

COMP3900
Hal_3900 Proposal

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Contents

1	Background	3
1.1	The Problem	3
1.2	The Existing Solution	4
1.3	Our Solution	4
1.4	Technical Details	5
2	Epics	6
2.1	Answers administrative questions about course	6
2.2	Answers questions about course content	6
2.3	Meaningfully quizzes and interacts with students	7
2.4	Informs course admin/staff about cohort	7
2.5	Learns to service new courses with a minimal setup process	8
3	Epic Selection	9
4	Summary	9
5	Glossary	9

1 Background

1.1 The Problem

Online learning is changing the way students access and engage with higher education. Courses with online delivery increase the flexibility and accessibility of education by providing students with a platform to learn course content in their own time, at their own pace. Increasingly courses which are taught face to face include some online content delivery, including course materials, quizzes, online lecture recordings, and forums to ask questions and discuss the course content outside of class. Because online learning is so prevalent in higher education, it is crucial for universities to ensure student satisfaction with their learning experience remains strong.

There is a delay between when students ask a question and when they get a response, and this can vary from hours to days. Answering individual student questions via email or on the forums requires a significant amount of time for tutors, course administrators and lecturers. Often the same questions will be asked many times by different students, making it inefficient to have course staff respond to each one individually.

Some key factors that contribute to student satisfaction in the online learning space are:

- Students preference for actively participating in learning, rather than passive learning styles.
- Students expectation on instructors to facilitate their learning by organising their resources and learning experiences.¹
- The amount of interaction students have, and the availability of their instructor, contributes significantly to student satisfaction.²
- Students require strong administrative support when using online learning tools to ensure they are able to access the resources they need, and to clarify questions about assessments and learning expectations.
- Organization and motivation play a key role in success of students using online learning tools.

Additionally to student satisfaction, lecturers and tutors are concerned with the quality of their course delivery, and want to know what their students need the most help with. Students are in different places with their learning and often need more individualised support to learn either the basic content, or suggestions of more advanced material to extend themselves. This becomes more challenging as classes grow in size.

¹https://www.researchgate.net/publication/282699144_Student_Satisfaction_with_Online_Learning_Is_it_a_Psychological_Contract

²'Key Factors for Determining Student Satisfaction in Online Courses': https://www.learntechlib.org/primary/p/2226/article_2226.pdf

1.2 The Existing Solution

Currently at UNSW, learning support is provided to students through email, forums and help sessions. This is very man hour heavy, requiring countless tutors to be on hand to answer questions which of themselves are quite repetitive. In addition as these courses become larger with increasing enrollment sizes it becomes more difficult to be able to give students individual attention and personalised education.

Another side effect of growing cohort sizes is the fact that many tutors and lecturers are forced to spend most of their time answering admin related questions and helping students to clarify their understanding, time that could be spent bettering the course and writing course material. Hiring more staff and offloading many questions to forums has been the current approach used by courses to handle this increasing load but forums are full of repeat questions and require many tutors to man them.

This growth is becoming unsustainable and with the rise of online education platforms many students are eager to interact with course material in a more interactive meaningful way which works with their schedule. Waiting for a tutor to respond to them often creates a distance between the initial question and the answer which limits the effectiveness of a response. That is if the tutor finds time to respond at all.

In some areas of education chat bots have been deployed which interact with students in meaningful ways out of class hours³ and some have even been created to answer higher education questions⁴. However these tools are not able to be easily mapped to a UNSW university course, it's administration, assessments and can not utilise archives of previous iterations of the course to learn common questions and issues.

1.3 Our Solution

The goal is to create a chat bot companion for students to enhance their learning experience. The chat bot will provide students with learning support by responding to their questions about course administration and the content they are learning, in real time, and monitoring their understanding of the course content with follow up questions. This is expected to increase both the amount and quality of interaction students have during the course, by providing them with more frequent and timely interaction through the chat bot, and diverting more complex questions to tutors and lecturers who in turn will have more time to respond to such questions in depth.

The chat bot will assist students with revision of course content, and will help to individualise student learning by providing resources at the level required by the individual student.

The chat bot will provide organizational support by keeping students informed of their grades and upcoming due dates. This is expected to increase learning outcomes by boosting students' motivation to study and supplementing their organisational skills.

³<https://botsify.com/education-chatbot>

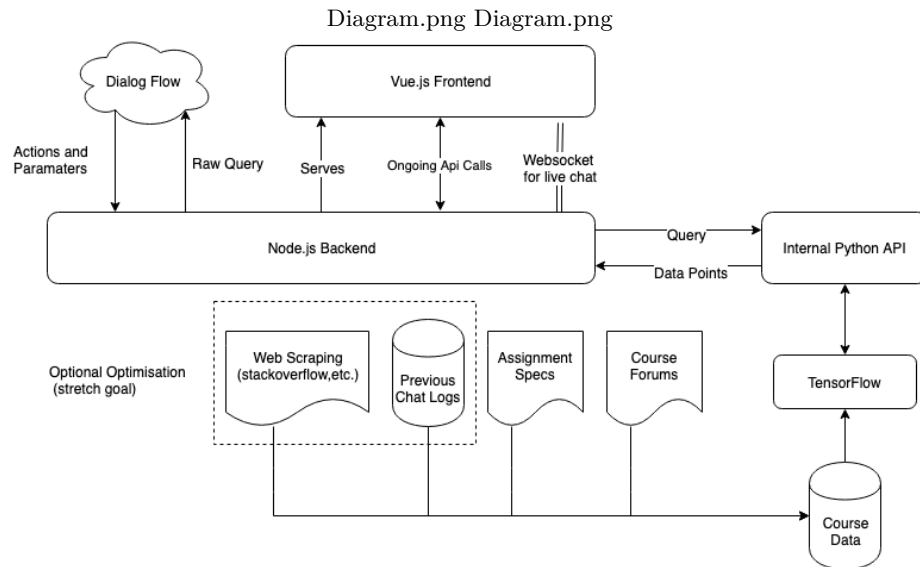
⁴<https://www.canberra.edu.au/about-uc/media/newsroom/2018/february/students-make-new-friend-in-lucy-the-chatbot>

The chat bot will enhance course delivery by keeping staff informed of their students' learning needs and frequently asked questions. It will reduce the load on lecturers, tutors and course administration staff by answering many of the questions that students have, allowing them to focus on the overall delivery of the course.

1.4 Technical Details

For this bot we will be building several layers to form our technical stack.

- A frontend will be built in **Vue.js** interacting with a **Node.js** backend via **Websockets** to provide a frontend to interact with the chatbot.
- **Dialogflow** will be used to parse user input and provide the natural language processing aspect of this project.
- Actions will be passed to the knowledge base of the bot, which will be built on top of **TensorFlow** and will use machine learning to classify data and form connections between an input query and the relevant data points.
- Data will be stored on **Amazon S3** buckets.
- **Docker** will be used to unify the several layers of this application into a holistic program.



The scope of this program is to have a bot which can answer most basic administration questions such as when assignments are due and has at least a 50% success rate with responding to direct questions with a simple data point response i.e "how do you print with no new line in python" should respond with "you can use `sys.stdout.write()`". In addition the bot should have the ability to quiz students from a lecturer defined set of questions, a stretch goal would be for the bot to automatically generate these.

2 Epics

2.1 Answers administrative questions about course

The chatbot will play the role of “Course administrator” and help students to efficiently manage their course. It will answer questions about the following information:

- **Assignments management:** includes the requirements of assignments, relevant dates (release date, deadlines), weighting, and materials provided by the lecturer.
- **General information:** includes locations of the lectures, timetables, information of lecturers (e-mails, details etc.), notices, course schedule, teaching strategies, assumed knowledge, student learning outcomes and homepage address.
- **Assessment details:** includes items with their weightings, due dates, and calculation method of the final score.
- **Textbooks:** includes the list of textbooks as well as webpage links to where they can be purchased.

This epic aims to help students to access the course administrative information, which is mostly gained from the course outline. It will be limited to answer questions about existing information which is already provided by the course homepage. Questions about further information such as detailed course context will not be included in this epic.

This epic has an estimated difficulty score of 4/10, because the workload is not large, and a time estimate of 5 units.

2.2 Answers questions about course content

This is the next major category that student questions will fall into. Although questions in this category may be less common for course administrators compared to queries such as “when is assignment 2 due?”, they make up a significant proportion of questions directed to tutors. Implementing this feature in this chat bot will remedy a number of problems that this poses.

- Gives immediate answers to students, eliminating the need to wait for tutors’ responses.
- Reduces workload of tutors, who are typically only paid for one hour of associated work.
- Can answer questions beyond the scope of tutors’ knowledge.
- Discourages plagiarism by providing an officially endorsed information bank.
- Offers an outlet for shy students to ask individual questions.

The bot’s knowledge base can be built from a number of sources. Apart from manual input, this can also include information scraped from appropriate sources such as course syllabus, lecture slides and past assignment submissions.

Information not directly related to the course content should be considered out of scope. However as there is no clear divide between what constitutes course content and what doesn't, there will be some degree of leniency as to what is included.

As one of the primary features, it has an estimated difficulty score of 8/10 with a time estimate of 5 time units. That said, the actual implementation is not unlike that of epic 1, so there is potential for this epic to be developed alongside epic 1 as the functionality may be shared.

2.3 Meaningfully quizzes and interacts with students

The chatbot will be continuously trained and personalized to fit students' needs, as well as provide meaningful quizzes to students. Students can conveniently examine themselves and compensate their weakness. The chatbot's answers will increase in accuracy as it learns.

The epic includes 2 important fields:

- **Statistics:** the chatbot will gather questions which the student has asked, to analyze the learning status of the student in topics included in the course. According to the analysis, the student's areas of weakness will be figured out to help form the content of future quizzes. These quizzes will be provided when they are asked for by the student. Additionally, a statistics conclusion will also be provided to students, which will be helpful for their final review.
- **Personalization:** the chatbot will interact with the student and train itself according to the feedback it receives. This process will help students to personalize their chatbots, to make the chatbots be more familiar with the users' language habits. Therefore, chatbots can provide progressively more accurate answers.

The scope of the epic is limited to provide this learning for only one student, and all conversations that occur will be treated as information from one person. Moreover, the quizzes questions will come from a preset database, further questions will not be included.

This epic has an estimated difficulty score of 7/10, and a time estimate of 8 units.

2.4 Informs course admin/staff about cohort

This feature will allow the chat bot to maintain information about the questions users are asking and the performance of users in the exercises the bot sets forward. This will be accessible from the admin web interface available to course staff.

The main metrics that should be captured for a requested time frame are:

- A list of the most common questions asked and their relative frequency.
- A list of missed questions.
- A list of the questions or triggers which the bot had a low satisfaction rate for.

- A breakdown of every topic covered and its retention rate amongst users (derived from interactive quizzing).
- General statistics on the bot's usage rate, uptime and the average computation time taken for a response.

The web interface will provide the ability to:

- View interactive sortable tabular data for the followed metrics.
- View certain data such as usage rate and computation time as a graph against time.
- Export the metrics as `csv` or `json`.
- Register admin staff to be notified by email when certain conditions are met, i.e missed question rate rises past 50%.

Out of scope will be any more advanced interaction with the data other than simple tabulation and graphing against time. More forms of data visualisation should be deferred to specialist tools.

In addition this is simply to inform users of the bots performance and will not provide features to adjust the parameters of the bot, this will be deferred to the second epic involving the bot's interaction with course content.

This will be a somewhat difficult set of features to implement, its estimated difficulty score is 7/10 with a time estimate of 5 time units.

2.5 Learns to service new courses with a minimal setup process

This feature will allow a course administrator to set up the chatbot to service the students in a given course, with minimal configuration. The course administrator will be able to walk through a short setup process to provide the chat bot with access to course materials. This will allow the chat bot to learn from the course materials provided and start giving students support for that course.

The information provided by course administrators during setup will be:

- Access to all course materials available to students.
- Student timetable and handbook information.
- Enrolment information for students in the course to facilitate student login.

Following the administrator completing this setup process, the chatbot program will start ingesting the data itself and no further setup will be required by the course administrator.

This epic has an estimated difficulty score of 3/10, as it will combine significantly with the main implementation of the bot in epics 1 and 2, and a time estimate of 4 units.

3 Epic Selection

Of the proposed epics, the following epics will be delivered in the final release:

- Answers administrative questions about course.
- Answers questions about course content.
- Learns to service new courses with a minimal setup process.

Considering the goals of this project, these epics clearly outline the core functionality that should be achieved to deliver a minimum viable product. The main goal is to have a chat bot that students can direct questions to, and the epics were chosen accordingly.

The first two epics that were chosen directly correlate with the intended final outcome. Although the third epic is not directly related to this cause, it is an important feature required to perform the initial configuration of the chat bot, which is required to allow it to function normally.

The remaining epics are:

- Meaningfully quizzes and interacts with students.
- Informs course admin/staff about cohort.

These epics go hand in hand to an extent, and while the features they provide are definitely useful, they are not essential to the basic functionality and upkeep of the chat bot. As such, they will be considered stretch goals which will be implemented if the scope of the project allows.

4 Summary

This project aims to deliver a chat bot that students can use as an assistant while taking certain courses. It will be implemented as a web application to provide an easy-to-use interface and developer-friendly code base to allow for extensibility.

5 Glossary

Missed Question A question which the chat bot was not able to answer