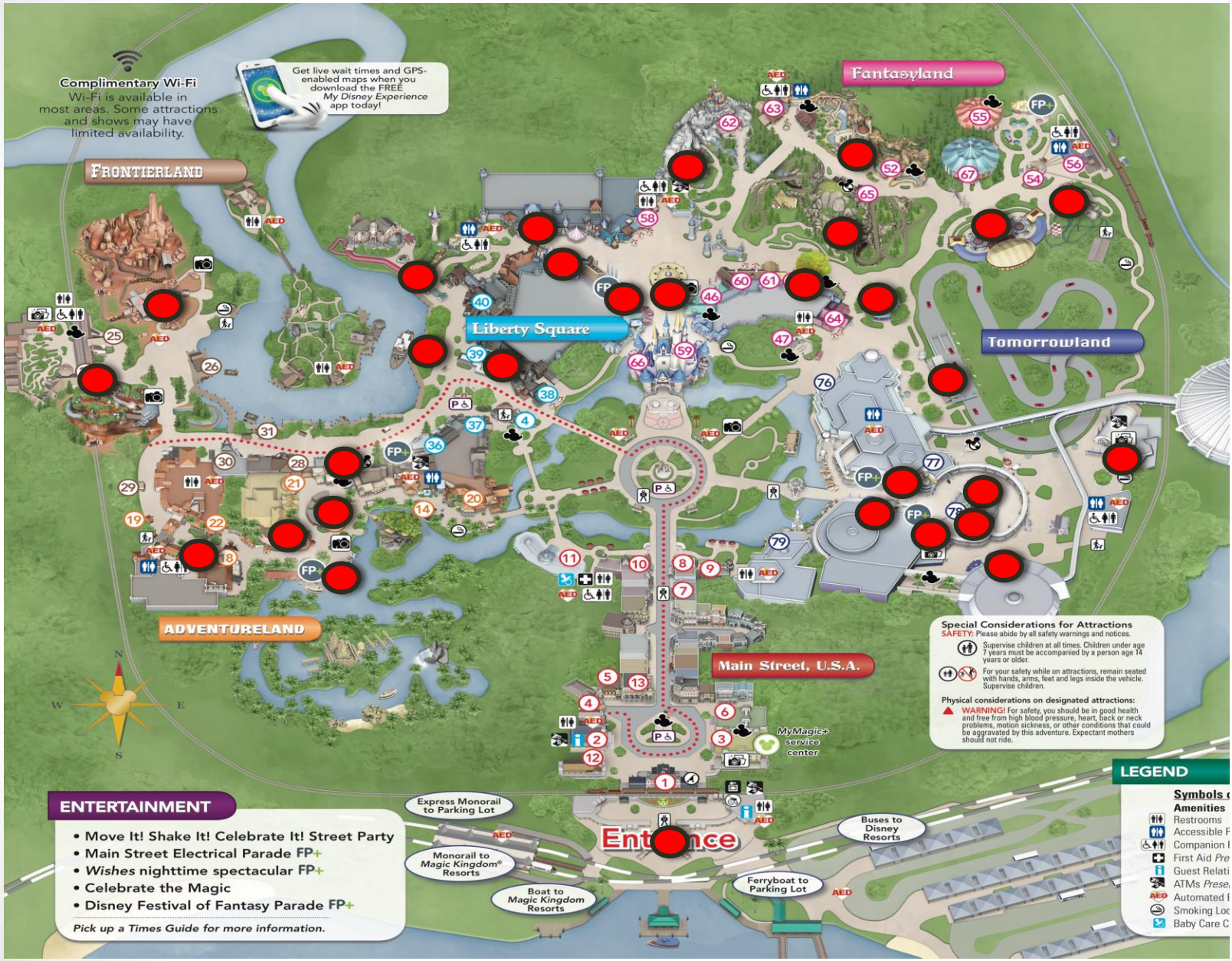


# Touring Disney – Faster, Faster!

The growth of the TDTSP algorithm and code  
Jordan Brown, Kate Causey, Danny Rivers

**Complimentary Wi-Fi**  
Wi-Fi is available in most areas. Some attractions and shows may have limited availability.

Get live wait times and GPS-enabled maps when you download the FREE My Disney Experience app today!



**ENTERTAINMENT**

- Move It! Shake It! Celebrate It! Street Party
- Main Street Electrical Parade FP+
- Wishes nighttime spectacular FP+
- Celebrate the Magic
- Disney Festival of Fantasy Parade FP+

Pick up a Times Guide for more information.

**Special Considerations for Attractions**  
**SAFETY:** Please abide by all safety warnings and notices.  
 (⚠) Supervise children at all times. Children under age 7 years must be accompanied by a person age 14 years or older.  
 (⚠) For your safety while on attractions, remain seated with hands, arms, feet and legs inside the vehicle. Supervise children.  
**Physical considerations on designated attractions:**  
 ⚠ **WARNING!** For safety, you should be in good health and free from high blood pressure, heart, back or neck problems, motion sickness, or other conditions that could be aggravated by this adventure. Expectant mothers should not ride.

**LEGEND**

- Symbols & Amenities**
- Restrooms
  - Accessible F
  - Companion I
  - First Aid Pre
  - Guest Relati
  - ATMs/Prese
  - Automated I
  - Smoking Loc
  - Baby Care C

# Optimality

- Estimated Bitcoin hash rate =  $10^{19}$  operations a second
- $20!$  =  $2.4 * 10^{18}$ , less than a second
- $21!$  : one second
- $22!$  : less than 2 minutes
- $23!$  : 43 minutes
- $24!$  : 17 hours
- $25!$  : 17 days
- $26!$  : 460 days
  
- $29!$  : 28018 years

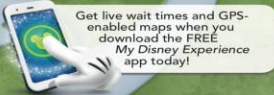
Ok, time to go home

# How to make a good guess

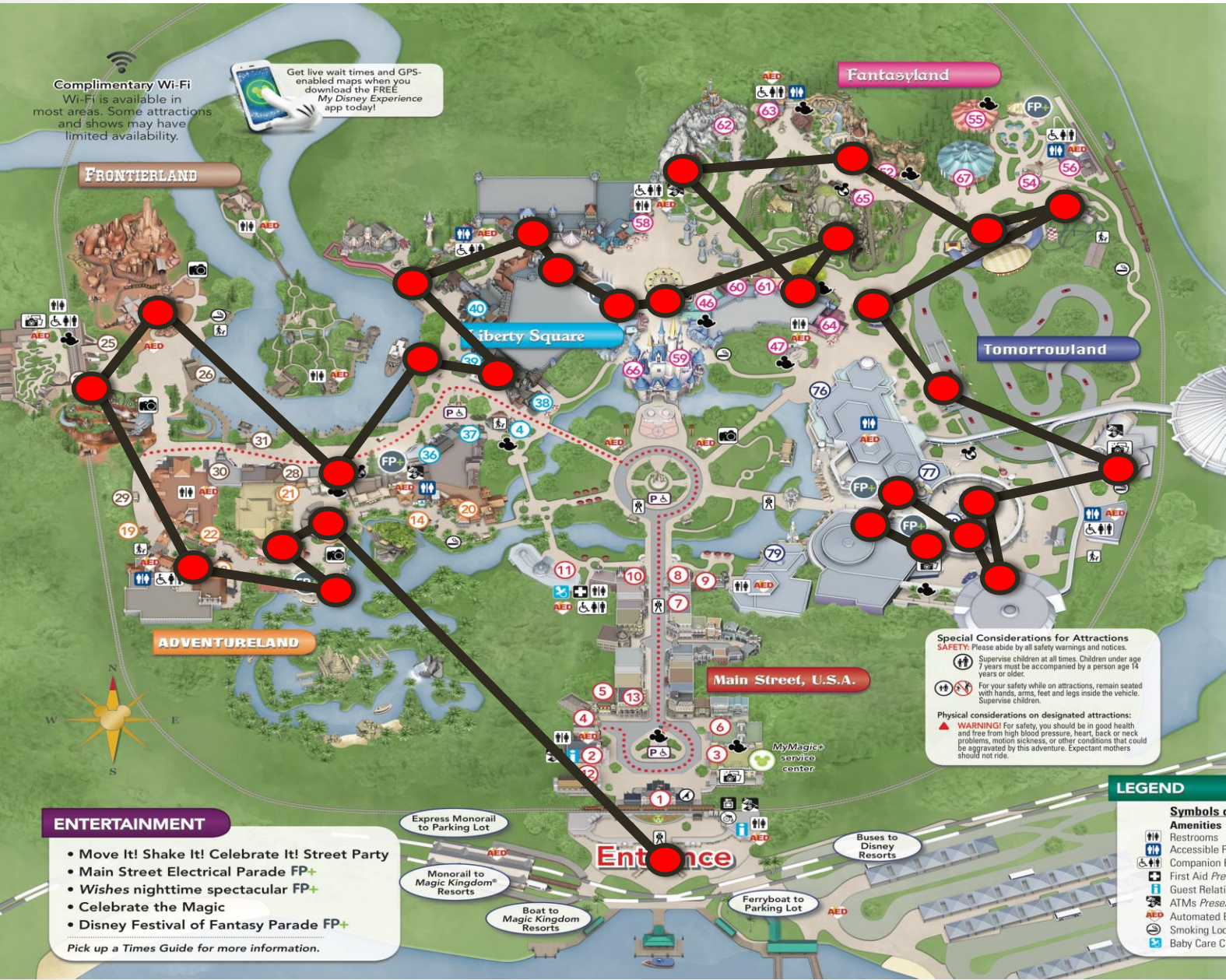
- Genetic algorithm
- Initialize a 'population' of tours
- For some number of generations:
  - Pick one or two 'parent' tours
  - Pick an operation and use it to make a 'child' tour
  - If the child tour is fit enough, it gets included in the population and bumps another tour out
- Output the best tour



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# But wait...

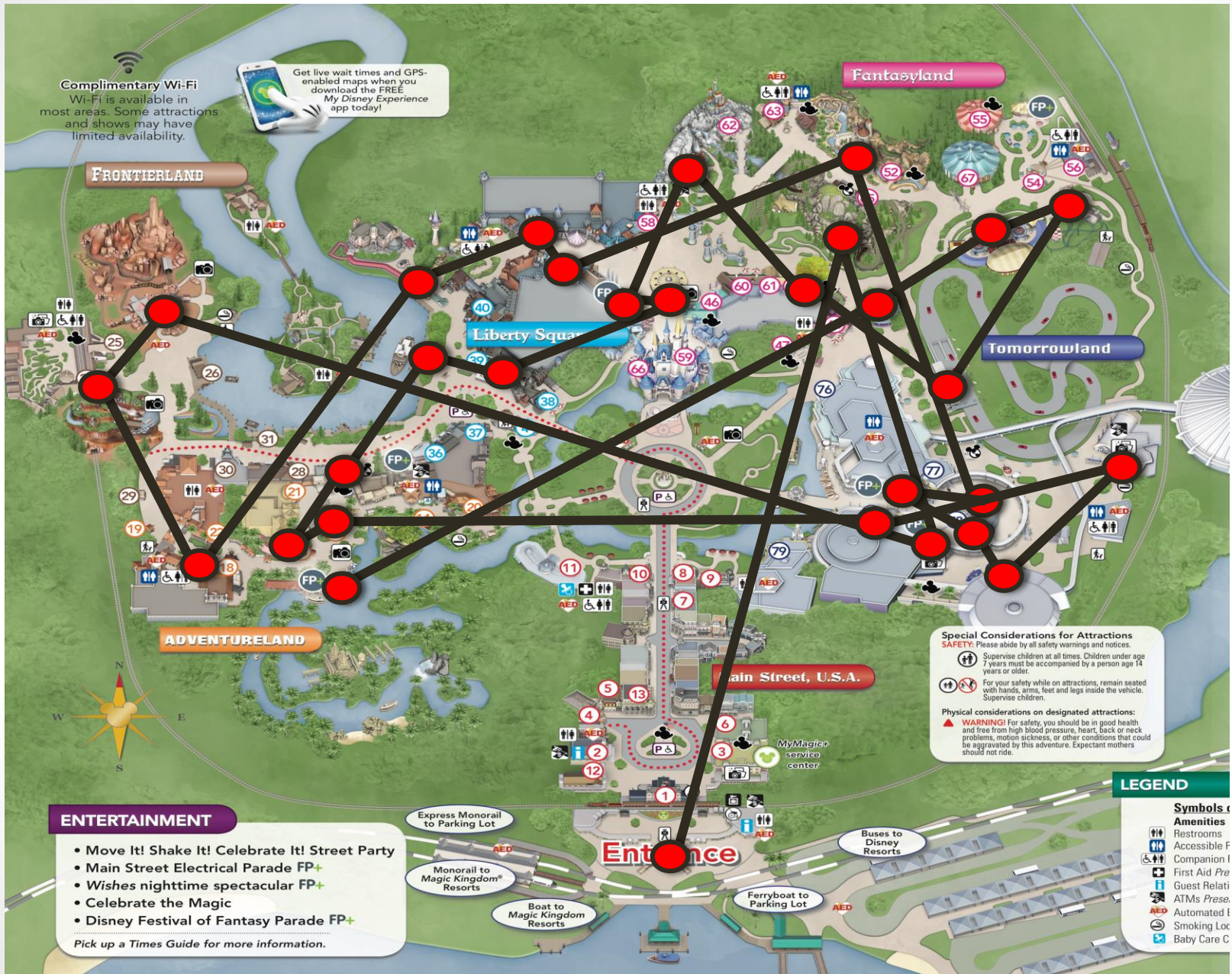
- TD = Time Dependent
- TDTSP
- Takes more computation to determine fitness
- Using time dependency we can find tours that see everything in Magic Kingdom in one day\*

\* With Extra Magic Hours



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**FRONTIERLAND**

**Fantasyland**

**Tomorrowland**

**ADVENTURELAND**

**Liberty Square**

**Main Street, U.S.A.**

**Entrance**

**ENTERTAINMENT**

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Express Monorail to Parking Lot

Monorail to Magic Kingdom® Resorts

Boat to Magic Kingdom Resorts

Buses to Disney Resorts

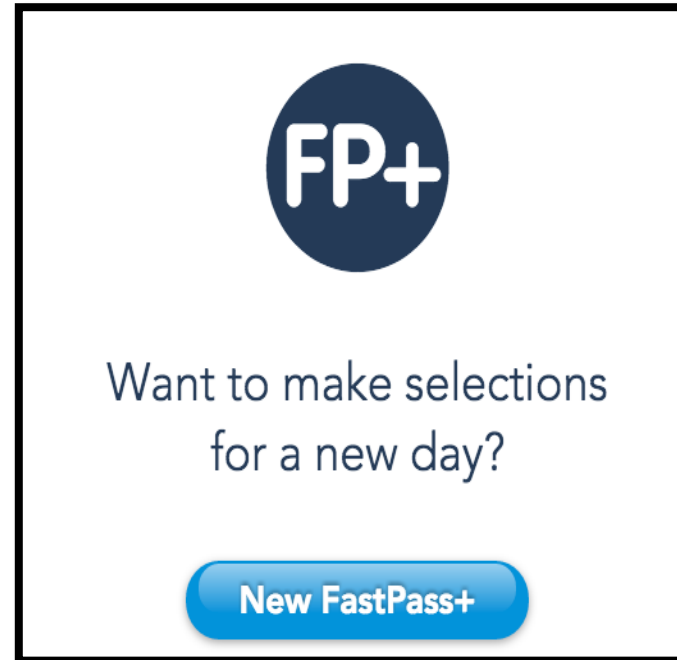
Ferryboat to Parking Lot

MyMagic+ service center



# But wait... (2)

- FastPasses
  - At most three attractions
  - Same park
  - Tiers (Epcot and HS)
  - No overlap
- User friendly

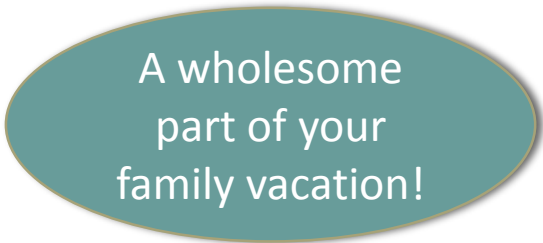




**TDTSPWTW**



Now with Time  
Windows!



A wholesome  
part of your  
family vacation!

# Cases

- I've already selected my FastPasses!
- Disney is offering me some sets of FastPasses.
- I want FastPasses for these rides!
- What's a FastPass?



# I've already picked FastPasses!

- Population-wide FastPasses
  - Change the wait times for all tours in the population
  - Over time, the tours that fit the FastPasses (and are faster) become more common


# Changes


- OneShift
  - 'Shifts' the parent's rides repeatedly
  - Tries to fit all rides with FastPasses into their allotted time slots
  - Problem is as hard as the TSP
  - Can only make a child if it is successful
  - Depth : 4
  - success Rate : 80%
- Not that useful

# Disney gave me four options for FastPasses!

- Population-wide FastPass groups
  - New tours are forced to have one of the population's groups
  - May the best group win!




### Choose One of These 4 Options

 FastPass+ Party  
Elizabeth

 Magic Kingdom Park  
Tuesday, April 12, 2016

Option 1 - Best!    Option 2    **Option 3**    Option 4

This option provides popular selections, based on availability.

	<b>Space Mountain</b> Tomorrowland Height: 44in (112cm) or taller <a href="#">Accessibility and Other Information</a> <a href="#">Show Details</a>	Arrive Between 1:25 PM and 2:25 PM	1
	<b>Dumbo the Flying Elephant</b> Fantasyland Height: Any Height <a href="#">Accessibility and Other Information</a> <a href="#">Show Details</a>	Arrive Between 2:55 PM and 3:55 PM	2
	<b>"it's a small world"</b> Fantasyland Height: Any Height <a href="#">Accessibility and Other Information</a> <a href="#">Show Details</a>	Arrive Between 4:25 PM and 5:25 PM	3



# Changes

- Initialization stage of populations
  - Give each new tour a random group
- RandomFastPassGroup
  - Make a child tour with the same list of rides as the parent tour
  - Pick a random fast pass group and give it to the child tour

# I want FastPasses for these rides, but I don't care when

- Move FastPasses around
  - Start with population-wide FastPasses
  - Let them change times
- Fake rides that are given all day FastPasses
  - Mimic a real ride, and can replace them
  - Specified when you start a new population of tours

# Changes

- MatchFastPassesToRides
  - Similar to OneShift
  - Shift FastPass times rather than arrival times
- 'Fake' nodes always get FastPass wait times
  - Doubles the number of rides you 'could' see



# Disney has FastPasses?!?

- Let the algorithm pick FastPasses for you
- New operations that change a tours FastPasses
- FastPass constraints
  - Three per tour (including all-day-fast-pass rides)
  - No overlapping times
  - Tiers in some parks (Epcot and Hollywood Studios)
  - These may still give invalid FastPasses

# Changes

- New Operations:
  - addFastPassWorstContrarian
  - addFastPassWorstWait
  - MatchFastPassesToRides
  - randomFastPassRideChange
  - randomFastPassTimeChange
  - AverageFastPassesCross
  - DuplicateFastPassesCross

# Other improvements

- New Operations:
  - Initialize Interval
  - Super LKTD
- Partial tours and duplicated rides
  - Issues in some old operators
  - PathRelink, Cycle Cross
- Bug Fixes
  - Edge Recombination
  - Merge Cross?

# How can *I* find a good tour?

- I VERY SERIOUSLY recommend looking at [touringPlans.com](http://touringPlans.com); we get our data from them
- They also have cool things like a crowd calendar, and they can help find the cheapest ticket package
- Take the Disney MayX, you'll get to use this application!

Demo

# I don't want to download anything, just tell me tips

- If you think a ride will have a big wait time, see it either in the first hour or two of the day, or between 2:45 and 3:45.
  - Unless it is a new ride that was just built, in which case you **MUST** see it in the morning to have a reasonable wait time.
- Don't see Peter Pan in the afternoon. Just don't.
- If you want to finish as fast as possible, don't be afraid to walk across the park more than once. 20 min of walking can often save 30 min of waiting.
- Pick some big rides to see early in the day, and don't waste a FastPass on them that early.
- Good choices for FastPasses in MK:
  - Seven Dwarfs, Peter Pan, Space Mountain, Winnie The Pooh



# Acknowledgements

- Professors:
  - Liz Bouzarth
  - Kevin Hutson
- Other:
  - Len Testa, President of TouringPlans.com, coauthor of *The Unofficial Guide to Walt Disney World*
  - Rahul Isaac