Course Content Mining for Academic Program Selection

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What do you want to be when you grow up?

19.6 million students
in the US enroll in college annually

1,800+ Majors | 44,000+ Accredited Programs | 6,000+ Colleges

Accounts for 2.5% of the US GDP

Choosing the Right Program…?

What should I major in?
(High School)

About **66%** of students feel overwhelmed by the process of selecting a major

Am I in the right major?
(College)

More than **50%** of students change their major at least once

Did I pick the right major?
(Career)

44% of job-seeking graduates regret their major

https://www.ellucian.com/assets/en/2019-student-success-survey-results.pdf
https://www.ziprecruiter.com/blog/regret-free-college-majors/

It is difficult for students to identify their interests within a complex university curriculum.

IME Courses

IME 101. Introduction to Industrial and Manufacturing Engineering.   1 unit
Term Typically Offered: F

Introduction of major topics in industrial and manufacturing engineering such as data analysis, process improvement, operations research, product design, and supply chain management. Professional ethics, cheating and plagiarism. Resources for academic success. Career opportunities review. 1 laboratory.

IME 141. Manufacturing Processes: Net Shape.   1 unit
Term Typically Offered: F,W,SP,SU

Metal casting as a net shape process in manufacturing. Properties of molding materials and methods of casting. Introduction to rapid prototyping. Pattern and casting design principles. 1 laboratory.

IME 142. Manufacturing Processes: Materials Joining.   2 units
Term Typically Offered: F,W,SP,SU

Theory and application of metal cutting and welding processes. Includes shielded metal arc, flux cored arc, submerged arc, gas metal arc, gas tungsten arc, brazing, resistance, and oxy-acetylene processes. Bonding theory, joint design, codes and testing. Introduction to adhesive bonding. Open to all majors. 1 lecture, 1 laboratory.

IME 143. Manufacturing Processes: Material Removal.   2 units
Term Typically Offered: F, SP

Uses, capabilities, and theoretical and operational characteristics of lathe and milling machine tools, including conventional, automatic and numerical control. Cutting tool characteristics, machining parameters, quality control, and production methods. Design considerations for manufacturing. Introduction to robotics and automation. Open to all majors. 1 lecture, 1 laboratory.

IME 144. Introduction to Design and Manufacturing.   4 units
Term Typically Offered: F, W, SP

Supplemental review of visualization, sketching, and drafting fundamentals. Computer-aided solid modeling of parts and assemblies. Introduction to conventional machining processes on lathes and mills, computer numerical control, quality control, production methods, and design for manufacturing. Open to all majors. 2 lectures, 2 laboratories.

Large number of academic programs and courses

Ambiguous high-level program info

Dynamic program structure and content

How might we bridge the gap between university curriculum and student's interests?

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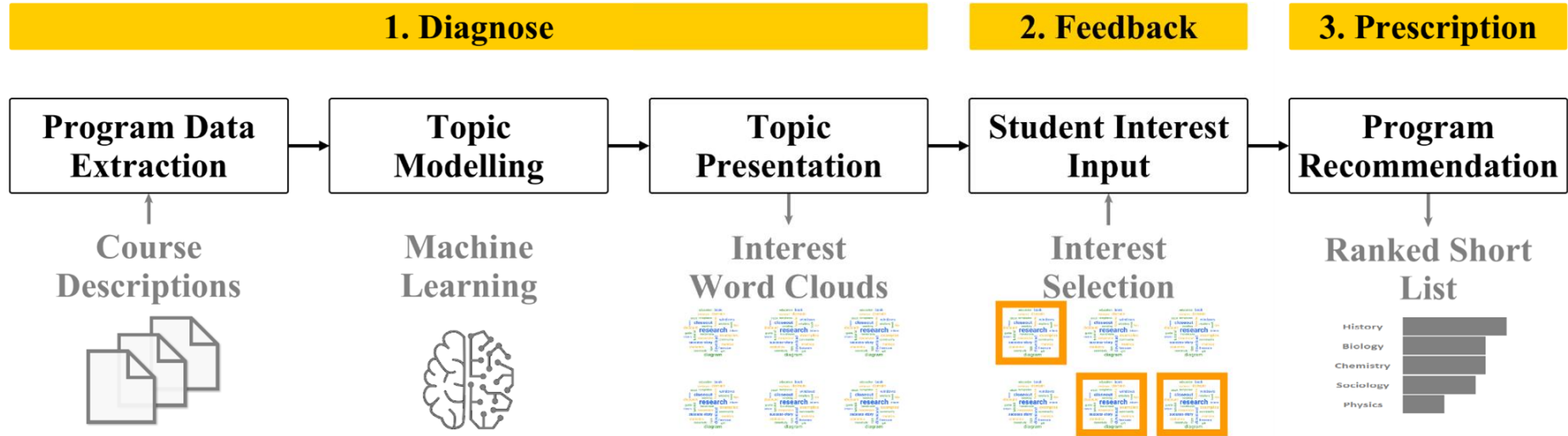Term Typically Offered: F, W, SP

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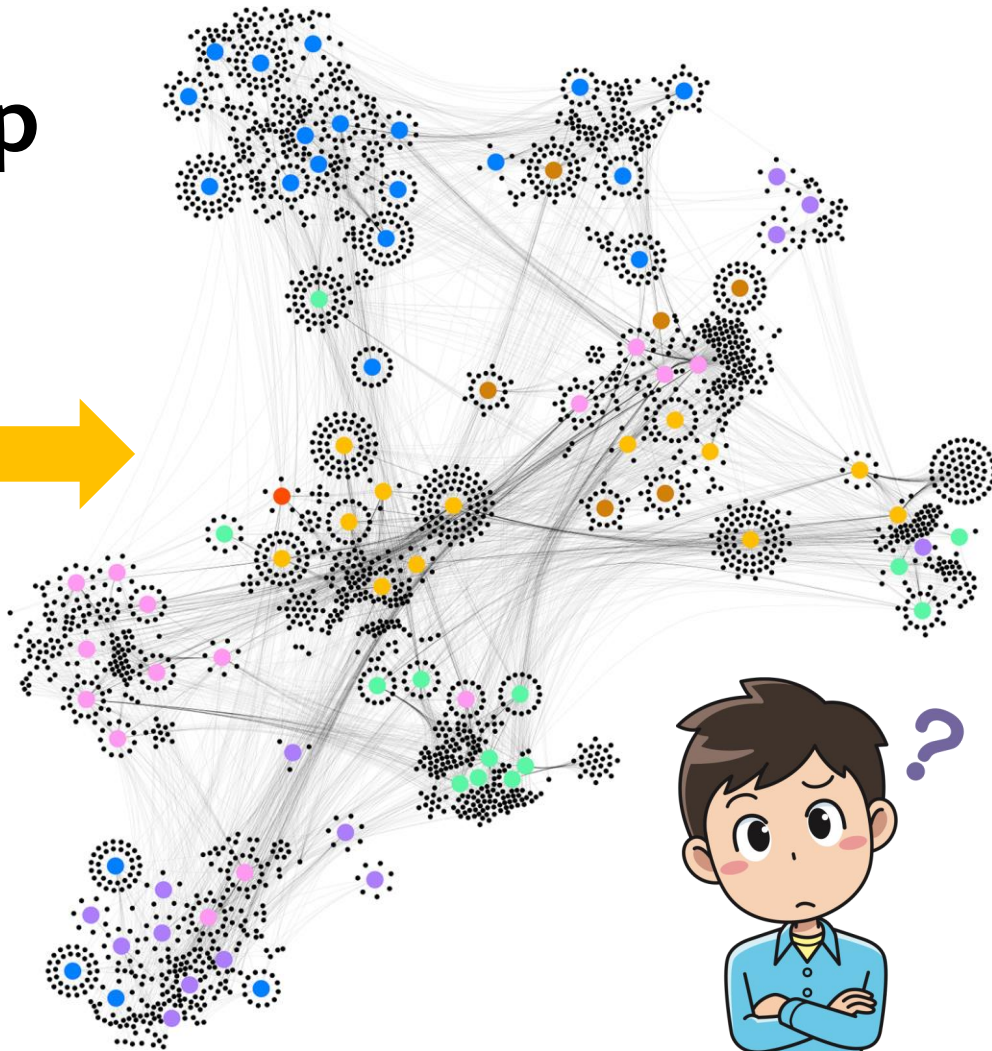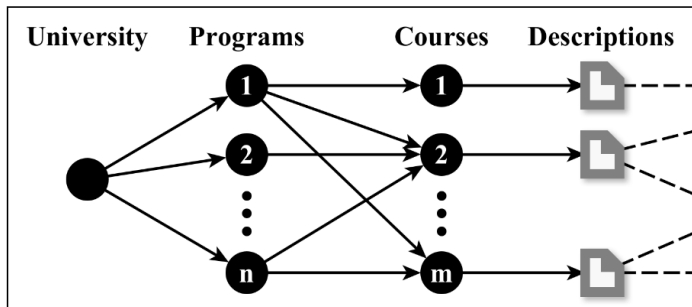
Our Methodology

Top Program Recommender (TopProRec)

1. Diagnose

2. Feedback

3. Prescription

Program Data Extraction	Topic Modelling	Topic Presentation	Student Interest Input	Program Recommendation

Course Descriptions

Machine Learning

Interest Word Clouds

Interest Selection

Ranked Short List

History
Biology
Chemistry
Sociology
Physics

Case Study

2021-2022 Academic Year | 84 programs | 4,251 courses

The Knowledge Map

- 84 programs (colored by college)
- 2,565 courses (black nodes)
- 6,143 connections

Example: Creating Word Clouds with BERTopic

Course Descriptions (4000+)

Topic Modeling →

Word Clouds (30)

IME 223. Process Improvement Fundamentals.   4 units
Term Typically Offered: F, W, SP
Prerequisite: MATH 141. Recommended: IME 101.

Principles of work simplification and motion analysis. Recording of work flow and methods. Process improvement through work measurement and standards, time study, synthetic data, predetermined time systems and work sampling. Allowances and performance rating, productivity measures. Introduction to lean manufacturing principles. Client based project. 3 lectures, 1 laboratory.
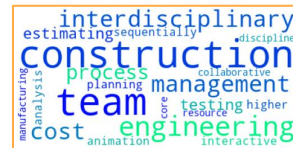
ART 102. Art and Design Foundation Studies I.   4 units
Term Typically Offered: F

Introduces elements and principles of design, establishing a foundation for all artistic practice. Emphasizing critical thinking and creative problem solving, the interrelationship between form and content are examined. Traditional, digital and lens-based media are explored through individual and collaborative experiences. 3 lectures, 1 laboratory.

FSN 330. Principles of Food Engineering.   4 units
Term Typically Offered: F
Prerequisite: FSN 204.

Fundamental engineering principles related to heat transfer in food processing unit operations. Engineering properties of foods, mass and energy balances, thermodynamics, and heat transfer in various unit operations (drying, mixing, refrigeration). Sustainability applied to unit operations will be introduced. Field trip required. 3 lectures, 1 laboratory.

**BUS 301. Global Financial Institutions and Markets.**   4 units
Term Typically Offered: F, W, SP
Prerequisite: ECON 222.

Role of private and public financial institutions in allocating capital globally and promoting international commerce. Financial institutions covered include the FED, IMF, World Bank, investment banks and others. Detailed exploration of the history and functions of these institutions. 4 lectures.
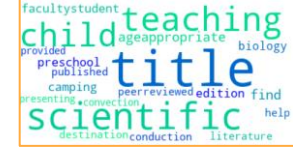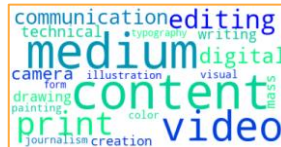
Example: Topic Selection
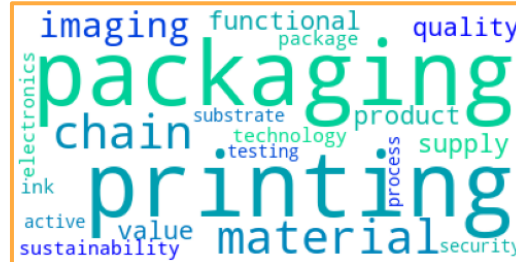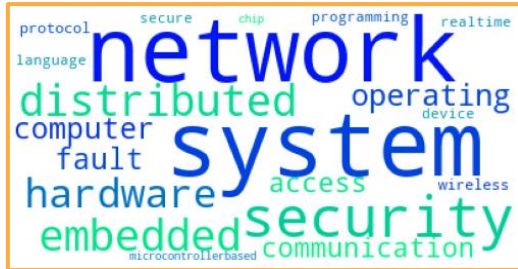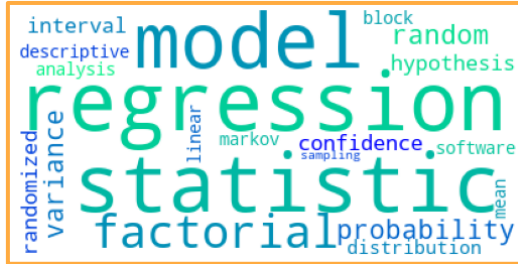
Example: Program Recommendation

| Rank	Program	# Courses	PIS	R-PIS
1	Bioinformatics	16	86	5.38
2	Industrial Engineering	102	546	5.35
3	Management & Human Resources	14	73	5.21
4	Manufacturing Engineering	115	585	5.09
5	Industrial Technology	27	135	5.00
6	Computer Science	176	822	4.67

PIS (Program Interest Score): *# of times that keywords appear in courses*

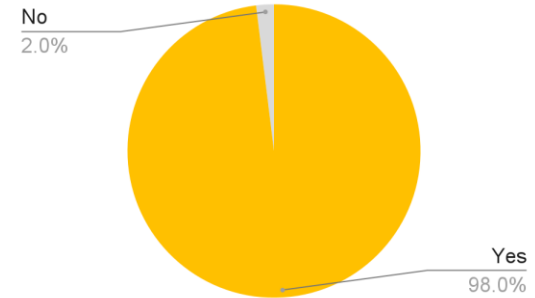**R-PIS (Relative Program Interest Score):** *Average PIS per course (PIS divided by # of courses)*
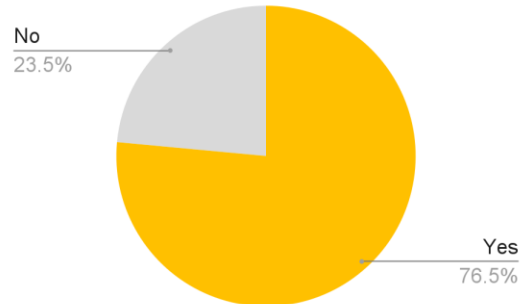
Evaluation

User Testing Survey Results
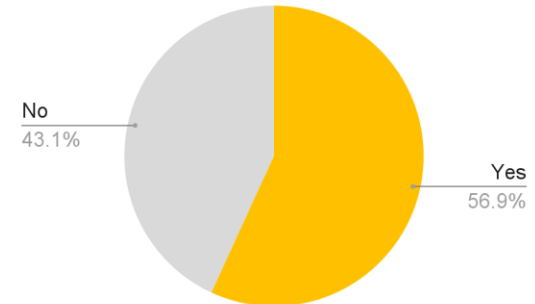
My current program was recommended

No
56.9%

Yes
43.1%
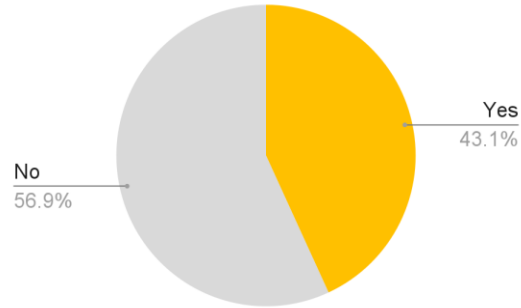
One or more of the recommended programs matched my interests

No
2.0%

Yes
98.0%

There is an unexpected program that I did not consider yet

No
23.5%

Yes
76.5%

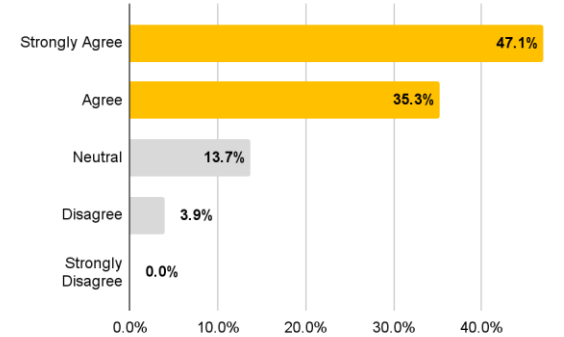A program that I would consider (besides the one I'm enrolled in) is not recommended

No
43.1%

Yes
56.9%

User Testing Survey Results

System is useful to select a major.

Strongly Agree	45.1%
Agree	49.0%
Neutral	2.0%
Disagree	3.9%
Strongly Disagree	0.0%
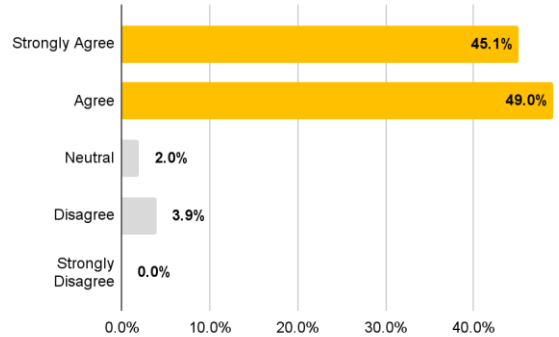
It is easy to select interesting word clouds.

Strongly Agree	47.1%
Agree	35.3%
Neutral	13.7%
Disagree	3.9%
Strongly Disagree	0.0%

I would consider using this tool in addition to existing resources

Strongly Agree	43.1%
Agree	51.0%
Neutral	2.0%
Disagree	2.0%
Strongly Disagree	2.0%
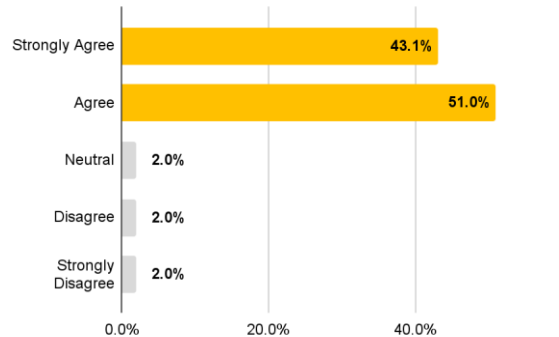
I think the interest word clouds were mostly meaningful.

Strongly Agree	23.5%
Agree	62.7%
Neutral	9.8%
Disagree	3.9%
Strongly Disagree	0.0%
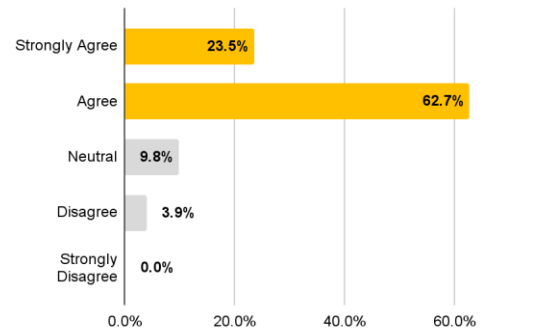
TopProRec System Features

Fairness
Representative of almost all programs

Real-Time
Instant results leveraging large amounts of data

Serendipity
Discoverability of new programs
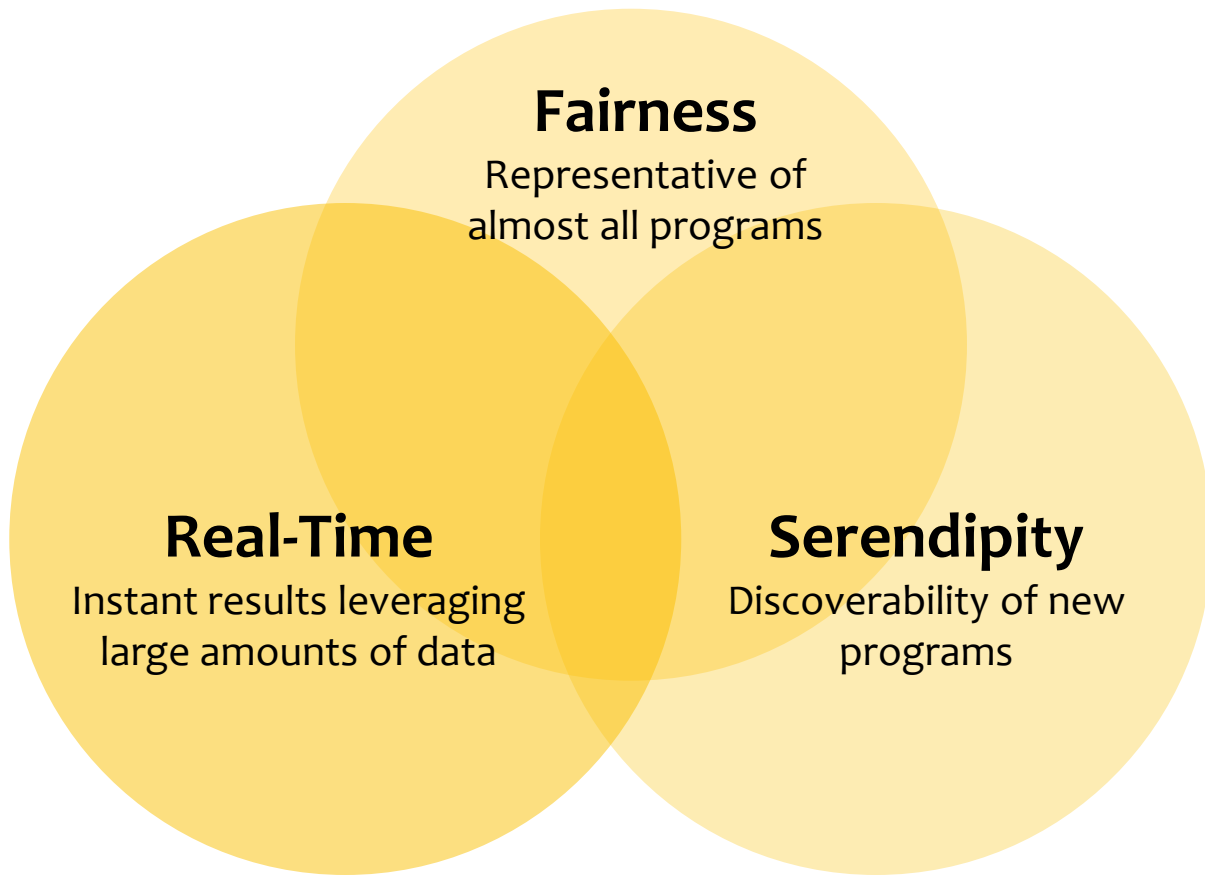
Key Contributions

- Novel recommender system for **program selection based on individual student interest**

- Applied **knowledge representation techniques and tools** (knowledge graph and word clouds) to the domain of higher-education

- **Prototype implementation** at a university with 80+ programs and 4,000 courses

- **Qualitative method validation** through student testing and survey

Next Steps & Future Opportunities

- Make the recommendation system **accessible to the public**

- Explore **alternative topic modeling** methods

- Include **syllabi and lecture content** in the dataset

- Recommendations for **minors, certificates, and study abroad programs**

- Implement at **other universities**

Thank You!

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