

The logo for 'busyroute' features the word in a lowercase, rounded sans-serif font. The letters are white with a light blue horizontal band across the middle. A dotted blue line arches over the 'b' and 'u', and another dotted blue line arches under the 'r' and 'o'. A solid blue downward-pointing arrow is positioned within the 'o'.

A SIMPLE ROUTING APP FOR BUSY PEOPLE

WHAT are the motivations?



TECHNOLOGY CONNECTS PEOPLE TO PLACES THEY NEVER KNEW EXISTED

WHAT are the motivations?

PEOPLE have
LIMITED TIME

WHAT are the motivations?

→ Citymapper

Google maps



FAIL AT FINDING
TIME-OPTIMAL
ROUTES

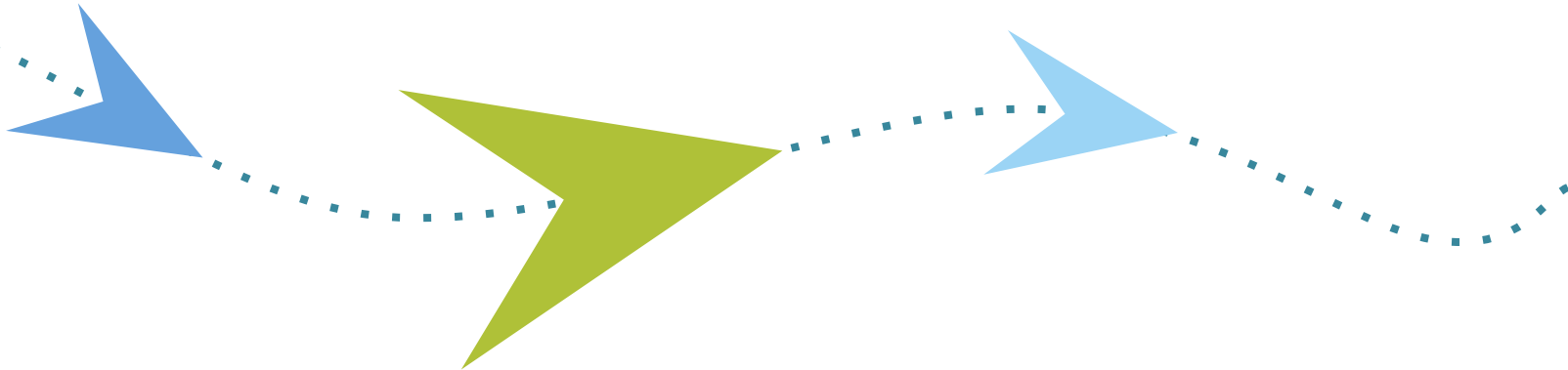
AS SOON AS THE NUMBER
OF PLACES TO VISIT GROWS

busyroute



WHAT is busyroute?

ROUTING APPLICATION



WHAT is busyroute?

“ Tell me
WHAT you
want to do ”

“ I’ll tell you
WHERE to
do it ”

WHAT is busyroute?



THE KEY QUESTIONS ABOUT OUR PROJECT

HOW

can you use it?

THE KEY QUESTIONS ABOUT OUR PROJECT

HOW

can you use it?

HOW

did we implement it?

THE KEY QUESTIONS ABOUT OUR PROJECT

HOW

can you use it?

HOW

did we implement it?

WHAT

is the future of busyroute?

HOW

can you use it?

HOW can you use it?

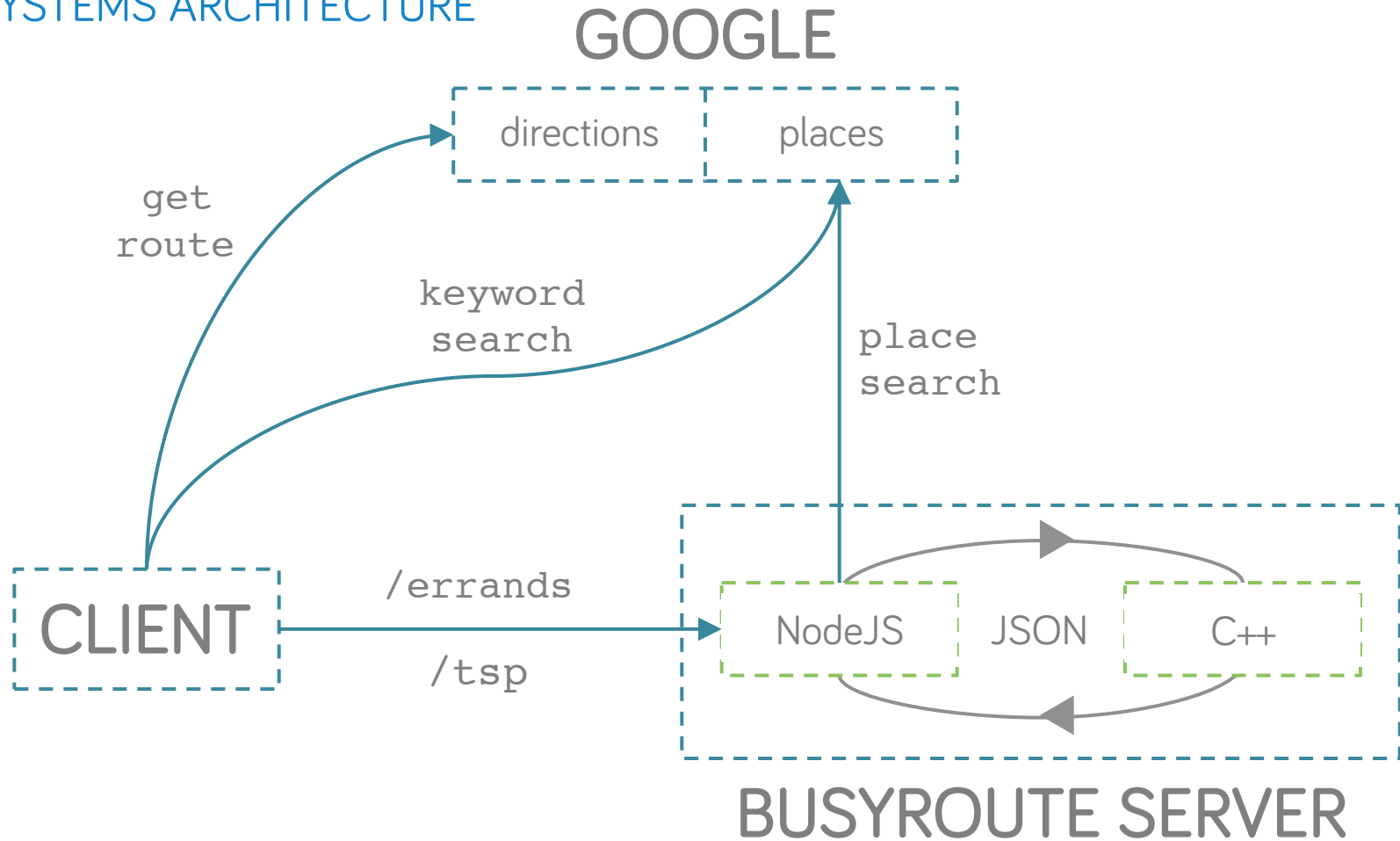
“A demo is worth
a thousand words”

HOW

did we implement it?

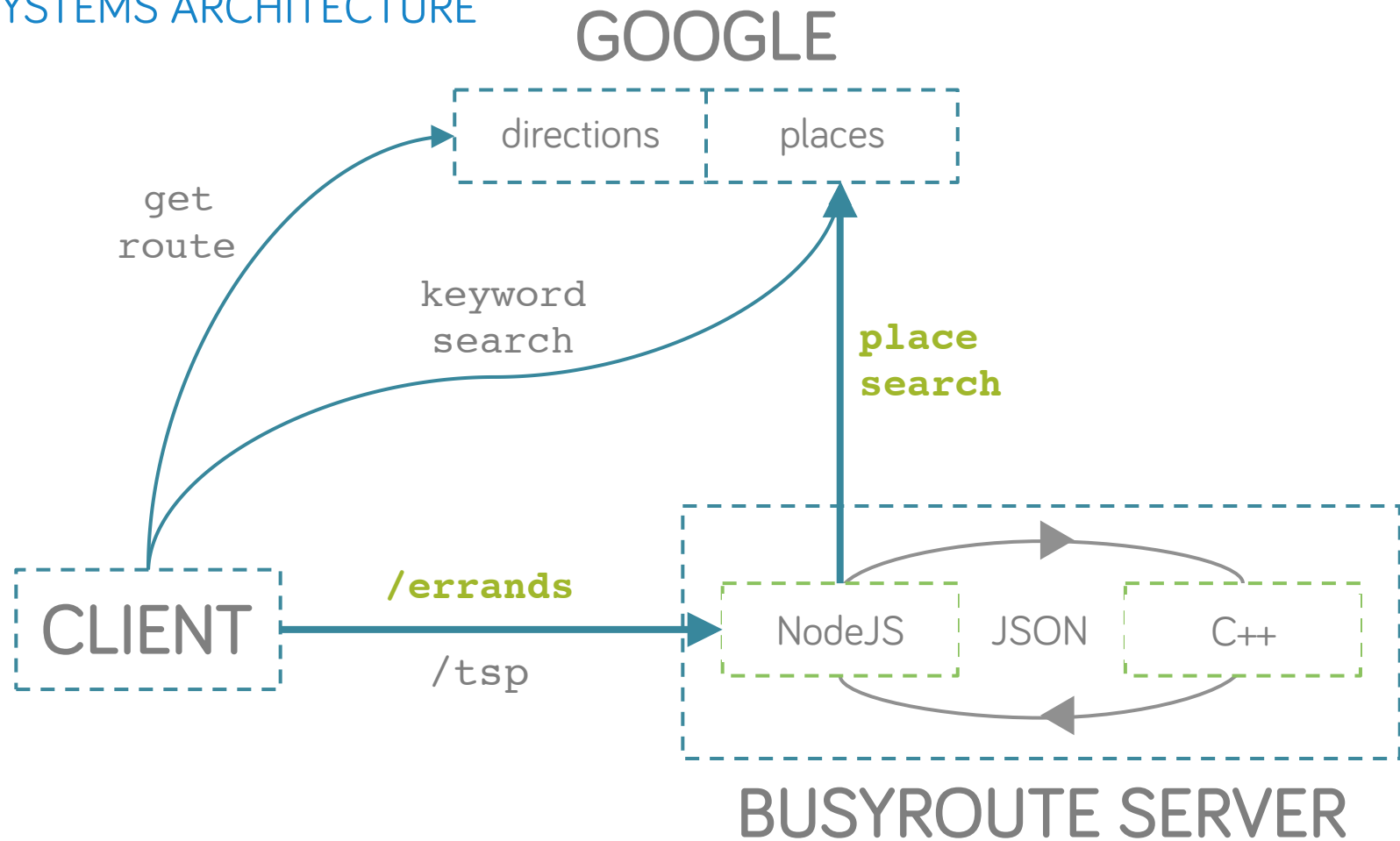
HOW did we implement it?

SYSTEMS ARCHITECTURE



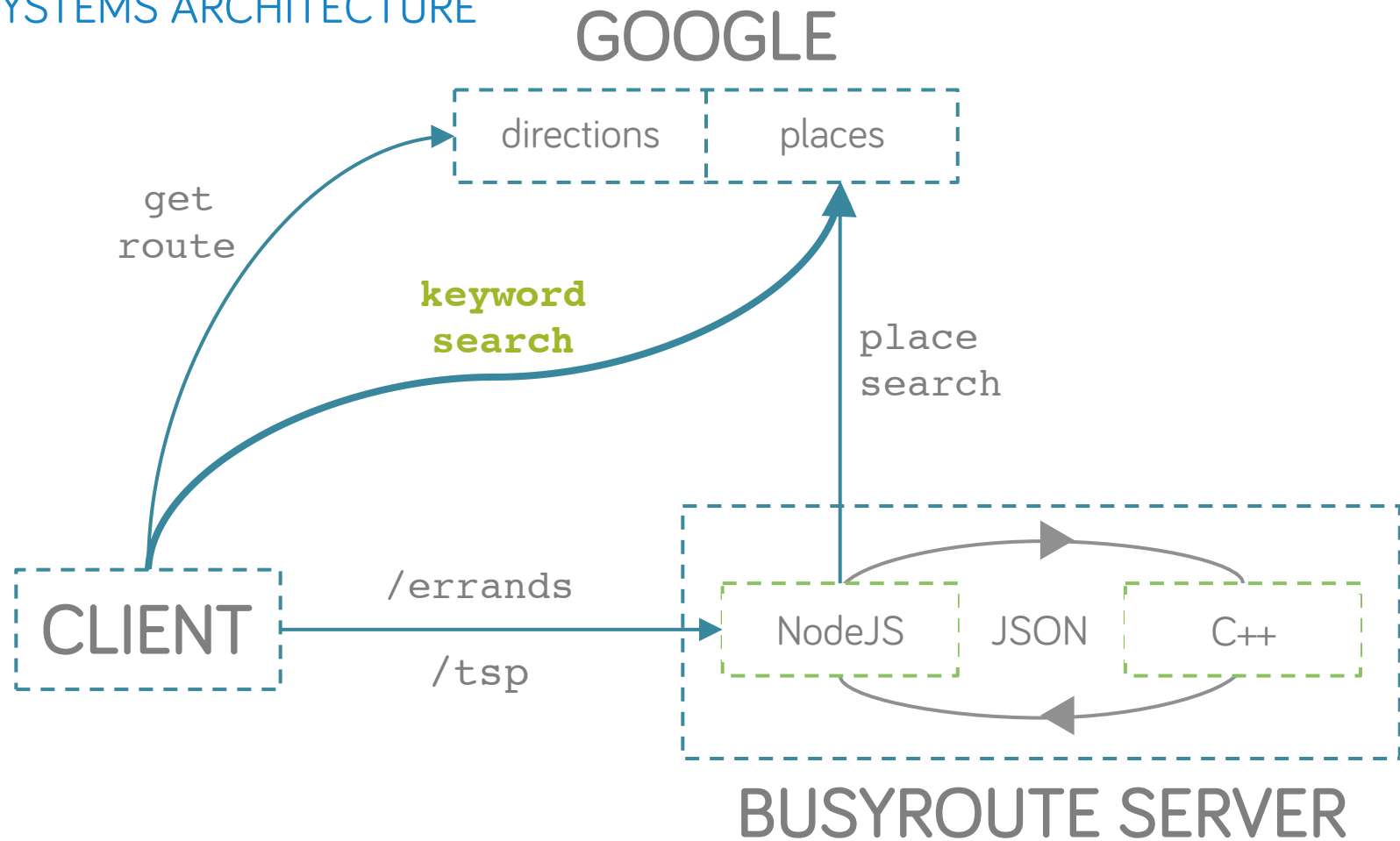
HOW did we implement it?

SYSTEMS ARCHITECTURE



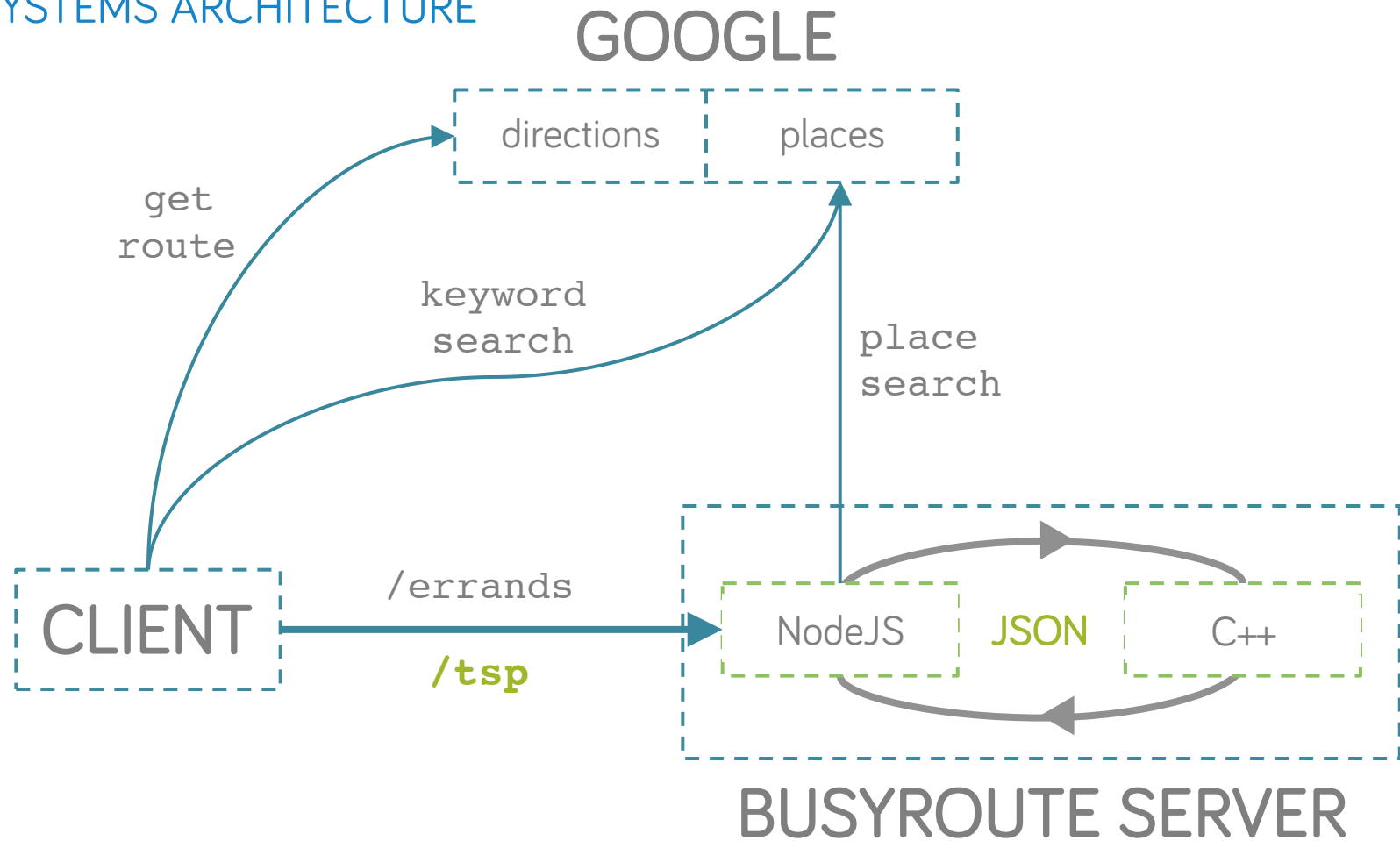
HOW did we implement it?

SYSTEMS ARCHITECTURE



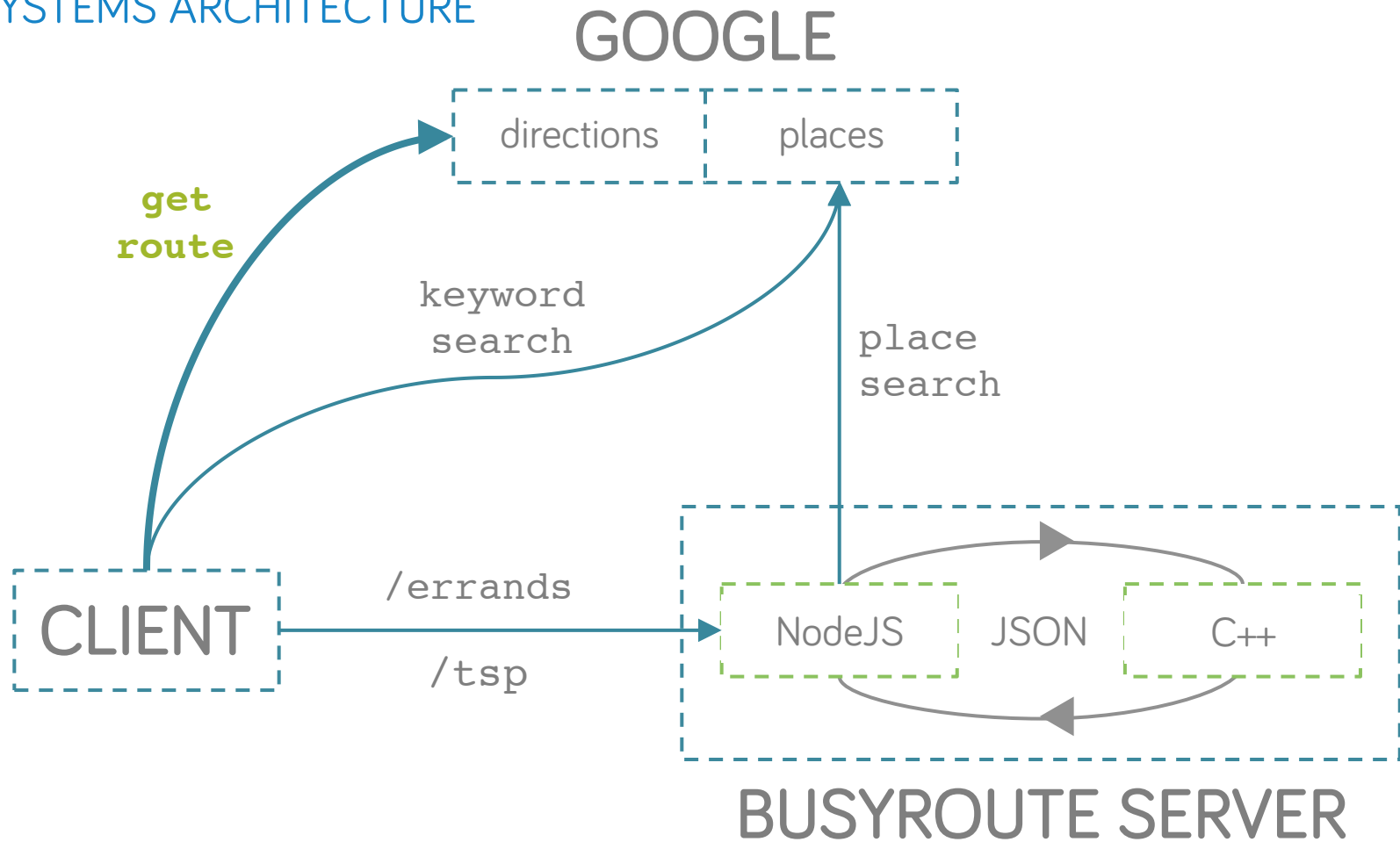
HOW did we implement it?

SYSTEMS ARCHITECTURE



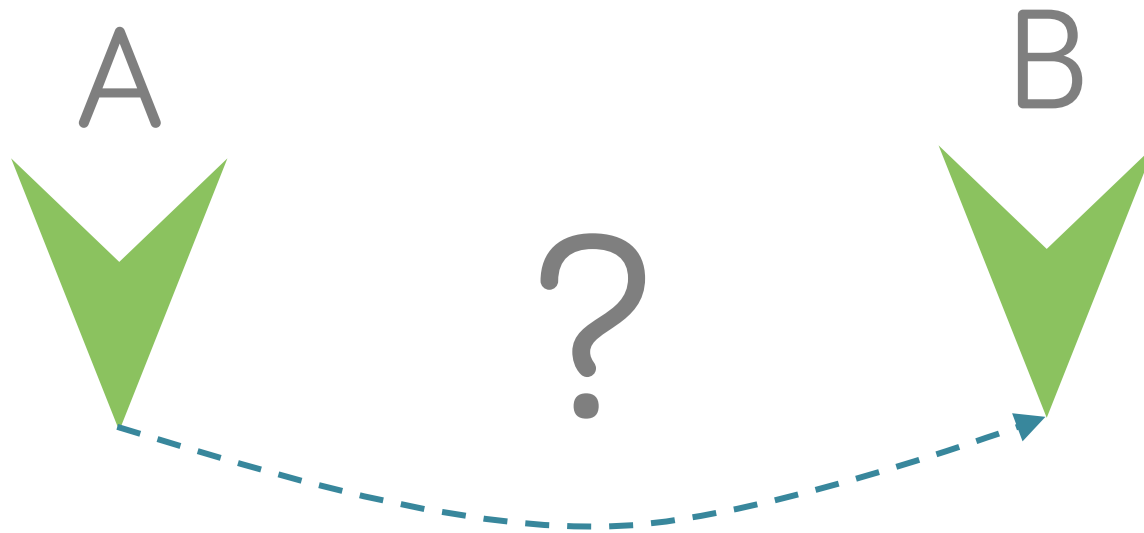
HOW did we implement it?

SYSTEMS ARCHITECTURE



HOW did we implement it?

EDGE WEIGHTS: GOOGLE MAPS



GOOGLE MAPS ➤ LIMITED number of API calls

HOW did we implement it?

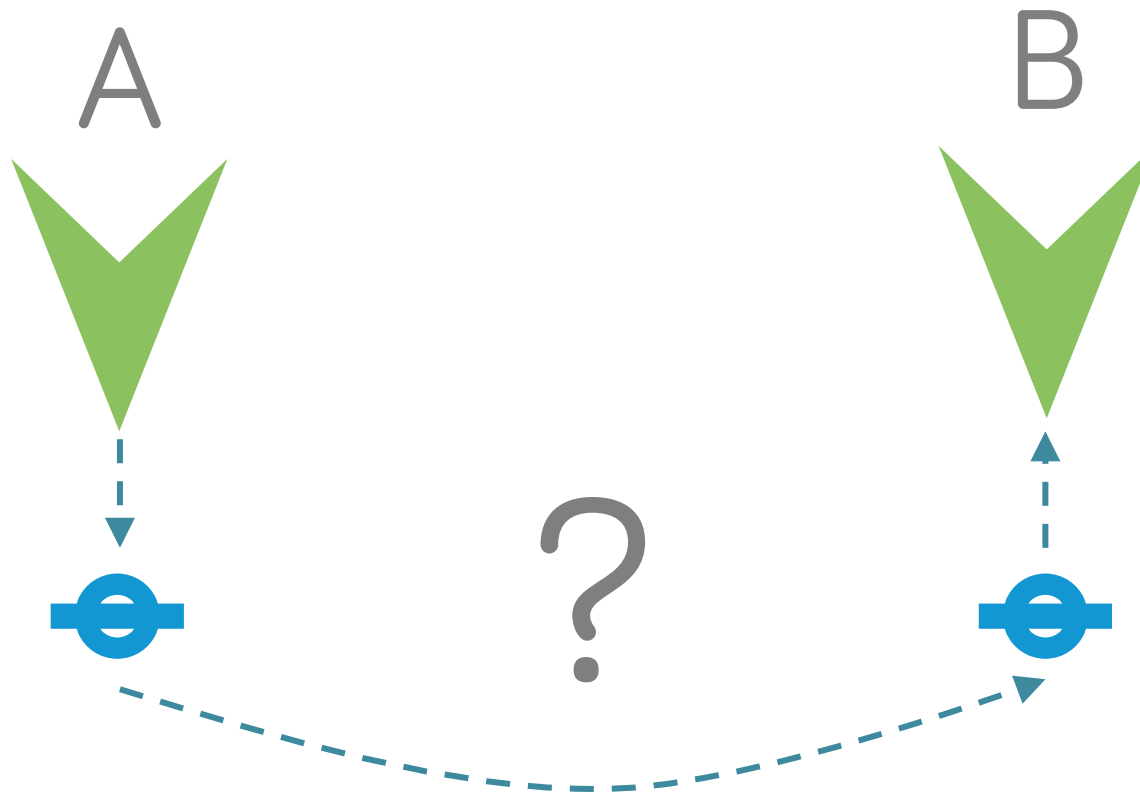
EDGE WEIGHTS: WALKING



WALKING ➤ Haversine Formula

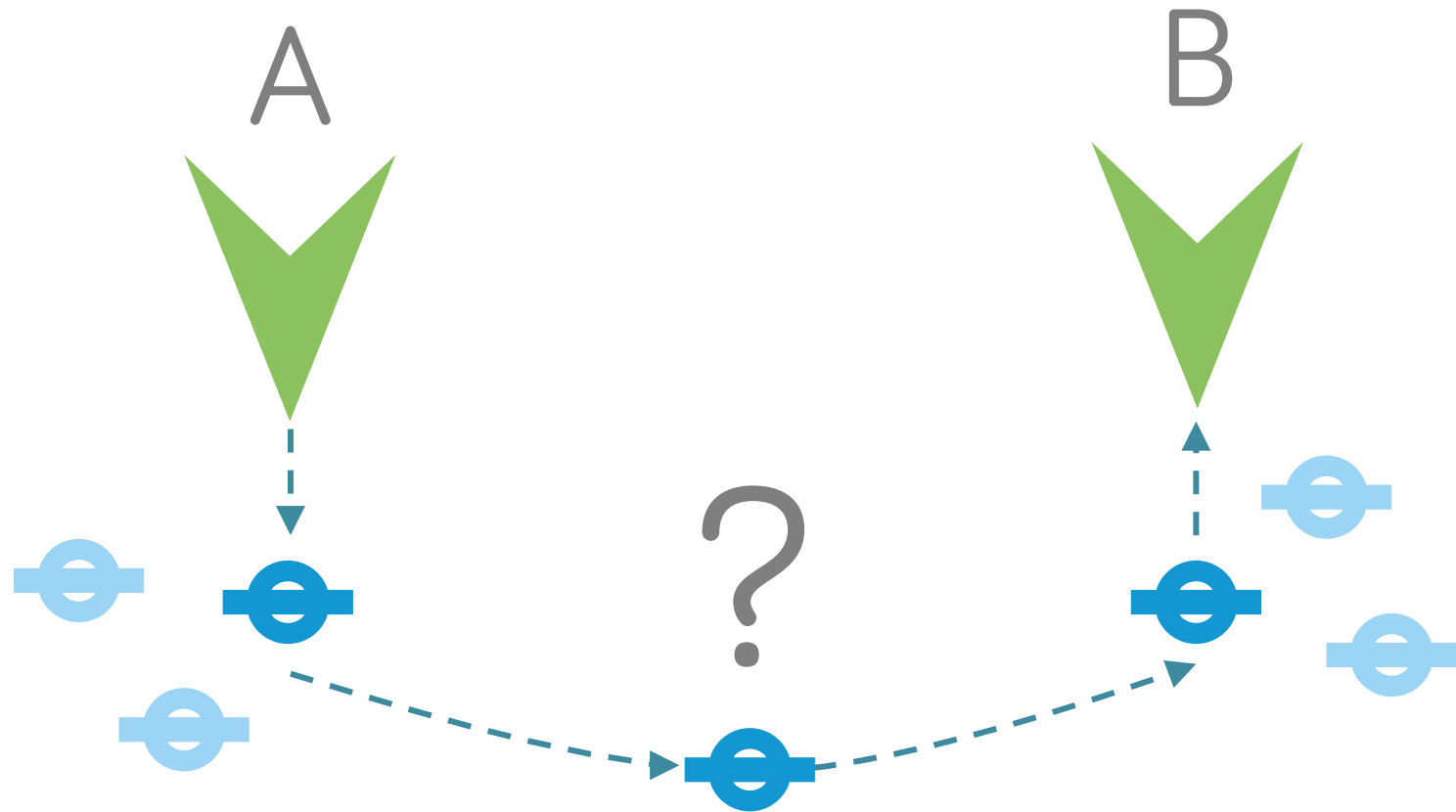
HOW did we implement it?

EDGE WEIGHTS: PUBLIC TRANSPORTS



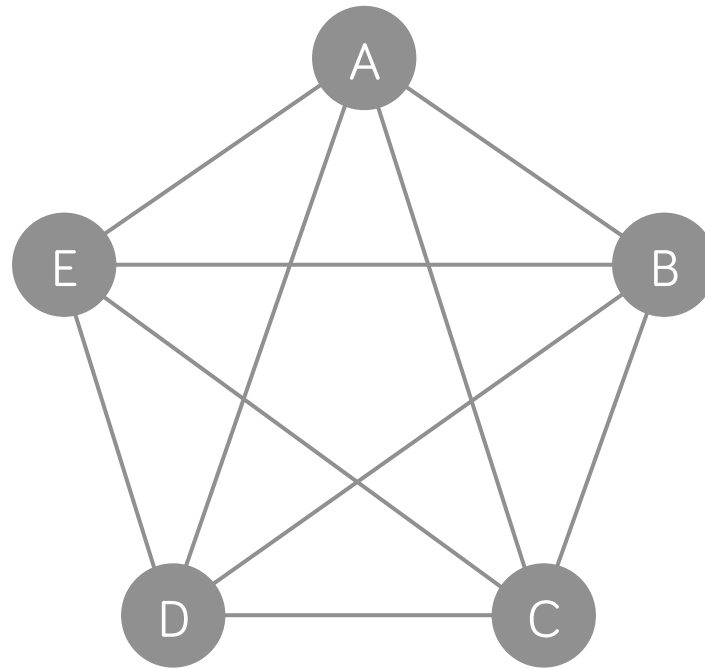
HOW did we implement it?

EDGE WEIGHTS: PUBLIC TRANSPORTS & INTERCHANGES



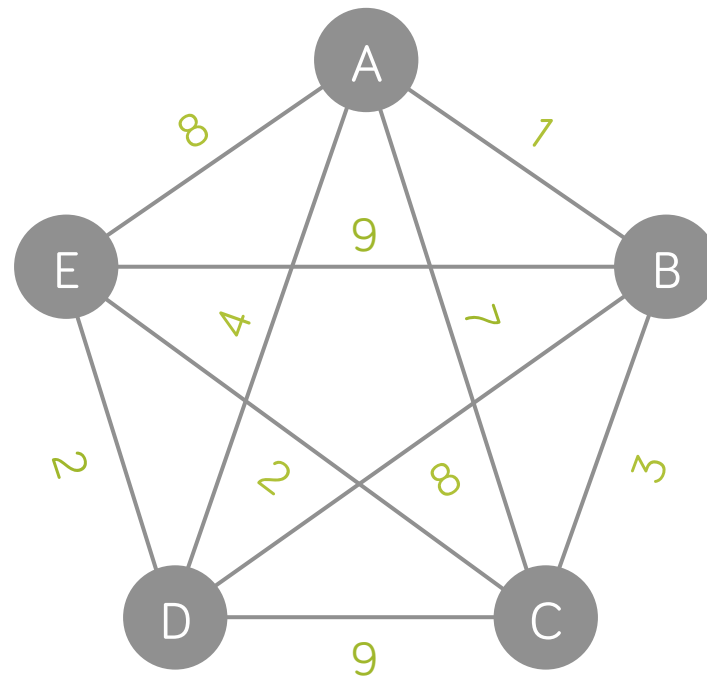
HOW did we implement it?

TRAVELLING SALESMAN PROBLEM (TSP)



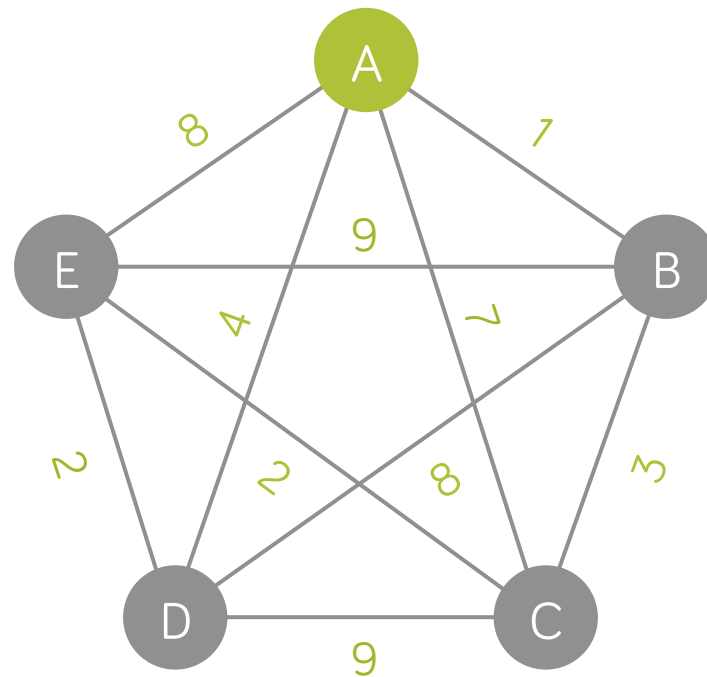
HOW did we implement it?

TRAVELLING SALESMAN PROBLEM (TSP)



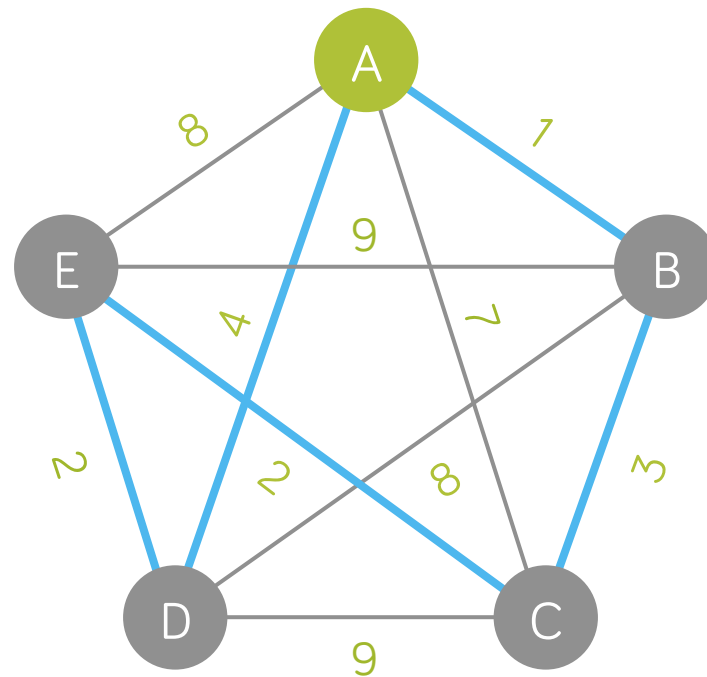
HOW did we implement it?

TRAVELLING SALESMAN PROBLEM (TSP)



HOW did we implement it?

TRAVELLING SALESMAN PROBLEM (TSP)



OPTIMAL ROUTE (COST: 12)

HOW did we implement it?

TRAVELLING SALESMAN PROBLEM (TSP): BACKTRACKING

$O(n!)$

BACKTRACKING

HOW did we implement it?

TRAVELLING SALESMAN PROBLEM (TSP): DYNAMIC PROGRAMMING

$$O(n^2 \times 2^n)$$

DYNAMIC PROGRAMMING

HOW did we implement it?

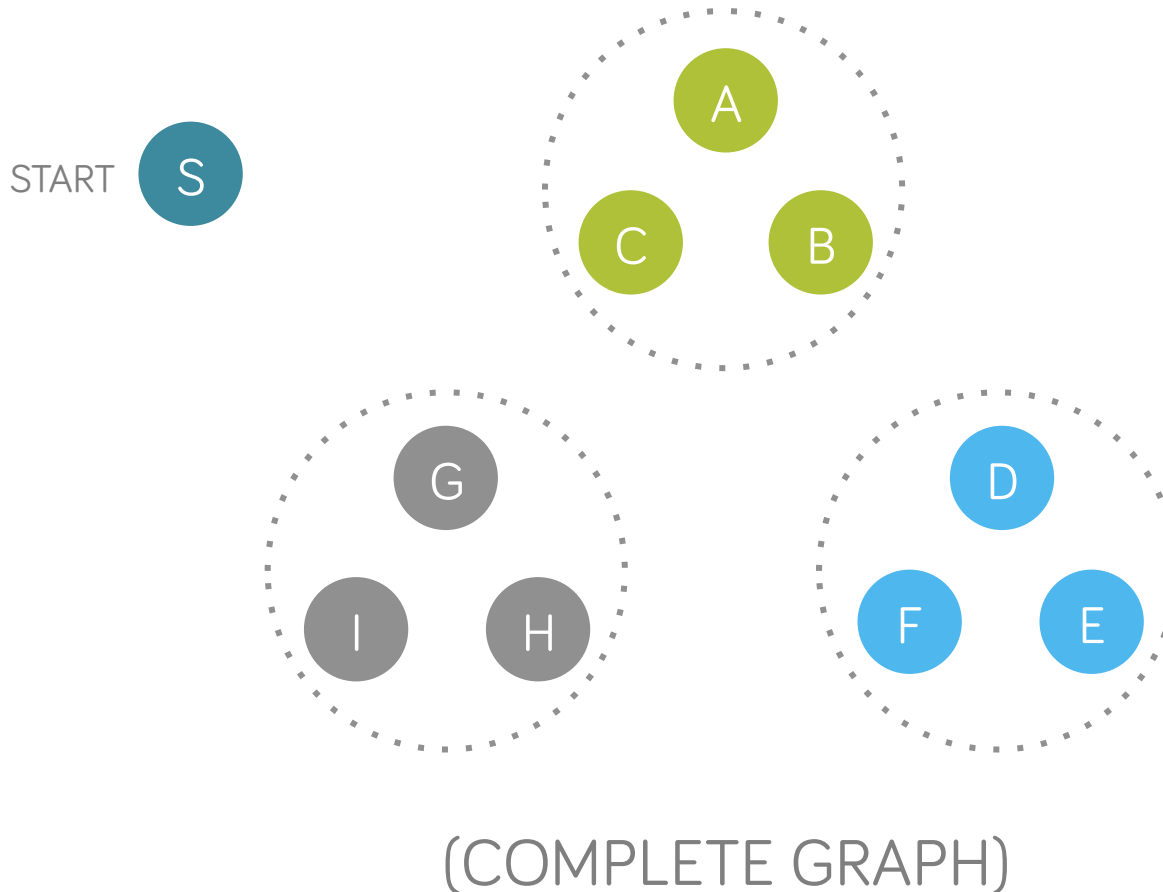
TRAVELLING SALESMAN PROBLEM (TSP): NEAREST NEIGHBOUR

$$O(n^2)$$

NEAREST NEIGHBOUR HEURISTIC

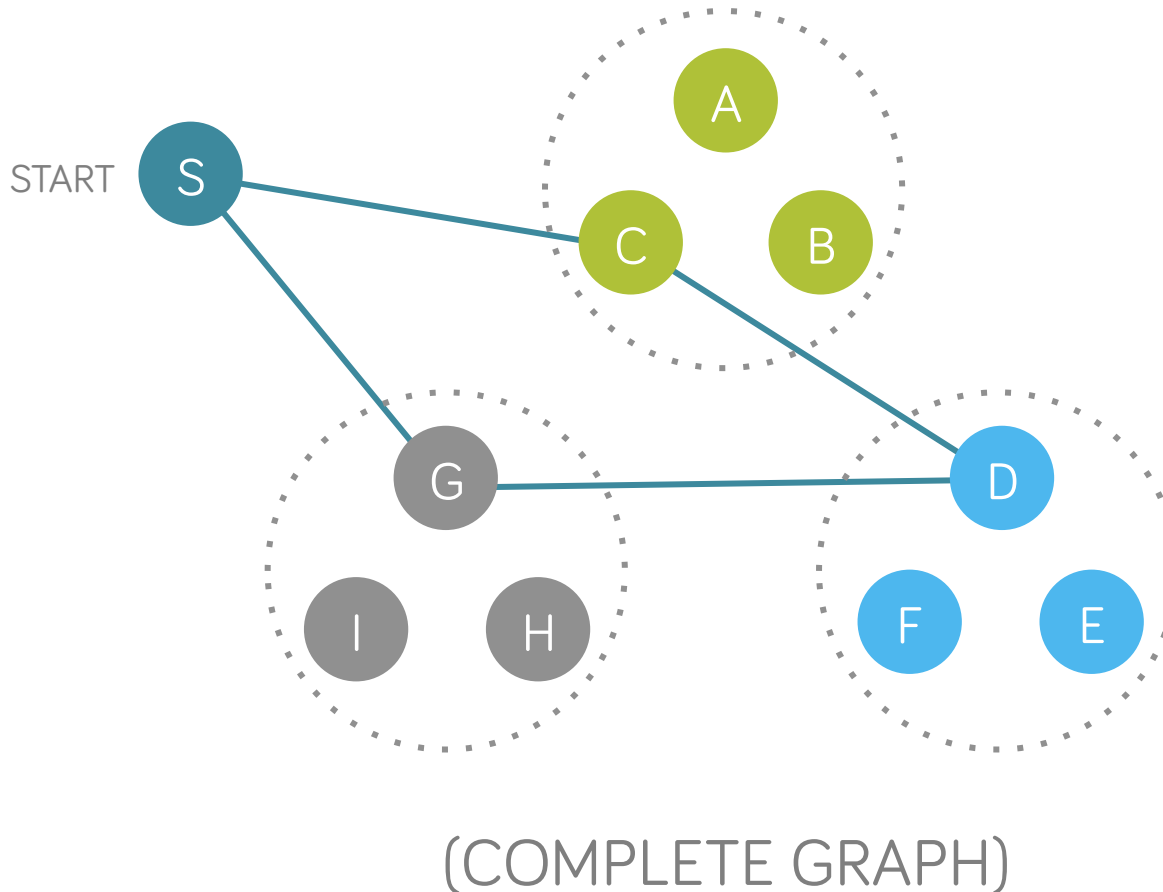
HOW did we implement it?

GENERALISED TRAVELLING SALESMAN PROBLEM (GTSP)



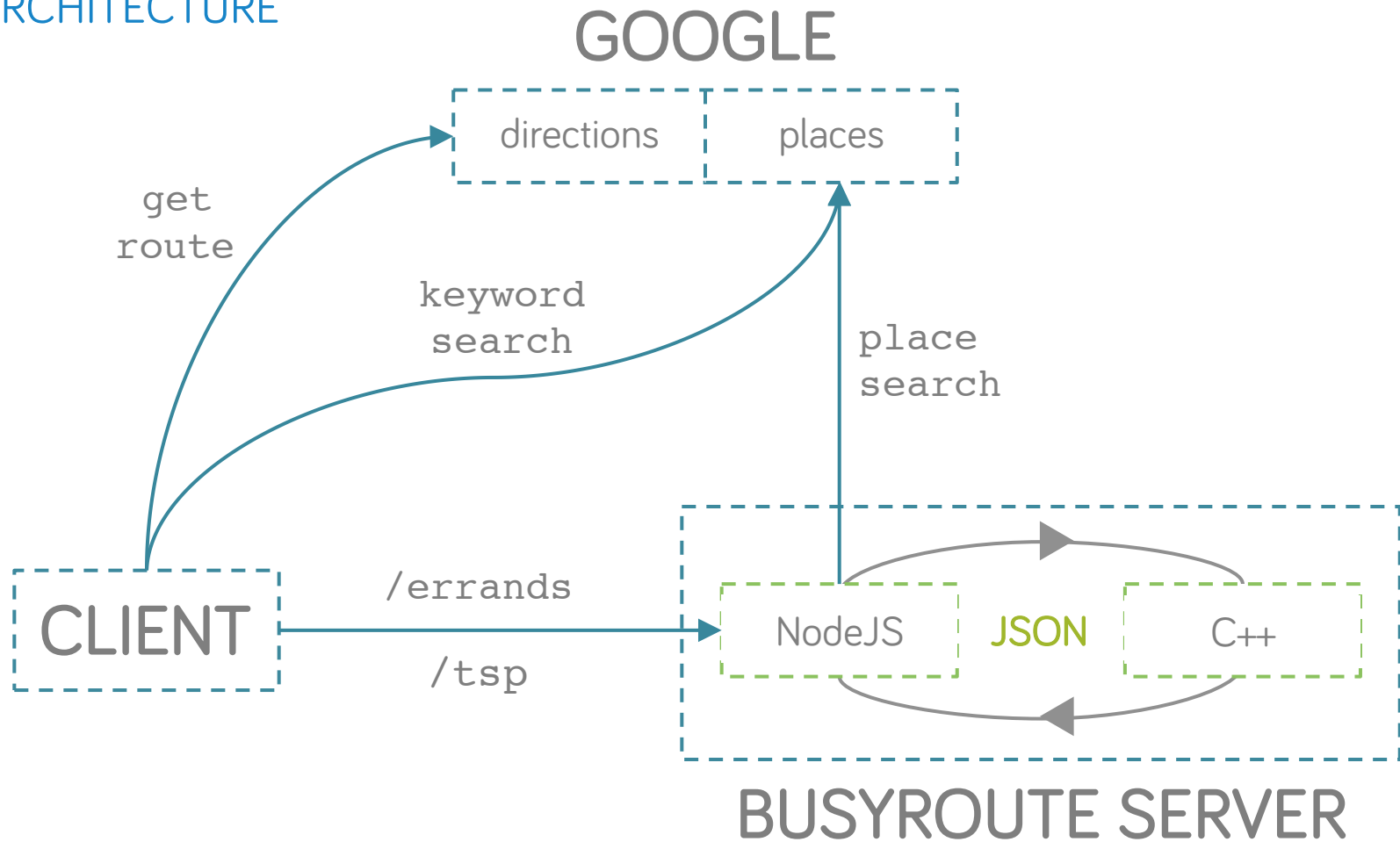
HOW did we implement it?

GENERALISED TRAVELLING SALESMAN PROBLEM (GTSP)



HOW did we implement it?

ARCHITECTURE



HOW did we implement it?

TOOLS USED



Jenkins

GitHub



mocha



ANSIBLE



VAGRANT

google
Google C++ Testing



express



GRUNT

WHAT

is the future of
busyroute?

WHAT is the future of busyroute?

API CONSTRAINTS

GOOGLE API ➤ **LIMITED** number of API calls

WHAT is the future of busyroute?

API CONSTRAINTS

GOOGLE API ➤ LIMITED number of API calls
=
SCALABILITY issues

WHAT is the future of busyroute?

API CONSTRAINTS

GOOGLE API ➤ **LIMITED** number of API calls
=
SCALABILITY issues

SOLUTION?

WHAT is the future of busyroute?

API CONSTRAINTS

GOOGLE API ➤ **LIMITED** number of API calls
=
SCALABILITY issues

PAY FOR A LARGER QUOTA

WHAT is the future of busyroute?

API CONSTRAINTS

GOOGLE API ➤ **LIMITED** number of API calls
=
SCALABILITY issues

USE ALTERNATIVE SERVICES

WHAT is the future of busyroute?

COMPUTATIONAL POWER CONSTRAINTS

1 machine running

WHAT is the future of busyroute?

COMPUTATIONAL POWER CONSTRAINTS



machine running

WEB SERVER

WHAT is the future of busyroute?

COMPUTATIONAL POWER CONSTRAINTS

1

machine running

WEB SERVER

+

C++ PROCESSES

computationally intensive



WHAT is the future of busyroute?

STRETCH GOALS

Precedence errands

“ I need to get my
cash before my
coffee ”

WHAT is the future of busyroute?

STRETCH GOALS

Precedence errands

Future planning support

“ I want to go to a
nightclub but not
until 10pm ”

WHAT is the future of busyroute?

STRETCH GOALS

Precedence errands

Future planning support

Restriction of the set of points

“ I want to grab a
lunch for less than
£10 ”



A SIMPLE ROUTING APPLICATION FOR BUSY PEOPLE

CONCLUSION

ANY

QUESTIONS?



PROJECT BY

THOMAS BURNELL
ANDREI CIOARA
ANDREA MICHI
JEREMY KONG
ALICE SIBOLD

MANY THANKS TO

PROF. SOPHIA DROSSOPOULOU