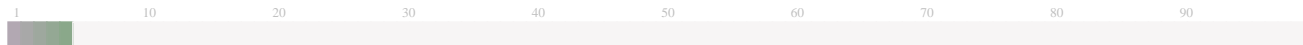


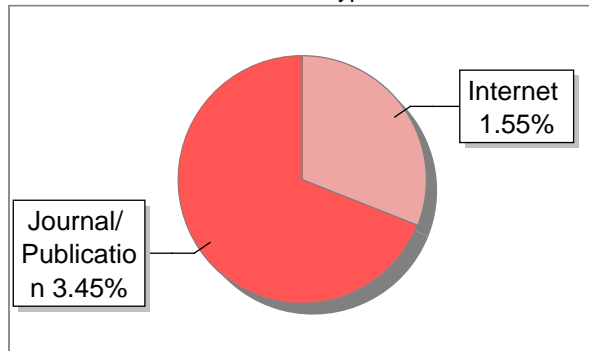
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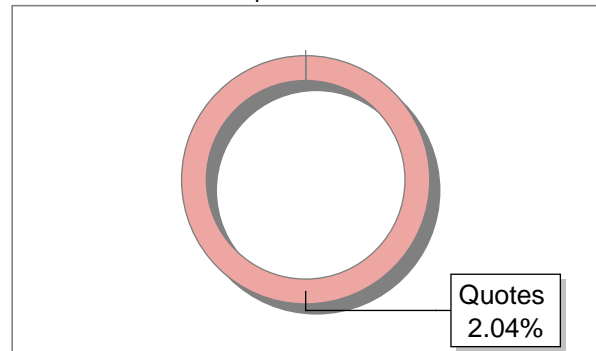
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### EXCLUDED SOURCES

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1	<a href="http://prosiding-icostec.respati.ac.id">prosiding-icostec.respati.ac.id</a>	97	Publication
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Detection of Book and Borrower Communities Based on Book Borrowing Records in the Library Using Complex Network Analysis Tedy Setiadi<sup>1</sup>, Rina Ratih<sup>2</sup>, Nanik Arkiyah<sup>3</sup>, Gretha Prestisia<sup>4</sup>

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2grethaprestisia@staff.uad.ac.id 3nanik.arkiyah@staff.uad.ac.id Abstract— To improve user services, libraries need to have deep insight into users and the books they manage. This study aims to identify the community of users and borrowed books based on book borrowing records using complex network analysis. It starts with collecting book borrowing data, then converting it into a bipartite book-borrowing network using python programming and visualizing it with Gephi. Network analysis is performed to investigate network properties, and to use the BIMLPA method to find communities. The results of the investigation show that the structure of the book borrowing network is divided into two separate components. One main component of the network represents the optimal process of borrowing books, and the rest consists of many small components representing suboptimal borrowing. Community detection on the main component found 217 borrowing communities and 141 book communities. Most of the communities are small, where the book community is 2-4 members, while the borrowing community is in the form of individual borrowers. This research also produces the top 5 book communities, and borrower communities, the most popular books and the most active borrowers. The characteristics of the users and the books found can be used as a library reference for a more effective and efficient book development policy strategy, as well as book recommendations for more targeted users.

Keywords— Community Detection, Book Borrowing, Libraries, Bipartite Networks I.

INTRODUCTION The university library is an important source of knowledge for University students and academics [1][17]. The library also acts as a data generating unit [18]. Data in university libraries continues to increase along with the development of existing business processes such as increasing procurement of collections, adding visitors, and transactions such as borrowing collections, accessing online collections, borrowing places[2][3]. University libraries generally already have a database transaction system. Unfortunately, this data is generally not used optimally. The data has not been extensively analyzed to produce useful knowledge to improve services to users [19]. For example, data on book borrowing is only used to report the number of books borrowed and the number of visitors who borrow books. It has not been used more to extract knowledge such as grouping books and users borrowing books [4]. Especially the process of borrowing books, even though there has been rapid digital transformation in publications such as e-books and other types of digital publications, but the process of borrowing physical books is still the most important service that university libraries provide to readers. Clustering is a data analysis technique used to group objects into several groups (clusters) based on the similarity of their features or attributes [5][20]. In the context of borrowing books at the library, clustering can be used to help group books based on similar themes or topics. This can help libraries to organize books more effectively and make it easier for visitors to find the books they are looking for. In addition, clustering can also help libraries identify the most popular or most

frequently borrowed books, so that libraries can prepare better book stocks. Meanwhile, user clustering can be used to help group library users based on common interests or their preferences

for the types of books they read. they borrow. This can help the library to suggest books that suit the user's interests and help increase the level of user satisfaction with library services. In addition, it can help identify groups of users who have different preferences, so that the library can provide books that are more varied and interesting for all users. Thus, clustering is very beneficial for libraries to provide better services to their visitors[6] Currently data analysis using a network analysis approach is growing rapidly. One of the main parts of network analysis is community detection, which aims to automatically identify relevant groups of nodes in a network. Community is another name for a cluster for data in the form of a network, namely a collection of nodes in a network that are stronger than the others [7]. In the real world, we find a lot of data in the form of networks. The process of borrowing books produces a special type of data where each transaction of borrowing books connects certain readers to certain books. Using these transactions, it is possible to create a book borrowing network, which is a bipartite network. In this type of network, a reader is connected to one or more books that he borrows from the library, but he is not connected to other readers. Similarly, a book is linked to one or more readers who have borrowed it, but is not linked to any other book[8] There are two ways to define a community in a bipartite network, one-to-one correspondence community and many-to-many correspondence community. The one-to-one correspondence community is a group of closely connected nodes, for example in Fig. 1a, two types of nodes are located at the top and bottom respectively, a community, surrounded by dotted lines, is the composition of the two types of nodes. on the other hand, it is called a many-to-many correspondence community that is a group of nodes that are of the same type and have a similar link pattern. as shown in the Fig. 1b, there are two communities for the top node and three communities for the bottom node. The nodes in each community have a similar link pattern. For example, the nodes in the second bottom community (in the middle) all have solid connections with the top two communities. Fig. 1. Communities in a bipartite network The many-to-many correspondence community structure is more natural in representing heterogeneity in the real world. On the book borrowing network in the library, students can borrow many books, and books can be borrowed by many students. For example, in Fig. 2, the student community majoring in computer science will correspond with a community of books related to programming and mathematics, while a community of students majoring in physics will correspond with a community of books related to mathematics and physics. This creates a many-to-many correspondence community structure. Fig. 2. Community structure in the user-book Network (Taguchi, 2020) This study will analyze community detection based on book borrowing data. This analysis shows the network properties, distribution of book and borrower communities, top book and borrower communities, homogeneity characteristics of each community and the hub (strongest member) of each community. The findings of this study can be used as important information for libraries to help recommend books for users, optimize book stock, and improve library promotion services.

This study will conduct a community analysis based on book borrowing data. **The contribution of this research** can be used as important information for libraries in recommending books for users, optimizing book stocks, and improving library promotion services. **This research continues our previous** research [16] which compared **the community detection method for clustering** books and borrowers, but still uses a one-to-one correspondence type community structure. In addition, this research complements the work done by Tunali and Tumer [9] who analyzed the book lending

network and community at Ardahan University. Their findings **are the most** important books and book network communities, their size and genre. **The limitations of** their research are they still use a one-to-one correspondence community approach and only discuss book networks, not discussing the borrower network, so they cannot describe how the borrowing community is in lending books. Therefore, the purpose of **our research is to describe the** book clusters and borrowers obtained from the book lending reports available in the library. **It is hoped that this paper will be useful for libraries as a practical guide in analyzing book clusters and their users, and useful for further research** II. LITERATURE REVIEW Research on community detection by utilizing library management book borrower data is still rare, including: Yassine et al applied the community detection method to online learning networks obtained from learning repositories at Khan Academy[10]. **The aim of the research is to investigate the structure of online learning networks and the engagement patterns of their users. The learning network is formed from users interacting with Khan Academy's videos through questions and answers.** **The results show that the community detection method is successful in finding good learning communities that are not necessarily related to the learning domain or topic.** In addition, the author uses a density measure to measure the level of community density, **as well as** centrality to determine the hub (the most influential) **in the community.** Tunali and Tumer analyzed the book borrowing network at Ardahan University by applying complex network analysis techniques [9]. The author builds a bipartite network of book readers, through the projection technique the bipartite network (two-mode) is transformed into a unipartite network (one- mode), namely a reader-reader network and a book network. Then apply the community detection method on each network. In addition, the author identifies the most central book in the network of books **using a measure of centrality.** **The result is** works of Turkish and world literature that are on the reading lists of many readers. Xin et al proposed a community detection-based book recommendation by constructing a similar network of readers [11]. **The results of the study, the authors found that most people** only borrow one or two books once **at a time and the** interval between two consecutive borrowing records is usually taken half a month. **All of the studies above, have limitations on community detection methods used aimed at unipartite networks or one-to- one correspondence communities, this strategy often leads to loss of information and inaccuracies in the resulting community [8].** As far as the author's knowledge from the literature, there has been no study of the application of community detection to borrowing books with bipartite networks where the community structure is many to many correspondence. Several community detection methods developed for bipartite networks with many community types include biSBM [12], with the method using the stochastic block model

many community types include BiSBM [12], with the method using the stochastic block model formula. ComSim [13] with a projection network approach, where the edges are weighted and the weights represent the similarity of the same node type, then applies the unipartite community detection technique. BiLouvain [14] by developing Louvain's algorithm there is detection of unipartite graph communities. BIMLPA [15] based on multi-labels, the authors devised a specific label propagation procedure for bipartite networks. In this study, we chose to apply the BIMLPA method, with the consideration that besides having the characteristics of finding many-to-many community structures, it also has better speed and stability than the method described above [15].

### III. RESEARCH METHODS

The stages of the research are shown in Fig. 3, starting with collecting data on book borrowing obtained from the book borrowing data base at the Ahmad Dahlan

University Library. The next step is to construct a bipartite book-borrower network, as the relationship between the borrower and the book. Network preprocessing process to produce a bipartite network that focuses on the core network by eliminating insignificant network components. Community detection steps with the BIMLPA algorithm are implemented to find book communities and borrowers. The final step is to analyze the results by looking at the network properties as well as the found community properties Fig. 3. Framework for Community Detection of Book Borrowing in Libraries

### IV. RESULTS AND ANALYSIS

#### A. Collection of Book Borrow Data

Records of borrowing books were obtained from the information system of the Ahmad Dahlan University Library in the circulation report (book borrowing) section. Then from the report only the column (attribute) title of the book, NIM, and Student Study Program were selected. The result is 6575 borrowing records (see table 1).

No	Title	No	Student	Dept
1	Calculus	1	1800014008	Physics
2	Data Mining	1600020001	Informatics	3
3	Fundamentals of Biochemistry	1500003016	Pharmacy	.....
4	Qualitative Methods Approach	1700005093	Communication Studies	B.

#### B. Bipartite Book Borrower Network Construction

The initial process of network analysis is to construct a bipartite network for borrowing books from table 1. The network design is illustrated in Fig. 4, where a student with student number 1800014008, in the Physics department, borrows a calculus book Fig. 4.

Illustration of a book borrowing network We visualize the bipartite network results from the data in table 1 with the Gephi software shown in Figures 5a, 5b, and 5c. Fig.5a Fig.5b Fig.5c In the bipartite network in Fig. 5a, it can be seen that not all of the nodes in the bipartite network are connected, but consist of connected components. Visually there is one core component as the main component (having 1029 nodes) while the remaining connected components are very small (called peripheral components) which are separated from one another in large numbers. The size distribution of connected components is shown in Fig. 6, where the core component has 1029 members, or (57%) of all members. Fig. 6. Distributed connected component of Book Borrowing Network

This finding indicates that in the process of borrowing books in the library, there are two separate categories of borrowing books. The first class is 'active-inclusive borrowing' which is shown in major tissue components, and the second class is 'exclusive borrowing' which is less active, which is shown in peripheral tissues. The number of active-inclusive borrows is only 57%

active, which is shown in peripheral issues. The number of active inclusive borrowers is only 0.7%, indicating that the use of existing books is not yet optimal. Construct a Bipartite Network of Book Borrowers Graph PreProcessing Implement BIMLPA Community Detection Collect Book Loan data 1 Result Analysis Calculus 1 1800014008 Physics Dept. 1800014008 Kalkulus J... 1600020001 Pemodelan ... 1500003016 Metodologi... 1800030123 PANCASILA ... 1800030139 Cultural A... 1500031059 Metode Pen... 1600025023 SOSIOLOGI ... 1400029043 Ergonomi S... 1500019146 Teknik Per... 1800030134 Dasar-Dasa... 1800030138Pengantar ... Asas-Asas ... 1800030131 Ilmu Komun... 1800031205 Urgensi Pe... 1500004074 Metode Pen... Aktualisas... 1700013214Teori Sosi... 1800030151 Sistem Kom... 1800031208 Meneladani... 1800030137 Komunikasi... 1800030014 Komunikasi... 1400001241 PANDUAN KR... 1800030119 Komunikasi... Fikih Sunn... 1500030104Komunikasi... Komunikasi... Fashion Se... 1800031200 PARADIGMA ... 1500019043 Tata Letak... 1800030502 Etika Komu... Pengantar ... Media Pemb... Komunikasi... 1800030142 HUKUM TATA... 1711031136 Media Pemb... Komunikasi... Komunikasi... Prosedur P... Teori Komu... 1800023194 Biologi Mo... 1500009041 Komunikasi...

Gatra-Gatr... Belajar da... Sosiologi ... 1700030185 Analisis I... 1400005042 MENJADI GU... 1500004097 TEORI-TEOR... 1500008139 Metode pen... 1500008003 METODE PEN... 1500011210 Metode Pen... 1800009004 SISTEM POL... 1800030073 Teori Komu... 1807044033 PSIKOLOGI ... 1500031073 Metode Pen... 1700030217 Memahami P... 1504004111Metode dan... 1700030150 Com unikat... 1800020078 Kimia Orga... 1500008143 Interaksi ... Guru Profe... 1700005239 Disruption Metode Pen... PENGANTAR ... Model pemb... 1400004037 All you ne... Etika Kehu... Perencanaa... 1700024194 MANUSIA DA... 1807044001PSIKOLOGI ... EMOSI: P N... 1600001200 Pengembang... LANGUAGE A... HUKUM PERK... 1700003134 MORFOLOGI ... 1514002070 Psikologi ... 1600020112 1514002059 Tes IQ dan... 1700004135 RANGKAIAN ... BIMBINGAN ... 1400030004 Semiotika ... Komunikasi... STUDI ILMU... Paradigma ... TEACHING E... Periklanan... HUKUM ADAT... 1800023190 1500031043 1700030039 1500003022 PRINSIP-PR... 1500020086 1800023173 1700020098Prinsip Da... 1800030028 Media Sosi... 1500030231 Menjadi Su... 1800003099 Supernova ... 1800023186 KIMIA ORGA... 1500009042 Pembelajar... 1600024287 PEMBAHASAN... 1500030252 Membincang... 1500003002 SOSIOLOGI ... 1614027069 Memotret N... PENGKAJIAN... 1800023187 1800018344 Kalkulus 1500007058 Fisika Uni... 1800030490 KARTUN:STU... Metodologi... 1500003178 Kurikulum ... 1800018346 1800030479 Psikologi ... 1500020106 Chemical P... Tata Artis... 1500009056 Komunikasi... Manajemen ... 1500 1183 1500005249 1500020091Enzymes in... 15 031 57 Pengajaran... 1514002074 1700018233Membangun ... Matinya Ra... 1800018335 DPR, DPD d... Sastra Ind... Filsafat P... 1700031171 Teori Komu... Mata Najwa... Penelitian... Metodologi... PRAGMATIK 1800018337 Fisika Jil... Rahasia si... 1500004177 The Study ... 1500030056 Komunikasi... 1800024008The Book o... 1800023138 1614027049 Masal AI-F... 1800002034Komunikasi... Educationa... 1500005112 Media Pemb... 1700031045 1500001153 Tafsir Aya... 1700031084 Kuliah Aqi... 1500003076 Teori Bela... 1500001128 PROSEDUR P... 1500003153 MFTODOI OGI 1500026096 Teori Kepr II MU NFGARA 1500015026 Teori dan FIKIH



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1600029093 Kedokteran... 1600011174 Metode Pen... 1900023268 Bahasa Lat... 1800023060  
1600008130 Atlas Tumb... KAJIAN SDM... Fisiologi ... 1600008134 Flora untu... 1600008140  
Fisiologi ... 1700023228 ISO Indone... MANAJEMEN ... 1800029238 Perempuan&... Kuliah Aqi...  
Ramuan Tra... 1907062104 Herbal Med... 1900023088 1707045025 Imunologi ... 1903329016  
Statistik ... Metode Sta... Statistik ... 1700029213 Epidemiolo... 1800023167 Farmasi Fi...  
1800023179 1600031014 Research D... 180 023181 1800023123 1800023127 1700029073  
1600008042 Kimia Farm... 1600008023 Toksikolog... Al-Islam d... Deteksi Di... Konsep Das...  
Himpunan P... Etika Huku... Toksikolog... Himpunan P... Himpunan P... 1700011326 Service, Q...  
1600023042 1600023021 Official M... 1600023034 Metodologi... 1800023214 Dasar-Dasa...  
Farmakogno... Besar Samp... 1700023199 Handbook o... Materia Me... Menelaah V...  
1703329005 Sistem Inf... Metode Pen... 1600011115 PEMAHAMAN ... 1900023255 Farmakope ...  
60171017 Persamaan ... A Practica... Entomologi... Statistik ... 1907062042 1600006133  
1900023069 Ilmu Kimia... 1900023062 1900029057 PUBLIC REL... Parasitolo... Strategi P...  
Zoologi In... 1800029311 1900023076 1700029227 Stop Diabe... 1600023125 Dasar Krom...  
1900023043 Ilmu Kimia... 1707045010 Imunologi:... Manajemen ... 1600008009 Strategi P...  
Metodologi... 1800029247 Pengantar ... 1600023113 Tanaman Be... 1907062106 1600006160  
Genetika S... 1800023145 Kimia Medi... 1500011221 Budaya Org... Parasitolo... 1800029103  
Buku Ajar ... Buku Ajar ... Penilaian ... 180002909 GIZI Prinsip Da... 1600011177 Psikologi ...  
1602005336 Mahalnya H... Manajemen ... 1507045011 Langkah-La... Aneka Manf... Detik-Deti...  
1600008133 Metode Fit... 1600008038 Tanaman La... 1900029153 Tumbuhan O... 1600023250  
Farmakope ... Manajemen ... Etika Prof... Penelitian... Kayu Manis... Dasar-dasa... Kesehatan ...  
1600006124 Strategi P... 1700023186 Teori dan ... 1700023213 1900023015 Dasar-Dasa...  
Pengantar ... Buku Pelaj... Farmakolog... 1800023206 Casarett A... Acute asth... 1903329015  
Buku Ajar ... 1800023166 1600008011 1700029208 Bahaya Gul... 1600008088 Metode Pen...  
Manajemen ... Buku Ajar ... Toksikolog... Mikrobiolo... Analisis I... Fitoterapi... 1800023132  
1800023241 Kodeks Kos... 1600023036 Proposal P... 1600023062 Teori dan ... 1700029273

Penyakit I ... 1907045002 1700029275 1900023008 Pelajaran ... 1500023199 Metode Pen...  
Pengelolaa... Metodologi... Kuliah Ulu... 1600023012 Statistik ... 1907062099 Statistik ...  
1800008023 Taksonomi ... Kimia Medi... 1800023210 Belajar Mu... 1800026174 1700029147  
1900029166 DASAR-DASA... 1600023027 1700023099 Modul Kimi... 1600006100 Kimia Anal...  
1600011301 1800023211 1600023049 Dasar-Dasa... 1600023093 Sistem Inf... 1700020102  
Formulariu... 1800023012 Kimia Dasa... 1800023205 Farmakokin... Analisis M... Biologi Mo...

Morfologi ... 1900023033 1800029014 1900023034 Intisari K... 1900023030 Intisari K...  
1800023268 Modul Spek... Kimia Orga... Modul Kuli... Mikrobiolo... 1800023156 1800026178  
1800026188 1700023180 Ilmu Keseh... Pengantar ... Goodman &#... 1700029004 Petunjuk P...  
1600023026 Ramuan Tra... 1500019068 Sistem Man... 500019082 Efek Toksi... 1700029164  
Penyakit J... Penyakit D... 1600023020 1900029156 1900023218 1800023159 Bawang Put...  
1903329006 Gizi Dan K... Ilmu Gizi ... 1900023219 Biologi Farmakokin... 1600006144 Kesehatan  
... Metodologi... Farmasi Fi... 1600023019 Sistem Dis... Diabetes Stop Diabe... 1800023262  
Farmakope ... 1300008063 1600006068 1700029284 Buku Ajar ... 1907062065 1800023243  
1700023218 1800023207 1800029248Seri Ibu D... Buku Pinta... Seri Kimia... 1900023004 Kimia  
Dasa... 1600011158 Demografi ... 1600023083 1708047020 Metode Pen... Prinsip-Pr...  
1600011213 EVALUASI K... Total Qual... Kepemimpin... 1700023178 ISO Indone... 1703329018  
1700029262 Modul Kuli... Malaria Pe... 1700029183 Penyakit J... Malaria Ep... Sanitasi H...  
1600006123 Analisis D... 1900029101 Hipertensi Parasitolo... 1800023065 Perilaku O...  
Kesehatan ... 1900023072 1600017139 Prinsip-pr... 1800020133 Anatomi Kl... 1900005206  
Taksonomi ... 1800023222 Kromatografi 1600005090 1700023257Medicinal ... 1700029289  
1700029206 LIFE HEALT... 1700029129 Diabetes M... Bebas Diab... 1900029079 Penuntun L...  
1700029037 Pembedahan... 1700029153 Serangan J... Bebas dari... Mengenal D... 1900029073  
Sistem Inf... Anatomi Da... 1700029215 Memadu Met... At a Glanc... Dasar Epid... 1800012272  
1700008098 1600023087 Medical Ph... 1903329011 1907062112 Drug Infor... BNF 62 (Br...  
1500029150 1600023143 Sikap Manu... 1800023081 1500013251 Biokimia: ... Ringkasan ...  
1808047010 1800008011 Dasar-Dasa... 1600023008 1800008005 Biokimia P... 1800023130  
Mikrobiolo... Brock Biol... Social Mar... 1700029175 1900023003 Dampak Pen... Komunikasi...  
1800029404 Manajemen ... 1700023226 Etika Dan ... Drug Infor... Drug Infor... Pengembang...  
Isolasi da... 1800023193 1600018051 1900023029 Ilmu Penya... 1600023219 Infectious...  
1800023227 1800023122 Analisa Ba... Metodologi... 1800023225 The United... 1700008115 Pilar  
Dasa... 1700023253 1800023278 AHFS Drug ... 1700029160 Drug Infor... 1900029232  
1900023040 1800023273 1700023191 Farmakolog... 1600023024 1800023113 1600023045  
1800029021 Biokimia: ... 1700023182 1900029167 1800023104 Organisasi... 1600023013  
1500029135 1600005098 1700011313 1400002018 Principles... ISO Indone... 1500029308  
150002 186 PHBS Peril... 1907062089 1500029184 Aplikasi S... 1500029278 Infeksi No...  
1500023159 Biologi Ji... 17 0029260 Nilai Kese... 1600030088 Fisiologi ... Modul Mata... Fisiologi  
... 1600008084 1600008120 Taksonomi ... Taksonomi ... 1600008119 1700013083 60970160  
1700005004 Metodologi... Kesehatan... 1600000010 Epidemiolo... Indikasi D... Sistem Man...

1700005204 Metodologi... Keselamata... 1600029013 Epidemiolo... Iradiasi P... Sistem Man...  
Kewirausah... 1600013058 1600008031 60030465 1800029224 1800029241 1800029007  
1800023175 1800029038 1600029245 Analisis F... 1700023041 1900023276 Analisis S... Ilmu  
dan T... 1600029052 Promosi Ke... Pengantar ... 1800023117 Health Beh... 1800023171  
1600029044 Farmakolog... 1700023261 1800023169 Epidemiology 1800023245 1900033187  
Tuntunan I... Cara Kroma... 1800023213 1800023074 Kuliah Akh... 1800023118 1800029003  
Cara Mengi... 1600029130 1600029226 Wilson &#3... 1900023022 Kimia Orga... 254 Hadits...  
1908062178 Modul Kuli... 1800029216 Buku Ajar ... Kebijakan ... 1800029214 1800029011  
1800029225 Modul Kuli... Obat Wajib... Modul Kuli... Modul Kuli... Modul Kuli... 1900023080 Buku  
Teks ... Tidur Tanp... Instrument... 1700023157 1900023115 1900023134 Identifika... 1900023026

Buku Ajar ... 1900023263 Dasar-Dasa... 1800023261 1800023252 1700023258 Sintesis O...  
1900023117 Periptaan ... Peraturan ... 1700023237 1900008041 1900008065 1900008045  
1900008001 Al-Quran T... 1600023089 Perempuan,... 1600023168 Materia Me... Toxicology...  
Prosedur L... Metode Eko... 1600017173 1600023146 Histologi ... 1500029327 1708047018  
1700026034 1600023078 1700023108 1700023136 1908062156 1808062182 1908062222  
1500012272 1800023125 1600029158 Kuliah Bio... 1900023028 Etika Huku... 1900023278  
1900023012 1900023039 1800023061 1900023051 1600029011 Mengungkap... 1600008111  
1900023280 Wilson and... 1800023208 Analisis F... Tanaman Ob... 36 Resep T... 1900023282  
1900023283 1900023286 1300023021 1900023222 1907062094 Proses Bel... 1600008063  
1600022061 Seri Biolo... Keselamata... 1608045037 1800023056 Akidah Islam 1900023257  
Kesehatan ... Apa Yang I... 1600008089 1700029204 Dasar-Dasa... Cara Pembu... 1600029258  
Manajemen ... 1500008016 Sistem Hem... Metodologi... 1700011327 Demam Berd... Parasitolo...  
Desain dan... 1900033121 1700005093 1500003016 Metodologi... 1500031059 Metode Pen...  
1500004074 Metode Pen... 1800030151 Etika Komu... Media Pemb... 1711031136 Media Pemb...  
Prosedur P... Teori Komu... 1800023194 Biologi Mo... 1500009041 1700030185 Analisis I...  
1500008139 Metode pen... METODE PEN... Metode Pen... 1700030150 Interaksi ... Metode  
Pen... 1400004037 Paradigma ... 1800023190 1500031043 1800023173 Media Sosi... KIMIA  
ORGA... 1500003002 1614027069 Metodologi... 1500004177 1800023138 1614027049 Media  
Pemb... 1700031045 Kuliah Aqi... PROSEDUR P... 1500003153 METODOLOGI... 1500005183  
1800031093 1500001111 Metodologi... 1700030093 1500008033 Metode Pen... 1500005187  
1700030164 1800032155 1800005348 1500008075 1600001176 1500013166 ERGONOMI K...  
1500008149 TEORI,METO... 1500009046 Negara Huk... Pendidikan... 1700030056 1500009047  
1800020019 Fisika: Pr... 1500009002 1700030055 1700030145 Konsep Man... 1600001278  
1500008047 Hujan Bula... 1600024141 HAK ASASI ... 1500006160 Model Pemb... 1500026011  
Psikologi ... 1800023180 1700023131 1600001041 Kuliah Akh... 1700023107 1800010185  
1800023209 Analisis K... 1500006090 1500030163 1500013081 1500005357 1600024173  
1700003148 Kimia Orga... 1700023070 1800029346 Epidemiolo... Dasar-Dasa... 1900023216  
Kuliah Ulu... 1800029255 Epidemiolo... Etika &#38... 1900024047 1600029077 Panduan Le...  
1600011008 Manajemen Farmakon... 1800023070 Dasar Dasa... Ilmu Merga... 1800023260

1000011030 Manajemen ... Farmakop ... 1800023070 Dasar-Dasa... Ilmu Metac... 1800023200  
Kimia Medi... 1800023057 ISO Farmak... 1800029253 1600023016 Dasar-dasa... Farmakolog...  
1600029201 Kesehatan ... Dasar-Dasa... Farmasi Fi... Psikologi ... Statistik ... 1907047001 Ilmu  
Keseh... Teori &#38... Keluarga B... Pelayanan ... Promosi Ke... 1800023073 Teknologi ...  
Promosi Ke... Pengantar ... 1700029162 1600006157 Statistika... 1800023067 Herbal Ind...  
5029096 1900023215 Biofarmase... Farmasetika 1600011174 Metode Pen... 1900023268  
1800023060 1600008130 Atlas Tumb... Flora untu... ISO Indone... Kuliah Aqi... 1907062104  
Imunologi ... 1903329016 Epidemiolo... 1800023167 1800023179 Research D... Ki ia Farm...  
1600008023 Konsep Das... Toksikolog... Himpunan P... Official M... 1600023034 Metodologi...  
1800023214 Dasar-Dasa... Farmakogno... Besar Samp... 1703329005 1600011115 Farmakope ...  
Entomologi... Statistik ... Ilmu Kimia... 1900029057 Parasitolo... Strategi P... 1900023076  
1700029227 Stop Diabe... Dasar Krom... Imunologi:... Manajemen ... 1600008009 Metodologi...  
1800029247 1600023113 Tanaman Be... 1907062106 Kimia Medi... Parasitolo... 1800029103  
Buku Ajar ... Buku Ajar ... Prinsip Da... 1600011177 Manajemen ... Metode Fit... 1900029153

Tumbuhan O... Farmakope ... Manajemen ... 1600006124 1700023186 1900023015 Dasar-  
Dasa... Pengantar ... Buku Pelaj... Farmakolog... 1800023206 1903329015 Buku Ajar ...  
1800023166 1600008011 Bahaya Gul... Analisis l... Fitoterapi... 1800023241 1600023036  
1600023062 1700029273 Penyakit T... 1907045002 1900023008 Metodologi... Statistik ...  
1907062099 Statistik ... Taksonomi ... Kimia Medi... 1800023210 1600023027 Kimia Anal...  
1800023211 Dasar-Dasa... 1700020102 1800023012 Kimia Dasa... Biologi Mo... Morfologi ...  
1900023033 1900023034 1800023268 Kimia Orga... 1700023180Ilmu Keseh... Pengantar ...  
1700029004 1600023026 Sistem Man... 1700029164Penyakit D... 1800023159 1903329 6  
1600006144 Kesehatan ... Farmasi Fi... Farmakope ... Buku Ajar ... 1700023218 1800023207  
1800029248 1600011158 1600023083 Metode Pen... Prinsip-Pr... K pemimpin... ISO Indone...  
1700029183 Analisis D... Hipertensi Perilaku O... Kesehatan ... Taksonomi ...  
1800023222Kromatografi 1700029289 1700029129 1700029037 1700029153 Memadu Met... At  
a Glanc... 1907062112 1500029150 1800023081 1808047010 1600023008 1700029175 Etika  
Dan ... 1800023227 1700029160 Farmakolog... 1800023113 1800029021 1700023182 PHBS  
Peril... Aplikasi S... 1500023159 Biologi Ji... 17 0029260 Taksonomi ... 1600029013 1800029038  
1900023276 1600029052 Promosi Ke... 1600029044 Farmakolog... Tuntunan l... 1800023074  
Kuliah Akh... Cara Mengi... Wilson &#3... 1900023022 1900023080 1900023026  
16000231461700026034 1600029158 1600029011 Analisis F... 170 029204 0 500 1000 1500 0  
100 200 300 The next step, this study focuses on the main network. The visualization of the main  
network is shown in Fig. 5b, while Fig.5.c contains the main network with the size of the nodes  
following the ranking degree. Nodes with a greater degree are described as larger. Degrees show  
activeness in borrowing books.Five top degrees for each book and reader can be seen in Tables  
2a and 2b. Books on the topics of religious books, pharmacy, health and research are the most  
borrowed, while students from the Public Health and Pharmacy study programs are the most  
active students in borrowing books. TARI F 2A TOP FIVE BOOKS No Book Degree 1 Ilmumul

active students in borrowing books. TABLE 2A TOP FIVE BORROWERS No Student No. Dept. Degree 1 1800029253 Public Health 24 2 1800023260 Pharmacy 20 3 1800023070 Pharmacy 18 4 1800023209 Farmasi 17 5 1800029346 Public Health 15 C. Community Detection <sup>2</sup> The results of community detection using the BIMLPA method obtained the number of communities, the largest community size, the smallest community size and the average community size in book and student networks is presented in table 3., while the community distribution is presented in Fig. 7 Tabel 3. Detected communities from Book-Reader network number of com Smallest com size Largest com size Avg. com size Readers 217 1 21 5.09 Books 141 1 37 5.49 Fig. 7. Community Size Distribution Other findings, although the number of communities is high, the average size is small. The book community is dominated by a community of 2-4 members, even in the borrowing community it is dominated by a borrowing community with 1 member or can be called individual borrowing (shown in Fig.7). The small size of the community indicates that most of the books are rarely borrowed from different people, and most borrowers also rarely borrow different books. Of the 217 borrowing communities and 141 book communities, we present the five largest communities which are presented in table 4 and table 5. TABLE 4 TOP FIVE COMMUNITIES BORROWERS No Com

Size Com Avg. deg Max Deg Student No Dept 1 21 5.38 18 800023070 Pharmacy 2 15 4.40 24 1800029253 Public Health 3 11 1.0 21 1900023028 Pharmacy 4 10 2.0 11 1600029077 Public Health 5 10 4.2 5 1500008047 Biology TABLE 5 TOP FIVE COMMUNITIES BOOK Com No Com size Avg degree Max Degree Title 1 37 3.8 17 Analytical Pharmaceutical Chemistry 2 28 2.2 24 Public Health Leadership: Applications In Practice 3 18 2.9 18 Health Promotion And Health Behavior 4 17 2.11 9 Educational Research Methods: Quantitative Qualitative Approach 5 15 1.73 5 Textbook of Medicinal Chemistry We also investigate the composition of the community. The composition of the community is homogeneous if the members consist of the same study program. As can be seen in Fig. 8a and Fig. 8b, not all communities are always homogeneous 124 72 18 3 40 65 29 7 1 2 - 4 5 - 1 0 >10 # Students # Books Fig. 8a Borrower Community Composition Fig. 8b. Books Community Composition In the composition of the student community, the community is homogeneous in the largest communities 1, 2 and 3, while the 4th and 5th communities are not homogeneous. Inhomogeneity indicates that several borrowers from different study programs have the same interests. Likewise in the book community, for example, in the largest community of members, books other than Pharmacy books, but there are a small number of Islamic religious books. This indicates the habit of borrowers borrowing pharmacy books as well as borrowing Islamic religious books. V. CONCLUSIONS In this research, we have demonstrated how the database of borrowed books available at the library can be analyzed using network analysis and community detection methods to obtain a comprehensive description of the characteristics of students and borrowed books. Analysis of the results showed that almost half of the library members (47%) were classified as inactive book borrowers. <sup>10</sup> This indicates that the use of books

so far has not been optimal. <sup>2</sup> The results of community detection obtained 217 borrowing communities and 141 book communities, most of which are small communities. Similar to the results of network analysis, this indicates limited (less diverse) books borrowed by students and less diverse students who borrow book. The largest community for borrowers is Pharmacy and Public Health students, while for books, the largest community is books with the field/topic of Pharmacy and public health. Intuitively, the composition of the community is generally homogeneous, but it is found that several borrowing communities and the books of their members are not homogeneous. Based on the results of this study, some of our recommendations for libraries include (1) preparing better book stocks, especially for popular books, (2) giving appreciation to students or communities who frequently borrow books (3) recommending borrowing books to communities that accordingly, (4) provide more varied books to increase lending which is still not active. The findings of students who are less active in borrowing text books can be suspected that there is a change in student interest patterns from textbooks to digital books. This research opens opportunities for further research related to accessing ebooks, journals and other digital collections. REFERENCES [1] L. Klain Gabbay and S. Shoham, "The role of academic libraries in research and teaching," *J. Librariansh. Inf. Sci.*, vol. 51, no. 3, pp. 721–736, 2019. [2] G. L. Casali, M. Perano, and T. Abbate, "Understanding Roles and Functions of Academic Libraries as Innovation Intermediaries within the Service-Dominant Logic Perspective: An Australian Case Study," *J. Libr. Adm.*, vol. 57, no. 2, pp. 135–150, 2017. [3] P. Sanjay, "Collection development in academic libraries," *Int. J. Libr. Inf. Sci.*, vol. 8, no. 7, pp. 62–67, 2016. [4] T. Silwattananusarn, I. Science, P. Campus, P. Kulkanjanapiban, and K. L.

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