Software Development Agreement

This Agreement entered into this 6th day of November, 2023, concerning the final project for the course AC107/AC207 “Systems Development for Computational Science”. This Agreement (hereinafter “Agreement”), sets forth the nature and requirements of the project and is entered into by the CS107/AC207 Teaching Staff, whose principal place of business is at the Science and Engineering Complex, 150 Western Ave, Office 1.312-05, Allston, Massachusetts 02134 (hereinafter referred to as the “Client”), and **ROYGBIVRadicals**, comprised of students **Clare Morris, Kyle Ke**, **Kevin Liu**, **Abbie Kinaro**, and **Carrie Cheng** (hereinafter collectively referred to as the “Developer”), having a contact address at the Science and Engineering Complex, 150 Western Ave, Allston, Massachusetts 02134.

1. **Definitions**

    1.1. “Software”: The computer program(s) to be developed by Developer as detailed in the Software Requirements Specification (“SRS”).

    1.2. “SRS”: A comprehensive description of the intended purpose and environment for the Software, as attached in Annex A.

2. **Scope of Work**

    2.1. Developer shall design, develop, and implement the Software according to the SRS.

    2.2. Developer shall deliver the Software as a public Python library on Test PyPi and include the source code in a Github repository under the CS107 Organization, with accompanying documentation in HTML format, and a test suite.

3. **Timeline**

    3.1. Development begins on November 6, 2023, and is expected to be completed by December 14, 2023.

    3.2. Developer is to meet the milestones outlined on the course webpage, which details associated points and deadlines.

4. **Compensation**

    4.1. Completion of the Software will constitute 35% of the Developer’s final grade for the course AC107/CS207.

5. **License**

    5.1. Developer shall apply a copyleft license to the code, with specifics to be communicated to Client before delivery.

6. **Confidentiality**
    6.1. Developer agrees not to disclose development details to third parties.

7. **Intellectual Property Rights**
    7.1. Client retains rights to the Software, though Developer may cite the work professionally.
8. **Warranties and Representations**
    8.1. Developer warrants the Software will meet SRS standards, be free from significant defects, and fit its intended purpose, with limitations noted in documentation.
    8.2. Developer warrants the Software will not infringe on third-party intellectual property rights.

9. **General Provisions**
    9.1. This Agreement is governed by Harvard University and SEAS rules.
    9.2. This document constitutes the entire Agreement.
    9.3. Amendments must be in writing, published, and announced via email and forum post, and acknowledged by Developer via email.
    9.4. Disputes will be resolved by Professor Ignacio Becker.
    9.5. This Agreement is non-terminable during the course project duration.

10. **Attachments**
    10.1. Annex A: Software Requirements Specification
    10.2. Annex B: Additional Software Requirements Specification

The parties have executed this Software Development Agreement on the date(s) written below.

CLIENT:
CS107/AC207 Teaching Staff

By: _____
Name: _____
Title: _____
Date: _____

DEVELOPER TEAM: ROYGBIVRadicals
By: Clare Morris

Name: Clare Morris
Title: Team Leader
Signature: Clare Morris
Date: 11/07/2023

Acknowledged by Team Members:

Name: Kevin Liu
Signature: _____
Date: _____11/07/2023_____

Name: Kyle Ke
Signature: _____
Date:_____11/07/2023_____

Name: Abbie Kinaro
Signature: Abbie Kinaro
Date: 11/07/2023

Name: Carrie Cheng
Signature:
Date: _____11/08/2023_____

Annex A: Software Requirements Specification

1. Overview

The Software consists of a library to help with astronomical research, specifically the classification between stars, galaxies, and QSOs. It must interface with Sloan Digital Sky Survey (SDSS) services, specifically their databases and APIs containing spectral data and related information.

2. Interface Requirements

Software must accept an ADQL query as a string format; a series of constraints for a select subset of variables; and data in the same format as the one obtained from the SDSS.

3. Core Functionalities

1. Includes data preprocessing (normalization, outlier removal, interpolation, redshift correction).
2. Facilitates metadata extraction (identifiers, coordinates, chemical abundances, redshifts, or other fields requested by end-user).

3. Alignment in wavelength for all the spectra across a predefined range, which might require interpolation.

4. Visualization Requirements

Provides a matplotlib-based interface for spectral visualization with an overlay of the inferred continuum.

5. Data augmentation module

Software must provide a data augmentation module able to compute derivatives as well as fractional derivatives and append them to each preprocessed spectra.

6. Implementation Specifications

1. Developer will select and implement at least two additional features from Annex B.
2. The methodology used should be flexible for future changes without compromising library functions.

7. Documentation and Reporting

All design and implementation details must be documented and reviewed with the client prior to final submission.

Annex B: Additional Software Requirements Specification

1. **Cross-Matching Module:**

   Develop a module for cross-referencing astronomical objects with catalogs such as Pan-STARRS or Gaia, prioritizing match purity. Precise criteria for purity will be specified in collaboration with Client.

2. **Machine Learning Module:**

   Implement a machine learning model capable of distinguishing between Stars, Galaxies, and QSOs. Include fit, predict, and predict_proba functions for training and predictions, following the Scikit Learn API. The chosen machine learning framework should be justified based on its fit for purpose, efficiency, and compatibility.

3. **Interactive Visualization Module:**

   Create an interactive module using matplotlib to enable users to select plot regions and quantify the flux of spectral lines. Performance standards for interactivity and responsiveness will be agreed upon with the client.

4. **Spectral Feature Extraction:**

   Extract spectral features defining emission and absorption lines as those with flux levels exceeding 2 sigma from the continuum. Document the algorithmic approach and ensure integration with visualization tools.

5. **Additional Modules:**

   Proposals for modules beyond the listed requirements are welcome. A proof-of-concept must be provided for client evaluation, demonstrating feasibility and relevance to the project's goals. After approval, Developer should implement all the features requested by Client.