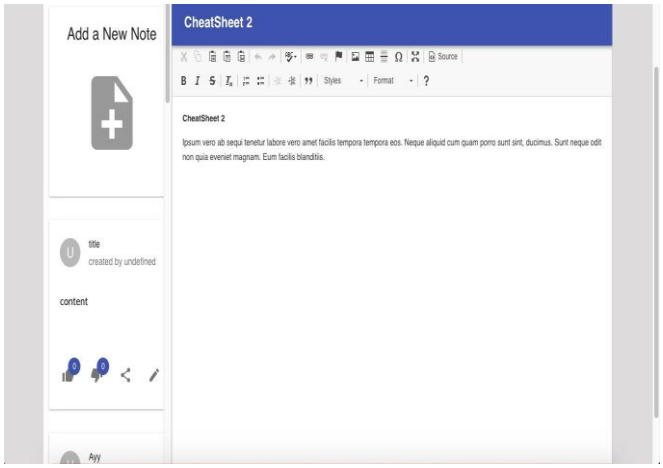


**Figure 4.6:** User Cheat Sheet page

Having a page that creates cheat sheets on the fly along with note creation and sharing, helps user to select the notes to be used in cheat sheet creation, more notes available to choose from while creating cheat sheet, editing and deleting content on the cheat sheet made easy, there by decreasing the time taken for cheat sheet creation and editing during exam preparation. As the amount of time spent on cheat sheet creation/editing decreased user can find more time to concentrate for reading for exam. It also decreases anxiety, stress, exhaustiveness related to exam preparation and help them achieve better performance. Thus, having cheat sheet creation on the fly answers, the question how cheat sheet creation on the fly helps students in exam preparation and performance.

## 4.5 API technical details

For the backend, we have used express server with APIs written in node js. Once the API is called from react actions page, the request goes to express server which directs the request to appropriate API endpoints are given in the routes.js file. For the client part, we chose to use react framework to modularize the application pages into components. This makes the reuse of the similar UI components easier.

# 5. Evaluation

After designing the system, we have given restricted access to 13 Graduate students in Industrial Engineering. We have asked them to create cheat sheets with legitimate content and tag all of them and asked them to make searches on the created notes. According to our system design, we have stored the search history of the user to build a content filtering model. The search history is stored as a Map with tag as key and frequency of the tag appearing in the searched notes as its values. The following is an actual search history of a student


[
  {

```
  "term": "MLE",
  "count": 7
 },
 {
  "term": "Data Normalization",
  "count": 5
 },
 {
  "term": "Factorial Design",
  "count": 4
 }
]
```

Using this history, we have modeled a elastic search query using the "count" field in search history above to boost the score of a term in all the notes that are displayed on the homepage. The following is a query modeled of a user

```
{
 "query": {
  "bool": {
   "should": [
    {
     "constant_score": {
      "filter": {
       "term": {
        "content": "MLE"
       }
      },
      "boost": 7
     }
    },
    {
     "constant_score": {
      "filter": {
       "term": {
        "content": "Data Normalization"
       }
      },
      "boost": 5
     }
    },
    {
     "constant_score": {
      "filter": {
       "term": {
        "content": "Factorial Design"
       }
      },
      "boost": 4
     }
    }
   ]
  }
 }
}
```

After integrating the above query in to the system for each user, we have asked them to Upvote or Downvote the top 25 notes displayed on their homepage according the usefulness or relevance the notes. We have then given 0 point to an upvote and -1 to a downvote to calculate the accuracy of the recommendations on the homepage. The number of downvotes received by each user were -1, -1,0, -6, -3, -1, -7,0, -2, -8, -2, -1, -4. Considering the Downvotes as error in recommendations for each user, we calculated the Root Mean Square Error which is sqrt (178)/13 = 1.027. This error means that we can expect 1-2 irrelevant notes shown at the top of the homepage for each user which is better than just showing notes randomly.

The flipside to the above recommendation system is that we have not considered the Date when the note was created. By considering the time, we can decrease the score exponentially in time for a note, so the recent and relevant notes show up on top.

# 6. Conclusion

## 6.1 Summary

We have developed a web application that enables students create, update notes, share the notes publicly or keep it as private view. The web application also facilitates cheat sheet creation as a part of exam preparation. Student can do various action such as create, edit, delete a note, create a cheat sheet, edit a cheat sheet, search for a note, search for a note to be added to cheat sheet etc.

We analyzed the actions, interactions of students with the web application for notes and cheat sheets and took feed back from them regarding whether and how they find using the tool for note collaboration and cheat sheet. Asked feedback from users on how they find using the tool for note taking, sharing and cheat sheet creation and whether it had an advantage over the traditional methods. This investigation indicated positive relationship between note taking and cheat sheet creation on the fly and reduced exhaustiveness and increased exam preparation and performance.

Most of the students found the tool very useful and told it helped them to have a complete material for an exam with the note collaboration and can create a cheat sheet on the fly very easily. They told it reduced the time taken, exhaustiveness of preparing for an exam, and saved time for cheat sheet creation which hand written takes hours of time, whereas they can use our tool to do the same in a few minutes. Able to edit a cheat sheet is something that they are awed about as in traditional method it would take so much effort as the space allocated for a cheat sheet is limited and they might have to re-write a cheat sheet thus answering the questions: how students collaborating on notes can improve the quality of notes available for a course and how cheat sheet creation on the fly helps students in exam preparation and performance.

## 6.2 Discussions

Although note taking and cheat sheet creation on the fly increased students performance, there could be other reasons for their increased performance such as attending, concentrating in classes, or students made greater effort for exam preparation.

Study Genie however has collected information in the form of feedback from students how their cheat sheet preparation time decreased, Study Genie also provides opportunities such as analyzing the notes taken, notes shared publicly versus privately and cheat sheets contents for an exam by various students and get an insight into how different students choose and select content for good notes and cheat sheet creation.

## 6.3 Limitations and Future Work

As mentioned in discussions, there is a possibility that there could be other reasons for their increased performance such as attending, concentrating in classes, or students made greater effort for exam preparation. The tool needs to be used by a vast number of students to determine its true effect. Also, studies have shown that handwriting cheat sheets is more beneficial compared to computerized cheat sheets (Hsiao, 2016)

There is also feedback that more students wanted features like drag and drop for cheat sheet creation and editing, currently we are using a content copy method for cheat sheet creation, we will be improving the cheat sheet creation to use drag and drop

Feedback is calculated from a student data comprising of only a few students, though the feedback on evaluation is positive, the fact that the abbreviated time span it is collected and less data due to Study Genie being in development phase are all the factors that needs to be considered. We plan to deploy the web application an an AWS server and recommend it over the course of upcoming semesters to determine the validity of current data

Currently, we have restricted the tags to choose from a list of tags for a question and every student should add at least one tag for every note. In future development we plan to add more tags to accommodate the needs of the course in which it will be used. The ICAP Framework: Linking Cognitive Engagement to Active Learning Outcomes (Chi, 2014) says that as students become more engaged with the learning materials, from passive to active to constructive to interactive, their learning will increase [18]. The adaptiveness of notes with usage of the web application, visualizations provided for personal progress and Open Social User Modelling will help in the goal of adaptive software with Open Social User Modelling thus help the student progress

We have not implemented the group collaboration for notes i.e forming study groups, we will be implementing the study groups in next development phase thus attaining more collaboration between students to achieve successful exam preparation and performance, we are planning to implement hybrid recommender engine in our future tasks which use both content and collaborative based recommendations as according to Burke, R (2007) hybrid web recommender systems fare better than a single recommender system.

Many students also felt that there should be interfaces for image uploading or drawing in order to incorporate cheat sheets for few courses, in the upcoming phases we plan to make Study Genie more adaptive and user friendly.

## 7. ACKNOWLEDGMENTS

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## 8. REFERENCES

[1] Anderson, J. R., & Skwarecki, E. (1986). The automated tutoring of introductory computer programming. Communications of the ACM, 29(9), 842-849.

[2] Atkinson, R. K., & Renkl, A. (2007). Interactive example-based learning environments: Using interactive elements to encourage effective processing of worked examples. Educational Psychology Review, 19(3), 375-386.

[3] Barnes, T., & Stamper, J. (2008, June). Toward automatic hint generation for logic proof tutoring using historical student data. In International Conference on Intelligent Tutoring Systems (pp. 373-382). Springer Berlin Heidelberg.

[4] Chi, M. T., & Wylie, R. (2014). The ICAP framework: Linking cognitive engagement to active learning outcomes. Educational Psychologist, 49(4), 219-243..

[5] Dennis, B. L. (2012). Using Alternative Assessment Methods to Alleviate Math Test Anxiety (Doctoral dissertation, Minot State University).

[6] Hsiao, I. H., & López, C. (2016, July). Lessons Learned from Students' Cheat Sheets: Generic Models for Designing Programming Study Guides. In Advanced Learning Technologies (ICALT), 2016 IEEE 16th International Conference on (pp. 209-211). IEEE

[7] Kam, M., Wang, J., Iles, A., Tse, E., Chiu, J., Glaser, D., ... & Canny, J. (2005, April). Livenotes: a system for cooperative and augmented note-taking in lectures. In Proceedings of the SIGCHI conference on Human factors in computing systems (pp. 531-540). ACM.

[8] Kobayashi, K. (2006). Combined Effects of Note-Taking/-Reviewing on Learning and the Enhancement through Interventions: A meta-analytic review. Educational Psychology, 26(3), 459-477.

[9] Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard advantages of longhand over laptop note taking. Psychological science, 0956797614524581.

[10] de Raadt, M. (2012, January). Student created cheat-sheets in examinations: impact on student outcomes. In Proceedings of the Fourteenth Australasian Computing Education Conference-Volume 123 (pp. 71-76). Australian Computer Society, Inc.

[11] Reilly, M., & Shen, H. (2011, July). GroupNotes: encouraging proactive student engagement in lectures

[12] through collaborative note-taking on smartphones. In The 9th International Conference on Computer Supported Collaborative Learning (pp. 908-909).

[13] Rivers, K., & Koedinger, K. R. (2013, June). Automatic generation of programming feedback: A data-driven approach. In The First Workshop on AI-supported Education for Computer Science (AIEDCS 2013) (Vol. 50).

[14] Robins, A., Rountree, J., & Rountree, N. (2003). Learning and teaching programming: A review and discussion. Computer science education, 13(2), 137-172.

[15] Song, Y., Guo, Y., & Thuente, D. (2015, October). A quantitative case study on students' strategy for using authorized cheat-sheets. In Frontiers in Education Conference (FIE), 2016 IEEE (pp. 1-9). IEEE.

[16] Waddington, R. J., Nam, S., Lonn, S., & Teasley, S. D. (2016). Improving Early Warning Systems with Categorized Course Resource Usage. Journal of Learning Analytics, 3(3), 263-290

[17] Terry Wen, Jiaqi Wu, (2017) STUDY GENIE: An Analysis of a Web-based Note-Sharing and Cheat Sheet Tool

https://repository.asu.edu/attachments/182242/content/Wu_J_Spring_2017.pdf

[18] Michelene T. H. Chi & Ruth Wylie, (2014)The ICAP Framework: Linking Cognitive Engagement to Active Learning Outcomes, Educational Psychologist Vol. 49 , Iss. 4,2014

[19] Burke, R. (2007). Hybrid web recommender systems. In The adaptive web (pp. 377-408). Springer Berlin Heidelberg.

[20] Gauch, S., Speretta, M., Chandramouli, A., & Micarelli, A. (2007). User profiles for personalized information access. In The adaptive web (pp. 54-89). Springer Berlin Heidelberg.

[21] Bull, S., & Kay, J. (2007). Student models that invite the learner in: The SMILI:() Open learner modelling framework.International Journal of Artificial Intelligence in Education, 17(2), 89-120.

[22] Hsiao, I. H., Bakalov, F., Brusilovsky, P., & König-Ries, B. (2011). Open social student modeling: visualizing student models with parallel introspectiveviews. In User Modeling, Adaption and Personalization (pp. 171-182). Springer Berlin Heidelberg.

[23] Brusilovsky, P., & Millán, E. (2007, January). User models for adaptive hypermedia and adaptive educational systems. In The adaptive web (pp. 3-53). Springer-Verlag.

[24] Bunt, A., Carenini, G., & Conati, C. (2007). Adaptive content presentation for the web. In The adaptive web (pp. 409-432). Springer Berlin Heidelberg.

[25] Brusilovsky, P. (2007). Adaptive navigation support. In The adaptive web (pp. 263-290). Springer Berlin Heidelberg.

[26] Brusilovsky, P., Chavan, G., & Farzan, R. (2004, January). Social adaptive navigation support for open corpus electronic textbooks. In Adaptive Hypermedia and Adaptive Web-Based Systems (pp. 24-33). Springer Berlin Heidelberg.

[27] Pazzani, M. J., & Billsus, D. (2007). Content-based recommendation systems. In The adaptive web (pp. 325-341). Springer Berlin Heidelberg. [6.2] Schafer, J. B., Frankowski, D., Herlocker, J., & Sen, S.

[28] Collaborative filtering recommender systems. In The adaptive web (pp. 291-324). Springer Berlin Heidelberg.

[29] Smyth, B. (2007). Case-based recommendation. In The adaptive web (pp. 342-376). Springer Berlin Heidelberg.

[30] Jameson, A., & Smyth, B. (2007). Recommendation to groups. In The adaptive web (pp. 596-627). Springer Berlin Heidelberg.

[31] Micarelli, A., Gasparetti, F., Sciarrone, F., & Gauch, S. (2007). Personalized search on the world wide web. In The adaptive web (pp. 195-230). Springer Berlin Heidelberg.

[32] Mehta, V. & Hsiao, I-H.(under review) Sift through Online Programming Discussions: Effective Search-Result Navigation via Interactive Visualization

[33] Parra, D., & Brusilovsky, P. (2015). User-controllable personalization: A case study with SetFusion. International Journal of Human-Computer Studies, 78, 43-67.

[34] O'Donovan, J., Smyth, B., Gretarsson, B., Bostandjiev, S., & Höllerer, T. (2008, April). PeerChooser: visual interactive recommendation.InProceedings of the SIGCHI Conference on Human Factors in Computing Systems (pp. 1085-1088). ACM.

[35] Herlocker, J. L., Konstan, J. A., Terveen, L. G., & Riedl, J. T. (2004). Evaluating collaborative filtering recommender systems. ACM Transactions on Information Systems (TOIS), 22(1), 5-53.

[36] Parra, D., & Sahebi, S. (2013). Recommender systems: Sources of knowledge and evaluation metrics. In Advanced Techniques in Web Intelligence-2 (pp. 149-175). Springer Berlin Heidelberg.

[37] Koren, Y., Bell, R., & Volinsky, C. (2009). Matrix factorization techniques for recommender systems. Computer, (8), 30-37.

[38] Griffiths, T. L., & Steyvers, M. (2004). Finding scientific topics. Proceedings of the National Academy of Sciences, 101(suppl 1), 5228-5235.