Swift 3-based application design and development

INTERACTIVE LEARNING APPLICATION FOR CHINESE MEDICINE

Project Plan

COMP4801 Final Year Project
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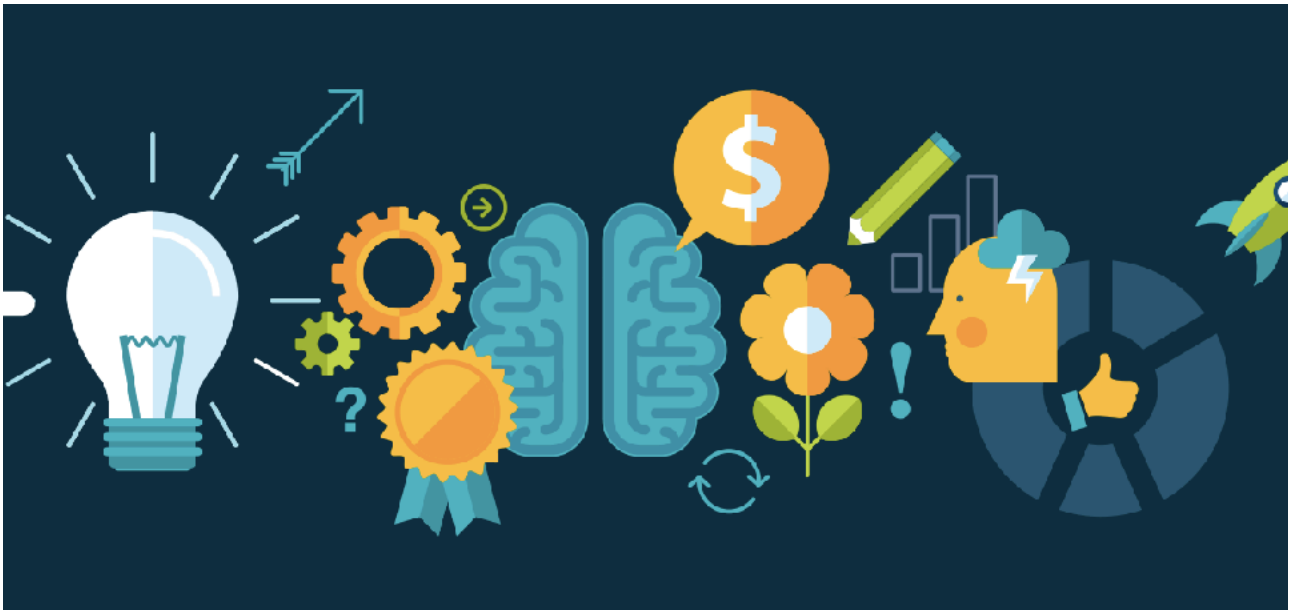
1 TABLE OF CONTENTS



2 BACKGROUND

Imagine a scenario in which a student encounter a new terminology when reading a thesis. To learn its definition, he searches the phrase by a web search engine, compares different results, filters out irrelevant ones, and finally, acquires the new knowledge. However, soon after that, the acquisition of new knowledge starts to decay and eventually be forgotten.

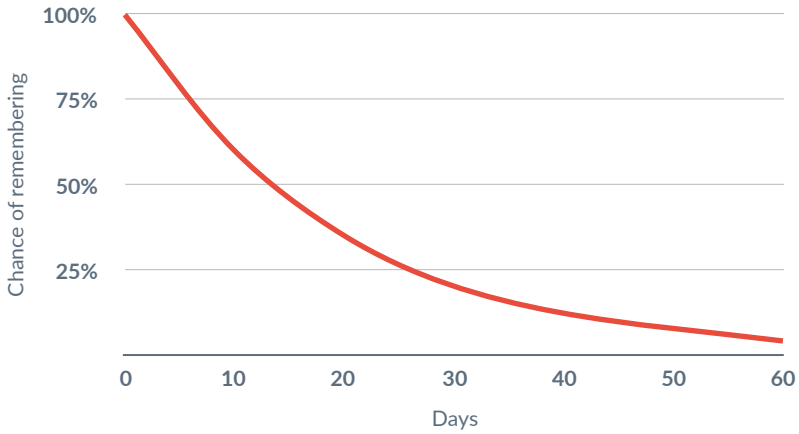


Figure 2.1. Projected forgetting curve

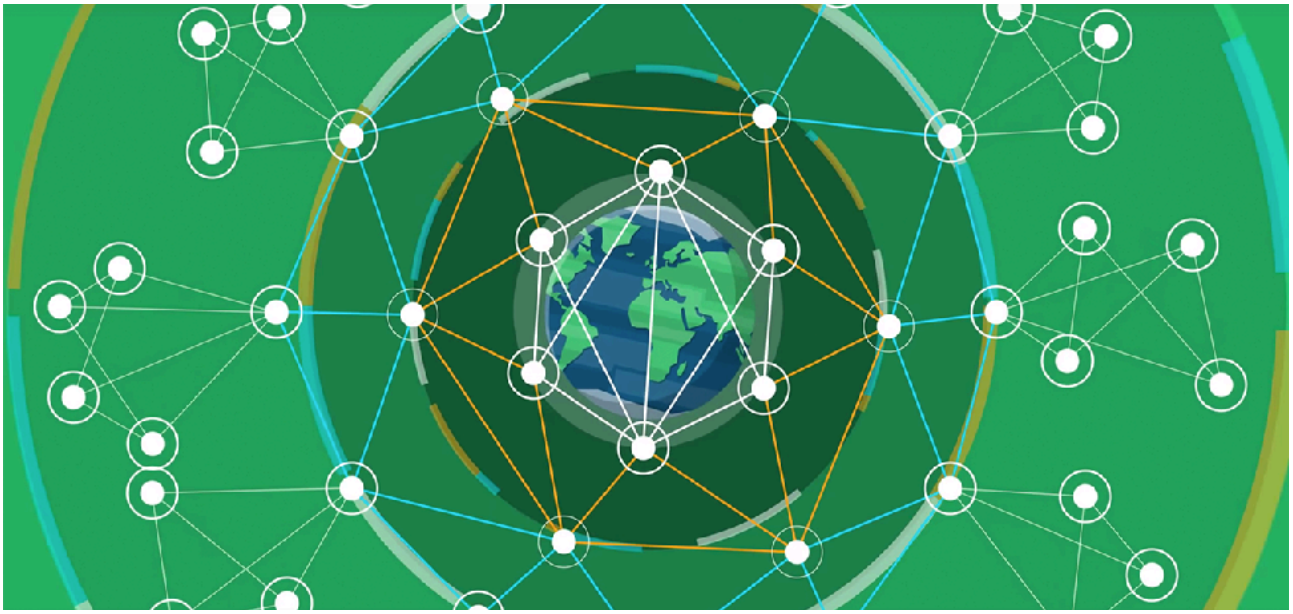
This scenario, unfortunately, is a learning process that we may commonly experience. Scattered and varied information available on the Internet reduces the efficiency of acquiring new information. Our memory model prone to forget information that is not revised regularly, as illustrated in the forgetting curve [1] in Figure 2.1, may further diminish the effectiveness of our learning.

Numerous solutions are available for students which aim to enhance the effectiveness of learning. However, none of them could instantly provide accurate and credible information, and meanwhile, preventing users from forgetting the information.

To address the situation, we plan to develop an **interactive learning application for Chinese Medicine**. The application allows users to lookup information about **Traditional Chinese Medicine ("TCM")** instantly from anywhere without leaving the current application with an iOS device. The application records all lookups by users and reminds them to revise regularly to ensure their memory retention. **Learning effectiveness** can be enhanced to a great extent with its lookup and revision features.

The application could further implement for all fields of study if evaluated as helpful for learning. Weighing the complexity and amount of resources available, TCM is chosen as the first implementation of the application. Information of TCM is complex and often required explanations with interactive materials, and few credible sources of information are available currently.

In the project, an **interactive learning application for Chinese Medicine** will be developed, with enhanced learning effectiveness, collectively defined by **(1) the speed of information lookup** and **(2) the performance of retaining information**.



3 EXISTING SOLUTIONS

3.1 ONLINE RESOURCES

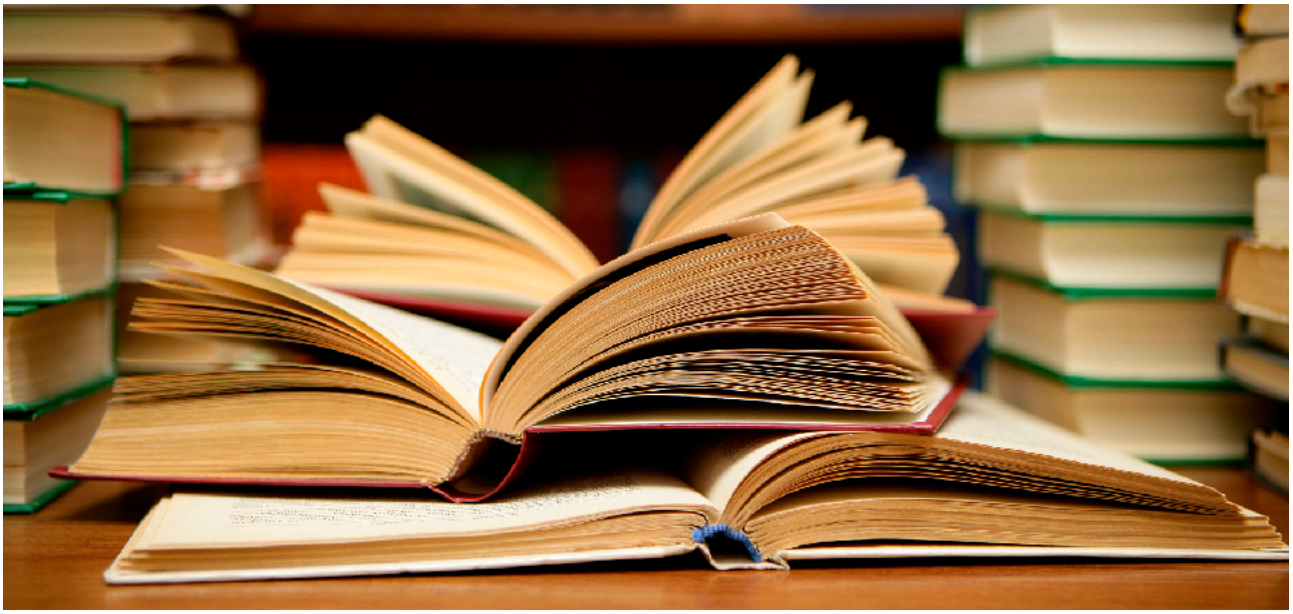
The Web contains a great amount of online resources that are useful to students. Some of the popular ways to lookup online resources are by **Google Search** or **Wikipedia**. Google Search is the most-used web search engine developed by Google. The engine provides **efficient lookup** (comparing to other search engines) by sorting search results by "PageRank" algorithms that **intelligently comprehend the keyword**. Wikipedia is a free online encyclopaedia that contains over **5 millions of articles** about different fields of study.

Advantages

- Extensive amount of resources
- **Relatively efficient** lookup functionality

Disadvantages

- **Doubtable creditability** of information
- **Scattered** and varied information
- Prone to forgotten unless regularly retrieved



3.2 BOOKS

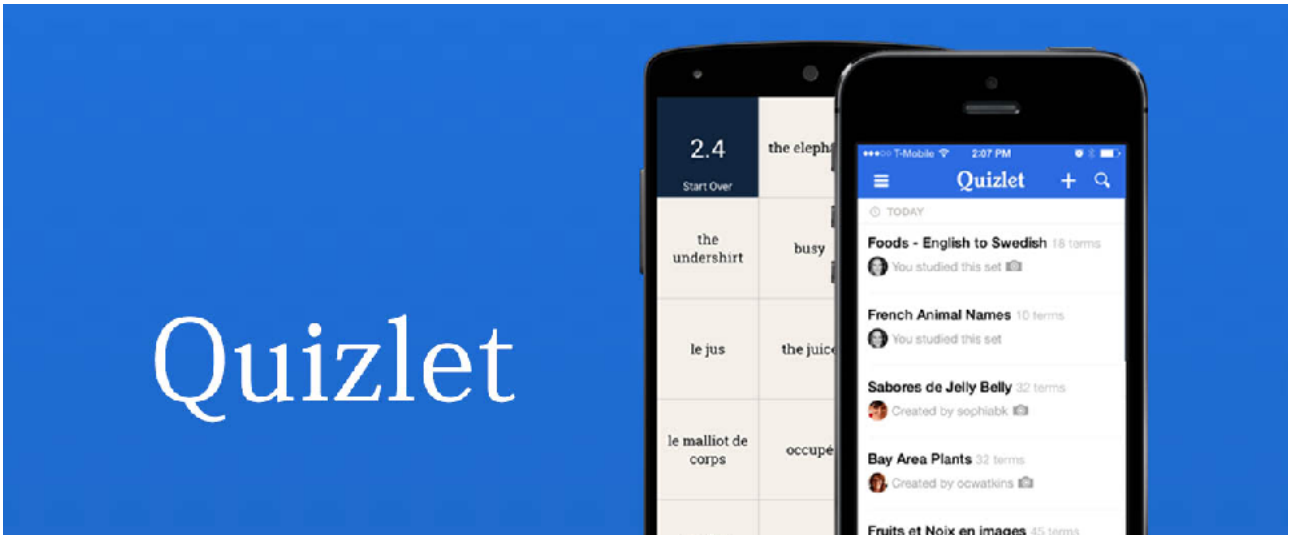
Textbooks and **reference books** are manuals of instruction in studies and are key learning materials for students. They usually contain well-organised and credible information about the field of study. The books are published in **printed format**, while many are now available as online **electronic books**.

Advantages

- **Credible information** by distinguished authors
- Centralised and **well-organised information**

Disadvantages

- Tedious and **time-consuming** for information lookup
- Prone to forgotten unless regularly retrieved
- Usually **high cost**



3.3 QUIZLET

Quizlet is an online learning tool for academic subjects with a cross-platform **flashcard and revision application**. The tool costs HK$160/year, and it provides 6 learning functions with pronunciations and images. Users can choose from community-designed flashcards or create their own.

Advantages

- Efficient learning by refreshing memory

Disadvantages

- Explicit download or creation of flashcard decks required
- Lack of interactive materials to hinder memory

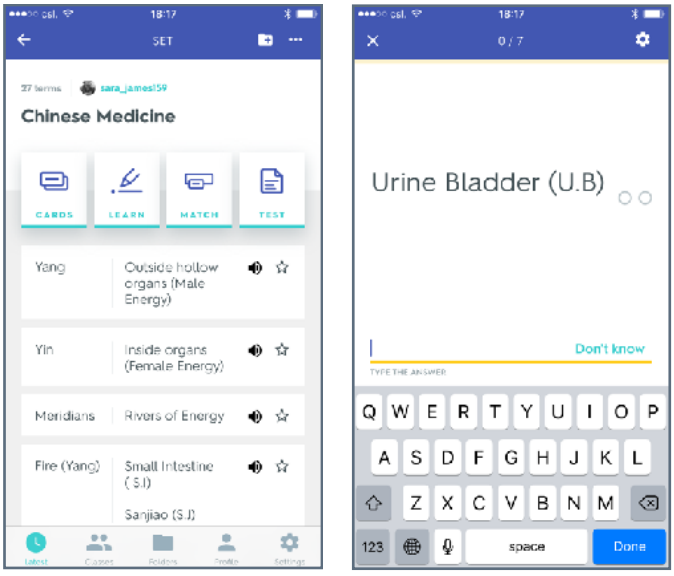


Figure 3.1. Screenshots of Quizlet iPhone application

3.4 ACUPUNCTURE – MERIDIANS AND ACUPOINTS

Acupuncture – Meridians and Acupoints is an iPhone application developed by **School of Chinese Medicine, The Chinese University of Hong Kong** for TCM students and other healthcare professionals to study acupuncture. The **free application** includes information and pictures of medians and acupoints.

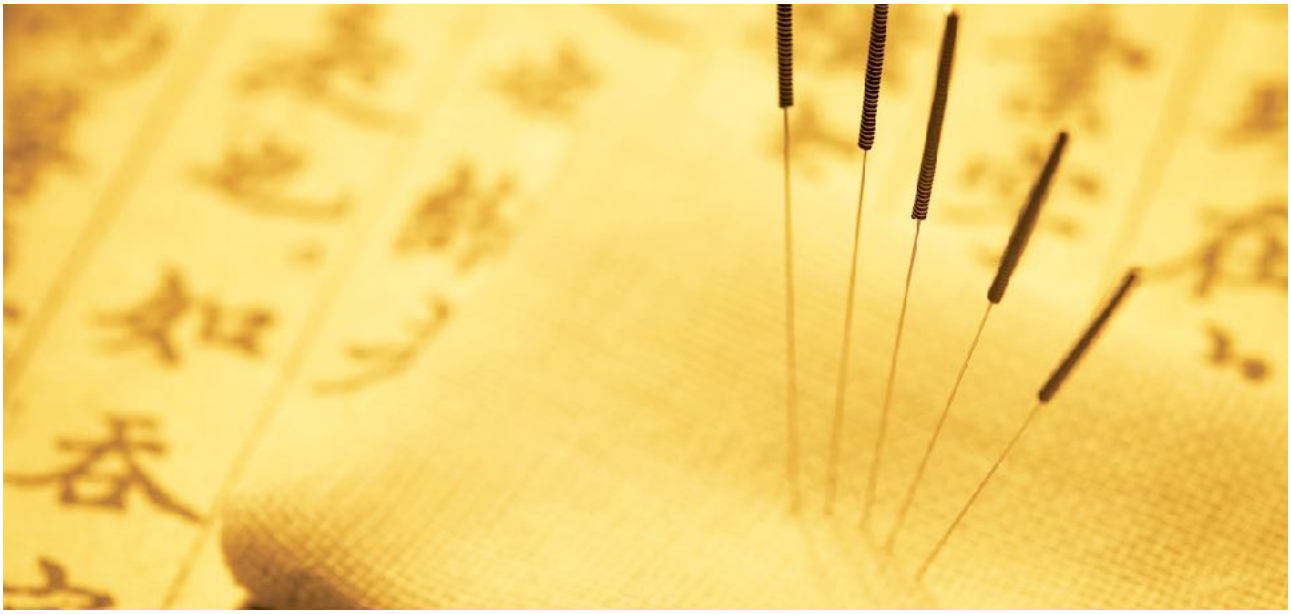
Advantages

- **Credible information** endorsed by registered TCM practitioners and professors
- **Trilingual interface** and contents for international learners
- Well organised information

Disadvantages

- Inconvenient and tedious lookup functionality
- **Lack of bookmark features** for subsequent retrievals

Figure 3.2. Screenshots of Acupuncture – Meridians and Acupoints iPhone application



4 OBJECTIVES

The objective of the project is to develop an **iOS application** which:

- is written in **Swift 3** programming language
- enhance **effective learning** *(defined in Section 4.2)*
- provides credible, organised, and **regularly updated information** related to TCM
- presents **interactive materials**
- actively log user lookup and practice history
- reminds revision based on the **memory model**
- provides interface and contents in **multiple languages**
- enables **system-wide instant lookup**
- is free

4.1 SCOPE

The goal of the project is to develop an interactive learning application for all areas of the Traditional Chinese Medicine which act as supplementary learning materials to enhance the effectiveness of learning TCM. With the relatively short span of the project, a major section of TCM, **acupuncture including meridians and acupoints**, is chosen to be implemented in the project schedule for demonstration and evaluation of the effectiveness of such application. Acupuncture is chosen to be implemented due to its **importance and complexity among all TCM areas**, which can be simplified to a great extent with an **interactive presentation and design of the application**.

4.2 EFFECTIVENESS

Enhancing the **effectiveness of learning** is to be of paramount importance among the project objectives, and this abstract measurement is **collectively defined and quantified** by:

- the speed of **information lookup**; and
- the performance of **retaining information**

4.2.1 Information lookup

A **simple experiment** was conducted with current students from School of Chinese Medicine, HKU, target users of the application. Participants were instructed to **lookup a designated TCM terminology** from different sources, **time elapsed** and **screen tap counts** are measured until they provided the correct definition of the phrase. Figure 4.1 illustrates the experiment result (in red, small dots) where a large number of screen taps and long durations are generally required.

Figure 4.1. Experiment on screen taps and time duration required to lookup a terminology

To provide effective learning, the application attempt to reduce the effort in information lookup to **under 5 screen taps** and **10 seconds** (illustrated in Figure 4.1 in green, larger dot) as the objective.

4.2.2 Information retention

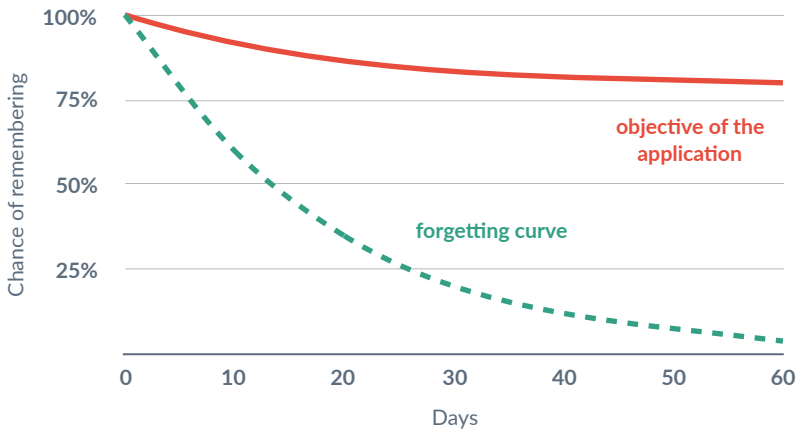


Figure 4.2. Projected forgetting curve (in dotted line) and targeted memory retention (in solid line)

Dotted line in Figure 4.2 shows the **forgetting curve** which hypothesises the **decline of memory retention** in time. [1] If an acquired information is not subsequent practised, the memory retention of the information may drop under 60% in less than 10 days and **under 10% in around 60 days**.

To provide effective learning, the application aims to assist users to **retain over 80% of the acquired information after 60 days**, as illustrated by solid line in Figure 4.2.

4.3 DELIVERABLES

Application source code

An iOS application written in **Swift 3** programming language will be delivered, which can be installed on **iPhones or iPads** with firmware **iOS 10**.

Database

The application supports user learning profile and progress tracking by **storing user profiles** in an online database. The database will be delivered with the application for testing.

Unity project file

The **3D body model** displayed on the application will be drawn and written in Unity and mapped to Swift. The Unity project file will be delivered with the application for reference.

5 METHODOLOGY

5.1 CREDITABILITY

5.1.1 Cooperation with School of Chinese Medicine, HKU

To provide credible information for the application, we plan to invite cooperation with a **professor from the School of Chinese Medicine, HKU**. Throughout the development stages, comments will be collected from the professor for modifications in following deliverables, and contents will be proofread prior to the final deliverable.

5.1.2 Regular correction and update of information

Information in the application could be **corrected or updated after releasing to the public**. Information is stored in a database hosted in Amazon Web Service, and the application will **automatically fetch the up-to-date information** from the server.

5.2 EFFECTIVITY

5.2.1 User profile

The application **stores all lookup histories and practice performances** in user profiles. User profiles are stored in the database and are used to **calculate and determine the effective revision schedule** for users. Users can synchronise their profile across multiple devices to learn everywhere, and they can opt-out from storing lookup histories for privacy concern.

5.2.2 Instant lookup functionality

With the implementation of **Lookup API** provided by the new released iOS 10, users can lookup TCM terminology **directly from any third-party application**, and retrieve the definition and explanation instantly **without launching the application**. Every lookup by the user will be recorded, and reminded for revision to ensure the memory retention.

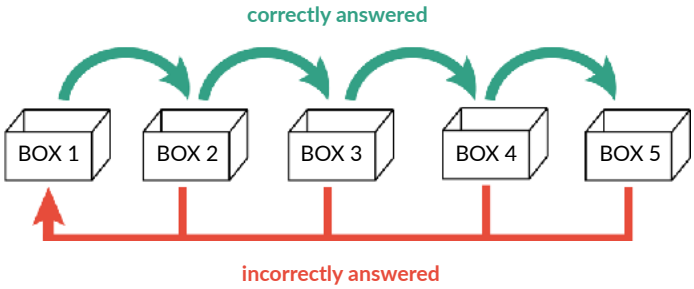


Figure 5.1. Illustration of Leitner System

5.2.3 Logged practice

The performance of each practice and revision will be recorded in the database to determine the memory retention. The application will implement the **Leitner System** [2] to **design a set of contents for next revision or practice**. Figure 5.1 illustrates the implementation of Leitner System with cards as an analogy of information, and cards will be sent to next box if the user correctly answered, or to the first box if failed. Each succeeding box represents a better memory retention, while the first group represents the worst.

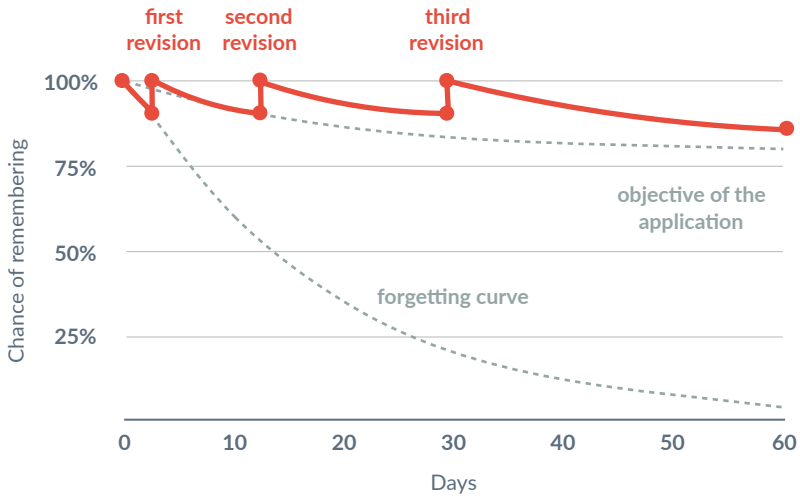
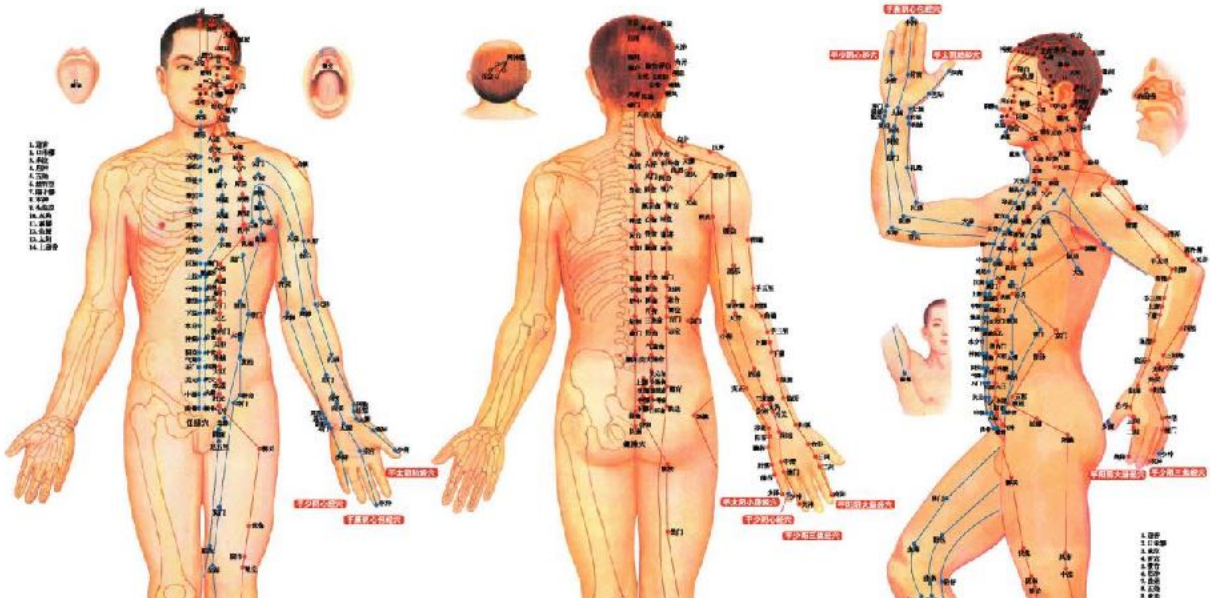


Figure 5.2. Projected forgetting curve with spaced repetition (in red, solid line), forgetting curve and objective of the application (in grey, dotted lines)

5.2.4 Revision reminder

The application reminds user for revision by implementing the **spaced repetition** [3] to determine the **review schedule**. Figure 5.2 illustrates the **projected forgetting curve** with **spaced repetition**, maintaining **over 80% of memory if regularly revised**. The application implements **iOS notifications API** for sending revision reminders to users.



5.3 INTERACTIVITY

5.3.1 Interactive materials

Along with interactive materials including images and videos, a **3D body model with animation** will be tailor-made for the application to present **medians and acupoints** distribution. The 3D body model will be implemented with **Unity Game Engine** and mapped to Swift.

5.4 ACCESSIBILITY

5.4.1 Universal application

The application will provide adaptive layouts for **iPhone and iPad** resolutions to utilise the screen real estates comprehensively.

5.4.2 Interface and contents with multiple languages

The application will provide **interface and contents** in **Traditional Chinese, Simplified Chinese and English**, to accommodate the needs of growing trend of **international learners**. Initial language will be determined by user's system language and can be changed anytime in the application preferences.

6 SCHEDULE

The project schedules from September 2016 to Mid-April 2017. The application development adopts the **incremental build model** with a deliverable in each of the 6 defined milestones, each providing more implementation and functionality. Testing will be conducted after each iteration, and TCM students and professors will be invited to **test and provide feedback after Milestone 3**.

Scheduled Completion	Milestone	Description
2016 October 2		**Phase 1 Deliverables** - Detailed project plan - Project website
by October	**Milestone 1**	**Project study** - Swift 3 programming language and APIs - Unity game engine - Journals on spacing effect and spaced repetition
by November	**Milestone 2**	**Initial preparation** - Server and database setup - User interface - 3D body model in Unity - Sample data set for development
by December	**Milestone 3**	**Preliminary app** - Browse and lookup functionality - Practices and lessons - Tester comments and feedback collection
2017 January 22		**Phase 2 Deliverables** - Preliminary implementation - Detailed interim report
by February	**Milestone 4**	**Finalised app** - 3D body model mapped in Swift - Algorithms implementation
by March	**Milestone 5**	**System-wide features** - System-wide lookup API - 3D Touch, dashboard support - data loading
by April	**Milestone 6**	**Project wrap-up** - Optimisation - Testing - Documentation
April 16		**Phase 3 Deliverables** - Finalised tested implementation - Final report

7 REFERENCES

[1] Ebbinghaus, H., Ruger, H. A., & Bussenius, C. E. (1913). Memory: A contribution to experimental psychology. doi:10.1037/10011-000

[2] Leitner, S., & Totter, R. (1980). *So lernt man lernen*. Freiburg/Br. u.a.: Herder.

[3] Pavlik, P. I., & Anderson, J. R. (2008). Using a model to compute the optimal schedule of practice. *Journal of Experimental Psychology: Applied, 14*(2), 101-117. doi:10.1037/1076-898x.14.2.101