

Supplementary Materials

All figures from the case studies can be found on Google Drive:

https://drive.google.com/drive/folders/1lrtxylsmCas42NM3Zv138gEL7EV4W-Jx?usp=drive_link

In this document, we describe the execution of the case study, presented in Section 5 of the manuscript, executed in the Lens software. We directly compare the results and examine whether the insights of PatentInspector correspond with them. Moreover, we present three additional case studies that serve as further testing of the tool's validity, using different search parameters (e.g., inventor, assignee, granting year). **Please note that all comparisons are made with patents from the USPTO and not for the global patent landscape. Thus, any results are inevitably skewed towards the US region.** However, based on the research literature, the USPTO is a good source for patent trends and thus the conducted case studies have merit.

In our comparisons, we first present the query used in PatentInspector and Lens and then we provide tables of the produced results from both tools, highlighting the identical (red marking) and different data (black marking). We should note, though, that due to Lens being a global patent index, supporting real-time data retrieval and including patents that may have advanced coverage in different patent offices, and due to PatentInspector being limited to one data source (USPTO), slight deviations in the number of retrieved patents, inventors and assignees are expected. However, if the majority of the fields are identical, we consider that the case studies are successful.

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Case Study #1: Comparison with the Case Study of the Manuscript

In this case study, which is also presented in Section 5 of the manuscript, we compare the granted patents that belong to the CPC class “G06Q10/06”.

The queries used are the following:

- 1) **Patent Office: US, CPC Group (with exact matching): G06Q10/06 (for PatentInspector);**
- 2) **Document Type: granted_patent, Jurisdictions: United States, CPC = G06Q10/06 (for Lens).**

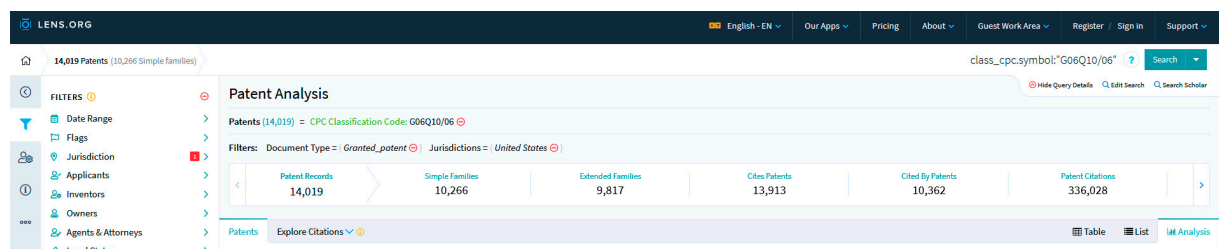


Figure 1. Case Study 1—Retrieved Patents (Lens)

This returned 14019 patents in Lens and 13424 patents in PatentInspector. The discrepancy in numbers can be attributed to the fact that Lens also handles extended and patent families, which may increase the number of documents, while the jurisdiction may include patents from other offices that are legally bound to the United States.

Table 1. Case Study 1—Top Inventors and Assignees

Top Inventors		Top Assignees	
PatentInspector	TheLens	PatentInspector	Lens
Rick A. Hamilton, II	Curtis Chambers	IBM	IBM
Curtis Chambers	Rick A. Hamilton, II	Microsoft	SAP
Steven Nielsen	Jeffrey Farr	SAP	Microsoft
Jeffrey Farr	Kabir A. Barday	Oracle	Oracle
Kabir A. Barday	Jalili Reza	Hitachi	Hewlett Packard

Regardless, the top inventors (Table 1) are almost identical, apart from Steven Nielsen and Jalili Reza. We should note that in PatentInspector, we found Jalili Reza in a lower position. In addition, the assignees (Table 1) are largely similar, with only Hitachi and Hewlett Packard being different, although, once again, these assignees were found in Lens but in lower positions than in PatentInspector. Given that Lens is a global index database and may store patents in a different way in terms of the owning assignee, we expect some deviation in the ordering of organizations.

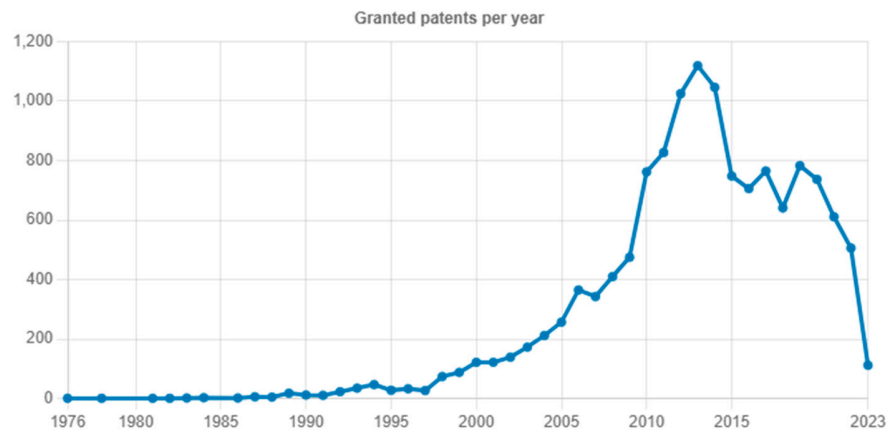


Figure 2. Case Study 1—Timeline of Granted Patents (PatentInspector)

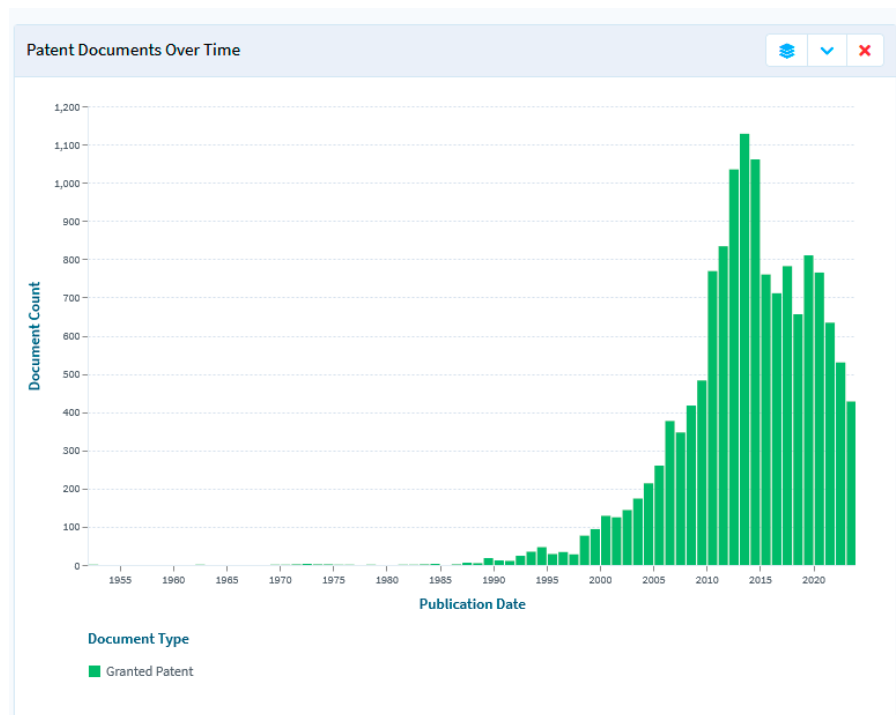


Figure 3. Case Study 1—Timeline of Granted Patents (Lens)

The timeline of patents (Figures 3 and 4) follows a similar trajectory, with 1128 patents in 2013 for both tools. The fact that PatentInspector has less patents in 2023 is attributed to the fact that we do not have all the data from USPTO in that year and, thus, some granted patents are not recorded. In a future version of the tool, we will ensure that the tool is periodically updated to include the most recent USPTO data.

Finally, the top cited patents (Table 2) are identical, proving that PatentInspector can yield valid results in a large-scale analysis.

Table 2. Case Study 1—Top Cited Patents

<i>PatentInspector</i>	<i>Lens</i>
US6850895—Assignment manager	US6850895—Assignment manager
US6665648—State models for monitoring process	US6665648—State models for monitoring process
US8082301—System for supporting collaborative activity	US8082301—System for supporting collaborative activity
US7356482—Integrated change management unit	US7356482—Integrated change management unit
US8484111—Integrated change management unit	US8484111—Integrated change management unit

Overall, the case study of the manuscript is **successfully validated** in Lens, as the inventors, assignees, granting years and top cited patents present a high level of agreement and indicate that PatentInspector can produce actionable insights for patent analysis.

Case Study #2: Granted Patents of Assignee NVIDIA Corporation

In this case study, we compare the granted patents that are owned by the NVIDIA Corporation.

The queries used are the following:

- 1) **Patent Office: US, Assignee Organization: NVIDIA Corporation (for PatentInspector);**
- 2) **Document Type: granted_patent, Jurisdictions: United States, Applicant Name Exact: Nvidia Corp.**

These queries retrieved 4393 patents in Lens and 4185 patents in PatentInspector (Figures 4 and 5). Given that PatentInspector contains a snapshot of the USPTO data from September 2023, it is reasonable that more patents were granted after this period and, hence, Lens offers more patent records.

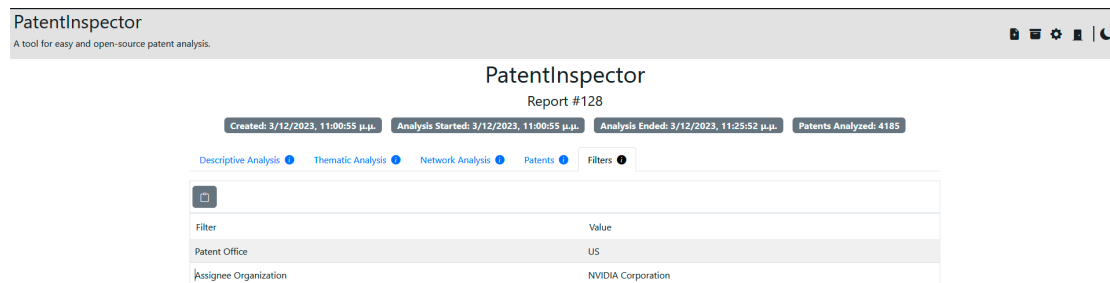


Figure 4. Case Study 2—Retrieved Patents (PatentInspector)

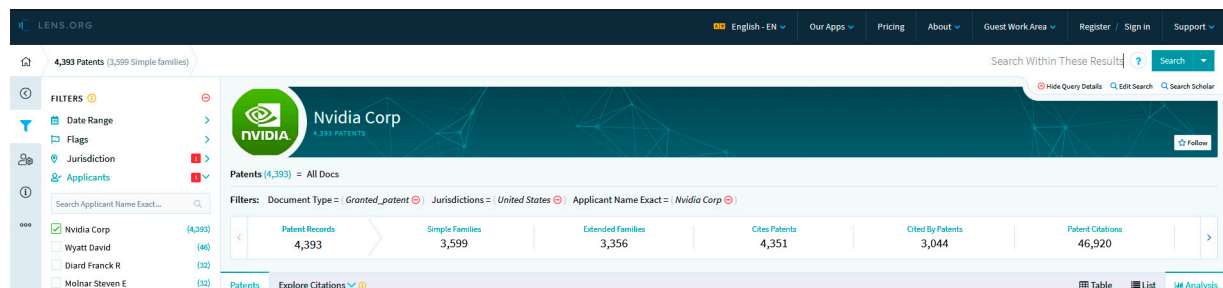


Figure 5. Case Study 2—Retrieved Patents (Lens)

Table 3. Case Study 2—Top Inventors

Top Inventors	
PatentInspector	Lens
John Erik Lindholm	John Erik Lindholm
Henry Packard Moreton	Jerome F. Duluk, Jr.
Franck R. Diard	Molnar Steven
Jerome F. Duluk, Jr.	Franck R. Diard
Ziyad S. Hakura	Kilgariff Emmett

The top inventors of NVIDIA Corporation patents (Table 3) have some differences, which can be attributed to the different filtering in each tool, as the Patent Office filter of PatentInspector may differ slightly from the Jurisdiction filter of Lens, which in turn may influence the primary inventor of a patent. However, we must emphasize that all different inventors (Henry Packard Moreton, Ziyad S. Hakura, Molnar Steven, Kilgariff Emmett) appear in the lists of the top inventors of both tools, albeit in different positions.

Both tools have the NVIDIA Corporation as the only owning assignee of all patents. In addition, the CPC and IPC codes (Tables 4 and 5) of the two queries are almost the same, with one IPC code differing. We expect a small deviation in the IPC codes, as USPTO records the IPC codes **at issue** and not the **current** ones.

Table 4. Case Study 2—CPC Codes

Top CPC Codes	
<i>PatentInspector</i>	<i>Lens</i>
G06T15/005	G06T15/005
G06T1/20	G06T1/20
G09G5/363	G09G5/363
Y02D10/00	G06T1/60
G06T1/60	Y02D10/00

Table 5. Case Study 2—IPC Codes

Top IPC Codes	
<i>PatentInspector</i>	<i>Lens</i>
G09G 5/00	G06T 15/00
G06T 15/00	G09G 5/00
G06T 1/20	G06T 1/20
G06F 13/00	G06T15/50
G06F 15/16	G06F 13/00

The timelines of the granted patents match (Figures 6 and 7), with 350 patents in 2016 for Lens and 353 for PatentInspector, while both tools record high numbers of patent grants between 2013 and 2017.

Finally, although the cited patents (Table 6) present some differences, the US6938176 patent (fifth in Lens) appears in PatentInspector in the sixth position, while the US8190767 patent (fourth in PatentInspector) appears in Lens in the seventh position.

Chart

Table

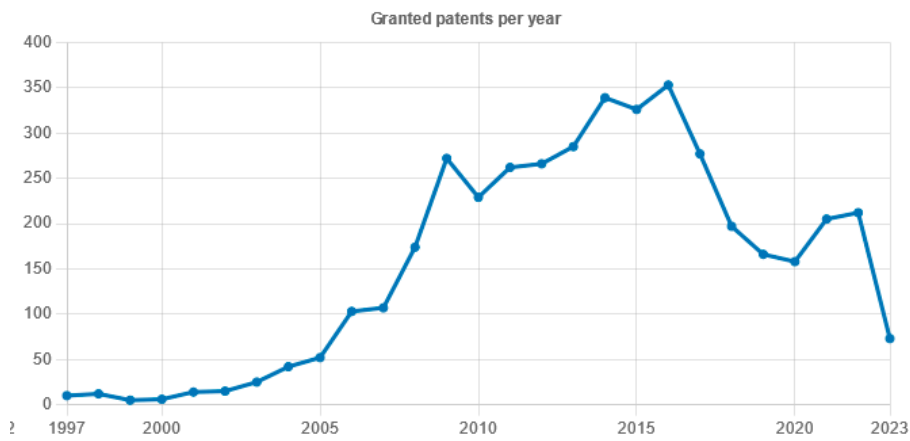


Figure 6. Case Study 2—Timeline of Granted Patents (PatentInspector)

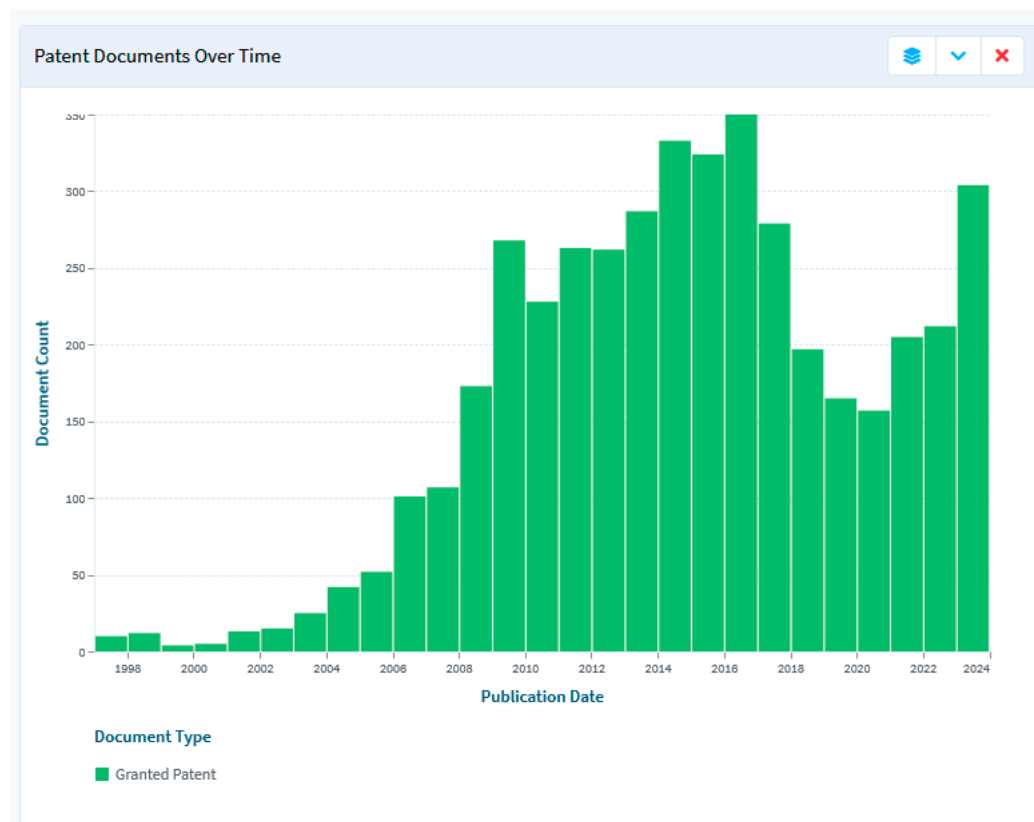


Figure 7. Case Study 2—Timeline of Granted Patents (Lens)

Table 6. Case Study 2—Top Cited Patents

<i>PatentInspector</i>	<i>Lens</i>
US7805587—Memory addressing controlled by PTE fields	US7805587—Memory addressing controlled by PTE fields
US7574274—Method and system for synchronizing audio processing modules	US7170515—Rendering pipeline
US7170515—Rendering pipeline	US7136953—Apparatus, system, and method for bus link width optimization
US8190767—Data structures and state tracking for network protocol processing	US7015913—Method and apparatus for multithreaded processing of data in a programmable graphics processor
US7136953—Apparatus, system, and method for bus link width optimization	US6938176—Method and apparatus for power management of graphics processors and subsystems that allow the subsystems to respond to accesses when subsystems are idle

Overall, this case study was **successfully completed**, as the number of documents was similar, and while there were small differences in the top cited patents, there was notable agreement in the CPC codes and granting years.

Case Study #3: Granted Patents of Inventor “Khakifirooz Ali”

In this case study, we compare the granted patents that have “Khakifirooz Ali”, a principal engineer at Intel, as their first inventor.

The queries used are the following:

- 3) **Patent Office: US, Inventor First Name: Ali, Inventor Last Name: Khakifirooz (for PatentInspector);**
- 4) **Document Type: granted_patent, Jurisdictions: United States, Inventor Name Exact: Khakifirooz Ali (for Lens).**

In Figures 8 and 9, the filters and retrieved patents are presented. As observed, the retrieved documents match very closely, with PatentInspector retrieving 746 patents and Lens retrieving 749 patents.

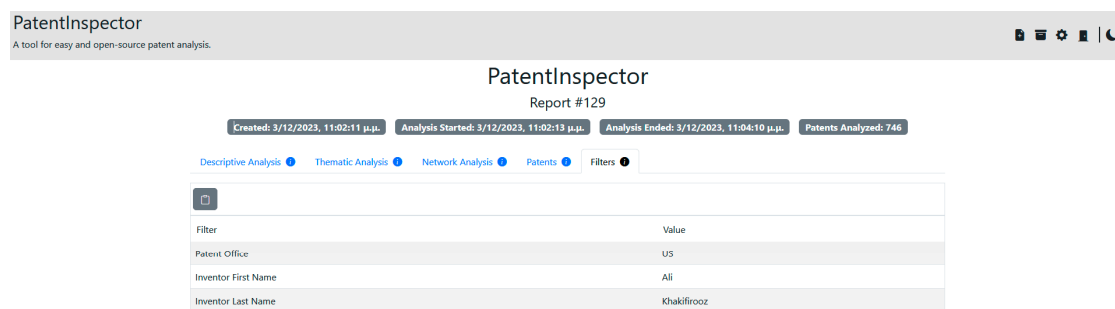


Figure 8. Case Study 3—Retrieved Patents (PatentInspector)

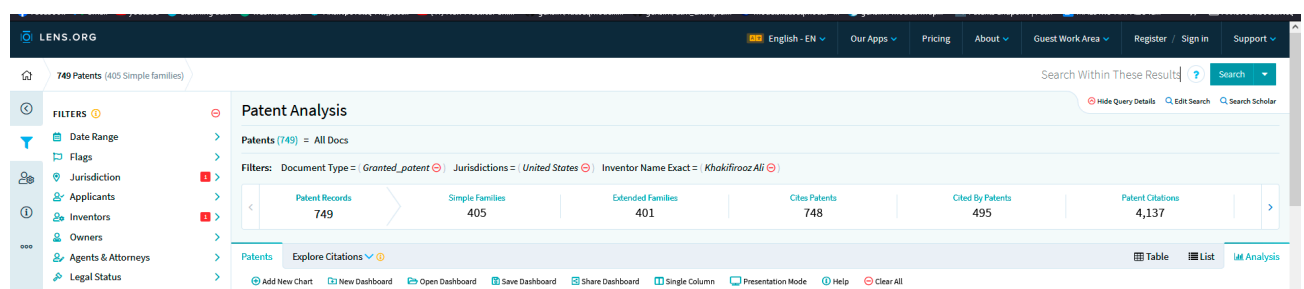


Figure 9. Case Study 3—Retrieved Patents (Lens)

In Table 7, we present the results extracted from both tools, comparing the top assignees and inventors

Table 7. Case Study 3—Top Inventors and Assignees

Top Inventors		Top Assignees	
<i>PatentInspector</i>	<i>Lens</i>	<i>PatentInspector</i>	<i>Lens</i>
Khakifirooz Ali	Khakifirooz Ali	IBM	IBM
Kangguo Cheng	Kangguo Cheng	GlobalFoundries Inc.	Globalfoundries Inc.
Alexander Reznicek	Alexander Reznicek	Intel Corporation	Elpis Technologies INC
Bruce Doris	Bruce Doris	Stmicroelectronics Inc.	Alsephina Innovations INC
Poya Hashemi	Poya Hashemi	Commissariat a l'energie atomique	Intel Corporation

The top inventors are completely identical between the two tools, while, in the top assignees, we have three out of the top five assignees being identical. We should note that GlobalFoundries Inc. had two subsidiaries (GlobalFoundries US 2 LLC and GlobalFoundries US Inc.), but we opted to omit them as they represented the same assignee.

Table 8. Case Study 3—Top CPC Codes

Top CPC Codes	
<i>PatentInspector</i>	<i>Lens</i>
H01L29/66795	H01L29/785
H01L29/785	H01L29/66795
H0129L/66545	H01L29/66545
H01L21/845	H01L21/845
H01L27/1211	H01L27/1211

Table 9. Case Study 3—Top IPC Codes

Top IPC Codes	
<i>PatentInspector</i>	<i>Lens</i>
H01L 29/66	H01L29/66
H01L 29/78	H01L29/78
H01L 21/84	H01L29/06
H01L 27/12	H01L21/84
H01L 29/06	H01L21/02

Large similarities are also present in the CPC and IPC codes (Tables 8 and 9), although the order in the IPC codes is different. This may be attributed to the Jurisdiction filter of Lens, where patents

may have extended coverage, or to the fact that PatentInspector presents the IPC codes **at issue**, and **not** the current ones (which has been emphasized in the manuscript).

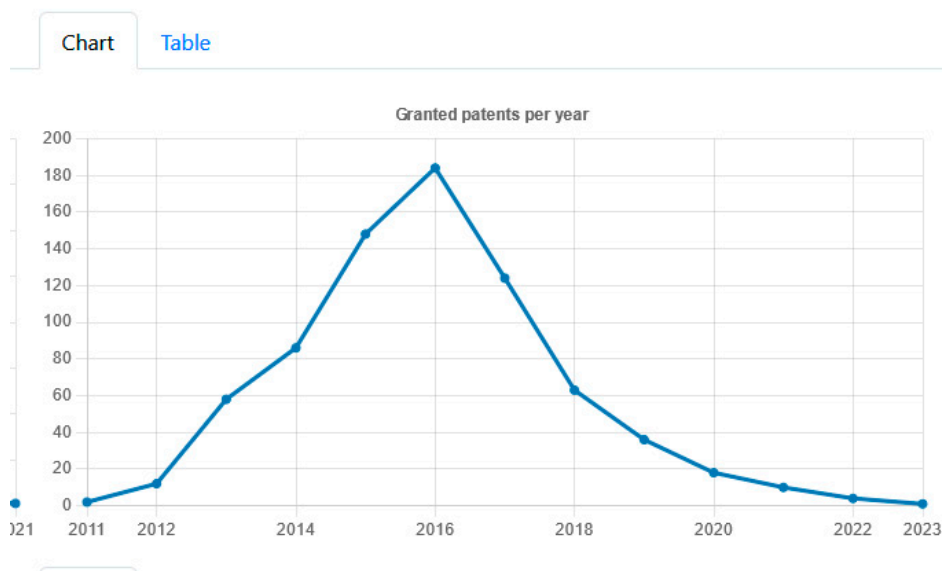


Figure 10. Case Study 3—Timeline of Granted Patents (PatentInspector)

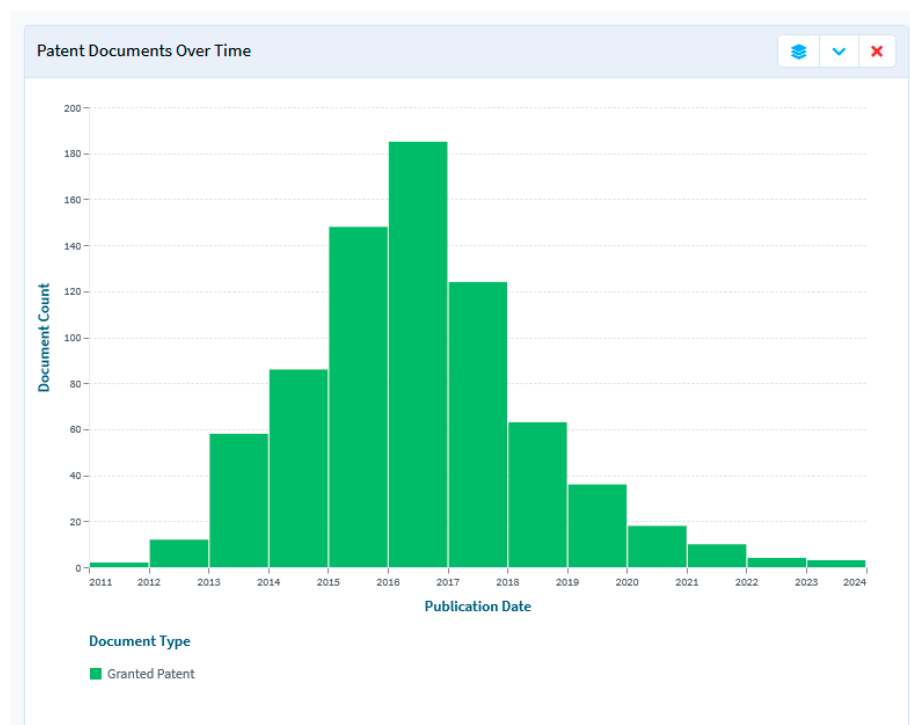


Figure 11. Case Study 3—Timeline of Granted Patents (Lens)

The timelines of the granted patents (Figures 10 and 11) are also quite similar, with the highest number of patents being 184 in PatentInspector and 185 in Lens.

Finally, in Table 10, we present the top globally cited patents of the two tools.

Table 10. Case Study 3—Top Cited Patents

<i>PatentInspector</i>	<i>Lens</i>
US8969934—Gate-all-around nanowire MOSFET and method of formation	US8969934—Gate-all-around nanowire MOSFET and method of formation
US7993999—High-K/metal gate CMOS finFET with improved pFET threshold voltage	US7993999—High-K/metal gate CMOS finFET with improved pFET threshold voltage
US8169025—Strained CMOS device, circuit and method of fabrication	US8169025—Strained CMOS device, circuit and method of fabrication
US8796093—Doping of FinFET structures	US8796093—Doping of FinFET structures
US9659963—Contact formation to 3D monolithic stacked FinFETs	US8524592—Methods of forming semiconductor devices with self-aligned contacts and low-k spacers and the resulting devices

The top cited patents are almost identical, and we should note that the fifth top cited patent of PatentInspector was found as the seventh most cited patent in Lens, indicating the close similarity of the extracted insights.

Overall, this case study was **successfully completed**, as, in all compared fields, there were noticeable similarities, while the number of retrieved documents was almost the same in both tools.

Case Study #4: Advanced Case Study

In this case study, we compare the patents granted between 01/01/2010 and 01/11/2023 that belong to the CPC class “H01L29/66795” and have “Alexander Reznicek”, a Research Staff Member at IBM, as their first inventor.

The queries used are the following:

- 1) **Patent Office: US, Patent Granted Date: 2010-01-01 – 2023-11-01, CPC Group (with exact matching): H01L29/66795, Inventor First Name: Alexander, Inventor Last Name: Reznicek (for PatentInspector);**
- 2) **Granted Date: 2010-01-01 – 2023-11-01 Document Type: Granted_patent, Jurisdictions: United States, Inventor Name Exact: Reznicek Alexander, CPC = H01L29/66795 (for Lens).**

In Figures 12 and 13, the filters and retrieved patents are presented. Lens retrieves 356 patents, while PatentInspector retrieves 350 patents. The numbers match very closely, indicating that even in a complex scenario, the filtering of PatentInspector is efficient.

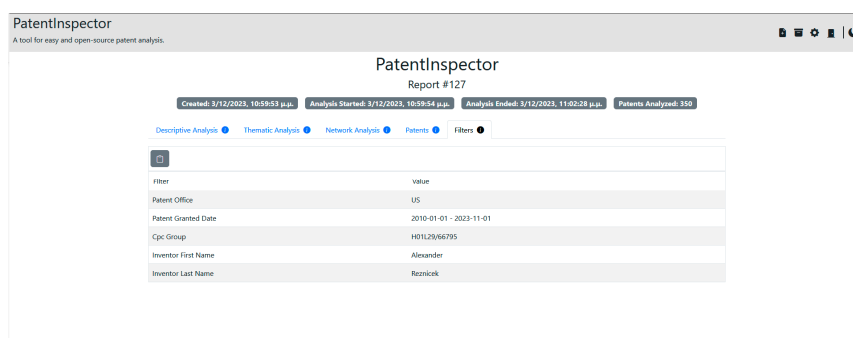


Figure 12. Case Study 4—Retrieved Patents (PatentInspector)

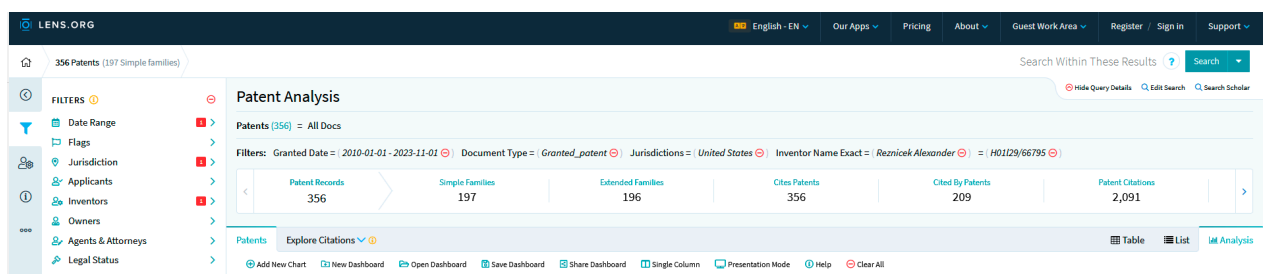


Figure 13. Case Study 4—Retrieved Patents (Lens)

The top inventors and top assignees (Table 11) present a high level of similarity, with only one assignee being different in both tools.

Table 11. Case Study 4—Top Inventors and Assignees

Top Inventors		Top Assignees	
<i>PatentInspector</i>	<i>Lens</i>	<i>PatentInspector</i>	<i>Lens</i>
Alexander Reznicek	Alexander Reznicek	IBM	IBM
Kangguo Cheng	Kangguo Cheng	GlobalFoundries Inc.	Globalfoundries Inc.
Poya Hashemi	Poya Hashemi	Elpis Technologies INC	Elpis Technologies INC
Ali Khakifirooz	Ali Khakifirooz	Tessera Inc.	Tessera Inc.
Bruce Doris	Bruce Doris	Renesas Electronics Corporation	Alsephina Innovation Inc.

Table 12. Case Study 4—Top CPC Codes

Top CPC Codes	
<i>PatentInspector</i>	<i>Lens</i>
H01L29/66795	H01L29/66795
H01L29/785	H01L29/785
H01L29/66545	H01L29/66545
H01L21/02532	H01L21/02532
H01L21/845	H01L21/845

Table 13. Case Study 4—Top IPC codes

Top IPC Codes	
<i>PatentInspector</i>	<i>Lens</i>
H01L 29/66	H01L 29/66
H01L 29/78	H01L 29/78
H01L 29/06	H01L 29/06
H01L 21/02	H01L 21/02
H1L 29/66	H01L21/8234

The CPC and IPC codes (Tables 12 and 13) are also very similar, with only one IPC code being different in both tools, possibly due to the alternating IPC codes in the passing years after the patent grant. However, the results are very encouraging.

As per the previous cases, the timelines of the granted patents in both tools (Figures 14 and 15) are similar, with the largest number of granted patents being 87 in 2016 (for Lens) and 86 in 2016 (for PatentInspector), validating that the developed tool retrieves and filters patent data correctly, even in an advanced scenario with multiple parameters.

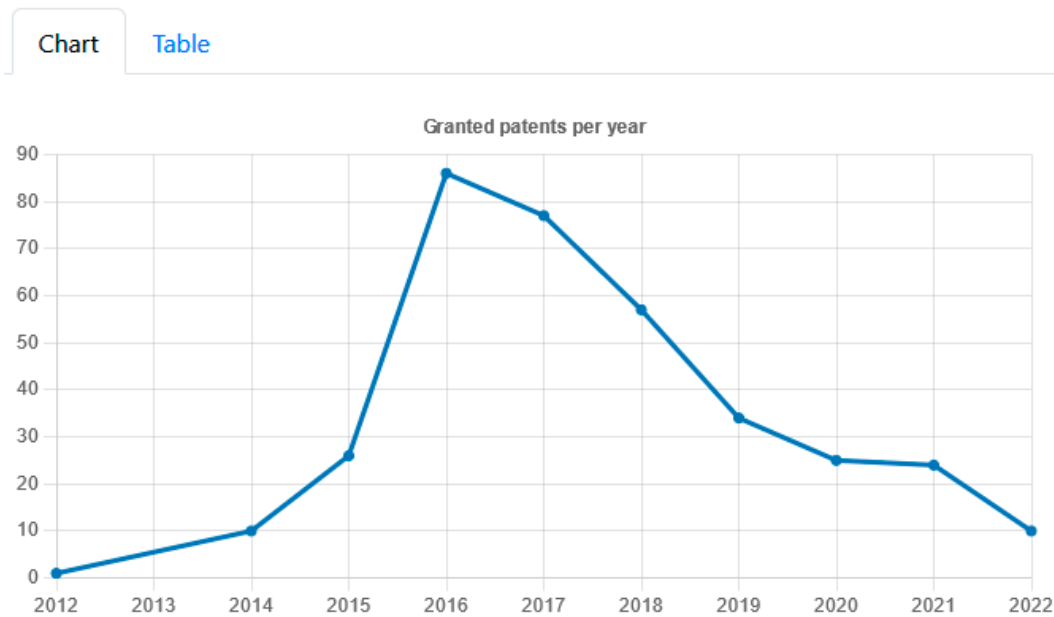


Figure 14. Case Study 4—Timeline of Granted Patents (PatentInspector)

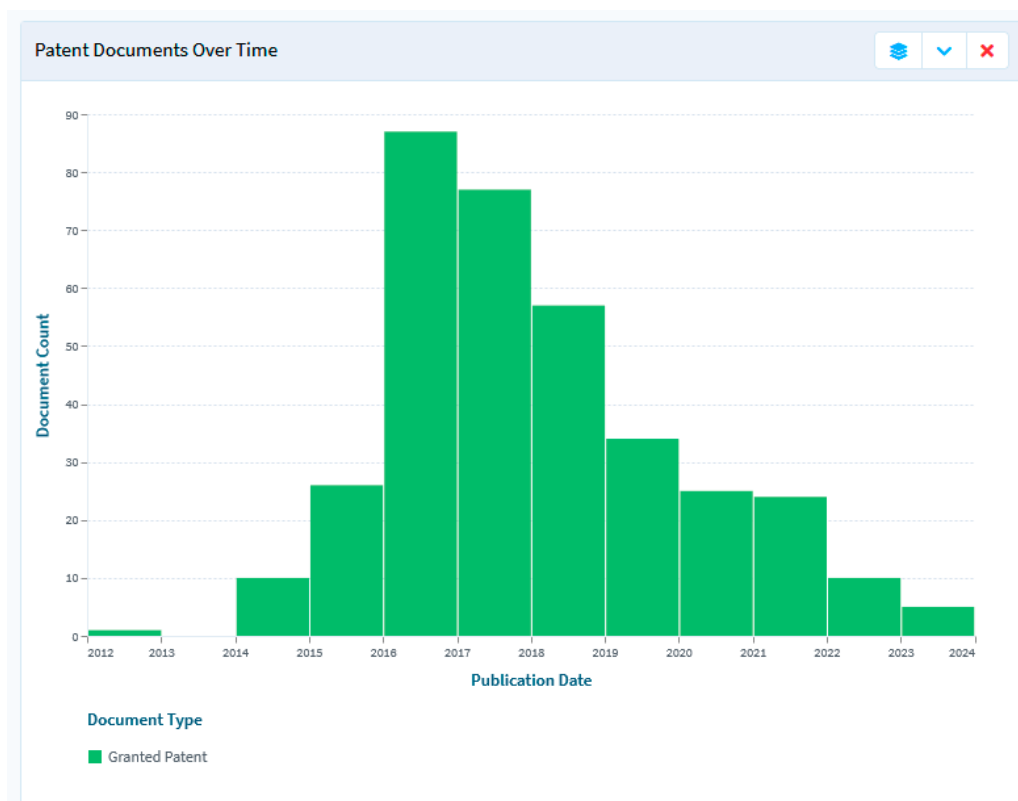


Figure 15. Case Study 4—Timeline of Granted Patents (Lens)

Finally, in Table 14, we present the top globally cited patents of the two tools.

Table 14. Case Study 4—Top Cited Patents

<i>PatentInspector</i>	<i>Lens</i>
US9799736—High acceptor level doping in silicon germanium	US9287135—Sidewall image transfer process for fin patterning
US8895395—Reduced resistance SiGe FinFET devices and method of forming same	US8895395—Reduced resistance SiGe FinFET devices and method of forming same
US9570551—Replacement III-V or germanium nanowires by unilateral confined epitaxial growth	US9716158—Air gap spacer between contact and gate region
US9716158—Air gap spacer between contact and gate region	US9570551—Replacement III-V or germanium nanowires by unilateral confined epitaxial growth
US9287135—Sidewall image transfer process for fin patterning	US9287135—Sidewall image transfer process for fin patterning

The top cited patents are identical, although the fourth and fifth patents are in reversed order.

Overall, this case study was **successfully completed**, as, in all compared fields, there were noticeable similarities, while the number of retrieved documents was practically the same in both tools. We can see that PatentInspector yields relevant results, even in an advanced filtering scenario.