**Quest for the Ultimate Trail Mix**

Cataloguing, describing and storing plant specimens from around the globe has been common for nearly two centuries in the United States. Many of these samples and data about the plants is stored in herbaria across the nation with the New York Botanic Gardens having one of the largest. In fact, there are over 3.5 million digital records of plants in the collection. The goal of this challenge is to use the open API from the New York Botanical Gardens to build a beautiful application that connects that resource with other tools like the Open Tree of Life and iNaturalist. You will need to use your skills in database management, UI/UX and API integration to build a web app that provides both scientifically relevant data presentation and a beautiful design for exploring the vast diversity of plants in the New York Botanic Gardens collection.

Long Description

Herbaria are libraries of pressed, dead plants. They represent perhaps the most valuable source of cataloged biodiversity on our planet, and botanists are constantly adding new specimens to them every day. As a result, we are discovering new species, combining incorrectly split species into one, and extracting DNA from those pressed plants to explore the phylogenetic diversity of plants on our planet. How do botanists and geneticists make sure that they are cataloging a true diversity of species in these herbaria, and how do we find those missing species in the wild? Luckily, new databases like iNaturalist exist, where anyone with a smartphone can record a photo and GPS location of a plant anywhere in the world. It is challenging for herbaria like the one at the New York Botanic Gardens to incorporate the vast number of tools available that could add to the scientific understanding of plant species and diversity across the globe. In this challenge, you be creating a web application that brings the resources of the New York Botanical Gardens herbarium to new heights by combining it with matching data available by the crowd-sourced application iNaturalist and the Open Tree of Life, which builds relationship maps of living things. The best part is that all of these resources are free to use, but to date, no one has incorporated them in an easy-to-use application. To complete the entire challenge, participants should consider creating a functional product that contains both parts; UI/UX and Integration. However, participants may also choose to focus on only one of the sub-challenges.

1. UI/UX

This is a web application for both the general public and the scientific research community. As such, it needs to have both an intuitive and beautiful design, but also simple access to powerful tools, filtering, and sorting of information. You will need to think carefully about how you design menus, options, images, text and information being displayed from the various databases. You will need to take on the perspective of a visitor to the New York Botanic Gardens that would like to explore the herbarium collection in more detail as well as the scientist that is trying to prioritize how to identify new locations of a species that should be collected and deposited in an herbarium. At a minimum, you will need an interface that includes a way to sort/filter by plant type/species name, a display that renders a relationship diagram of that species (from Open Tree of Life), images uploaded by the New York Botanic Gardens and iNaturalist and location data for the specimens that have been collected or recorded by either the New York Botanic Garden or iNaturalist. The ease of use of this application is all about intuitive UI/UX and it must serve two very different populations making it even more challenging.

1. Integration

With over 3.5 million records from the New York Botanic Garden, hundreds of thousands of records in iNaturalist it would be impractical to build a master database combining both datasets and keep it updated in real-time. Therefore, the integration sub-challenge asks participants to build integration schemes to use the available open APIs from both of these sources as the source of truth for the data. There will be discrepancies, there will be matching errors and there will be challenges in what data to use. That is all part of what participants must work through in this challenge. In addition to the data sources needed for information to populate this application, participants are asked to incorporate Open Tree of Life diagram that display the relationship map for a given species of plant and a mapping application (i.e. Google Maps) to display collection locations as are available in the datasets. It will be the seamless integration of the datasets with these tools that drive the data being served to the application frontend.

**Burn FHIR, Burn**

Electronic Health/Medical Records (EHR/EMR) are being used to keep track of your medications, lab results and office visits. Unfortunately, there is only so much that individual EHR/EMRs can do on their own and interoperability of one EHR/EMR to another is very challenging. Fortunately, data standards are beginning to be implemented around health data in the form of the Fast Healthcare Interoperability Resources (FHIR). Additionally, some EHR/EMR systems have implemented integrations for Smart-on-FHIR which allows 3rd party applications to be accessible within their software. Burn FHIR, Burn is all about creating a Smart-on-FHIR app that presents genomic test data back to a provider within the EHR/EMR.

Long Description

Modern medicine is just barely past the days of huge stacks of paper that represent every patient’s life-long medical record. Unfortunately, electronic medical/health records (EMR/EHR) were originally designed by billing companies that helped hospitals and doctor’s offices get reimbursement from insurance for services. The modern EHR is a storage vault of information with a few, commonly-used tools for healthcare providers. As an afterthought, many have incorporated some patient portal concept where patients have access to some of the data in their medical record at a surface level. EHRs are not designed to be analytical tools, intuitively designed web applications, interactive software packages or a shareable data service. Instead, the modern EHR in the United States is a proprietary data storage system for medical information that hospitals and medical offices must learn to use. Newer governmental regulation in the U.S., the 21st Century Cures Act, aims to standardize health data and make it more transferrable from one hospital to the next and provide more transparency into healthcare to the individual patient. In January of this year, the U.S. Core Data for Interoperability was released. This contains the data standard for some of the basic information held within EHRs. All EHRs are to make this data available through the defined standard, however the policy does not state HOW that must be done between one EHR and another. This is, however, a step in the right direction to begin solidifying around a single data standard called FHIR. In this challenge, participants are asked to develop a third-party application that will interact with modern EHRs through a format called Smart-on-FHIR to order genetic tests and return the test results to the provider. This will include building a test ordering application that functions within the EHR, ensuring the correct information is sent to the testing laboratory and picks up result data and PDFs from the laboratory to display back to the provider within the EHR. Fortunately for participants, there are excellent resources to use that provide example EHR datasets, specifications for shared login and guides for how to build a successful Smart-on-FHIR application. Successfully completing this challenge will require participants to not only build the application and get it running in the EHR, but will also need to pay special attention to getting the order information to a laboratory and pick up result data from the lab when it is ready. There will need to be both EHR data integration and sharing and an intuitive UI/UX for providers to order test and receive results. However, participants may also choose to focus on only one of the sub-challenges.

1. EHR Integration

A major challenge in building anything that interacts with EHR data is data security. There are specific protocols that EHR companies put into place to ensure that their data is safe and secured from data leaks and hacking attempts. As such, the data transfer to and from EHRs is extremely limited and each company allows transfer of different data in different ways. Integrating with an EHR also has to include validation of users to ensure that providers can order a test and have the credentials/rights within the EHR to do so. This challenge focuses on a genetic test ordering application that can reach into the EHR to validate the ordering provider, pull patient and provider information into the order form, select the test being ordered and send that order to the receiving laboratory. Upon completion of the test, the laboratory will result both a data file and one or more PDFs of the report. In an ideal application both the data and the PDF report will be added back to the EHR, however it is more likely that only the PDF report will be allowed back into the EHR. Therefore, it is important to think about how this application is more than just a PDF transfer system and provides additional on-screen information about the result to the provider as well as a PDF copy.

1. UI/UX

A busy physician may spend less than 7 minutes per patient on a typical office or hospital visit. That 7 minutes includes the time the healthcare provider has to record notes in the EHR, make any necessary changes to the care plan and order any new tests or medications. Given the very short time a healthcare provider has to serve the huge number of patients he/she sees in a day, any ordering platform must not require a lot of time to log into a new system, navigate the ordering choices, type in data and ensure everything is correct. The UI/UX experience for this Smart-on-FHIR application must be simple, must limit the number of clicks-to-completion, must display the most important choices prominently and must have a way to review the order before it is submitted. When results are returned, the same principles apply. The application data must be easily understood and navigated and the most important information should be displayed first. Access to PDF copies for printing and sharing with a patient should also be included. The experience that a healthcare provider has with this test ordering and result system should be envious and set a standard for what should be expected by other Smart-on-FHIR applications across all EHR systems.

**More than Pharm to Table**

One of the fastest growing area of genomic testing is in a field called pharmacogenomics. Pharmacogenomics uses DNA signatures and large population studies to predict how an individual’s genomic data can provide insights into how that individual will process and react to certain medications. Although there is good data out there, it is not always as simple as a one-to-one cause and effect. Additionally, there are multiple resources that can inform interpretation, including the FDA, CPIK, and PharmGKB. More Than Pharm to Table asks participants to create a custom web-based application to interpret pharmacogenomic data by pulling resources from a variety of databases, creating custom interpretation fields and generating both an API and PDF endpoint.

Long Description

Rare disease diagnosis, cancer and a host of other specific use cases for genomic data have emerged as important proof-of-utility for integration of medical genomics into clinical care. As a society, we are still working on determining how to integrate genomics into common clinical practice. One of the fastest growing areas for this is in pharmacogenomics. Pharmacogenomics is the use of genetic data to predict how medications will be tolerated or processed by an individual. Many medications have side effects for some people, but not for others. Some medications work very well for one person, but not for another. Some of this variation can be explained by differences found in the genetic code of people. The science in this area has been expanding for a number of years and is at a point where it can start to be incorporated into clinical practice. The FDA has issued guidance around some medications that have differential outcomes based on genetics and has created medication labels and language to go with those medications. In addition, other international groups continue working on creating gene-medication linkages and publishing those in databases. One of the most reliable is CPIK. It contains information collected from multiple other sources and makes that data accessible by third-party software applications. This challenge is centered on creating an application to be used by testing laboratories that helps link genetic data to the FDA and CPIK information. A critical component is to allow the individual laboratory director to make decisions about which information source to use (FDA or CPIK) if they differ or to write their own interpretation for a particular gene-medication linkage. In order to succeed in this challenge, participants will need to create an application that allows a laboratory director to view the FDA and CPIK analysis/recommendation language, choose which of those to use in a resulting report, edit/modify/create their own analysis/recommendation language for any gene-medication linkage, import genetic data and create a result report using the selected language. To complete the entire challenge, participants should consider creating a functional product that contains both parts; UI/UX and Integration. However, participants may also choose to focus on only one of the sub-challenges.

1. UI/UX

UI/UX is an important part of this challenge. Laboratory directors are as busy as healthcare providers which means they have limited time per report to review and approve the analysis. The largest task for the laboratory directors is choosing which of the analysis/recommendations to use for reporting or writing their own. The UI/UX for this function needs to be robust and intuitive with specific attention to ease of use. The use of easy checkboxes or other simple ways of indicating choice is highly encouraged. Think outside of the box on this and there might be a new design that can be implemented to reduce the burden of choice even further. Finally, UI/UX should include a report template for results that make the information easy to view and understand, highlighting the most important results first.

1. Integration

The expectation is that the primary user of this system, the laboratory director, will have up-to-date FDA and CPIK guidelines at their fingertips. Changes in either of these should be indicated to the user so that individual can make appropriate changes to language. These two resources have a number of different data points and each provide different sets of information. The challenge requires participants to not only integrate the data from these sources but to reconcile any discrepancies or highlight discrepancies between the two. It is important to realize that both of these will be downloaded databases that will need to have a plan for updates and checks for new information in the updates as they come through.