# Tracing the deportation to define Holocaust geometries. The exploratory case of Milan.

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**Abstract**

This paper presents a pilot project conducted in collaboration with the Fondazione CDEC to shed light on the historical dynamics of the arrests and deportations of Jews from Italy to foreign concentration camps between 1943 and 1945. Led by a multidisciplinary team, including a Digital Humanities expert, an archivist, a GIS developer, and an education manager, the project aimed to rework archival information into data visualisation models utilising a subset of data from the CDEC LOD dataset of the victims of the Holocaust in Italy to construct detailed visual representations of deportation routes.

Drawing inspiration from previous projects like the Atlas of Nazi-Fascist Massacres and research on Holocaust testimonies, this project sought to create interactive maps, network and graphs illustrating the paths of forced transfers endured by arrested Jews, particularly focusing on those born or arrested in Milan. Despite challenges such as incomplete or imprecise data, the team managed to reconstruct deportation routes and classify transport convoys, enhancing the understanding of this dark period in history. The visualisations, along with detailed repositories and links provided on GitHub, serve as valuable research tools for both scholarly and educational purposes, offering users varying levels of granularity to explore historical events and timelines. Through meticulous data analysis and visualisation techniques, this project contributes to ongoing efforts to preserve and understand the tragic events of the Holocaust, emphasizing the importance of archival work and interdisciplinary collaboration in historical research.

**Keywords:** Data Visualisation, Spatial Humanities, Jewish Deportation

## 1. Introduction

This paper aims to take stock of a pilot project that seeks to address the need to put the historical dynamics that characterised the arrests of Jews, living in Italy (Italians and foreigners) and their subsequent deportation to concentration and extermination camps between 1943 and 1945, back at the centre of the scientific debate. After the Armistice the 8th of September 1943 and subsequent Nazi occupation of Italy, deportation of Jewish people started and more than 8,000 Jews were deported from Italy to Nazi concentration camps. This project was carried out in close collaboration with the Fondazione CDEC (Contemporary Jewish Documentation Center) and is the result of a work that starts with the reworking of archival data, also from the Fondazione CDEC, to their transformation into data visualisation models. All steps of this work were shared and discussed by a four-person working team:

- Giovanni Pietro Vitali, Associate Professor in Digital Humanities at the Université de Versailles Saint Quentin en Yvelines - Université Paris-Saclay who was in charge of coordinating the work, structuring the data, and creating a link between the archive activities and the final creation of the models.
- Laura Brazzo, vice director of the CDEC Foundation and head of its historical archives, who was in charge for the analysis and revision of the archive materials.
- Simone Landucci, GIS (Geographic Information System) developer who worked on the creation of the JavaScript models that enable the geographical visualisation of maps.
- Patrizia Baldi, education Activities Manager at CDEC, who supported the historical and critical reflection around the creation of models.

On the occasion of International Holocaust Remembrance Day, the work was officially published on the Fondazione CDEC website at this link: https://www.cdec.it/milano-mappe-sugli-arresti-e-le-deportazioni-degli-ebrei-1943-1945/.[1]

Before delving into previous projects that paved the way for GIS applications in the study of deportation and outlining the specificities of our work along with its potential in deportation analysis, it is important to note that this type of study faces significant challenges. This difficulty primarily stems from the near-complete destruction of transport lists containing the names of deported Jews.[2]

A concluding introductory remark pertains to technical matters. All technologies utilised in our endeavour are entirely open-source. The project

[1] These tools are currently available only in Italian. However, the development team of these visualisations intends to create an English-language version with the aim of expanding the scope of data to encompass the entire database of CDEC Foundation.

[2] Only two convoys left from Milan bound for Auschwitz, and one bound for Bergen Belsen. The other convoys which left Milan were directed to the concentration camps (Polizei und Durchgangslager) of Fossoli, Modena (from February until August 1944) and then to Bolzen (until December 1944). From Fossoli and then Bolzano most of the convoys departed for Auschwitz. The total number of convoys that left from the territories of the Italian Social Republic was 20 (Picciotto Fargion, 2002: 58-65).



*The First Workshop on Holocaust Testimonies as Language Resources @LREC-COLING-2024*, pages 53–62

development team has thoroughly annotated both the data and code, thereby facilitating its reuse by any individual requiring it.

## 2. State-of-the-art

This work has been possible reusing data that the CDEC Foundation made available through its endpoint (http://dati.cdec.it/lod/shoah/website/html). Via the CDEC endpoint the full dataset of Jewish people arrested and deported from Italy can be queried, downloaded and reused (CC License 4.0) (Brazzo and Rodriguez, 2019). Behind the creation of this dataset, as well as behind the work presented in these pages, there is clearly *Il libro della memoria. Gli Ebrei deportati dall'Italia (1943-1945)* by Liliana Picciotto (Picciotto Fargion, 2002) that represents the reference point for all studies dealing with Jewish deportation from Italy. This book, published for the first time in 1991, is the central reference of this paper. In this monumental work the full list of both Jewish deportees and victims of massacres in Italy is recorded. This list is made of more than 8000 individual records; data come from a variety of sources including already-mentioned four Nazi-list of transports[3] out of the 20 transports which left from the RSI (Picciotto Fargion, 2002: 58-61).[4]

One of the primary sources of inspiration for this project was the *Atlante delle stragi Nazifasciste* [Atlas of Nazi-Fascist Massacres] (http://www.straginazifasciste.it/), published in 2012. This research, funded by the German government, has been coordinated by the National Institute for the History of the Liberation Movement in Italy (INSMLI, http://www.reteparri.it/), and the National Association of Italian Partisans (ANPI, https://www.anpi.it/). The Atlas of Nazi-Fascist Massacres consists of an online database and related materials (documentaries, iconographic documents, videos) on some ~~specifical~~ specific historical recorded episodes: war massacres carried out by the Nazis and fascists principally during the German occupation period. The efforts dedicated to the development of this Atlas have culminated in the creation of a volume that stands as one of the pioneering endeavours in applying Spatial Humanities methodologies to conduct historiographic analysis of a significant phenomenon such as the spreading of violence during WWII: *Zone di guerra, geografie di sangue. L'Atlante delle stragi naziste e fasciste in Italia (1943–1945)* [War zones, blood geographies. An Atlas of the Nazi and Fascist massacres in Italy (1943-1945)] by Paolo Pezzino and Gianluca Fulvetti (Fulvetti and Pezzino, 2016).

Expanding upon the groundwork laid by CDEC's exploration of Holocaust testimonies, as well as Picciotto's research and the data compiled by the Ferruccio Parri National Institute's atlas of massacres in Milan, a significant study was released in 2021. For the first time, this paper interlinked wartime massacres and deportations, offering a comprehensive understanding of these intertwined historical events: *Visualizing Second World War Violence Through an Atlas of Nazi-Fascist Repression* by Giovanni Pietro Vitali (Vitali, 2021). In this essay, the author pioneers the use of data visualisation technologies and novel approaches to dataset creation, which serve as the foundation for the maps and networks presented in this paper.

Finally, it is important to mention previous scholarly efforts in addressing the challenge of visualizing deportation in Italy. Scholars such as Alberto Giordano, Tim Cole, and Maël Le Noc have undertaken significant work in this area. Their research focused on clustering Jewish arrests in Italy, culminating in the development of a model capable of tracing the movements of family members from the moment of arrest to their arrival at concentration camps (Le Noc *et al.*, 2020). Prior to this, Cole and Giordano collaborated with Anne Kelly Knowles on an innovative volume titled *GeoGraphies of the Holocaust* (Knowles *et al.*, 2014) which stands as a pioneering example of digitally assisted spatial humanities analysis within the field of Holocaust studies.[5]

This paper aims to present a project that aligns with prior research in Spatial Humanities and Deportation, with the objective of contemplating the interrogation of our understanding of the Holocaust phenomenon through archival sources and scholarly endeavours.

## 3. The project

The first goal of this project was to craft an elaborate map delineating the routes of involuntary displacements endured by Jews subjected to arrest and subsequent deportation to Nazi concentration and extermination camps. Utilising already available data, archival materials and data visualisation, the team sought to construct a research instrument primarily for scholarly endeavours, while also bolstering educational and training initiatives at CDEC

[3] The four transports are: (1) 5 April 1944/Auschwitz; (2) 16 May 1944/Bergen Belsen; (3) 16 May 1944/Auschwitz; (4) 26 June 1944/Auschwitz. They can all be viewed via the Digital Library at this link: https://digital-library.cdec.it/cdec-web/storico/search/result.html?query=Transportliste&titoloStorico=&contenutoStorico=&startDate=&endDate=&personeStorico=&luoghiStorico=&entiStorico=
The convoys departing from Trieste (Operationszone Adriatisches Küstenland, are numbered from 21T to 43T while the unique convoy departing from Rhodes is numbered 44R).

[4] RSI stands for Repubblica Sociale Italiana [Italian Social Republic], a puppet state under Nazi-German influence during the latter stages of World War II. Established following the German occupation of Italy in September 1943, RSI endured until the surrender of German forces in Italy in May 1945. The presence of German troops fuelled significant opposition across Italy, sparking widespread resistance and ultimately precipitating the Italian Civil War.

[5] In this volume, the third chapter in particular: Retracing the *'Hunt for Jews' A Spatial-Temporal Analysis of Arrests during the Holocaust in Italy* by Alberto Giordano and Anna Holian (Knowles *et al.*, 2014: pp. 53-86).

Foundation as well as at the Shoah Memorial of Milan. Therefore, the decision was made to launch this pilot project using data related to the arrests of Jews in Milan, encompassing both those born in Milan and arrested elsewhere across Italy. Recognising the unique aspects of the phenomenon under study - deportation - and its geospatial data representation, the project team deemed it essential to empower users of the visualisations with control over both the historical events and their chronological context.

The *Graphs, Maps and Trees* (Moretti, 2005), and networks approach that we proposed, recalling Franco Moretti's distant reading methodology (Moretti, 2013) applied to History. The graphical tools we have developed encompass various types of dataviz approaches - graphs, maps, trees and networks - and are designed to underscore the identified relationships between individuals, locations, and time periods, offering varying levels of detail granularity. This approach allows users to explore specific aspects based on their choices and research needs of the tools we have created. Through our work, the case studies we have conducted can be examined using both a close and distant reading approach, depending on the user's specific inquiries. Our underlying philosophy is to encourage users to 'ask the data graphically', enabling them to explore the information in a visual and interactive manner according to their preferences and research objectives.

The data sample we used for our project includes information on two case studies:

- **Jews born in the city of Milan** (and arrested in Milan or the rest of Italy), 166 persons
- **Jews arrested in the city of Milan** (born in Milan or the rest of Italy or Europe), 278 persons.

While these are two separate sets of data, there is an overlap of 41 cases between them, thus bringing the total number of cases examined to 403.

The two datasets were acquired by executing two separate SPARQL queries on the entire LOD dataset of the Victims of the Holocaust in Italy (http://dati.cdec.it/lod/shoah/website/html). The query criteria for the data were the birthplace in the first case and the place of arrest in the second case.

The dataset of the Victims of the Holocaust in Italy is the structured digital version of the textual information reported in *Il Libro della Memoria*, This volume is the result of a multi-year research conducted by CDEC, led by Liliana Picciotto, on the persecution and deportation of the Jews from Italy. The MS Access database that formed the basis of *Il Libro della Memoria* underwent subsequent processing starting in 2013: the data were massively transformed into RDF format based on established ontologies and a specifically crafted OWL domain ontology (*Shoah Ontology*) that formally describes the concepts and relationships proper to the persecution and deportation of the Jews from Italy.

The RDF dataset of the Victims of the Holocaust in Italy is exposed since 2014 on a SPARQL endpoint where queries, downloading and reusing of data by third parties are enabled. This dataset formally titled "Shoah Victim Names" was included in the LOD Cloud Diagram of the University of Mannheim in September 2014 (https://lod-cloud.net/).

The research on the Victims of the Holocaust in Italy relies on a diverse array of sources, meticulously documented in a dedicated introductory section of *Il Libro della Memoria*. Among these sources is the collection of handwritten paper cards created by CDEC in the early 1970s at the beginning of the research on Jewish deportations from Italy, used to record information about each of the deportees. Information was systematically gathered from sources of that time, including testimonies of the relatives of the victims or survivors.

These cards often provide granular details regarding specific locations – such as the address of residence and the exact place of arrest - which have not been included in *Il Libro della Memoria* or subsequent databases. Data about these locations have been incorporated into the two subsets used for our project.

The inclusion of such information (when available) has provided the precise georeferencing of where people lived and/or were arrested - whether it was at their own home, on the street, or at another location (e.g., at the home of friends or acquaintances who were hiding them).

In short, the two datasets upon which the project is based, incorporate information sourced from both the entire dataset of the Victims of the Holocaust in Italy queried via the SPARQL endpoint and the archival handwritten paper cards.

### 3.1 Repositories and links

The visualisations showcased in this paper have been archived in the repository space of Giovanni Pietro Vitali's GitHub profile: https://github.com/digitalkoine. The datasets, as well as the R and HTML, CSS and JavaScript code, along with the web pages developed, have been released under the MIT license within the repositories of this profile.

The initial visualisation is a graph illustrating the timeline of arrests carried out by Fascist and Nazi authorities against Jews in Milan during the specified period. The graph is accessible through the following link: https://digitalkoine.github.io/chronology_arrests_milan/.[6]

[6] GitHub repository: https://github.com/digitalkoine/chronology_arrests_milan

One of the most important issues of the deportation is the classification of the trains that took the Jews out of Italy. In the specific case of this paper, we used the numbering of convoys proposed by Liliana Picciotto with departure and arrival dates.[7] In order to eliminate any ambiguity surrounding the description of the transports, a dedicated website was created. On this site, we have included the information necessary to identify each of the convoys represented in the maps and network displays: https://digitalkoine.github.io/convogli_lager/.[8] Below the description of each convoy, the users will find a list of the deported Jews, categorised based on the two case studies. By clicking on the name of each deportee, the user is directed to their personal and persecution data, accessible via the LOD browser LodView (e.g., http://dati.cdec.it/lod/shoah/person/418/html).

In terms of visualisations, each of the two case studies consists of a map and a network, both interactive:

- **Jews born in the city of Milan**
  Map (map_milan_deportees):[9] https://digitalkoine.github.io/map_milan_deportees/;
  Network (network_milan_deportees):[10] https://digitalkoine.github.io/network_milan_deportees/;
- **Jews arrested in the city of Milan**
  Map (map_milan_arrested):[11] https://digitalkoine.github.io/map_milan_arrested/;
  Network (network_milan_arrested): https://digitalkoine.github.io/network_milan_arrested/.[12]

## 3.2 Data and code

The visualisations we have crafted arise from a thorough examination of the historical intricacies surrounding arrests and deportations during the Holocaust. To accurately depict each stage of every deportee's journey, bespoke models were tailored for the two case studies. The objective was to explore digital solutions, facilitating the application of the same methodology to all deportees in the CDEC endpoint in the future. The project team had engaged in prior discussions concerning the potentialities afforded by visualisation techniques and the nature of the data it possessed, including associated challenges. Through a comprehensive exploration of sources and available options, the team harmonised the data and selected appropriate coding methodologies. This process was conducted with a synergistic approach, ensuring the interoperability of data across all chosen programming environments, primarily R and JavaScript.

### 3.2.1 Data

The approach to data was a crucial aspect of our methodological framework. Through the SPARQL endpoint, we obtained the basic and necessary information to construct visualizations. In order to accurately depict the deportation routes, comprehensive data detailing each individual's journey across all its stages was indispensable.

In addition to biographical data, the pertinent information encompasses details pertaining to the various phases of each individual's journey, commencing from the moment of their arrest:

- First and last name
- Place and date of birth
- Address of residence
- Place and date of arrest
- Period of imprisonment (if any)
- Period of internment (ddmmyyyy to ddmmyyy) in prison and/or transit camp (until August 1944 at the camp of Fossoli di Carpi, and then at the camp of Bolzano)
- Place and date of departure of convoy
- Place and date of arrival of convoy

The data available are in some cases very precise, in others less so. For instance, sometimes the date of the arrest is only known with the month without the day. Or again, the perpetrators of the arrest are only known for 99 out of 278 cases. The provenance of these data is the milestone research of Liliana Picciotto, namely the already-mentioned *Il Libro della Memoria.* Information provided by this book are rich and complex: last known place of residence (e.g. Milan); place and date of arrest (e.g. Milan, 11 November 1943), perpetrators of the arrest (Fascist, Nazi) transfer(s) from prison to prison before deportation; Convoy Departure place and date, Arrival place and date; fate. This complex of information has been structured through both consolidated ontologies (FOAF, Event, BIO, Schema.org and DCMI, for biographical information) and the OWL domain Shoah Ontology (http://dati.cdec.it/lod/shoah/reference-document.html for data regarding persecution) in a large dataset that has been used for our pilot project. However, the mapping part of the project we were constructing necessitated a higher degree of precision, particularly concerning the dates and locations of arrests. This precision could, in certain instances, be deduced from the scrutiny of the already mentioned handwritten paper cards Consequently, it was feasible, in numerous instances, to revisit the archives and reconcile discrepancies within the data,

[7] A different numbering system to classify convoys to prison and extermination camps is proposed by Italo Tibaldi in *Compagni di viaggio* (Tibaldi, 1994) and in *Calendario della deportazione italiana* (http://www.associazioni.milano.it/aned/tibaldi_calendar.htm).
[8] GitHub repository https://github.com/digitalkoine/convogli_lager
[9] GitHub repository: https://github.com/digitalkoine/map_milan_deportees
[10] GitHub repository: https://github.com/digitalkoine/network_milan_deportees
[11] GitHub repository: https://github.com/digitalkoine/map_milan_arrested
[12] GitHub repository: https://github.com/digitalkoine/network_milan_arrested

or integrate with additional information. Our work has tried to remedy data gaps such as the case of dates. By going back into the archives, we managed to resolve certain conflicts or in other cases we reconstructed a plausible date that would allow us to digitally design the journey of each deportee. Where, for example, a date was only indicated by the year, we provided a possible option that would allow the map to function and that it was coherent with the rest of the data, especially the dates. All acts aimed at rectifying inconsistencies in cases with gaps in the dataset were resolved by relying on contextual historical data such as the dates of arrival and departure of convoys. We duly noted this particular aspect for each individual. Regrettably, it was not feasible to reconstruct all deportation routes.

- **For the Jews born in the city of Milan** (and arrested in Milan or elsewhere in Italy), our 166 persons dataset had to exclude 4 people: Gutenberger Elda, Pisetzky Dorotea, Spiro Eva, and Volterra, Nissim. From now on, we will refer to this dataset as **DS1**.

- **For the Jews arrested in the city of Milan** (and born in Milan or elsewhere in Italy or abroad), our 278 persons dataset had to exclude 19 people: Adler Oscar Zeliko, Adler Zora, Americano Carolina, Araf Marco, Percowiez Adolfo, Rabinoff Anna, Milul Isacco Gino, Dana Salomone, Dana Samuele, Guastalla Luciano, Lemberger Marcella, Lemberger Wolf, Lenghi Walter, Rosenbaum Elena, Foà Aldo, Romano Ferdinando Vittorio, Gutenberger Elda, Leoni Giulia, Voghera Augusta. From now on, we will refer to this dataset as **DS2**.

As a result, DS1 decreased from 166 to 162 and DS2 from 278 to 259 deportees.

DS1 is composed of fewer people but with more complex histories, and the errors multiply. This table provides a summary of the dataset fields that have undergone rectification. We incorporate accuracy information, which pertains to the entirety of the data scrutinised for each respective field outlined in the dataset, juxtaposed with the errors detected within each single field as delineated in the subsequent table lines:

| Fields (original name Digital Library) | Errors on 1782 fields | Accuracy |
|---|---|---|
| dateOfBirth | 3 | 0,0017 |
| arrestPlace | 8 | 0,0045 |
| arrestDate | 36 | 0,02 |
| transferDate | 85 | 0,048 |
| convoyDepatureDate | 16 | 0,0089 |
| convoyArrivalDate | 17 | 0,0095 |
| labelToNaziCamp | 16 | 0,0089 |
| dateofDeath | 56 | 0,031 |

Table 1: Table of the accuracy of data concerning Jews born in Milan - DS1

This table indicates that the data pertaining to Jews born in Milan and detained either inside or outside the city are notably more deficient, and also less numerous compared to DS2. Nevertheless, it is important to note that the aforementioned gaps in the data within the CDEC endpoint did not impede the possibility to devise methodologies for visualising the deportation routes of individuals affected by these discrepancies. However, this observation prompts consideration regarding the ongoing necessity for the analysis and categorisation of historical source material, particularly regarding the Second World War and, more specifically, the Holocaust (Vitali, 2022). It is evident that there exists a requirement to revisit primary sources and rectify the data through increased dialogue between archives' documentation and digital technologies.

With regard to the data concerning Jews arrested in Milan, it appears that the primary challenge encountered concerning these historical records lies in the dates of arrest, which exhibit the highest frequency of errors. The table presenting accuracy metrics illustrates the following:

| Fields (original name Digital Library) | Errors on 2849 fields | Accuracy |
|---|---|---|
| dateOfBirth | 1 | 0,00035 |
| arrestsDate | 35 | 0,013 |
| detentionDate | 7 | 0,0025 |
| campDate | 5 | 0,0017 |
| convoyDepatureDate | 1 | 0,00035 |

Table 2: Table of the accuracy of data concerning Jews arrested in Milan – DS2

It is of note that the entirety of errors within the reference dataset underscores the richness of information present in the most comprehensive dataset. Notably, all inaccuracies in the dataset pertain to dates. It is intriguing to observe that the dataset focusing on individuals arrested in Milan exhibits greater accuracy compared to the dataset encompassing a broader scope, such as individuals born in Milan but arrested beyond the Lombard capital. Upon examining the accuracy data, one discerns the intricacies involved in reconstructing the history of these deportees, likely attributable to the complexity of their movements.

The design and manipulation of the data were conducted concomitantly, not through a process of conforming the datasets to predetermined specifications, but rather by refining the programming to align the models with the data themselves - an established focal point determined by the project team. As the data underwent harmonisation, the coding evolved in tandem, adapting to accommodate the evolving datasets.

### 3.2.2 Code

Undoubtedly, the primary objective of the team engaged in this project was to develop interactive maps. The imperative was to craft an interactive map capable of addressing the intricacies inherent in the historical phenomenon of deportation. The sole viable approach to adhere to open-source principles involved utilising HTML, CSS, and particularly JavaScript.[13] The provided HTML code served the purpose of constructing interactive web maps that visualise historical data pertaining to the deportation of individuals from Milan or arrested in Milan during World War II. It leveraged several JavaScript libraries and plugins to achieve various functionalities. Firstly, the maps are built using Leaflet.js, a widely-used JavaScript library for creating interactive maps. This library is imported from a Content Delivery Network (CDN). Additionally, Turf.js, a JavaScript library for spatial analysis, is utilized for geospatial operations such as buffering and intersecting. To enhance user interaction and visualisation, several Leaflet plugins are incorporated. Leaflet.Coordinates is employed to display mouse coordinates on the map, while Leaflet.Search facilitates searching for specific features on the map. Leaflet.GeometryUtil enables geometric operations, and Leaflet.AlmostOver assists in handling mouseover events. Moreover, the maps design are enriched with features like multiple style layers, SVG shape markers, arrowheads for lines, and polyline decorators, all achieved through respective Leaflet plugins. OverlappingMarkerSpiderfier-Leaflet is employed to manage overlapping markers effectively. For user convenience, EasyButton.js is integrated to add customizable buttons to the map interface. Additionally, ISO8601.js aids in parsing ISO 8601 durations, crucial for handling time-related data. Furthermore, the map relies on Leaflet.TimeDimension, a plugin enabling time capabilities such as time sliders and animations. This allows users to visualise temporal aspects of the deportation data. The HTML code includes references to various GeoJSON files containing geographic data layers, such as birthplaces, arrest locations, detention camps, and convoy routes. Moreover, CSS files are utilized for styling map elements, while JavaScript files define map interactions, such as popups when hovering over features and searching for specific individuals. In summary, the HTML code amalgamates diverse JavaScript libraries and plugins to craft an engaging and informative web maps showcasing historical deportation data during World War II.

Concerning the adoption of R programming language, this one was selected due to the straightforwardness exhibited by specific packages in crafting interactive networks, such as visNetwork, or graphs, such as plotly. The simplicity inherent in programming networks and graphs with R was the rationale behind this selection.

The Graph's code utilises basically the plot_ly function to generate an elaborate area chart depicting comprehensive statistics on Jewish arrests in Milan between 1943 and 1945. This visualisation comprehensively illustrates diverse categories of arrests, encompassing those carried out by Italians and Germans, as well as arrests with unidentified authorship. The layout of the plot is meticulously customised to enhance technical aspects such as axis labels, title positioning, and annotation alignment, culminating in a visually refined and informative presentation.

The networks' code begins by loading essential libraries for data manipulation and visualisation, including visNetwork and tidyverse, followed by the importation of pertinent data on nodes, edges, and additional contextual information from CSV files. Subsequently, utilising the visNetwork function, the code generates a dynamic network visualisation, allowing for customizations in dimensions and the incorporation of explanatory text. Configuration options are set to enable user interaction, such as node highlighting, selection by identifiers or groups, and tooltip management. Finally, a randomised seed is introduced to ensure a consistent layout for the network visualization.

## 3.3 Graphs

The graph is a scatter plot with an underlying area, displaying the temporal trend of arrests for the different groups of individuals. Each group is represented by a different colour, and the area under the curve represents the total number of arrests up to that point. Annotations on the chart provide additional information about the temporal period considered and the source of the data used (information and legend on maps and graphs are provided in Italian only so far). In summary, the script generates an interactive chart that offers a visual representation of the statistics of Jewish arrests in Milan during World War II, divided into groups of arrest authors.

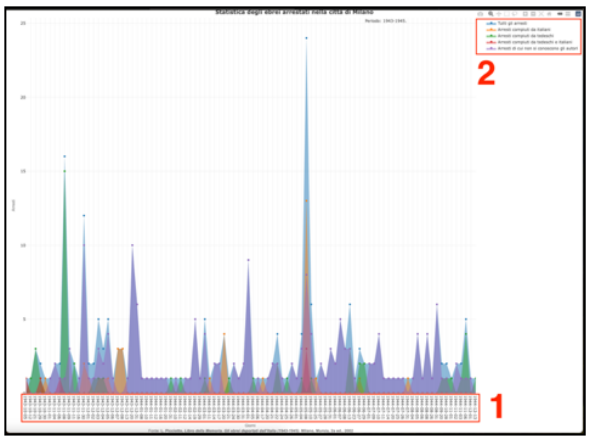

Figure 1: Interactive chronology of Jewish arrests 1943-45.

[13] In the current state of the art, there exists no readily available method to employ leaflet libraries in Python or R for effortlessly generating geometrically intricate time charts without resorting to services like shinyapps.

**How to use the graph.** This graph is fully interactive and through the zoom function allows you to select a chosen area that corresponds to a specific period. The dates of the Jewish arrests are on the x-axis (Number 1, Figure 1) and the number of arrests on the ordinates. The 5 lines in the graph correspond to the 5 options listed in the legend/option menu (Number 2, Figure 1). By clicking on the lines represented in the legend, one can highlight or hide the trends of arrests in Milan in order to visualise who the perpetrators are. More than one option can be selected and displayed at a time in order to make comparisons within the lines of arrest trends.

## 3.4 Maps

The two maps are web applications provide intuitive user interfaces enabling users to explore the data interactively. Information is organised into various layers, each representing a specific aspect of the deportees' lives, such as birthplaces, arrest locations, detention camps, and deportation routes. Each entity on the maps is associated with an informative popup providing details about the individuals or locations. Users can control which data layers are displayed and utilise a time function to explore the data over time. Furthermore, a search function allows users to look up specific individuals within the dataset. In summary, the maps offer an effective means of exploring and gaining a deeper understanding of the phenomenon of deportations from Milan during the Second World War.

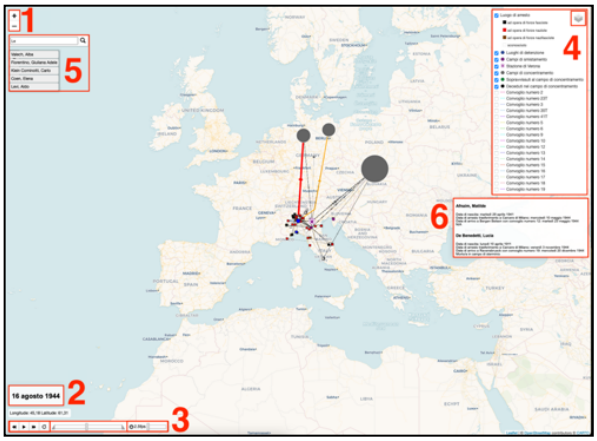


Figure 2: Interactive map of deportation explained with legends.

**How to use the maps.** The two maps are digital tools that can be browsed like any multimedia object. Figure 2 is an example representing both maps. It highlights the tools allowing the user to see the information he or she is looking for. The maps are dynamic and visualise the evolution of historical events day by day. They show the route of each individual person from the moment of his or her arrest at a certain location to his or her arrival in the concentration and/or extermination camp. On the screen, the places of passage that characterised the persecution route of these people are constantly highlighted and traced. Each point or line, which 'switches on and off' with the passage of time, can be clicked on to display information about the person it represents. These are the instructions for using the maps schematised in Figure 2:

**(1) Zoom tool** and positioning on the map

**(2) Date box**: The date constantly changes based on the passage of time given by the time bar.

**(3) Time bar**: This is the tool for starting and stopping the flow of time. The dates displayed day by day have been defined by default between 8 September 1943 and 25 April 1945. As can be seen from the image, the time bar is divided into three groups of buttons; each block corresponds to a different functionality:

- In the first group, the play/rewind/fast forward buttons allow the user to start/stop or advance the time scroll.
- The cursor in the middle block allows the user to manually move the time or date displayed forwards or backwards. Using the play/rewind/fast forward buttons, it is possible to manually move forward or backward the time and thus the events that the map represents.
- In the right-hand group of the time bar, a slider allows the user to change the speed of time scrolling.

**(4) Legend/options menu**: the legend explains the meaning of lines and dots and colours that are displayed on the map. It is opened by clicking on the layer selector icon. The legend also functions as an options menu: it enables lines of convoy trajectories and/or the places that marked each person's persecution route to be viewed at the same time.

**(5 & 6) Search/Selection Tool**: allows the user to select the persecutory journey of a single person, from those represented on the map. By typing, letter by letter, the searched name, the tool gradually suggests one or more options. The biographical information on the chosen person(s) is displayed in the box marked No. 6. At the same time, the line identifying the person(s) on the card changes colour:

- turns orange if on the date on the card the deportation of the person has not yet taken place
- turns red if on the date indicated on the card by the time bar the person has already been deported.

## 3.5 Networks

The networks allow users to explore the deportation routes of individual persons from the moment of their arrest to their arrival at Nazi camps. Users can interact with the visualisation by clicking on nodes to highlight the deportation routes of specific individuals. Additionally, a dropdown menu enables users to select specific names, convoys, or places of imprisonment for further exploration. The aim of this visualisation is to provide insights into the deportation of Jews from Milan during the specified period. It serves as a tool for understanding the historical context and human impact of these events.

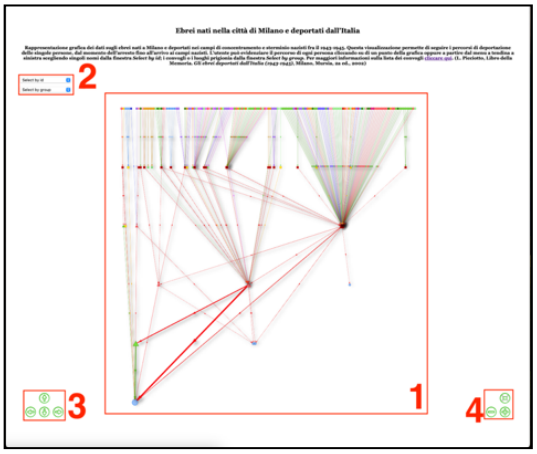


Figure 3: Interactive network visualisation of deportation explained with legends.

**How to use the networks.** The network analysis designed for this research are developed in the form of dendrograms and allow a further visualisation of the deportees' journeys and the relationships established between them and the places that characterised their deportation. Both network graphs are fully interactive, which means that by clicking on any element of the graph this element lights up, highlighting all the other points connected to it. Figure 3 schematises how to act with both dendrograms:

(**1) Development area of the graph**, nodes and edges are displayed in this area. The aligned dots at the top of the graph represent each deportee, the squares the first places of imprisonment (e.g. police stations or penitentiaries - in the network of those born in Milan), the diamonds the places of arrest (in the network of those arrested in Milan), the triangles the internment camps (*Polizei- und Durchgangslage* e.g. Fossoli or Bolzano) and finally the blue dots at the bottom of the network are the extermination and/or Concentration camps (Auschwitz, Bergen Belsen, Buchenwald, Ravensbrük). By clicking on each point/person, lines light up representing the path of persecution and deportation suffered by that person. Clicking on a point that defines a place will 'light up' all those representing the people who were arrested in that place. By hovering the mouse over each point, it is possible to view the information associated with that place or person via a pop-up.

**(2) Drop-down menus**, a tool enabling the focused display of places, people (id menu), or convoys (group menu). Selecting an item from these menus will illuminate it and all others connected to it. For example, in the case of arrestees in Milan, clicking on an arrest location will highlight all those arrested there. If, on the other hand, the user clicks on a specific convoy, he or she will immediately be able to see all the people who were transported there.

**(3) Arrow buttons**: with this tool you can navigate the network left and right, just like with a mouse.

**(4) Graph zoom options**.

## 4. Conclusions

This dataviz project is a valuable example of the potential unlocked by making research data available for public reuse. In this case, data about the victims of the Holocaust in Italy have been used to trace the movements of each individual and to test geo-mapping and networks tools. These case studies highlight how far we still are from obtaining a complete view of the events leading up to deportation. The lack of data primarily concerns the events that occurred before their arrest. This renders our map slightly incomplete when attempting to trace the entire pathway of each individual from his/her birthplace to the deportation site. For instance, information concerning the arrests of Jews in Milan during this period underscore the imperative for sustained research efforts aimed at augmenting the available data. As depicted in the ensuing graph, the identity of the perpetrator remains undisclosed for the majority of arrests conducted in Milan throughout this timeframe.

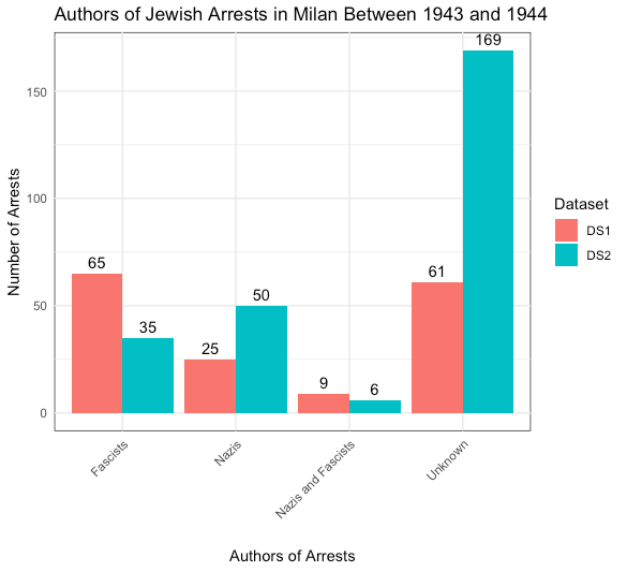


Figure 4: Authors of Jewish Arrests in Milan Between 1943 and 1944

Nevertheless, this project offered the opportunity to utilize sets of information such as addresses of residence or exact places of arrest, which allow us to at least begin the schematization of both the modalities of the arrests (house-to-house, for example, or by surveillance operations) and the urban areas where people were arrested.

The collection of data and the digital tools we have created during the research help us, again, to take stock of the state of the art of what we know, and

impose new challenges on us, such as trying to fill the information gap of the 61 (DS1) + 169 (DS2) cases of arrests of unknown perpetrators.

Despite this partial incompleteness of the data, our geographical and network model succeeds in giving new insight into the dynamics of deportation experienced by the people included in our two case studies. The visualisations our team has developed make possible a comprehensive overview of the origins, forced movements, and final destinations for each of the individuals arrested (whether in Milan or elsewhere in Italy), deported, and subsequently annihilated in concentration and extermination camps. The maps, along with the associated graphs, allow for a deeper understanding of the places where Jews were rounded up and of the way the Nazis organised their transports to concentration and extermination camps. The combination of space and time in relation to individuals - never before tested in such a manner - makes this project relevant for both educational and research purposes. Such overviews and details at the same time would not have been possible, neither querying data from the endpoint neither browsing through over a thousand pages of the *Il Libro della memoria*.

It is worth noting that the data about the Victims of the Holocaust (in Italy as well as elsewhere) are still subject to continuous revisions, with integration or correction of previously provided information. Consequently, data on Jews deported from Italy, available on the CDEC SPARQL endpoint, may vary over time due to possible further revisions. To mitigate discrepancies between the data presented in our maps and graphs and the information obtained by querying the SPARQL endpoint, one of our future objectives is to establish a direct linkage between the tools and the data on the endpoint. The other objective is certainly applying our model to the entire dataset of the Victims of the Holocaust in Italy.

In conclusion, deportation was a tragic page in the history of the twentieth century that took on the scope of a collective memory (Erll *et al.*, 2008: 109-118) and at the same time represented the individual drama of thousands of people. This project aims precisely to unite collective and individual memory of the Holocaust through the use of the digital; considering how these tools, and data visualisation in particular, can play an important role in recalling the collective memory (Koçak, 2017). In our maps and networks, the user can witness the global phenomenon represented by the deportation but, at the same time, can go and find each deportee one by one and follow what was the terrible ordeal they went through individually. The maps and the networks of this project were designed precisely to capture this dichotomy between the history of the individual and that of the many. We wanted to give scholars and the general public the possibility both to read/browse the general phenomenon of deportation in a distant reading approach and to be able, by zooming in or by a simple name search in the sidebar, to follow each individual deportee in a close reading approach.

The dynamism of our models and its capability to combine distant and close reading approaches demonstrate how the digital can create a bridge between the historical representation of collective and individual memories.

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