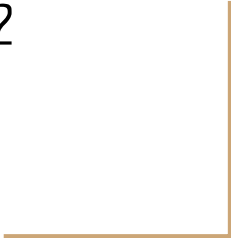


# Programming, Problem Solving, and Algorithms

CPSC203, 2023 W2



# Announcements

- TBD

# Today's Plan...

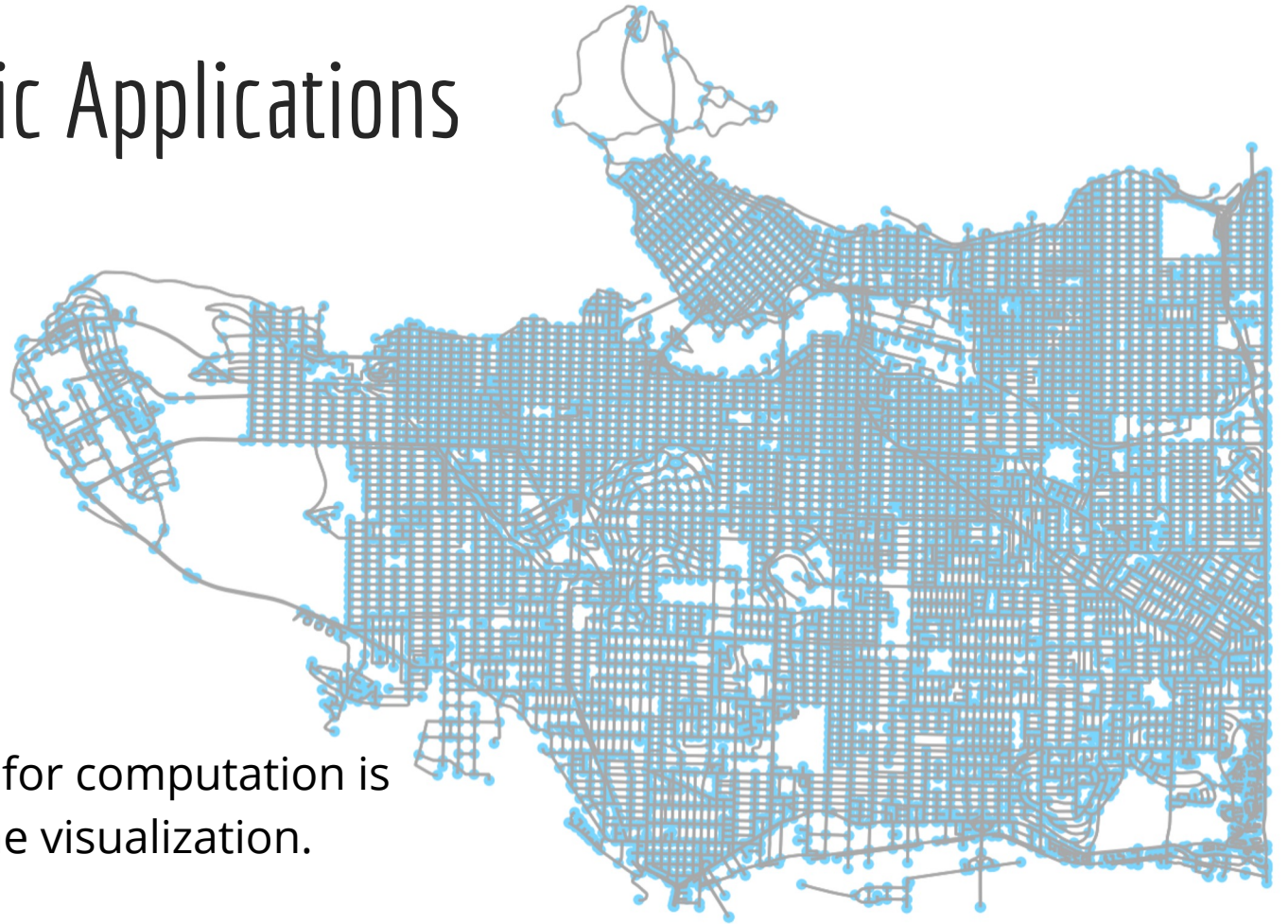
1. Announcements! (10 mins)
2. Weekly Videos Review/Questions (10 mins)
3. Demo and live coding of OSMNX (40 mins)



# Slides from the Assigned Videos



# Geographic Applications



The data we use for computation is separate from the visualization.

Data:

# Open Street Maps

An open-source alternative to Google Maps' *data*.

<https://www.openstreetmap.org/>

OSM provides an Application Programmer's Interface (API) that allows our program to request data, which is returned in a reasonable format.

Example:

```
place_names = ['UBC', 'Vancouver', 'Stanley park']
```

```
x.geocode_to_gdf(place_names)
```

```
geometry place_name bbox_north bbox_south bbox_east bbox_west
0 POLYGON ((-123.26221 49.26737, -123.26178 49.2... University of British Columbia, West 16th Aven... 49.273124 49.243131 -123.227362 -123.262213
1 POLYGON ((-123.24492 49.27961, -123.24467 49.2... Pacific Spirit Regional Park, West 16th Avenue... 49.279788 49.235248 -123.193671 -123.244925
2 POLYGON ((-123.22496 49.27462, -123.22475 49.2... Vancouver, Metro Vancouver Regional District, ... 49.316171 49.198445 -123.023242 -123.224961
```

# Map applications

## Three parts:

1. Assembling the data - OSM, local data stores, statsCan, etc. This is mostly the art of assembling geodataframes.
2. Computing on the data - library osmnx simplifies graph algorithms and computation, but also supports other spatial computation.
3. Visualizing the data - matplotlib for static maps, folium for interactive maps. Other alternatives available.

# Introductory Demo

<https://classroom.github.com/a/qYP0az4U>

What surprises you in the code?

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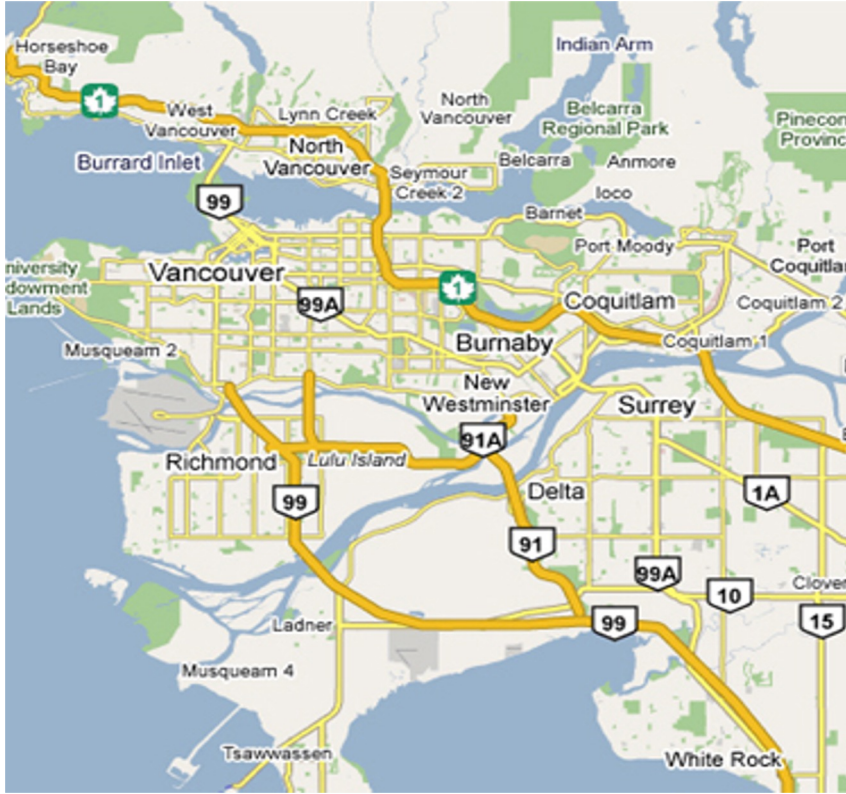
What surprises you in the maps?

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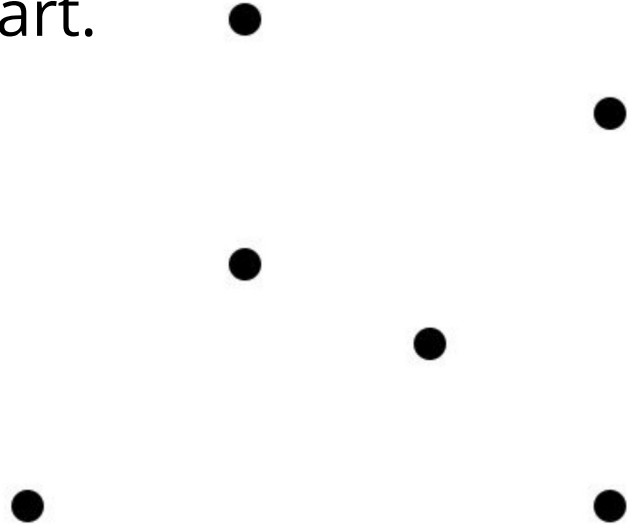
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# Another algorithm: Running Errands



Determine the least cost route through a set of given locations, returning to the start.



# TSP how many routes?

Suppose you have 6 locations. How many different candidate solutions are there? Generalize to  $k$  locations?



A



B



C



D



E



F

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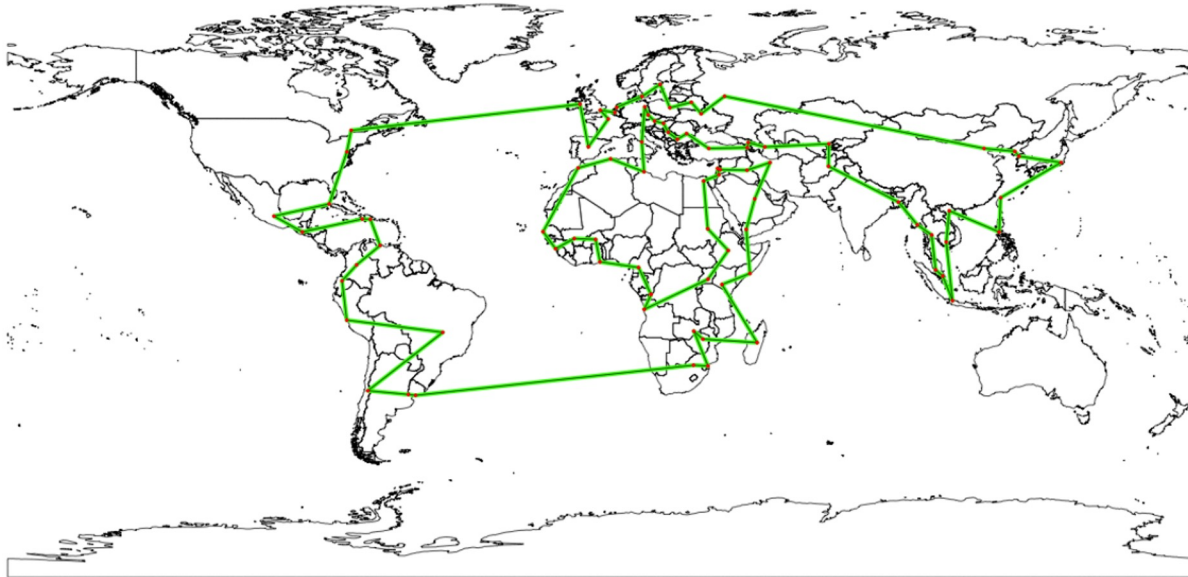
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# Demo Blog

<https://towardsdatascience.com/around-the-world-in-90-414-kilometers-ce84c03b8552>



# Plan for Code

## Steps to assemble our solution:

1.

2.

3.

4.

5.



To assist you with your travel in British Columbia, more than 100 communities operate Visitor Centres as members of the Visitor Centre Network. Their friendly staff offer personalized visitor consulting, community information, accommodation reservations, and provincial itinerary planning.

### Driving Times for the Oceanside (19A) and North Island Routes

VICTORIA TO:	
SIDNEY	35 min
SOOKE	25 min
DUNCAN	45 min
NANAIMO	1 hr 30 min
PORT ALBERNI	4 hr 30 min
TOFINO	5 hr
PARKSVILLE	2 hr
COMOX VALLEY	3 hr
CAMPBELL RIVER	2 hr 30 min
GOLD RIVER	2 hr 30 min
ZEBALLOS	6 hr
PORT HARDY	6 hr 30 min

### BAMFIELD - F6

246 CAMPBELL RIVER - F4
217 191 CHEMAINUS - H6
201 45 146 COMOX VALLEY - F5
230 204 13 159 DUNCAN - H6
337 91 281 136 294 GOLD RIVER - E4
528 282 472 326 485 220 HOLBERG - B5
336 310 113 265 386 400 591 JORDAN RIVER - H7
202 176 17 131 28 266 457 134 LADYSMITH - H6
232 226 43 182 30 317 308 136 51 LAKE COWICHAN - H6
179 153 37 106 51 243 435 157 23 73 NANAIMO - H5
145 147 76 72 87 208 299 195 28 189 36 PARKSVILLE - G5
95 151 322 186 135 342 433 241 107 137 84 50 PORT ALBERNI - G5
495 248 439 293 452 187 97 558 424 475 802 366 400 PORT ALICE - C3
484 238 428 282 441 176 50 547 413 484 391 355 389 53 PORT HARDY - C3
445 189 389 243 822 137 88 508 374 425 352 316 350 54 44 PORT McNEILL - C3
375 249 152 304 145 440 830 26 172 175 196 222 280 597 586 547 PORT RENFREW - G7
140 107 84 87 87 197 588 283 48 110 47 11 45 353 344 395 242 QUALICUM BEACH - G5
310 284 96 229 80 375 566 88 308 119 311 147 215 533 322 483 1227 175 SIDNEY - I7
305 279 88 234 275 370 361 31 103 305 126 162 210 537 537 478 70 172 57 SOOKE - H7
403 157 347 202 360 66 286 466 332 383 309 274 308 253 242 202 506 263 441 436 TAHESIS - D4
217 273 241 228 256 363 354 267 228 279 206 171 122 531 510 471 401 164 337 331 429 TOFINO - E6
191 248 218 203 231 238 529 337 203 253 180 146 96 496 445 446 276 141 311 306 404 42 UCLUELET - F6
290 204 75 212 62 146 146 88 80 90 111 147 195 512 502 483 107 158 26 37 422 318 291 VICTORIA - I7
442 196 387 241 400 135 170 506 372 422 349 313 347 136 126 87 545 303 480 475 201 449 444 440 ZEBALLOS - D4

### DISTANCE CHART in Kilometres - 1 km = .6 miles approx.



**LEGEND**

- Main Highway
- Oceanside Route (19A)
- North Island Route
- Parcel Road
- Gravel Road
- Car & Passenger Ferry
- Major Airport
- National Park
- Area of Interest

**AIRPORT CODES**

- Campbell River (YRL)
- Comox (YX0)
- Nanaimo (YNO)
- Port Hardy (YPT)
- Sofus (YR2)
- Sofus (YR2)
- Victoria (YVC)

Everyone needs a little Island time.

# Demo

Accept the repo:

<https://classroom.github.com/a/LXKH9ZuB>