**IBDP Computer Science Internal Assessment**

# Criterion A: Planning

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## 1. The scenario

My school offers co-curricular activities (CCAs) to students after academic periods from Monday to Thursday. Most of those activities are relatively limited in space, and my campus has approximately 586 students across 4 year groups.

Before I joined the school, the CCA department has already been using SchoolsBuddy as a CCA selection interface for students. However, SchoolsBuddy has the following problems when used at the scale and to the requirements of our school:

- When too many students attempt to choose one course at a time, most of their attempts would be confirmed and recorded in the database, and the CCA department staff must notice them after-the-fact that their attempt at choosing a course was unsuccessful. At that point, there would be much fewer other CCAs with available places too, leaving the student with insufficient choices—after they have been told by the system that their place has already been confirmed.
- The only way to sign in to SchoolsBuddy, at least for our school's configuration, is to log on to PowerSchool and click the SchoolsBuddy Single Sign-on link. This generally works well, except for the fact that PowerSchool only allows approximately 300 simultaneous sessions, which means that there would be approximately 200 students unable to choose CCAs on SchoolsBuddy.
- Even after logging in, the SchoolsBuddy web page is extremely bloated. It takes 16.5 MiB to get completely load the SchoolsBuddy home page, and an additional 8 MiB per additional page. This takes about 8 seconds on a relatively good connection without congestion. But when CCA selection starts and everyone is trying to use student WiFi to log on at the same time, loading each page could take well more than a minute.
- Some parts of the interface is unintuitive to students. We have 6 CCA slots: MW1, MW2, MW3, TT1, TT2, and TT3, which basically mean "CCA Period $n$".

- The selection system does not enforce CCA hours requirements, and the CCA office's staff must manually verify that students have completed CCA choices to the year group's requirements, by literally printing out the spreadsheet to paper and reading through them.
- The school has to pay SchoolsBuddy an expensive subscription fee.

I am developing this project to replace this legacy system and to improve the user experience for both the CCA department and individual students.

## 2. Rationale for the proposed solution

I have consulted with the school's IT department and confirmed that, with the approval of appropriate faculty such as the Head of Co-curricular Activities, the IT can provision a virtual machine on the school's LAN, running a suitable server operating system such as Alpine Linux or Debian, to run the solution that I develop. I am also capable of running the solution on my own hardware in my dorm if necessary for beta and acceptance testing.

I am relatively experienced in developing low-latency network applications such as IRC software, and I am comfortable reading specifications of network protocols on various layers of the OSI model. I am somewhat familiar with developing web applications in the context of our school's environment, and I have previously developed a library for web services written in Go to interface with our school's Microsoft Entra ID system for authentication (previously known as Azure Active Directory).

The program does not need input data during the development process. During production, all data is automatically retreived from Microsoft Entra ID and the Microsoft Graph API via delegated access once a student has logged in via OAuth 2.0; in practice, this data includes the year group (grade level), name, student number, and email address, all of which are publicly available to any student via the Microsoft Entra ID portal.

There are no special security considerations other than various standard ones present when working with web applications. Care must be taken not to leak client secrets used in the OAuth 2.0 authorization code flow, although leakage thereof is considered inconsequential as an authorization code would be required anyway. Cookies must be protected against cross-origin request forgery and should have `httponly` and `secure` flags. It should be made impossible for a student to spoof another student's course choices, provided that the victim's school login credentials haven't been already leaked.

## 3. Success criteria

The product shall present to students and administrators an accessible and easy-to-use web interface for choosing and managing CCAs. It shall address each of the issues of SchoolsBuddy as presented above.

- When too many students attempt to choose one course at a time, their attempts are sequentially processed, and those that exceed the CCA's member limit are properly rejected.
- It should be possible to log in via Microsoft Entra ID.
- The web page must be lightweight. The login page shall be preferrably no more than 15 KiB. The course selection page shall be preferrably no more than 50 KiB. If a compressing content encoding such as `gzip` or `deflate` is used, the values above refer to the size of resources after decompression. If minification is used, the values above refer to the size of resources after minification. The experience should be fast and it should not take excessive resources on the host server.
- The course selection categories shall be relatively intuitive. Students may choose from a table of dropdown choices, where there is one dropdown per CCA slot; or they may choose from a set of tables, where one table represents all CCAs in one CCA slot.
- The selection system must enforce CCA hours requirements.
- The selection system must be able to take a CSV of CCAs with fields such as period, location, teacher, and member cap. It must then be able to populate its own CCAs table that it presents to the students with information in the CSV.
- The selection system must be able to export student choices as a CSV containing the following fields:
  - Student name
  - Numeric student ID
  - Student year group (grade level)
  - CCA name
  - CCA period

  These may then be used to trivially import choices to PowerSchool. It would be best if the PowerSchool API could be directly accessed to insert the courses, but the API is not publicly documented.