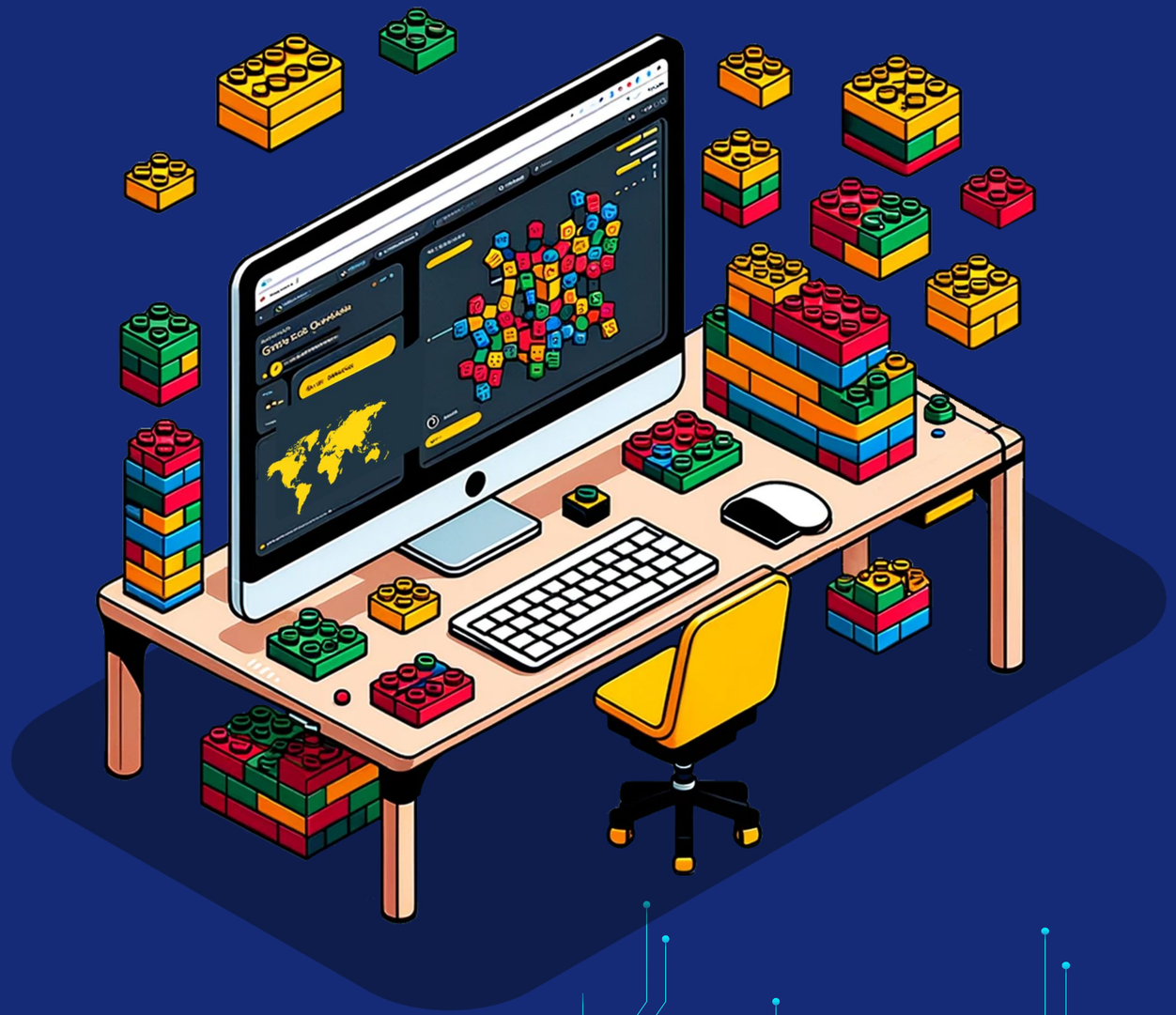


Play Geospatial Analysis
with the Ease of Building Blocks

An introduction to KNIME and its Geospatial Analytics Extension

Lingbo Liu

Nov. 7th, 2023

Challenges: Complexity in Spatiotemporal Analysis

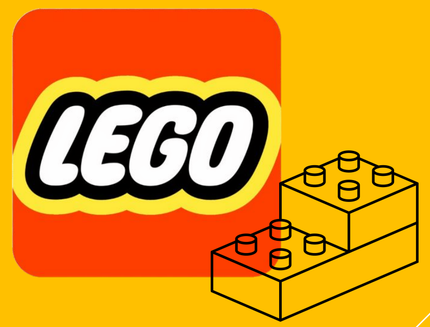
Image: Generated by DALL·E3 and subsequently edited

Challenges: Surging Learning Curve in GIS

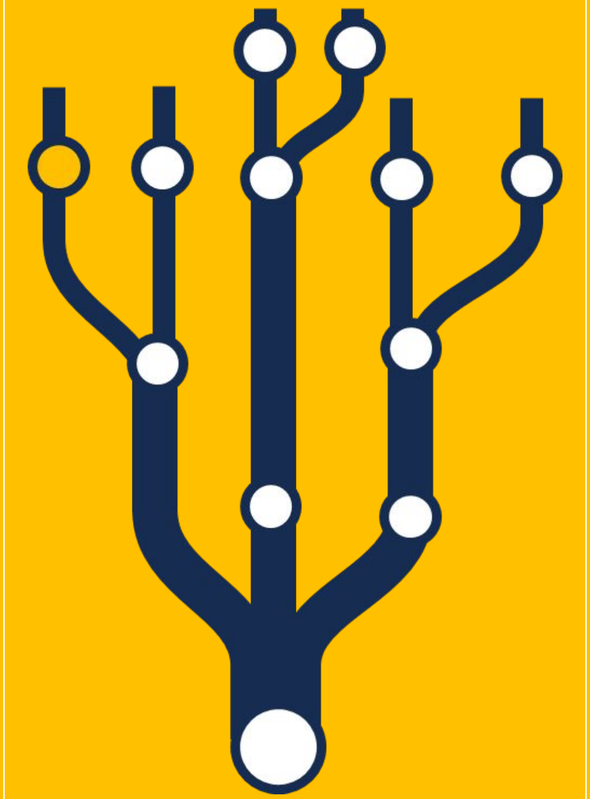
Image: Generated by DALL·E3

Visual Programming as Solution

Visual Programming



GIS Knowledge Tree



Embracing Data Science

General Data Science Platform

↑

GIS

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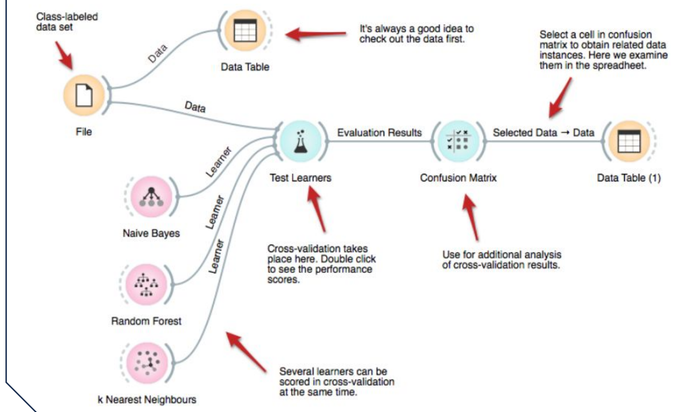
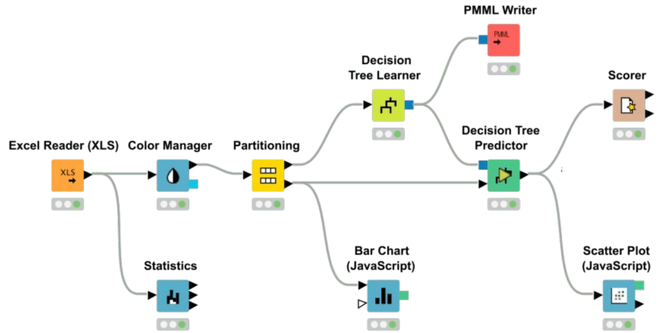
Visual Programming for Spatial Analysis

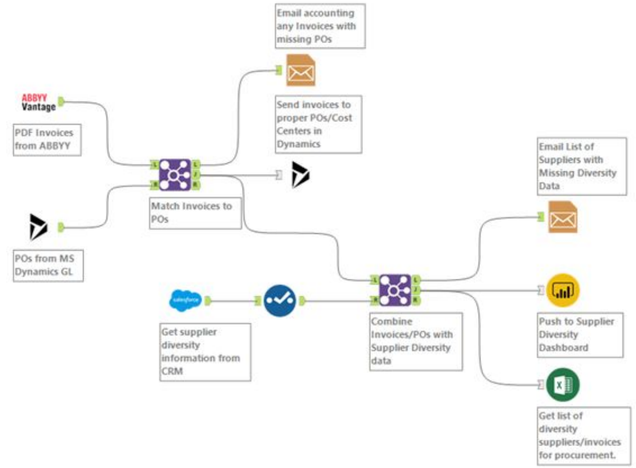
orange
DATA MINING



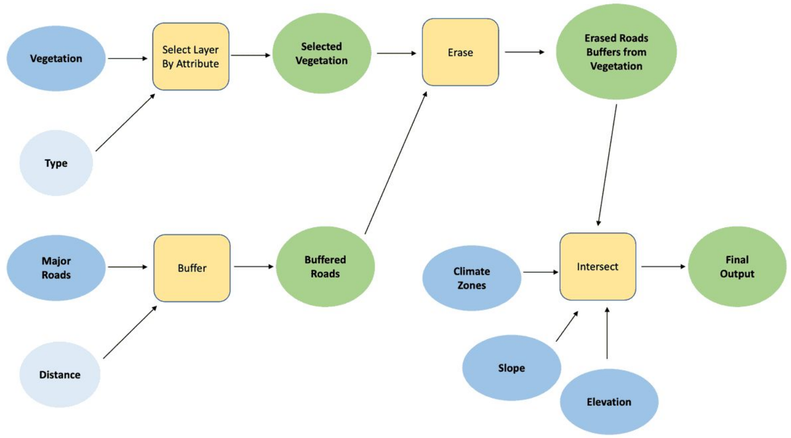
Open for Innovation
KNIME



alteryx



ARCGIS PRO
MODEL BUILDER



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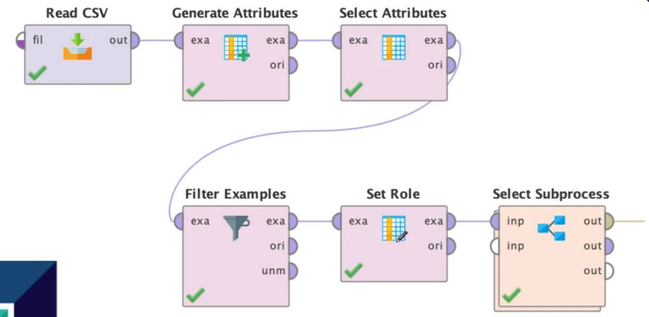
https://www.knime.com/



RAPIDMINER

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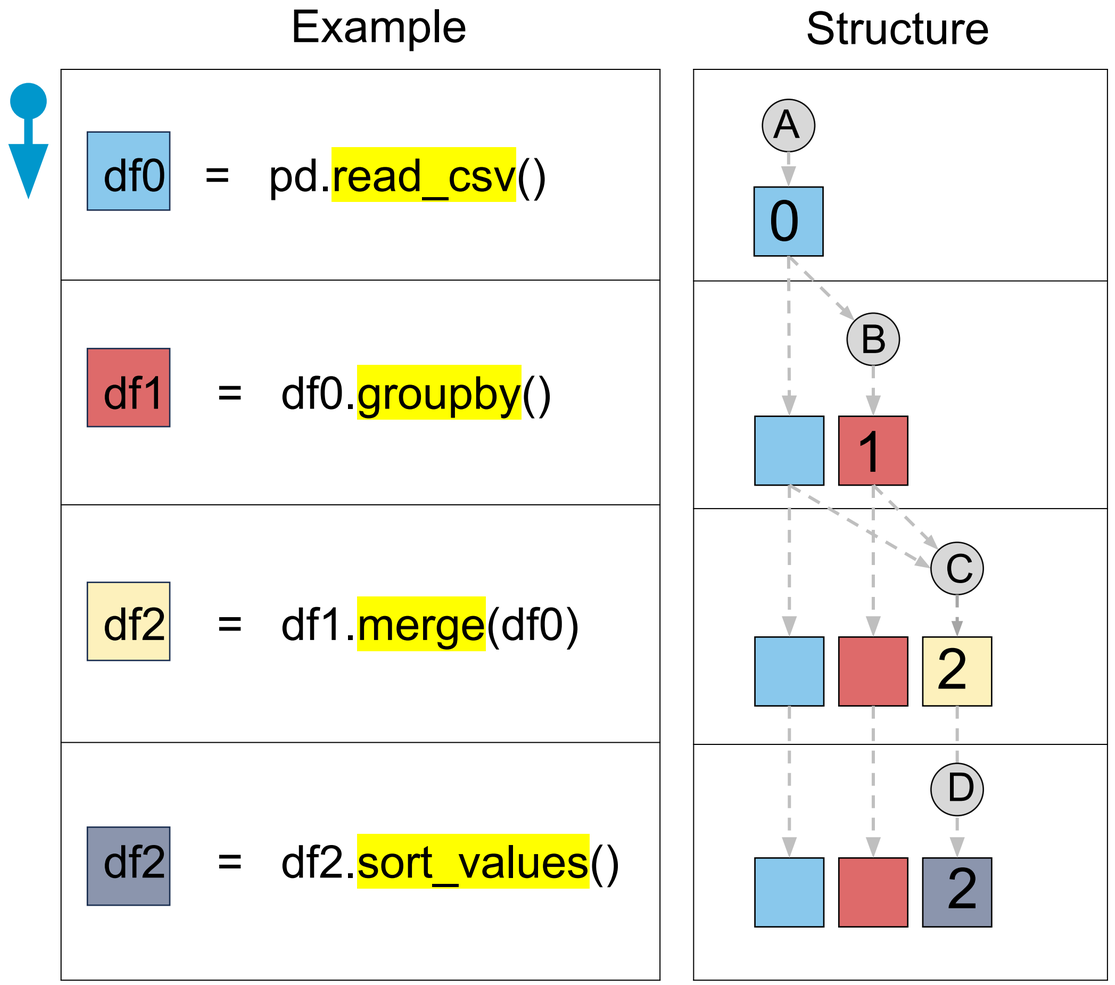
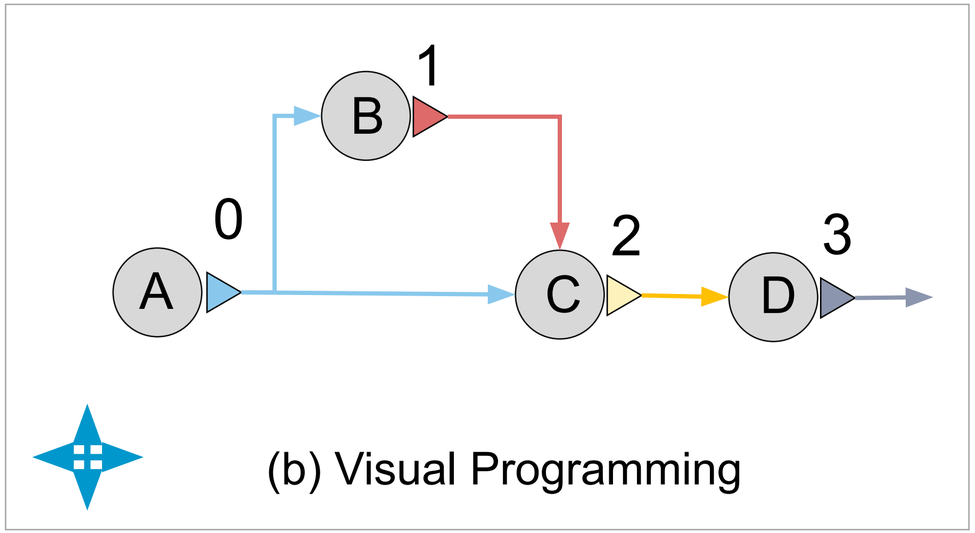
Analyst as Mind mapping in KNIME: From 1D to 2D



(a) Jupyter Notebook



Legend

- Function
- Data
- Hidden link
- Code line
- Function Node
- Function
- Data port
- Data link

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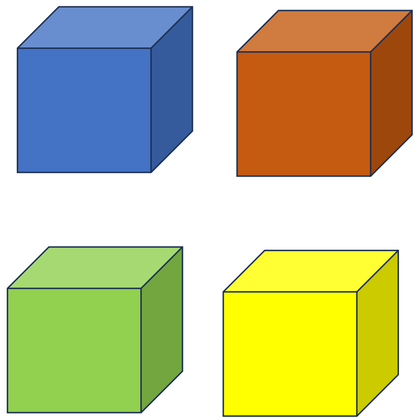
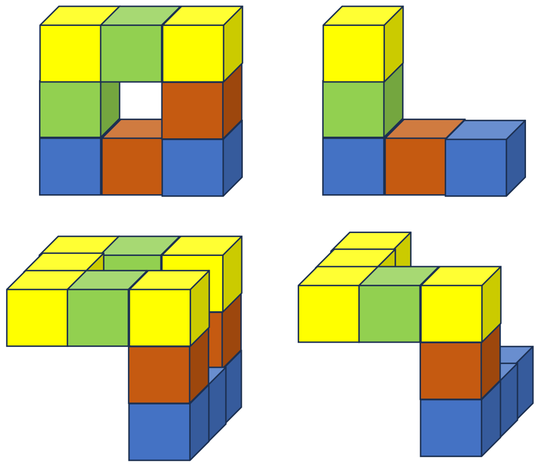
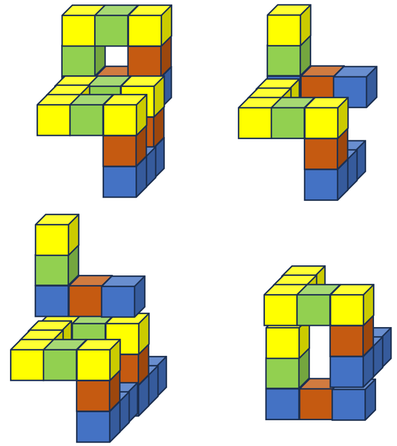
Scalability in KNIME : Nodes and Component



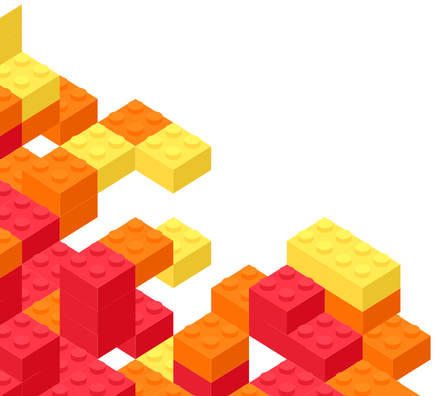
Single
Functions



Nodes Combination as
Component



Workflows



Python Script
Python Extension

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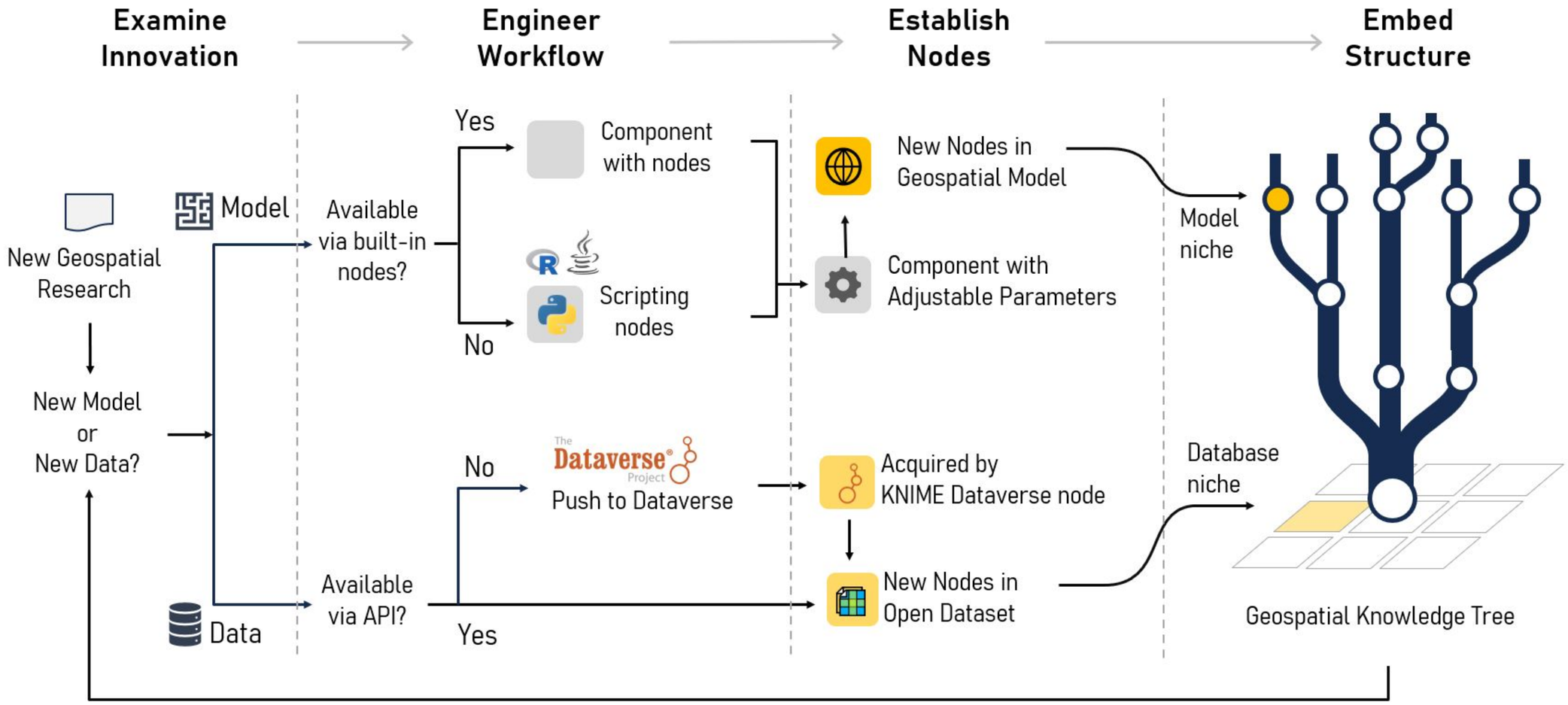
Framework for Developing Geospatial Extension



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KNIME

Geospatial Analytics Extension for KNIME

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Basic Functions in KNIME

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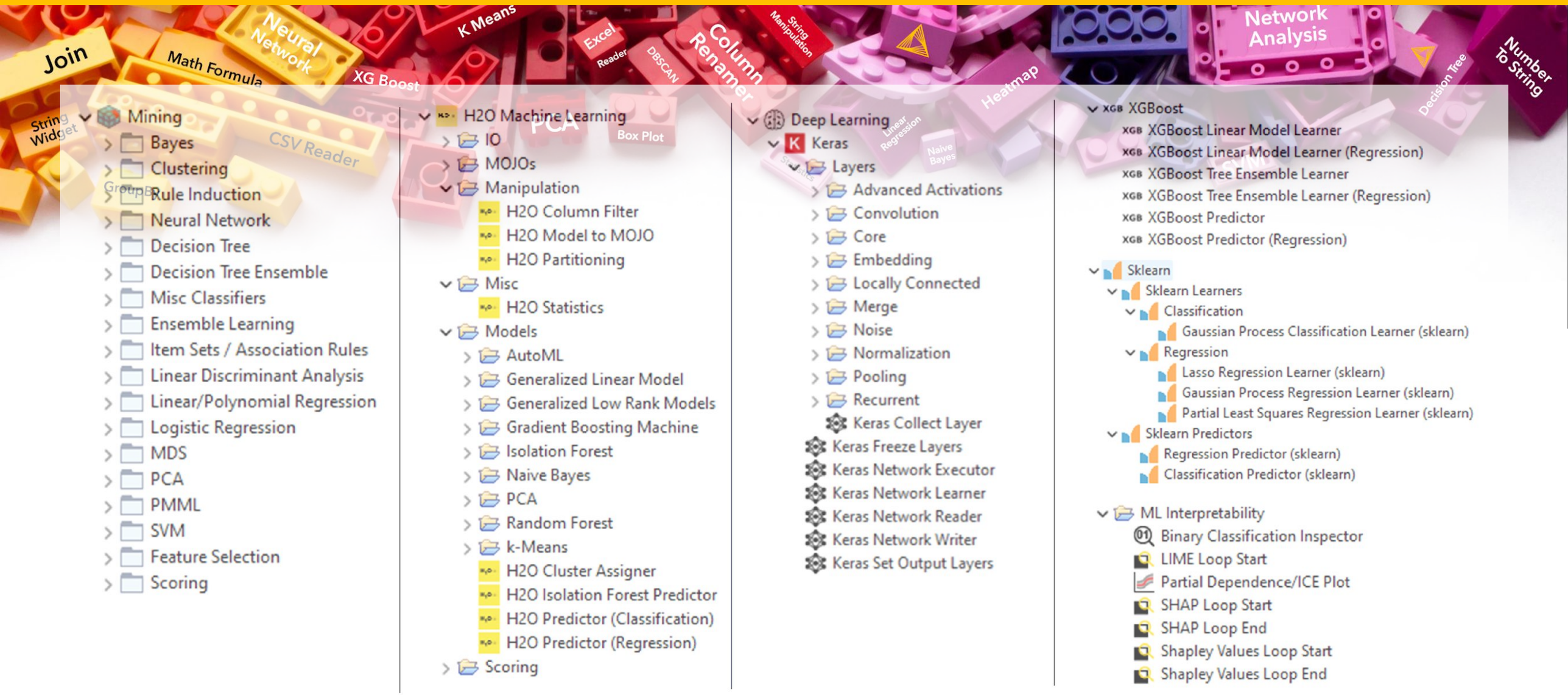
Advanced Functions in KNIME



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Geospatial Analytics Extension For KNIME

Latest Version 1.2.0

Spatial IO

Spatial Calculation

Spatial Manipulation

Spatial Transformation

Spatial Conversion

Spatial Visualization

Exploratory Spatial Data Analysis

Spatial Modelling

Location Analysis

Spatial Network

Open Dataset

Spatial Clustering

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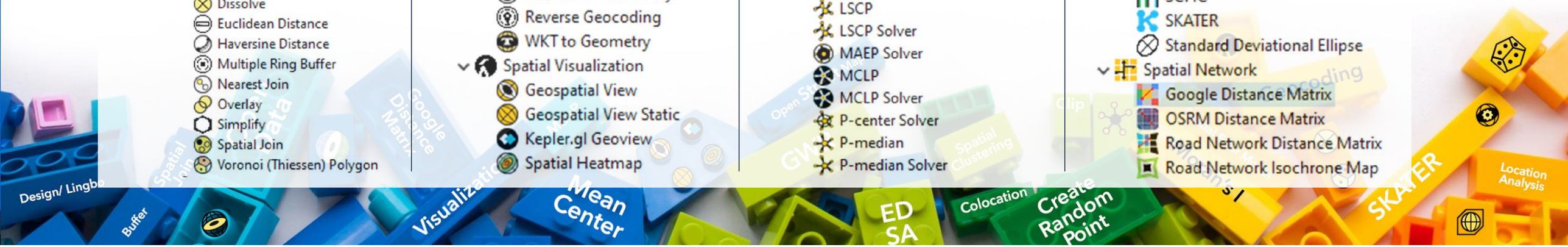
Geospatial Analytics Extension For KNIME

Latest Version 1.2.0

- Spatial IO
  - GeoFile Reader
  - GeoFile Writer
  - GeoPackage Reader
  - GeoPackage Writer
- Spatial Calculation
  - Area
  - Bounding Box
  - Bounding Circle
  - Bounds
  - Convex Hull
  - Coordinates XYZ
  - Length
  - Line Endpoints
  - Total Bounds
  - Unary Union
- Spatial Manipulation
  - Buffer
  - Clip
  - Create Grid
  - Dissolve
  - Euclidean Distance
  - Haversine Distance
  - Multiple Ring Buffer
  - Nearest Join
  - Overlay
  - Simplify
  - Spatial Join
  - Voronoi (Thiessen) Polygon
- Spatial Transformation
  - Create Random Points
  - Geometry To Point
  - Line To MultiPoint
  - Multipart To Singlepart
  - Points To Line
  - Polygon To Line
  - Projection
- Spatial Conversion
  - GeoJSON to Geometry
  - Geocoding
  - Geometry to GeoJSON
  - Geometry to Lat/Long
  - Geometry to Metadata
  - Geometry to WKT
  - IP to Geometry
  - Lat/Lon to Geometry
  - Reverse Geocoding
  - WKT to Geometry
- Spatial Visualization
  - Geospatial View
  - Geospatial View Static
  - Kepler.gl Geoview
  - Spatial Heatmap
- Exploratory Spatial Data Analysis
  - Global Geary's C
  - Global Getis-Ord G
  - Global Moran's I
  - Local Getis-Ord G
  - Local Moran's I
  - Spatial Weights
- Spatial Modelling
  - 2SLS with Spatial Test
  - GWR Model
  - GWR Predictor
  - MGWR Model
  - OLS with Spatial Test
  - Spatial Error Model
  - Spatial Error Panel Model
  - Spatial Lag Model
  - Spatial Lag Panel Model
- Location Analysis
  - LSCP
  - LSCP Solver
  - MAEP Solver
  - MCLP
  - MCLP Solver
  - P-center Solver
  - P-median
  - P-median Solver
- Open Datasets
  - OSM Boundary Map
  - OSM POIs
  - OSM Road Network
  - US ACS 5-Year Estimates
  - US2020 Census Data
  - US2020 TIGER Map
- Spatial Clustering
  - MSSC Initialization
  - MSSC Refiner
  - AZP
  - Isolation Tackler
  - MaxP
  - Mean Center
  - Peano Curve
  - REDCAP
  - SCHC
  - SKATER
  - Standard Deviational Ellipse
- Spatial Network
  - Google Distance Matrix
  - OSRM Distance Matrix
  - Road Network Distance Matrix
  - Road Network Isochrone Map



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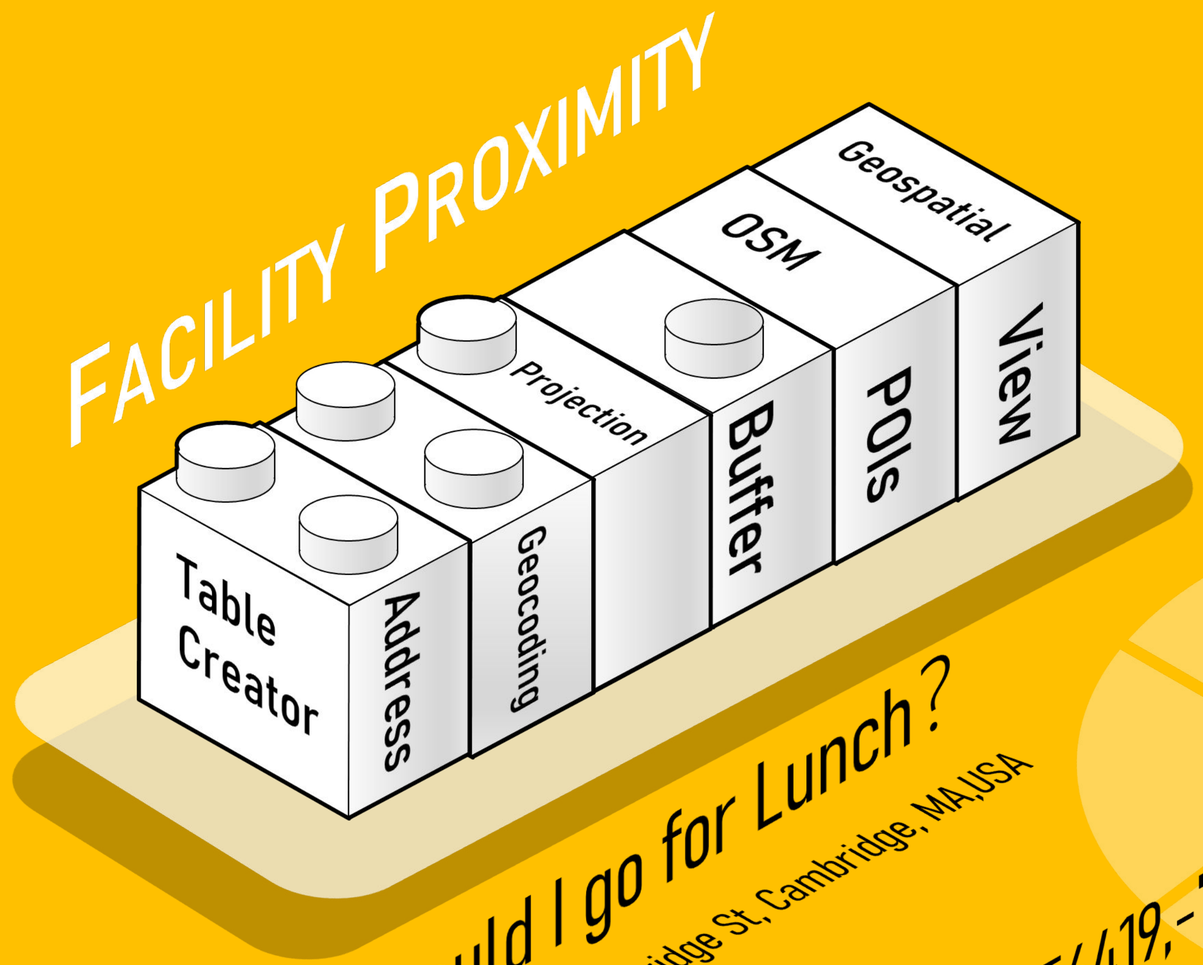
Case study 1 : Find Nearest Restaurant

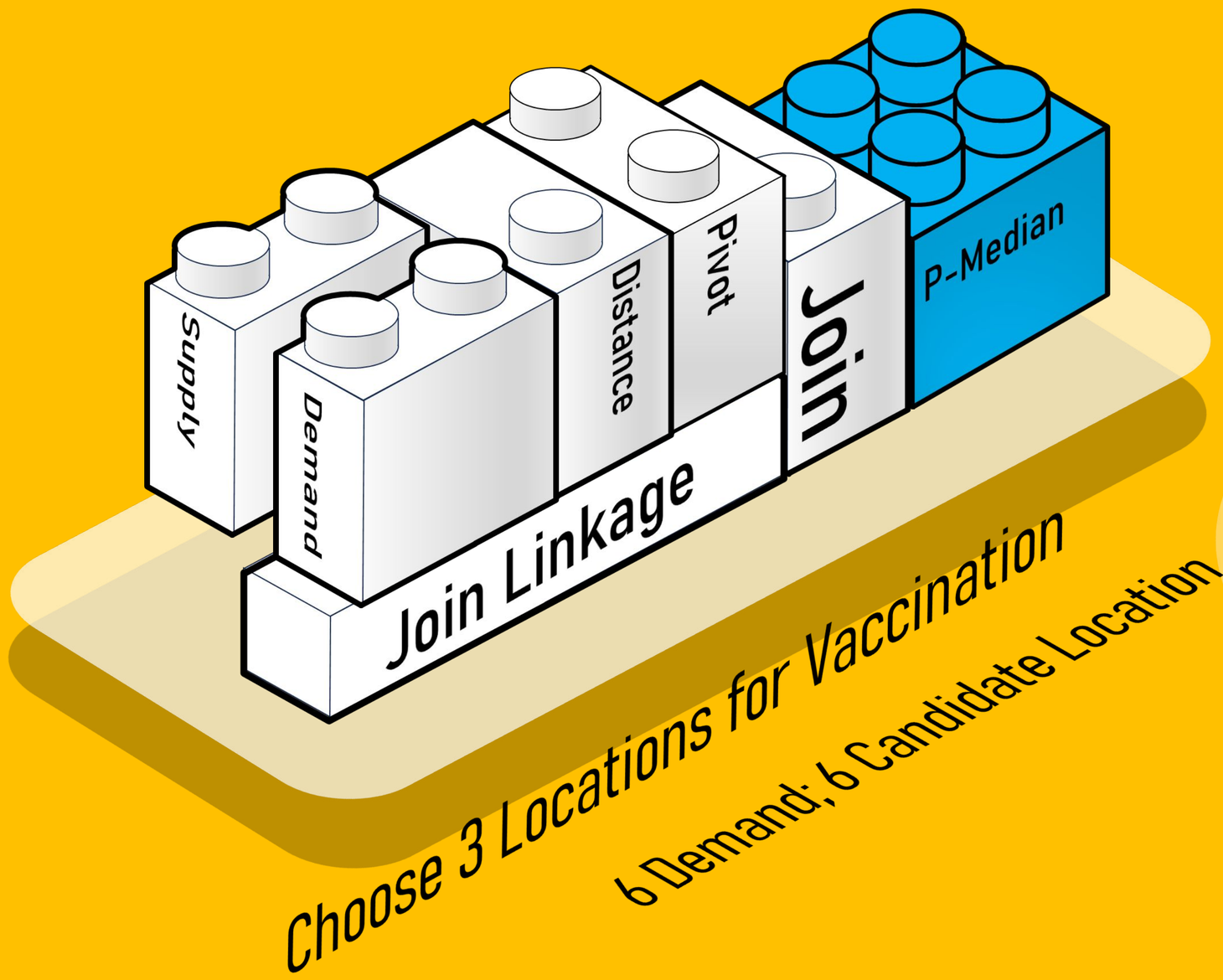


Where should I go for Lunch?

1737 Cambridge St, Cambridge, MA,USA

42.3756419,-71.1158105

Case study 2 : location-allocation



Choose 3 Locations for Vaccination

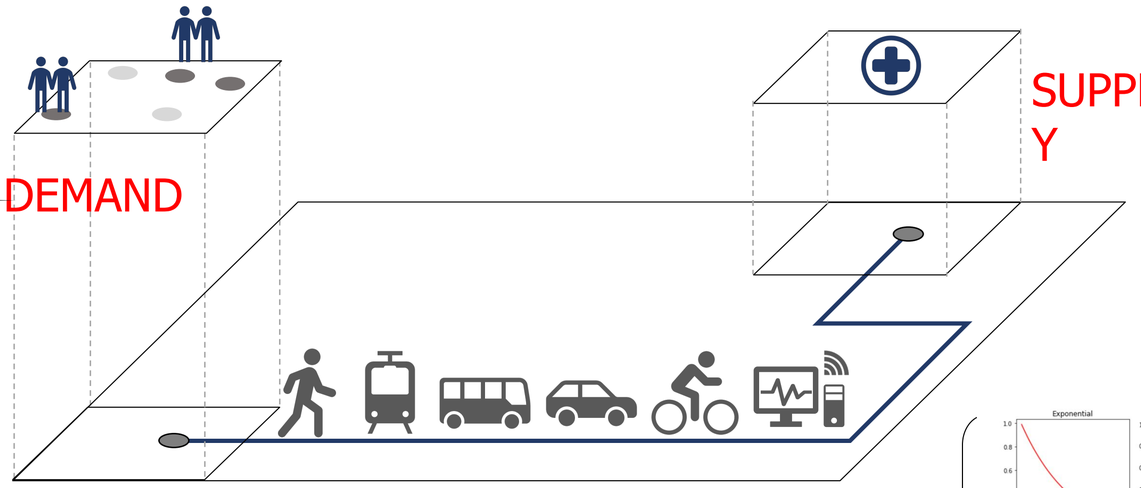
6 Demand; 6 Candidate Location

Case study 3: Healthcare Accessibility

SCALE

Different Group
Urban/rural
Ethnic groups
Income
Age

DEMAND



SUPPL
Y

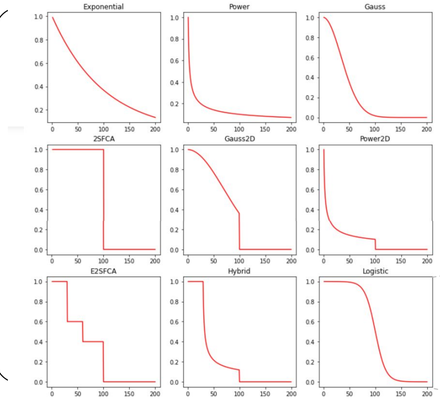
Different Resources
Specialty
Capacity
Service boundary

Network distance
Euclidean distance

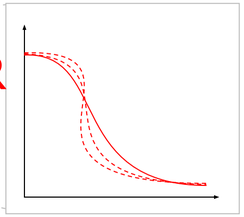
Various Travel mode
Time cost
Expenditure
Departure time

TRAVEL COST
d

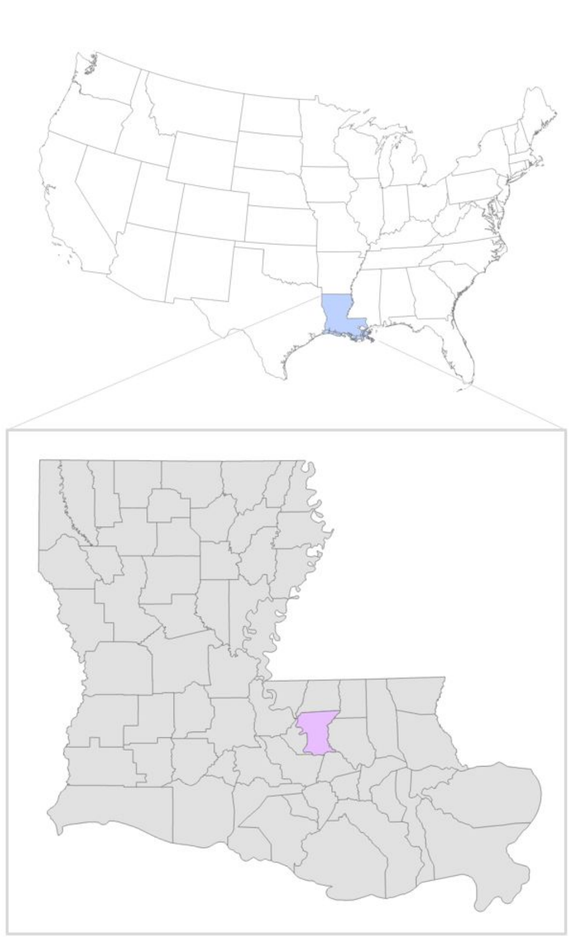
MODEL
f (d)



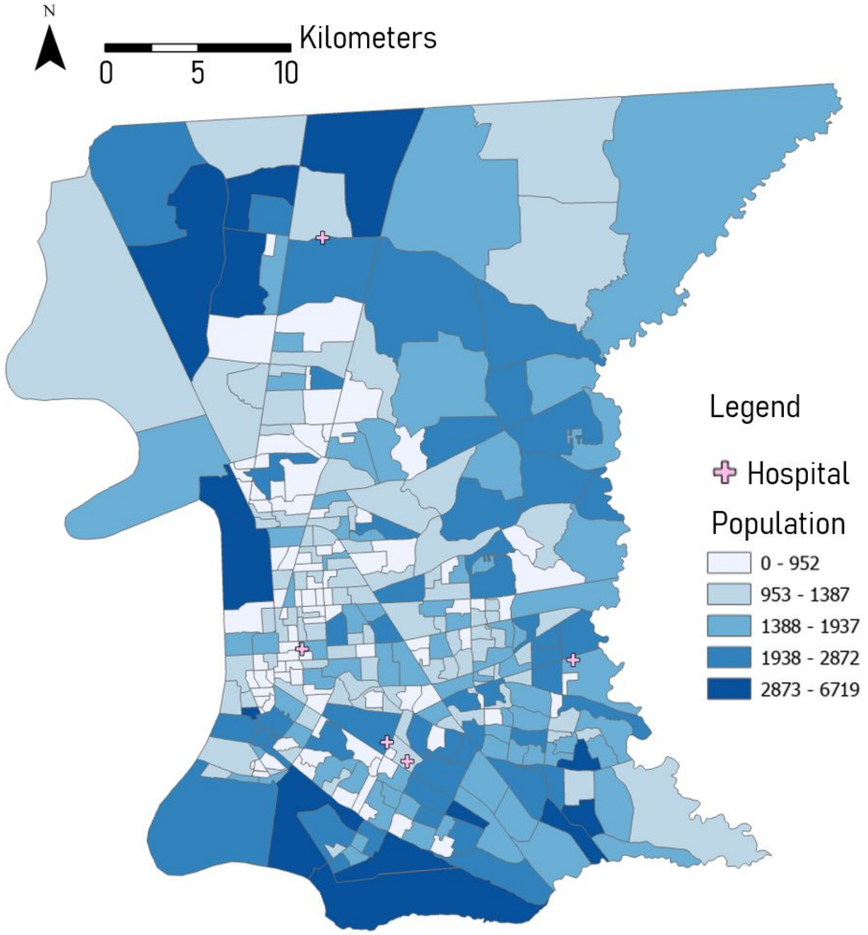
PARAMETER



Case study 3: Healthcare Accessibility

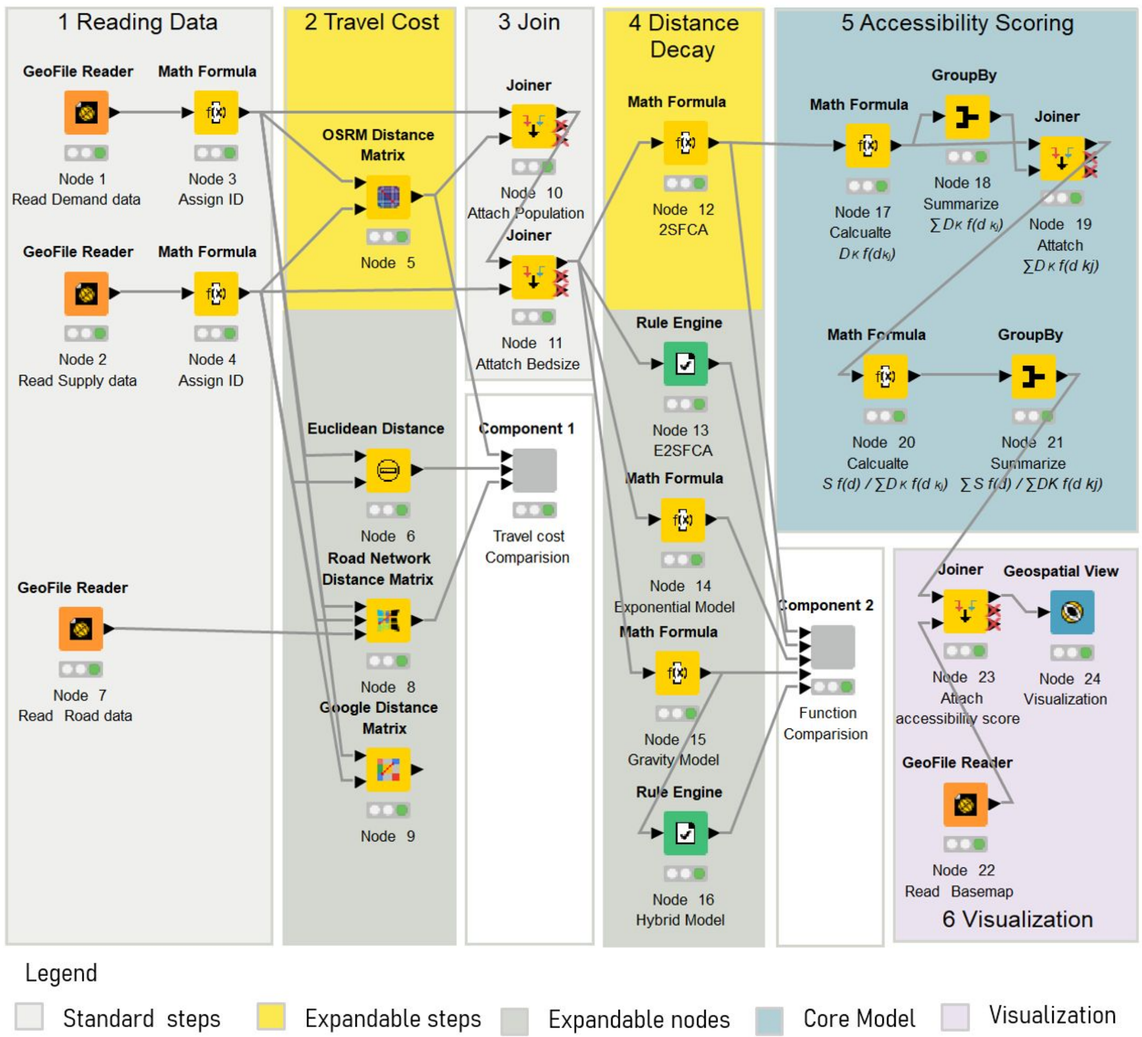


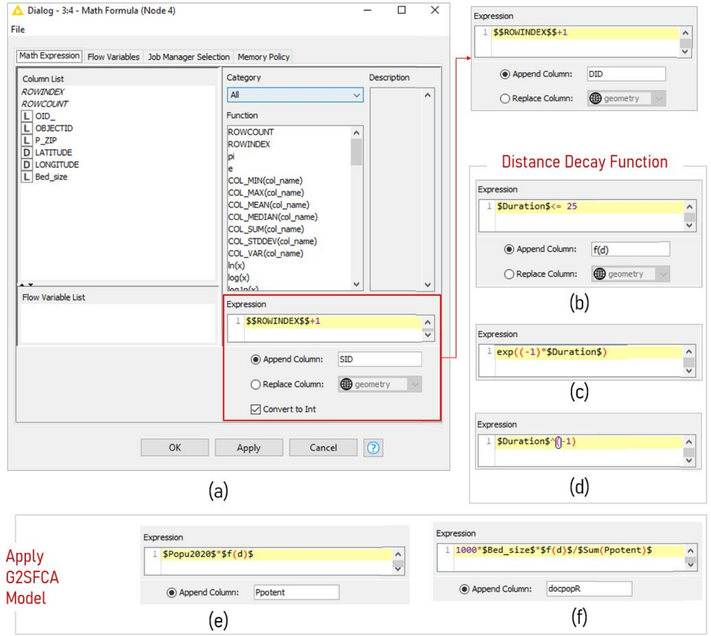
(a)



(b)

KNIME workflow for implementing G2SFCA





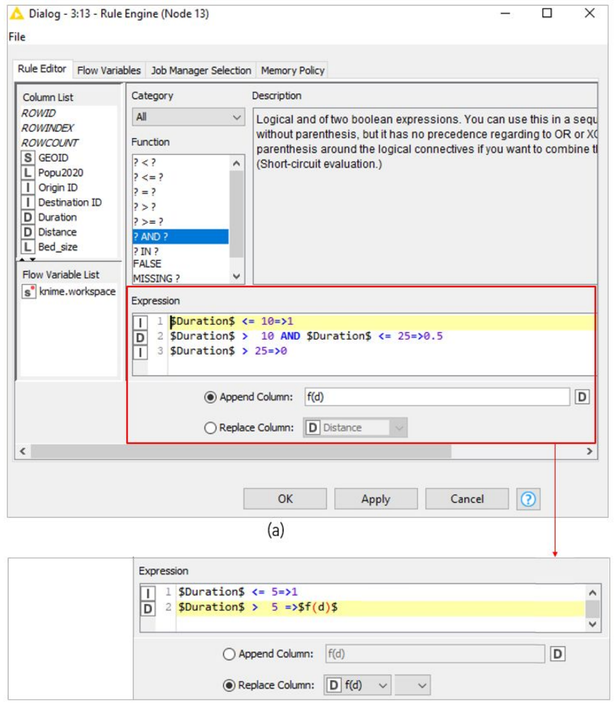


Figure 6 . KNIME workflow for G2SFCA model

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Component in KNIME workflow

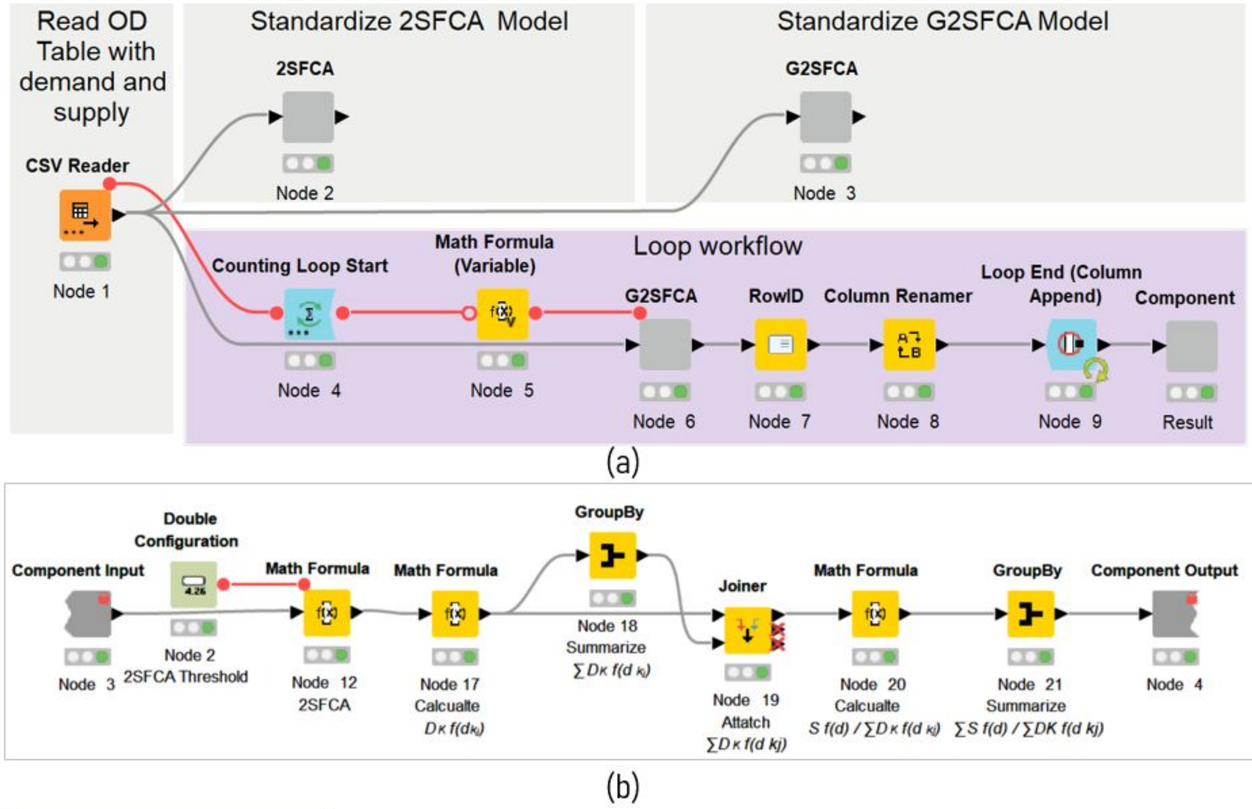
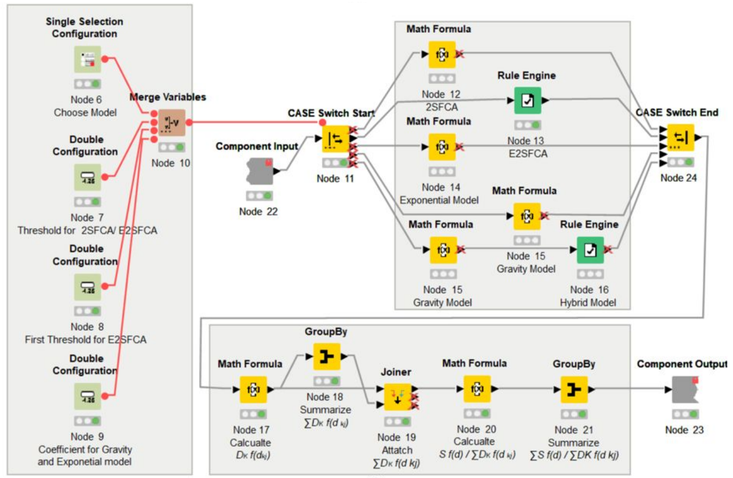


Figure 7: (a) A refined workflow for using component of 2SFCA and G2SFCA, and its sub-workflows inside the components of (b) 2SFCA Model and (C) G2SFCA



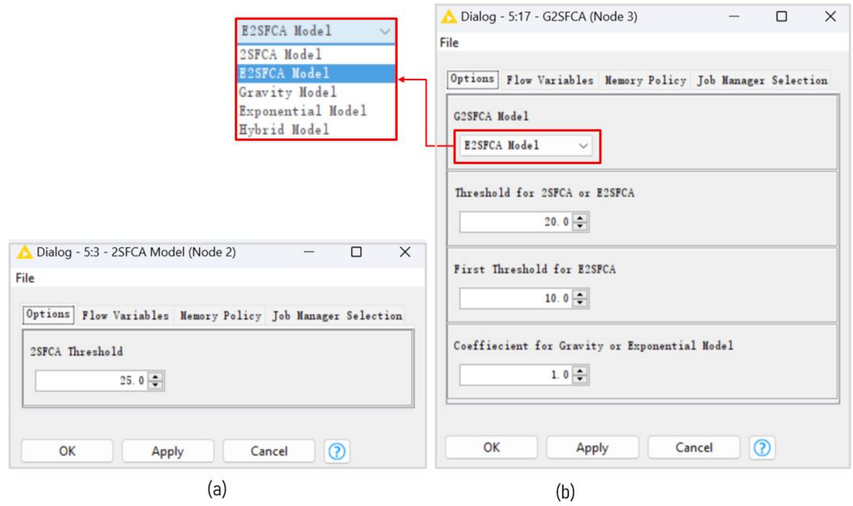


Figure 8: Interface of the components (a) 2SFCA and (b) G2SFCA

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Knowledge tree of healthcare accessibility

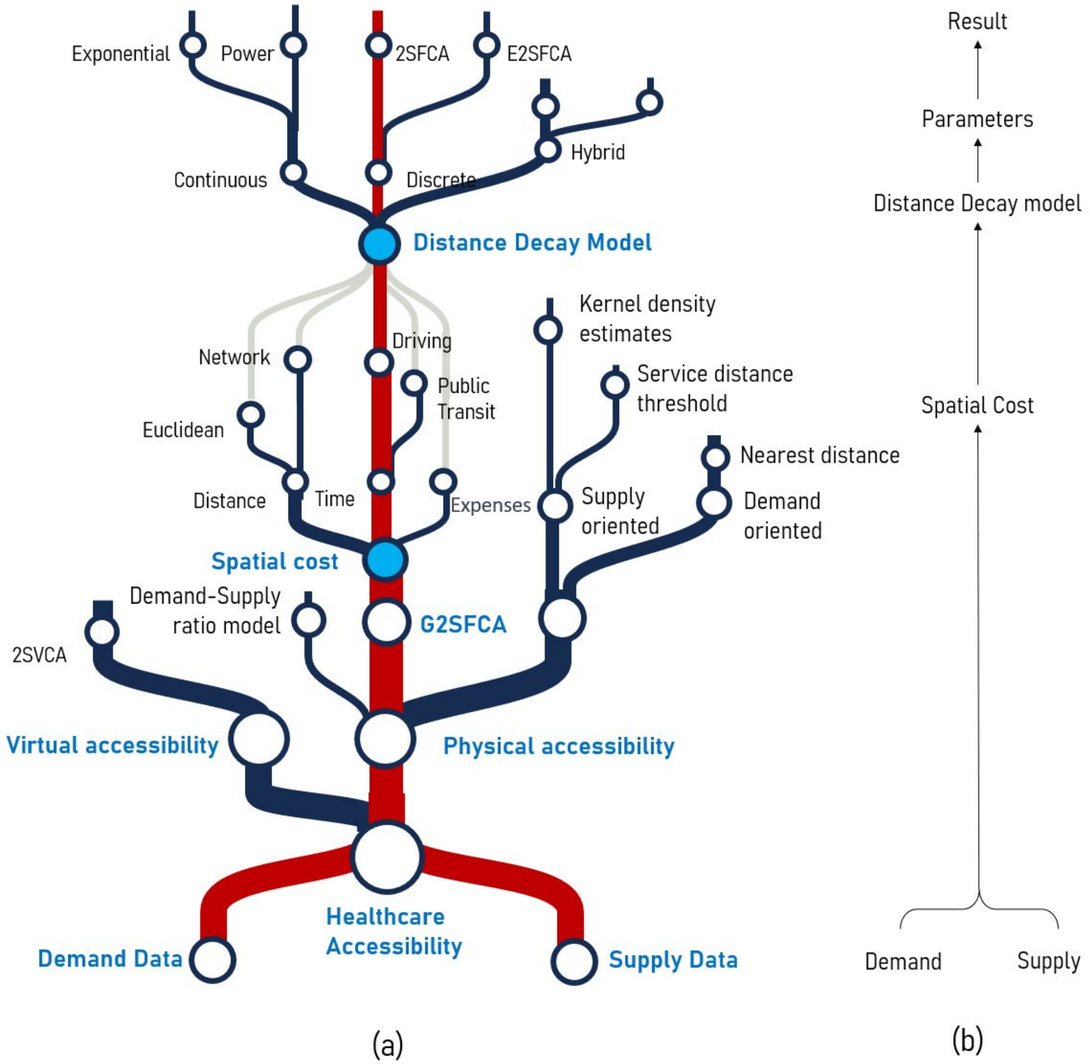

Figure 12. (a) Knowledge tree of healthcare accessibility, and (b) conceptual workflow for G2SFCA model

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Executable Textbook in KNIME

Title
Objective
Methodology
Data

Upload Download Refresh

Result Dashboard

Step 1: Preliminary exploration of Input Data

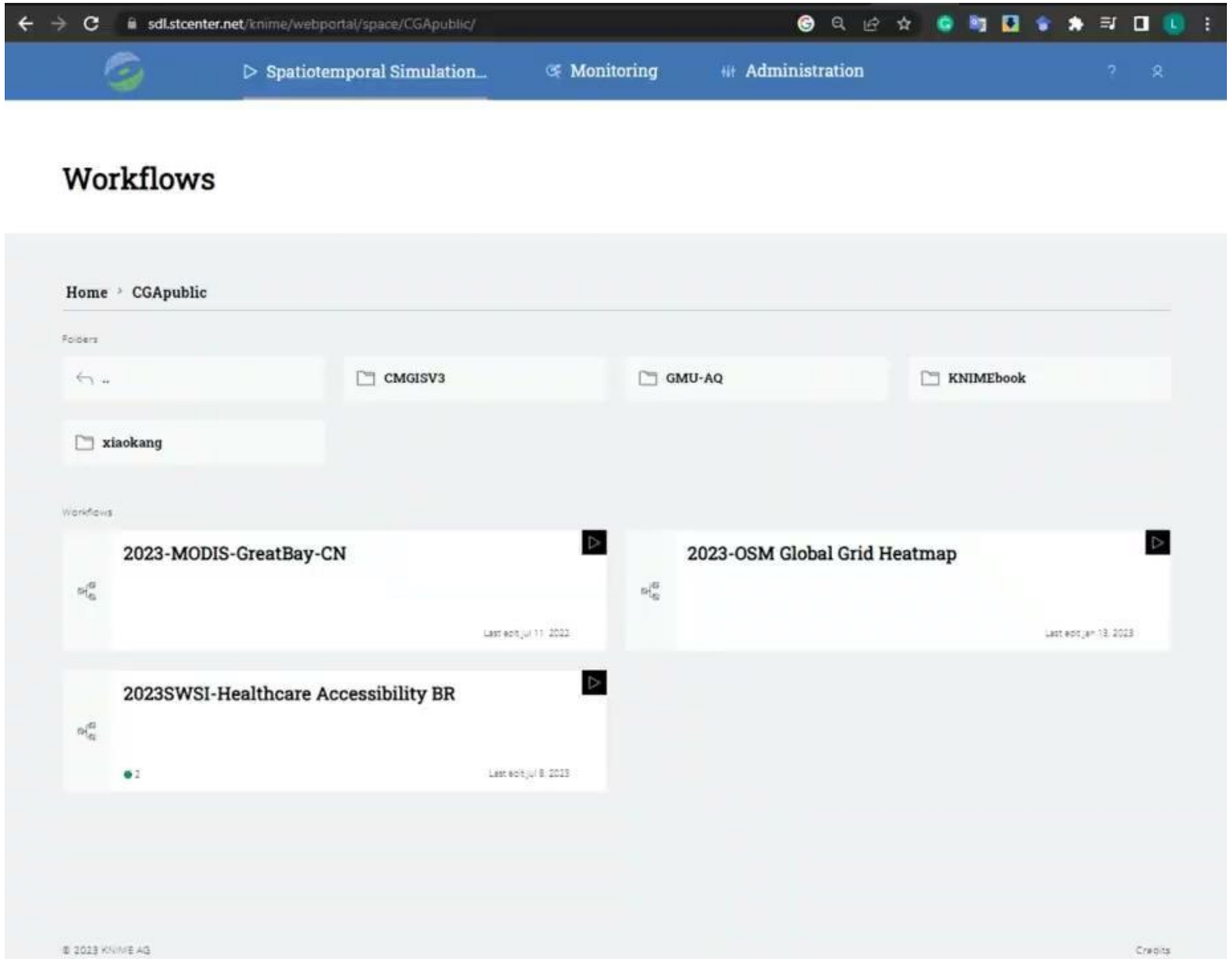
Explanation
Interoperable Text Input

Step 2: Model Parameter Setting and Adjustment

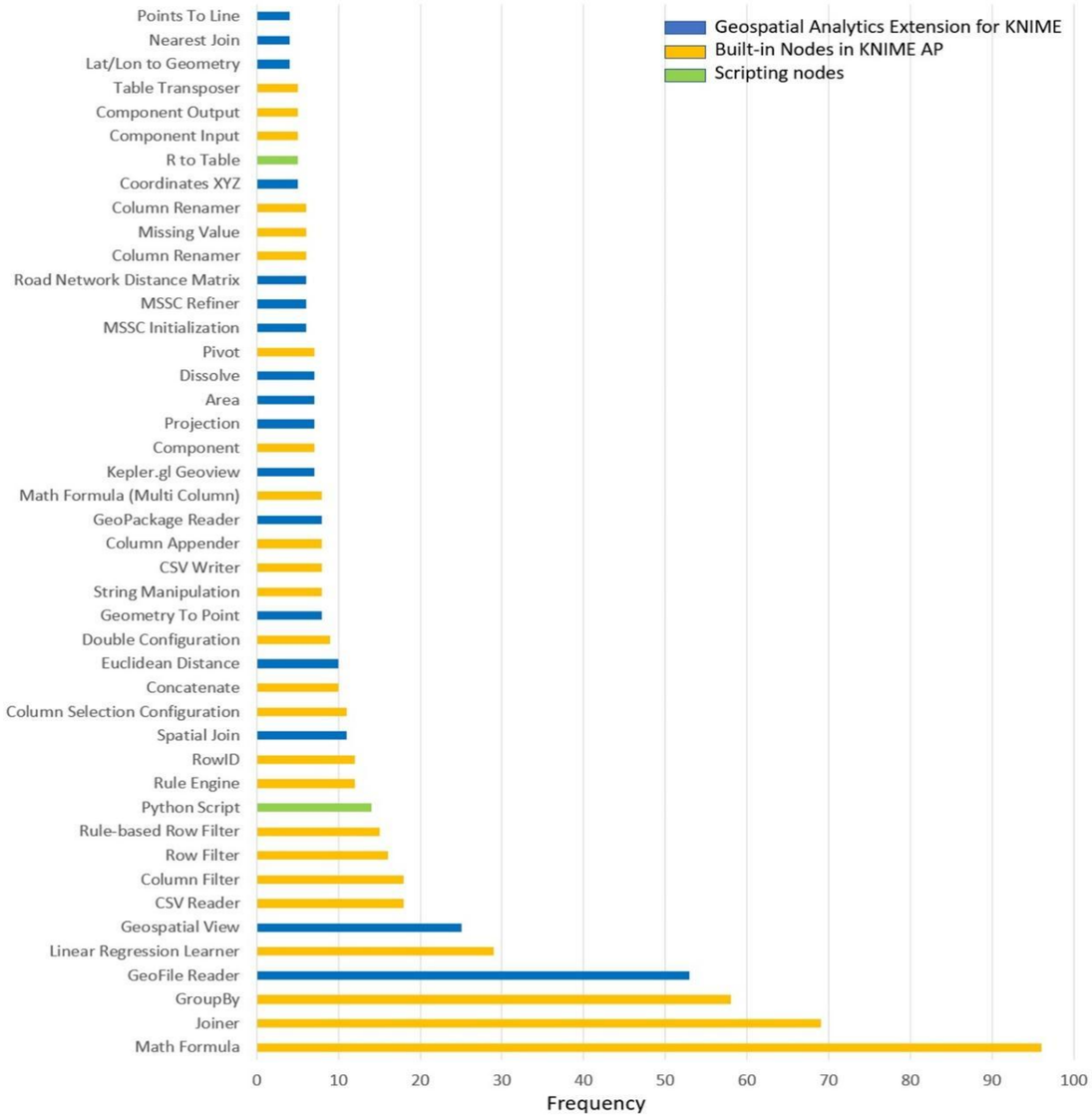
Parameter 1
Parameter ·····

Step 3: Result based on fixed parameters

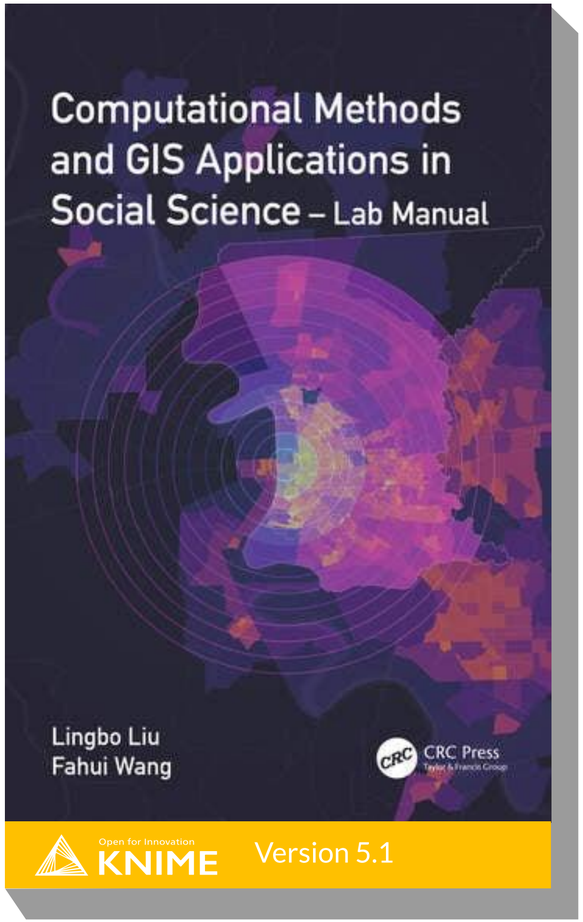
Explanation



Visual Programming nodes Comparison



Publish Date 8/15/2023



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Install KNIME and GAEK

https://www.knime.com/downloads

Download KNIME

Windows

Microsoft Defender SmartScreen may block download in its attempt to prevent malicious software installations.
To solve the problem click here.

KNIME Analytics Platform for Windows (installer) *The installer adds an icon to the desktop and suggests suitable memory settings*	Download
KNIME Analytics Platform for Windows (self-extracting archive) *The self-extracting archive only creates a folder holding the KNIME installation*	Download
KNIME Analytics Platform for Windows (zip archive)	Download

Linux

KNIME Analytics Platform for Linux	Download

Mac

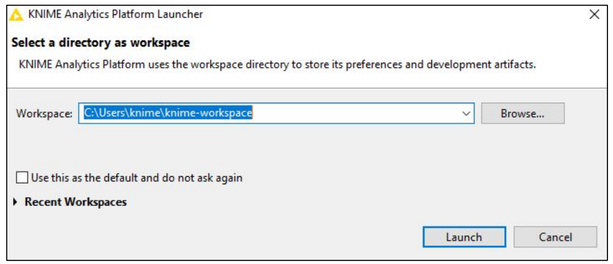
KNIME Analytics Platform for macOS x86_64 (Intel)	Download
KNIME Analytics Platform for macOS arm64 (Apple silicon)	Download

launch KNIME via the Knime.exe

knime.ini Xmx2048m -> Xmx8g

KNIME Workspace

folder/directory in which workflows (and potentially data files) are stored for the current KNIME session. Portable (just like KNIME).




```
-Xmx2048m
-Dorg.eclipse.swt.browser.IEVersion=11001
-Dsun.awt.noerasebackground=true
-Dequinox.statechange.timeout=30000
-Darrow.enable_unsafe_memory_access=true
-Darrow.memory.debug.allocator=false
-Darrow.enable_null_check_for_get=false
--add-opens=java.security.jgss/sun.security.jgss.krb5=ALL-UNNAMED
--add-exports=java.security.jgss/sun.security.jgss=ALL-UNNAMED
--add-exports=java.security.jgss/sun.security.jgss.spi=ALL-UNNAMED
```

Install GAEK

In KNIME> File> Install KNIME extension, input ‘geo’

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Acknowledgement

Open for Innovation KNIME

IQSS The Institute for Quantitative Social Science

NSF U/I CRC

Future Data Lab

George Mason University

Spatiotemporal Thinking, Computing and Applications STC

Spatiotemporal Innovation Center

https://projects.iq.harvard.edu/chinadatalab

https://github.com/spatial-data-lab/knime-geospatial-extension