How to Use CohortAlgebra R Package

Gowtham A. Rao

2023-06-01

Contents

1 Introduction **1**

1.1 Installation 1

1.2 Cohort UNION 2

1.3 InterSect Cohort 4

1.4 Minus Cohort 12

1 Introduction

(This package is NOT part of HADES.)

The idea behind this package is to allow the construction of new cohorts from previously instantiated cohorts in the cohort table. All cohorts in OHDSI have a standard definition: "A cohort is a set of persons who satisfy one or more inclusion criteria for a duration of time."

- One person may belong to multiple cohorts
- One person may belong to the same cohort for multiple different time periods
- One person may not belong to the same cohort multiple times during the same period of time
- A cohort may have zero or more members

This is represented in a cohort table as cohort_definition_id, subject_id, cohort_start_date and cohort_end_date. For more details about the concept of a cohort please review The Book of OHDSI.

This package allows the creation of new cohorts from previously instantiated cohort table using cohort algebra (similar to temporal set algebra). The output is one or more new cohorts.

1.1 Installation

- This is an installable R-package that may be installed as follows:

```
remotes::install_github("OHDSI/CohortAlgebra")
```

```
#>
#> Attaching package: 'dplyr'
#> The following objects are masked from 'package:stats':
#>
#>     filter, lag

#> The following objects are masked from 'package:base':
#>
#>     intersect, setdiff, setequal, union

#> Consider adding `DATABASECONNECTOR_JAR_FOLDER='D:/windows_temp/AppData/Local/Temp/rtemp\Rtmp0eBySJ\j
#> DatabaseConnector postgresql JDBC driver downloaded to 'D:/windows_temp/AppData/Local/Temp/rtemp\Rtm
```

1.2 Cohort UNION

- Given two or more cohorts, an UNION operator on these cohorts creates a new cohort with continuous days the persons was present in any of the cohorts. For example: given a cohort table as follows

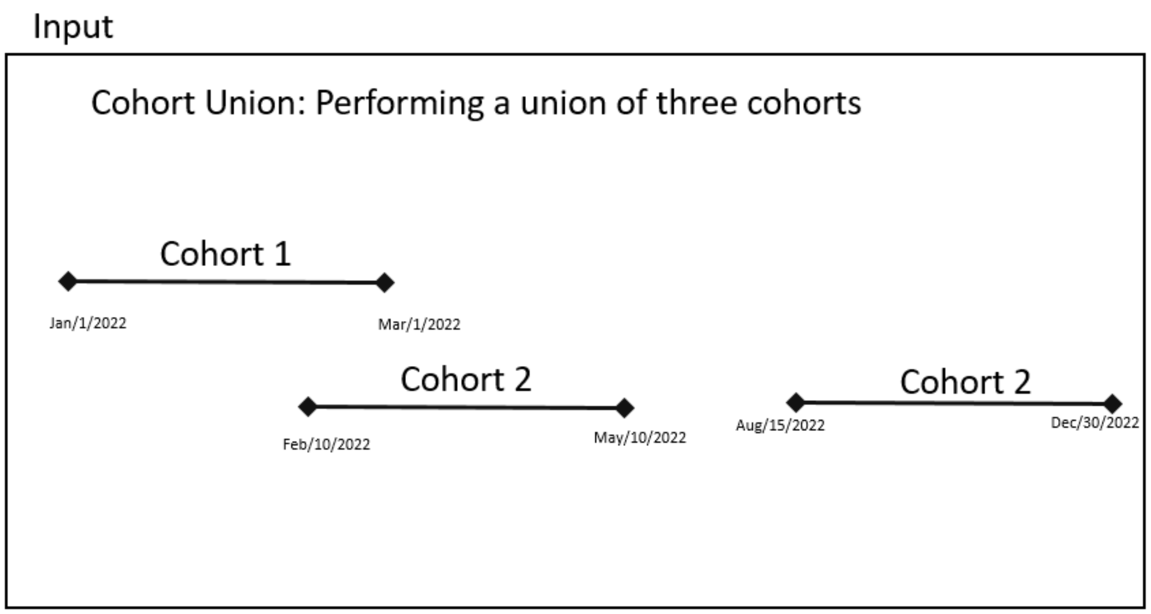
```
cohort
```

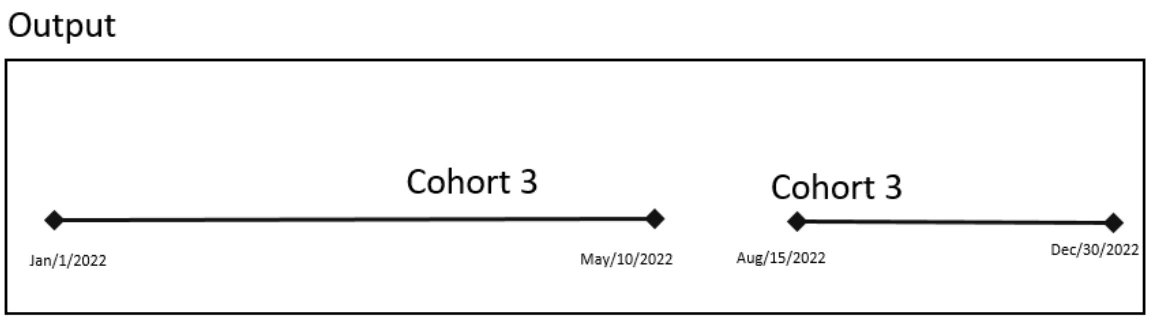
```
#> # A tibble: 3 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  1         1 2022-01-01      2022-03-01
#> 2                  2         1 2022-02-10      2022-05-10
#> 3                  2         1 2022-08-15      2022-12-30

#> Connecting using PostgreSQL driver
#> Inserting data took 0.0534 secs
```

The union of the two cohorts is expected to give us

```
cohortExpected
```

```
#> # A tibble: 2 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  3         1 2022-01-01      2022-05-10
#> 2                  3         1 2022-08-15      2022-12-30
```





To perform Cohort Union, we use the unionCohorts function. This function requires as an input a data.frame called oldToNewCohortId. Here we specify the cohort id's of the cohorts we want to union. The newCohortId is the cohortId of the resultant cohort. The oldCohortId are cohorts that are already in the cohort table.

```
oldToNewCohortId <-
  dplyr::tibble(
    oldCohortId = c(1, 2, 2),
    newCohortId = c(3, 3, 3)
  )

CohortAlgebra::unionCohorts(
  connection = connection,
  sourceCohortDatabaseSchema = cohortDatabaseSchema,
  sourceCohortTable = tableName,
  targetCohortDatabaseSchema = cohortDatabaseSchema,
  targetCohortTable = tableName,
  oldToNewCohortId = oldToNewCohortId
)
```

Now we will have a new cohortId '3' which is the union of cohortId's 1 and 2.

```
data
```

```
#> # A tibble: 2 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  3         1 2022-01-01      2022-05-10
#> 2                  3         1 2022-08-15      2022-12-30
```

Note: if the target cohort table had a cohort with cohortId = 3, before running the union function - this would cause a conflict. In those cases, the union function would not run. We can purge all records for cohortId = 3 from the target cohort table. The parameter purgeConflicts will delete any cohort records in the cohort table where cohortId is the cohortId of the newCohort.

1.3 InterSect Cohort

- Given two or more cohorts, an INTERSECT operator on these cohorts creates a new cohort with continuous days the persons was present in ALL of the cohorts.

1.3.1 Intersect cohort example 1

Input:

```
cohort
```

```
#> # A tibble: 2 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  1         1 2022-01-01      2022-01-15
#> 2                  2         1 2021-12-15      2022-01-30
```

```
#> Inserting data took 0.0266 secs
```

```
CohortAlgebra::intersectCohorts(
  connection = connection,
  sourceCohortDatabaseSchema = cohortDatabaseSchema,
  sourceCohortTable = tableName,
  targetCohortDatabaseSchema = cohortDatabaseSchema,
  targetCohortTable = tableName,
  cohortIds = c(1, 2),
  newCohortId = 3
)
```

```
#>   |                                                                          |
```

```
#> Executing SQL took 0.0181 secs
#> Currently in a tryCatch or withCallingHandlers block, so unable to add global calling handlers. Paral
```

```
#>  Intersecting cohorts.
#>  Generating eras and saving.
```

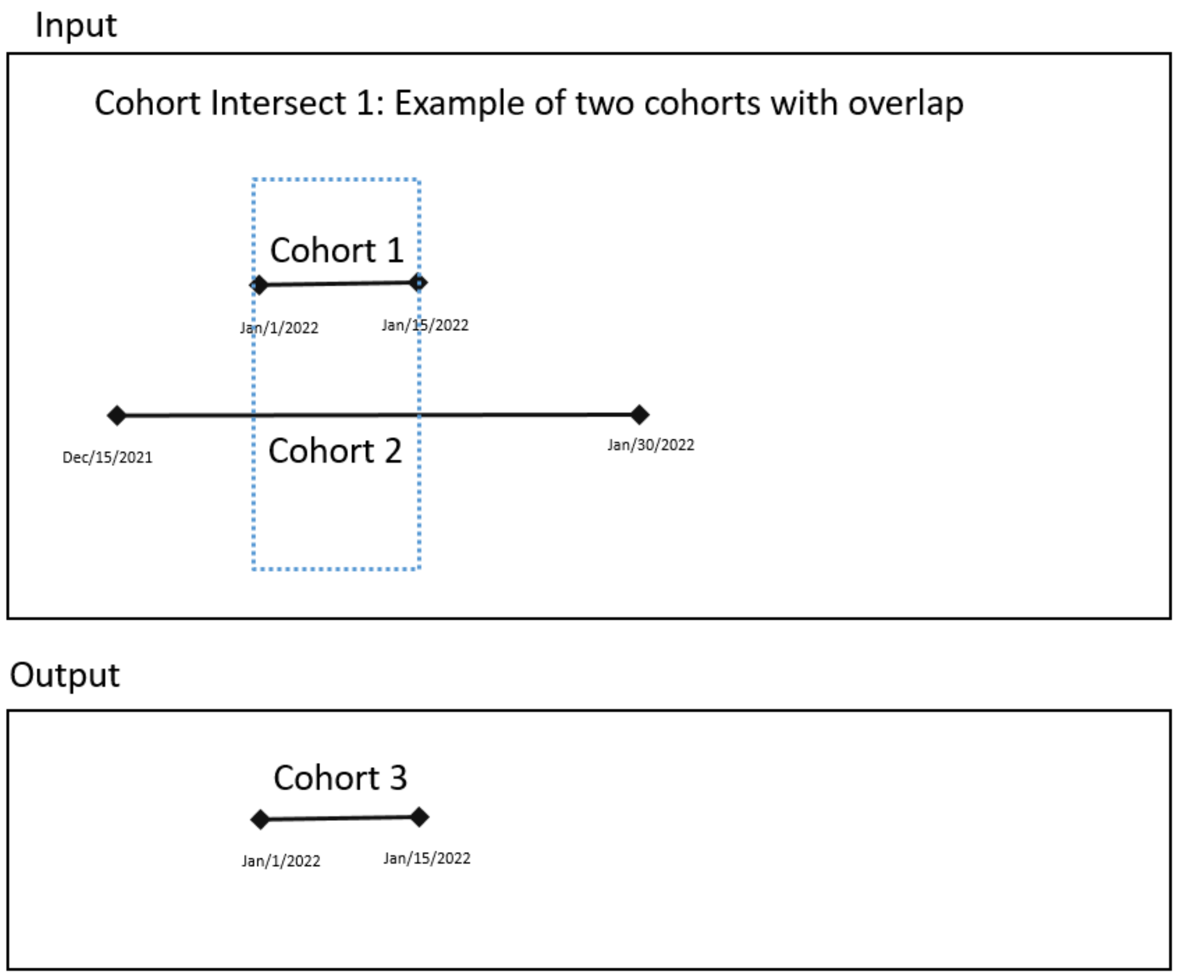


Figure 1: Cohort Intersect 1

Output

```
#> # A tibble: 1 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  3         1 2022-01-01      2022-01-15
```

1.3.2 Intersect cohort example 2

Input:

```
cohort
```

```
#> # A tibble: 3 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  1         1 2022-01-01      2022-01-15
#> 2                  2         1 2021-12-15      2022-01-05
#> 3                  2         1 2022-01-10      2022-01-30
```

```
#> Inserting data took 0.026 secs
```

```
CohortAlgebra::intersectCohorts(
  connection = connection,
  sourceCohortDatabaseSchema = cohortDatabaseSchema,
  sourceCohortTable = tableName,
  targetCohortDatabaseSchema = cohortDatabaseSchema,
  targetCohortTable = tableName,
  cohortIds = c(1, 2),
  newCohortId = 3
)
```

```
#>   |                                                                          |
```

```
#> Executing SQL took 0.0171 secs
```

```
#>  Intersecting cohorts.
#>  Generating eras and saving.
```

Output

```
#> # A tibble: 2 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  3         1 2022-01-01      2022-01-05
#> 2                  3         1 2022-01-10      2022-01-15
```

1.3.3 Intersect cohort example 3

Input:

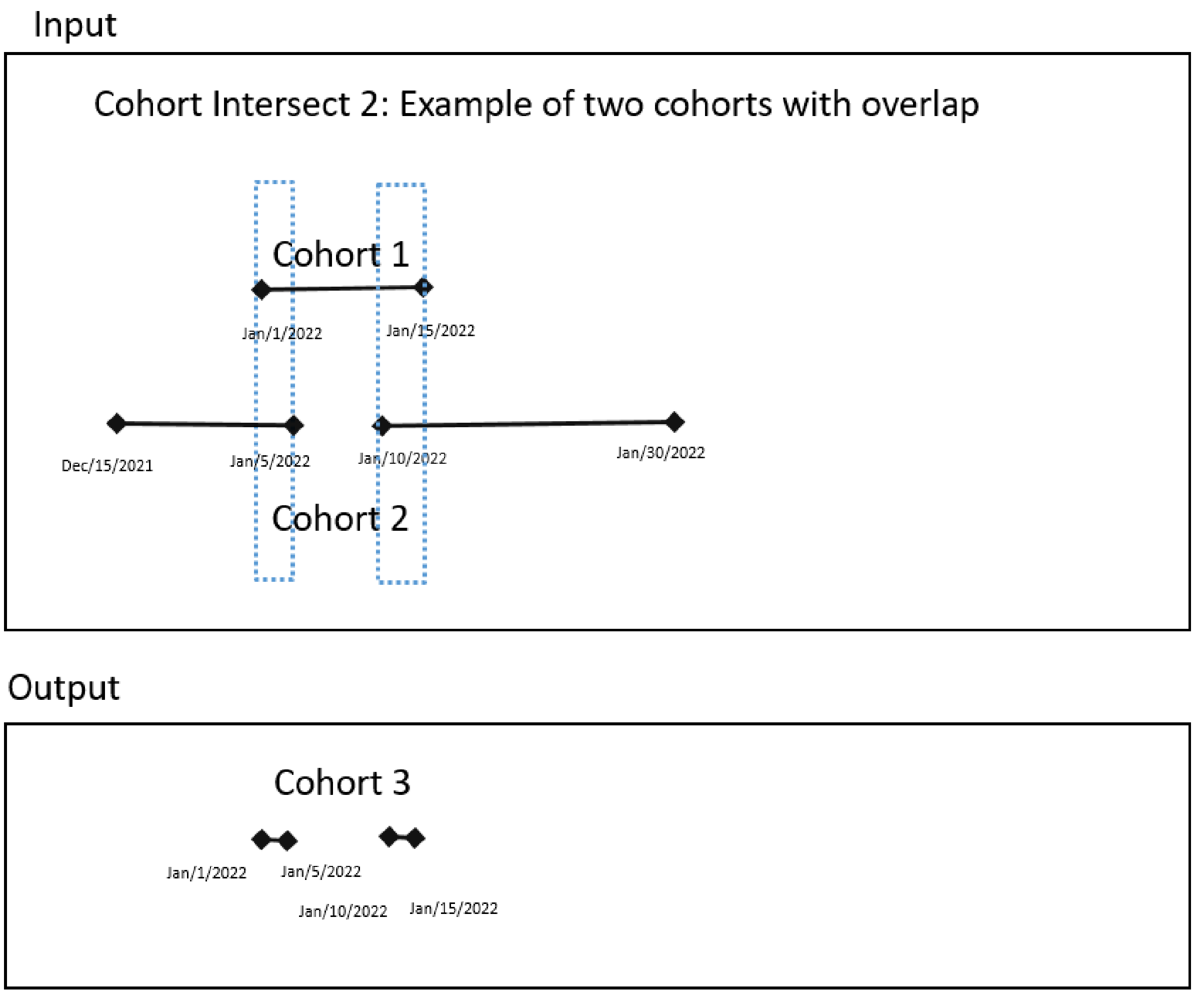


Figure 2: Cohort Intersect 2

```
cohort
```

```
#> # A tibble: 3 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  1         1 2022-01-01      2022-01-15
#> 2                  2         1 2021-12-15      2022-01-30
#> 3                  3         1 2022-03-01      2022-03-15
```

```
#> Inserting data took 0.0274 secs
```

```
CohortAlgebra::intersectCohorts(
  connection = connection,
  sourceCohortDatabaseSchema = cohortDatabaseSchema,
  sourceCohortTable = tableName,
  targetCohortDatabaseSchema = cohortDatabaseSchema,
  targetCohortTable = tableName,
  cohortIds = c(1, 2, 3),
  newCohortId = 4
)
```

```
#>   |                                                                          |
```

```
#> Executing SQL took 1.8 secs
```

```
#>  Intersecting cohorts.
#>  Generating eras and saving.
```

Output

```
data
```

```
#> # A tibble: 0 x 4
#> # i 4 variables: cohortDefinitionId <dbl>, subjectId <dbl>,
#> #   cohortStartDate <date>, cohortEndDate <date>
```

1.3.4 Intersect cohort example 4

Input:

```
cohort
```

```
#> # A tibble: 2 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  1         1 2022-01-01      2022-01-15
#> 2                  2         1 2021-12-15      2022-01-30
```

```
#> Inserting data took 0.0266 secs
```

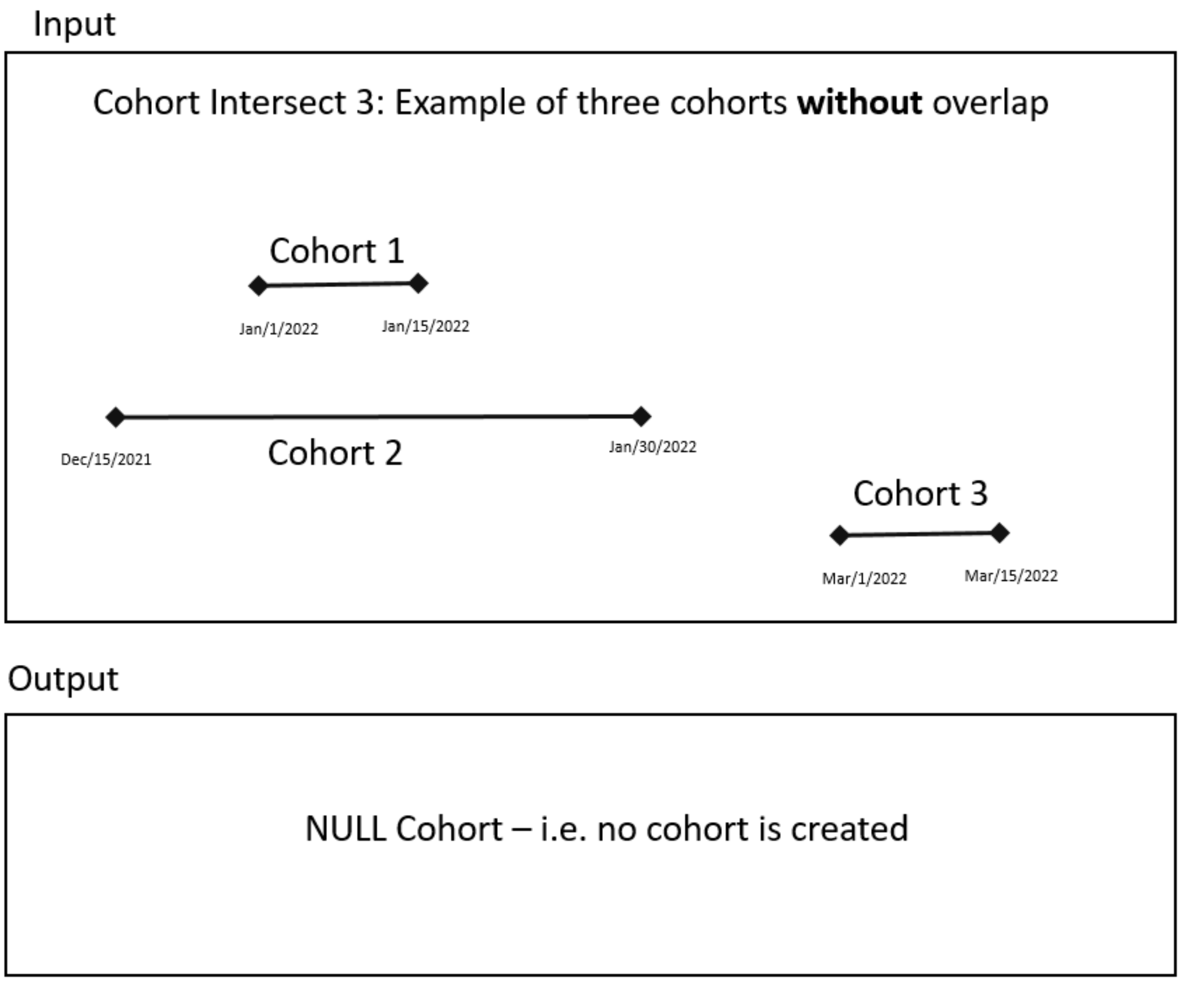

Input
Cohort Intersect 3: Example of three cohorts **without** overlap
Cohort 1
Jan/1/2022
Jan/15/2022
Dec/15/2021
Cohort 2
Jan/30/2022
Cohort 3
Mar/1/2022
Mar/15/2022
Output
NULL Cohort – i.e. no cohort is created

Figure 3: Cohort Intersect 3

```r
CohortAlgebra::intersectCohorts(
  connection = connection,
  sourceCohortDatabaseSchema = cohortDatabaseSchema,
  sourceCohortTable = tableName,
  targetCohortDatabaseSchema = cohortDatabaseSchema,
  targetCohortTable = tableName,
  cohortIds = c(1, 2, 3),
  newCohortId = 4
)
```

```
#>   |                                                                          |
```

```
#> Executing SQL took 0.0173 secs
```

```
#>  Intersecting cohorts.
#>  Generating eras and saving.
```

Output

```r
data
```

```
#> # A tibble: 0 x 4
#> # i 4 variables: cohortDefinitionId <dbl>, subjectId <dbl>,
#> #   cohortStartDate <date>, cohortEndDate <date>
```

1.3.5 Intersect cohort example 5

Input:

```r
cohort
```

```
#> # A tibble: 2 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  1         1 2022-01-01      2022-01-01
#> 2                  2         1 2022-01-01      2022-01-02
```

```
#> Inserting data took 0.0276 secs
```

```r
CohortAlgebra::intersectCohorts(
  connection = connection,
  sourceCohortDatabaseSchema = cohortDatabaseSchema,
  sourceCohortTable = tableName,
  targetCohortDatabaseSchema = cohortDatabaseSchema,
  targetCohortTable = tableName,
  cohortIds = c(1, 2),
  newCohortId = 3
)
```

```
#>   |                                                                          |
```

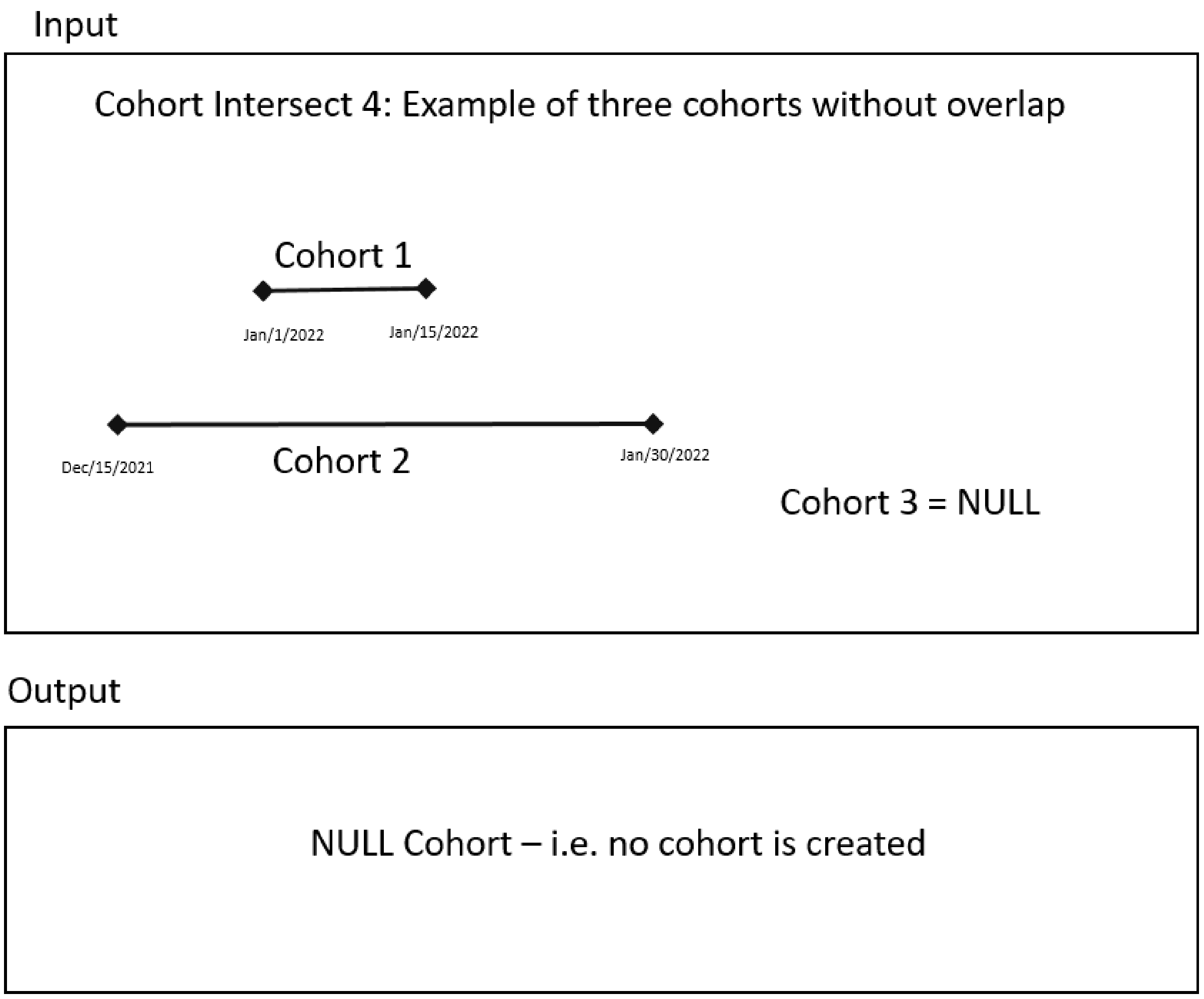

Input
Cohort Intersect 4: Example of three cohorts without overlap
Cohort 1
Jan/1/2022
Jan/15/2022
Dec/15/2021
Cohort 2
Jan/30/2022
Cohort 3 = NULL
Output
NULL Cohort – i.e. no cohort is created

Figure 4: Cohort Intersect 4

```
#> Executing SQL took 0.0173 secs
```

```
#>  Intersecting cohorts.
#>  Generating eras and saving.
```

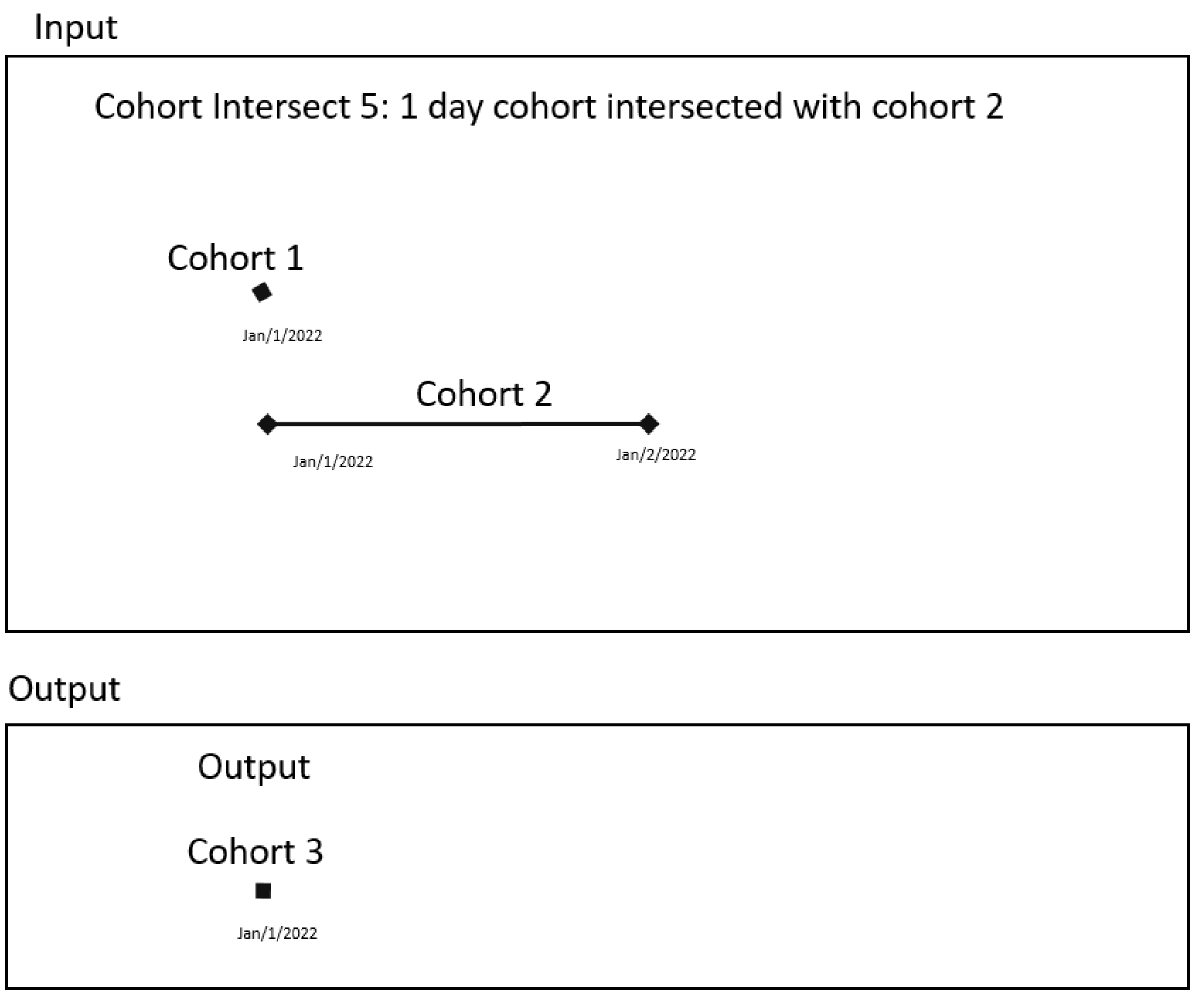


Figure 5: Cohort Intersect 5

Output

```
data
```

```
#> # A tibble: 1 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  3         1 2022-01-01      2022-01-01
```

1.4 Minus Cohort

Input:

```
cohort
```

```
#> # A tibble: 2 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  1         1 2022-01-01      2022-03-01
#> 2                  2         1 2022-02-10      2022-05-10
```

```
#> Inserting data took 0.0276 secs
```

```
CohortAlgebra::minusCohorts(
  connection = connection,
  sourceCohortDatabaseSchema = cohortDatabaseSchema,
  sourceCohortTable = tableName,
  targetCohortDatabaseSchema = cohortDatabaseSchema,
  targetCohortTable = tableName,
  firstCohortId = 1,
  secondCohortId = 2,
  newCohortId = 3
)
```

```
#>   |                                                                          |
```

```
#> Executing SQL took 0.0179 secs
```

```
#>   |                                                                          |
```

```
#> Executing SQL took 0.0193 secs
```

```
#> Performing minus operation.
#>   |                                                                          |
```

```
#> Executing SQL took 0.0157 secs
```

```
#>  Intersecting cohorts.
#>  Generating eras and saving.
```

Output for example 1

```
data
```

```
#> # A tibble: 1 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  3         1 2022-01-01      2022-02-09
```

But if the cohorts are switched, i.e. minus cohort 1 from Cohort 2

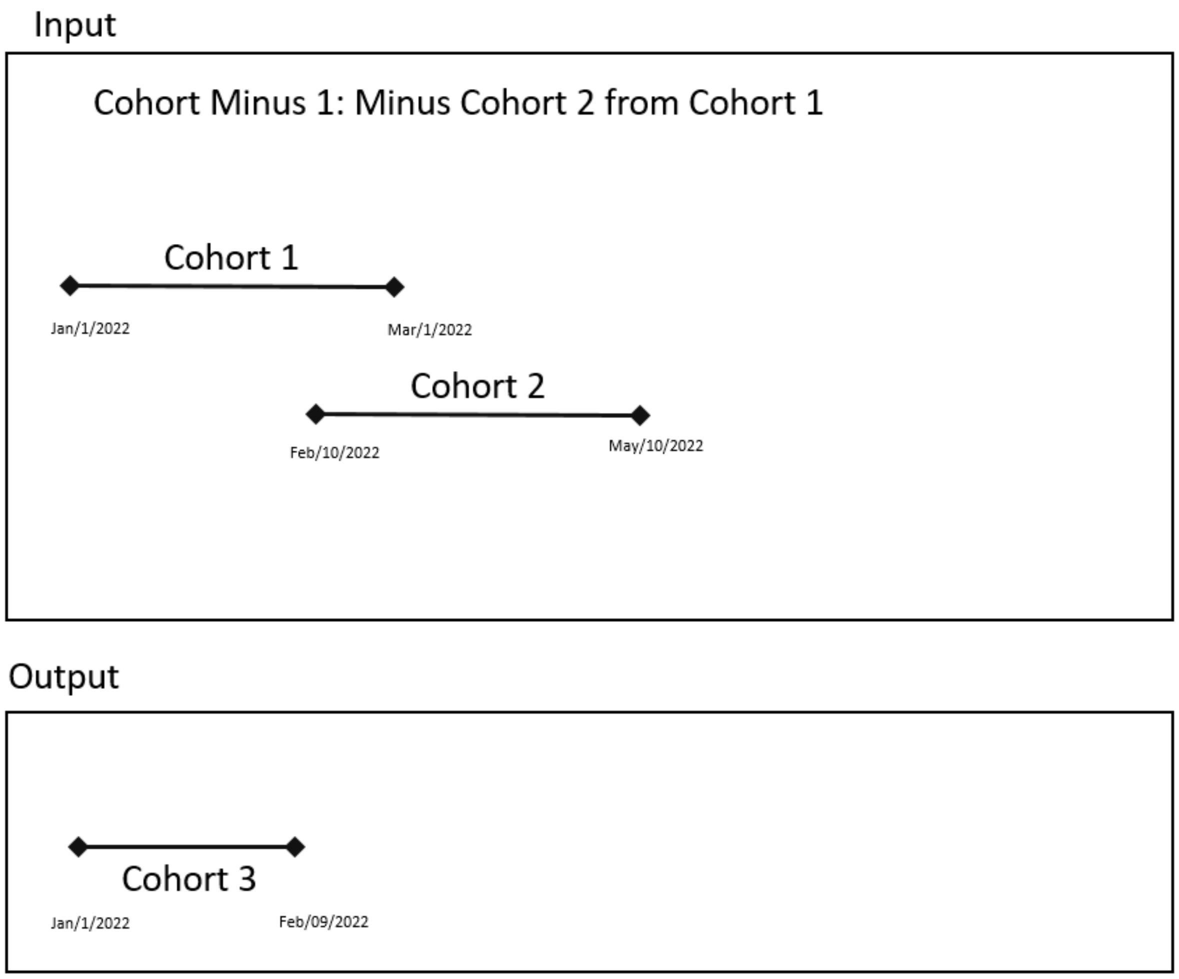


Figure 6: Cohort Minus

```
CohortAlgebra::minusCohorts(
  connection = connection,
  sourceCohortDatabaseSchema = cohortDatabaseSchema,
  sourceCohortTable = tableName,
  targetCohortDatabaseSchema = cohortDatabaseSchema,
  targetCohortTable = tableName,
  firstCohortId = 2,
  secondCohortId = 1,
  newCohortId = 4
)
```

```
#>   |                                                                          |

#> Executing SQL took 0.0173 secs

#>   |                                                                          |

#> Executing SQL took 0.0158 secs

#> Performing minus operation.
#>   |                                                                          |

#> Executing SQL took 0.0164 secs

#>  Intersecting cohorts.
#>  Generating eras and saving.
```

Output

```
data
```

```
#> # A tibble: 1 x 4
#>   cohortDefinitionId subjectId cohortStartDate cohortEndDate
#>                <dbl>     <dbl> <date>          <date>
#> 1                  4         1 2022-03-02      2022-05-10
```

Sequence of cohorts are important for minusCohort

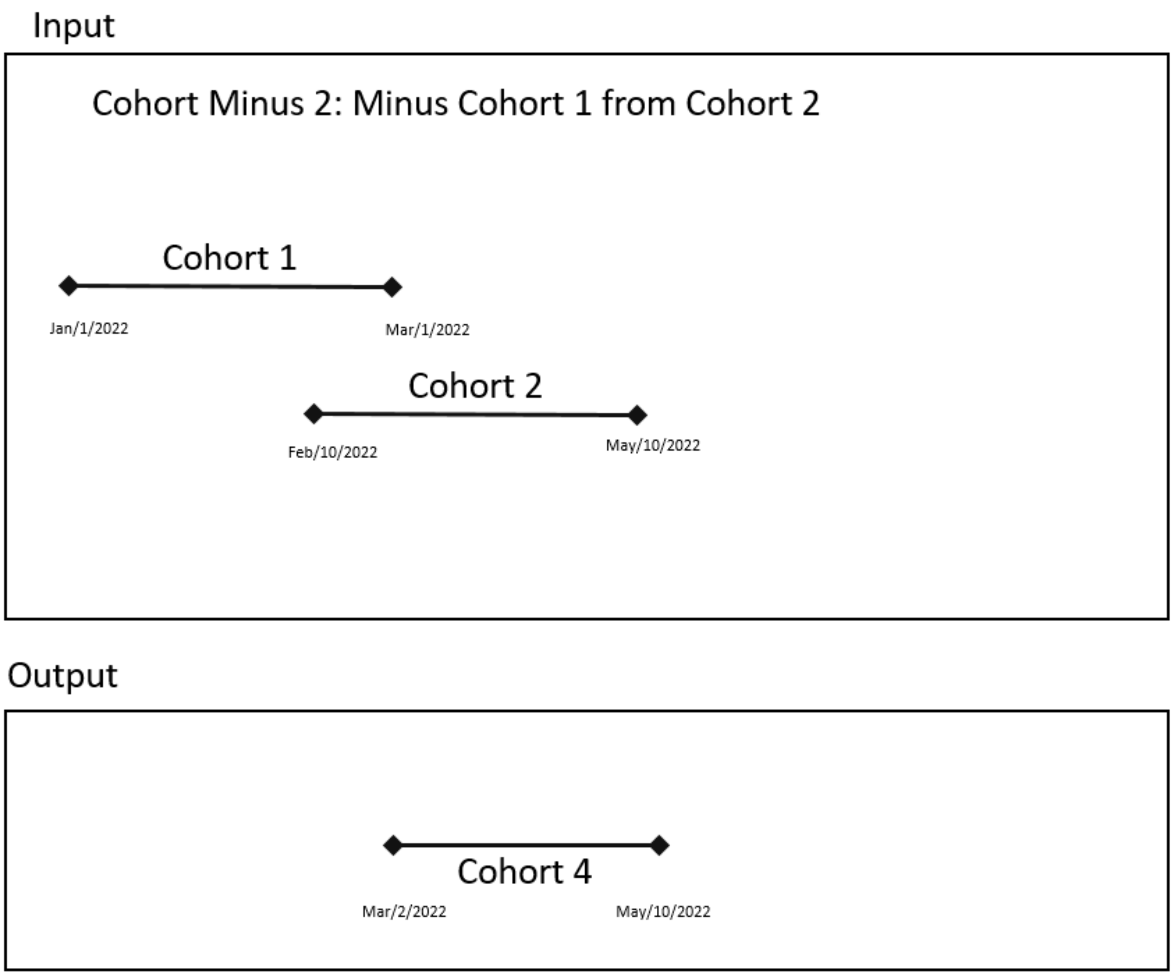


Figure 7: Cohort Minus