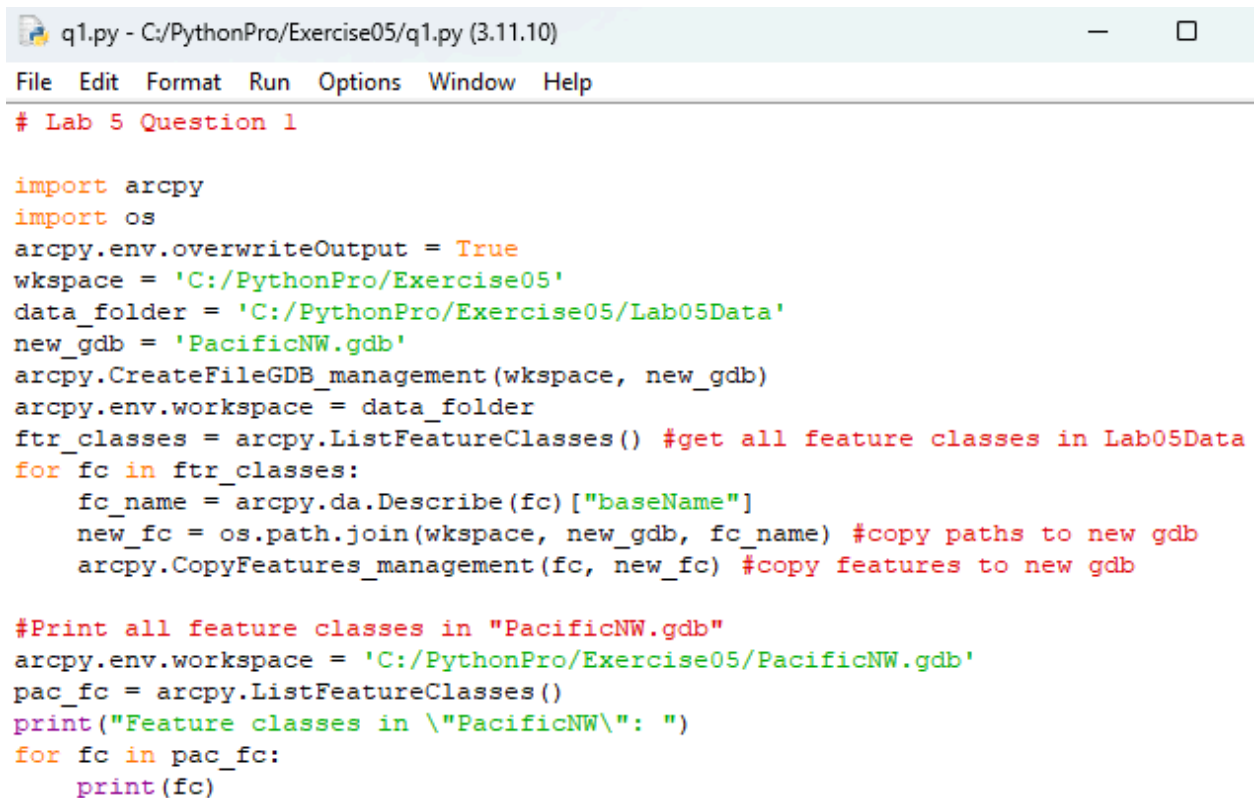# Spatial Programming Lab 5
Seth Opatz

(Python script combining all 8 questions attached with assignment submission)

Question 1 script:
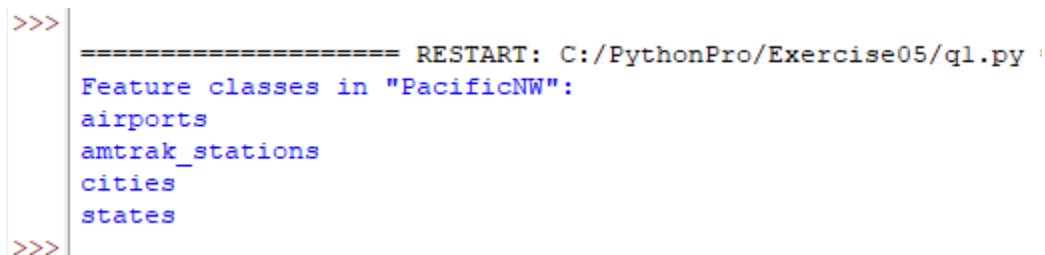
```
q1.py - C:/PythonPro/Exercise05/q1.py (3.11.10)                              —    □
File  Edit  Format  Run  Options  Window  Help

# Lab 5 Question 1

import arcpy
import os
arcpy.env.overwriteOutput = True
wkspace = 'C:/PythonPro/Exercise05'
data_folder = 'C:/PythonPro/Exercise05/Lab05Data'
new_gdb = 'PacificNW.gdb'
arcpy.CreateFileGDB_management(wkspace, new_gdb)
arcpy.env.workspace = data_folder
ftr_classes = arcpy.ListFeatureClasses() #get all feature classes in Lab05Data
for fc in ftr_classes:
    fc_name = arcpy.da.Describe(fc)["baseName"]
    new_fc = os.path.join(wkspace, new_gdb, fc_name) #copy paths to new gdb
    arcpy.CopyFeatures_management(fc, new_fc) #copy features to new gdb

#Print all feature classes in "PacificNW.gdb"
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'
pac_fc = arcpy.ListFeatureClasses()
print("Feature classes in \"PacificNW\": ")
for fc in pac_fc:
    print(fc)
```
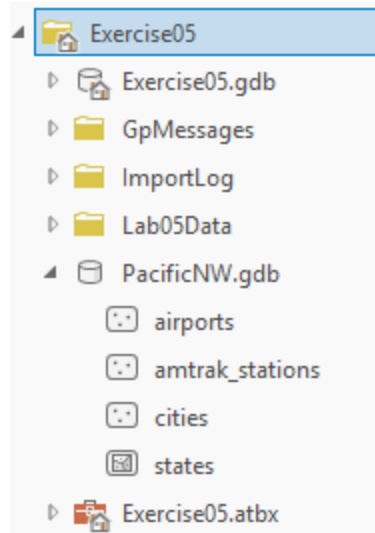
Question 1 output:

```
>>>
        ==================== RESTART: C:/PythonPro/Exercise05/q1.py
        Feature classes in "PacificNW":
        airports
        amtrak_stations
        cities
        states
>>>
```

- Exercise05.gdb
- GpMessages
- ImportLog
- Lab05Data
- PacificNW.gdb
  - airports
  - amtrak_stations
  - cities
  - states
- Exercise05.atbx

Question 2 script:

```python
# Lab 5 Question 2
import arcpy
arcpy.env.overwriteOutput = True
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'

in_fc = 'cities'
out_fc = 'cities_wa'
delim_field = arcpy.AddFieldDelimiters(in_fc, "ST")
sql_exp = delim_field + " = 'WA'"
arcpy.analysis.Select(in_fc, out_fc, sql_exp)

in_fc = 'airports'
out_fc = 'airports_wa'
delim_field = arcpy.AddFieldDelimiters(in_fc, "STATE")
sql_exp = delim_field + " = 'WA'"
arcpy.analysis.Select(in_fc, out_fc, sql_exp)

in_fc = 'amtrak_stations'
out_fc = 'amtrak_stations_wa'
delim_field = arcpy.AddFieldDelimiters(in_fc, "STATE")
sql_exp = delim_field + " = 'WA'"
arcpy.analysis.Select(in_fc, out_fc, sql_exp)

in_fc = 'states'
out_fc = 'states_wa'
delim_field = arcpy.AddFieldDelimiters(in_fc, "STATE_ABBR")
sql_exp = delim_field + " = 'WA'"
arcpy.analysis.Select(in_fc, out_fc, sql_exp)
```
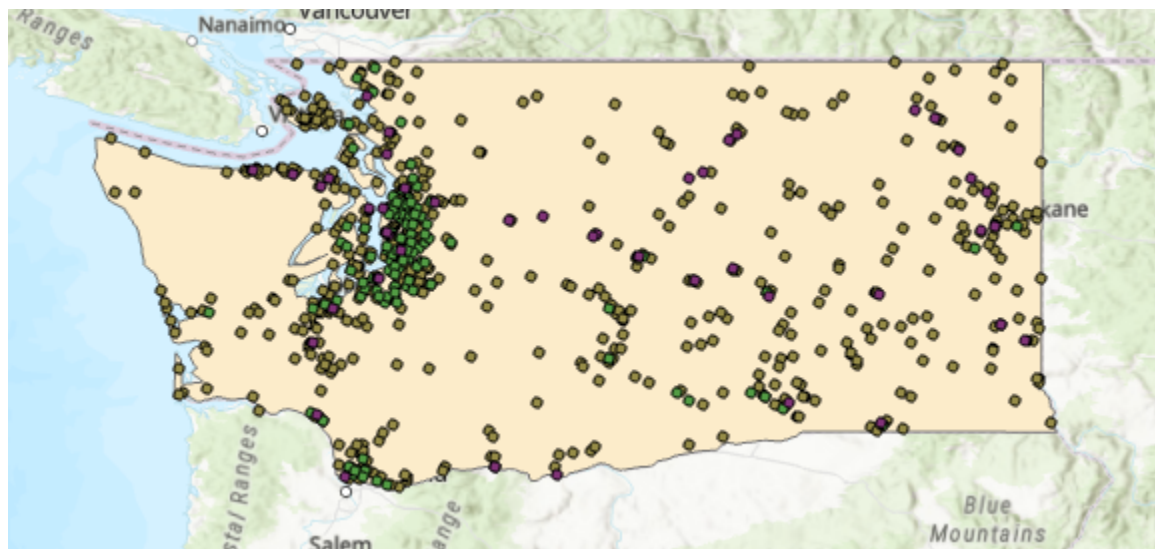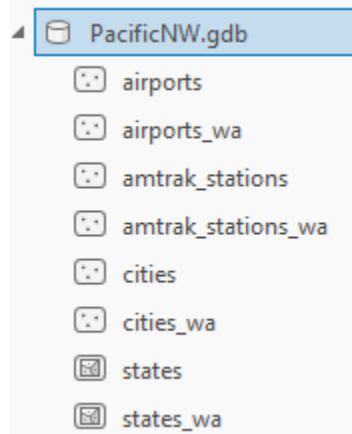
Question 2 output:

Question 3 script:

```python
# Lab 5 Question 3
import arcpy
arcpy.env.overwriteOutput = True
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'

print(f"There are {arcpy.management.GetCount('airports_wa')} airports in Washington.")
print(f"There are {arcpy.management.GetCount('amtrak_stations_wa')} amtrak stations in Washington.")
print(f"There are {arcpy.management.GetCount('cities_wa')} cities in Washington.")
print(f"There are {arcpy.management.GetCount('states_wa')} states in Washington. Itself!")
```

Question 3 output:

```
==================== RESTART: C:/PythonPro/Exercise05/q3.py =
There are 550 airports in Washington.
There are 50 amtrak stations in Washington.
There are 116 cities in Washington.
There are 1 states in Washington. Itself!
```

Question 4 script:

```python
# Lab 5 Question 4
import arcpy
arcpy.env.overwriteOutput = True
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'

fc = "airports_wa"
sql_exp = '"PASSENGERS" > 100000'
cursor = arcpy.da.SearchCursor(fc, ["NAME"], sql_exp)
print("Airports in Washington with more than 100,000 passengers:")
for row in cursor:
    print(row[0])

fc = "cities_wa"
sql_exp = '"POPULATION" > 100000'
cursor = arcpy.da.SearchCursor(fc, ["NAME"], sql_exp)
print("\nCities in Washington with more than 100,000 population in 2014:")
for row in cursor:
    print(row[0])

fc = "airports_wa"
sql_exp = '"FACILITY" = \'Ultralight\''
cursor = arcpy.da.SearchCursor(fc, ["NAME"], sql_exp)
print("\nAirports in Washington for ultralight vehicles:")
for row in cursor:
    print(row[0])
```

Question 4 output:

```
==================== RESTART: C:/PythonPro/Exercise05/q4.py ====
Airports in Washington with more than 100,000 passengers:
Seattle-Tacoma Intl
Spokane Intl
Bellingham Intl
Tri-Cities

Cities in Washington with more than 100,000 population in 2014:
Bellevue
Everett
Seattle
Spokane
Tacoma
Vancouver

Airports in Washington for ultralight vehicles:
Walters Arv
Johnson'S Landing
Lester State
Swanton
```

Question 5 script:

```python
# Lab 5 Question 5
import arcpy
arcpy.env.overwriteOutput = True
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'

fc = "amtrak_stations_wa"
with arcpy.da.UpdateCursor(fc, ["stntype"]) as cursor:
    for row in cursor:
        if row[0] == 'BUS':
            cursor.deleteRow()
```

Question 5 output:

	cities	cities_wa	airports_wa	amtrak_stations_wa	states_wa	amtrak_stations_wa ✕

Field: ⊞ Add ⊞ Calculate   Selection: ⬚ Select By Attributes ⬚ Zoom To ⬚ Switch ⊟ Clear ⬚ Delete ⬚ Copy

	OBJECTID_12 *	Shape *	objectid_1	OBJECTID	statype	stntype	zipcode	STATE	city	address2	address1	name
1	2	Point	0	1027	Platform with Shelter	TRAIN	98801	WA	Wenatchee		1 Kittitas Street	Amtrak Station
2	3	Point	0	1037	Platform only (no shelt...	TRAIN	98673	WA	Wishram		1 Railroad Avenue	
3	5	Point	0	527	Platform with Shelter	TRAIN	98826	WA	Leavenworth		11645 North Road	Icicle Station
4	9	Point	0	616	Station Building (with...	TRAIN	98273	WA	Mount Vernon		105 East Kincaid Street	
5	11	Point	0	677	Station Building (with...	TRAIN	98513	WA	Lacey		6600 Yelm Highway SE	
6	13	Point	0	745	Station Building (with...	TRAIN	99301	WA	Pasco		535 North 1st Avenue	
7	20	Point	0	850	Station Building (with...	TRAIN	98104	WA	Seattle		303 South Jackson Str...	King Street Sta
8	23	Point	0	905	Station Building (with...	TRAIN	99201	WA	Spokane		221 West 1st Avenue	Amtrak Station
9	26	Point	0	932	Platform only (no shelt...	TRAIN	98292	WA	Stanwood		27111 Florence Way	

(All train stations, no bus stops)

Question 6 script:

```python
# Lab 5 Question 6
import arcpy
arcpy.env.overwriteOutput = True
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'

cities = []
fc = "amtrak_stations_wa"
cursor = arcpy.da.SearchCursor(fc, ["city"], sql_clause=(None, "ORDER BY city ASC"))
for row in cursor:
    cities.append(row[0])

print("Each city in Washington with an amtrak station (listed alphabetically):")
for city in cities:
    print(city)

print("\nLast 5 cities in Washington alphabetically with an amtrak station:")
print(cities[-5:])
```

Question 6 output:

```
==================== RESTART: C:/PythonPro/Exercise05/q6.py =============
Each city in Washington with an amtrak station (listed alphabetically):
Bellingham
Bingen
Centralia
Edmonds
Ephrata
Everett
Kelso
Lacey
Leavenworth
Mount Vernon
Pasco
Seattle
Spokane
Stanwood
Tacoma
Tukwila
Vancouver
Wenatchee
Wishram

Last 5 cities in Washington alphabetically with an amtrak station:
['Tacoma', 'Tukwila', 'Vancouver', 'Wenatchee', 'Wishram']
```

Question 7 script:

```python
# Lab 5 Question 7
import arcpy
arcpy.env.overwriteOutput = True
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'

fc = "cities_wa"
delim_field = arcpy.AddFieldDelimiters(fc, "POPULATION")
sql_exp = delim_field + " > 100000"
with arcpy.da.UpdateCursor(fc, ["CLASS"], sql_exp) as cursor:
    for row in cursor:
        row[0] = "major city"
        cursor.updateRow(row)

cursor = arcpy.da.SearchCursor(fc, ["NAME", "CLASS", "POPULATION"], sql_clause=(None, "ORDER BY POPULATION DESC"))
for i, row in enumerate(cursor):
    if i >= 10:
        break
    print(f"{row[0]} is a {row[1]} with a population of {row[2]}")
```

Question 7 output:

```
==================== RESTART: C:/PythonPro/Exercise05/q7.py :
Seattle is a major city with a population of 638776
Spokane is a major city with a population of 211296
Tacoma is a major city with a population of 202416
Vancouver is a major city with a population of 166264
Bellevue is a major city with a population of 128302
Everett is a major city with a population of 105341
Renton is a city with a population of 96200
Kent is a city with a population of 95493
Yakima is a city with a population of 93599
Spokane Valley is a city with a population of 92720
```

Question 8 script:

```python
# Lab 5 Question 8
import arcpy
arcpy.env.overwriteOutput = True
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'

fc = "cities_wa"
new_field = "pop_change"
fieldtype = "LONG"
pop_change = arcpy.ValidateFieldName(new_field)
arcpy.management.AddField(fc, pop_change, fieldtype)

arcpy.management.CalculateField(
    in_table="cities_wa",
    field="pop_change",
    expression="!POPULATION! - !POP2010!",
    expression_type="PYTHON3",
    code_block="",
    field_type="TEXT",
    enforce_domains="NO_ENFORCE_DOMAINS"
)

sql_exp = '"pop_change" < 0'
cursor = arcpy.da.SearchCursor(fc, ["NAME", "pop_change"], sql_exp)
print("\nCities in Washington that lost population from 2010 to 2014:")
for row in cursor:
    print(f"{row[0]}'s population declined by {-row[1]} people between 2010 and 2014")
```

Question 8 output:

```
>>>
    ==================== RESTART: C:/PythonPro/Exercise05/q8.py ===========

    Cities in Washington that lost population from 2010 to 2014:
    Aberdeen's population declined by 350 people between 2010 and 2014
    Oak Harbor's population declined by 402 people between 2010 and 2014
    Port Angeles's population declined by 122 people between 2010 and 2014
    Sedro-Woolley's population declined by 54 people between 2010 and 2014
>>>
```

Combined Script:

```
# Lab 5 All Scripts (Questions 1-8 combined)

# Lab 5 Question 1
import arcpy
import os
arcpy.env.overwriteOutput = True
wkspace = 'C:/PythonPro/Exercise05'
data_folder = 'C:/PythonPro/Exercise05/Lab05Data'
new_gdb = 'PacificNW.gdb'
arcpy.CreateFileGDB_management(wkspace, new_gdb)
arcpy.env.workspace = data_folder
ftr_classes = arcpy.ListFeatureClasses() #get all feature classes in Lab05Data folder
for fc in ftr_classes:
    fc_name = arcpy.da.Describe(fc)["baseName"]
    new_fc = os.path.join(wkspace, new_gdb, fc_name) #copy paths to new gdb
    arcpy.CopyFeatures_management(fc, new_fc) #copy features to new gdb

#Print all feature classes in "PacificNW.gdb"
arcpy.env.workspace = 'C:/PythonPro/Exercise05/PacificNW.gdb'
pac_fc = arcpy.ListFeatureClasses()
print("Feature classes in \"PacificNW\": ")
for fc in pac_fc:
    print(fc)


# Lab 5 Question 2
in_fc = 'cities'
out_fc = 'cities_wa'
delim_field = arcpy.AddFieldDelimiters(in_fc, "ST")
sql_exp = delim_field + " = 'WA'"
arcpy.analysis.Select(in_fc, out_fc, sql_exp)

in_fc = 'airports'
out_fc = 'airports_wa'
delim_field = arcpy.AddFieldDelimiters(in_fc, "STATE")
sql_exp = delim_field + " = 'WA'"
arcpy.analysis.Select(in_fc, out_fc, sql_exp)

in_fc = 'amtrak_stations'
out_fc = 'amtrak_stations_wa'
delim_field = arcpy.AddFieldDelimiters(in_fc, "STATE")
```

```
sql_exp = delim_field + " = 'WA'"
arcpy.analysis.Select(in_fc, out_fc, sql_exp)

in_fc = 'states'
out_fc = 'states_wa'
delim_field = arcpy.AddFieldDelimiters(in_fc, "STATE_ABBR")
sql_exp = delim_field + " = 'WA'"
arcpy.analysis.Select(in_fc, out_fc, sql_exp)


# Lab 5 Question 3
print(f"\nThere are {arcpy.management.GetCount('airports_wa')} airports in
Washington.")
print(f"There are {arcpy.management.GetCount('amtrak_stations_wa')} amtrak
stations in Washington.")
print(f"There are {arcpy.management.GetCount('cities_wa')} cities in Washington.")
print(f"There are {arcpy.management.GetCount('states_wa')} states in Washington.
Itself!")


# Lab 5 Question 4
fc = "airports_wa"
sql_exp = '"PASSENGERS" > 100000'
cursor = arcpy.da.SearchCursor(fc, ["NAME"], sql_exp)
print("\nAirports in Washington with more than 100,000 passengers:")
for row in cursor:
    print(row[0])

fc = "cities_wa"
sql_exp = '"POPULATION" > 100000'
cursor = arcpy.da.SearchCursor(fc, ["NAME"], sql_exp)
print("\nCities in Washington with more than 100,000 population in 2014:")
for row in cursor:
    print(row[0])

fc = "airports_wa"
sql_exp = '"FACILITY" = \'Ultralight\''
cursor = arcpy.da.SearchCursor(fc, ["NAME"], sql_exp)
print("\nAirports in Washington for ultralight vehicles:")
for row in cursor:
    print(row[0])
```

```python
# Lab 5 Question 5
fc = "amtrak_stations_wa"
with arcpy.da.UpdateCursor(fc, ["stntype"]) as cursor:
    for row in cursor:
        if row[0] == 'BUS':
            cursor.deleteRow()


# Lab 5 Question 6
cities = []
fc = "amtrak_stations_wa"
cursor = arcpy.da.SearchCursor(fc, ["city"], sql_clause=(None, "ORDER BY city ASC"))
for row in cursor:
    cities.append(row[0])

print("\nEach city in Washington with an amtrak station (listed alphabetically):")
for city in cities:
    print(city)

print("\nLast 5 cities in Washington alphabetically with an amtrak station:")
print(f"{cities[-5:]}\n")


# Lab 5 Question 7
fc = "cities_wa"
delim_field = arcpy.AddFieldDelimiters(fc, "POPULATION")
sql_exp = delim_field + " > 100000"
with arcpy.da.UpdateCursor(fc, ["CLASS"], sql_exp) as cursor:
    for row in cursor:
        row[0] = "major city"
        cursor.updateRow(row)

cursor = arcpy.da.SearchCursor(fc, ["NAME", "CLASS", "POPULATION"],
sql_clause=(None, "ORDER BY POPULATION DESC"))
for i, row in enumerate(cursor):
    if i >= 10:
        break
    print(f"{row[0]} is a {row[1]} with a population of {row[2]}")


# Lab 5 Question 8
```

```python
fc = "cities_wa"
new_field = "pop_change"
fieldtype = "LONG"
pop_change = arcpy.ValidateFieldName(new_field)
arcpy.management.AddField(fc, pop_change, fieldtype)

arcpy.management.CalculateField(
    in_table="cities_wa",
    field="pop_change",
    expression="!POPULATION! - !POP2010!",
    expression_type="PYTHON3",
    code_block="",
    field_type="TEXT",
    enforce_domains="NO_ENFORCE_DOMAINS"
)

sql_exp = '"pop_change" < 0'
cursor = arcpy.da.SearchCursor(fc, ["NAME", "pop_change"], sql_exp)
print("\nCities in Washington that lost population from 2010 to 2014:")
for row in cursor:
    print(f"{row[0]}'s population declined by {-row[1]} people between 2010 and 2014")
```

Combined Script Output:
Feature classes in "PacificNW":
airports
amtrak_stations
cities
states

There are 550 airports in Washington.
There are 50 amtrak stations in Washington.
There are 116 cities in Washington.
There are 1 states in Washington. Itself!

Airports in Washington with more than 100,000 passengers:
Seattle-Tacoma Intl
Spokane Intl
Bellingham Intl
Tri-Cities

Cities in Washington with more than 100,000 population in 2014:
Bellevue
Everett
Seattle
Spokane
Tacoma
Vancouver

Airports in Washington for ultralight vehicles:
Walters Arv
Johnson'S Landing
Lester State
Swanton

Each city in Washington with an amtrak station (listed alphabetically):
Bellingham
Bingen
Centralia
Edmonds
Ephrata
Everett
Kelso
Lacey
Leavenworth

Mount Vernon
Pasco
Seattle
Spokane
Stanwood
Tacoma
Tukwila
Vancouver
Wenatchee
Wishram

Last 5 cities in Washington alphabetically with an amtrak station:
['Tacoma', 'Tukwila', 'Vancouver', 'Wenatchee', 'Wishram']

Seattle is a major city with a population of 638776
Spokane is a major city with a population of 211296
Tacoma is a major city with a population of 202416
Vancouver is a major city with a population of 166264
Bellevue is a major city with a population of 128302
Everett is a major city with a population of 105341
Renton is a city with a population of 96200
Kent is a city with a population of 95493
Yakima is a city with a population of 93599
Spokane Valley is a city with a population of 92720

Cities in Washington that lost population from 2010 to 2014:
Aberdeen's population declined by 350 people between 2010 and 2014
Oak Harbor's population declined by 402 people between 2010 and 2014
Port Angeles's population declined by 122 people between 2010 and 2014
Sedro-Woolley's population declined by 54 people between 2010 and 2014