BCPC Pipeline: A Reproducible Workflow to Sketch City-to-City Rail Corridors

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Abstract

[cite$_s$tart]$BCPC("BringCitiesBacktothePeople, nottheCars")isaPython-Poetryprojectthatassembleso$ $integeroptimisationtotestthefirst-orderfeasibilityofnewraillinks[cite : 7]. [cite_start]Thecodebaseisintentio$ $modelsorrunthewholeworkflowfromaJupyternotebookwithminimalgluecode[cite : 8].$

1 Motivation

[cite$_s$tart]$Motorisationratesinmanymiddle-incomecountriesarerisingfasterthanroadcapacity, causi$ $10]. [cite_start]Whilefullrailwaymasterplansrequireyearsofengineering, governmentsandNGOsstillr$ $11]. [cite_start]BCPCfillsthatgapwithanopen, scriptabletool-chain[cite : 12].$

2 Pipeline Walk-Through

The core workflow is a sequence of reproducible steps executed from the command line:

[cite$_s$tart]**Read Scenario:**$TheCLIacceptsauser-providedCSVtable[cite : 24]. [cite_start]Missingvalue$ $the-fly[cite : 25]. [cite_start]$**Boundary & DEM:**$Thecity'sadministrativeboundaryisfetchedfromNo$ $26, 27].$ **Routing:**$TheroutingalgorithmsnapsthestartandendpointstotheOpenStreetMaprailnetwork. [a$ $29]. [cite_start]$**Demand & Optimisation:**$Dailyboardingestimatesfeedamixed-integermodelthatdec$ $30]. [cite_start]$**Cost Breakdown:**$Thetotaltrackkilometers, stations, andfleetsizearepassedthroughaco$ $32]. [cite_start]$**Export:**$ThefinalrouteisconvertedtoGeoJSONforeasyvisualizationinGISsoftwarelik$ $33].$

3 Data & Core Modules

3.1 Data Sources

[cite$_s$tart]$Thepipelinereliesentirelyonopendatasources[cite : 15, 16, 17, 18] :$

> [cite$_s$tart]**OpenStreetMap:**$Usedforcityboundariesandexistingrail/roadnetworkgraphs[cite :$ $15]. [cite_start]$**OpenTopography API:**$ProvidesSRTMGL1\_E30melevationdata[cite :$ $16]. [cite_start]$**Wikipedia:**$Usedtoscrapecataloguesofhigh-speedlinesandtrainsets[cite :$ $17]. [cite_start]$**User-provided CSV:**$Containscitydatalikepopulation, tourismindex, andbudget[c$ $18].$

3.2 Code Layout

The main responsibilities are separated into the following modules:

File	Responsibility	
[cite$_s$tart]scenario_io.py	CSV validation and budget forward-filling[cite: 21]. cite$_s$tart > cite$_s$tart	[cite$_s$tart]
city_pipeline.py	End-to-end execution for a single city entry[cite: 21]. cite$_s$tart > cite$_s$tart	
terrain.py	DEM download, caching, and slope calculation[cite: 21]. cite$_s$tart > cite$_s$tart	
routing.py	Terrain-aware A* search on the transport network[cite: 21]. cite$_s$tart > cite$_s$tart	
demand.py	Commuter and discretionary demand estimation[cite: 21]. cite$_s$tart > cite$_s$tart	
optimise.py	Mixed-integer programming to select track and rolling stock[cite: 21]. cite$_s$tart > cite$_s$tart	
catalog_fetch.py	Scrapes Wikipedia for rolling stock and track catalogues[cite: 21].	

Table 1: Core modules of the BCPC pipeline[cite: 22].

4 Limitations

The BCPC model has several known limitations:

[cite$_s$tart]$Engineering challenges such as tunnels, bridges, and land acquisition are not modelled[cite$ 49]. [cite$_s$tart]$The cost coefficients are based on EU 2019 averages and require localization for accura$ 50]. [cite$_s$tart]$The Wikipedia scrapers may require maintenance if the source page structure changes[$ 51].

5 Conclusion

[cite$_s$tart]$BCPC is not a substitute for a full engineering feasibility study, but it serves as a power ful$ 53]. [cite$_s$tart]$Its open-source dependency stack ensures that every run is fully reproducible[cite : $ 54].

Source Code

[cite$_s$tart]$The full project is available on GitHub : github.com/MiguelIbrahimE/Train_Scheduler[cite : $ 4].