

Assignment 1

Analysis and Design Document

Digital Library System

(using GAIA methodology)

Project Group 2

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Table of Contents

1	System Specifications	3
1.1	Problem Statement	3
1.2	System Description	3
1.3	Assumptions	4
1.4	Requirements	4
1.5	Wishlist (Not Implemented)	4
2	System Analysis	5
2.1	Role Model	5
2.2	Role Schema	5
2.3	Interaction Model	7
3	System Design	8
3.1	Agent Model	8
3.2	Services Model	9
3.3	Acquaintance Model	10
4	Multi-Agent System Architecture	11
5	Agent Description	12
5.1	Admin	12
5.2	Librarian	12
5.3	Stationer	12
5.4	Print	12

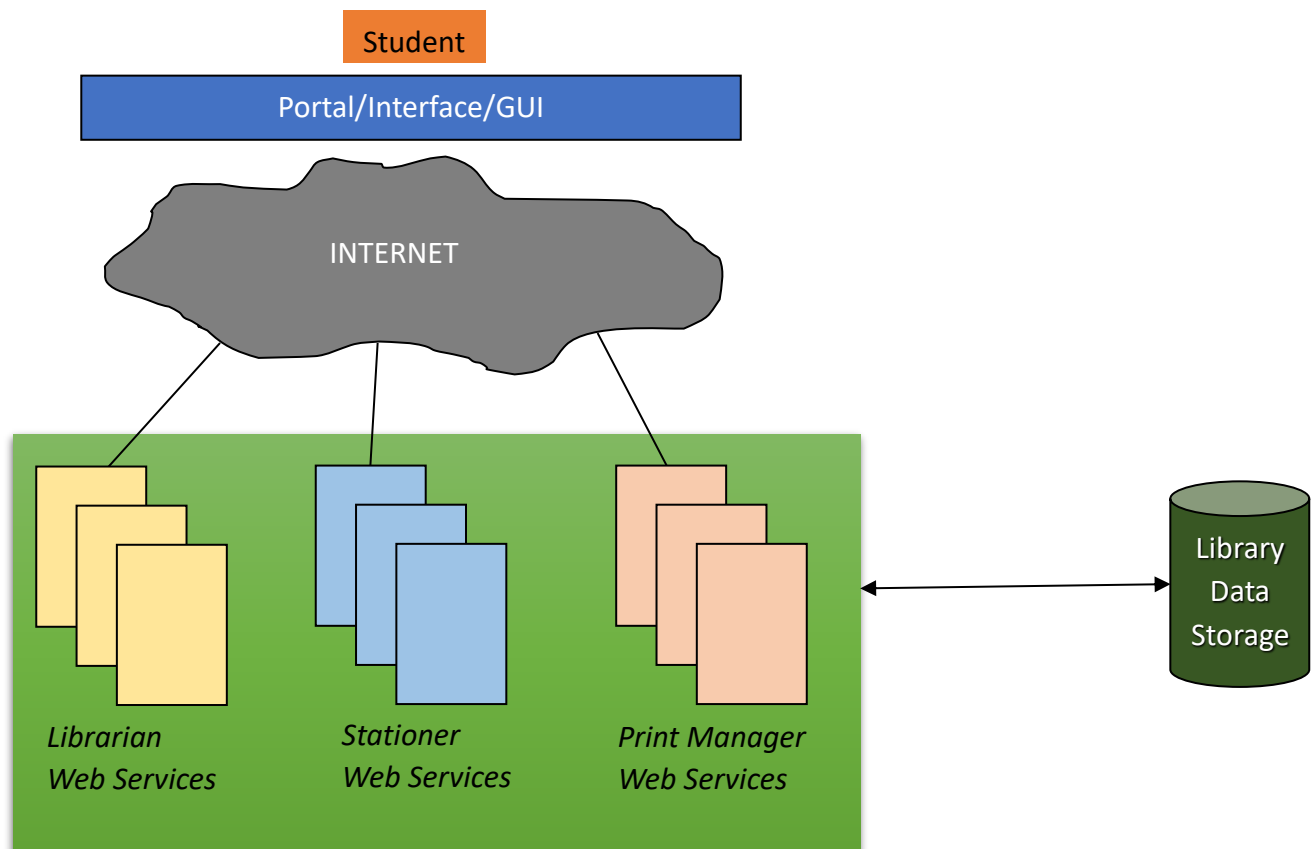
1 System Specifications

1.1 Problem Statement

- The pandemic has boosted digitization of technologies which has led to conversion of physical resources into digital technology that could be accessed using a computer
- Computer can be used to access resources available on the internet which in turn benefits a variety of users including students
- Students have been comfortable taking virtual classes which brings the need to provide the students with materials and books as required for academics
- Unlike pre-pandemic times the students cannot access the library at ease due to social distancing and so the optimum solution could be to bring the library to them over a computer
- A digital library system for the students to extending the library functionality and accessibility would be a convenient solution beyond papers and in-person arrangements

1.2 System Description

- The proposed Digital Library System (DLS) is a multi-agent system designed to provide access to books and various functionalities of a library
- The system also helps to register a new student and de-register an existing student
- The system provides access to millions of books, various stationary items, and access the printer features



1.3 Assumptions

- The system maintains the student data, stationary item data and books data
- A Student has two options –
 - A register student can enter their details such as student name, the email-id to access the system
 - An unregistered student can register by entering the student details
- The student can access the admin portal to
 - lend and/or return books
 - purchase stationary items
 - take printouts
- The Librarian takes the book name from the student and
 - checks for the availability in the Data Storage
 - lends the book to the student if available
 - collects the book from the student and updates the Data Manager
- The Stationer takes the stationary item name from the student and
 - checks for the availability in the Data Storage
 - gives the item to the requesting student
- The Print Manager takes the request from the student and
 - checks for the allowed no of free pages for the student in the Data Storage
 - prints the page/s based on the above criterion

1.4 Requirements

- The DLS shall provide access to the list of books in the library
- The DLS shall provide access to the stationary items
- The DLS shall provide the student document printouts
- The DLS shall register, de-register and update the student data
- The DLS shall keep the count of the books and the stationary items updated

1.5 Wishlist (Not Implemented)

- The DLS shall allow the student to login using an SSO
- The DLS shall not allow multiple logins of the same student to avoid the conflict of multiple update requests on the books, the stationary items, and the student data
- The DLS shall have a payments-based system to allow students to take printouts once the free pages count is exhausted
- The DLS should have alert mechanisms to send remainder to the students of the return dates of the borrowed books

2 System Analysis

2.1 Role Model

We have identified the below roles for our multi-agent Digital Library System –

- Verification
- Registration
- Book Handling
- Stationer
- Printer

2.2 Role Schema

Role Schema		Verification
Description		verifies student identity
Protocols and Activities		AuthenticateStudent
Permissions		read studentdata write studentdata
Responsibilities	Liveness	authenticate = (Authenticate, Student)
	Safety	successful authentication of a student

Role Schema		Registration
Description		Registers/Deregisters a student
Protocols and Activities		RegisterStudent DeregisterStudent UpdateStudentData
Permissions		read studentdata
Responsibilities	Liveness	register = (Register, Student) deregister = (De-register, Student) update = (Update.StudentData, Student)
	Safety	successful register/de-register a student keep the data storage updated

Role Schema		Book Handling
Description		handles lending and collecting books with students
Protocols and Activities		LendBook, CollectBook UpdateBookData
Permissions		read studentdata read bookdata write bookdata
Responsibilities	Liveness	lending = (Lending.Books, Books) collecting = (Collecting.Books, Books) update = (Update.BookData, Book)
	Safety	lending books based on availability collecting books and updating the data storage keep the data storage updated

Role Schema		Stationer
Description		give stationary items
Protocols and Activities		GiveStationary
Permissions		read itemdata write itemdata UpdateItemData
Responsibilities	Liveness	giving = (Giving.Items, Items) update = (Update.ItemData, Item)
	Safety	giving items based on availability keep the data storage updated

Role Schema		Printer
Description		prints pages for the students
Protocols and Activities		PrintPages
Permissions		read studentdata
Responsibilities	Liveness	print = (Print.Pages, Pages)
	Safety	printing pages based on availability keep the data storage updated

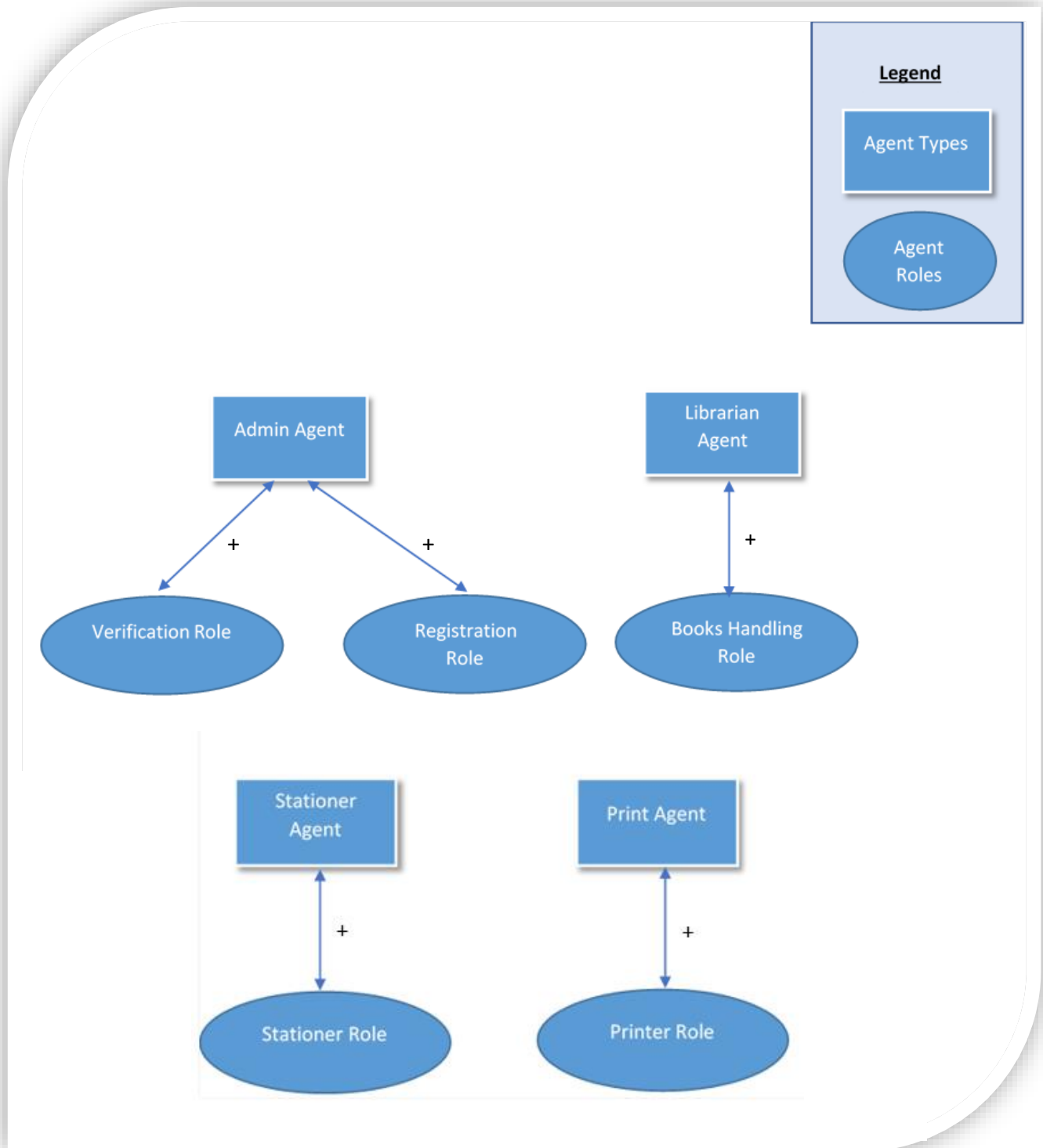
2.3 Interaction Model

Protocol	RegisterStudent	DeregisterStudent	AuthenticateStudent	LendBook	CollectBook
Purpose/ Parameters	Register a student	Deregister a student	Authenticate a student	Lending a book	Collecting a returned book
Initiator	Student	Student	Student	Book Handling	Book Handling
Receiver	Registration	Registration	Verification	Data Manager	Data Manager
Responding Protocol	Student registration successful	Student de-registration successful	Student authenticated successfully	Book lent successfully + name of the book	Book returned successfully + name of the book

Protocol	GiveStationary	PrintDocuments	UpdateStudentData	UpdateBookData	UpdateItemData
Purpose/ Parameters	Giving stationary items	Print documents requested by the student	Makes required changes to student data (number of books, printouts, stationary)	Makes required changes to book data (updating details of books lent and returned)	Makes required changes to stationery items (updating details of stationery items given and added to data storage)
Initiator	Stationer	Printer	Admin	Book Handling	Stationer
Receiver	Data Manager	Data Manager	Data Storage	Data Storage	Data Storage
Responding Protocol	(Name of item given) + "given successfully!"	Printing successful	Changes updated in Data Storage	Changes updated in Data Storage	Changes updated in Data Storage

3 System Design

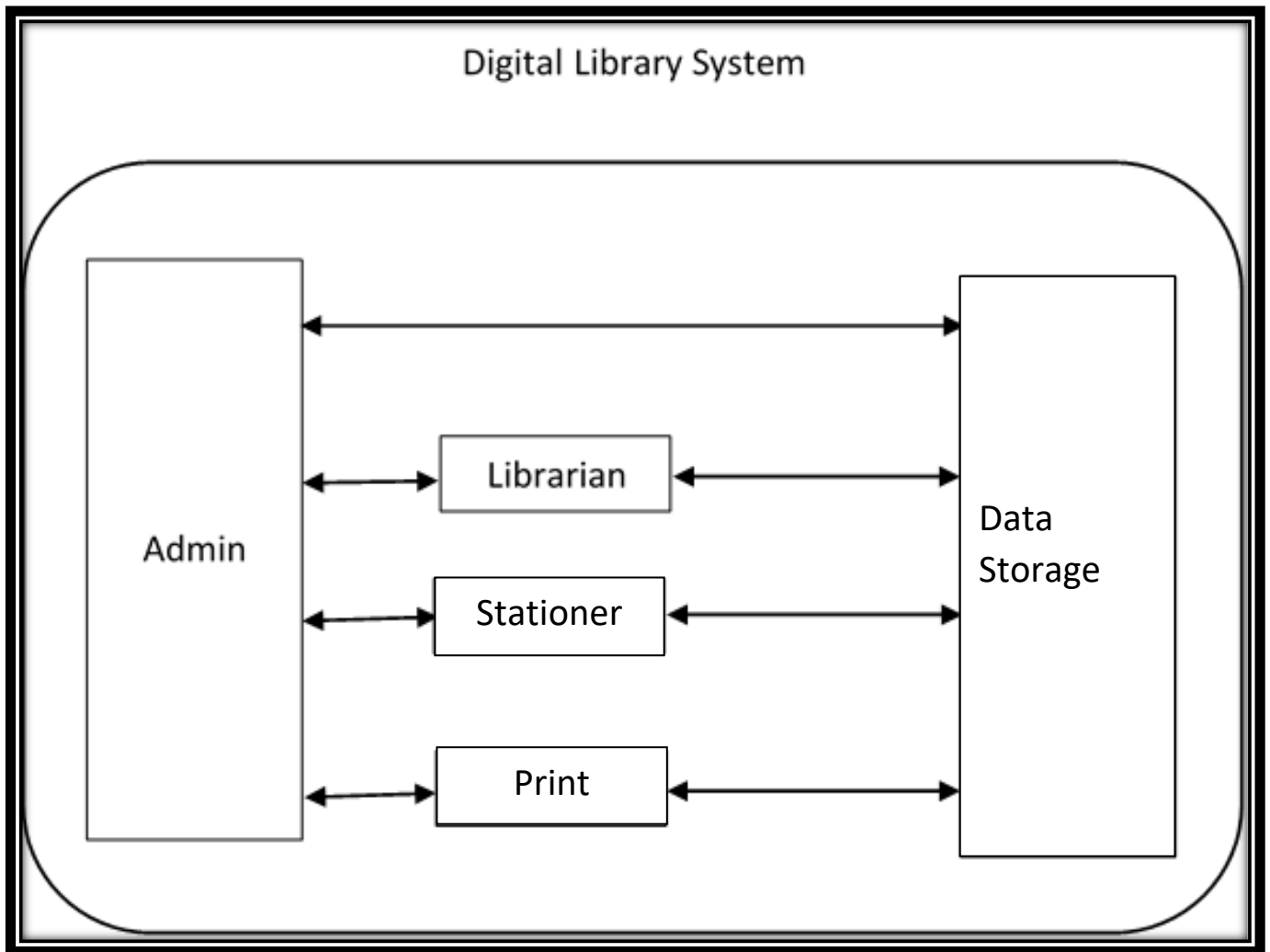
3.1 Agent Model



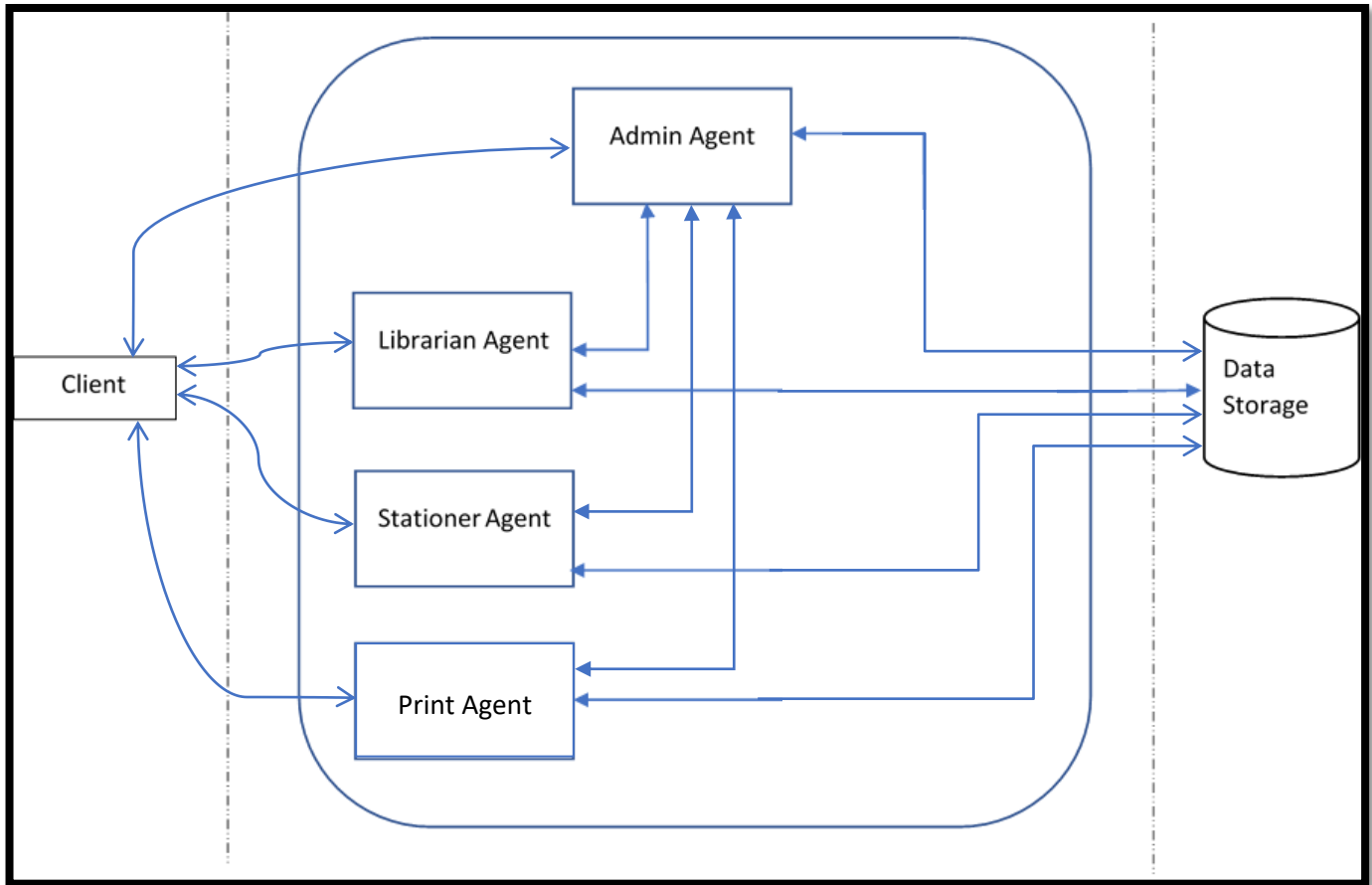
3.2 Services Model

Service	Inputs	Outputs	Pre-conditions	Post-conditions
Admin	Student Name	verification, registration, deregistration, update notification	Launch the Admin GUI	Send a request to the data storage to verify or update the student data or remove the student data
	Student ID			
Librarian	Book name	book lent, book is not available	Go to the Librarian GUI	Send a request to the data storage to check the book name and its availability
		book collected		
		update book count		
Stationer	Item name	item given, item is not available	Go to the Stationer GUI	Send a request to the data storage to check the stationary item and its availability
		update item count		
Print	Number of pages	printout successful, printout unavailable	Go to the Print manager GUI	Send a request to the data storage to check the allowed number of pages to print for the student
		update print count		

3.3 Acquaintance Model



4 Multi-Agent System Architecture



- The multi-agent system based Digital Library System is envisioned to work between the client and the already existing web-services that are playing distinctive roles
- The Student would be requested to enter specific information on the GUI to allow the agents process their requests
- Agents would pick up the information provided by the student and process the request in the backend to provide a positive or negative response/result
- The Agents communicate internally to keep all the necessary data updated in the storage to offer non-conflicting and seamless service to each student

5 Agent Description

5.1 Admin

- The Admin agent talks to the client through the portal or the web interface. It is the primary point of correspondence with the client (the student) and handles all the tasks that require interaction with the client
- The Admin agent talks to the Librarian, the Stationer, and the Print agents to lead the processes of lending/collection library books, giving stationary items and adding items to the data storage, and fulfilling the process of printing documents requested by the client
- Finally, the Admin agent can communicate directly with the Data Manager. This direct communication with the Data Manager is made possible to have a single point of control for all the data handled by the system

5.2 Librarian

- As the name suggests, the Librarian agent takes care of all the duties a librarian in a real-world library would do; this agent handles the tasks of lending books to students, as well as collecting book returned by students
- The Librarian agent talks to the Admin agent to receive details about the books (to be lent or received)
- The Librarian agent in turn talks to the Data Manager, to search for books and keep track of what books were lent and if a book requested by a client is available or not

5.3 Stationer

- The Stationer agent is responsible for giving items from the available stationery items data storage. This is made possible by having the Stationer agent talk to the Data Manager agent, so that the remaining items in the Data Storage can be searched through. Once the search is completed, the items can be given as per the request made by the client.
- The request to the Stationer agent is made through the Admin agent. This means that the Admin agent first receives the request, and then this request is relayed to the Stationer agent.

5.4 Print

- The Print agent takes care of all requests pertaining to printing pages. These requests are also relayed to the Print agent by the Admin agent (who initially receives them from the clients).
- The Print agent then communicates with the Data Manager agent to check the status of the client's print quota. Once this verification is complete, the printing task is completed, and the print status is shown to the client.