



**BITS Pilani**  
Dubai Campus

## **A\* ROUTE PLANNER**



Done by:

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## **AIM**

Making an route planner, which would find nearby points of interests, given an input location and a search radius and find the route from that location to all other nearby POIs having the least total travel distance using A\* algorithm.

## **PACKAGES AND LIBRARIES USED**

1. Requests - for performing query operations
2. JSON: built-in module for working with JSON data
3. Numpy: third-party package for scientific computing
4. Slugify: third-party package for generating URL-friendly slugs
5. Geopy.distance: third-party package for calculating distances between coordinates
6. Random: built-in module for generating pseudo-random numbers
7. Operator: built-in module for performing operations on Python objects
8. PrettyTable: third-party package for creating better looking tables
9. NetworkX: third-party package for graph algorithms and visualization
10. Pylab as plt: third-party package for plotting and visualization

## **Motivation**

Tourists and locals alike often find it difficult to plan and organize their visits.

Using Python and Jupyter Notebook(Google Collab), we have implemented a solution, using the A\* algorithm, to list out places to visit and in what order to visit them in a way the total travel distance is minimized, to save valuable time.

## **Main Idea**

The person running the code is supposed to enter the locality of interest, to search for nearby Point of Interests, along with the search radius.

The A\* algorithm is run after fetching Point of Interests in the user defined area using the Bing API via JSON using predefined heuristics that is found from past outputs, and actual distances. The final path from start to end, including all fetched places is generated in a complete and optimal manner, along with the total path distance

## Input :

Area: " Qusais 1 "

Search\_Radius: " 2 "

## Output (1): using A\*, the Optimal Path with Total Path Distance is generated

0. Qusais 1 -> Start here

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
Abu Fattima Traditional Food	0.108	0.10552942048802465	0.21352942048802465
Al Sada Grocery	0.122	0.12036527036203368	0.24236527036203367
Al Jeel Al Saeed Grocery	0.33	0.2400703499547188	0.5700703499547188
Edathil Ammoothi Cafeteria	0.507	0.28274475680906874	0.7897447568090687
Wonderful International Restaurant	1.394	0.48437910785286964	1.8783791078528695
China Wok Restaurant	1.152	0.5622751191961373	1.7142751191961372
Quick Bite Restaurant	1.159	0.5704916884831535	1.7294916884831535
Al Mamzar Kitchen	1.166	0.578458102224763	1.744458102224763
Al Barq Grocery	1.213	0.5866654501693913	1.7996654501693914
General Dept.of Criminal Investigation	2.829	0.5882956691152859	3.417295669115286
Al Darq Mini Mart	1.218	0.5885498681084972	1.806549868108497
Dhaba Restaurant	1.184	0.5982891508119623	1.7822891508119623
Hashtag Emirates Rent-a-Car	1.2	0.5986893292764373	1.7986893292764372
ATM - RAK Bank	1.437	0.609876169171022	2.046876169171022
Quick Move Rent-a-Car	1.2	0.6160596366044737	1.8160596366044737
Al Hamba Vegetarian Restaurant	1.196	0.6169858362740436	1.8129858362740436
ATM - CBD	1.547	0.631673087850279	2.178673087850279
Emarat Petrol Station	1.547	0.6322467437991698	2.17924674379917
Emirates Islamic	1.572	0.644592963612849	2.216592963612849
ATM - Emirates Islamic	1.575	0.6446555161583023	2.2196555161583023
Top Cafeteria	1.525	0.6452493562693762	2.170249356269376
ATM - Al Hilal Bank	1.696	0.6454460342416334	2.3414460342416334
Juice World Express Restaurant	1.618	0.6460589998316232	2.264058999831623
ATM - HSBC	1.68	0.647659288489195	2.327659288489195
Natural Pastries	1.227	0.6512378325651862	1.8782378325651863

1. Abu Fattima Traditional Food

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
Al Sada Grocery	0.014	0.015137170664428004	0.029137170664428003
Al Jeel Al Saeed Grocery	0.34	0.27963375391470696	0.619633753914707
Edathil Ammoothi Cafeteria	0.517	0.3179407525398721	0.8349407525398721
Wonderful International Restaurant	1.404	0.5661131297320131	1.9701131297320131
China Wok Restaurant	0.812	0.572047444119475	1.384047444119475
Quick Bite Restaurant	0.819	0.5804607791128844	1.3994607791128844
Al Mamzar Kitchen	0.826	0.5881869452075533	1.4141869452075533
Al Barq Grocery	1.223	0.6883341707023646	1.9113341707023648
General Dept.of Criminal Investigation	2.489	0.4991698315310403	2.98816983153104
Al Darq Mini Mart	1.228	0.6907501299967571	1.918750129996757
Dhaba Restaurant	0.844	0.6074371923341865	1.4514371923341864
Hashtag Emirates Rent-a-Car	1.21	0.7036454760626049	1.9136454760626047
ATM - RAK Bank	1.079	0.668733374439575	1.747733374439575
Quick Move Rent-a-Car	1.21	0.7205387876030035	1.9305387876030036
Al Hamba Vegetarian Restaurant	0.856	0.6258400559740948	1.4818400559740947
ATM - CBD	1.557	0.7371898406782178	2.294189840678218
Emarat Petrol Station	1.557	0.7377131393901695	2.2947131393901694
Emirates Islamic	1.582	0.7497524468424674	2.3317524468424677
ATM - Emirates Islamic	1.585	0.7497805211347051	2.334780521134705
Top Cafeteria	1.535	0.7507647809283714	2.2857647809283714
ATM - Al Hilal Bank	1.706	0.7473619967164669	2.453361996716467
Juice World Express Restaurant	1.628	0.7504817504376384	2.378481750437638
ATM - HSBC	1.69	0.7502770037988078	2.4402770037988075
Natural Pastries	0.887	0.6688291508464644	1.5558291508464643

## 2. Al Sada Grocery

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
Al Jeel Al Saaed Grocery	0.354	0.28522541026165243	0.6392254102616524
Edathil Ammoothi Cafeteria	0.531	0.32256949681310915	0.8535694968131091
Wonderful International Restaurant	1.418	0.5763579643171073	1.9943579643171072
China Wok Restaurant	0.798	0.5780928774541999	1.3760928774541998
Quick Bite Restaurant	0.805	0.5865109240551474	1.3915109240551473
Al Mamzar Kitchen	0.812	0.5941868489931299	1.40618684899313
Al Barq Grocery	1.237	0.7034615689529559	1.9404615689529559
General Dept.of Criminal Investigation	2.475	0.4852983228894465	2.9602983228894466
Al Darq Mini Mart	1.242	0.7058847879769556	1.9478847879769556
Dhaba Restaurant	0.83	0.6133159825659446	1.4433159825659445
Hashtag Emirates Rent-a-Car	1.224	0.7186805111322117	1.9426805111322116
ATM - RAK Bank	1.065	0.6803955485774	1.7453955485774
Quick Move Rent-a-Car	1.224	0.7356247450363708	1.9596247450363706
Al Hamba Vegetarian Restaurant	0.842	0.6316397057822583	1.4736397057822583
ATM - CBD	1.571	0.7519431318523393	2.3229431318523392
Emarat Petrol Station	1.571	0.7524049651639669	2.323404965163967
Emirates Islamic	1.596	0.7647526254573599	2.36075262545736
ATM - Emirates Islamic	1.599	0.7647877314103962	2.363787731410396
Top Cafeteria	1.549	0.7656104284633937	2.3146104284633937
ATM - Al Hilal Bank	1.72	0.7624925704743194	2.4824925704743195
Juice World Express Restaurant	1.642	0.7655723849358949	2.4075723849358948
ATM - HSBC	1.704	0.7654140027844346	2.4694140027844345
Natural Pastries	0.873	0.6756786762901242	1.5486786762901241

## 3. Al Jeel Al Saaed Grocery

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
Edathil Ammoothi Cafeteria	0.176	0.04294987134276573	0.21894987134276572
Wonderful International Restaurant	1.063	0.32355568894863024	1.3865556889486301
China Wok Restaurant	0.821	0.799417643827566	1.620417643827566
Quick Bite Restaurant	0.828	0.8075188276562499	1.63551882765625
Al Mamzar Kitchen	0.835	0.8155065646128375	1.6505065646128374
Al Barq Grocery	0.882	0.6572652588597064	1.5392652588597064
General Dept.of Criminal Investigation	2.498	0.5592369578277151	3.0572369578277154
Al Darq Mini Mart	0.887	0.6544878352775835	1.5414878352775836
Dhaba Restaurant	0.853	0.83539114750202	1.6883911475020201
Hashtag Emirates Rent-a-Car	0.869	0.6283366719409648	1.4973366719409649
ATM - RAK Bank	1.106	0.8074220265313647	1.9134220265313648
Quick Move Rent-a-Car	0.869	0.6534641966649481	1.5224641966649481
Al Hamba Vegetarian Restaurant	0.865	0.8540674554407243	1.7190674554407241
ATM - CBD	1.216	0.6286891653611918	1.8446891653611917
Emarat Petrol Station	1.216	0.6243475696034019	1.8403475696034017
Emirates Islamic	1.241	0.6657601653008824	1.9067601653008825
ATM - Emirates Islamic	1.244	0.6667706829879808	1.9107706829879807
Top Cafeteria	1.194	0.649391907109026	1.843391907109026
ATM - Al Hilal Bank	1.365	0.7098393072813464	2.0748393072813465
Juice World Express Restaurant	1.287	0.682257942517286	1.9692579425172858
ATM - HSBC	1.349	0.7055576138408903	2.05455761384089
Natural Pastries	0.896	0.8846861765078722	1.780686176507872

#### 4. Edathil Ammoothi Cafeteria

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
Wonderful International Restaurant	1.096	0.3109892705704366	1.4069892705704368
China Wok Restaurant	0.916	0.8423662485888375	1.7583662485888376
Quick Bite Restaurant	0.923	0.8504663498985702	1.77346634989857
Al Mamzar Kitchen	0.93	0.8584541714095911	1.7884541714095912
Al Barq Grocery	0.977	0.6825075817686429	1.6595075817686429
General Dept.of Criminal Investigation	2.593	0.5594930520084471	3.152493052008447
Al Darq Mini Mart	0.982	0.6790917897391477	1.6610917897391477
Dhaba Restaurant	0.948	0.878338978981826	1.826338978981826
Hashtag Emirates Rent-a-Car	0.964	0.647794040115588	1.611794040115588
ATM - RAK Bank	1.201	0.8472915081826238	2.048291508182624
Quick Move Rent-a-Car	0.964	0.6738059057066459	1.6378059057066459
Al Hamba Vegetarian Restaurant	0.96	0.8970148373519683	1.8570148373519682
ATM - CBD	1.311	0.6427911983067988	1.9537911983067988
Emarat Petrol Station	1.311	0.6376695397068187	1.9486695397068186
Emirates Islamic	1.336	0.6833752736832172	2.019375273683217
ATM - Emirates Islamic	1.339	0.6845263889793896	2.0235263889793895
Top Cafeteria	1.289	0.6644123257953567	1.9534123257953566
ATM - Al Hilal Bank	1.46	0.7336328679839695	2.1936328679839696
Juice World Express Restaurant	1.382	0.7020667869341354	2.084066786934135
ATM - HSBC	1.444	0.7284312320848	2.1724312320848
Natural Pastries	0.991	0.9275104549608519	1.918510454960852

#### 5. Wonderful International Restaurant

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.304	0.9605668067336254	2.2645668067336255
Quick Bite Restaurant	1.311	0.9675338995867062	2.278533899586706
Al Mamzar Kitchen	1.318	0.9751708104993437	2.293170810499344
Al Barq Grocery	0.731	0.5420697421408409	1.2730697421408408
General Dept.of Criminal Investigation	2.967	0.866985200042081	3.833985200042081
Al Darq Mini Mart	0.736	0.5336283139644383	1.2696283139644384
Dhaba Restaurant	1.336	0.9942230638058104	2.3302230638058106
Hashtag Emirates Rent-a-Car	0.718	0.4652936982583852	1.1832936982583853
ATM - RAK Bank	0.955	0.8608607663081527	1.8158607663081527
Quick Move Rent-a-Car	0.718	0.4949687612369771	1.212968761236977
Al Hamba Vegetarian Restaurant	1.348	1.0117551888966847	2.359755188896685
ATM - CBD	0.698	0.42358478820368295	1.121584788203683
Emarat Petrol Station	0.698	0.41398057625492257	1.1119805762549224
Emirates Islamic	0.723	0.4837392532367888	1.2067392532367887
ATM - Emirates Islamic	0.726	0.485762113031259	1.211762113031259
Top Cafeteria	0.676	0.44904207283942366	1.1250420728394237
ATM - Al Hilal Bank	0.847	0.5757265154986738	1.422726515498674
Juice World Express Restaurant	0.769	0.5163474917395088	1.285347491739509
ATM - HSBC	0.831	0.5636188144958942	1.3946188144958942
Natural Pastries	1.379	1.023267641393892	2.402267641393892

#### 6. Emarat Petrol Station

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.463	0.8618216038238592	2.3248216038238594
Quick Bite Restaurant	1.463	0.866084760651719	2.3290847606517193
Al Mamzar Kitchen	1.463	0.871993890035243	2.334993890035243
Al Barq Grocery	0.255	0.20625447000712646	0.4612544700071265
General Dept.of Criminal Investigation	2.9	1.174348244023802	4.074348244023802
Al Darq Mini Mart	0.25	0.19372130826300793	0.44372130826300793
Dhaba Restaurant	1.463	0.8868831900630749	2.349883190063075
Hashtag Emirates Rent-a-Car	0.287	0.09835877673462706	0.38535877673462704
ATM - RAK Bank	0.912	0.6424672236050171	1.554467223605017
Quick Move Rent-a-Car	0.3	0.11957537243500761	0.4195753724350076
Al Hamba Vegetarian Restaurant	1.41	0.9001778842486926	2.3101778842486924
ATM - CBD	0.11302848389346146	0.013028483893461458	0.1260569677869229
Emirates Islamic	0.086	0.08238554000840591	0.1683855400084059
ATM - Emirates Islamic	0.089	0.08499310045279149	0.17399310045279148
Top Cafeteria	0.039	0.037396430512990034	0.07639643051299003
ATM - Al Hilal Bank	0.21	0.20411032896842554	0.41411032896842553
Juice World Express Restaurant	0.132	0.12433495890920514	0.25633495890920516
ATM - HSBC	0.194	0.1862567419642958	0.3802567419642958
Natural Pastries	1.387	0.884370350336648	2.271370350336648

#### 7. Top Cafeteria

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.423	0.8485681117046664	2.271568111704666
Quick Bite Restaurant	1.423	0.8525321436199084	2.2755321436199085
Al Mamzar Kitchen	1.423	0.8582194020124116	2.281219402012412
Al Barq Grocery	0.215	0.17964512589234027	0.39464512589234024
General Dept.of Criminal Investigation	2.86	1.1956648063233768	4.055664806323376
Al Darq Mini Mart	0.21	0.16707993066775398	0.37707993066775397
Dhaba Restaurant	1.423	0.8725731072412842	2.2955731072412844
Hashtag Emirates Rent-a-Car	0.247	0.07542945498521793	0.3224294549852179
ATM - RAK Bank	0.872	0.6199343317002042	1.4919343317002043
Quick Move Rent-a-Car	0.26	0.09004876109935858	0.35004876109935856
Al Hamba Vegetarian Restaurant	1.37	0.8853469349801627	2.255346934980163
ATM - CBD	1.141	0.025767879110677364	1.1667678791106775
Emirates Islamic	0.046	0.046930377051739386	0.09293037705173939
ATM - Emirates Islamic	0.049	0.0495854378653614	0.09858543786536139
ATM - Al Hilal Bank	0.17	0.17071530394510864	0.3407153039451086
Juice World Express Restaurant	0.092	0.0895080607662528	0.1815080607662528
ATM - HSBC	0.154	0.15235261342370238	0.30635261342370235
Natural Pastries	1.347	0.8671032711395497	2.2141032711395496

#### 8. Emirates Islamic

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.376	0.8164348212942008	2.1924348212942006
Quick Bite Restaurant	1.376	0.8200924010443847	2.1960924010443845
Al Mamzar Kitchen	1.376	0.8255490039926824	2.201549003992682
Al Barq Grocery	0.168	0.1380503870566832	0.3060503870566832
General Dept.of Criminal Investigation	2.813	1.2052556978406854	4.018255697840686
Al Darq Mini Mart	0.163	0.12571361886133853	0.2887136188613385
Dhaba Restaurant	1.376	0.8393495424403828	2.2153495424403826
Hashtag Emirates Rent-a-Car	0.2	0.04802784080266712	0.24802784080266713
ATM - RAK Bank	0.825	0.5795568017362668	1.4045568017362666
Quick Move Rent-a-Car	0.213	0.048597770810705355	0.26159777081070534
Al Hamba Vegetarian Restaurant	1.323	0.8515934574341804	2.17459345743418
ATM - CBD	1.094	0.06950963983189973	1.1635096398318998
ATM - Emirates Islamic	0.002	0.0026550618505407466	0.004655061850540747
ATM - Al Hilal Bank	0.123	0.12399771726023891	0.2469977172602389
Juice World Express Restaurant	0.045	0.042582594593983183	0.08758259459398318
ATM - HSBC	0.107	0.10551394729460768	0.21251394729460768
Natural Pastries	1.3	0.8310461990288476	2.1310461990288476

# 9. ATM - Emirates Islamic

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.373	0.8146580242180763	2.1876580242180763
Quick Bite Restaurant	1.373	0.8182973679538778	2.1912973679538776
Al Mamzar Kitchen	1.373	0.8237401108305686	2.196740110830569
Al Barq Grocery	0.165	0.13579988866658912	0.30079988866658913
General Dept.of Criminal Investigation	2.81	1.2058482578947018	4.015848257894702
Al Darq Mini Mart	0.16	0.12349096811529774	0.2834909681152977
Dhaba Restaurant	1.373	0.8375074048645103	2.21050740486451
Hashtag Emirates Rent-a-Car	0.197	0.04739952416636162	0.24439952416636163
ATM - RAK Bank	0.822	0.5773008086574384	1.3993008086574383
Quick Move Rent-a-Car	0.21	0.04656299700937015	0.25656299700937013
Al Hamba Vegetarian Restaurant	1.32	0.8497195566498318	2.1697195566498317
ATM - CBD	1.091	0.07210374484774701	1.163103744847747
ATM - Al Hilal Bank	0.12	0.12135932772546477	0.24135932772546476
Juice World Express Restaurant	0.042	0.03992810281269861	0.0819281028126986
ATM - HSBC	0.104	0.10286638797113917	0.20686638797113915
Natural Pastries	1.297	0.8290372403829955	2.1260372403829955



# 10. Juice World Express Restaurant

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.335	0.7878826031063424	2.1228826031063424
Quick Bite Restaurant	1.335	0.7912407002944712	2.1262407002944714
Al Mamzar Kitchen	1.335	0.7964679052512216	2.1314679052512213
Al Barq Grocery	0.122	0.10369000244747238	0.2256900024474724
General Dept.of Criminal Investigation	2.772	1.21459583437218	3.9865958343721797
Al Darq Mini Mart	0.117	0.09222780311551285	0.20922780311551287
Dhaba Restaurant	1.335	0.8097183778885217	2.1447183778885215
Hashtag Emirates Rent-a-Car	0.154	0.054463629265408944	0.20846362926540896
ATM - RAK Bank	0.743	0.5433377342835013	1.2863377342835012
Quick Move Rent-a-Car	0.167	0.0300815224052783	0.19708152240527832
Al Hamba Vegetarian Restaurant	1.282	0.8214381788634936	2.1034381788634935
ATM - CBD	1.048	0.11134041781515525	1.1593404178151552
ATM - Al Hilal Bank	0.077	0.08168217240485216	0.15868217240485216
ATM - HSBC	0.061	0.06303601720296911	0.12403601720296911
Natural Pastries	1.259	0.7987071808418238	2.057707180841824

# 11. ATM - HSBC

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.026	0.7436920079545468	1.7696920079545468
Quick Bite Restaurant	1.033	0.7465944298577322	1.779594429857732
Al Mamzar Kitchen	1.04	0.7514658733093565	1.7914658733093565
Al Barq Grocery	0.06	0.06595358787456866	0.12595358787456867
General Dept.of Criminal Investigation	2.693	1.225447960808592	3.9184479608085923
Al Darq Mini Mart	0.055	0.06032767837455366	0.11532767837455365
Dhaba Restaurant	1.058	0.7638648716337846	1.8218648716337846
Hashtag Emirates Rent-a-Car	0.092	0.10029405190589663	0.19229405190589663
ATM - RAK Bank	0.681	0.4883993526375261	1.1693993526375261
Quick Move Rent-a-Car	0.105	0.07115825392099541	0.1761582539209954
Al Hamba Vegetarian Restaurant	1.07	0.7747802586583845	1.8447802586583846
ATM - CBD	0.986	0.17322885630096094	1.159228856300961
ATM - Al Hilal Bank	1.135	0.018953854134788117	1.1539538541347882
Natural Pastries	1.101	0.7488826594752125	1.8498826594752125

# 12. Al Darq Mini Mart

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	0.97	0.6958301501834506	1.6658301501834507
Quick Bite Restaurant	0.977	0.6991340196659027	1.6761340196659027
Al Mamzar Kitchen	0.984	0.7043259106684326	1.6883259106684325
Al Barq Grocery	0.004	0.012582579241450745	0.016582579241450745
General Dept.of Criminal Investigation	2.637	1.1682597192380932	3.8052597192380935
Dhaba Restaurant	1.002	0.717515980968423	1.7195159809684228
Hashtag Emirates Rent-a-Car	0.059	0.09554104767532366	0.15454104767532367
ATM - RAK Bank	0.625	0.45387150753861516	1.078871507538615
Quick Move Rent-a-Car	0.072	0.07756688551539122	0.1495668855153912
Al Hamba Vegetarian Restaurant	1.014	0.7292113065172615	1.7432113065172614
ATM - CBD	0.93	0.18142573405010134	1.1114257340501015
ATM - Al Hilal Bank	1.079	0.057201579077924766	1.1362015790779247
Natural Pastries	1.045	0.7067517197765	1.7517517197764998

## 13. Al Barq Grocery

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	0.965	0.6849275275080486	1.6499275275080487
Quick Bite Restaurant	0.972	0.6881616634978694	1.6601616634978695
Al Mamzar Kitchen	0.979	0.6933000580492843	1.6723000580492844
General Dept.of Criminal Investigation	2.632	1.1678234025638907	3.7998234025638906
Dhaba Restaurant	0.997	0.7063641789479254	1.7033641789479255
Hashtag Emirates Rent-a-Car	0.064	0.10802237289642899	0.172022372896429
ATM - RAK Bank	0.62	0.44150641467978124	1.0615064146797812
Quick Move Rent-a-Car	0.077	0.09004242301792838	0.16704242301792838
Al Hamba Vegetarian Restaurant	1.009	0.7179430096525886	1.7269430096525884
ATM - CBD	0.925	0.19398071103448253	1.1189807110344825
ATM - Al Hilal Bank	1.074	0.05921199339116278	1.1332119933911629
Natural Pastries	1.04	0.6950391810842894	1.7350391810842893

## 14. Quick Move Rent-a-Car

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.186	0.7684687890854837	1.9544687890854835
Quick Bite Restaurant	1.193	0.772053798817725	1.965053798817725
Al Mamzar Kitchen	1.2	0.7774577429126328	1.9774577429126328
General Dept.of Criminal Investigation	2.7	1.184664409595113	3.8846644095951133
Dhaba Restaurant	1.218	0.7911413638078139	2.0091413638078137
Hashtag Emirates Rent-a-Car	0.12971385315966769	0.029713853159667684	0.15942770631933537
ATM - RAK Bank	0.688	0.5313773871440101	1.21937738714401
Al Hamba Vegetarian Restaurant	1.23	0.8032864464787093	2.0332864464787095
ATM - CBD	0.856	0.10677224424179266	0.9627722442417926
ATM - Al Hilal Bank	1.005	0.08708503258214532	1.0920850325821452
Natural Pastries	1.261	0.7824743492560842	2.0434743492560843

## 15. Hashtag Emirates Rent-a-Car

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.199	0.7738859167876923	1.9728859167876922
Quick Bite Restaurant	1.206	0.7777559351409526	1.9837559351409526
Al Mamzar Kitchen	1.213	0.7833765500572779	1.996376550057278
General Dept.of Criminal Investigation	2.7	1.1630956615798247	3.863095661579825
Dhaba Restaurant	1.231	0.7975835857169513	2.0285835857169516
ATM - RAK Bank	0.688	0.5454250088313968	1.2334250088313967
Al Hamba Vegetarian Restaurant	1.243	0.8102347112788463	2.0532347112788463
ATM - CBD	0.869	0.08632993802039807	0.953299380203981
ATM - Al Hilal Bank	1.018	0.11532473152610717	1.1333247315261072
Natural Pastries	1.274	0.7916835278989715	2.0656835278989716

## 16. ATM - CBD

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.463	0.8528553504239053	2.3158553504239054
Quick Bite Restaurant	1.463	0.8570387332390064	2.3200387332390067
Al Mamzar Kitchen	1.463	0.8628893764671793	2.3258893764671793
General Dept.of Criminal Investigation	2.9	1.1771539548839909	4.077153954883991
Dhaba Restaurant	1.463	0.8776384066354046	2.3406384066354047
ATM - RAK Bank	0.912	0.6311862534881277	1.5431862534881278
Al Hamba Vegetarian Restaurant	1.41	0.8907976444784778	2.300797644478478
ATM - Al Hilal Bank	0.21	0.19109404843372105	0.40109404843372104
Natural Pastries	1.387	0.8743626905367429	2.261362690536743

## 17. ATM - Al Hilal Bank

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	1.257	0.7283274112487844	1.9853274112487842
Quick Bite Restaurant	1.257	0.7311114582580168	1.9881114582580168
Al Mamzar Kitchen	1.257	0.7358895493298426	1.9928895493298424
General Dept.of Criminal Investigation	2.694	1.2254569974675888	3.919456997467589
Dhaba Restaurant	1.257	0.7480666797592805	2.00506667975928
ATM - RAK Bank	0.706	0.4705572536989356	1.1765572536989355
Al Hamba Vegetarian Restaurant	1.204	0.7587754295685045	1.9627754295685045
Natural Pastries	1.181	0.732114155403674	1.9131141554036741

## 18. ATM - RAK Bank

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	0.683	0.30587485320479274	0.9888748532047928
Quick Bite Restaurant	0.683	0.3050559596077769	0.9880559596077769
Al Mamzar Kitchen	0.683	0.306824937782737	0.9898249377827371
General Dept.of Criminal Investigation	2.12	1.155679802622907	3.275679802622907
Dhaba Restaurant	0.683	0.3121282465934831	0.9951282465934832
Al Hamba Vegetarian Restaurant	0.63	0.31693123773370635	0.9469312377337064
Natural Pastries	0.607	0.27414182023481093	0.8811418202348109

#### 19. Natural Pastries

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	0.076	0.10382049925319568	0.17982049925319568
Quick Bite Restaurant	0.076	0.09600779768221343	0.17200779768221341
Al Mamzar Kitchen	0.076	0.09000039338849607	0.16600039338849606
General Dept.of Criminal Investigation	1.601	1.0976323103958978	2.698632310395898
Dhaba Restaurant	0.076	0.07667839918506741	0.15267839918506743
Al Hamba Vegetarian Restaurant	0.023	0.066012513669714	0.089012513669714

#### 20. Al Hamba Vegetarian Restaurant

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	0.052	0.054711788621993954	0.10671178862199396
Quick Bite Restaurant	0.052	0.04654929778065497	0.09854929778065497
Al Mamzar Kitchen	0.052	0.038563133095543024	0.09056313309554302
General Dept.of Criminal Investigation	1.632	1.0410066988367797	2.6730066988367795
Dhaba Restaurant	0.052	0.018696979006032018	0.07069697900603202

#### 21. Dhaba Restaurant

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	0.1360148125786868	0.036014812578686814	0.17202962515737363
Quick Bite Restaurant	0.12787894288427348	0.027878942884273485	0.15575788576854696
Al Mamzar Kitchen	0.11988961985042723	0.019889619850427226	0.13977923970085446
General Dept.of Criminal Investigation	1.644	1.0248233194752794	2.6688233194752793

#### 22. Al Mamzar Kitchen

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	0.11623083772117292	0.016230837721172908	0.13246167544234583
Quick Bite Restaurant	0.10798934553518742	0.007989345535187417	0.11597869107037484
General Dept.of Criminal Investigation	1.662	1.0084572861092391	2.6704572861092393

#### 23. Quick Bite Restaurant

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
China Wok Restaurant	0.10841859232760037	0.008418592327600359	0.11683718465520074
General Dept.of Criminal Investigation	1.669	1.0019062870023727	2.6709062870023725

#### 24. China Wok Restaurant

Place Name	Actual Distance (km)	Heuristic Distance (km)	Total Distance (km)
General Dept.of Criminal Investigation	1.676	0.9939119511135066	2.6699119511135065

#### 25. General Dept.of Criminal Investigation -> Ends here

Total Actual Distance for Path = 7.3810114108728815 km  
Total Distance for Path (Actual+Heuristic) = 11.074477715569984 km

## Output (2):Visiting Order

Order of visiting the nearby places	
Visiting Order	Place Name
0	Qusais 1
1	Al Sada Grocery
2	Al Jeel Al Saaed Grocery
3	Al Qusais Police Station
4	All Day Minimart
5	Sharjah Islamic Bank
6	Emarat Petrol Station
7	ATM - CBD
8	Emirates Islamic
9	ATM - Emirates Islamic
10	ATM - HSBC
11	Al Darq Mini Mart
12	Al Barq Grocery
13	Quick Move Rent-a-Car
14	Hashtag Emirates Rent-a-Car
15	Planters Mini Mart
16	Atiq Mubarak Grocery
17	ATM - Standard Chartered Bank
18	Sunrise City Supermarket
19	Sunrise City Supermarket
20	General Dept.of Criminal Investigation
21	ATM - Al Hilal Bank
22	Al Madeena Super Market
23	Al Madeena Super Market
24	ATM - RAK Bank

## Output (3):Graph :

