

**Sprint 1 Planning Document**

Team 18: Chunao Liu, Anurag Shah, Jenna Zhang, Yierpan Abuduwaili, Michelle He, Jingyuan Yang

**Sprint Overview:**

The major goal of this sprint is to construct the basement of this project for further function implementations. In this sprint, we will create all the front-end UI needed and achieve communication between the front-end and the back-end through specific ports. We will also write shell scripts in the back-end to automatically push the code received from the front-end into the GCC compiler, fetch the runtime result (including stack trace, terminal output, etc.) and send them back to the front-end.

**Scrum Master:** Chunao Liu

**Meeting Plan:** Tuesdays/Thursdays 4:30 pm

**Sprint Challenge:**

Although most of the implementations for this Sprint are individual UI pages, we have to connect the components and send requests back and forth, linking those separated components is crucial for the functionality of our program. Since all of our team members will be working for each sprint, it is very important to achieve a unified interface through communication. OCR would be the most difficult challenge as it is unfamiliar for most of our team and there are not many pre-build models that exactly satisfy our needs. Editing the model to allow detection for critical grammar syntaxes such as parentheses and curly brackets would be challenging and might become a long-term objective from Sprint 1 to Sprint 2.

**Current Sprint Detail:**

* App design on react native
  + User Story #1(Welcome Page)

As a user, I would like to see an introduction page with the logo of the APP when I open the program

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create UI page with the WhiteBoard logo | 1 hrs | Yierpan |
| 2 | Checks if the user is logged in(remember me) or not and redirects the user to different Camera pages | 3 hrs | Yierpan |
| 3 | Debug and test algorithm using unit tests | 3 hrs | Yierpan |

Acceptance Criteria:

* Given that the UI for the glossary is implemented correctly, when the user attempts to open the APP, they should be able to see an introduction page with the WhiteBoard logo
* Given that the APP functions properly, when the user opens the APP for the first time in a while, they should see the introduction screen, otherwise there is no introduction pages
* Given that the boolean functions properly, if the user is logged in within the time strain and haven't logged out, they should be taken to the Logged in Camera page, if the user didn’t use the Remember me function, send the user to the default Camera page.
  + User Story #2(Login Page)  
    As a user, I would like to be able to sign in to my account.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create a UI page with a login form that allows users to enter their username and password | 1 hr | Jenna |
| 2 | Create a User entity Class on the back-end which contains all info of a user | 1 hr | Jenna |
| 3 | Implement login processing functions on the back-end to receive login requests from the front-end, communicate with the database, and send login results back to the front-end. | 3 hrs | Jenna |
| 4 | Set up the connection between the server and the database | 2 hrs | Jenna |
| 4 | Implement login authentication on the back-end | 2 hrs | Jenna |
| 5 | Debug and test algorithm using unit tests | 4 hrs | Jenna |

Acceptance Criteria:

* Given that the Login UI is correctly implemented, when users enter matched username and password, they will be redirected to the Camera Page and the features for logged-in users will be displayed.
* Given that the Login UI is correctly implemented, when users enter a wrong password, the password input box will be highlighted in red and an error message will be shown.
* Given that the connection between the back-end and front-end is correctly implemented, when the back-end receives a login request, it will send a response in JSON format back to the front-end.
* Given that the connection between the server and the database is correctly implemented, the database will respond with a record of the user with the given username or 0 if no user with the given username is found.
* Given that the back-end login algorithm is correctly implemented, the back-end will do login authentication using the data retrieved from the database.
  + User Story #3  
    As a user, I do not need to log in again if I’ve logged in before and did not log out.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create a “remember me” checkbox on Login Page | 1 hr | Jenna |
| 2 | Create a login session for each user (both front-end and back-end). | 2 hrs | Jenna |
| 3 | Debug and test algorithm using unit tests | 4 hrs | Jenna |

Acceptance Criteria:

* Given that the “remember me” checkbox UI is correctly implemented, when users check this option, the system will remember the username and password by default so that users do not need to re-enter their username and password again.
* Given that the authentication algorithm is correctly implemented, the login session should not expire as long as the user does not log out.
  + - Users should be able to input their username and password in corresponding textView
    - Users should be able to click on the Login Button
    - Users should be able to click on the Sign Up Button and be redirected to the Sign-Up Page.
  + User Story #4  
    As a user, I would like to have a way to reset my password.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create a Forgot Password Button where users can click to reset their passwords | 1 hr | Jenna |
| 2 | Create a pop-up window that prompts users to enter an email linked to their accounts. | 1 hr | Jenna |
| 3 | Implement reset password functions on the back-end to receive reset password requests from the front-end and send an email with a reset password link to the given email address. | 5 hrs | Jenna |
| 4 | Create an HTML page where users can enter and submit their new passwords. | 1 hr | Jenna |
| 5 | Implement update password functions on the back-end which receive new passwords from the user and send updated password queries to the database | 1 hr | Jenna |
| 6 | Debug and test algorithm using unit tests | 4 hrs | Jenna |

Acceptance Criteria:

* Given the UI is implemented correctly, a pop-up window asking for an email address will show up after users click the “Forgot Password” button.
* Given the connection between the back-end and the front-end is implemented correctly, a “Reset password email sent” message will be shown to the user after the server has successfully sent an email.
* Given the reset password functions are implemented correctly on the back-end, the user who initiates the reset password request will receive an email with a password reset link.
* Given the HTML page for password resetting is correctly implemented, an update password request will be sent to the back-end.
* Given the connection between the server and the database is implemented correctly, the database will update the user's record with the email address and the new password provided.  
    
  + - Users should be able to click on the Forget Password Button to reset their passwords
    - Users should be able to go back without logging in
    - There should be a “remember me” option for users if they want the app to remember their login info
  + User Story #5(Create Account)

As a user, I would like to be able to create my own account.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create a Sign-Up button on the Login Page that redirects to the Registration page | 1 hr | Michelle |
| 2 | Create a UI page with a registration form with allows users to enter their username, email address, password, and password confirmation | 2 hrs | Michelle |
| 3 | Create error messages that show when the email address is in an invalid form and when the password and the confirmed password are different respectively | 1 hr | Michelle |
| 4 | In the back-end, create a registration processing function to check the username is not already in use by other users and check the email address is not already linked to an account. Sends the successful/error message respectively and adds the users to the database if successful | 3 hrs | Michelle |
| 5 | Display the message that tells the users to either change a username or change an email address if creating an account is not successful | 2 hrs | Michelle |
| 6 | Create a popup window to notify that the account is successfully created and send an email for confirmation | 2 hrs | Michelle |
| 7 | Debug and test algorithm using unit tests | 4 hrs | Michelle |

Acceptance criteria:

* Given the UI for the Login Page is implemented correctly, when users click the Sign-Up button, they will be redirected to the registration page.
* Given the email textbox is implemented correctly, when the users enter their email address in an invalid format, an error message should show up.
* Given the password and confirmation textbox are implemented correctly, when users try to long-press to copy-paste the password into the confirmation textbox, the password will not be copied.
* Given the password and confirmation textbox are implemented correctly, when the users enter a confirmation password that is different from the previously entered one, an error message should be displayed.
* Given the registration processing function is implemented correctly, when users enter a username that is already in use by another user, a message that tells the users to change a username should be displayed.
* Given the registration processing function is implemented correctly, when users enter an email address that is already linked to another account, a message that tells the users to try to login or to change an email address should be displayed
  + User Story #6(Team page)

As a user, I would like to manage and see my team’s information.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create a list of teams that the user is in | 2 hrs | Jingyuan Yang |
| 2 | The list of teams should include the name of the team, the coordinator, and a short description of the team depending on whether a team has one | 3 hrs | Jingyuan Yang |
| 3 | Create a button that leads users to a page that allows users to create a team | 3 hrs | Jingyuan Yang |
| 4 | Create a team page should allow the user to input team name, team description, and set the user to the coordinator, creates a library that contains the code for the team | 4 hrs | Jingyuan Yang |
| 5 | Users should be able to move to the page specific to a team by clicking the team that shows team members, contact information or the members and coordinator, and the code shared amongst the team, user should be able to share code to the code library of the team  If the user is the coordinator of the team, the coordinator should have an ADD button that adds members to the team | 8 hrs | Jingyuan Yang |
| 6 | Create a button to allow users to go back to the Team list, team list page should have a button that takes the user back to the Camera page(Home page) | 4 hrs | Jingyuan Yang |
| 7 | Test the functionality, debug and test algorithm using unit tests | 4 hrs | Jingyuan Yang |

Acceptance Criteria:

* Given that the Team list UI page is correctly implemented, users should be able to see a list of the team they are in with a short description and the coordinator of the team, they should also be able to click on the team.
* Given that the Team information page specific to a team is implemented correctly, users should be able to see the coordinator of the team, team members, their contact information and the code shared amongst the team.
* Given that the Team information page specific to a team is implemented correctly, the coordinator should be able to add users to the team.
* Given the back buttons are implemented correctly, users should be able to go back to the Team list page and Camera page.
  + User Story #7(Account page)

As a user, I would like to be able to see and edit my account information.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create UI page with user profile picture, username, email address and their team information | 2 hrs | Yierpan |
| 2 | Users should be able to change their user profile picture, username, email address and password(change password send request to backend implemented for resetting password in Forgot Password) | 3 hrs | Yierpan |
| 3 | Users should be able to see the teams they belong to and be able to be redirected to the Team Page | 2 hrs | Yierpan |
| 4 | Create UI button so users should be able to go to their team page or the Camera Page | 2 hrs | Yierpan |
| 5 | Test the functionality, debug and test algorithm using unit tests | 4 hrs | Yierpan |

Acceptance Criteria:

* Given that the UI page is correctly implemented, users should be able to see their account information.
* Given that the UI page is correctly implemented, users should be able to change their information and get updated.
* Given that the UI button is implemented correctly, users should be able to navigate to the Team page and Camera page.
  + User Story #8(Camera page)

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | This page will be the root page of this app. Just like a normal camera app, the middle area of the screen would display the real time view captured by the camera. | 6 hrs | Yierpan |
| 2 | There should be a collapsible sidebar on the upper left corner that shows different functions and redirects user to different pages(Save, Library, Team, Account, Logout) | 8 hrs | Yierpan |
| 3 | If user is not logged in, they should only be able to see a login button, different UI, this function is connected with introduction page | 1 hr | Yierpan |
| 4 | Create a pop of window after the picture is taken, user needs to select Accept to send the picture to OCR and compile or Decline to retake the photo | 4 hrs | Yierpan |
| 5 | Users can either take a photo of the code or import a photo of the code from their local picture library and send it to backend compile | 2 hrs | Yierpan |
| 6 | Users should be able to click on the keyboard icon on the upper right corner of the page and be redirected to the Text Editor Page | 1 hr | Yierpan |
| 7 | Create a UI that shows the result sent back from compiler | 2 hrs | Yierpan |
| 8 | Test the functionality, debug and test algorithm using unit tests | 4 hrs | Yierpan |

Acceptance Criteria:

* Given that the UI page is set up correctly, the camera page should be able to retrieve data and send data to the database.
* Given that the UI page is implemented correctly, users should be able to be redirected to the Camera page and navigate to other pages.
* Given that the UI page is set up correctly, users should be able to see the real time view of their camera and take the picture.
* Given that the testing for if the user is logged in or not works correctly, users should see different drop down menus.
* Given that the UIs are implemented correctly, users should see the results sent back to them after compiling.
  + - User Story #9(Text Editor Page)

As a user, I would like to type the code in the text editor and run it.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create UI page with a text editor that allow users to directly type their code | 1 hr | Michelle |
| 2 | Create a sidebar that include access to additional features if the users are logged in | 1 hr | Michelle |
| 3 | Create a run button that sends the code to the back end | 3 hrs | Michelle |
| 4 | Create a popup window that asks the user whether they confirm to submit the code | 2 hrs | Michelle |
| 5 | In the back end, create a run algorithm that accepts the code of the users, compiles the code, and runs the code. If it compiles successfully, the algorithm sends the run results back; if not, it sends the error back | 5 hrs | Michelle |
| 6 | Display the compilation results and run results | 2 hrs | Michelle |
| 7 | Debug and test algorithm using unit tests | 4 hrs | Michelle |

Acceptance Criteria:

* Given the UI for the sidebar is correctly implemented, when the users click the sidebar, several more features would be displayed, including saving, library, team, and account.
* Given the UI for the text editor is correctly implemented, when the users finish typing their code and click the run button, a popup window shows up and asks users to confirm sending the code.
* Given the popup window works correctly, when the users press “submit”, the code should be sent to the back end in order to compile and run.
* Given the popup window works correctly, when the users press “cancel”, the users should be returned to the text editor page.
* Given the run algorithm is implemented correctly, when the compilation is complete and there is an error, the users would be able to see the error in their code.
* Given the run algorithm is implemented correctly, when the compilation is complete and the run is successful, the users would be able to see the run results.
  + - User Story #10(Library page)

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | display basic info of the code | 2 hrs | Jingyuan |
| 2 | display a small preview of the code | 2 hrs | Jingyuan |
| 3 | when user clicks on the tab they can see the run results and the whole code | 4 hrs | Jingyuan |
| 4 | testing and debug | 2 hrs | Jingyuan |

* + - The library page displays a list of saved code of typen and picture forms. For each code, there is some basic information, such as name, date created, and short description of the code, displayed on the right of a small preview of the code segments. When the user click into a specific one, they can see the whole code and the details of the run results.
* User Story #11 (Backend networking)

As a developer, I would like to establish steady TCP communication between the server and each of the users in different threads.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Write a script that Infinitely listens to specific ports and receive requests from the front end | 2 hrs | Chunao |
| 2 | Upon receiving a sign-in request, authenticate the user’s information and send the result back to the user | 3 hrs | Chunao |
| 3 | Upon receiving a sign-up request, create a new entry in our database and send the status to the front-end | 3 hrs | Chunao |

Acceptance Criteria:

1. The back-end should receive HTTP requests from users and create a thread for each user continuous services
2. The script should be able to identify if the request is a sign-in request, sign-up request, compilation request, or OCR request
3. If the request is a sign-in request, it should correctly verify the user and update the status of authentication if necessary. If the authentication failed, an error message with an empty JSON should be delivered back to the user
4. If the request is a sign-up request, it should add an entry to our database with the given information and return a message indicating the sign-up status
5. The script should correctly parse the JSON package sent from the user to the correct handler script for the desired services

* User Story #12(Compilation Script)

As a developer, I would like to automatically compile the code given by the user and send the correct runtime result back to the user

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Write a script that will take a piece of code, compile and run it with GCC. | 2 hrs | Chunao |
| 2 | Upon compilation and runtime, fetch any output, including stack trace and terminal output, and pack them into a JSON file | 2 hrs | Chunao |
| 3 | Upon finalizing the output package, send it back to the correct User’s device in the same thread | 2 hrs | Chunao |
| 4 | Unit tests and Debug to ensure the correctness of the compilation and runtime | 3 hrs | Chunao |
| 5 | Unit tests and Debug to ensure the package is correct and it will be sent to the correct User’s device | 3 hrs | Chunao |

Acceptance Criteria:

1. The original code must be correctly parsed into the GCC compiler
2. GCC should be able to run the script (code) in a standard environment
3. If the code compile successfully, the script should parse all terminal output correctly and pack it into a JSON file
4. If the code failed to compile, the script should parse all the terminal output and the stack trace into a JSON file
5. The script should send the runtime result packed as a JSON file back to the correct user

* User Story #13(Back-end Database)

As a developer, I would like to deploy a MySQL DBMS with specific tables to store any user and group’s information

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Deploy a MySQL server on our back-end server | 2 hrs | Chunao |
| 2 | Create one default schema for all tables | 2 hrs | Chunao |
| 3 | Create a table of User Info in the default schema | 2 hrs | Chunao |
| 4 | Create a table of Group Info in the default schema | 3 hs | Chunao |
| 5 | Create a table of Output Info in the default schema | 3 hs | Chunao |
| 6 | Create a table of Authentication info in the default schema | 2 hs | Chunao |
| 7 | Write a trigger that when a new user signs up, a private group should be created and will become the default group of the user | 3 hs | Chunao |
| 8 | Debug and Unit tests to ensure the database works correctly | 5 hs | Chunao |

Acceptance Criteria:

1. The MySQL server must be active and accessible locally once initialized
2. The Database should contain at least one schema to store all user’s information
3. For the default schema, There must be a User\_Info table, which includes each user’s username, auth\_ID, email, group list, banner\_url, icon\_url, and default group ID.
4. For the default schema, There must be a Team\_Info table, which includes each team’s team ID, team leader, team member and all codes and image reference URLs belongs to this team.
5. For the default schema, There must be an Auth\_Info table, which includes all the authentication information of each user. This should include each user’s username, password, auth\_status, auth\_token and last\_login date.
6. There should be a Trigger that every time a new user signed up, a group be will automatically be created and will be the default group of the new user

* User Story 14 (OCR for Typeform Data)

As a user, I would like the application to process my image of typeform code, and convert it to the relevant textual representation.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Setup the OCR pipeline, and setup functions the backend can call for OCR. | 2 Hours | Anurag |
| 2 | Setup a pre-trained OCR model, and configure it to work with images of typeform text (printed or screenshot) of the correct size. | 4 Hours | Anurag |
| 3 | Setup the preprocessing suite for the OCR model in (2). | 4 Hours | Anurag |
| 4 | Create the end of the OCR pipeline, with the postprocess filter, a (for now) redundant filter for language detection, and pipe it into the Compiler (as in user story 12) | 2 Hours | Anurag |

* User Story #13(Back-end Database)

As a developer, I would like to deploy a MySQL DBMS with specific tables to store any user and group’s information

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Deploy a MySQL server on our back-end server | 2 hrs | Chunao |
| 2 | Create one default schema for all tables | 2 hrs | Chunao |
| 3 | Create a table of User Info in the default schema | 2 hrs | Chunao |
| 4 | Create a table of Group Info in the default schema | 3 hs | Chunao |
| 5 | Create a table of Output Info in the default schema | 3 hs | Chunao |
| 6 | Create a table of Authentication info in the default schema | 2 hs | Chunao |
| 7 | Write a trigger that when a new user signs up, a private group should be created and will become the default group of the user | 3 hs | Chunao |
| 8 | Debug and Unit tests to ensure the database works correctly | 5 hs | Chunao |

Acceptance Criteria:

1. The MySQL server must be active and accessible locally once initialized
2. The Database should contain at least one schema to store all user’s information
3. For the default schema, There must be a User\_Info table, which includes each user’s username, auth\_ID, email, group list, banner\_url, icon\_url, and default group ID.
4. For the default schema, There must be a Team\_Info table, which includes each team’s team ID, team leader, team member and all codes and image reference URLs belongs to this team.
5. For the default schema, There must be an Auth\_Info table, which includes all the authentication information of each user. This should include each user’s username, password, auth\_status, auth\_token and last\_login date.
6. There should be a Trigger that every time a new user signed up, a group be will automatically be created and will be the default group of the new user

* User story 15 (OCR for Handwritten Data)  
  As a user, I would like the application to process my image of handwritten code, be able to distinguish it from typeform code, and convert it to the relevant textual representation.

| # | Description | Estimated Time | Owner |
| --- | --- | --- | --- |
| 1 | Create a dataset of images with handwritten and typeform text, in various image sizes and resolutions. | 3 Hours | Anurag |
| 2 | Create a classifier for images to compare between handwritten text and typeform text, train this classifier to a high accuracy (on the data in (1) ). Insert this into the OCR pipeline. | 6 Hours | Anurag |
| 3 | Create a dataset of handwritten characters for the full ASCII set, with at least 100 images for each character. | 3 Hours | Anurag |
| 4 | Create a HCR classifier for handwritten characters and train it to a high accuracy on the data in (3). | 6 Hours | Anurag |
| 5 | Use a character segmentation/text detection model prior to HCR | 4 Hours | Anurag |
| 6 | Create a basic preprocessing suite to convert code written in dark on a white background seen from the front into the format needed for the OCR. | 5 Hours | Anurag |

* Remaining Backlog:
* As a user, I would like to have a welcome page when I open the app.
* As a user, I would like to have a “remember me” feature at login.
* As a user, I do not need to log in again if I’ve logged in before and did not log out.
* As a developer, I would like to send a password resetting link to users via their email addresses when they forget their passwords.
* As a user, I would like to be able to create my own account.
* As a developer, I would like to link users’ accounts with their emails/phone numbers.
* As a user, I would like to have a profile page where I can edit/update my info.
* As a user, I would like to be able to change the theme of the app (light/dark).
* As a developer, I would like to have a navigation bar that directs users to different pages.
* As a developer, I would like to prompt users to re-login when the account is inactive for a week.
* As a user, I would like to be able to deactivate/reactivate my account.
* As a developer, I would like to delete a deactivated account permanently if the user does not reactivate within 90 days.
* As a user, I would like to use the Apps feature without creating an account.
* As a user, I would like to have a way to reset my password.
* As a developer, I would like to load pictures and snapshots faster using multi-thread.
* As a user, I would like to have a profile picture and a banner.
* As a user, I would like to see if there is any syntax error in my code, have the lines physically underlined with a marker on my code image, and have a popup after clicking on that inform me about the full error details encountered at that line.
* As a user, I would like to access an archive of the scanned documents in digitized text form that can be saved in an editor app (such as the Note app in iOS).
* As a user, I would like to retake a photo of the code if the image taken is not satisfying.
* As a user, I would like to join/create/leave multiple teams.
* As a team member, I would like to see who is the coordinator/creator of the team.
* As a team manager/member, I would like to see the team members.
* As a team manager/member, I would like to be able to access all shared code between the team.
* As a team manager, I would like to remove a user from the team.
* As a user, I don’t need to see the login page as I re-enter the app starting from the second time.
* As a team manager, I would like to have access to view and change the team members’ code.
* As a user, I would like to be able to upload a photo from my phone’s library in place of taking a new photo.
* As a user, I would like to save the OCR-generated code on my device storage.
* As a user, I would like the backend to be able to figure out what language my code is in, and use the correct compiler.
* As a user, I would like to delete the archive of a scanned document if it is no longer needed.
* As a user, I would like to have my C/C++ code compiled & run.
* As a user, I would like to have my Java code compiled & run.
* As a user, I would like to have my C# code compiled & run.
* As a developer, I would like to design various user roles so that users with different roles can access different features.
* As a developer, I would like to allow users to have multiple roles.
* As a developer, I would like to use cacheManager to load data so that the backend does not need to retrieve data from the database every time there’s a request so that data access latency is decreased (if possible).
* As a developer, I would like to store each user’s authentication information in a SQL query.
* As a developer, I would like to be able to retrieve entries of a specific user’s authentication information during the user’s login session
* As a developer. I would like to keep track of each user’s current status, either logged in or not logged in
* As a developer, I would like to be able to store each user’s uploaded pictures in a relational database
* As a developer, I would like to be able to retrieve the picture after the OCR detection and send it back to the front-end
* As a developer, I would like to keep track of each user’s team information in a relational SQL query
* As a user, I would like to be able to access photos I have taken previously
* As a developer, I would like the database to be able to store the image filename, detected code, and compilation results/error messages
* As a product manager, I would like to see continuous delivery on the backend.
* As a product manager, I would like to have unit tests for both the front-end and back-end.
* As a user, I would like to be able to take photos from slight angles or at a slight tilt, and not have that affect the app
* As a developer, I would like to have an image preprocessing suite that can de-skew and remove lines/spots
* As a developer, I would like to have a separate segmentation algorithm for typeform code images
* As a developer, I would like to ensure that each model can correctly place spaces in the program where necessary for the compiler