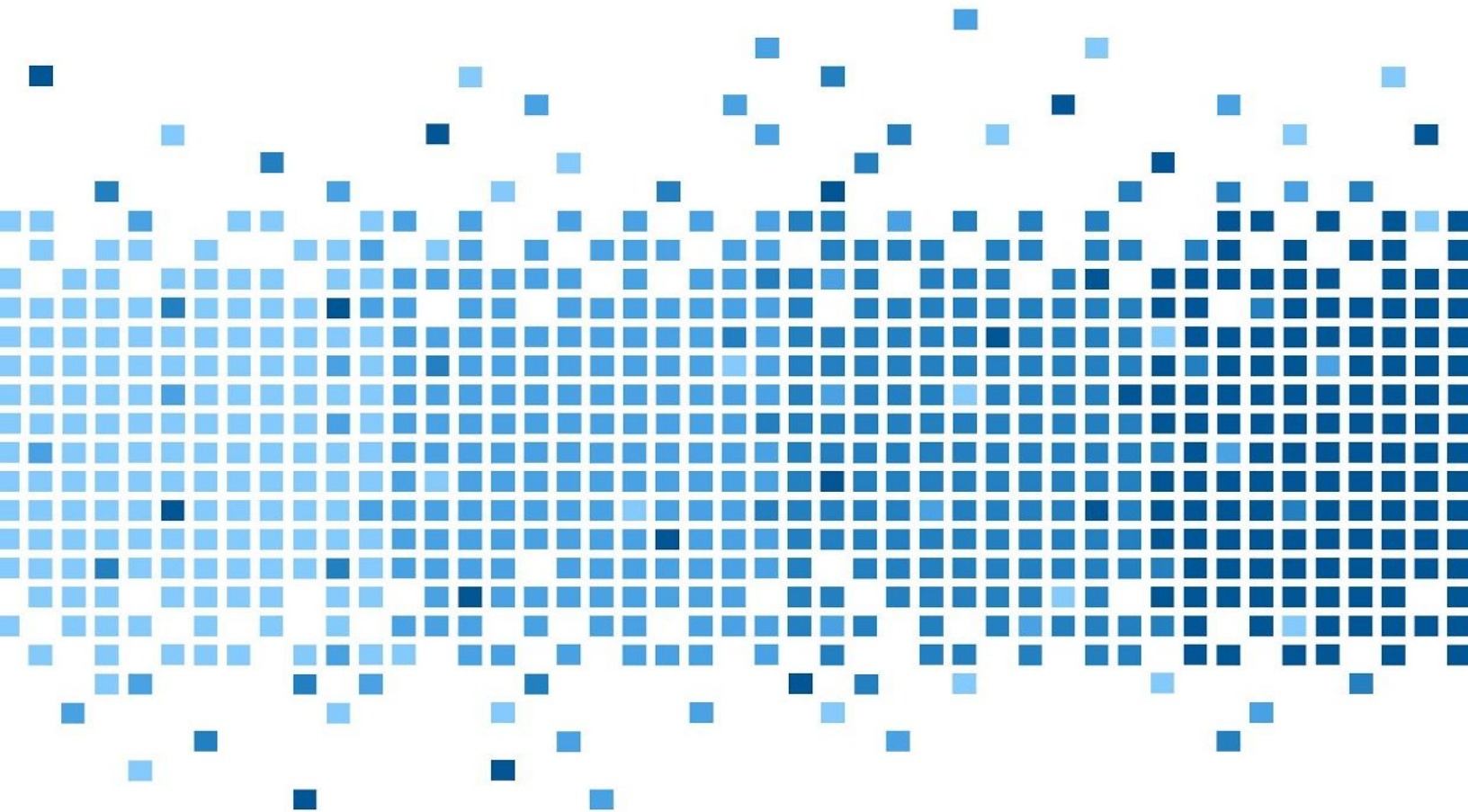


Application Analysis: Fitbit

Written and Researched by: Courtney Grimes



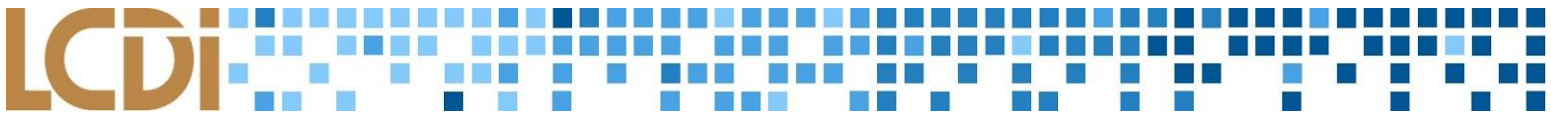


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Introduction

Web applications are essential for many of the day-to-day operations conducted on a computer.. As these applications become increasingly integrated with one another, and as we myriad amounts of information online, it is more important than ever to ensure your apps are secure and, in case of a breach, to know what you stand to lose. Despite the concept of web applications being that most of its data is downloaded when needed, having all necessary resources being processed at runtime is a resource intensive process, and much of that can be mitigated by storing some data on the host computer. As such, these applications can leave varying artifacts on the host. This project will focus on the artifacts left behind by the Fitbit Application.

Background

In autumn of 2013, a project called “Cloud Forensics” was conducted by the LCDI to investigate web applications from a storage perspective, in terms of how they relate and interact with cloud services. Web applications were then explored more in depth in May of 2017, when another team from the LCDI completed a project analyzing web applications in a similar manner to this project. The previous Application Analysis project and the current one focus on the client side of web applications, as opposed to the Cloud Forensics Project. Both projects were conducted in a similar manner, however, they have different focuses. The past project focused on the applications Slack, Discord, and Dropbox, and analyzed them within the operating systems Mac OS Sierra, Windows 7, and Windows 10. In contrast, this project will focus on Fitbit, all within a Windows 10 environment.

Purpose and Scope

The purpose of our research is to identify artifacts left behind by the Fitbit desktop application in a Windows 10 environment. Even if information contained in an application has been deleted, there is always a chance that something important can be recovered. This research will provide a glimpse into the inner functions of certain Web Apps, the artifacts that they leave behind, and the forensic implications of these artifacts.



Research Questions

1. What data is recoverable in each application from Windows 10 operating systems?
2. What are the forensic implications of the revealed artifacts?

Terminology

AA User: The Fitbit test user account that was created for data generation and analysis.

Artifacts: Any data generated by user interaction that can be collected and examined. Any user data retrieved from the browser is considered an artifact, including cookies, caches, geolocation, search history, etc.

Badges: Users are rewarded with a badge when they meet certain criteria involving steps and floors climbed (with Fitbit device only) and when they meet their weight goals.

Challenges: Users have the option to challenge friends in competitions to help motivate users to move more.

Community: A new feature in Fitbit that provides users a better social experience.

Digital Evidence: “Information of probative value that is stored or transmitted in a binary form” (NCFS, 2012). Digital evidence not only includes computers in the traditional sense, but also digital audio, video, and pictures.

Digital Forensics: A division of forensic science which focuses on the identification, examination, collection, preservation, and analysis of data from any device that can store electronic/digital information, such as computers and mobile phones. The science is applied in both criminal and civil investigations in a court of law, and in the private sector when investigating internal issues or intrusions

EnCase: A suite of digital forensics tools created by Guidance Software. The software comes in several forms designed for forensic, cyber security, and e-discovery use.

Exercise Log: A feature of the app where users can log exercise sessions manually based predetermined exercises by the app.

Group: A component of the community feature in which users can join groups to connect with others based on interests and lifestyles.

Feed: A component of the community feature in which users can see posts from group members and friends all in one convenient place.

Food Log: A feature of the App that allows users to log what they eat in order to compare intake calories vs. outtake calories

Fitbit: An exercise tracker with social media services through the associated application that interfaces with the devices through a Bluetooth device on both smartphones and computers.



Friends: A component of the community feature in which users can add friends, view their profiles and send direct messages to friends.

Profile: A user's account information and personalized settings.

Virtual Machine (VMs): A software-based computer that executes and runs programs like a physical machine.

Web Application: an application in which all or some parts of the software are downloaded from the Web each time it is run. It may refer to browser-based apps that run within the user's Web browser, or to "rich client" desktop apps that do not use a browser or to mobile apps that access the Web for additional information.

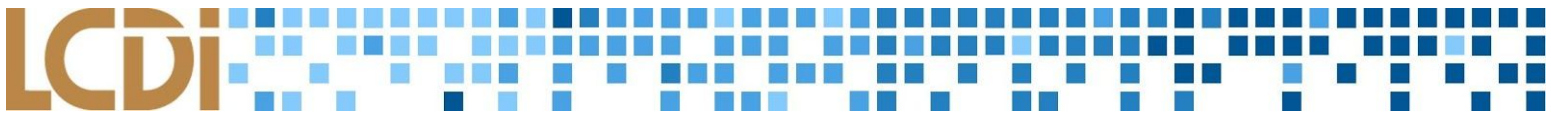
Methodology and Methods

Before we began, our team split up into three groups and each group was assigned at least one of the applications researched. We began by establishing a virtual machine for each application, all using Windows 10. Each installation was updated then powered off. From there, the application data generation began. We worked off of a pre-made list of features for each application to ensure that as much data was generated and stored as possible. The actual data generation process was similar for each case, with each application yielding different results.

After data generation was completed, we then used the VMDK files for each VM and analyzed them using EnCase, Autopsy, and FTK Imager. We systematically looked through the evidence, verifying each artifact, and making sure there were no changes by using MD5 and SHA1 hashes that were calculated before and after analysis.

The forensic tool we used for this project was EnCase. EnCase is a piece of software that contains multiple tools that allowed our team to look further into virtual machine files. After creating the cloned virtual machine files, the team took each file, then processed it inside of EnCase. This tool allowed us to view cache files directly. Links, pictures, and even user input that was recorded in cache were all found within the caches of the web apps that we looked at.

VMware Workstation Pro was our tool for data generation in this project. VMware Workstation Pro was used as a platform for our virtual machine allowing us to access to the VM from one computer. In order to start our data gen on our applications, we first had to install our Windows 10 systems on VMware Workstation Pro. We then used the interface to generate data for the project. Afterwards, we cloned the .vmdk file and then exported it, so that we could investigate what artifacts are on the machine.



Equipment Used

Device	OS Version	Comments
VMware Workstation Pro	12.5.0	Used to interact with the VM
Fitbit (Device)	Blaze 17.8.402.1	Worn for data generation
VM	Windows 10.0.15063	Windows machines
Fitbit (Windows Application)	2.26.1310	Used for data generation
Google Chrome	61.0.3163.100	Used for data generation
EnCase	v8.04	Acquire and process data generated

Data Collection

Using EnCase, we analyzed the VMDK files, searching for any stored information on the machine that would only be available while logged into an account., We specifically looked for any artifacts that could be relevant in a forensic investigation, or those that could indicate compromised security within any of the apps. The artifacts we collected can be found in the [appendix.: Fitbit Evidence Table.](#)

Analysis

Based on the research questions, we expected that there would not be major breaches of information given that Fitbit has a very large user base and has been around for more than six years. Therefore, will most likely have better security as a precaution. However, there may be information that could prove critical to future forensic investigations. The Fitbit app has the potential to store crucial personal information, and this analysis may shed light on possible weaknesses or leakages of information within the applications.

Results

Fitbit Community

Fitbit users saw a notable change to the application in the beginning of 2017, with the new Community feature. Located at the top of the desktop application (Figure 1), the Community feature entails three components: Groups, Friends and Feed.

With the Group component users have the option to join community groups that meet their interests, goals or lifestyle. Users can connect with other members by sharing status updates, pictures and even their stats to the group's feed. Members can like and comment to further engage with each other all without being friends. For

more personal relationships, users can add each other to their friends list. Becoming friends allows users to challenge, message and see more personal information about each other. The Feed is where users can see updates from both friends and groups all in one convenient place.

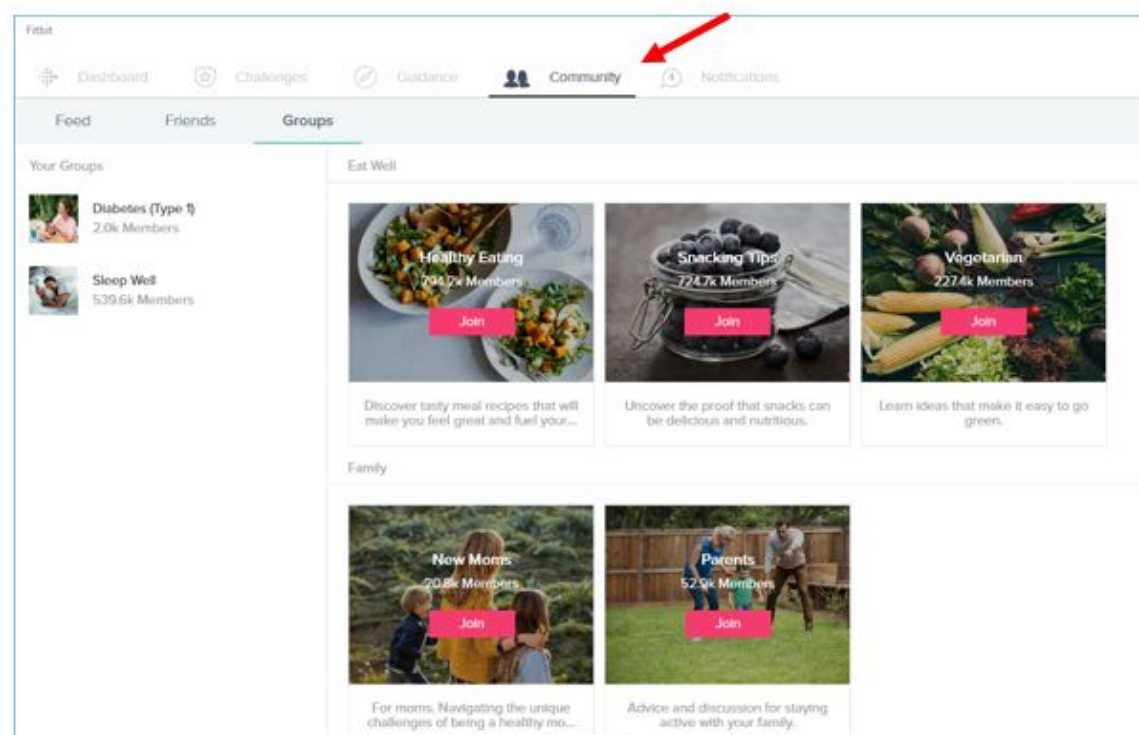


Figure 1

Feed Digital Evidence

Having joined two Fitbit community groups (Diabetes (Type1) and Sleep Well) digital evidence was found in the form of .jpeg's on the VM using Encase. The evidence as seen from the AA users Newsfeed (Figure 3) of the AA user's account. The profile picture (Figure 2) of the Sleep Well group member who posted and the image they shared (Figure 4) was found archived on the VM. There were numerous evidence files of this nature found spread across multiple dates as well as posted by members in different groups

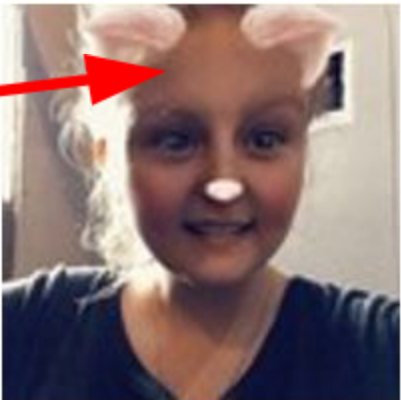
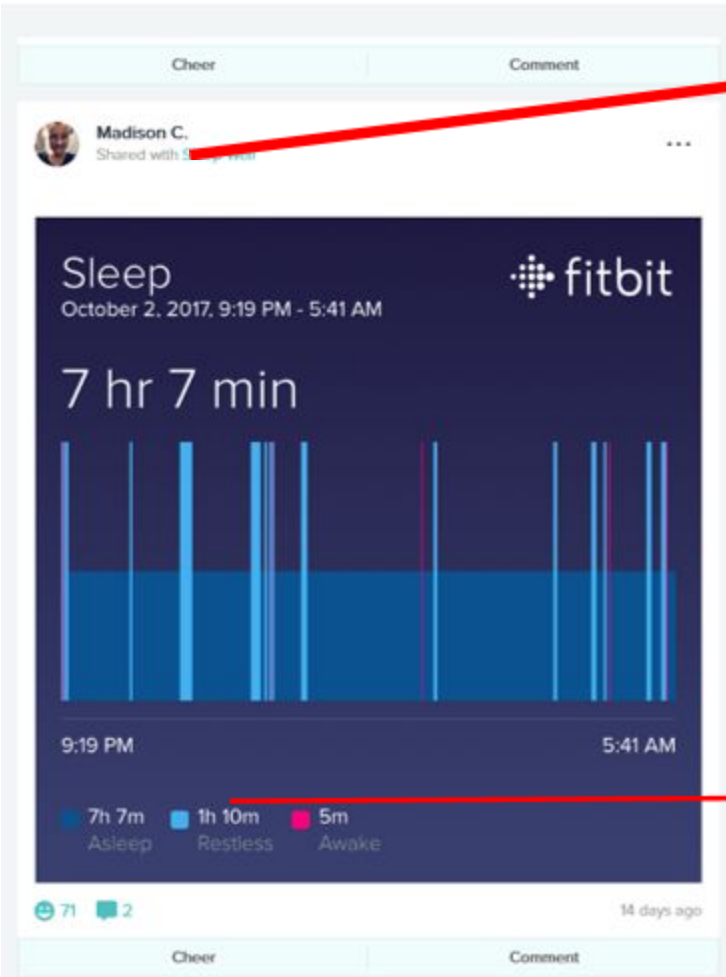


Figure 2

Item Path:
FitbitAnalysis\untitled\C\LostFiles\95555c84824f9482d5641d9117d15714b5f4108a

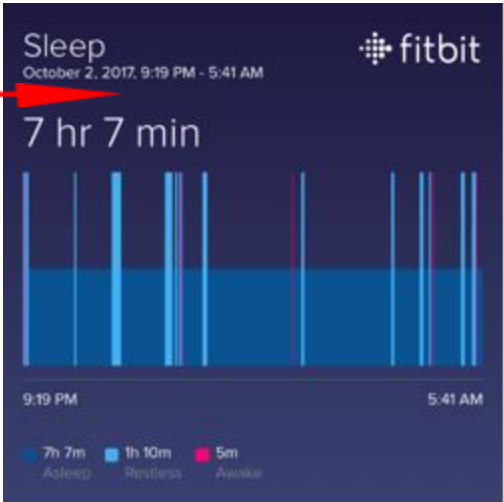


Figure 4

Item Path:
FitbitAnalysis\untitled\C\LostFiles\c73764cee85b03ddc48f505ad0b27d56f2953781

Also found archived on the VM, was a picture (Figure 6) shared by the AA user with friends through the feed. Figure 5 shows the post as viewed from AA users newsfeed.



Figure 6

Item Path:

```
untitled\C\Users\cgrimes\AppData\Local\Packages
\Fitbit.Fitbit_6mqt6hf9g46tw\TempState\c1bxtxnu.
3kt.png
```



Figure 5

Fitbit Friends Digital Evidence

Digital evidence of the AA User’s friends on Fitbit was found on the VM in a .json format. What information was found depended on what information the friend provided to Fitbit and the progress in which they made using the App (lifetime steps and badges earned).

Evidence located on the VM (Figure 7) for the AA user’s friend “Courtney A.” showed age, date of birth, display name, friend status, height, member since, time zone and about me description. Figure 8 and Figure 9 show the profile of Courtney A. as views from the AA user’s account.

```

11625 }, {"user": {"age": 20, "ambassador": false, "avatar": "https://static0.fitbit.com/images/profile/defaultProfile_100_female.png", "avatar150": "https://static0.fitbit.com/images/profile/defaultProfile_150_female.png", "avatar640": "https://static0.fitbit.com/images/profile/defaultProfile_640_female.png", "averageDailySteps": 0, "city": "", "clockTimeDisplayFormat": "12hour", "corporate": false, "country": "", "dateOfBirth": "1997-09-29", "displayName": "Courtney A.", "encodedId": "5YYDSS", "features": {}, "friend": true, "fullName": "", "gender": "NA", "height": 69.01574803149606, "locale": "en_US", "memberSince": "2017-09-11", "offsetFromUTCMillis": -14400000, "state": "", "strideLengthRunning": 0, "strideLengthWalking": 0, "timezone": "America/New_York", "topBadges": [], "weight": 0}}, {"user": {"aboutMe": "I am a 19 year old college student who is ready to get fit. This is the first time I am using Fitbit and I am excited to get started on my goals. Hopefully, I can also analyze the artifacts left behind by this application.", "age": 0, "ambassador": false, "avatar":

```

Figure 7

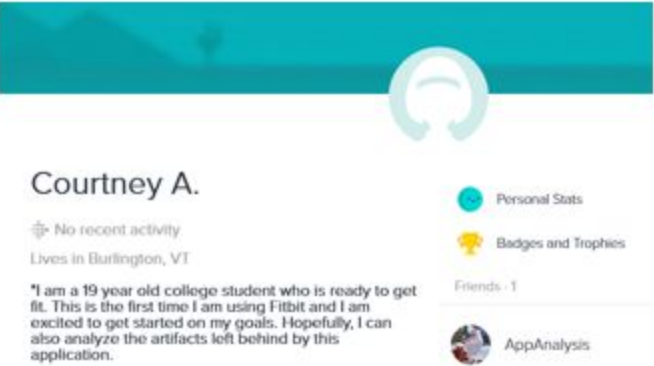


Figure 8

Item Path:

untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User Data\Default\Cache\Internet\Chrome (Windows)\Cache\Code\friends.json



Figure 9

Key:

- Red = Age
- Orange = Birthdate
- Yellow = Name
- Gray = Friend Status
- Pink = Height
- Blue = Member Since
- Purple = Time Zone
- Green = About Me Description

Evidence located on the VM (Figure 13) for the AA user’s friend “Joe G.” showed average daily steps, name, friend status, gender, member since, time zone, and badges earned and when they were earned. Figures 10, 11 and 12, and show the profile of Joe G. as viewed from AA user’s account.

```
06766", "shortName": "Helicopter", "timesAchieved": 1, "value": 500}, {"weight": 0}], {"user": {"age": 0, "amb
06859assador": false, "avatar": "https://static0.fitbit.com/images/profile/defaultProfile_100_male.png",
06952g", "avatar150": "https://static0.fitbit.com/images/profile/defaultProfile_150_male.png", "avata
06945r640": "https://static0.fitbit.com/images/profile/defaultProfile_640_male.png", "averageDailySt
06133eps": 4777, "city": "", "clockTimeDisplayFormat": "12hour", "corporate": false, "country": "", "dateOfB
06231irth": "", "displayName": "Joe G.", "encodedId": "5GLFS3", "features": {"friend": true, "fullName": "
06324", "gender": "MALE", "height": 0, "locale": "en_US", "memberSince": "2017-02-07", "offsetFromUTCMillis
06417": -14400000, "state": "", "strideLengthRunning": 0, "strideLengthWalking": 0, "timezone": "America/New
06510w_York", "topBadges": [{"badgeGradientEndColor": "A495E8", "badgeGradientStartColor": "38216E", "ba
06609dgeType": "DAILY_STEPS", "category": "Daily Steps", "cheers": [{"date": "2017-05-25", "descript
06696ion": "20,000 steps in a day", "earnedMessage": "Congrats on earning your first High Tops badge!
06785", "encodedId": "228TTP", "image100px": "https://static0.fitbit.com/images/badges_new/100px/badge
06882_daily_steps20k.png", "image125px": "https://static0.fitbit.com/images/badges_new/125px/badge_d
06975aily_steps20k.png", "image300px": "https://static0.fitbit.com/images/badges_new/300px/badge_dai
07068ly_steps20k.png", "image50px": "https://static0.fitbit.com/images/badges_new/badge_daily_steps2
071610k.png", "image75px": "https://static0.fitbit.com/images/badges_new/75px/badge_daily_steps20k.p
07254ng", "marketingDescription": "You've walked 20,000 steps And earned the High Tops badge!", "mob
07347ileDescription": "When it comes to steps, it looks like you're not playing around. This achiev
07440ement was a slam dunk.", "name": "High Tops (20,000 steps in a day)", "shareImage640px": "https://
07533/static0.fitbit.com/images/badges_new/386px/shareLocalized/en_US/badge_daily_steps20k.png", "s
07626hareText": "I took 20,000 steps and earned the High Tops badge! #fitbit", "shortDescription": "2
077180,000 steps", "shortName": "High Tops", "timesAchieved": 1, "value": 20000}, {"badgeGradientEndColor
07812": "42C401", "badgeGradientStartColor": "007D3C", "badgeType": "LIFETIME_DISTANCE", "category": "Lif
07905etime Distance", "cheers": [{"date": "2017-09-01", "description": "500 lifetime miles", "earne
07998dMessage": "Whoa! You've earned the Serengeti badge!", "encodedId": "228BMC", "image100px": "https
08091://static0.fitbit.com/images/badges_new/100px/badge_lifetime_miles500.png", "image125px": "htt
08184s://static0.fitbit.com/images/badges_new/125px/badge_lifetime_miles500.png", "image300px": "htt
08277ps://static0.fitbit.com/images/badges_new/300px/badge_lifetime_miles500.png", "image50px": "htt
08370ps://static0.fitbit.com/images/badges_new/badge_lifetime_miles500.png", "image75px": "https://s
08463tatic0.fitbit.com/images/badges_new/75px/badge_lifetime_miles500.png", "marketingDescription":
08556"By reaching 500 lifetime miles, you've earned the Serengeti badge!", "mobileDescription": "Imp
08645ressive! You've walked distance of the Serengeti! u2014one of the 7 Natural Wonders of the Wor
08742ld.", "name": "Serengeti (500 lifetime miles)", "shareImage640px": "https://static0.fitbit.com/im
08835ages/badges_new/386px/shareLocalized/en_US/badge_lifetime_miles500.png", "shareText": "I covere
08928d 500 miles with my #fitbit and earned the Serengeti badge.", "shortDescription": "500 miles",
09021shortName": "Serengeti", "timesAchieved": 1, "unit": "MILES", "value": 500}, {"badgeGradientEndColor
09114": "B0DF2A", "badgeGradientStartColor": "00A550", "badgeType": "DAILY_FLOORS", "category": "Daily Cli
09207mb", "cheers": [{"date": "2017-07-22", "description": "25 floors in a day", "earnedMessage": "C
09300ongrats on earning your first Redwood Forest badge!", "encodedId": "228T5Z", "image100px": "https
09393://static0.fitbit.com/images/badges_new/100px/badge_daily_floors25.png", "image125px": "https://
09486/static0.fitbit.com/images/badges_new/125px/badge_daily_floors25.png", "image300px": "https://s
09579tatic0.fitbit.com/images/badges_new/300px/badge_daily_floors25.png", "image50px": "https://stat
09672ic0.fitbit.com/images/badges_new/badge_daily_floors25.png", "image75px": "https://static0.fitbi
09765t.com/images/badges_new/75px/badge_daily_floors25.png", "marketingDescription": "You've climbed
09858 25 floors to earn the Redwood Forest badge!", "mobileDescription": "The tallest trees on Earth
09951 can't top the heights you've been conquering.", "name": "Redwood Forest (25 floors in a day)",
10044"shareImage640px": "https://static0.fitbit.com/images/badges_new/386px/shareLocalized/en_US/ba
10137dge daily_floors25.png", "shareText": "I climbed 25 flights of stairs and earned the Redwood Fo
```

Figure 13

Item Path:

untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\UserData\Default\Cache\Internet\Chrome(Windows)\Cache\Code\friends

Key: Pink = Avg. Daily Steps Red = Gender Green = Badges
Yellow = Name Blue = Member Since
Gray = Friend Status Purple = Time Zone

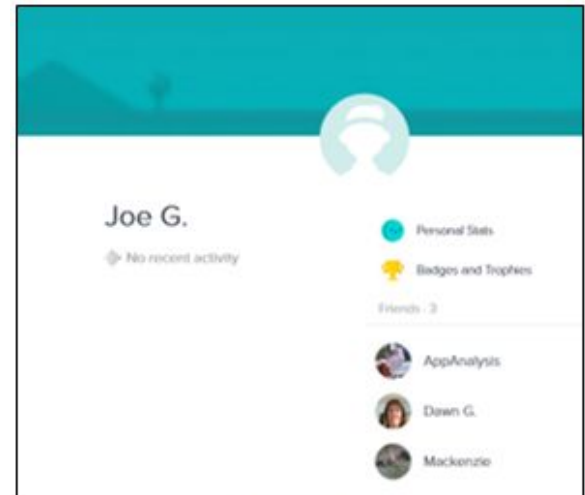


Figure 10



Figure 11

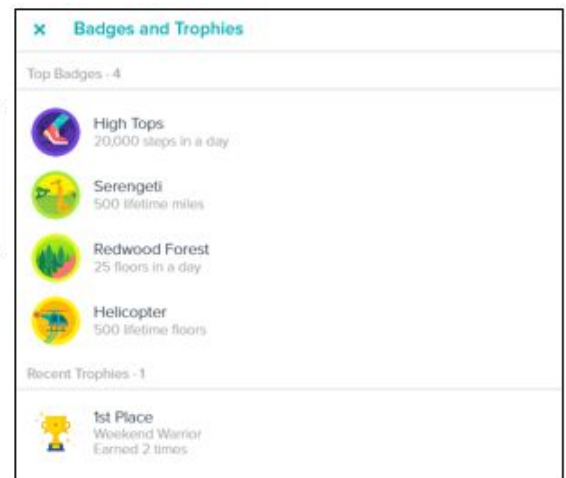


Figure 12

Fitbit Challenges

To help motivate users to move more, the challenge feature allows users the option to challenge friends in one of four different friendly competitions (Figures 14, 16, 17 and 18). The challenge feature can be located at the top of the desktop application (see Figure 15)

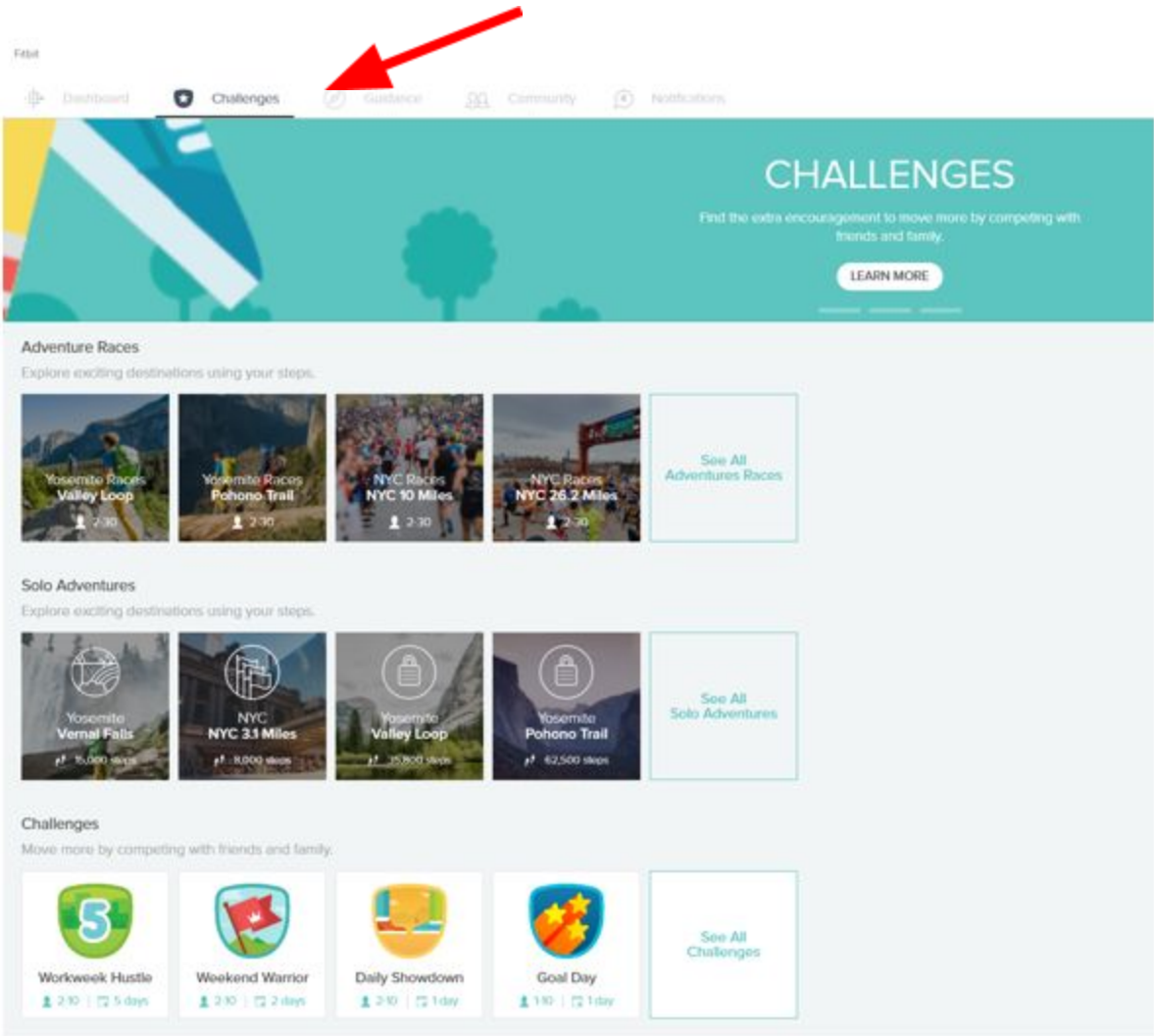


Figure 15



Figure 14



Figure 16



Figure 17



Figure 18

Workweek Hustle: The user who walks the most steps between Monday and Friday wins!

Weekend Warrior: The user who walks the most steps between Saturday and Sunday wins!

Daily Showdown: The user who walks the most steps in a day wins!

Goal Day: A challenge to see who can hit their personal step goal in a day.

Badges Evidence

The Sneakers Badge earned by the AA user was found archived on the VM as a picture (Figure 23) and a description (Figure 22). Other badges earned by the AA user were also found archived on the VM in the same manner. Figure 24 shows the badges earned by AA user as viewed from AA users profile page.

```
0182400 STEPS ·Ö·-1fÄ·10,000 steps in a dayCongrats on earning your first Sneakers badge!228TQBhttps://s
0182495 tatic0.fitbit.com/images/badges_new/100px/badge_daily_steps10k.pnghttps://static0.fitbit.com/im
0182590 ages/badges_new/125px/badge_daily_steps10k.pnghttps://static0.fitbit.com/images/badges_new/300p
0182685 x/badge_daily_steps10k.pnghttps://static0.fitbit.com/images/badges_new/badge_daily_steps10k.png
0182780 https://static0.fitbit.com/images/badges_new/75px/badge_daily_steps10k.pngYou've walked 10,000
0182875 steps And earned the Sneaker badge!You stepped up your game and just reached the recommended n
0182970 umber of steps per day.Sneakers (10,000 steps in a day)https://static0.fitbit.com/images/badges
0183065 _new/386px/shareLocalized/en_US/badge_daily_steps10k.pngI took 10,000 steps and earned the Snea
0183160 kers badge! #Fitbit10,000 stepsSneakers ·5ZFNHL'·00000000-0000-0000-0000-0000···i|?···È|5···î|4·
```

Figure 22

Item Path:

untitled\C\Users\cgrimes\AppData\Local\Packages\Fitbit.Fitbit_6mqt6hf9g46tw\LocalState\fitbit.5ZFNHL.db

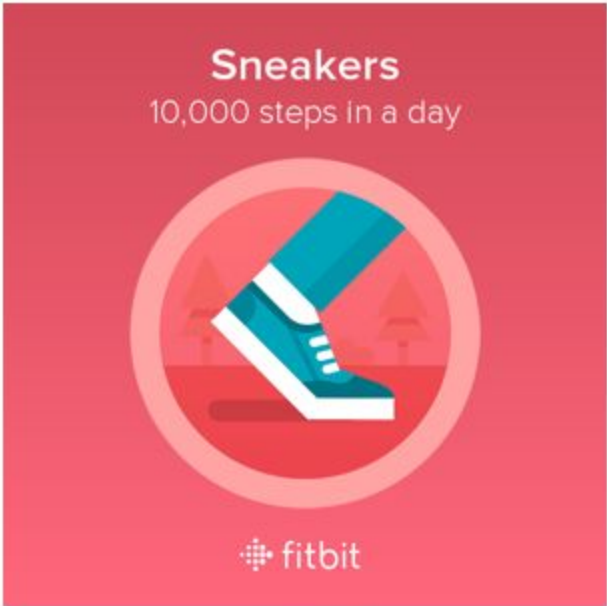


Figure 23

Item Path:

untitled\C\Users\cgrimes\AppData\Local\Package s\Fitbit.Fitbit_6mqt6hf9g46tw\AC\INetCache\1C COI6YC\badge_daily_steps10k[1].png

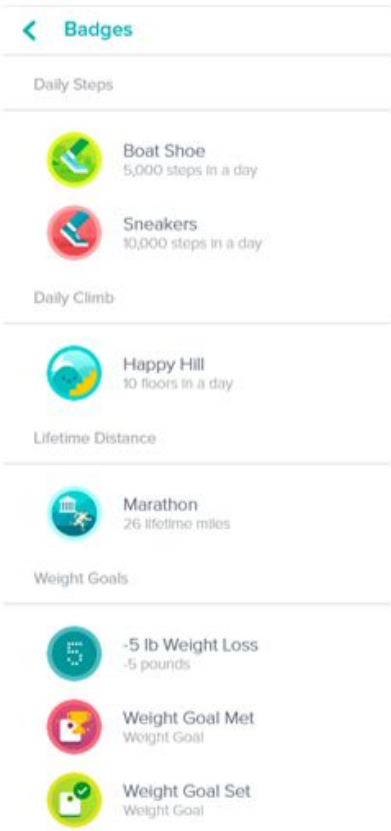


Figure 24

Fitbit User Profile Information

The Fitbit App allows user's various options to configure the app (Figure 25) to better suit their needs and goals and change how their profile is viewed by others and what is shared. When signing up for a Fitbit account, users are asked for the following things:

- First Name
- Last Name
- Gender
- Birthday
- Height
- Weight

User's then have the option to add the following things to their profile

- Profile Picture
- Cover Photo
- "About Me" Description
- Location
- Nickname

Users can also adjust their goals for the following things

- Activity
- Exercise
- Water Intake
- Food Intake
- Weight
- Sleep

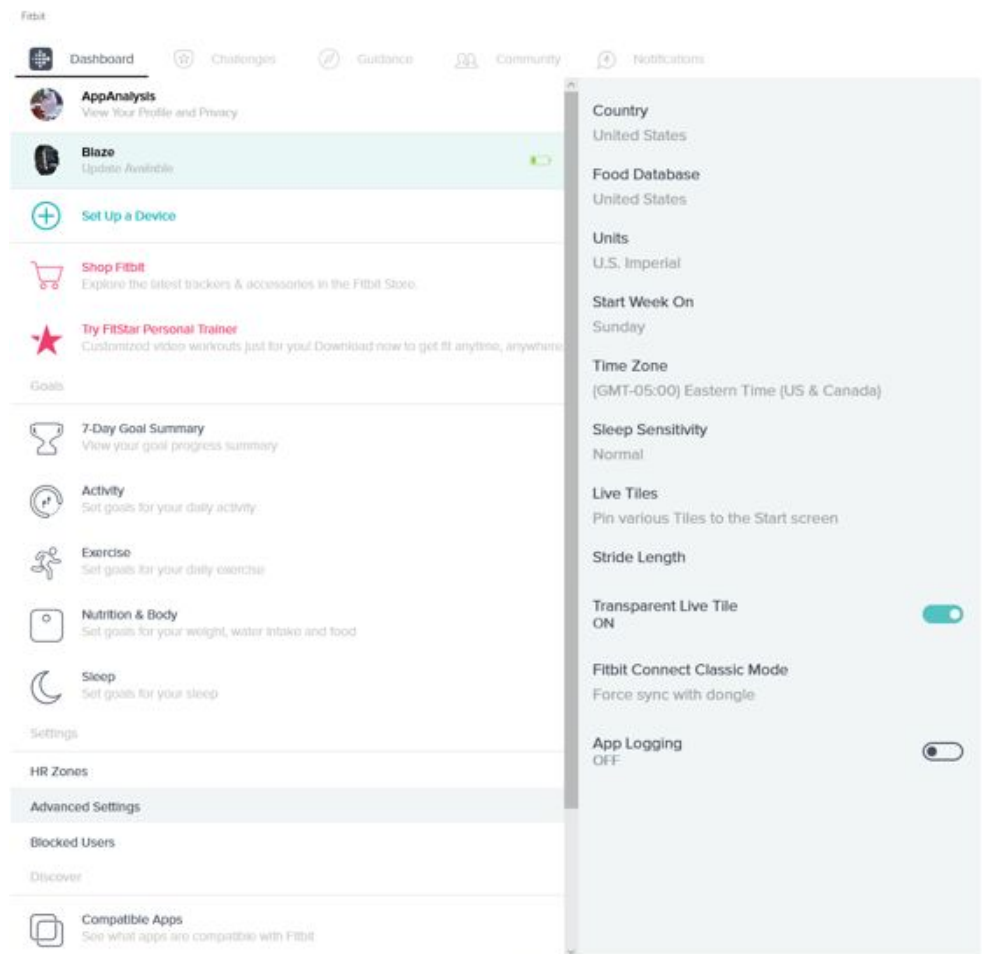


Figure 25

User Profile Evidence

AA user’s account cover photo (Figure 26) was found archived on the VM, along with AA user’s current profile picture (Figure 27) and the previous profile picture (Figure 28). Note: The AA user’s account only had two profile pictures associated with it.



Figure 26



Figure 27

Item Path:

untitled\C\Lost
Files\2378e0cc136711f4107a45e1e2593d0d65ab50da

Item Path:

untitled\C\Lost
Files\ca08638ed404b8b82eb002513539931757d62f48



Figure 28

Item Path:

untitled\C\Lost
Files\c5fd7c44b1e1829574c278ebe7082642e91aa33b

AA user's profile information (Figures 29, 30, and 31) was found archived on the VM in a .JSON format (Figure 32), continued on page 18.

Figure 29

Figure 30

Figure 31

```
0000 {"user":{"aboutMe":"I'm a 20 year old, college student majoring in Computer and Digital Forensics at Champlain College
0059 ring in Computer and Digital Forensics at Champlain College
0118 , who wants to see what artifacts are left behind by the app
0177 p. ", "age":20, "ambassador":false, "autoStrideEnabled":true, "
0236 avatar":"https://d6y8zfzc2qfsl.cloudfront.net/5D799127-1C3C-072E-936C-D31E8CE12FFA_profile_100_square.png", "avatar150"
0295 -072E-936C-D31E8CE12FFA_profile_150_square.png", "avatar640":"https
0354 :\"https://d6y8zfzc2qfsl.cloudfront.net/5D799127-1C3C-072E-9
0413 36C-D31E8CE12FFA_profile_640_square.png", "averageDailySteps":5477,
0531 E8CE12FFA_profile_640_square.png", "averageDailySteps":5477,
0590 "challengesBeta":true, "clockTimeDisplayFormat":"12hour", "co
0649 rporate":false, "corporateAdmin":false, "country":"US", "custo
0708 mHeartRateZone":{"enabled":false, "max":0, "min":0, "name":"Cu
0767 stom Zone"}, "customMaxHeartRate":{"enabled":false, "maxHeart
0826 Rate":0}, "dateOfBirth":"1997-09-29", "displayName":"AppAnaly
0885 sis", "displayNameSetting":"username", "distanceUnit":"en_US"
0944 , "email":"LCDIfitbitanalysis17@gmail.com", "emailVerificationRequired":false, "encodedId":"52FNHL", "features":{"exercise
1003 nRequired":false, "encodedId":"52FNHL", "features":{"exercise
1062 Goal":true, "phoneNumberFriendFinding":{"algorithm":"SHA-256
```

Figure 32

- Key:
- Red = About Me Description
 - Orange = Age
 - Yellow = Avg. Daily Steps
 - Gray = Country
 - Pink = Birthdate
 - Blue = Display Name
 - Purple = Display Name Setting
 - Green = Email

Item Path:

```
untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User
Data\Default\Cache\Internet\Chrome (Windows)\Cache\Code\profile.json
```

More of AA user's profile information found archived on the VM in a .JSON format (Figure 33) continued from page 17.

```

1121 ", "countries":["CN"],"salt":"UY9M1E70VQE3UAA4"}}, "firstName
1180 ":"Courtney", "foodsLocale":"en_US", "fullName":"Courtney Gri
1239 mes", "gender":"FEMALE", "glucoseUnit":"en_US", "height":175.2
1298 000000000000002, "heightUnit":"en_US", "languageLocale":"en_US"
1357 , "lastName":"Grimes", "legalTermsAcceptRequired":false, "loca
1416 le":"en_US", "memberSince":"2017-09-20", "mfaEnabled":false, "
1475 offsetFromUTCMillis":-14400000, "sleepTracking":"Normal", "st
1534 artDayOfWeek":"SUNDAY", "strideLengthRunning":91.7, "strideLe
1593 ngthRunningType":"default", "strideLengthWalking":72.4, "stri
1652 deLengthWalkingType":"default", "swimUnit":"en_US", "timezone
1711 ":"America/New_York", "topBadges":[{"badgeGradientEndColor":

```

Figure 33

Item Path:

```

untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User
Data\Default\Cache\Internet\Chrome
(Windows)\Cache\Code\profile.json

```

Key:

Red = First Name
 Orange = Full Name
 Yellow = Gender
 Gray = Height
 Pink = Last Name
 Blue = Member Since
 Purple = Stride Length Running
 Green = Stride Length Walking
 Turquoise = Time Zone

AA user's starting weight and current weight along with the date in which the AA user started trying to losing weight was found archived on the VM in a .JSON format (Figure 34).

```

000 {"goal":{"goalType":"LOSE", "startDate":"2017-09-20", "startWeight":106549
072 , "weight":104327, "weightThreshold":50}}

```

Figure 34

Item Path:

```

untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User
Data\Default\Cache\Internet\Chrome
(Windows)\Cache\Code\profile.json

```


Fitbit Foods Logged

Users have the option to track the foods they eat in order to get a better understanding of the number of intake calories compared to outtake calories (Figure 35). Users can enter a food name into a search bar and select the food from a huge database of pre-entered food.

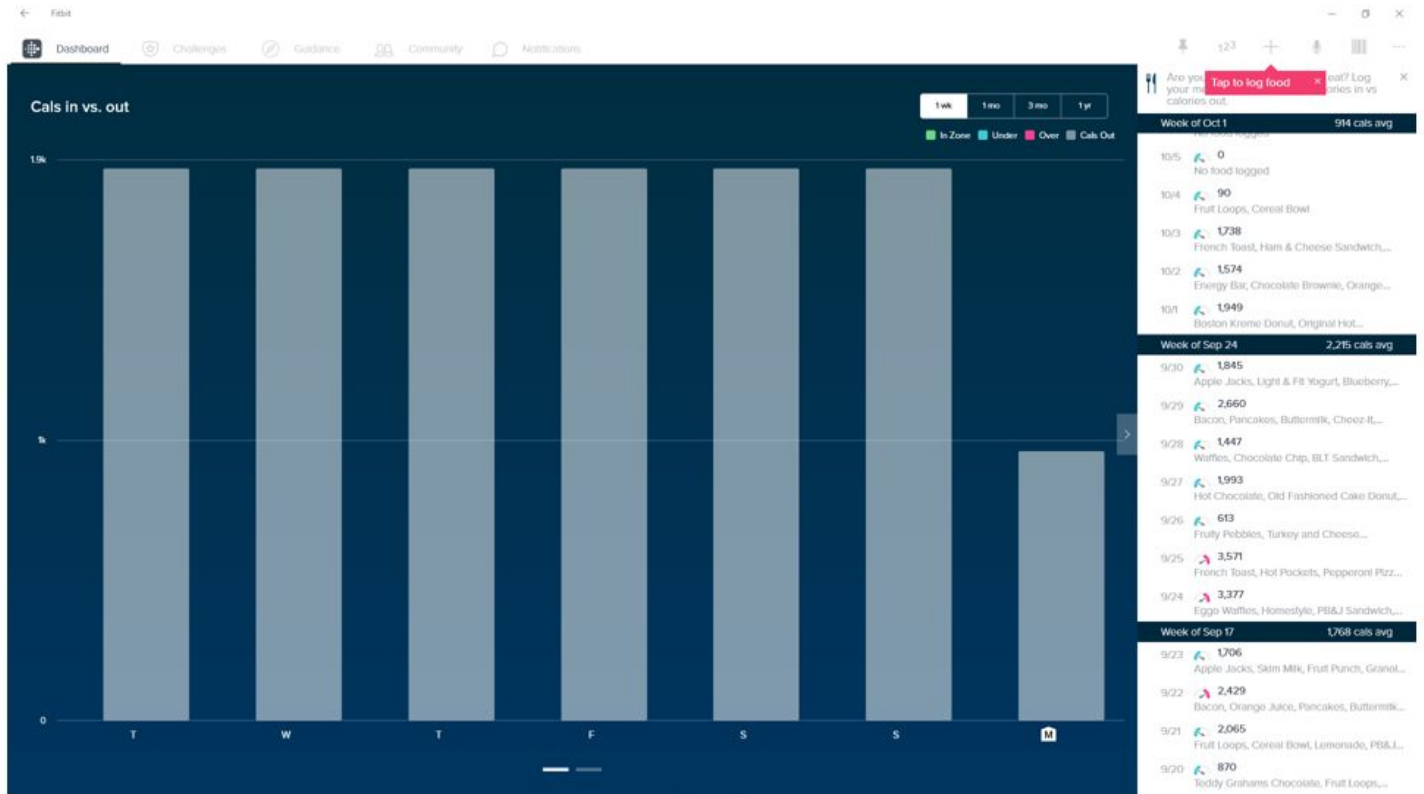


Figure 35

Foods Logged Evidence

AA User's food logged was found archived on the VM (Figure 36). Interestingly enough, not only was the food name found but the nutritional information as well. Besides total calories (Figure 37), nutritional information is not found in the Fitbit App.

```
0263610 chen_US ·£ ·á ·ÂTurkey and Cheese Sandwich{ "calcium": 0.3
0263668 , "caloriesFromFat": 120.0, "cholesterol": 60.0,
0263726 "dietaryFiber": 3.0, "iron": 1.8, "protein": 35.0,
0263784 "saturatedFat": 4.5, "sodium": 1500.0, "sugars": 4
0263842 .0, "totalCarbohydrate": 52.0, "totalFat": 13.0,
0263900 "vitaminA": 1500.0, "vitaminC": 9.0 }{"sandwich":{"mul
```

Figure 36

Item Path:

untitled\C\Users\cgrimes\AppData\Local\Packages\Fitbit.Fitbit_6mq66hf9g46tw\LocalState\fitbit.5ZF NHL.db

Key:

- Red = Food Name
- Orange = Calcium
- Yellow = Calories from Fat
- Gray = Cholesterol
- Pink = Dietary Fiber
- Blue = Iron
- Purple = Protein
- Green = Saturated Fat
- Turquoise = Sodium
- Dark Green = Sugars
- Light Purple = Total Carbohydrates
- Red-Orange = Total Fat
- Gold = Vitamin A
- Lavender = Vitamin C

Tuesday, September 26, 2017

Calories - Under Target



Macronutrients [Learn More](#)



BREAKFAST	163
Fruity Pebbles	163
LUNCH	450
Turkey and Cheese Sandwich	450

Figure 37

Fitbit Exercise

Users can log exercise both manually using the app and with certain Fitbit Trackers. Using the App, users can choose from a wide variety of pre-programmed exercises that allow you enter a start time and end time then it automatically calculates distance and calories based on the average user (REF _Ref498353366 \h * MERGEFORMAT Figure 38). If the user was wearing their Fitbit device during the time of exercise it will automatically add the information collected by the device during the exercise time such as, heart rate, to the exercise log.

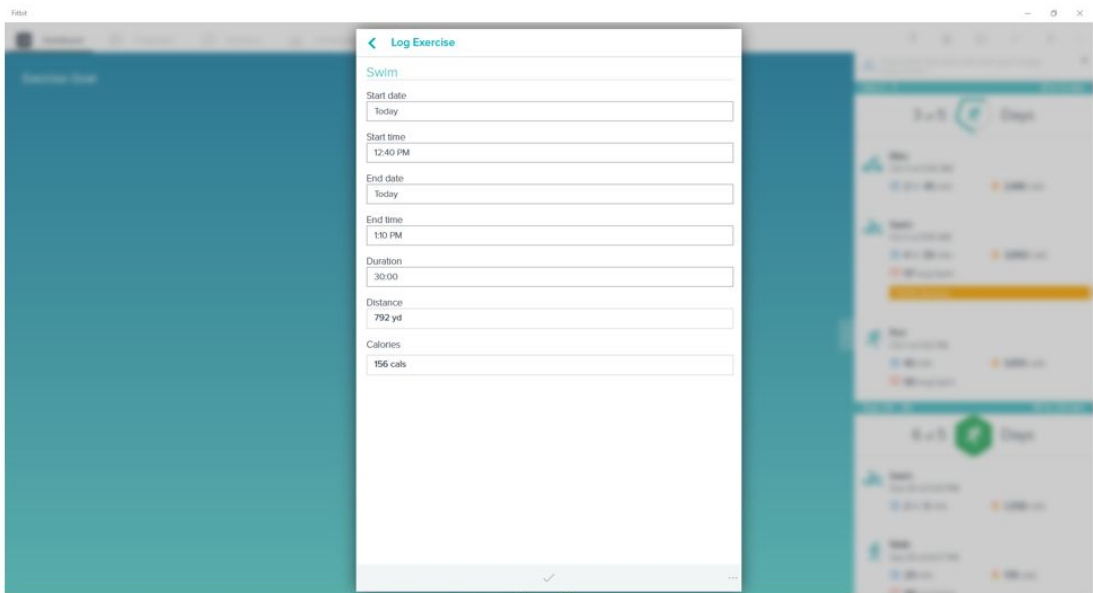


Figure 38

Exercise Evidence

AA user’s run exercise on 9/20/17 (REF _Ref498353473 \h Figure 40) were found archived on the VM in a .JSON format (REF _Ref498353488 \h * MERGEFORMAT Figure 39). Data found included the name of the exercise activity, calories burned, description of the exercise activity, distance, duration in Milliseconds, date, start time, and steps. Files for each exercise logged by AA user were found archived on the VM with the date of the exercise used for the name of the file.

```
0000{"activities":[{"activityId":90009,"activityParentId
0052 ":90009,"activityParentName":"Run","calories":2381,"
0104 description":"Running - 5 mph (12 min/mile)","distan
0156 ce":17.999999,"duration":10800000,"hasStartTime":tru
0208 e,"isFavorite":false,"lastModified":"2017-09-20T16:5
0260 3:00.000Z","logId":9986519391,"name":"Run","startDat
0312 e":"2017-09-20","startTime":"09:30","steps":31833}],
```

Figure 39

Key:

Red

 = Activity Name

Orange

 = Calories Burned

Yellow

 = Description

Gray

 = Distance

Pink

 = Duration (in Milliseconds)

Blue

 = Date

Purple

 = Start Time

Green

 = Steps

Item Path:

untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User

Data\Default\Cache\Internet\Chrome (Windows)\Cache\Code\2017-09-20.json

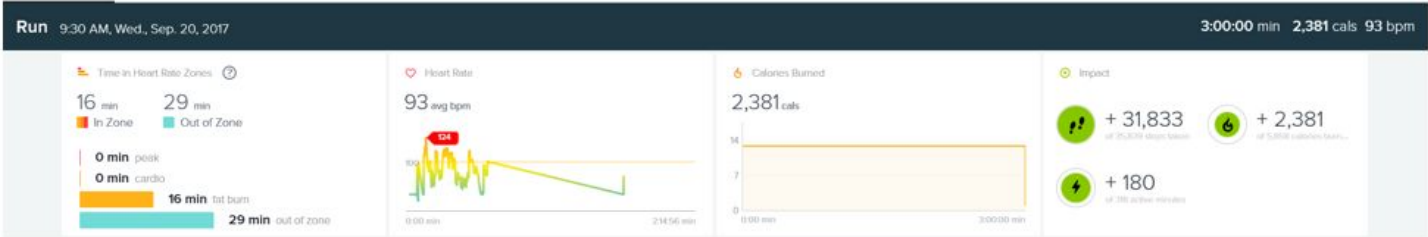


Figure 40

Fitbit Steps

The Fitbit devices most primitive feature is in its pedometer abilities. It tracks your daily steps, floors climbed, distance traveled and minutes active using a highly accurate 3-D motion sensor. Users have the ability to see their daily progress [past and present] on the dashboard of the app (REF _Ref498357002 \h Figure 41).



Figure 41

Steps Evidence

AA user's number of steps taken (REF _Ref498359222 \h Figure 43) were found archived on the VM in a .JSON format (REF _Ref498359249 \h Figure 42). Each week's data were put in their own separate file and subsequently named for the first date of that week's data.


```
000 {"activities-steps":[{"dateTime":"2017-09-27","value":
054 "12549"}, {"dateTime":"2017-09-28","value":"362"}, {"dat
108 eTime":"2017-09-29","value":"4095"}, {"dateTime":"2017-
162 09-30","value":"13095"}, {"dateTime":"2017-10-01","valu
216 e":"18797"}, {"dateTime":"2017-10-02","value":"2921"}, {
270 "dateTime":"2017-10-03","value":"302"}, {"dateTime":"20
324 17-10-04","value":"930"}]}
```

Figure 42

Item Path:

untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User
Data\Default\Cache\Internet\Chrome (Windows)\Cache\Code\2017-09-
20.json

Key:

- Red = 9/27/17 # of Steps
- Orange = 9/28/17 # of Steps
- Yellow = 9/29/17 # of Steps
- Gray = 9/30/17 # of Steps
- Pink = 10/01/17 # of Steps
- Blue = 10/02/17 # of Steps
- Purple = 10/03/17 # of Steps
- Green = 10/04/17 # of Steps

10/4	938 steps	
10/3	302 steps	
10/2	2,921 steps	★
10/1	18,797 steps	★
9/30	13,095 steps	★
9/29	4,095 steps	★
9/28	362 steps	
9/27	12,549 steps	★

Figure 43

Conclusion

The Fitbit App results were not congruent with our expectations. Fitbit first launched in 2011 therefore we thought little data would be found because they would have had ample time to install patches for better security. However, that proved not to be the case as there was a vast amount of artifacts left behind from all areas of the application. While it did take some digging through Encase to view these artifacts, the artifacts were still found and thus pose a great security risk for user's personal data.

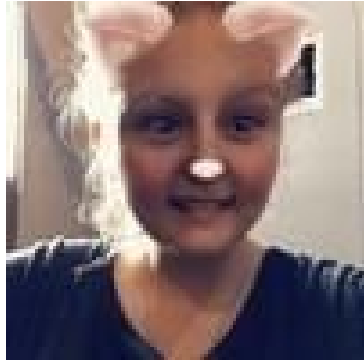

Further Work

While we covered a lot of ground with the Fitbit application, there are still other aspects we could look at with Fitbit. Most significantly, the integration between desktop app and mobile phone app, the use of other Fitbit devices such as the Aria Scale in conjunction with the tracker and utilizing the GPS features of these devices. In addition, there are numerous other applications that could be analyzed with future iterations of this project. So far, the LCDI has analyzed seven desktop applications over a variety of operating systems, but there are many more popular apps that could also contain relevant information on their hosts. During our initial research, our team narrowed down the list of applications of interest to twelve, including Twitter, Facebook, Venmo, Google Drive, and others which we found to be currently popular and relevant. In general, this project can be very flexible, and subsequent teams can narrow their focus based on interest and current popularity of specific applications





Appendix

Fitbit Evidence Table

Evidence found	Where	Notes	Screenshot
Group Member's Profile Picture	FitbitAnalysis\untitled\C\LostFiles\95555c84824f9482d5641d9117d15714b5f4108a	Sleep Well Group Member	
Group Members Post (Picture)	FitbitAnalysis\untitled\C\LostFiles\c73764cee85b03ddc48f505ad0b27d56f2953781	Sleep Well Group Member's Post	
Friends Information	untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User Data\Default\Cache\Internet\Chrome (Windows)\Cache\Code\friends.json	Friend: Courtney A.	<pre>11628}, {"user": {"age": 20, "ambassador": false, "avatar": "https://static0.fitbit.com/images/profile/defaultPr 11718 faultProfile_100_female.png", "avatar150": "https://static0.fitbit.com/images/profile/defaultPr 11811 ofile_150_female.png", "avatar640": "https://static0.fitbit.com/images/profile/defaultProfile_6 11904 40_female.png", "averageDailySteps": 0, "city": "", "clockTimeDisplayFormat": "12hour", "corporate": 11997 false, "country": "", "dateOfBirth": "1997-09-29", "displayName": "Courtney A.", "encodedId": "5YD5S 12090", "features": {}, "friend": true, "fullName": "", "gender": "NA", "height": 69.01574803149606, "locale" 12183: "en_US", "memberSince": "2017-09-11", "offsetFromUTC": -14400000, "state": "", "strideLengthR 12276 unning": 0, "strideLengthWalking": 0, "timezone": "America/New_York", "topBadges": {}, "weight": 0}, { 12369 "user": {"aboutMe": "I am a 19 year old college student who is ready to get fit. This is the fi 12462 rst time I am using Fitbit and I am excited to get started on my goals. Hopefully, I can also 12555 analyze the artifacts left behind by this application.", "age": 0, "ambassador": false, "avatar":</pre>

Friends Information	untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\UserData\Default\Cache\Internet\Chrome(Windows)\Cache\Code\friends.json	Friend: Joe G	<pre> 05744", "shortName": "Helicopter", "timesAchieved": 1, "value": 500}, {"name": "0", "weight": 0}, {"user": {"age": 0, "amb 05859 "avatar": false, "avatar": "https://static0.fitbit.com/images/profile/defaultProfile_100_male.png", 05952 "g": "avatar100", "https://static0.fitbit.com/images/profile/defaultProfile_100_male.png", "ava 06045 "r40": "https://static0.fitbit.com/images/profile/defaultProfile_140_male.png", "avatarSize": 100, 06139 "age": 40, "age": 40, "clockTimeDisplayFormat": "12hour", "country": "US", "date": "2017-09-01", " 06231 "birth": "1980-01-01", "display": "Joe G.", "encodedId": "501F33", "features": {"display": "full", "full": " 06324", "gender": "M", "height": 0, "locale": "en_US", "memberSince": "2017-02-01", "offsetFromGMT": 1440, 06417", "id": "1440000", "state": "CA", "strideLengthRunning": 0, "strideLengthWalking": 0, "timeZone": "America/Los 06510 "US_Tokyo", "topBadges": [{"badgeGradientEndColor": "A498E0", "badgeGradientStartColor": "39216C", "ba 06603 "type": "DAILY_STEPS", "category": "DAILY_STEPS", "cheers": [{"date": "2017-09-01", "description": 06739", "encodedId": "120722", "image100px": "https://static0.fitbit.com/images/badges_new/100px/badge 06882_daily_steps20k.png", "image125px": "https://static0.fitbit.com/images/badges_new/125px/badge_d 06978_daily_steps20k.png", "image300px": "https://static0.fitbit.com/images/badges_new/300px/badge_dai 07048_daily_steps20k.png", "image60px": "https://static0.fitbit.com/images/badges_new/badge_daily_steps2 071610k.png", "image75px": "https://static0.fitbit.com/images/badges_new/75px/badge_daily_steps20k.p 07234.png", "marketingDescription": "You've walked 20,000 steps and earned the High Tops badge!", "mob 07347 "description": "When it comes to steps, it looks like you're not playing around. This achievement 07440 "event": "a slam dunk", "name": "High Tops (20,000 steps in a day)", "shareImage40px": "https:// 07633 "static0.fitbit.com/images/badges_new/300px/shareLocalized/en_US/badge_daily_steps20k.png", "s 07624 "shareText": "I took 20,000 steps and earned the High Tops badge! #Fitbit", "shortDescription": "2 077190,000 steps", "shortName": "High Tops", "timesAchieved": 1, "value": 20000}, {"badgeGradientEndColor 07812", "4C0401", "badgeGradientStartColor": "00703C", "badgeType": "LIFETIME_DISTANCE", "category": "LIF 07904 "time": "Distance", "cheers": [{"date": "2017-09-01", "description": "500 lifetime miles", "name 07998 "message": "What! You've earned the Serengeti badge!", "encodedId": "12180C", "image100px": "https 08091 "static0.fitbit.com/images/badges_new/100px/badge_lifetime_miles500.png", "image125px": "https 08184 "static0.fitbit.com/images/badges_new/125px/badge_lifetime_miles500.png", "image300px": "https 08277 "static0.fitbit.com/images/badges_new/300px/badge_lifetime_miles500.png", "image60px": "https 08370 "static0.fitbit.com/images/badges_new/badge_lifetime_miles500.png", "image75px": "https://s 08443 "static0.fitbit.com/images/badges_new/75px/badge_lifetime_miles500.png", "marketingDescription": 08584 "By reaching 500 lifetime miles, you've earned the Serengeti badge!", "marketingDescription": "Imp 08643 "resolute": "You've walked distance of the Serengeti in 2017, the 3rd National Wonders of the World 08742 "id": "1", "name": "Serengeti (500 lifetime miles)", "shareImage40px": "https://static0.fitbit.com/im 08835 "age": "badge_new/300px/shareLocalized/en_US/badge_lifetime_miles500.png", "shareText": "I covere 08928 "d 500 miles with my #Fitbit and earned the Serengeti badge.", "shortDescription": "500 miles", " 09021 "shortName": "Serengeti", "timesAchieved": 1, "unit": "MILES", "value": 500}, {"badgeGradientEndColor 09114", "B0DF2A", "badgeGradientStartColor": "00A460", "badgeType": "DAILY_FLOORS", "category": "DAILY_CIL 09207 "up": "cheers": [{"date": "2017-07-27", "description": "25 floors in a day", "encodedId": "12 09300 "message": "Congrats on earning your first Redwood Forest badge!", "encodedId": "120722", "image100px": "https 09393 "static0.fitbit.com/images/badges_new/100px/badge_daily_floors25.png", "image125px": "https:// 09486 "static0.fitbit.com/images/badges_new/125px/badge_daily_floors25.png", "image300px": "https://s 09579 "static0.fitbit.com/images/badges_new/300px/badge_daily_floors25.png", "image60px": "https://stat 09672 "ic0.fitbit.com/images/badges_new/badge_daily_floors25.png", "image75px": "https://static0.fitbit 09768 "com/images/badges_new/75px/badge_daily_floors25.png", "marketingDescription": "You've climbed 09858 "25 floors to earn the Redwood Forest badge!", "marketingDescription": "The tallest trees on Earth 09951 "can't top the heights you've been conquering.", "name": "Redwood Forest (25 floors in a day)", 10044 "shareImage40px": "https://static0.fitbit.com/images/badges_new/300px/shareLocalized/en_US/ba 10137 "dge_daily_floors25.png", "shareText": "I climbed 25 flights of stairs and earned the Redwood Fo </pre>
Challenge Invite	untitled\C\Users\cgrimes\AppData\Local\Packages\Fitbit.Fitbit_6mq6hf9g46tw\LocalState\fitbit.5ZFNHL.db	Challenge Invite to Joe G.	<pre> 0709380 :U:AppAnalysis invited Joe G.e1461aef-a392-11e7-b534-0cc47aa5176d165 0709450 89db-a392-11e7-b534-0cc47aa5176dhttps://static0.fitbit.com/content/cha 0709520 11lenge/messages/default_80.png·0·>·)·00000000-0000-0000-0000-00000000 </pre>
Challenge Results	untitled\C\Users\cgrimes\AppData\Local\Packages\Fitbit.Fitbit_6mq6hf9g46tw\LocalState\fitbit.5ZFNHL.db	Challenge Results from challenge with Joe G	<pre> 0297065 ···U· ··········U···U·That's a wrap for the Weekend Warrior!eb5c2663-9e26-11e7-8d0c-0cc 0297160 47aa53075900507125-ala6-11e7-998a-3381121b4c0https://static0.fitbit.com/content/challenge/mess 0297255 ages/default_80.png·0· ·js····00000000-0000-0000-0000-00000000000000000000-0000-0000-0000-000000 0297350 000000,2\$-m-U· ··········U···U·Joe G. beat you this time, challenge them again?eb 0297445 5c2663-9e26-11e7-8d0c-0cc47aa530759e824123c-a20a-11e7-8a04-0cc47a393dfhttps://static0.fitbit.c 0297540 om/content/challenge/messages/rematch_80.png·0·EFz·00000000-0000-0000-0000-00000000000000000000 </pre>
Badge Earned Description	untitled\C\Users\cgrimes\AppData\Local\Packages\Fitbit.Fitbit_6mq6hf9g46tw\LocalState\fitbit.5ZFNHL.db	Sneakers Badge	<pre> 0182400 STEPS 0-15A 10,000 steps in a dayCongrats on earning your first Sneakers badge!123T08https://s 0182495 tatic0.fitbit.com/images/badges_new/100px/badge_daily_steps10k.pnghttps://static0.fitbit.com/im 0182590 ages/badges_new/125px/badge_daily_steps10k.pnghttps://static0.fitbit.com/images/badges_new/300px 0182685 x/badge_daily_steps10k.pnghttps://static0.fitbit.com/images/badges_new/badge_daily_steps10k.png 0182780 https://static0.fitbit.com/images/badges_new/75px/badge_daily_steps10k.pngYou've walked 10,000 0182875 steps And earned the Sneaker badge!You stepped up your game and just reached the recommended n 0182970 umber of steps per day.Sneakers (10,000 steps in a day)https://static0.fitbit.com/images/badges 0183065 new/300px/shareLocalized/en_US/badge_daily_steps10k.pngI took 10,000 steps and earned the Snea 0183160 kers badge! #Fitbit10,000 stepsSneakers 5ZFNHL·00000000-0000-0000-0000-0000··i?·EJ5··i4· </pre>

Badge Earned Icon	untitled\C\Users\cgrimes\AppData\Local\Packages\Fitbit.Fitbit_6mqt6hf9g46tw\AC\INetCache\1CCOI6YC\badge_daily_steps10k[1].png	Sneakers Badge	
Cover Photo	untitled\C\Lost Files\2378e0cc136711f4107a45e1e2593d0d65ab50da	AA Users	
Profile Picture	untitled\C\Lost Files\ca08638ed404b8b82eb002513539931757d62f48	AA Users Current Photo (1 of 2)	

Profile Picture	untitled\C\Lost Files\c5fd7c44b1e1829574c278ebe7082642e91aa33b	AA Users past photo (2 of 2)	
Photo Shared to Feed	untitled\C\Users\cgrimes\AppData\Local\Packages\Fitbit.Fitbit_6mq6hf9g46tw\TempState\c1btxnu.3kt.png	Posted by AA User to friends via Feed	
Profile Information	untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User Data\Default\Cache\Internet\Chrome (Windows)\Cache\Code\profile.json	AA Users profile information	<pre> 1121 ", "countries": ["CN"], "salt": "UY9M1E70VQE3UAA4"}}, {"firstName 1180 ": "Courtney", "foodsLocale": "en_US", "fullName": "Courtney Gri 1239 mes", "gender": "FEMALE", "glucoseUnit": "en_US", "height": 175.2 1298 00000000000002, "heightUnit": "en_US", "languageLocale": "en_US" 1357, "lastName": "Grimes", "legalTermsAcceptRequired": false, "loca 1416 le": "en_US", "memberSince": "2017-09-20", "mfaEnabled": false, " 1475 offsetFromUTCMillis": -14400000, "sleepTracking": "Normal", "st 1534 artDayOfWeek": "SUNDAY", "strideLengthRunning": 91.7, "strideLe 1593 ngthRunningType": "default", "strideLengthWalking": 72.4, "stri 1652 deLengthWalkingType": "default", "swimUnit": "en_US", "timezone 1711 ": "America/New_York", "topBadges": [{"badgeGradientEndColor": </pre> <p>Figure 33</p>
Weight	untitled\C\Users\cgrimes\AppData\Local\Google\Chrome\User Data\Default\Cache\Internet\Chrome (Windows)\Cache\Code\profile.json	AA Users Current Weight and Goal Weight	<pre> 000 {"goal": {"goalType": "LOSE", "startDate": "2017-09-20", "startWeight": 106549 072, "weight": 104327, "weightThreshold": 50}} </pre>
Food Logged	untitled\C\Users\cgrimes\AppData\Local\Packages\Fitbit.Fitbit_6mq6hf9g46tw\LocalStat	Turkey and Cheese Sandwich	<pre> 0263610 chen_US-£·á·ÂTurkey and Cheese Sandwich{ "calcium": 0.3 0263668, "caloriesFromFat": 120.0, "cholesterol": 60.0, 0263726 "dietaryFiber": 3.0, "iron": 1.8, "protein": 35.0, 0263784 "saturatedFat": 4.5, "sodium": 1500.0, "sugars": 4 0263842 .0, "totalCarbohydrate": 52.0, "totalFat": 13.0, 0263900 "vitaminA": 1500.0, "vitaminC": 9.0 }{"sandwich": {"mul </pre>

	e\fitbit.5ZFNHL.d b		
Exercise Logged	untitled\C\Users\c grimes\AppData\L ocal\Google\Chro me\User Data\Default\Cach e\Internet\Chrome (Windows)\Cache \Code\2017-09-20 .json	3 Hour Run	<pre> 0000{"activities":[{"activityId":90009,"activityParentId 0052":90009,"activityParentName":"Run","calories":2381," 0104description":"Running - 5 mph (12 min/mile)","distan 0156ce":17.999999,"duration":10800000,"hasStartTime":tru 0208e,"isFavorite":false,"lastModified":"2017-09-20T16:5 02603:00.000Z","logId":9986519391,"name":"Run","startDat 0312e":"2017-09-20","startTime":"09:30","steps":31833}], </pre>
Steps	untitled\C\ Users\cgri mes\AppData ata\Local\ Google\Ch rome\User Data\Defa ult\Cache\I nternet\Ch rome (Windows) \Cache\Co de\2017-0 9-20.json	Steps for 9/27/17 through 10/4/17	<pre> 000{"activities-steps":[{"dateTime":"2017-09-27","value": 054"12549"},{"dateTime":"2017-09-28","value":"362"},{"dat 108eTime":"2017-09-29","value":"4095"},{"dateTime":"2017- 16209-30","value":"13095"},{"dateTime":"2017-10-01","valu 216e":"18797"},{"dateTime":"2017-10-02","value":"2921"},{ 270"dateTime":"2017-10-03","value":"302"},{"dateTime":"20 32417-10-04","value":"930"}]} </pre>