Stat-Link

Design Document

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Web Frames

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1 - Doctor View

1.1 Login Page

Only doctors are able to login or sign up. Each login or sign-in attempt will produce an HTMX request that performs a database lookup. This will determine whether the text field credentials are correct in the case of login or that the username does not already exist in the case of signing up. If either of these checks fail, the "Invalid Credentials" message will appear, indicating that there is a problem. Otherwise, the doctor is brought to the Manage Test Link page.

1.2 Manage Test Link Page

Manage Test Links is the page displaying all actions relating to link management. Buttons for generating links, deleting links, and downloading link results are on

the Manage Test Links homepage. A list of links related to the logged in user are shown in the order they were generated and an associated button that when clicked will copy the link for the user to their clipboard and 3 additional buttons will appear for link management. Statuses of the test are also displayed alongside their associated links. In addition, if a link's status is "Incomplete" or "Invalid" the associated buttons for downloading results and viewing results are displayed, grayed out, and will not be usable.

The 4 buttons that are on this page are as follows:

- Selecting Generate test Link will generate a completely new test link.
  - A popup will appear requesting that the user provide an age, specifically the age of the patient being tested.
  - After providing an age, another popup will appear asking for the user to confirm they want to generate a link with the given age. After confirming, the generated link will be displayed in the list at the bottom of the page and the link's ID will be displayed below the Generate test Link button with an associated copy button.
  - Link ids will be generated based on the integer values not in use favoring the lowest integer value currently not in use by another link. This id will be compared to the database to make sure that a duplicate will not be created.
- Deleting will remove the link associated within the same row.
  - The process of removing the link will be to delete the link object from the database and dynamically refresh the page. If the test is completed the results will not be touched. A POST request will be sent to the server requesting that the server delete the specified link.
- Download Test Results will download a spreadsheet of the associated link.
  - All information relating to the test in the link will be compiled into a spreadsheet.
  - This spreadsheet will then be sent to the user and downloaded onto their machine. The user can confirm the download through the browser download prompt.
- View will take the user to another page displaying a plot of information that the user can look at individually (reference data page). A POST request with the link ID will be sent back to the server and the user will be redirected to the requested page.

The statuses of the test will also be displayed with the following possibilities:

- Complete: This means that the link's associated test has been completed.
- Pending: This means that the link's associated test has not been completed.
- Test Invalidated: This means that the link's associated test has been invalidated(user closed test prematurely, user refreshed page, etc)

Sample Manage Test Links page: Shows the functional buttons and layout of the page. Users will be able to select and button on the page. Note: the "Download" and "View" will be "grayed out" for tests with the "Pending" or "Test Invalidated" Result Status.
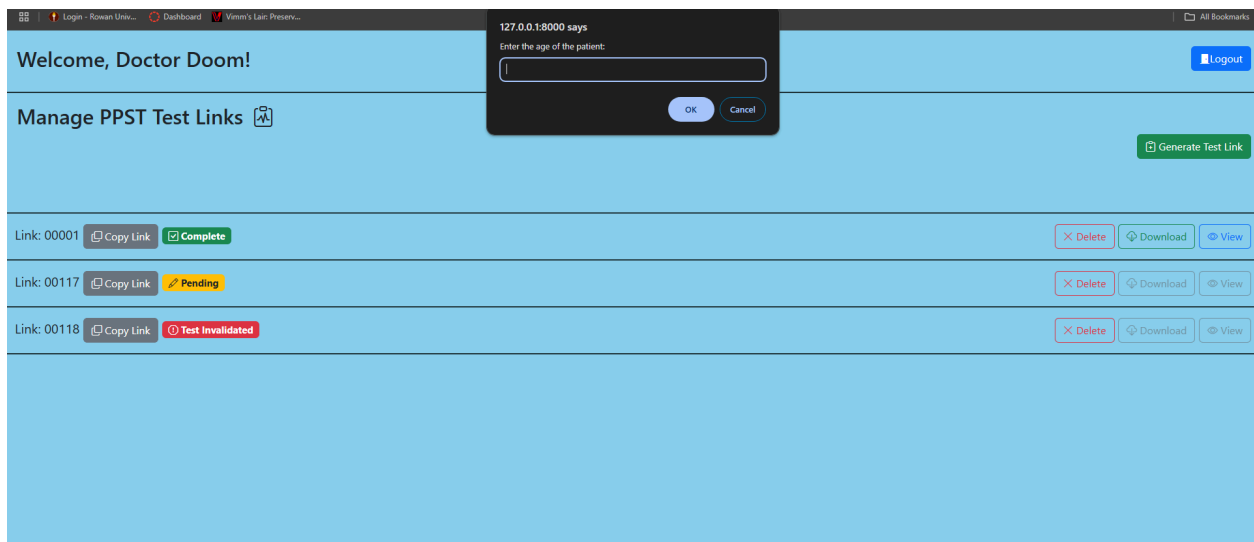
Generate Link Popup: Test link input prompt that appears after the user selects "Generate Link". Requests the age for the soon to be generated link.
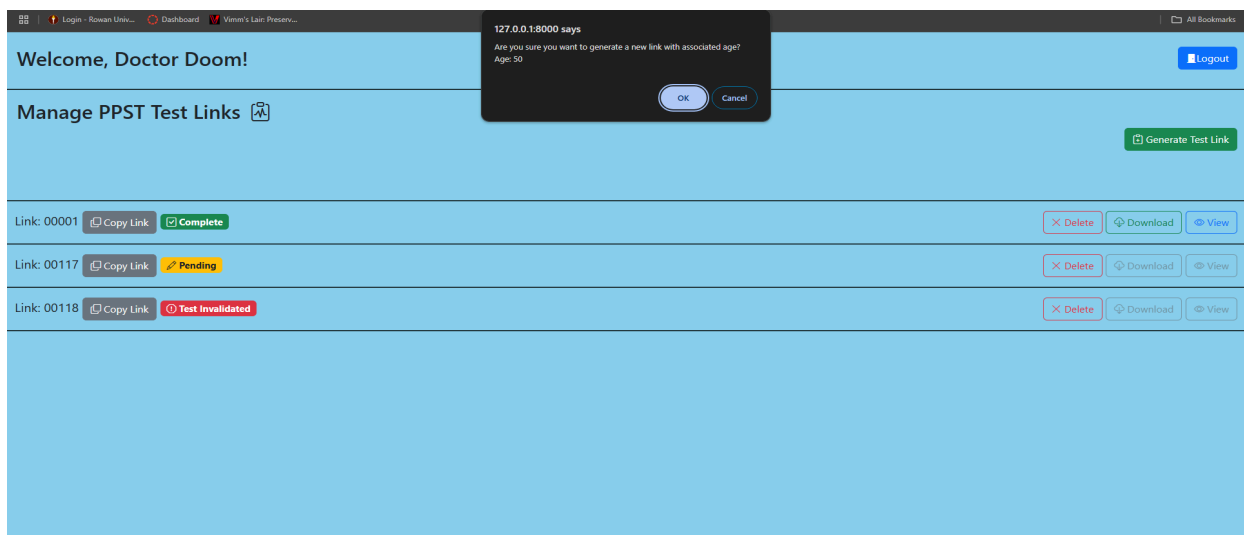
Generated Test Link Confirmation Popup: Test link produced confirmation. The user can cancel or confirm the creation of the link.
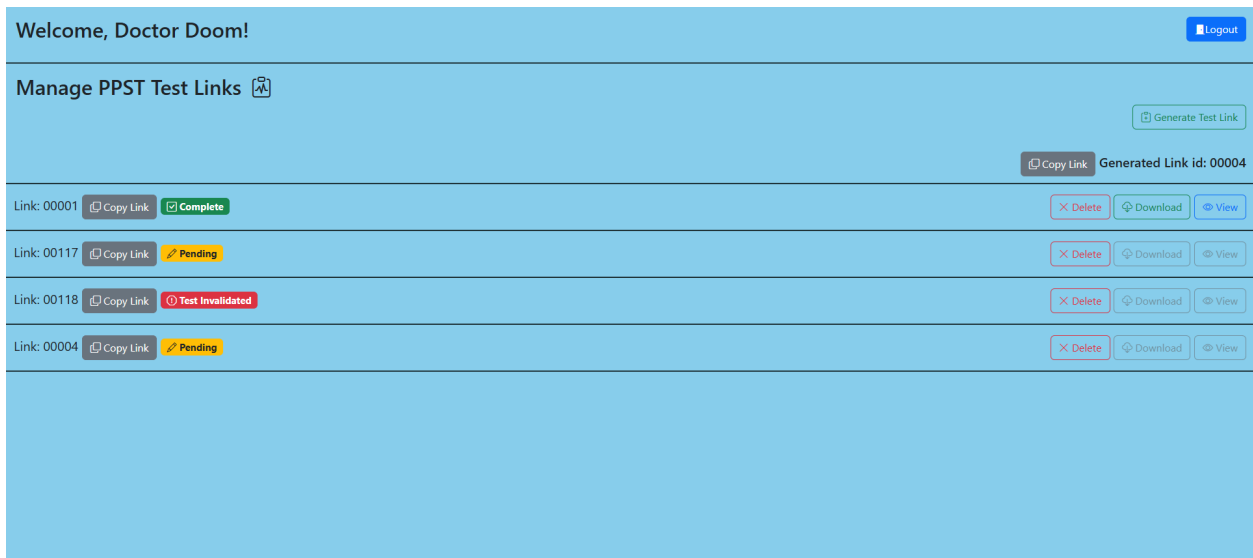
Generated Test Link operation result: After confirmation the link ID is displayed on the page and a button to copy the link is presented. This link is also placed at the bottom of the list at the very bottom of the page.
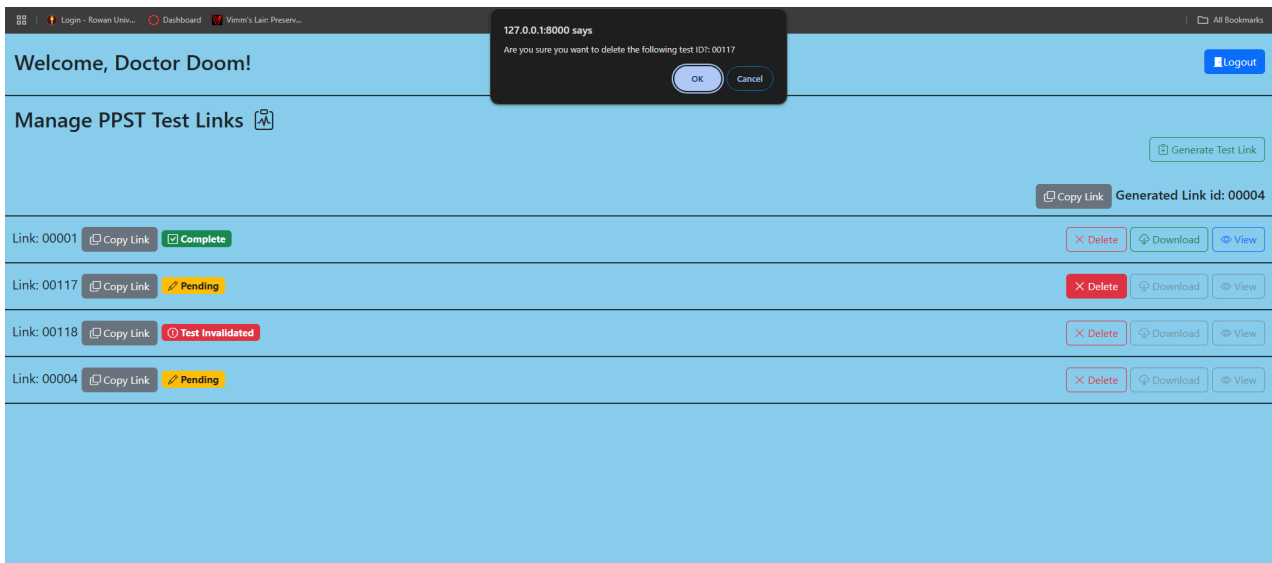
Test Link Deletion Confirmation: Popup that appears after selecting a "delete" button. Displays the link that will be deleted and asks for confirmation. Confirming will remove the link from the database and on the page.

1.3 Data Page
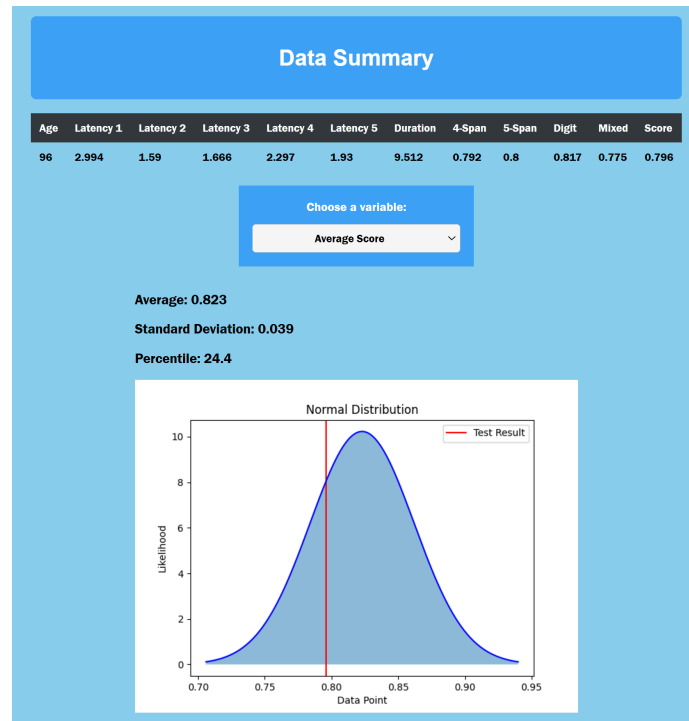
The data page populates after the view button from the
Manage Links page is clicked. The top of the page contains
a "Data Summary" title and a summary table underneath the header
includes a table of the patient's age as well as their
average performance on latencies, duration, 4-span and 5-span scores,
digit score, mixed score, and the overall score. The table
represents how a particular patient performed on the test based
on the link ID that was selected to view. Below the table is
a dropdown menu that can be used to select various variables, which
are related to the statistics shown on the table. Below the dropdown
menu are the average, standard deviation, and percentile results that
represent how a patient compares to others in their relevant age bracket.
These results dynamically change when a different variable is selected
from the dropdown menu. A normal distribution graph is shown on the page
to give a visual representation of where the patient lies based on the
specific variable that is selected. By default, the graph represents
where the patient lies in the age bracket based on the average score. Once
another variable is selected from the dropdown menu, the graph dynamically
changes to reflect the average, standard deviation, and percentile based
on that specific variable that was selected.

1.4 Data Visualization

Matplotlib, along with mpld3, generates an image visualization of the data that displays distributions based on the variable selected from the drop-down menu. The variables that are used to display these normal distributions derive from the models of the individual result table and the individual table. When a different variable is selected from the drop-down menu, the graph, along with the data, dynamically changes to reflect the patient's performance on that section of the relevant test.

2 - Patient View

Order of the webpages:
A. PPST Welcome Screen
B. Digit Stimuli Introduction
C. Digit Stimuli Practice Test (2: One 4-span & One 5-Span)
D. Digit Stimuli Practice Conclusion
E. Digit Stimuli Test (6: Three 4-Span & Three 5-span)
F. Mixed Stimuli Introduction
G. Mixed Stimuli Practice Test (2: One 4-span & One 5-Span)
H. Digit Stimuli Practice Conclusion
I. Mixed Stimuli Test (6: Three 4-Span & Three 5-span)
J. Conclusion

For the entire PPST, if the page is closed, switched to another page without using the "Continue" buttons, or refreshed, the link in the database is flagged as "INVALID."

2.1 PPST Welcome Screen

Welcome to the PPST!

Adjust font size: **+** **−**

FORMAT 🔊

The test will include **audio** so please turn on or up the volume. The test will consist of two practice stimuli before the 6 digit stimuli and two practice before the 6 mixed stimuli. The digit stimuli will begin first followed by the mixed. The test should be done in one sitting and closing the browser will result in an invalid test.

PRIVACY 🔊

This web application will not collect any identifying information. These tests are taken anonymously ensuring personal data remains confidential.

Continue

The Welcome Screen explains the format of the test including the amount and order of the digit and mixed stimuli. The page also warns users to do the test in one sitting. In addition, the page ensures patients that their personal data remains confidential.

- Pressing the "Continue" switches the page to the "Digit Stimuli Introduction"
- Audio button offers text-to-speech
- Adjust-font-size button offers the option for patients to increase or decrease font-size

2.2 Digital Stimuli Introduction

Digit Simuli Introduction

Adjust font size: + −

Format 🔊

A number of digits will appear in front of the screen one at a time. After the digits are displayed, selectable boxed digits will appear. The goal is to select the digits in ascending order that were displayed one at a time. On a desktop, a digit is selected by hovering over with the cursor and left clicking with the mouse. After completing the stimuli, press the "Submit" button to continue.

Example: 4512

Answer: 1245

Continue

The Digit Stimuli Introduction explains how the stimuli is completed including: how the digits/letters appear, the goal of the stimuli, instructions on completing the task. An example of a correct answer of the stimuli is also provided.
Behavior:

- Pressing the "Continue the Practice Button" switches the page to the "Digit Stimuli Practice Test"
- Audio button offers text-to-speech
- Adjust-font-size button offers the option for patients to increase or decrease font-size

2.3 Digit Stimuli Practice Test

Digit Stimuli Practice

Begin Stimuli

Digit Stimuli Practice

8

This page is where the patient completes the stimuli.
Behavior:

- Start Button: The test has a "Start" button where when the button is pressed, the test begins and the stimuli is displayed

- Display Stimuli: The stimuli displays one at a time in the center of the page visually and auditory. After the stimuli is displayed, the "keyboard is displayed
- Display Keyboard: For the digit stimuli, the keyboard displays all of the digits used in the entire test, while mixed stimuli displays both all the digits and letters used in the entire test.

2.4 Mixed Stimuli Full "Keyboard"

Mixed Stimuli Practice

5	3	8	4
7	2	6	9
J	R	W	Y
F	S	K	U

Continue

The page shows the full "keyboard" containing the set of all characters that appear in any stimuli.
Behavior:
- Pressing a boxed digit/letter highlights the box light blue briefly indicating the digit/letter has been selected.
- Pressing a boxed digit/letter also records the latency between the previous selection and current
- The order of the input is directly related to the order of the selected digit/letters

- Pressing the "Submit" button saves patient answers and latency of each digit/letter. The button also switches the page to the next stimuli or the "Practice Result Screen" if this is a practice
- The individualResultTable model updates to reflect patient input.

2.5 End of Test Category Transition

Practice Test Conclusion   Adjust font size: [+] [−]

Format 🔊

The practice has been completed. Starting on the next page and forward, the test will be recorded. Click the "Continue To Test" to begin.
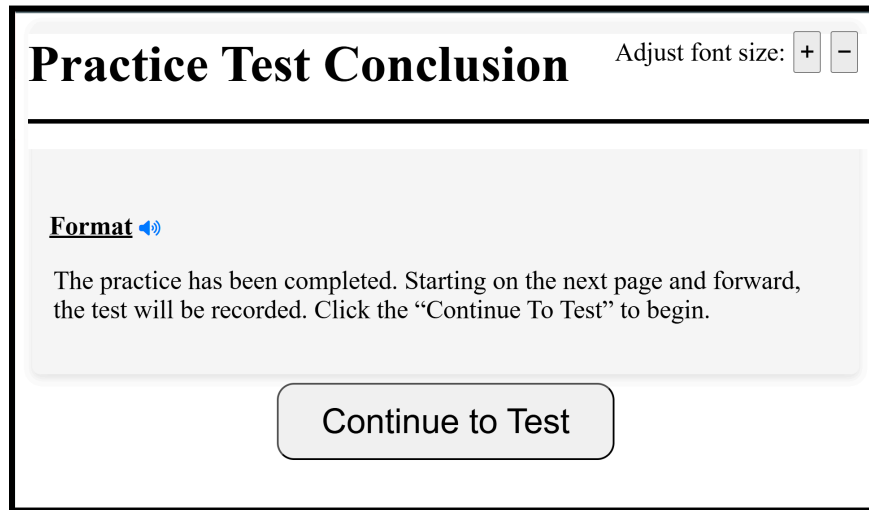
Continue to Test

This is a buffer screen meant for the patient to pause briefly before continuing. These screens occur at the end of each test

- Pressing the "Continue to Test" button switches to the stimuli test
- Audio button offers text-to-speech
- Adjust-font-size button offers the option for patients to increase or decrease font-size

2.6 Conclusion

Conclusion   Adjust font size: [+] [−]

🔊

Thank you for taking the PPST Test, You can close the Window at anytime, your test has been recorded
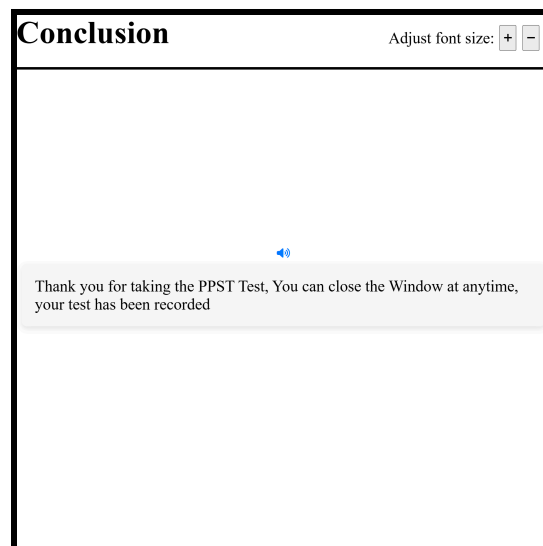
The page thanks the patients and states that they are free to close the PPST.
Behavior:
- The link in the database is marked as "Completed"
- Audio button offers text-to-speech
- Adjust-font-size button offers the option for patients to increase or decrease font-size
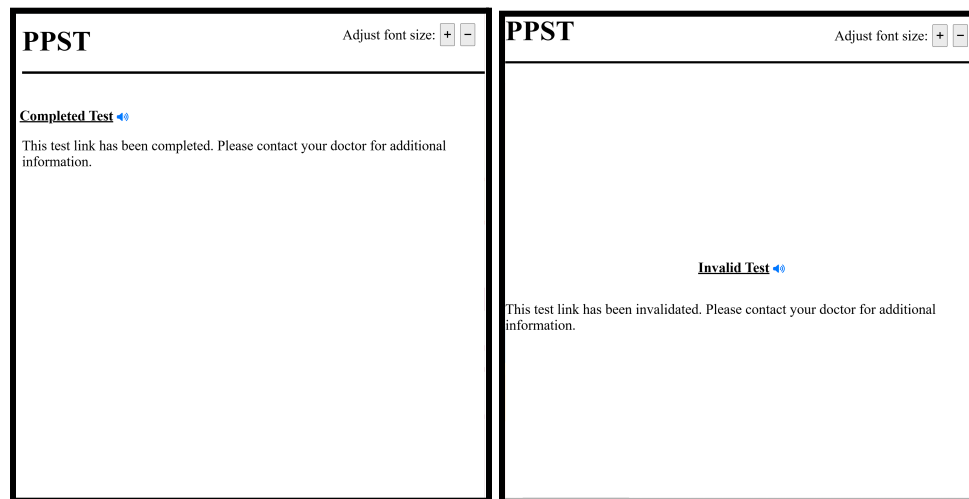
These are the pages where the patient is redirected to if they were trying to access a completed or invalid test..
Behavior:
- Audio button offers text-to-speech
- Adjust-font-size button offers the option for patients to increase or decrease font-size

3 - Spreadsheet

The spreadsheet contains all the relevant data for a given patient. The spreadsheet has seven sheets for the doctor to use. The first sheet in the spreadsheet has all of the patient's raw data from their results table as well as all of their latencies for each test. The second sheet has the same data as the first, but colors the portions of the data. The third sheet has all of the patient's aggregated data. Pages four through seven have graphs that are generated for the patient's average time for each test type, their average score based on how well they did on each test type, their average score based on if they had all the characters in the test correct but in the wrong order, and their average score based on if they had all the correct characters in the stimulus respectively.

The Aggregated Info, Time Graphs, Serial Score Graphs, Unordered Score Graphs and Response Position Score Graphs all have the same color options. The color options are chosen based on the patient's calculated z-score value. All color options have no correlation on how the patient did on any portion of the test and is only a visual indication for the doctor to view the data. All color meanings are displayed in a legend on all pages and are identical on all sheets that contain colored cells. The colors have been specifically chosen to cater toward color blindness as well.

To export the patient's data to the spreadsheet, openpyxl is used to create and write to an excel spreadsheet as well as coloring the necessary cells. Exporting the data is accomplished by utilizing a pandas library to create a dataframe of the Individual Results Table and Latency Table. The finalized spreadsheet is saved to the doctor's downloads folder with the generated test id as the excel file name.

Order of the sheets:
- A. Raw Data
- B. Raw Data 2
- C. Aggregate Info
- D. Time Graphs
- E. Serial Score Graphs
- F. Unordered Score Graphs
- G. Response Position Score Graphs

3.1 Raw Data

Test Type	Correct Answer	Patient Answer	Latency 1	Latency 2	Latency 3	Latency 4	Latency 5	Duration	Score	Start Time	End Time
Practice Digit 4 span	3568	3568	2.39	2.11	3.18	4.14		11.82	1	2022-12-07 23:20:32	2022-12-07 23:20:44
Practice Digit 5 span	34589	34379	2.6	1.43	0.42	1.26	1.13	6.84	0.6	2022-12-07 23:20:44	2022-12-07 23:20:51
First digit 4 span	2345	2345	2.39	2.11	3.18	4.14		11.82	1	2022-12-07 23:20:51	2022-12-07 23:21:02
Second digit 4 span	4568	4563	2.39	2.11	3.18	4.14		11.82	0.75	2022-12-07 23:21:02	2022-12-07 23:21:14
Third digit 4 span	2349	2344	2.39	2.11	3.18	4.14		11.82	0.75	2022-12-07 23:21:14	2022-12-07 23:21:26
First digit 5 span	34568	33568	2.6	1.43	0.42	1.26	1.13	6.84	0.8	2022-12-07 23:21:26	2022-12-07 23:21:33
Second digit 5 span	26789	26889	2.6	1.43	0.42	1.26	1.13	6.84	0.8	2022-12-07 23:21:33	2022-12-07 23:21:40
Third digit 5 span	34589	34569	2.6	1.43	0.42	1.26	1.13	6.84	0.8	2022-12-07 23:21:40	2022-12-07 23:21:47
Practice mixed 4 span	37FK	3JFK	2.8	1.02	1.71	2.28		7.81	0.75	2022-12-07 23:21:47	2022-12-07 23:21:54
Practice mixed 5 span	37JRU	37JRK	4.19	1.8	1.35	1.5	2.73	11.58	0.8	2022-12-07 23:21:54	2022-12-07 23:22:06
First mixed 4 span	45KW	4KKW	2.8	1.02	1.71	2.28		7.81	0.75	2022-12-07 23:22:06	2022-12-07 23:22:14
Second mixed 4 span	47RW	47R6	2.8	1.02	1.71	2.28		7.81	0.75	2022-12-07 23:22:14	2022-12-07 23:22:22
Third mixed 4 span	48FS	486S	2.8	1.02	1.71	2.28		7.81	0.75	2022-12-07 23:22:22	2022-12-07 23:22:29
First mixed 5 span	45JRY	4FJ5Y	4.19	1.8	1.35	1.5	2.73	11.58	0.6	2022-12-07 23:22:29	2022-12-07 23:22:41
Second mixed 5 span	46RUY	46RUY	4.19	1.8	1.35	1.5	2.73	11.58	1	2022-12-07 23:22:41	2022-12-07 23:22:53
Third mixed 5 span	48KSW	48KSR	4.19	1.8	1.35	1.5	2.73	11.58	0.8	2022-12-07 23:22:53	2022-12-07 23:23:04

Raw Data | Raw Data 2 | Aggregate Info | Time Graphs | Serial Score Graphs | Unordered Score Graphs | Response Posit ⋯ +

Description: The Raw Data sheet is the sheet that gives the doctor an overview of how the patient took the test. This includes having the patient's latencies for every test as well as the test those latencies are connected to, the duration the patient

took for each test, the starting time of the test and the ending time for the test and finally the patient's score based on the patient's answer versus the correct answer.

3.2 Raw Data 2

Description: The Raw Data 2 page is the same sheet as the Raw Data sheet, but just adds a colorization to the Latency 1, Latency 2, Latency 3, Latency 4, Latency 5, Duration and Score columns for the patient. The legend is displayed under the table for easily observable comparison. A second table is displayed to visualize the patient's mean difference score for the 4 Span tests versus the 4 Span tests.

3.3 Aggregate Info

Description: The Aggregate Info sheet contains comparison of key summary metrics of the patient's test to the averages of their age range. The sheet is broken down into four sections related to the aggregate data fields as described in the Aggregated Data section of the design document. The sections are time, serial score, unordered score, and response position score. In each of these sections the tables have the field, patient average, aggregate age range average, standard deviation, and z-score. The z-score is also colored in relation to how many standard deviations the patient's average is from the mean which is shown in the legend.

3.4 Time Graphs
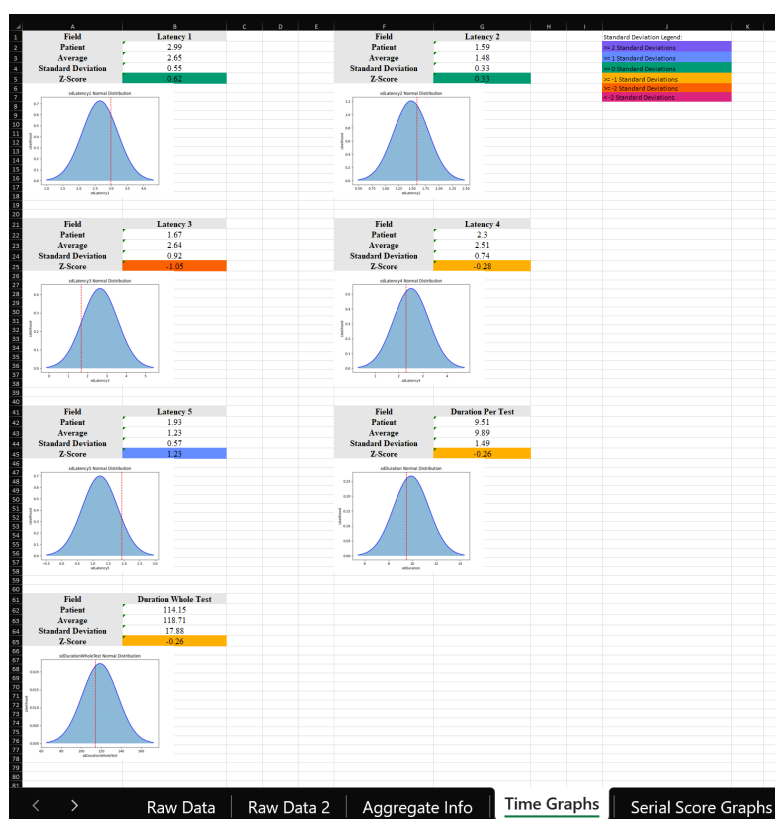
Description: The Time Graphs sheet is a more in depth analysis of the Aggregate Info sheet. As can be seen, this sheet has the same variables as present in the Time section of the Aggregate Info sheet and has the same metrics of patient average, age range average, standard deviation, and z-score. However, now each of the fields also has a graph that shows the normal distribution of the patient's age range and has a red line showing where the patient's data point lies on the distribution. Again, the z-score is also colored the same way as in the Aggregate Info sheet and the legend describing that is present on the right of this sheet.

3.5 Serial Score Graphs

Description: The Serial Score Graphs sheet is a more in depth analysis of the Aggregate Info sheet. As can be seen this sheet has the same variables as present in the Serial Score section of the Aggregate Info sheet and has the same metrics of patient average, age range average, standard deviation, and z-score. However, now, each of the fields also has a graph that shows the normal distribution of the patient's age range and has a red line showing where the patient's data point lies on the distribution. Again, the z-score is also colored the same way as in the Aggregate Info sheet and the legend describing that is present on the right of this sheet.
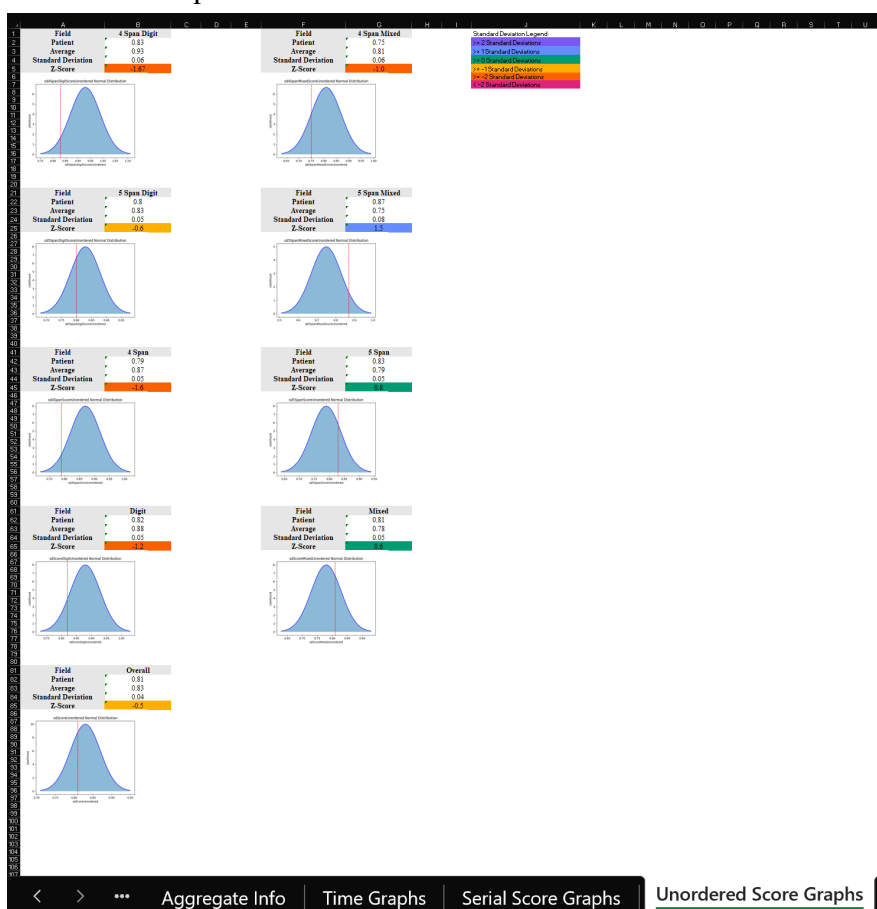
3.6 Unordered Score Graphs

Description: The Unordered Score Graphs sheet is a more in depth analysis of the Aggregate Info sheet. As can be seen, this sheet has the same variables as present in the Unordered Score section of the Aggregate Info sheet and has the same metrics of patient average, age range average, standard deviation, and z-score. However, now each of the fields also has a graph that shows the normal distribution of the patient's age range and has a red line showing where the patient's data point lies on the distribution. Again, the z-score is also colored the same way as in the Aggregate Info sheet and the legend describing that is present on the right of this sheet.
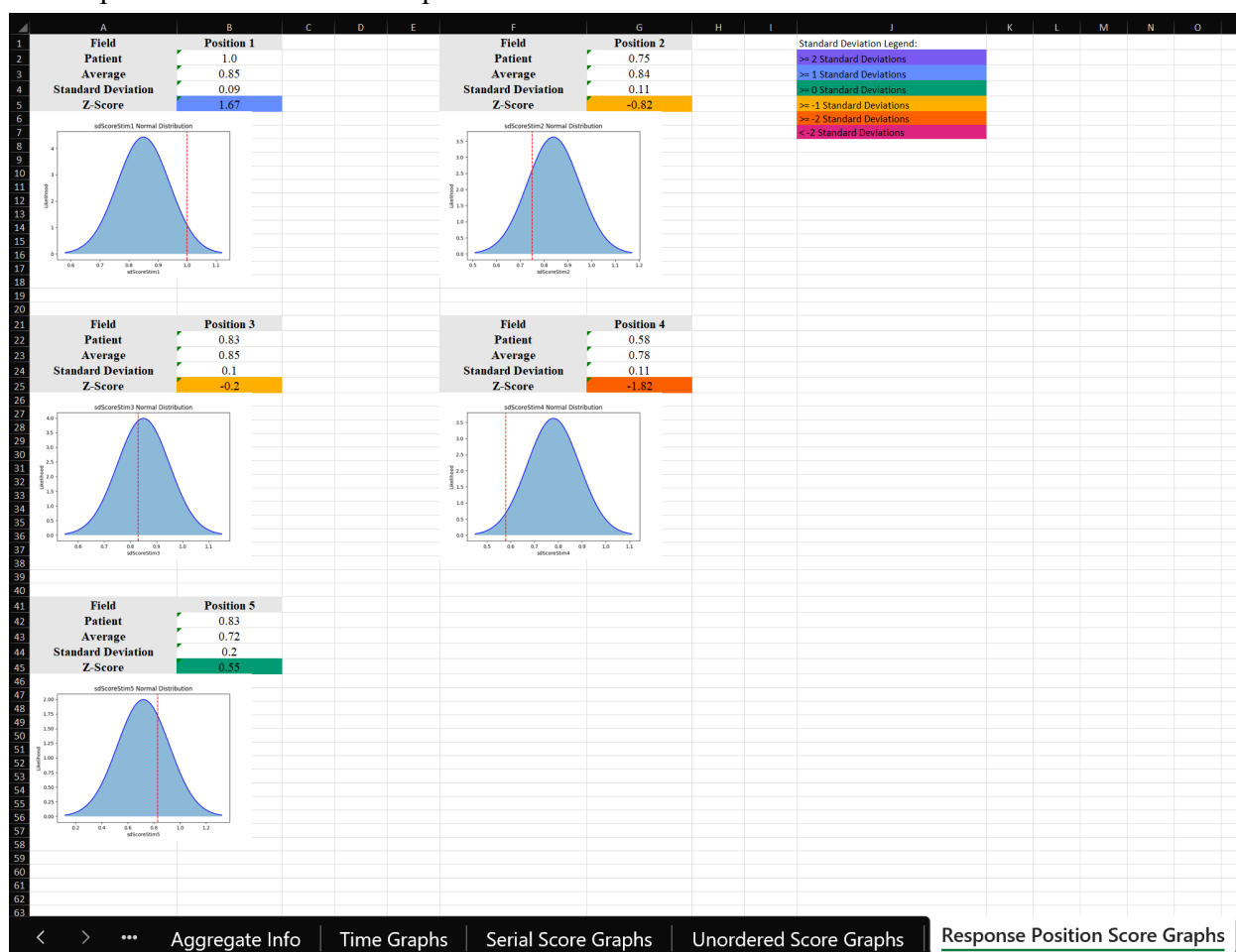
3.7 Response Position Score Graphs

Description: The Response Position Score Graphs sheet is a more in depth analysis of the Aggregate Info sheet. As can be seen, this sheet has the same variables as present in the Response Position Score section of the Aggregate Info sheet and has the same metrics of patient average, age range average, standard deviation, and z-score. However, now each of the fields also have a graph that shows the normal distribution of the patient's age range and has a red line showing where the patient's data point lies on the distribution. Again, the z-score is also colored the same way as in the Aggregate Info sheet and the legend describing that is present on the right of this sheet.

Models

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1 - Doctor Link Object

Doctor	LinkID
User Object	Text

The Doctor table is integrated into the application using Django's built-in User model, which is designed to handle all user-related functionalities, such as storing usernames and passwords securely.
- Doctor: The doctor's name is represented by the username field from the User model. Each doctor is uniquely identified by their username, which can be retrieved from Django's User model.
- LinkID: A TextField to store the unique identifier for the link between doctor and patient.

By utilizing the User model, there is no need to store the password directly, as Django handles this securely. Additionally, the links can be dynamically generated and related to the doctor's account, allowing the doctor to track all administered tests.

2 - Individual Object

Link ID Object	Date and Time	Age	Completed	Avg Latency1	Avg Latency2	Avg Latency3	Avg Latency4	Avg Latency5	Avg Duration	Avg 4 Span Score	Avg 5 Span Score	Avg Score Digit	Avg Score Mixed	Avg Score
Doctor Link Object	Date Time	Integer	Enum	Float sec	Float sec	Float sec	Float sec	Float sec	Float sec	Float	Flost	Float	Float	Float

The Individual Table stores data related to each patient's span test, including their responses, average latencies, and scores. Each span test corresponds to a unique link that is generated by a doctor (from the Doctor Table).

- LinkID: This field stores a doctor link object for each PPST test, allowing it to be linked back to the doctor who administered the test.
- Date & Time Created: The timestamp when the span test was created. This records the exact date and time of test creation.
- Age: The age of the patient at the time of the span test. This field helps track the patient's cognitive performance relative to their age.
- Completed: An Enum field (Completed, Incomplete and Quit) indicating whether the patient successfully completed the entire span test. This allows the system to track tests that were partially completed or quit during a mid test.
- Avg Latency (1-5): These fields store the average latency times (in seconds) for different spans of the test. Latency refers to the time taken by the patient to respond during different test segments.
- Avg Duration: The average duration (in seconds) that the patient took to complete the spans across the test session. This could reflect the overall pace of the patient during the test.
- Avg 4 Span Score: This field stores the average score for the 4 span part of the test. It could be measuring performance when recalling or responding to four stimuli during the test.
- Avg 5 Span Score: This field stores the average score for the 5 span part of the test. It could be measuring performance when recalling or responding to five stimuli during the test.
- Avg Score Digit: This field stores the average score for all digit-based spans in the test. It measures the patient's performance in recalling or responding to digit-based tasks.
- Avg Score Mixed: This field stores the average score for all mixed spans in the test, which could involve mixed types of tasks (e.g., digits and letter stimuli).
- Avg Score: The overall average score for the span test, summarizing the patient's performance across all spans, both digit and mixed.

Relationships:
This table is linked to the Doctor Table through the Link field, ensuring that each span test is tracked under the doctor who administered it. Additionally, the data captured here, such as latencies and scores, can be used for further analysis of the patient's performance.

3 - Individual Result Object

Ind Table	Test Name	Patient Answer String	Starting date and time	Ending date and time	Score	Duration
Individual Table Object	Stimuli Object	String	Date time field	Date time field	Float	Float sec

The Individual Result Table stores the detailed results for each of the individual test spans. This table tracks specific data points for each test span, including the test process, time taken, patient's responses, and scoring.
- Ind Table: This field stores an individual table object for each PPST span test, allowing it to be linked back to the patient who has taken the test.
- Name of the Test: A field stores a stimuli object indicating whether the test span was part of a practice session. This helps differentiate between practice trials and actual test spans. That can be used to identify the correct string for each span.
- Starting Day and Time: The date and time when the test span began, used to timestamp each test span and track the duration of the session.
- Ending Day and Time: The date and time when the test span ended, allowing for a precise measurement of how long the patient took to complete the span.
- Patient Answer String: The string provided by the patient in response to the given string, capturing their attempt to recall or repeat the stimuli.
- Score: The score assigned based on the patient's response. This could be a simple correct score, or it could be based on more detailed scoring criteria.
- Duration: The total time (in second) it took the patient to complete the specific span. This would be the difference between the starting and ending times.

Relationships:
This table is connected to the Individual object as part of the Ind Table field, which stores the individual object to identify the result belonging to which patient.

4 - Latency Object

Ind Res Object	Latency 1	Latency 2	Latency 3	Latency 4	Latency 5
Individual Result Object	Float sec	Float sec	Float sec	Float sec	Float sec

The Latency Table captures the latency values for each test span, representing the time it took for the patient to respond. Even if patients might give more answers than expected, the test will only record up to 5 latency.
- Ind Res Object: This field stores an individual result object for each PPST span test, allowing it to be linked back to the patient who has taken the test and tracking how much time spent on each span test.
- Latency 1-5: Each field in this table represents the latency (response time) for an individual response during the test span. If the patient provides more responses than what was expected or given, these additional latencies will not be stored.

Relationships:
This table can be linked back to the Individual Result Table to track the response times for each span test.

5 - Stimuli Object

Name	Given String	Correct String
Practice digit 4 span	5386	3586
Practice digit 5 span	94853	34589
First digit 4 span	3254	2345
Second digit 4 span	6584	4568
Third digit 4 span	9324	2349
First digit 5 span	65438	34568
Second digit 5 span	87962	26789

Third digit 5 span	53849	34589
Practice mixed 4 span	7K3F	37FK
Practice mixed 5 span	R3JU7	37JRU
First mixed 4 span	5WK4	45KW
Second mixed 4 span	R4W7	47RW
Third mixed 4 span	S8F4	48FS
First mixed 5 span	Y54JR	45JRY
Second mixed 5 span	6UYR4	46RUY
Third mixed 5 span	WS84K	48KSW

These objects represent the stimuli and correct answers for each test span given to patients in the test. Each row contains:

- Name: The type of test span e.g., Practice digit 4 span, First digit 5 span, Practice mixed 4 span.
- Given string: The stimuli string that is presented to the patient.
- Correct string: The correct answer string that the participant is expected to recall.

These objects essentially act as a reference to the test system, providing both the stimuli and the correct answers for each specific span.

6 - Aggregated Data

Min Age	Max Age	Num Tests	Avg Latency 1	Sd Latency 1	Avg Latency 2	Sd Latency 2	Avg Latency 3	Sd Latency 3	Avg Latency 4
Integer	Integer	Float	Float	Float	Float	Float	Float	Float	Float

Sd Latency 4	Avg Latency 5	Sd Latency 5	Avg Duration	Sd Duration	Avg 4 Span Score	Sd 4 Span Score	Avg 5 Span Score	Sd 5 Span Score	Avg Score Digit
Float	Float	Float	Float	Float	Float	Float	Float	Float	Float

Sd Score Digit	Avg Score Mixed	Sd Score Mixed	Avg Score	Sd Score	Avg 4 Span Digit Score	Sd 4 Span Digit Score	Avg 4 Span Mixed Score	Sd 4 Span Mixed Score	Avg 5 Span Digit Score
Float	Float	Float	Float	Float	Float	Float	Float	Float	Float

Sd 5 Span Digit Score	Avg 5 Span Mixed Score	Sd 5 Span Mixed Score	Avg 4 Span Score Unordered	Sd 4 Span Score Unordered	Avg 5 Span Score Unordered	Sd 5 Span Score Unordered	Avg Score Digit Unordered	Sd Score Digit Unordered	Avg Score Mixed Unordered	Sd Score Mixed Unordered
Float	Float	Float	Float	Float	Float	Float	Float	Float	Float	Float

Avg Score Unordered	Sd Score Unordered	Avg 4 Span Digit Score Unordered	Sd 4 Span Digit Score Unordered	Avg 4 Span Mixed Score Unordered	Sd 4 Span Mixed Score Unordered	Avg 5 Span Digit Score Unordered	Sd 5 Span Digit Score Unordered	Avg 5 Span Mixed Score Unordered	Sd 5 Span Mixed Score Unordered	Avg Score Stim 1
Float	Float	Float	Float	Float	Float	Float	Float	Float	Float	Float

Sd Score Stim 1	Avg Score Stim 2	Sd Score Stim 2	Avg Score Stim 3	Sd Score Stim 3	Avg Score Stim 4	Sd Score Stim 4	Avg Score Stim 5	Sd Score Stim 5	Avg Duration Whole Test	Sd Duration Whole Test
Float	Float	Float	Float	Float	Float	Float	Float	Float	Float	Float

Note: The above tables represent all the fields in one row of the aggregate table despite them being shown as separate tables. This is done to avoid clutter in one table

The aggregated data table holds the data comparison values that are used in the spreadsheet and graphs to demonstrate how a specific patient's results relate to their age demographic. Thus each row contains the combined information for all patients in that age range in the database but none of the practice test data is included. In production, these values will be updated during off hours to optimize the efficiency of the system. As a result, any downloads done by a doctor during the day will have comparisons that are a day old as any tests completed during the day won't be included in the averages until the next day. The z-score for each data point is patient-specific and is calculated on download by the doctor. To avoid looping over the data when viewing it on the doctor side, the percentile is calculated by finding the z-score and using the norm.cdf function in the scipy.stats library.

The aggregate fields are broken down into sections that are used in the spreadsheet. These sections are time fields, serial score fields, unordered score fields, and response position score fields. The time fields section are all the metrics that have to do with latencies or duration of the tests. The serial score fields are a breakdown of the different test types and their related serial scores. Serial score is awarded a point when the patient recalls the right digit/character in the exact position/order it should be. On the other hand, in an unordered score, a point is awarded for each correct digit/character even if it is not in the correct position. These scores are broken down into the different test types, the same way as with the serial scores. Also only the length of the span of the test is considered in the patient response for scoring, even if they enter more digits/characters than the span length. The last section of fields are the response position score fields. These track the accuracy of the patient for each position in their response in a serial fashion.

Miscellaneous Fields:
- Max Age, Min Age: These values make up the age ranges that are preset for the aggregate data. The determined age ranges are based on standard procedures in medical research and public health. These ranges represent children (0-12), adolescents (13-17), young adults (18-39), middle-aged adults (49-64), older adults (65-79), and the elderly (80+).
- Num Tests: The number of tests that have been taken where the patient falls into the specified age range. These tests are the ones that make up the aggregate data in that age range.
- Standard Deviation: The standard deviation for each of the below fields is tracked. This is calculated using the found averages, then looping through the Individual Table to get the squared deviation and eventually the standard deviation with the number of data points in the age range.

Time Fields:
- Avg Lat 1-5: The average latency for each stimulus in the span (in seconds). This is calculated by adding all the average latencies for the specific stimulus (1-5) in the Individual Table that fall into the age range. Then this sum is divided by the number of patients in the range.
- Avg Duration: The average duration to complete a single test of the 16 tests of the PPST. This is calculated by adding all the durations in the Individual Table that match the age range then dividing it by the number of patients in that range.
- Avg Duration Whole Test: The average duration to complete a test across all tests (in seconds). This is calculated by adding all the duration of each test in the Individual Table that matches the age range and then dividing it by the number of patients in that range.

Serial Score Fields:

- Avg Score 4 Span: The average score for all 4 span test scores in the PPST. This is calculated by adding all the average 4 span scores in the Individual Table that match the age range and then dividing it by the number of patients in that range.
- Avg Score 5 Span: The average score for all 5 span test scores in the PPST. This is calculated by adding all the average 5 span scores in the Individual Table that match the age range and then dividing it by the number of patients in that range.
- Avg Score Digit: The average score for all digit test scores in the PPST. This is calculated by adding all the average score digit fields in the Individual Tables that match the age range and then dividing it by the number of patients in that range.
- Avg Score Mixed: The average score for all mixed test scores in the PPST. This is calculated by adding all the average score mixed fields in the Individual Tables and then dividing it by the number of patients in that range.
- Avg Score: The average score across all tests in the PPST. This is calculated by adding all the average scores in the Individual Tables and then dividing it by the number of patients in that range.
- Avg 4 Span Digit Score: The average score for all 4 span digit test scores in the PPST. This is calculated by finding the average for these tests in each Individual Table where the patient is in that age range. These averages are then added together and divided by the number of patients in the age range.
- Avg 4 Span Mixed Score: The average score for all 4 span mixed test scores in the PPST. This is calculated by finding the average for these tests in each Individual Table where the patient is in that age range. These averages are then added together and divided by the number of patients in the age range.
- Avg 5 Span Digit Score: The average score for all 5 span digit test scores in the PPST. This is calculated by finding the average for these tests in each Individual Table where the patient is in that age range. These averages are then added together and divided by the number of patients in the age range.
- Avg 5 Span Mixed Score: The average score for all 5 span mixed test scores in the PPST. This is calculated by finding the average for these tests in each Individual Table where the patient is in that age range. These averages are then added together and divided by the number of patients in the age range.

Unordered Score Fields:

- The unordered score fields are the same as all the serial score fields however they are calculated in the unordered score fashion. This involves awarding a point for every correct digit/character in the patient response, even if they are not in the correct position. Repeated correct digits/characters are only awarded one point as there are no repeats in the given stimuli. Also only the length of the span of the test is considered in the patient response for scoring, even if they enter more digits/characters than the span length. These fields are all calculated by going to the individual table level and calculating the scores using the patient response and

the correct stimulus order. They are then rolled up into their specific test types and averaged for the number of tests and patients.

Response Position Score Fields:

- Avg Score Stim 1-5: The average score for each response position in all PPST tests. This is calculated by finding the serial score for each response position in all the PPST tests of a patient in the Individual Table. This number is then averaged and combined with the averages for that position from all other patients in that age range. Lastly, it is divided by the number of patients in that age range to get the overall average.

Fake Data

Numpy.random and random are libraries that are used extensively to create the numeric fake data found in the tables. Specifically, the normal function is used to generate fake data for entries in the individualTable and individualResultTable models. This determines individual scores/latencies which can then be used to calculate the averages. These distributions are made to match the conclusions found in the "A Digital Application for Assessment of Neurocognitive Disabilities" research paper by Thomas H. Auriemma. There are also three doctors created which have the patient tests randomly assigned to them. The doctor information including login is at the top of the fixture.py file and the different doctors include Doctor Who, Doctor Strange, and Doctor Doom. Lastly, the starting date and time of the patient tests are randomly calculated but the following parts of the PPST are continuous time measures from the start based on the durations of each test.

Purpose:
The purpose of the fake data ensures that every part of the web application can begin being worked on, especially the spreadsheet. By having fake data we were able to test our functions and wireframes to ensure they populate with the correct data. We could also begin designing the spreadsheet and how the data would be formatted and transferred when the doctor downloads the test results.

Design Turning Points

Throughout the development of our project we were able to stick mostly to our original design. There were minor changes on web frames with overall look and different pop ups, but the overall functionality remained consistent. The only major design turning point came when we started to consider the metrics to include in the spreadsheet for when doctors download patient data. The initial plan for the comparison part of the spreadsheet, where the patient is measured against their age range, was to include the patient data and the aggregate data for the following fields: latency 1-5, duration per test, four span score, five span score, digit score, mixed score, and overall score. Since these values were planned from the beginning, they were easy to keep track of and eventually aggregate. All the fields were stored in the Individual Table model so they were already calculated and when the age range average and standard deviation needed to be found it was easy to roll up all the Individual Tables where the age of the patient falls in the range. However after presenting our ideas for the spreadsheet at the end of sprint 1/beginning of sprint 2 we realized that there were many more metrics we could be and should be including in our report. These new metrics we determined were: four span digit score, four span mixed score, five span digit score, five span mixed score, four span score unordered, five span score unordered, digit score unordered, mixed score unordered, overall score unordered, four span digit score unordered, four span mixed score unordered, five span digit score unordered, five span mixed score unordered, stim 1 score, stim 2 score, stim 3 score, stim 4 score, stim 5 score, and duration whole test. Since these metrics were not added until the end of the project it was unreasonable to completely alter our model structures to account for the new fields. Instead we decided to just add these fields to the Aggregate Data model and update its functions. As a result, to compute these metrics we have to go all the way down our models, calculate them according to the raw data, and then roll it up in the aggregate function.