File format description

Every instance consists of a graph file and a vehicle file.

Both are explained below.

Graph files.

Note that the format of the graph files is the same for multiple problems. Therefore the structure is a bit complicated.

--- The header of the files contains the following information, numbered by lines:

1. Information of problem type (CARP, MC-CARP, SP-CARP, etc).
2. Number of nodes (nodes are numbered from 0 to n-1)
3. Number of edges (edges are numbered from 0 to m-1)
4. Node number for the depot

--- Then follows information regarding the number of different fractions and intervals for each fraction.

For the CARP, it looks like this:

```
NumberOfFractions:          1
NumberOfIntervalsForFraction        General_Glass_Metal_Plastic_Organic  1        14
```

For the CARP, there are always 2 lines. The only important information in these two lines for the CARP is the name of the fraction because it is important to use the compression factor for the correct fraction from the vehicle file. In the example above, the fraction is “General_Glass_Metal_Plastic_Organic”.

For the SP-CARP, it could look like this:

```
NumberOfFractions:  1
NumberOfIntervalsForFraction   General_Glass_Metal_Plastic_Organic      5        2.3        3.5        7        14        28
```

For the SP-CARP, there are always two lines. Here, as for the CARP, the fraction is important in order to use the correct compression factor from the vehicle file. Furthermore, for the SP-CARP, the number of intervals and the intervals are also important. In the example, there are 5 different intervals and they are 2.3, 3.5, …,28.

Furthermore, note that 2.3 means three times a week, 3.5 means two times per week, and 28 means every 28 days.

For the MC-CARP, it could look, for example, like this:

```
NumberOfFractions:          4
NumberOfIntervalsForFraction        Glass_Metal_Plastic        1        14
```

```
NumberOfIntervalsForFraction    General  1    14
NumberOfIntervalsForFraction    Organic  1    14
NumberOfIntervalsForFraction    Paper    1    14
```

For the MC-CARP, the number of fractions (4 in the example) is important, and also the name of the fraction (to get the correct compression factor).

For the C-CARP, it could look, for example, like this:

```
NumberOfFractions:  4
NumberOfIntervalsForFraction    Glass_Metal_Plastic    1    21
NumberOfIntervalsForFraction    General  1    14
NumberOfIntervalsForFraction    Organic  1    7
NumberOfIntervalsForFraction    Paper    1    28
```

Here, all the information is important. In the example, there are 4 different fractions. For each fraction, the name is used to get the correct compression factor, and the last number in each line (21, 14, 7, and 28) states the collection interval.

--- The waste fraction section is ended by the keyword “GRAPH”.

Then follows a list of table headers.

For all types of problems, we have the following:

EdgeNumber : The edge number – numbered from 0 to m-1 (we suggest to use this number)

EdgeId : The actual edge id, which can help identify physical streets across graphs in the same set. For instance, the edge with ID 81 in graph F17_g represents the same street as the edge with ID 81 in graph F1_g (for all problem types), if the edge is present.

Note that edges with negative ID have been created subsequently and do not have this cross-graph option. We recommend that edge ID is not used expect for cross-graph identification.

StartNodeNumber: Node number for one end of the edge.

EndNodeNumber: Node number for the other end of the edge.

Cost: cost of the edge. The cost is identical to the length of the edge in meters.

The remainder of the headers gives demand and number of actual waste bins on each edge and for each type of demand. The demand is given as liters. Remember, that the capacity constraint becomes “demand * compression factor <= vehicle capacity”. The number of bins is not used in the pure models, but becomes

relevant if time duration constraints or upper bound on the number of bins per route are added to the problem.

For the CARP, it looks like this:

Demand_0 Bins_0

Indicating that there is just a single demand number and a single bin number for each edge.

For the SP-CARP, it could look like this:

Demand_0 Bins_0 Demand_1 Bins_1 Demand_2 Bins_2 Demand_3 Bins_3 Demand_4 Bins_4

Where there is one demand and bins columns for each interval in the same order as they are stated in the header. So continuing the above example, “Demand_0” is the demand with interval 2.3, and “Demand_4” is the demand with interval 28. (similar for the bins).

For the MC-CARP and C-CARP, it could look like this:

Demand_0 Bins_0 Demand_1 Bins_1 Demand_2 Bins_2 Demand_3 Bins_3

Where the columns correspond to demand and bins for each of the four fractions in the same order as they are stated in the header.

--- The table header section is ended by the keyword “START”

Then follows, for every edge, the information stated by the header (all numbers are integers).

--- This is ended by the keyword “END”

After that, follows a little information section giving info about the generation of the data. This is not needed to work with the files.

Vehicle files.

The vehicle files also have the same layout. We explain the components based on the simple CARP structure and then explain the extensions for the remaining problems

For the CARP, the vehicle files contain the following information:

NumberVehicleTypes:	1	: There is only one type. (= homogeneous fleet)

VehicleType:	1	: Here follows information for the first (and only) type
NumberVehicles	1000	: The number of available vehicles (infinite for the CARP)
NumberCompartments	1	: Number of compartments (always 1 for CARP)
CompartmentCapacities	12000	: Vehicle capacity for the CARP, else compartment capacity
NumberCompression	2	: Number if lines to read with compression factors
General_Glass_Metal_Plastic_Organic	2	: Compression factor for each waste fraction

Paper	2	: !! Remember to use the correct one !!
TravelSpeed	1000	: The remaining info is only relevant when time duration
TimeEmptyPerBin	0	: constraints are added and is self explained.
TimeUnload	0	: In this example, they are given dummy values.
TimeDurationLimit	1000	
NumberBinsLimit	1000	

For the No-Split MC-CARP, the vehicle file also only contains one type of vehicles, and the files look like this:

NumberVehicleTypes:	1			

VehicleType:		1		
NumberVehicles	1000			
NumberCompartments		4		
CompartmentCapacities	4800	3900	5100	3000
NumberCompression		4		
Glass_Metal_Plastic		2		
General		6		
Organic		1		
Paper		2		
TravelSpeed		1000		
TimeEmptyPerBin	0			
TimeUnload		0		
TimeDurationLimit	1000			
NumberBinsLimit	1000			

Compared to the CARP, the difference is that there is more than one compartment (4 in the example) and thereby more than one compartment capacities (also 4 in the example). In the No-Split problem, the compartments are pre-assigned to fractions (compartment 1 for “Glass_Metal_Plastic” and 2 for “General”). Remember to use the correct compression factor for each fraction.

For the C-Split MC.-CARP, the vehicle file can now contain multiple vehicle types, and can for example look like this for an example with 5 types:

NumberVehicleTypes:	5	

VehicleType:		1
NumberVehicles	10	
NumberCompartments		2
CompartmentCapacities	16100	10000
NumberCompression		9
General_Organic	3	
General		3
Organic		1
Paper		3
Plastic		3
Glass		1
Metal		3
Cardboard		3
Glass_Metal_Plastic		2

ETC.

Note that

- The number of vehicles of each type is not limited
- The number and sizes of compartments can differ from one type to another
- There are typically more compression factors stated than compartments because one is free to put any fraction in any compartment as long as they are not mixed.
- Remember to use the correct compression factor for each fraction in each compartment.

For the Multi-Day C-Split MC-CARP, the files are as for the C-Split MC-CARP, except from one line at the top of the file which stated the number of days in the planning horizon. Like this:

```
NumberDaysPlanningHorizon5
NumberVehicleTypes:     6
-------------------------
VehicleType:            1
ETC.
```

For the SP-CARP, there is a header in the vehicle file giving information regarding the time perspective. It could look like this. After that follows the same information as above.

```
NumberDaysPlanningHorizon       28
NumberDaysWeek                  7
FirstDayIndex                   1
NumberDaysNoService             8
DaysNoService                   6       7       13      14      20      21      27      28
NumberVehicleTypes:             1
-------------------------
```

In this example, there are 28 days in the planning horizon. The length of the week is 7 days. There are 8 days where service is not allowed, these are day number 6, 7, …, 28, where the days are numbers starting with 1. (so in this example we work with normal weeks without work on Saturday + Sunday).

For the C-CARP, the header is similar to the SP-CARP, but because the factions have their individual set of vehicles, each fraction has its own section in the file, where each section is organized as above.

Comments are added in red below to explain

```
NumberDaysPlanningHorizon84
NumberDaysWeek          7
FirstDayIndex           1
NumberDaysNoService     24
DaysNoService           6       7       13      14      20      21      27      28      34      35      41
        42      48      49      55      56      62      63      69      70      76      77      83      84
NumberFractions         4               There are 4 different fractions in the graphs that use this vehicle file
-------------------------
FractionType:           1               We now consider the first fraction which is Glass_Metal_Plastic
Fraction        Glass_Metal_Plastic
NumberVehicleTypes:     2               There are two different types of vehicles for this fraction
-------------------------
VehicleType:            1               Here is the information for the first vehicle type for Glass_Metal_Plastic
```

NumberVehicles 2
NumberCompartments 1
CompartmentCapacities 16000
NumberCompression 1
Glass_Metal_Plastic 1
TravelSpeed 1000
TimeEmptyPerBin 0
TimeUnload 0
TimeDurationLimit 1000
NumberBinsLimit 1000

VehicleType: 2 and for the second vehicle type for Glass_Metal_Plastic
NumberVehicles 10
NumberCompartments 1
CompartmentCapacities 12000
NumberCompression 1
Glass_Metal_Plastic 1
TravelSpeed 1000
TimeEmptyPerBin 0
TimeUnload 0
TimeDurationLimit 1000
NumberBinsLimit 1000

FractionType: 2 We now consider the second fraction, which is General
Fraction General
NumberVehicleTypes: 2 Again there are two types of vehicles

VehicleType: 1 The first type of vehicle
NumberVehicles 2
NumberCompartments 1
CompartmentCapacities 18000
NumberCompression 1
General 3
TravelSpeed 1000
TimeEmptyPerBin 0
TimeUnload 0
TimeDurationLimit 1000
NumberBinsLimit 1000

VehicleType: 2 and the second
NumberVehicles 15
NumberCompartments 1
CompartmentCapacities 9000
NumberCompression 1
General 2
TravelSpeed 1000
TimeEmptyPerBin 0
TimeUnload 0
TimeDurationLimit 1000
NumberBinsLimit 1000

FractionType: 3 We now consider the second fraction, which is Organic
ETC.