OpenFlights Pathfinding Project Final Results

Our final build of the project turned out very well and was able to meet all the goals we set beforehand. Our program is successfully able to calculate the shortest flight path between two airports, as well as with an additional landmark airport in between. The algorithms we completed were BFS for traversal, Dijkstra's for shortest path, and Landmark for the pitstop airport. Our inputs/outputs are handled through .txt files, and some of the things our program will output are the shortest flight path, landmark flight path, distance of flight paths, and a complete traversal of our graph. After doing several tests between our program and real world data, we certified that all our algorithms work properly.

One discovery we made during development was the use of BFS in a graph data structure. Our initial thought was to use the traversal to find the path with the least connecting edges. However this was not the correct use of BFS, what we learned was that we needed to use the traversal to visit every connected node in the graph. After we adjusted for this we made another discovery. The output of our BFS function was meant to display every airport in our graph, however we noticed some were missing. After looking into the problem we discovered that many of the airports in the OpenFlights dataset had no commercial flights to them, and were disconnected from the other airports in the graph. This was an interesting find that also required us to add cases to catch this problem in our other functions. Another interesting thing we found with our program was that the distances we produced were extremely close to the real world distances. For example our program determined that to travel from Champaign IL to Sacramento CA you would need to go from CMI -> ORD -> SMF and that it would be a total trip distance of 3077.81km. When compared to the real world results, Google maps gave us the same flight path as well as a total distance of 3077.97. We were pleasantly surprised by the successes of our program.

Example input:

Starting location for BFS:
(Champaign, IL)
CMI

Shortest Path Algorithm Searches:
(Champaign, IL to Sacramento, CA; landmark in Dallas, TX)
CMI
NA
NA
NA
SMF
NA
NA
DFW

(Champaign, IL to Goroka, Papua New Guinea; landmark in London, UK)
(Capitalization does not matter for inputs)
cmi
GKA
LgW

(New York, NY to Hornafjörður, Iceland; landmark in Toronto, Canada)
(This will fail because there are no commercial flights to Hornafjörður, Iceland)
JFK
HFN
YYZ

(Chicago, IL (Midway) to London, UK (Heathrow); landmark in Winnipeg, Canada)
(Landmark will fail because there are no commercial flights to Winnipeg, Canada)
MDW
LHR
YAV

Example output (from above input):

BFS beginning at CMI:
CMI, ORD, DFW, YXE, STT, STC, SMF, SBN, BNA, RAP, PDX, PAH, MAD, GSO, ORF, NAS, MKG, MHT, SAN, MBS, LNK, LAN, JAN, IAD, HNL, GSP, ELM, MTY, VIE, DLH, CAK, BTV, BHM, ALB, CAE, ABE, IST, PNS, CPH, SCE, ACY, MCI, TUL, WAW, ARN, FRA, GCM, AMS, MSN, PTY, PWM, LAS, SAL, DEL, ALO, YWG, SJU, YQB, CID, TPA, YHZ, ABQ, ROC, YEG, DEN, YYC, DSM, YVR, BOI, COU, YUL, EAU, XNA, TYS, TXL, RDU, TVC, TUS, FOE, AUS, YOW, TOL, PUJ, SYR, SUX, FLL, ICN, SLC, SAV, AVL, BDL, SJD, SGF, ANC, GDL, SEA, SDF, RSW, RIC, BWI, PIA, BRU, CWA, OMA, SXM, YQR, SFO, OKC, SNA, NRT, MSP, DCA, MKE, PIT, MSY, MEX, SRQ, SJO, MEM, YYZ, SPI, MDT, STL, MQT, MLI, LAX, MCO, YKF, CMI, CMX, YXU, MBJ, LIT, PHX, LHR, PVG, LGA, BUF, LEX, DBQ, JFK, MYR, JAX, IAH, HSV, HPN, HKG, CVG, GRR, FSD, RNO, GRU, AMM, CDG, FAR, SAT, EVV, OAK, LSE, BRL, ELP, DUB, PSP, AZO, BOS, DEC, DTW, PBI, FCO, ZRH, MOB, HGU, MXH, LAE, GUR, HKN, GKA, DAU, PNP, PAC, YMO, YYU, MUK, MOI, MGS, AIU, AIT, RUA, PAF, YUS, TTT, YIE, WUZ, EWB, TEB, NAW, TST, PRH, UNN, KOP, SNO, ROI, LOE, NST, MAQ, CJM, BFV, LCX, ZNE, XCH, PBO, LEA, RVT, KNX, ALH, BQB, EPR, DCN, GET, WYA, CED, KGC, PLO, PUG, OLP, CPD, CIJ, TDD, CAW, JCB, CCM, BVS, MCP, ATM, CFB, SJK, MEA, PMY, VDM, TUC, SDE, RSA, RHD, RGL, RGA, RES, PSS, NQN, LUQ, IRJ, CPC, FMA, SFN, EQS, CTC, AFA, BHI, CRD, UAQ, MDQ, PRA, PDP, CFC, CXJ, GPB, CMG, ROO, OAL, JPR, AFL, BVH, POJ, GVR, AAX, SFL, MMO, TMM, NOS, SMS, DIE, WMN, SVB, TLE, MOQ, MJN, FTU, ANM, POG, NGE, GLO, GLH, ULK, UKX, ODO, KYZ, IKS, CKH, CYX, NGQ, IAA, DSK, AAN, HAQ, SCT, KSJ, UYU, POI, BSA, CIP, MFU, SLI, KAA, FJR, MHC, ZAL, SLX, LPD, LQM, ACR, NQU, BSC, PPB, JTC, CLV, RVD, BYO, MII, AQA, SNV, CAJ, JCK, DMD, BQL, SGO, WSZ, IVC, TIU, HKK, VLS, TGH, TAH, SWJ, PBJ, NUS, LPM, LNE, LNB, IPA, EAE, CCV, DLY, FLS, ULP, ZGU, WLH, SSR, MWF, LOD, SLH, VAO, RUS, RNL, RNA, RBV, SCZ, NNB, MUA, CHY, IRA, EGM, GZO, ATD, KGE, FRE, MNG, MCV, WIN, NNM, USK, UDJ, IAM, PPW, NRL, NDY, EOI, WRY, SOY, HFA, SDV, ANG, GRW, CVU, VPY, UEL, TTA, AHU, TQL, TMR, BMW, ELG, CSH, CSK, KTT, GNM, ABS, KHD, PFQ, YES, IIL, BXR, SDG, BJB, AFZ, BYC, TRR, ZLT, TMT, ITB, LLU, YMN, JQA, ZTB, JNS, RKV, JFR, GDE, LLI, PNI, KSA, ODN, MUR, LMN, MKM, LKH, LGL, BBN, JOL, TKP, UAP, UAH, MKP, GMR, KKR, VBV, LKB, ICI, FUN, FUT, GFN, VAW, RET, NVK, SVJ, LKN, PZH, DBA, BKZ, UKA, LKG, MRE, LAU, UAS, NYK, KTL, ASV, VXC, GOM, GMA, BKY, RJH, PSJ, MKW, BUW, SOQ, GTO, BIK, LUW, BEJ, HJR, PBD, MNA, KAZ, NAH, KTE, CNP, MEH, BJF, HVG, BVG, OMD, LEQ, GEL, URG, SJL, OLC, IRZ, ERN, CZS, OIA, TUR, RDC, YNO, YHP, KEW, ZPB, YTL, YAX, YER, WNN, ZRJ, YAC, MSA, XKS, XBE, KIF, YOG, YLH, YPL, ZFN, YHI, YGH, YEV, ZEM, YNC, AKV, YQC, YVM, YRB, YIO, BKM, NTX, ENE, LTI, KET, PBU, MGZ, KTG, WMX, OKL, NBX, MKQ, FKQ, SXK, TLJ, ELV, OBU, LUR, AUK, AKI, MYU, SCM, PKA, TOG, PTU, KYK, ANV, NUL, HSL, KAL, HUS, IRC, VEE, EGX, IGG, ONG, MIS, PUE, CHX, YFA, CCK, RIB, GYA, MPN, WMR, RCM, BUC, BEU, CMA, FTA, AWD, AUY, ULB, WNR, TOH, MTV, MGT, ELC, IFJ, EGS, AEY, BNC, KOO, BXB, OBY, CDJ, SUR, YSY, ZFM, YPC, YUB, YIK, YWB, YGZ, KAW, KNG, SLQ, KYU, ARC, SIC, JQE, ZKE, BVI, XTG, BUX, FMI, CMP, YZG, KPV, YAT, IRP, YPO

**********Traversal data has been shortened by about 3 pages for readability**********

Starting Location: CMI
Final Destination: SMF
Landmark Stop: DFW
For the least number of connecting flights, the airports you should fly to are:

CMI -> ORD -> SMF
For the shortest distance traveled, the airports you should fly to are:
CMI -> ORD -> SMF
Total distance of flights: 3077.71 kilometers
For the shortest distance from CMI to SMF with a pitstop at DFW, the airports you should fly to are:
CMI -> DFW -> SMF
Total distance of flights: 3412.82 kilometers

Starting Location: cmi
Final Destination: GKA
Landmark Stop: LgW
For the least number of connecting flights, the airports you should fly to are:
CMI -> ORD -> NAS -> GKA
For the shortest distance traveled, the airports you should fly to are:
CMI -> ORD -> ANC -> AKN -> PIP -> GKA
Total distance of flights: 14103.1 kilometers
For the shortest distance from cmi to GKA with a pitstop at LgW, the airports you should fly to are:
CMI -> ORD -> DUB -> LGW -> CPH -> LED -> GKA
Total distance of flights: 20697.3 kilometers

Starting Location: JFK
Final Destination: HFN
Landmark Stop: YYZ
We are sorry, there are no commercial flights between JFK and HFN

Starting Location: MDW
Final Destination: LHR
Landmark Stop: YAV
For the least number of connecting flights, the airports you should fly to are:
MDW -> SEA -> LHR
For the shortest distance traveled, the airports you should fly to are:
MDW -> YTZ -> YOW -> LHR
Total distance of flights: 6409.32 kilometers
We are sorry, there are no commercial flights that fly to YAV