Development of
Intelligent Tutoring System(ITS)
Framework using
Game-based Learning(GBL)

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Dual Degree Project – Stage II

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Outline

- Intelligent Tutoring System
- Game-Based Learning
- ITS Support for GBL
- Steps to be followed
- Components of ITS
- Architecture and Modules
- Android App
- Conclusion & Future Work
- References

ITS: Definition

- An Intelligent Tutoring System (ITS) is any educational software that provides direct customized instruction and feedback to learners, i.e. without the intervention of human beings, while performing a task

- It contains an Artificial Intelligence component which makes inferences about the learners strength and weakness based on his performance and activity log

Why ITS?

- There is a practical need for one to one teaching environment

- Studies show that students can learn up to 3 times faster in a one to one setting than in the traditional classroom

- Also, tutoring systems are interactive and hence more "interesting" than traditional text books

Problem with current e-Learning Techniques

- Most instructional technologies consist of a repository for lecture notes with a possible feature of a message board discussion forum

- Prensky (2001) described this method of online training as "enormous step backward" while Klaila (2001) described it as "the worst of all possible alternatives"

ITS: Goals

- The goal of ITSs development is to provide the benefits of one-on-one instruction automatically

- Minimum human intervention

- Easily integrable to any existing system

- User Interface should be rich and intuitive

- It should be cost effective

ITS: Examples

- Smart Tutor

- Wayang Outpost Tutor

- SQL Tutor

- Auto Tutor

- Thermo Tutor

Problem Statement

- Design and build an ITS framework which can support the following 4 teaching strategies
    1. Game based learning
    2. Scaffolding
    3. Question and answer
    4. Guided discovery

- Independent from subject domain

Game-Based Learning Teaching Strategy

Motivation

- The main challenge faced by the current educational system is that the students are not always eager to learn or do difficult things

- There is a lack of appropriate and interesting content that would engage learners and improve the learning process

- Unfortunately, instructors are less effective in motivating the students to learn

Motivation

- On the other hand, the students attitude towards computer games is the very opposite
  - Interested
  - Plays for hours
  - Competitive
  - Results-oriented
  - Actively seeking information and solutions

- Gameplay should be included in the process of education

Definition

- Game-based learning (GBL) refers to different kinds of software applications or products that use games for learning or educational purposes

- The main characteristic of an educational game is the fact that instructional content is blurred with game characteristics

- "students learn better when they are having fun and are engaged in the learning process" [Spectre and Prensky, 01]

Characteristics of Games

- Many authors gave different opinions about what the game characteristics are:

  - Fantasy, curiosity, challange, control [Malone et al., 81]

  - Interactivity is an essential aspect [Thornton et al., 90]

  - Dynamic visuals, rules, goal and interaction are the essential features [Johnston et al., 93]

  - The essence of playing is challenge and risk [Baranauskas et al., 99]

How learning occurs

- Incidental learning is characterized by discovering something while in the process of doing something else

- Incidental learning occurs by playing a game because the primary intent of the player is to accomplish the game rather than to learn

- Making a mistake is a primary way to learn and is considered the motivation for players to keep on trying
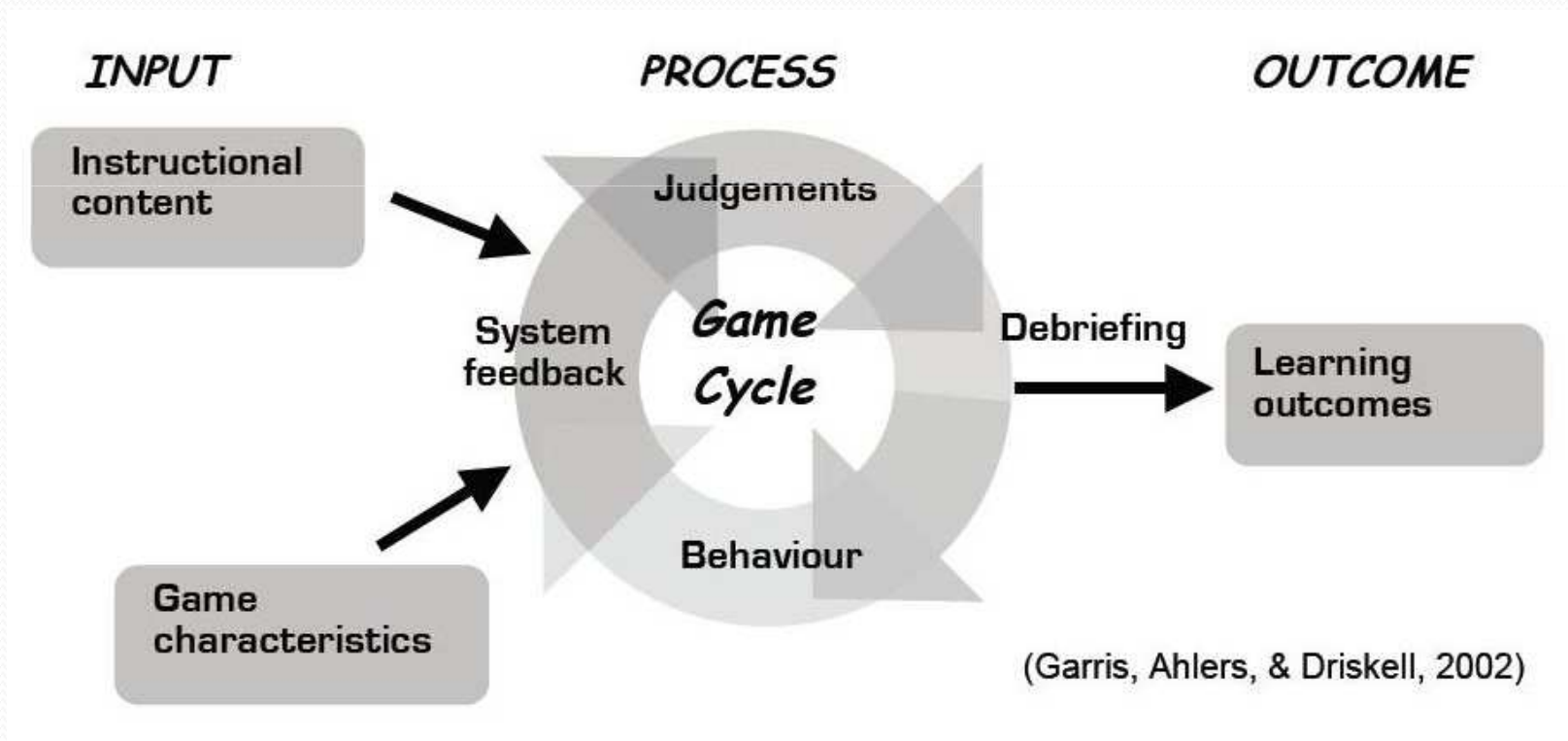
Learning outcomes

- Skill-based learning outcomes

- Affective learning outcomes

- Cognitive learning outcomes
  - Declarative knowledge
  - Procedural knowledge
  - Strategic knowledge

GBL Model

- Model of game-based learning by [Garris et al.,02]

INPUT

Instructional content

Game characteristics

PROCESS

Judgements

System feedback

Game Cycle

Behaviour

Debriefing

OUTCOME

Learning outcomes

(Garris, Ahlers, & Driskell, 2002)

Examples

- Environmental Detectives (2002)
  - Developed by MIT and Microsoft
  - Environmental education at high school level
  - Students play the role as a scientist and investigates the health problems in their city
  - Students learn basic investigative skills (observation, hypothesis testing, data gathering, data analysis, and data reporting)

Examples

- TopSIM by TERTIA Edusoft
  - Business game
  - Implement business by decision making
  - Understand connections within the organization
  - Study factors influencing the profit of the enterprise
  - For students of business administration, industrial engineering and trainees

ITS Support for GBL

- The following games will be used for Game-Based Learning in our ITS framework
  - Crossword
  - Treasure-Hunt

- The games were selected so that they can be used for teaching any subject and for any student level

Crossword

- The Crossword generation problem is: given an ordered finite alphabet A, a 0,1-matrix (grid), and a dictionary, replace all 1 entries in the grid with elements of A such that a crossword with (valid) dictionary words is obtained

- Crossword puzzles are a fun and interactive way to test the knowledge of a student in a particular subject

- It is an excellent way to engage students in thinking laterally and building links in language

Existing Software

- The bulk of the available crossword puzzle generators are not free, and most of them are shareware, where the user is obligated to pay a registration fee after a specific trial period, typically 30 days

- The problem with the freeware generation engines is that they are standalone products and cannot be integrated into any other systems

- The academic research on crossword is done on the default crossword generation process where the grid is fixed. They focused mainly on developing fast and effective search algorithms to find out the words which fit into the grid

Scavenger Hunt

- Treasure or Scavenger Hunt is an inquiry activity in which one systematically seeks knowledge with questions

- Treasure is considered to be information, truth, or knowledge, and hunt implies inquiry, which is a systematic investigation

- Treasure hunt activities are an engaging and active way for learners to enhance their skills

- Bates (1995) stated that the Scavenger Hunt game can produce significant savings in academic time, once designed, and greatly improve learning effectiveness.

Why scavenger hunts are popular in academic area?

- Easy to create and the resulting interactive searches are both fun and informative for students
- The hunts can be geared to virtually any curriculum area, simultaneously providing students with technological and subject matter knowledge
- It can be used as a whole class activity, as a team activity, or as a means of providing individual students with review or challenge activities
- Scavenger hunts can be as simple or involved as circumstances dictate

Examples

- U.S. History of the 1930s: This hunt encourages students to search the Web to learn more about the stories behind the people, places, events, and trends of the 1930s

- Animals of the World: To celebrate National Zoo and Aquarium Month, an online scavenger hunt is designed based on the natural habitats of the animals

- Track the Meteor Storm: This scavenger hunt is created to help students understand the causes and effects of meteors and meteor showers.

Steps to be followed by Instructor

1. The instructor has to login first using his username and password

2. Select or create a course

3. Select or create a topic for the course

4. Select the game which he wants to use as a teaching technique

5. For Crossword

    a. Add questions and answers to the game

    b. He can provide optional hints for each question

    c. Click on the generate puzzle

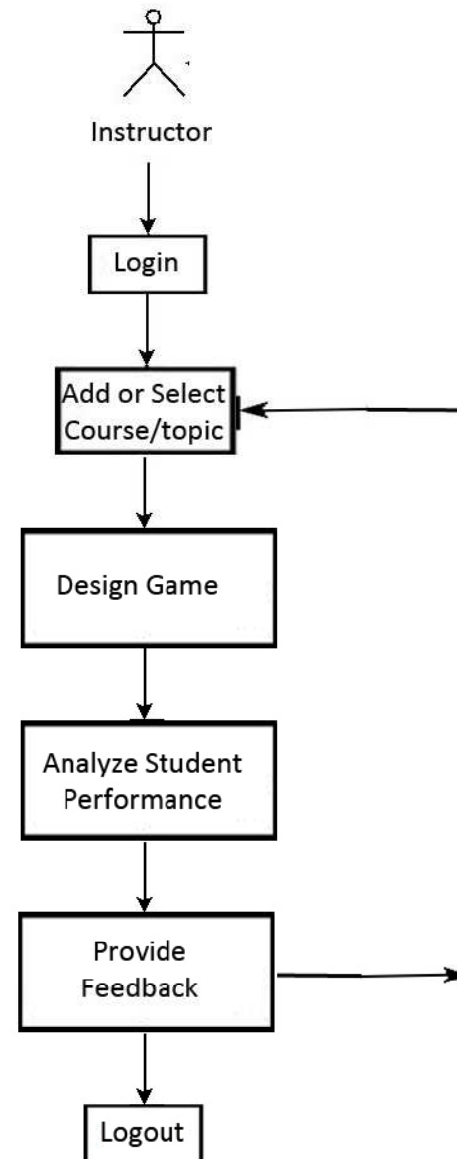   d. Select a puzzle from the generated ones by the ITS

Steps to be followed by Instructor

6. For Treasure-Hunt

    a. Add questions and answers to the game

    b. He can provide optional hints for each question

    c. Order the questions

7. After the students played the game check the students performance table, analyze it and give feedback
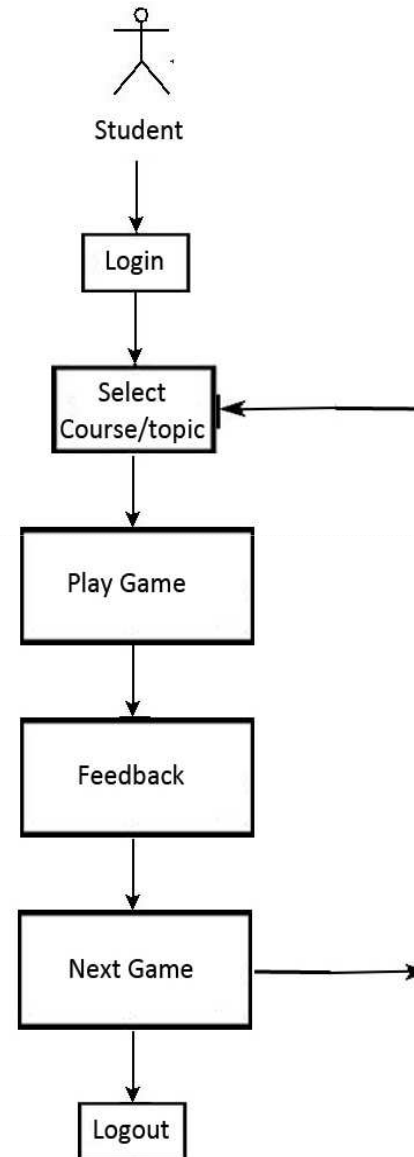
Workflow of Instructor

Steps to be followed by Student

1. The student also has to login first using his username and password

2. Select Course

3. Select Topic

4. Play the game which are provided under the given topic and course

5. Check the answers and learn from his mistakes

6. Check for feedback later from the instructor

# Workflow of Student

Steps to be followed by ITS

1. Allow login of users (instructors and students)
2. Maintain a profile for both instructors and students
3. For instructors, provide a interface for

    a. creating/selecting course

    b. creating/selecting topic

    c. designing the game

    d. adding hints

    e. viewing students performance table

    f. providing feedback

Steps to be followed by ITS

4. For students, provide a interface for

    a. selecting course and topic

    b. playing the game

    c. results

    d. viewing feedback from instructor

5. Maintain a student performance table

6. Get feedback from instructor after the completion of game

Architecture Diagram
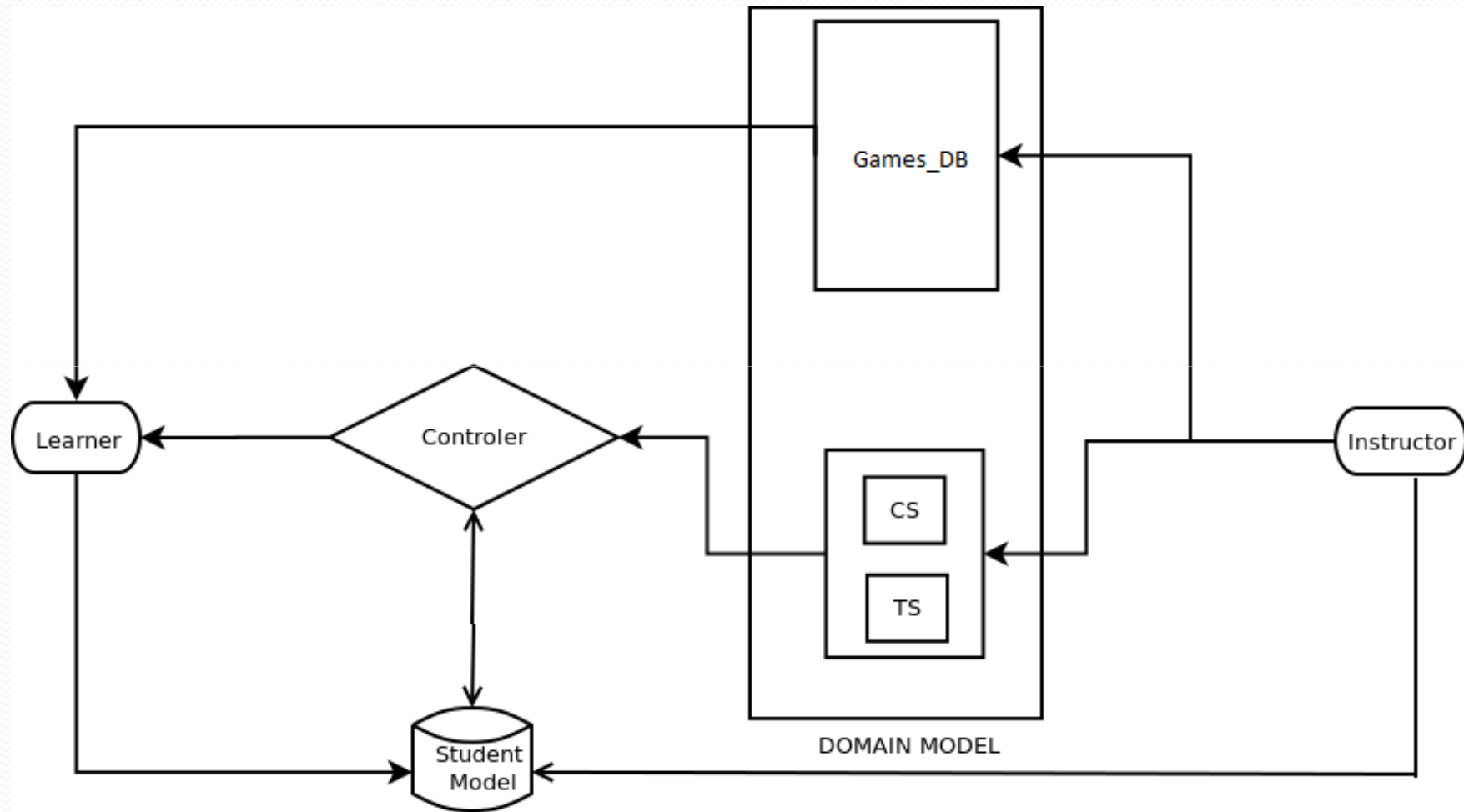
Architecture Diagram

- The most important part of the architecture is the controller which belongs to the Pedagogical Module

- Whenever a student interacts with it, it access the Student Module for student profile and Domain Module for content information and selects the appropriate teaching strategy or quiz based on his learning capability

- The overall content management is performed by the instructor using the Domain Module. He can manage course structure and also add content to the question bank

Modules

- The different modules used by our ITS are listed below
  - GUI Module
  - Input Validation Module
  - Registration Module
  - Authentication Module
  - Student Module
  - Course Module
  - Topic Module
  - Quiz Module
  - Question Module

Modules

- The different modules used by our ITS are listed below
  - Hint Module
  - Logic Module
  - Game Module
  - Status Module
  - Evaluation Module
  - Database Handling Module
  - Result Generator Module
  - Log Module
  - Feedback Module

Android App

- Why there is a need for mobile app?
  - Increasing use of smart phones by college students
  - For many Indian students in the cities and rural areas alike, smartphones will serve as PCs
  - A mobile app brings the learning process into the hands of student and they can access it at anytime
- Current Apps for Education
  - Blackboard Mobile Learn
  - eClicker
 - CourseSmart

Activities in Android

- The user interface of any android app is displayed on a device through an Activity. These can be considered as processes or modules of the app. The following are the Activities built for this app:
  - LoginActivity
  - RegisterActivity
  - CourseListActivity
  - TopicListActivity
  - SubtopicListActivity
  - ScaoldingActivity
  - SocraticActivity
  - GuidedDiscoveryActivity
  - CompileActivity
  - CrosswordActivity
  - TreasurehuntActivity

Layouts

- Layout is a type of View class whose primary purpose is to organize other controls.
- The following are the layouts used:
  - login.xml
  - register.xml
  - list.xml
  - quiz.xml
  - compile.xml
  - crossword.xml
 - treasurehunt.xml

Login Layout
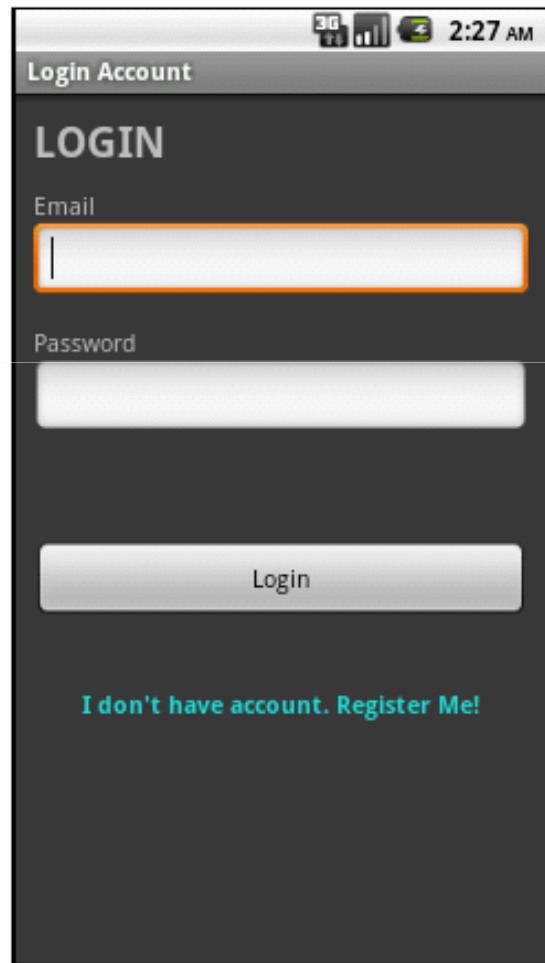
→Textview

→EditText

→Button

PHP API classes

- An android app cannot directly access the database on an external server. PHP APIs which are hosted on the external server acts as an intermediate between the app and database.

- PHP API classes built does the following:
  - Accept requests from app by GET/POST methods
  - Get data from database or store in database
  - Return output in JSON format

PHP API classes

src: http://androidhive.com
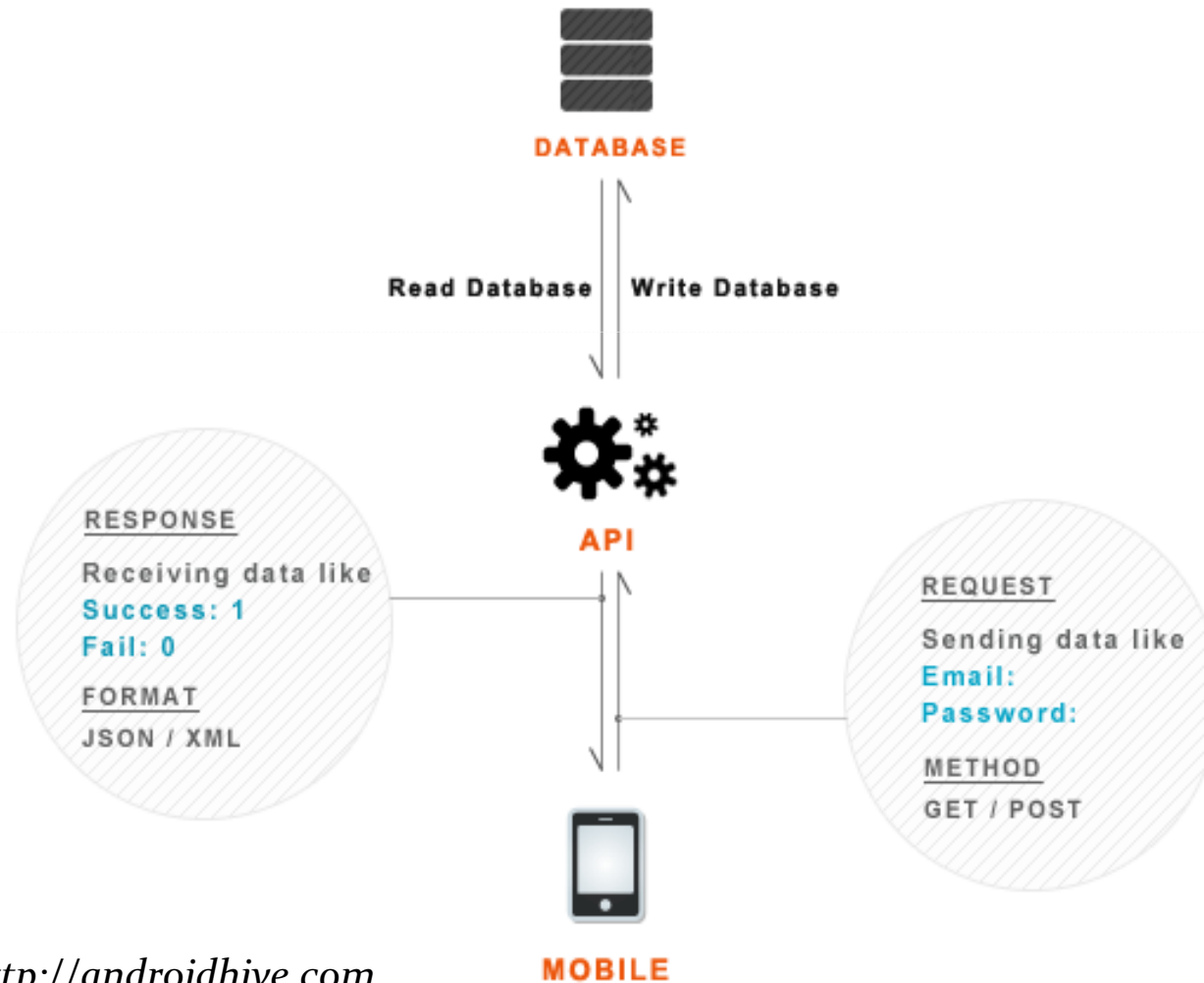
Login API JSON Responses

- Login Success Response - Success Code = 1 (User Logged in)

```
{
        "tag": "login",
        "success": 1,
        "error": 0,
        "uid": "2",
        "user": {
                "name": "Praveen",
                "email": "praveen@gmail.com",
                }
}
```

- Login Error Response - Error Code = 1 (Incorrect username/password)

```
{
        "tag": "login",
        "success": 0,
        "error": 1,
        "error_msg": "Incorrect email or password!"
}
```

Conclusion

- The ultimate goal of the project is to have a system with minimal human intervention in which students can learn and get instant feedback and hints. This project is only a first step towards achieving that goal

- The modular architecture ensures that each module can be extended and developed independently. This opens up a lot of avenues for future research and development

Future Work

- User Interface
- Evaluation
- Expanding the Scope

Future Work

- User Interface
  - The interfaces are built only for the prototype and needs to be developed more
  - More effort is required towards creating a flawless user experience for both students interface and instructors interface

- Evaluation
- Expanding the Scope

Future Work

- User Interface
- Evaluation
  - The system must be evaluated from both a design perspective and from an Educational Technology perspective. Evaluation must be done for each module and also for the whole integrated system
  - The interfaces must be evaluated for the user experience
  - Overall, the effectiveness of the system as a learning tool should also be evaluated either in a laboratory setting with a control group or by subject experts
- Expanding the Scope

Future Work

- User Interface
- Evaluation
- Expanding the Scope
  - Collecting material for teaching
  - Response Time Theory
  - More teaching strategies
  - More Games
  - Collaborative learning

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Thank You!