A Small Example

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Here, we will clean and process a small database into a temporal network of patient transfers.

All the functionality is provided in the `hospinet` library.

```
import hospinet

import polars as pl
import networkx as nx

from matplotlib import pyplot as plt # for later
```

We load the database (in the form of a csv), and clean it using the `hospinet.cleaner` submodule. We specify the column names, since they are different from the (standardised) default.

```
source_db = hospinet.cleaner.ingest_csv("./data/admissions.csv", convert_dates=True)
source_db.head(5)
```

patient i64	hospital str	admission datetime[s]	discharge datetime[s]
3	”D”	2020-04-02 02:56:19.917759	2021-06-04 14:58:15.715780
2	”E”	2020-04-10 13:56:21.043894	2021-06-07 14:35:45.036138
3	”B”	2020-04-15 03:22:06.938845	2020-05-27 10:14:20.476332
2	”A”	2020-04-20 20:33:17.858555	2020-05-23 10:31:03.186415
1	”E”	2020-04-26 03:36:11.245264	2021-01-08 13:36:08.182081

```
cleaned_db = hospinet.cleaner.clean_database(
    source_db,
    delete_missing="record",
    delete_errors="record",
```

```
    subject_id = 'patient',
    facility_id = 'hospital',
    admission_date = 'admission',
    discharge_date = 'discharge',
    retain_auxiliary_data = True,
)
# encode dates to numerics
first_date = cleaned_db.select(pl.col('Adate').min()).item()
numeric_db = hospinet.cleaner.normalise_dates(
    cleaned_db,
    cols = ['Adate', 'Ddate'],
    ref_date = first_date
)
```

```
INFO::hospinet::Checking existence of columns...
INFO::hospinet::Column existence OK.
INFO::hospinet::Standardising column names...
INFO::hospinet::Coercing types...
INFO::hospinet::Type coercion done.
INFO::hospinet::Checking for missing values...
INFO::hospinet::Checking for erroneous records...
INFO::hospinet::Removing duplicate records...
INFO::hospinet::Finding and fixing overlapping records...
INFO::hospinet::Attempting up to 100 iterations
INFO::hospinet::Iteration 0: 144 entries; 92 overlaps; 0.0026714359992183745 s
INFO::hospinet::Iteration 1: 171 entries; 62 overlaps; 0.0022785820183344185 s
INFO::hospinet::Iteration 2: 194 entries; 50 overlaps; 0.0033057639957405627 s
INFO::hospinet::Iteration 3: 215 entries; 44 overlaps; 0.002744395984336734 s
INFO::hospinet::Iteration 4: 234 entries; 38 overlaps; 0.0023581869900226593 s
INFO::hospinet::Iteration 5: 250 entries; 34 overlaps; 0.002557872037868947 s
INFO::hospinet::Iteration 6: 265 entries; 32 overlaps; 0.002452725952025503 s
INFO::hospinet::Iteration 7: 276 entries; 28 overlaps; 0.0028382480377331376 s
INFO::hospinet::Iteration 8: 286 entries; 21 overlaps; 0.002110183995682746 s
INFO::hospinet::Iteration 9: 294 entries; 18 overlaps; 0.002611069008708 s
INFO::hospinet::Iteration 10: 302 entries; 16 overlaps; 0.002957379969302565 s
INFO::hospinet::Iteration 11: 310 entries; 16 overlaps; 0.002604701032396406 s
INFO::hospinet::Iteration 12: 317 entries; 15 overlaps; 0.0023700519814155996 s
INFO::hospinet::Iteration 13: 324 entries; 14 overlaps; 0.0022482519852928817 s
INFO::hospinet::Iteration 14: 330 entries; 13 overlaps; 0.0024886580067686737 s
INFO::hospinet::Iteration 15: 335 entries; 12 overlaps; 0.0023688190267421305 s
INFO::hospinet::Iteration 16: 339 entries; 9 overlaps; 0.0027188339736312628 s
INFO::hospinet::Iteration 17: 243 entries; 7 overlaps; 0.0024568139924667776 s
```

```
INFO::hospinet::Iteration 18: 188 entries; 5 overlaps; 0.0030460780253633857 s
INFO::hospinet::Iteration 19: 120 entries; 4 overlaps; 0.002818793000187725 s
INFO::hospinet::Iteration 20: 122 entries; 4 overlaps; 0.00281722896033898 s
INFO::hospinet::Iteration 21: 123 entries; 3 overlaps; 0.0025224960409104824 s
INFO::hospinet::Iteration 22: 124 entries; 2 overlaps; 0.0029321539914235473 s
INFO::hospinet::Iteration 23: 125 entries; 2 overlaps; 0.002912027994170785 s
INFO::hospinet::Iteration 24: 126 entries; 2 overlaps; 0.00280821998603642 s
INFO::hospinet::Iteration 25: 127 entries; 2 overlaps; 0.0027175010181963444 s
INFO::hospinet::Iteration 26: 128 entries; 2 overlaps; 0.00297291501192376 s
INFO::hospinet::Iteration 27: 129 entries; 2 overlaps; 0.0025346739566884935 s
INFO::hospinet::Iteration 28: 130 entries; 2 overlaps; 0.0030280210194177926 s
INFO::hospinet::Iteration 29: 131 entries; 2 overlaps; 0.002856035018339753 s
INFO::hospinet::Iteration 30: 132 entries; 2 overlaps; 0.002567083982285112 s
INFO::hospinet::Iteration 31: 133 entries; 2 overlaps; 0.002165095997042954 s
INFO::hospinet::Iteration 32: 134 entries; 2 overlaps; 0.0023509410093538463 s
INFO::hospinet::Iteration 33: 135 entries; 2 overlaps; 0.0025193950277753174 s
INFO::hospinet::Iteration 34: 135 entries; 1 overlaps; 0.0026860389625653625 s
INFO::hospinet::Iteration 35: 0 entries; 0 overlaps; 0.002382597012910992 s
INFO::hospinet::History of non-overlapping patient records:
INFO::hospinet::[0, 0...{16x}, 99, 57, 70, 0...{15x}, 135]
INFO::hospinet::0 overlaps remaining after iterations
```

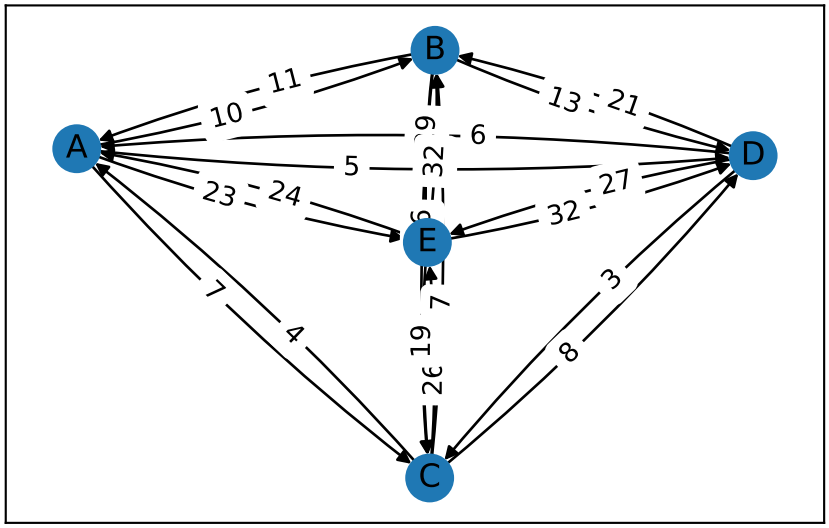
We can then process this into a TemporalNetwork object directly using the `from_presence` class method

```
network = hospinet.TemporalNetwork.from_presence(
    numeric_db,
    discretisation=1,
)
```

This object is also a `networkx.DiGraph` object, so we can use the native plotting functionality. We project this down to static nodes first, so that we don't get the full temporal graph.

```
static_network = network.to_static()
pos = nx.spring_layout(static_network, seed=1451)
edge_labels = {
        tuple(edge): f"{attr}"
        for *edge, attr in static_network.edges(data='weight')
    }
nx.draw_networkx(static_network, pos=pos, connectionstyle='arc3,rad=0.05')
nx.draw_networkx_edge_labels(
    static_network,
```

```
    pos=pos,
    edge_labels=edge_labels,
    label_pos=0.4,
    connectionstyle='arc3,rad=0.05'
);
```



We provide some basic indexing support via methods:

```
print("Nodes with presence at time 15: ", network.nodes_at_time(15))
print("When hospital D is occupied: ", network.when_present('D'))
```

```
Nodes with presence at time 15:  ['E' 'B']
When hospital D is occupied:  [  0   1   2   3   4   5   6   7   8   9  10  11  12  13  38  3
  42  43  44  45  46  47  48  49  50  51  52  53  54  55  56  57  58  59
  71  72  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88
  89  90  91  92  93  94  95  96  97  98  99 100 101 102 103 113 114 115
 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133
 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151
 152 153 154 155 156 157 158 159 160 175 181 182 183 184 185 186 187 188
 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206
 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224
 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242
 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260
 261 262 263 264 265 266 267 268 269 270 271 272 278 292 293 294 295 296
 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314
```

```
315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 345 346
347 348 349 350 351 352 353 355 356 357 358 359 376 377 378 379 380 381
382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399
400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417
418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435
436 437 438 439 440 441 442 443 444 445]
```