SoundCasting at PSRC:

Activity-Based Model Development with Emme

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INRO Conference, Seattle
October 2014

Puget Sound Regional Council
PSRC

Overview

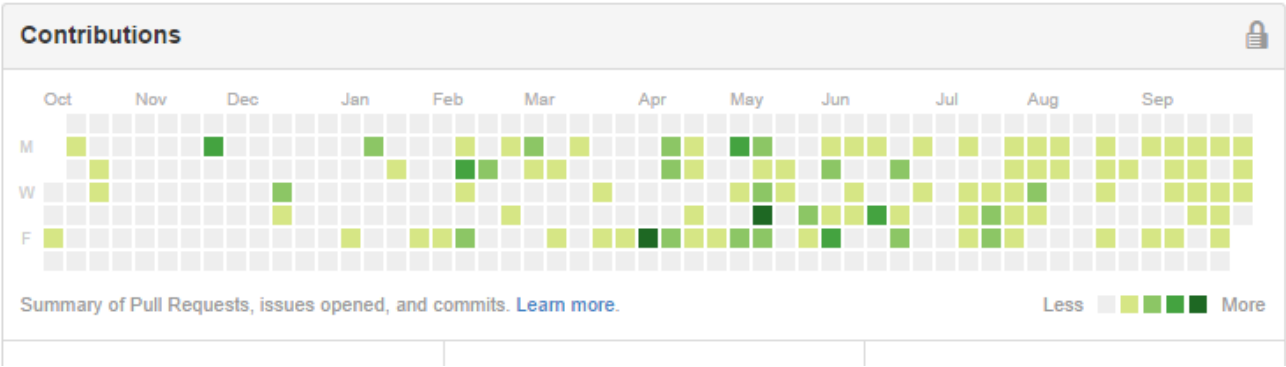
- **SoundCast** is:
  - PSRC's nearly-complete activity-based model
  - A model "package" including DaySim activity generation models as well as assignment and skimming with Emme
- In this presentation:
  - SoundCast model structure
  - Managing model development and code
  - Interfacing DaySim models with Emme
  - Lessons learned in Emme and Python

Development and Philosophy

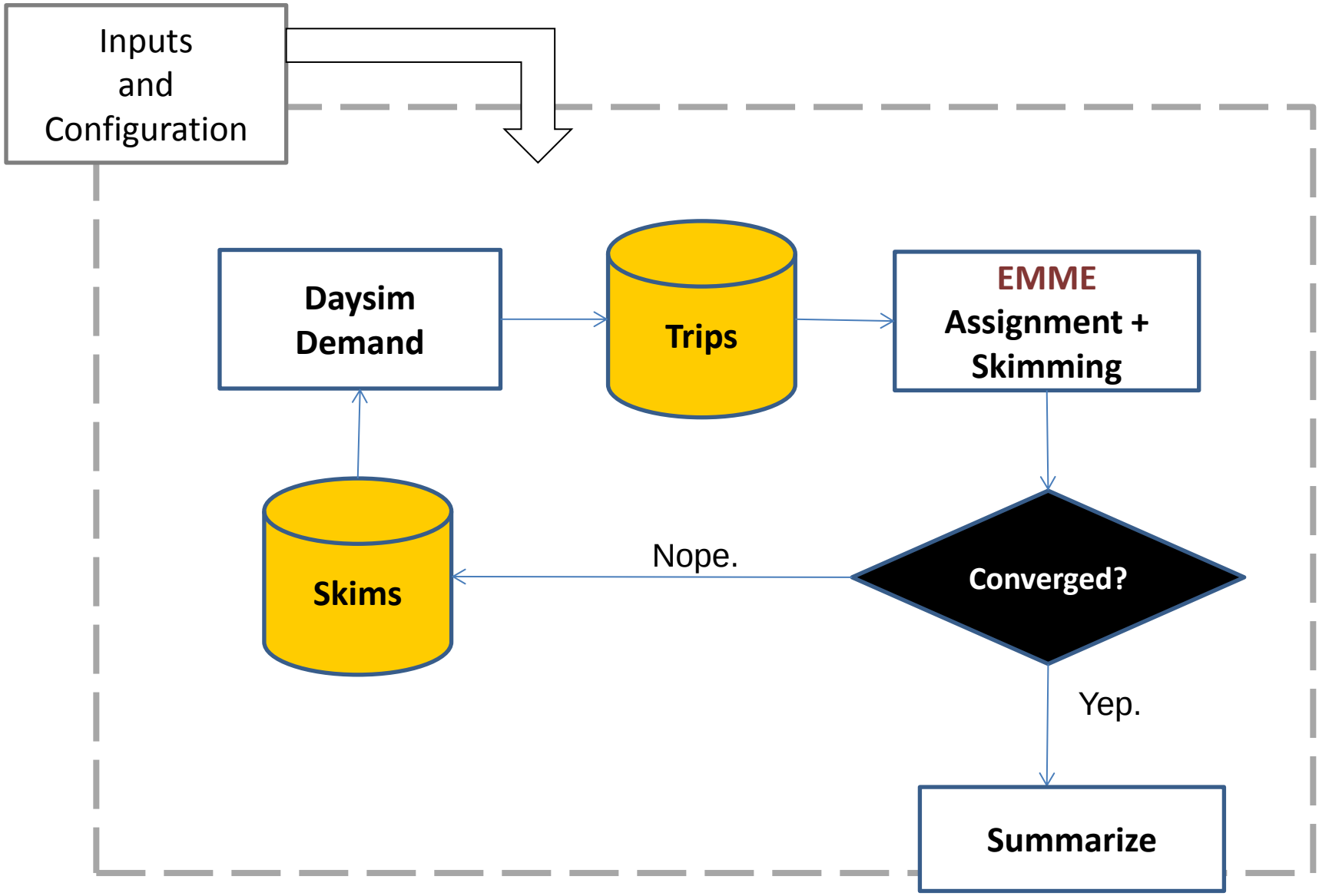
- SoundCast is **open source**, to build:
  - Transparency
    - To public, partner agencies
  - Accessibility
    - for model users
  - Developer community
    - Of travel modelers sharing tips, techniques, results, code
- We encourage other Emme-based modelers to follow this approach!

Development and Philosophy (2)

- Version control and open-source hosting with **GitHub**
  - Helps manage internal code development
  - Controls model releases
    - Easier to share, run, and manage model versions
    - Helps keep track of versions used for analyses



Model Structure



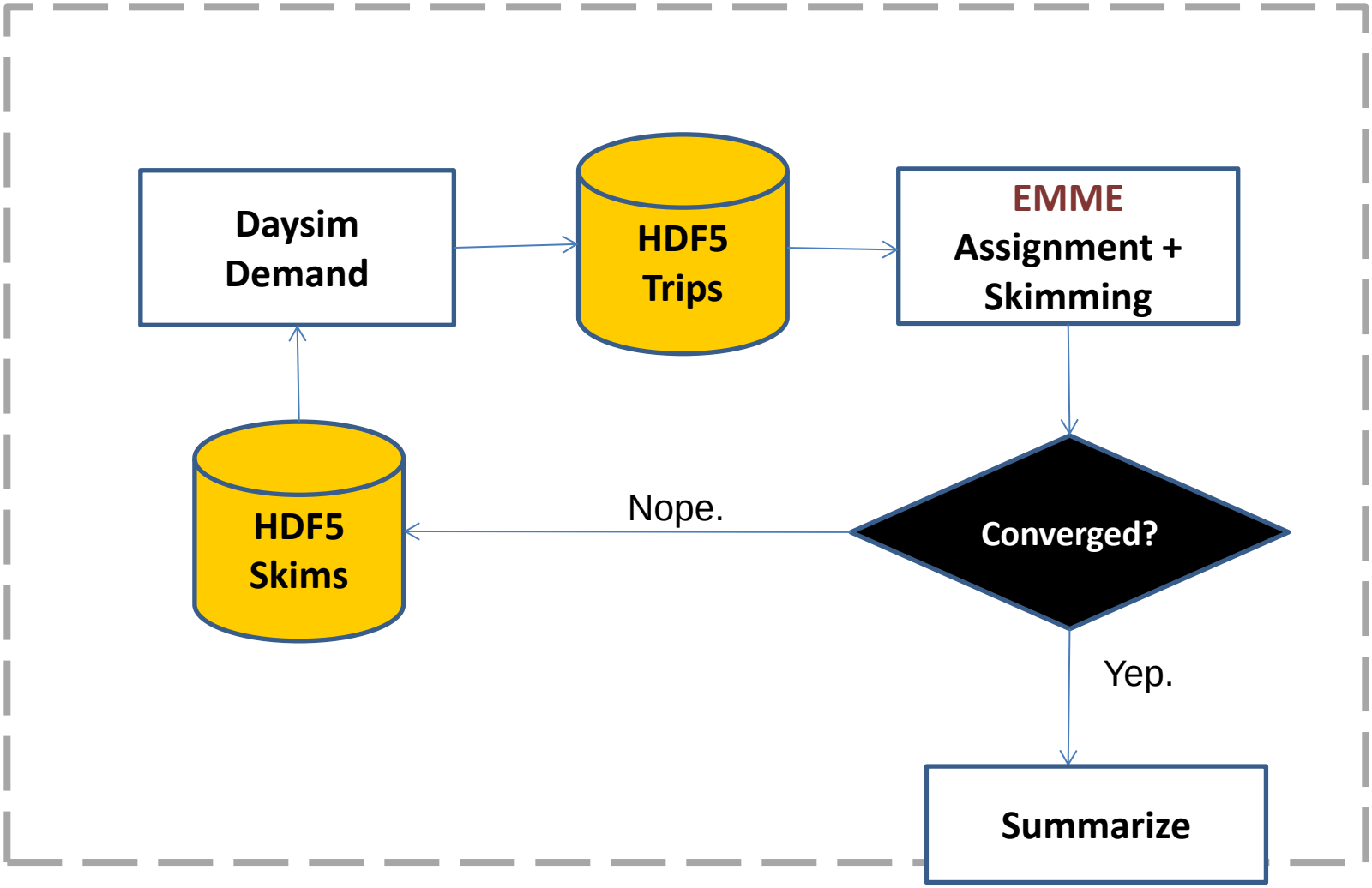
Python Controller Scripts

- Python scripts control the “arrows” in the model structure
  - Set run iterations, convergence, process flow
  - Initializes directories, projects, banks
  - Controls demand models
  - Transfers data from demand model to Emme for assignment and skimming
  - Tests for convergence
  - Summarizes model results

Input Configuration

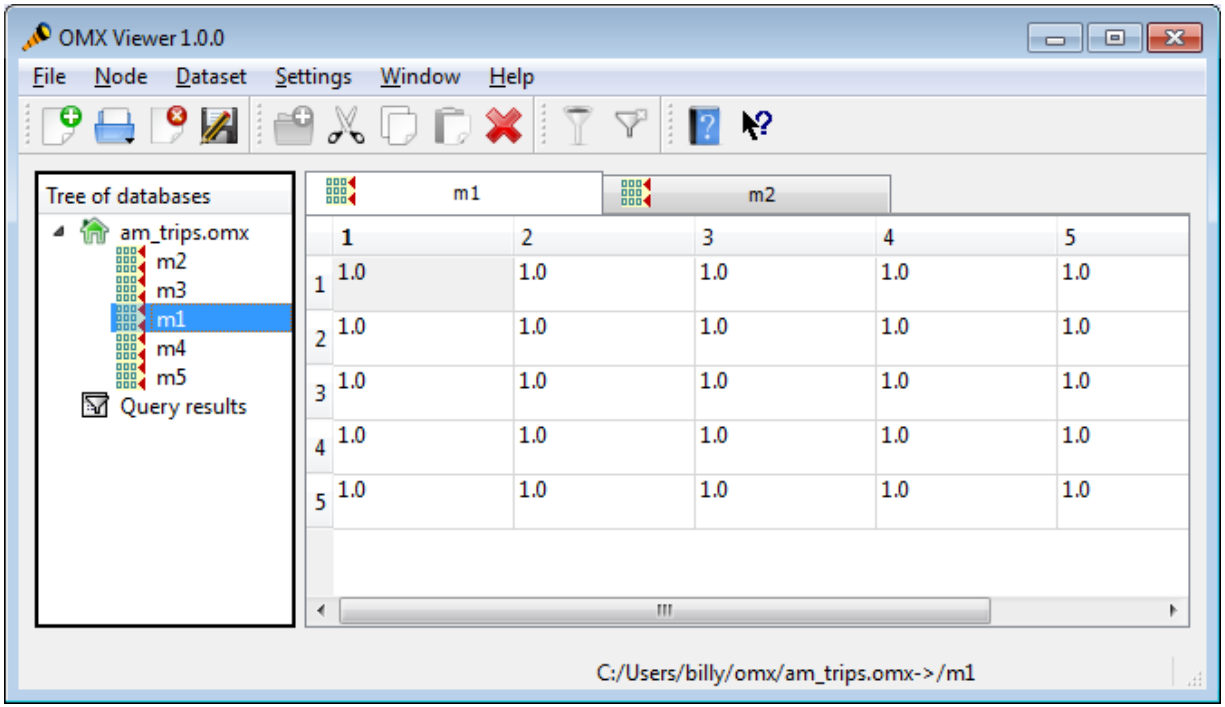
- Runs are managed by an “input configuration” file
- Switch on/off model processes like:
  - Basic directory setups
  - Use seed trips, run assignment only
  - Run specific sub-models like truck and external trips
- Holds variables and assumptions
  - Values that might change across analyses and important to quickly validate later

HDF5 Data handoffs

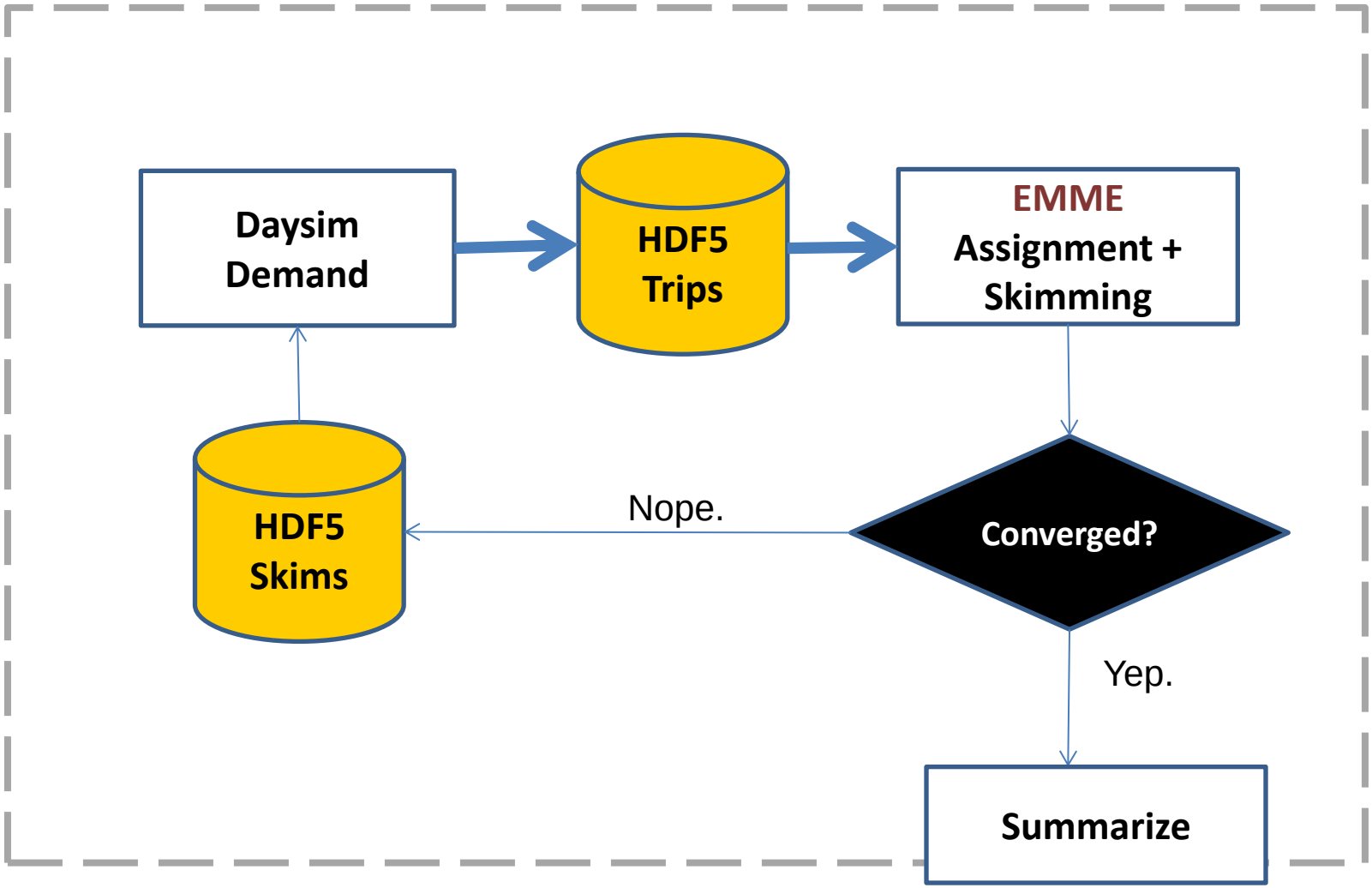


HDF5 is a more general form of Open Matrix (OMX) File Format

https://sites.google.com/site/openmodeldata/



Trips to EMME



Populating Trip Tables

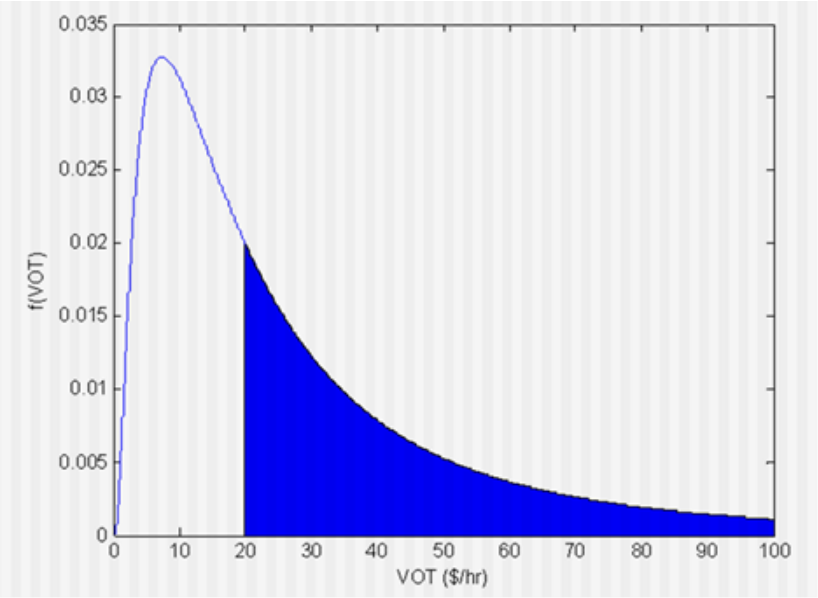
ID	Time	Mode	Origin Zone	Destination Zone
1	567	SOV	123	456
2	890	Walk	789	1011

By Mode, Time

	D				
O	1	2	3	…	3700
1					
2					
3					
…					
3700					

Value of time

Daysim Continuous

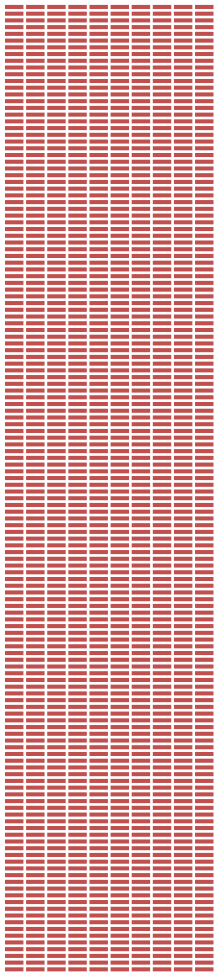


Assignment Discrete

```
if vot < 15:
        vot_category=1
elif vot < 25:
        vot_category=2
else:
        vot_category=3
```

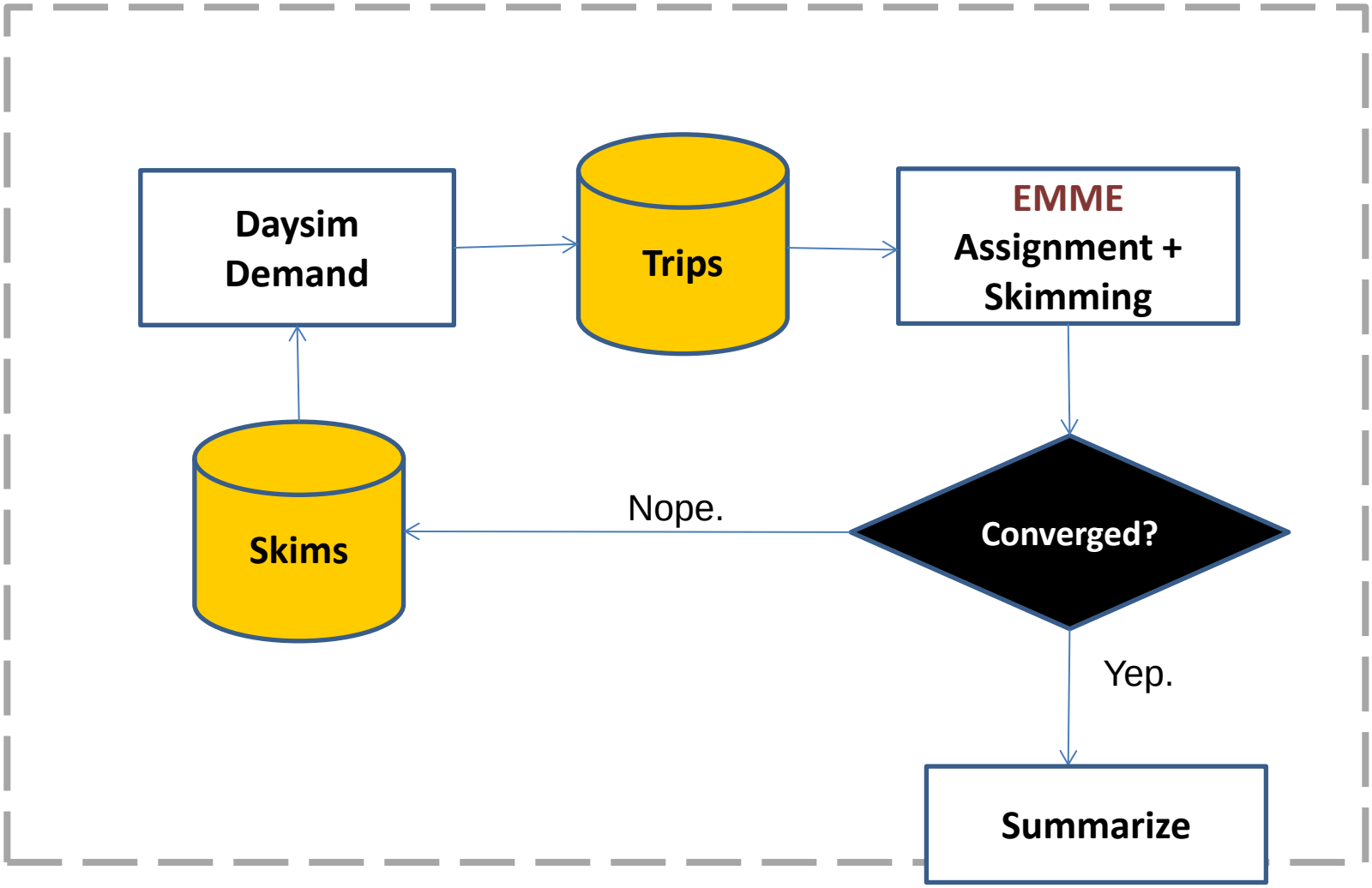
Map Minutes to 12 Periods

Daysim



Assignment

Feedback convergence



Convergence Test

Relative Trip-Weighted Average Absolute Skim Change

By John Gibb, Of DKS:

$$\frac{\sum_{ij} q|t_a - t_i|}{\sum_{ij} q t_a}$$

q = demand (trip table)
t_a = cumulative average skim travel time
t_i = this iteration travel time

When do we stop?

Configurable parameters:

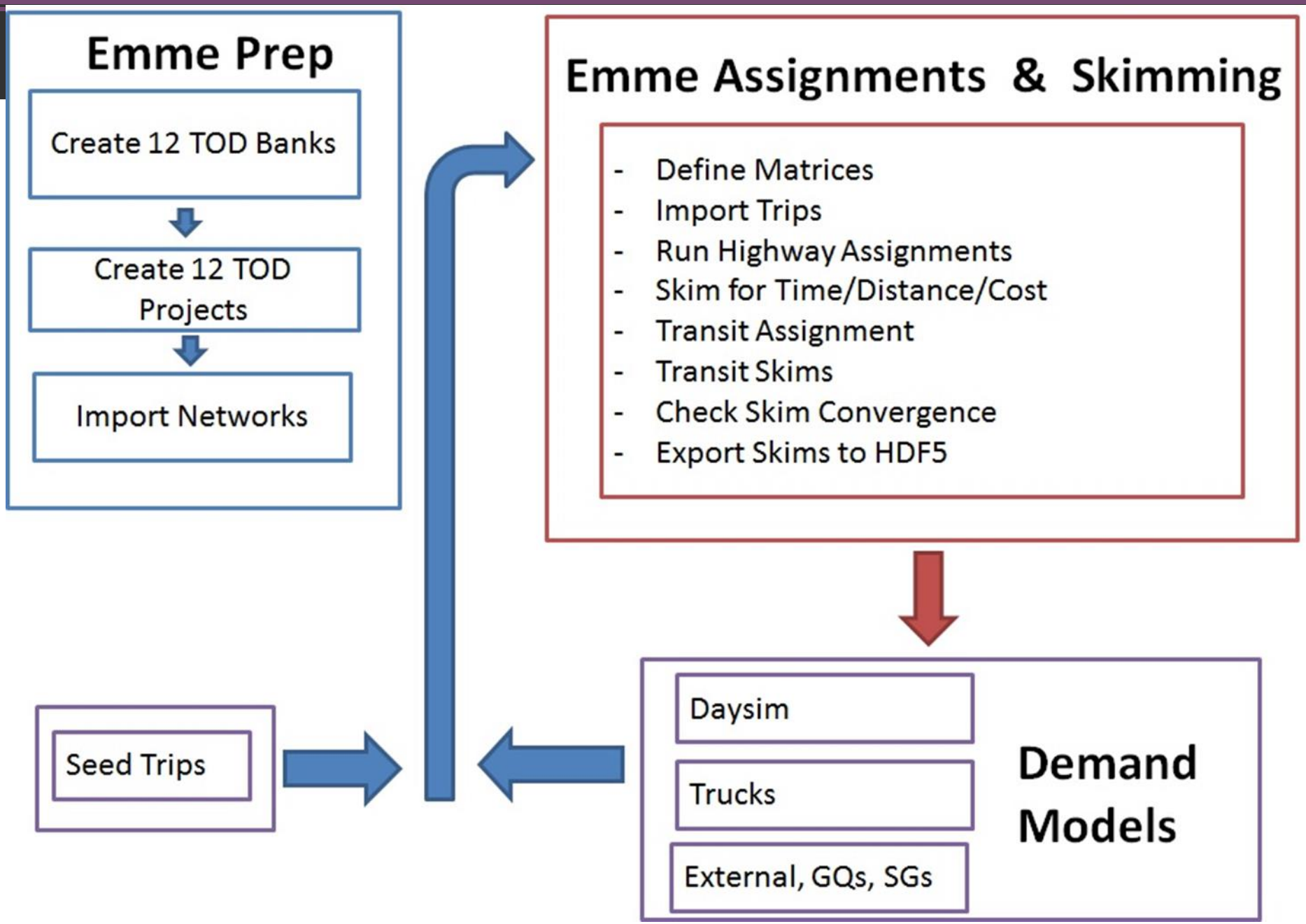
A list of travel time skims sent in for comparison

STOP_THRESHOLD = 0.025

Overview

Assignment/Skimming Process

- 12 Time Periods
- 21 User Classes
- Run Auto Assignment for each Time Period
- Transit for 5 Time Periods
- Skim for Time and Cost for all Time Periods
- Skim for Distance for Two Time Periods
- Run almost everything in Parallel


Emme Prep
Create 12 TOD Banks
Create 12 TOD Projects
Import Networks
Emme Assignments & Skimming
- Define Matrices
- Import Trips
- Run Highway Assignments
- Skim for Time/Distance/Cost
- Transit Assignment
- Transit Skims
- Check Skim Convergence
- Export Skims to HDF5
Seed Trips
Daysim
Trucks
External, GQs, SGs
Demand Models

Use Flexible/Extensible Code Design

```
class EmmeProject:
    def __init__(self, filepath):
        self.desktop = app.start_dedicated(True, "cth", filepath)
        self.m = _m.Modeller(self.desktop)
        #delete locki:
        self.m.emmebank.dispose()
        pathlist = filepath.split("/")
        self.fullpath = filepath
        self.filename = pathlist.pop()
        self.dir = "/".join(pathlist) + "/"
        self.bank = self.m.emmebank
        self.tod = self.bank.title
        self.current_scenario = list(self.bank.scenarios())[0]
        self.data_explorer = self.desktop.data_explorer()

    def create_extra_attribute(self, type, name, description, overwrite):
        NAMESPACE=("inro.emme.data.extra_attribute.create_extra_attribute")
        process = self.m.tool(NAMESPACE)
        process(extra_attribute_type=type,
                      extra_attribute_name= name,
                      extra_attribute_description= description,
                      overwrite=overwrite)
```

EmmeProject Class Example

```
from EmmeProject import *

# EmmeProject is a custom class
# Provides access to Modeller Object
# And methods and properties used by Soundcast

# Open Project
my_project = EmmeProject('c:/soundcast/projects/7to8.emp')

# Create link extra attribute to store the auto equivalent of bus vehicles
my_project.create_extra_attribute('LINK', '@trnv3',
                                  'Transit Vehicles', True)
```

Store inputs in Config file or JSON files

```python
import json

def json_to_dictionary(dict_file):

    my_dictionary = json.load(open(dict_file))
    return(my_dictionary)

file_path = 'z:/soundcat2/inputs/skim_params/user_classes.json'
my_user_classes = json_to_dictionary(file_path)
print my_user_classes['Highway'][0]['Name']
print my_user_classes['Highway'][0]['Value of Time']
```

```
>>>
svtl1
1200
>>>
```

user_classes.json - Notepad

File Edit Format View Help


```
{
  "Highway": [
    {
      "Name": "svtl1",
      "Description": "SOV Toll Income Level 1",
      "Value of Time": 1200,
      "Mode": "e",
      "Toll": "@toll1",
      "Time": "@timau",
      "Distance": "@dist"
    },
    {
      "Name": "svtl2",
      "Description": "SOV Toll Income Level 2",
      "Value of Time": 2400,
      "Mode": "e",
      "Toll": "@toll1",
      "Time": "@timau",
      "Distance": "@dist"
    },
    {
      "Name": "svtl3",
      "Description": "SOV Toll Income Level 3",
      "Value of Time": 4000,
      "Mode": "e",
      "Toll": "@toll1",
      "Time": "@timau",
      "Distance": "@dist"
    },
    {
      "Name": "svnt1",
      "Description": "SOV No Toll Income Level 1",
      "Value of Time": 1200,
```

Parting Thoughts

- Use a Software Development Paradigm
- Emme Python API's are intuitive and easy to program against.
- Python is (relatively) easy to learn and powerful
- Check out our code on Github:

https://github.com/psrc/soundcast