Bus-Fly-Go

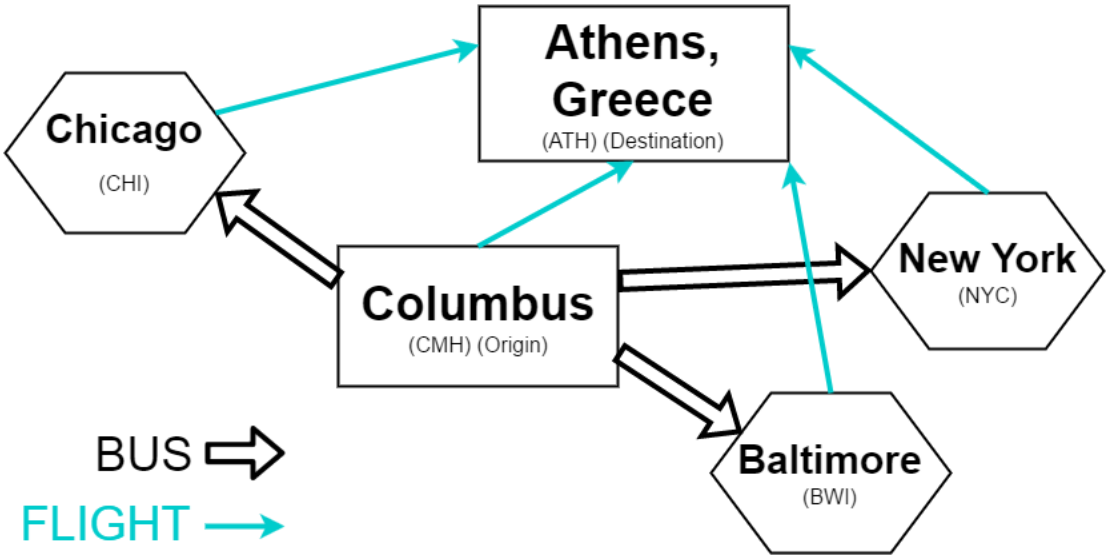
Kyle Justice | KyleJustice.us

What is *Bus-Fly-Go*?

Bus-Fly-Go is a budget travel application that pairs up bus tickets from regional cities, with air tickets originating from large cities.

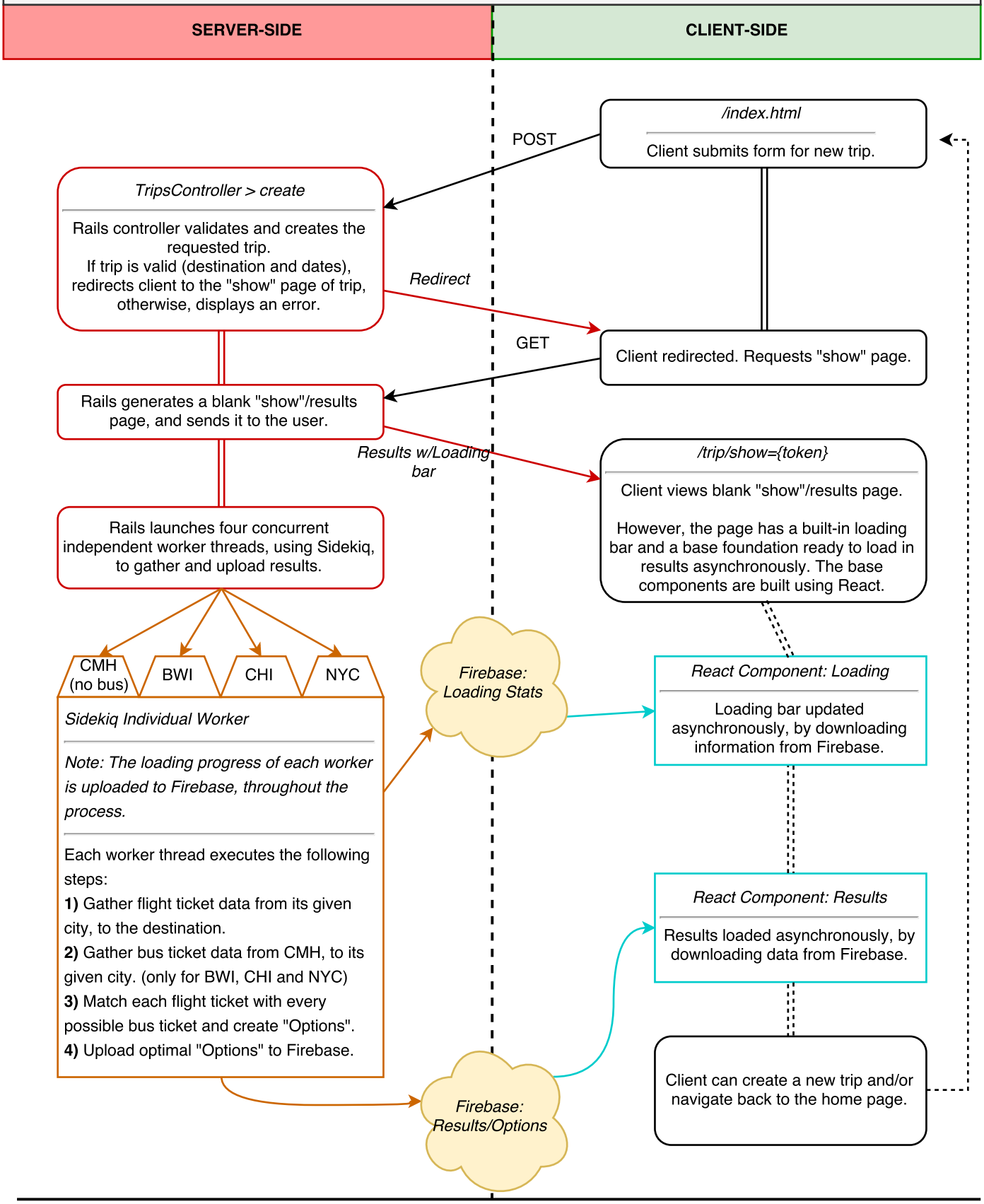
Example: You want to travel from Columbus, Ohio to Athens, Greece

- *Bus-Fly-Go* finds/returns…
  - direct flights between Columbus, Ohio ⇔ Athens, Greece
  - bus/flight pairings between Columbus ⇔ Baltimore ⇔ Athens, Greece
  - bus/flight pairings between Columbus ⇔ Chicago ⇔ Athens, Greece
  - bus/flight pairings between Columbus ⇔ New York ⇔ Athens, Greece



Web application framework: Ruby on Rails
Backend gems/technologies: PhantomJS, Sidekiq + Redis, SQLite
Cloud data storage: Firebase
Frontend libraries/technologies: HTML + CSS, jQuery, Bootstrap, React

Bus-Fly-Go High-Level Overview



COLOR KEY **TECHNOLOGY**

- Rails
- Sidekiq
- React
- HTML/JS
- Firebase

Authored by Kyle Justice | KyleJustice.us
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Bus-Fly-Go: Option Selection

Kyle Justice | KyleJustice.us

Option Definition

Option: Means one of two things:

1. Direct flight ticket
2. Bus ticket paired up with a flight ticket

Option Total Duration: Total time between leaving Columbus and arriving at the destination

Option Total Price: Total cost of the flight ticket and the bus ticket(s)

Option Selection Motivation

On average, **1,830 Options** are generated from each of the four cities.
On average, **0.46 seconds** are required to upload one Option to the user.
If we upload every Option, on average we would need about **14 minutes** per city!

Solution: Pareto Frontier

- Using Pareto efficiency, we can obtain the Pareto Frontier of Options.
- This frontier contains a simple representation of all of the Options, including *only* the optimal Options.

Visualize the Pareto Frontier

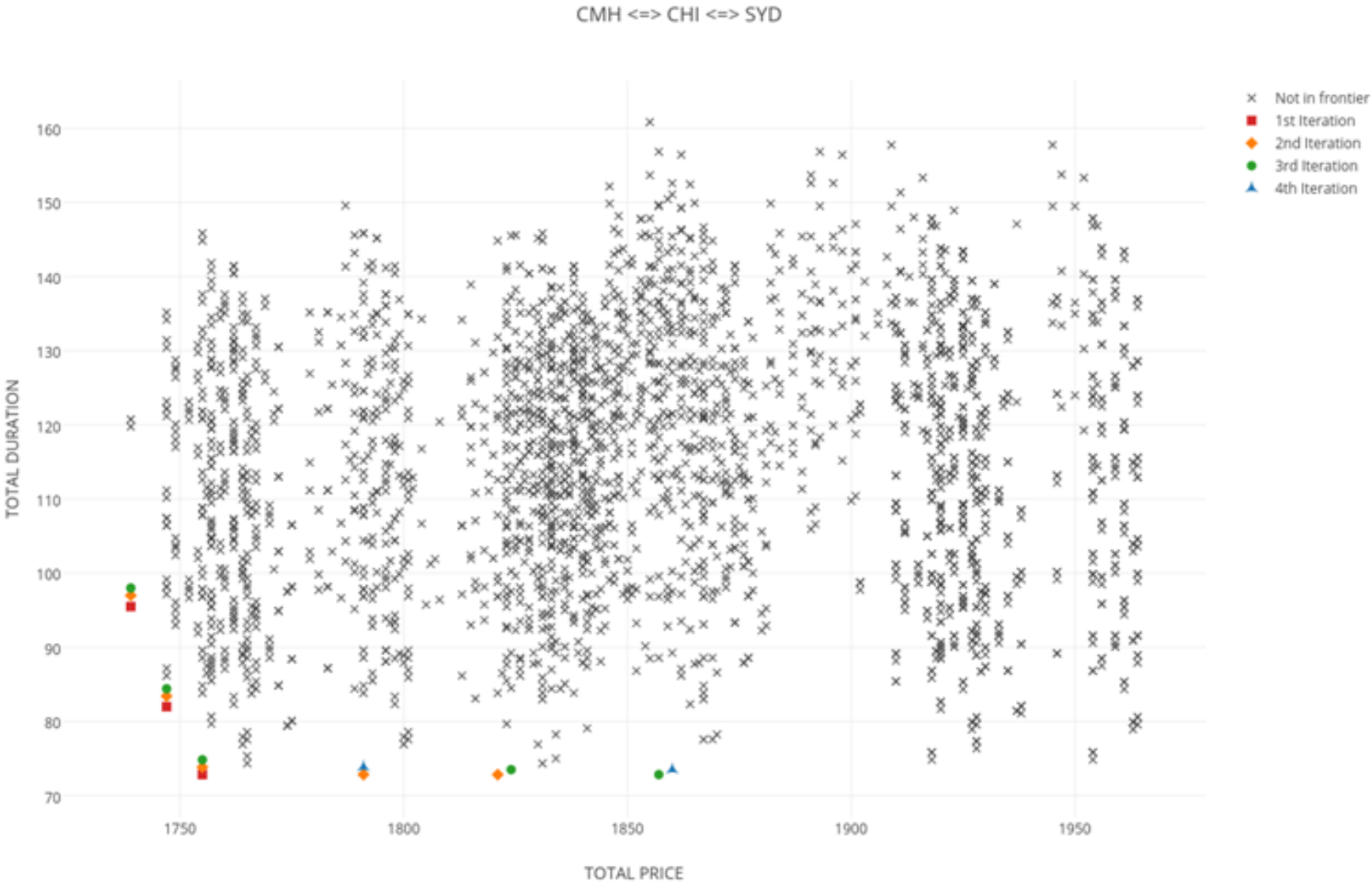
- Build a two-dimensional x-y coordinate graph
- Each point on the graph represents one Option
- The x-axis represents the Total Price of an Option
- The y-axis represents the Total Duration of an Option
- Utopia [most optimal] point is at (0, 0)

Example (right)

- Green points represent Options in the Pareto Frontier
- Red points represent Options not in the Pareto Frontier

Basic Pareto Frontier Pseudocode

1. Sort Options by lowest Total Price first; if price is same, sort by lowest Total Duration first
2. Let i = 1
3. Add Option[i] to the Pareto Frontier
4. Find smallest k > i, such that Option[k].duration < Option[i].duration
5. If k exists, set i=k and repeat step #3.
   If k doesn't exist, stop.


CMH <=> CHI <=> SYD
Not in frontier
1st Iteration
2nd Iteration
3rd Iteration
4th Iteration
TOTAL DURATION
160
150
140
130
120
110
100
90
80
70
1750
1800
1850
1900
1950
TOTAL PRICE

Bus-Fly-Go: Option Comparison

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Methods of sorting/comparing Options

1. Sort by "Total Price" - trivial implementation
2. Sort by "Total Duration" - trivial implementation
3. Sort by "Most Recommended" - **non-trivial implementation**

"Most Recommended" Comparator

Non-trivial situation given two Options, Option A and Option B:

- Option A has a lower total price, but a higher total duration than Option B
- Option B has a lower total duration, but a higher total price than Option A
- How do we know which Option is *better*?

Calculate the hourly rate you would be paying yourself!

Option ID	Total Price	Total Duration
A	$900	75 hours
B	$1,225	50 hours

Rate = ($1,225 - $900) / (75 - 50 hours) = $13/hour

Set some *MinWage* variable to represent the minimum amount the user will pay themselve per hour. (*MinWage* by default is set to equal Ohio's minimum wage of $8.10)

If *Rate* is higher than the *MinWage*, we prefer the Option with the lower total price.
If *Rate* is lower than the *MinWage*, we prefer the Option with the lower total duration.

Thus, in our example, we would prefer Option A over Option B.

"Most Recommended" Comparator Statistics

***MinWage* = $8.10:** Only 46% of top-5 slots favored taking a bus over flying straight from Columbus.
***MinWage* = $12.00:** Only 16% of top-5 slots favored taking a bus over flying straight from Columbus.
***MinWage* = $15.00:** None of the top-5 slots favored taking a bus over flying straight from Columbus.

Unfortunately, more often than not it is more favorable to simply fly from Columbus directly.