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IMPROVING SPATIAL ANALYSIS METHODS WITH COMPUTATIONAL INTELLIGENCE

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The Users' Characteristics

Students, Workers, Elderly, etc.

The CI Classification Model

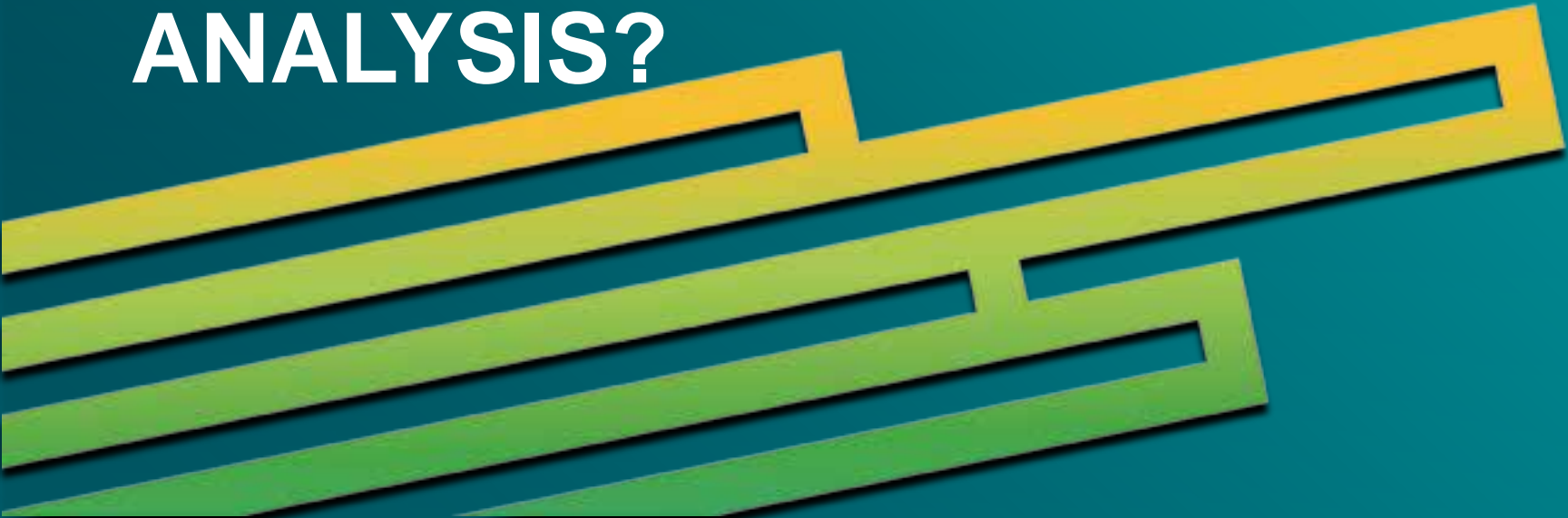
Routing Network Design with ArcGIS

CI Model and routing Integration using ArcPy Demo

The evolution to a BigData perspective

USERS

WHY THEY NEED INTELLIGENT
ANALYSIS?



Workers

Daily commuters

Reason: Work and sometimes study

Principal Mode: Metro or RBT

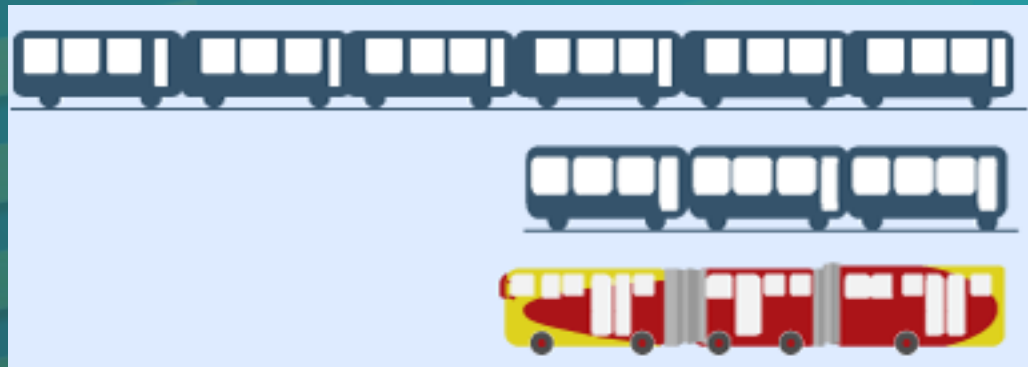
Decision Factor: Speed



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http://laud.udistrital.edu.co/sites/default/files/images/tarjeta%20de%20transmilenio_0.jpg

Retrieved From: <http://metrodebogota.gov.co/por-que-necesitamos-el-metro/>



Occupation	Employee
Education	High School, Technicians, Professionals
Socio-Economical Status	Average Income
Age	20 to 50
Distance to Stops	Not Relevant

Students

Daily commuters

Reason: go to study during school season

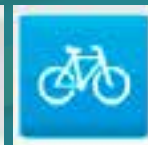
Principal Mode: RBT

Decision Factor: Cost

Occupation	Student
Education	High School, College, University
Socio-Economical Status	Low or Average Income
Age	15 to 25
Distance to Stops	Relatively close



Retrieved From: http://www.terra.com.co/addon/img/noticias/12219abtransmilenio_619.jpg



Elderly

Occasional commuters

Reason: Multiple

Principal Mode: SITP

Decision Factor: Comfort

Occupation	Not Relevant
Education	High School, Technicians, Professionals
Socio-Economical Status	Low or Average Income
Age	More than 60
Distance to Stops	Close



Retrieved From:

<http://st.elespectador.co/files/images/feb2009/ef185f9676bde451d54c658c38b16900.jpg>

Retrieved From: <http://m.semana.com/especiales/por-que-exploto-transmilenio/phone/index.html>



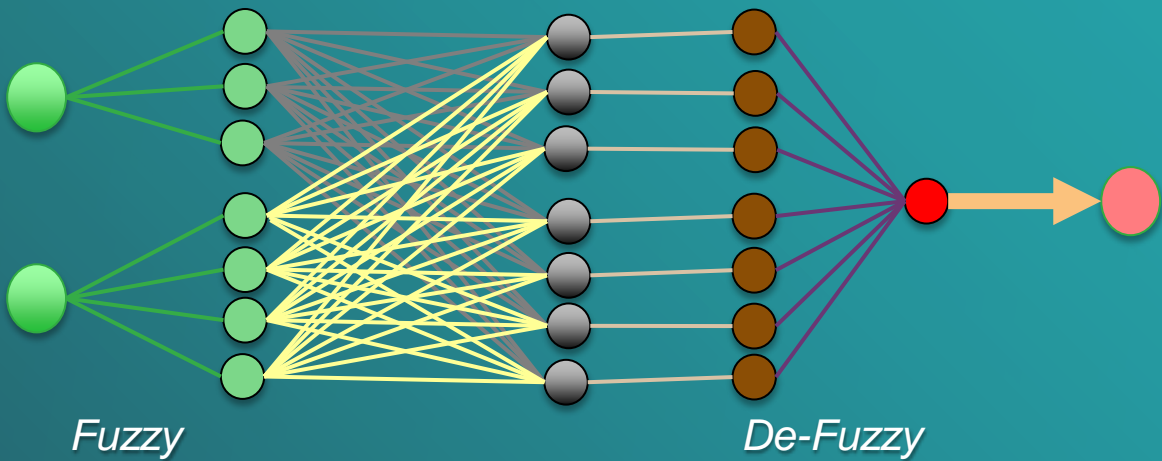
CI MODEL

HOW TO CLASSIFY USERS WITH
COMPUTATIONAL INTELLIGENCE?



Two of Multiple CI Classification Models

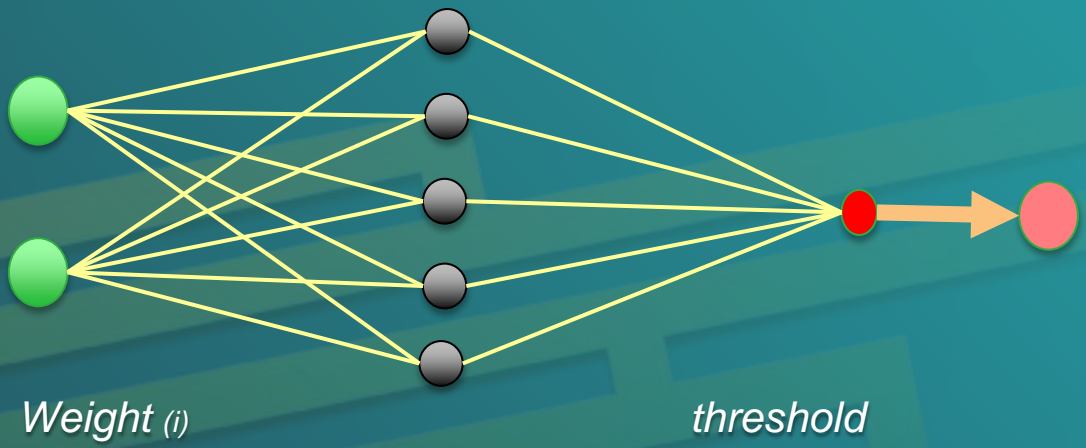
ANFIS



Input:
Start Time
Initial Stop
Final Stop
Age
Gender
Education
Occupation
Income level
Stop Distance
Special Pop.

Output:
Preferred
Mode

ANN

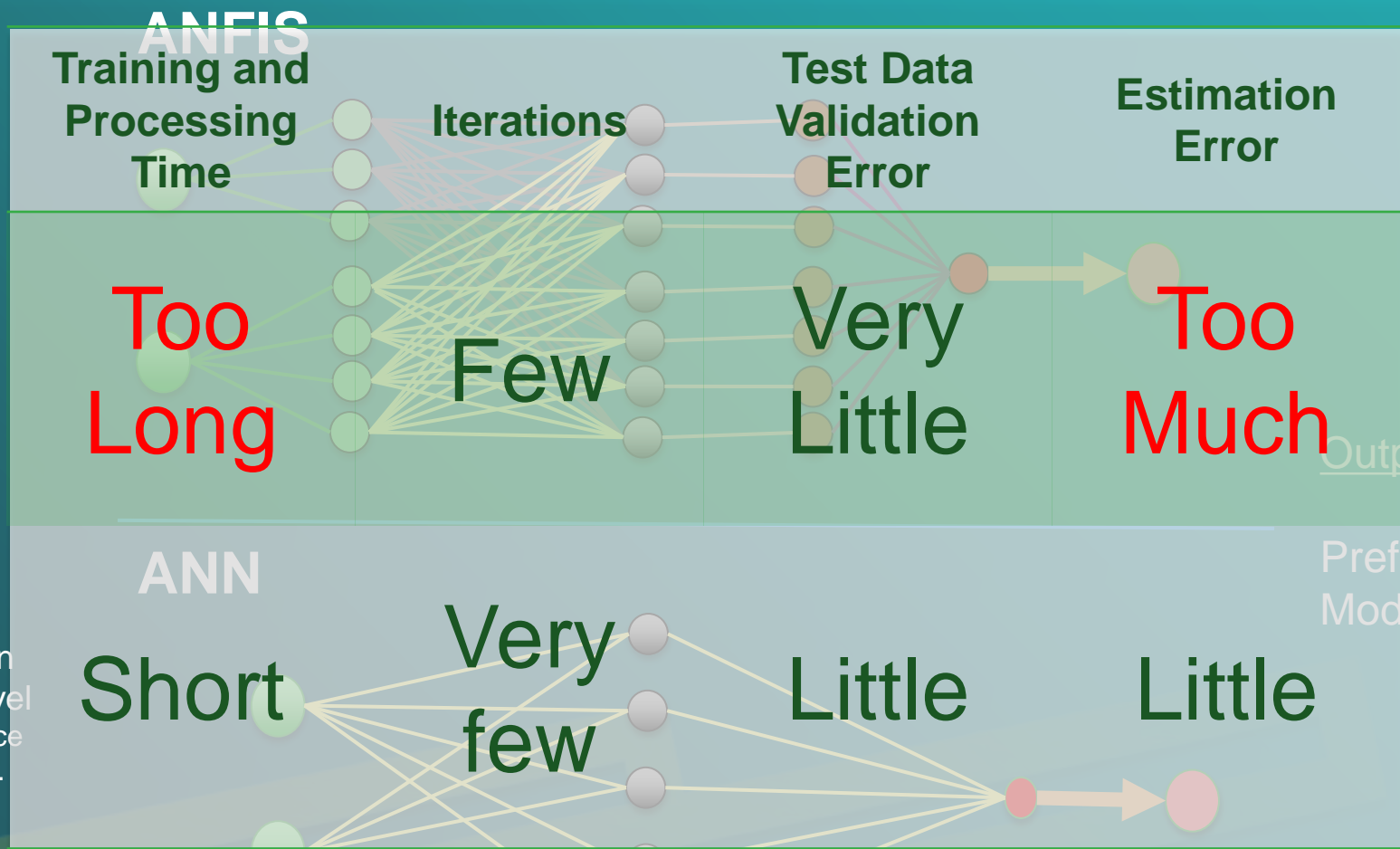


Weight (i)

threshold

Two of Multiple CI Classification Models

- Input:
- Start Time
 - Initial Stop
 - Final Stop
 - Age
 - Gender
 - Education
 - Occupation
 - Income level
 - Stop Distance
 - Special Pop.



Output:

Preferred Mode

NETWORK

BEYOND A NETWORK DATASET



Network Attributes - Impedance

Mode	Speed	Worker Factor	Students Factor	Elderly Factor
Metro	35 Km/h	<u>1,0</u>	1,5	1,5
Cable	20 Km/h	1,3	1,2	1,1
RBT	26 Km/h	<u>1,0</u>	<u>1,0</u>	1,7
SITP	19,3 Km/h	1,7	1,1	<u>1,0</u>
Walk	3,5 Km/h	2,0	1,3	2,0

$$Weight_g(x) = Length * Group Factor$$



2,0: Not Preferred

1,0: Preferred

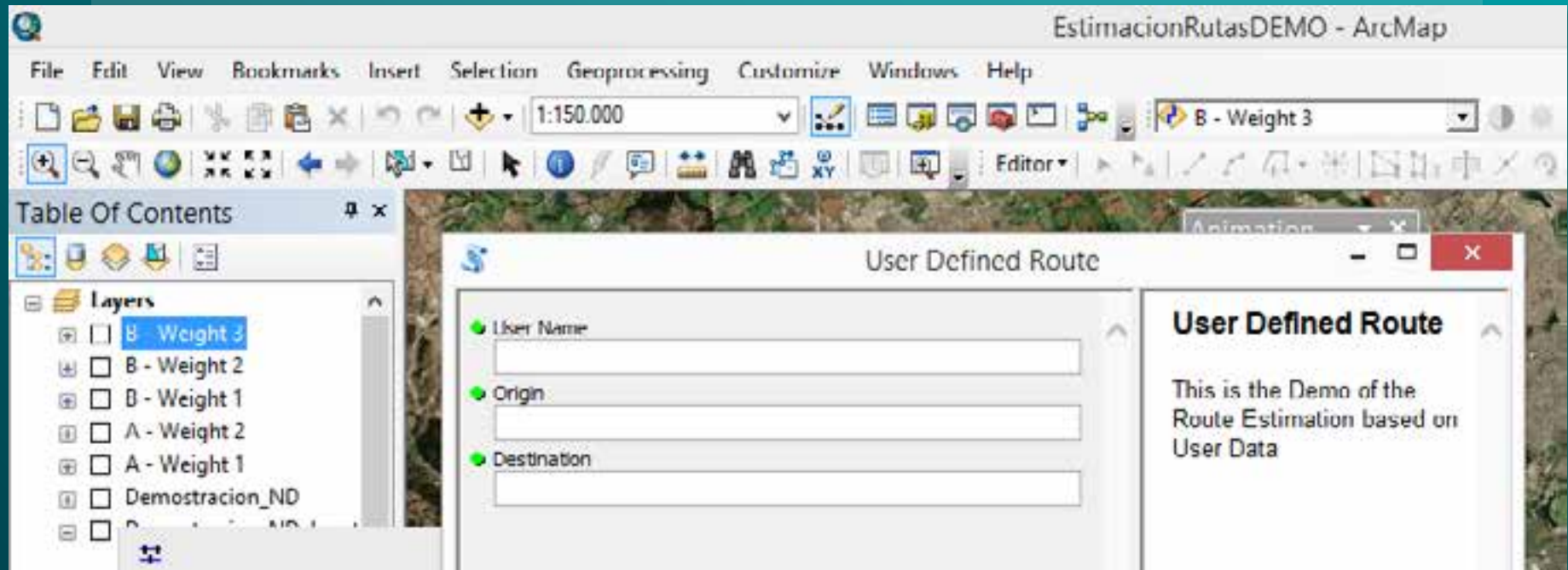
Every user should belong to a Group

ArcPy

GREAT INTEGRATION TOOL



Python Toolbox User Interface



Additional Parameters for routing

```
21
22 def getParameterInfo(self):
23     """Defining parameters starting with route parameters adding user parameters"""
24
25     # User ID Parameter
26     param0 = arcpy.Parameter(
27         displayName="User Name",
28         name="in_userid",
29         datatype="GPString",
30         parameterType="Required",
31         direction="Input")
32     # User ID Parameter
```

Python Toolbox Structure

A. Route Layer

```
46
47 """Setting up the Route Layer"""
48 arcpy.env.workspace = "C:/ArcTutor/Network Analyst/Tutorial/SanFrancisco.gdb"
49 """
50 arcpy.na.MakeRouteLayer("Network_Dataset", "Output_NA_Layer",
51     "Impedance_Att", ["Accumulate", "ALLS"])
52 """
53 arcpy.na.MakeRouteLayer("Demostracion/Demostracion_ND", "WorkersRoute",
54     "Weight_g1", ["Weight_g1"] )
55
```

B. Add Locations

Should be selected from ID

```
95
96 AddLocations_na (in_network_analysis_layer, sub_layer, in_table,
97     field_mappings, search_tolerance, {sort_field})
98 """
99 fieldMappings = arcpy.na.NAClassFieldMappings(outNALayer,
100     EndingFile, True, candidateFields)
101
102 arcpy.na.AddLocations("WorkersRoute", "Stops", "Demostracion/RouteStart",
103     fieldMappings, "10 Meters", "FID")
104
```

C. Solve D. Display

From User Inputs

DEMO

THREE ALTERNATIVES



Video



BIG DATA

HOW IT SEEMS TO BE!



MapReduce

Map Job

```
{  
  "User": "usuer_diego",  
  "date": "jan-01-01 09:12:42",  
  "from": [ 4.25, -74.25],  
  "to":  
  "route": "R21",  
  "mode": "RBT",  
  "itinerary": {  
    "stop_start": "AD2563",  
    "stop1": "AD4566",  
    ...  
  }  
}
```

```
{  
  "Workers_1": "1"  
}
```

```
{  
  "RBT": "1"  
}
```

Considering:
User and *Trip*
Characteristics

Considering:
Proportion of use

Reduce Job

```
{  
  "workers_1": "26987",  
  "workers_2": "5698463",  
  ...  
  "Students_4": "5654897985",  
  ...  
}
```

```
{  
  "RBT": "456987985656",  
  "Metro": "5984562316",  
  "SITP": "2156748551498",  
  "Tram": "156489321656",  
  ...  
}
```

Target:
Understand users'
dynamics and
tendency

Bullets

- CI Is highly related to BigData Analysis,
- User preferences could be analyzed via MapReduce
- Mayor dynamic could be identified
- Temporal variations are available for analysis
 - Impact measure of policy changes
- Every city has its own problems, dynamics and solutions
- BigData y Natural partner of GIS
- Python is the “Natural Link” of this two technologies
 - Even More...

Conclusion

How it would work for Bogotá



Challenges in Colombia - Bogotá

Political

Transport Planning Organizations are interested?

They are interested but do not like changes

Do they trust in Academia Results?

Academia must analyze real application problems

How to convince?

Being clear on how to catch user's interest (benefits)

Technical

How to get data from users?

Via Mobile and wearable devices

How to make results usable?

Better Users interfaces

What to change in Colombia's public policy?

ORGANIZATIONAL MINDS

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