**How to Run the Simulation:**

**Purpose:**

The intention of the Wait Please program is to simulate theme park wait times for a given day. Of course the scope isn’t large enough to cover any theme park on any day; thus, the following is a composition of assumptions, facts, and chosen specifications that base the simulation.

**Park and Park Guests:**

The chosen park for the simulation was Walt Disney World’s Magic Kingdom park. The park is one of four parks at Disney World and hosted an average of 57,000 people a day in 2019 (Citation). These people are represented by black circles in the program. The intelligence of these A.I. are at a level that does not allow 57,000 of these objects. If 57,000 objects were to be used, the program would certainly crash. Thus, each of the black circles represent a group of people instead. For simplicity purposes, I will refer to the “black circles” as subjects. The subjects spawn into the program in clusters of 560. There are 3 spawns that occur (1 initial and 2 additional) within 25 seconds of each other, summing to 1680 subjects. Based on our average number of guests in the park a day, each subject would represent 34 people. However, a specification was to only implement 13 out of the 23 rides in Magic Kingdom. Thus we will reduce the capacity of the park by a fraction equal to the fraction of rides. To reduce calculations, the subject’s cardinality will be directly reduced to 19 people per group. One more assumption will reduce this number: The number of people actively pursuing a ride at any given time during the day is equal to 70 percent of the total number of people in the park. Thus the cardinality can be reduced to 13 people. 13 people per subject is the final cardinality.

Magic Kingdom hosts 57,000 people a day on average

<https://blogmickey.com/disney-world-theme-park-capacity/>

560 groups of people per set

1 initial set and 2 more sets = 3 sets of 560 groups of people

Total of 1680 groups of people

57,000 / 1680 = about 34 people in each group normally

34 people in each group \* 13/23 = about 19 people per group

19 people per group \* 0.70 = 13 people in each group (final)

**Guest Behavior:**

The subjects, when spawned, determine their destination and then move left, right, up, or down until they reach the entrance point of their destination (marked by a red square). The arriving guest is then added to the ride’s line queue. The subjects in the line queue are popped from the queue and added to the “ride” (another queue) in the order in which they enter the line, one at a time. The subjects in the ride are then each released one at a time in the same way they were released from the line queue. This time they are released back into the park. The cycle then repeats with the subjects finding a new destination.

**Guest Characteristics:**

1. Age Group: Each subject can be in one of the following age groups:
2. Child
3. Young Adult
4. Adult
5. Destination: This is the attraction that the subject is headed to
6. Rides Ridden: This is a list of all of the attractions the subject has ridden. The list is wiped clean once the subject has ridden all of the rides available.
7. Tracker: Every subject is either being tracked or not being tracked. Only one guest can be tracked at a time.

**Destination Determination:**

The subject determines their destination by gauging all of their options and then determining which destination is best. This is determined by contrasting a score called “exhaust” which indicates how good or bad the destination is. The higher the exhaust, the worse the option is for the subject. Therefore, the subject sets their next location as the one with the least exhaust.

**Exhaust Algorithm:**

The amount of exhaust for any attraction relative to the subject in question during determination is . . .

**EXHAUST =** The total wait time of the attraction

* The distance the subject has to travel / 50
* The priority count of the attraction \* 1.5

The Exhaust is then altered if either of the following conditions are met . . .

1. If the attraction’s targeted age group is the same as the age group of the subject, the Exhaust is reduced by 15 points.
2. If the subject has already ridden the ride, the Exhaust for that ride is increased by 50 points.

**Attraction Characteristics:**

1. Name: The rides official name
2. Out Flow Time: The amount of time it takes to load one subject into the “ride” from the line queue + the amount of time it takes to remove one subject from the “ride.”
3. Experience Time: The time it takes for a subject to “experience” the attraction. In other words, it is the amount of time the subject must be on the “ride” (reminder: a queue) before being allowed to be released.
4. Target Audience: The attraction’s targeted age group. One of three options . . .
5. Child
6. Young Adult
7. Adult
8. Wait Time: The amount of estimated time that a subject not yet in line would have to wait to get on the ride.
9. Line Queue: The queue to hold the subjects waiting in the attraction’s line that are not yet on the ride.
10. Ride Queue: The queue to hold the subjects on the ride. A subject is released from the ride queue once they have been in the queue an amount of time equal to the experience time. (Disclaimer: The subject is not released immediately when this time has passed. They then must wait to be released from the ride. Again, this is done one by one at a certain rate)
11. Priority: This is a number assigned to the attraction that determines the assumed biased priority of each ride based on the ride’s popularity in the park. (That is, the popularity of the ride in real life). The assigned numbers are multiples of 5. The higher that the number is, the more popular the ride is assumed to be. Here are the possible priorities:

0, 5, 10, 15, 20.

1. Entrance Point: This is the location on the map that a subject must reach to be admitted into the line queue.
2. Exit Point: This is the location on the map where the subject is released to, from the ride queue.
3. Early Exit Point: This is the location on the map where the subject is released to when the attraction is closed. A subject will also be released to this location if they are in the line queue and determine that there is a better attraction than the one they are waiting for.

**Early Exit Elaboration and Ride Closures:**

Early exits occur for two reasons. The first reason early exits occur is because the ride is closed. When a user closes a ride, all subjects in the line queue for that ride and in the ride queue for that ride are released into the map via the early exit location. This happens one by one until all subjects are evacuated. While subjects are waiting in the line queue, they are constantly evaluating their attraction options, determining which attraction has the least exhaust. If any attraction's exhaust is 15 less than the exhaust of the attraction they are currently waiting for, they will change course and go to that new attraction. This is done via the early exit point and is the second reason for the early exit points’ use.

**Guest Move Speed:**

The speed in which subjects move is much much greater than it would be in reality. This is because the movement doesn’t necessarily only represent the subjects’ physical movement to and from attractions, it also represents the decision making of the subject. A subject may run all the way to the opposite side of the park because they have determined an attraction with less Exhaust. In reality, a person moving from one side of the park to the other would, typically, not be worth it. Since decision making is often a quick process, the subject's speed has been increased.

For this reason, you may see subjects moving to attractions, early exiting, and then moving again quite often. This represents the subject evaluating their options and then making a new based decision. The subject (despite how often they change their mind) will eventually find an attraction and stick with it.

**Outflow Time Algorithm:** The outflow time algorithm is the most important algorithm in the entire program. The out flow time is the amount of time it takes a subject to load into the ride from the line plus the time to be released from the ride. This is calculated like so . . .

(Hourly Capacities) The Park Database <https://www.theparkdb.com/results/in/name/61/view_details>

Given each attraction's capacity per hour, the amount of seconds it takes to load a single person on the ride is calculated like so: 60 / (Hourly Capacity / 60)

Then this new value, guest loading time, is multiplied by the number of guests each subject represents (13), resulting in the outflow time.

Therefore, the time it takes to process 13 people through a ride is relative to the attraction’s actual capacity.

**Wait Time Algorithm:**

The wait time algorithm is heavily based on the outlow time. In reality, the time a subject must wait until they are on the ride should be equal to the outflow time multiplied by the number of subjects in line; however, to keep the flow of simulation, only one individual can get off the ride at a time. Thus, there is a waiting time to get off of the ride. To ensure that the wait time is still accurate, the outflow time is split and used twice. Once, the split outflow time is the amount of time an individual is taken from the line queue and put in the ride queue. Once, the split outflow time is the amount of time an individual is taken from the ride queue and put back in the map. Thus (excluding the time the individual takes actually riding the ride) it takes the amount of time equal to outflow time to process one subject through the attraction.

Therefore, the wait time algorithm is calculated like so . . .

[(outflow time / 2) \* # of people in line] + [(outflow time / 2) \* # of people on the ride]

Which is a simulated equivalent of [outflow time \* # of people in line]

The wait time is then rounded up to the closest multiple of 5 to be in accordance with the wait times at Magic Kingdom (which are done in multiples of 5).

**Statistics Menu:**

On the right hand side of the screen, there exists a JList (Top Corner). This JList includes certain statistics for each ride. In each line there exists four pieces of information:

1. Ride Name
2. Wait Time
3. # of Subjects in Line
4. # of Subjects on Ride

**Ride Closures:**

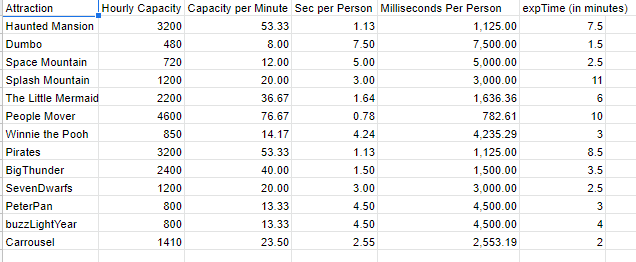
A separate JFrame opens upon running the program that allows the user to toggle rides closing and opening. If a ride is closed, new subjects cannot enter the line and subjects that are in line or on the ride are released to the map. See (**Early Exit Elaboration and Ride Closures)**

**Guest Tracker:**

Below the statistics menu is the tracker output. The output records the tracked user’s actions throughout the simulation. Upon starting the program, one subject is hard-coded to be tracked; however, the tracked subject can be changed by clicking on a different subject one wants to track. This is easily done by first pausing the simulation (see **Pausing Time**). When a new subject is selected to be tracked, the tracker output is cleared and restarts with the selected subject's next action after selection. The following are the various messages and their meanings:

* “Subject Experienced (Ride Name)” - The subject waited in line, was put on the ride and was released to the map after riding the ride.
* “Subject Evacuated (Ride Name)” - The subject was on the ride and then was released to the early exit point before the ride timer was finished
* “Subject Exited the Line for (Ride Name)” - The subject was in line for the ride and was released to the early exit point before boarding the ride.
* “Subject was loaded onto (Ride Name)” - The subject was released from the line queue and entered the ride queue.
* “The Subject Began waiting in Line for (Ride Name)” - The subject entered the entrance point from the map and was added to the ride’s line queue.

**Chosen Attractions and Statistics:**

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**Time Relation:**

Of course, the simulation is relative to time; however, it is also in real time. As explained before (see Guest Move Speed) subject movement is the only exception. Since the simulation is in real time, it would be very time consuming if one wanted to compare results from full day simulations. Thus, there is a way to skip time (see **Time Skip Function**).

**Pausing Time:**

The active time can be paused via the pause button. Subject’s will remain where they are during this time and will not advance within a ride if in the ride queue.

“Advance within a ride” - When the subject is in the ride queue, the subject has a timer that increases until it matches the experience time of the attraction; then, the subject can be released from the ride.

The active time can be resumed by pressing the pause button as well.

**Time Skip Function:**

In the right menu there is a button “Skip an Hour.” This button will simultaneously simulate the passing of an hour of time. The functions of the program are each set on their own timer. Each timer is set to different time intervals. When the interval is passed, the function is executed; then the timer restarts. Thus the skip an hour function works like so:

A counter counts until it reaches the number of milliseconds in an hour \* 2. Then each function is set to a modulo equal to zero. Thus when the counter hits a certain multiple (assigned to a function), that function executes. A functions multiple is equal to 2 \* the number of milliseconds it takes to repeat the function normally with the timers. Everything is multiplied by 2 to give the function more time to process. This limits concurrent modification errors.

**Label Configuration:**

Below the time skip function, there is a button to toggle turning the labels on and off. This may be helpful to view loadings and releases from the attractions since the labels conceal the exit/entrance points.

**Report Generator:**

At the end of the simulation, the user can enter a file location into the text field in the top center of the screen. Then, by pressing the print report button next to said text field, a report of the wait times for each attraction at each hour mark will be created to the written file location. Here is an example of this:

