# Transcriptomic Data Science

**The University of Toledo**

**Bioinformatics, Proteomics and Genomics, COMLS**

**BIPG** 7300

**Instructor**: Rammohan Shukla, PhD

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**Office Hours**: By arrangement

**Office Location**: Room 182 HSB (Block Science Bldg.)

**Instructor Phone**: 419-383-4506

**Offered**: Summer 2022

**Course Website**: [Blackboard Learn](https://blackboard.utdl.edu/) (if applicable)

**Class Location**: 127 Health Education Building **Class Day/Time**: W / 11:30AM – 2:30PM

**Lab Location**: N/A

**Lab Day/Time**: N/A

 **Credit Hours**: 3

CATALOG/COURSE DESCRIPTION\*

Transcriptomic though part of genomics has evolved tremendously over the past 10 years and has expanded to many other domains including drug discovery and cellular anatomy. This course introduces students to the basic biology of modern transcriptomics and the experimental tools that we use to measure it. Starting with the Central Dogma of Molecular Biology I will cover how next-generation sequencing can be used to measure RNA expression and its regulation. Recent advances in transcriptomic data science including single cell RNA sequencing, RNA-editing, and transcriptomic signature-based drug discovery approaches will also be covered. Students will also get an introduction to the key concepts in cluster computing and data science that you'll need to understand how data from next-generation sequencing experiments are generated and analyzed. The course is designed based on the need of transcriptomic data science and cluster computing in job market. Accordingly, the major focus will be on project-based teaching.

## COURSE OVERVIEW

The course answers many questions in modern biology that needs computational and big data transcriptomics approaches to solve them. It also provides a toolset of existing software resources built on the computational approaches that can be used to mine new information from existing data repositories.

STUDENT LEARNING OUTCOMES\*

After completion of the course, students should be able to:

L1. Will get an overview, Human genome project

L2. describe technologies involved in transcriptomic sciences and their applications.

L3. Operate cluster computing and Linux

L4. Use Bioconductor for transcriptomics data

L5. Locate online Resources for sequencing data

L6. Differentiate biological and technical replication, Sequencing depth and confounding variables

L7. Execute exploratory and gene set enrichment analysis

L8. Differentiate RNA editing from SNPs

L9. Define and describe metagenomics concept

L10. Examine metagenomics data

L11. Understand single cell sequencing

L12. Implement the transcriptomics data science methods

L13. Define drug from there transcriptomic signatures

L14. Select drug compounds using LINCS L1000 dataset

L15. Execute biomart query of genes and drug targets

TEACHING METHODOLOGY

A variety of teaching methods will be used, including in class lectures, exercises, quizzes, project, and online instructional lectures and videos.

PREREQUISITES AND COREQUISITES\*
None

## TEXTS AND ANCILLARY MATERIALS\*

There is no required text. All the required materials will be available on Blackboard. Readings will consist of original literature, review articles, and R based books.

TECHNOLOGY REQUIREMENTS
Cluster computing will be done on Ohio Supercomputer facility

ACADEMIC POLICIES\*
[Graduate Policies](http://www.utoledo.edu/policies/academic/graduate/): <http://www.utoledo.edu/policies/academic/graduate/>

## UNIVERSITY POLICIES\*

### Policy Statement on Non‐Discrimination on the Basis of Disability (ADA)\*

The University is an equal opportunity educational institution. Please read [The University’s Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.](http://www.utoledo.edu/policies/administration/diversity/pdfs/3364_50_03_Nondiscrimination_o.pdf)
Students can find this policy along with other university policies listed by audience on the [University Policy webpage](http://www.utoledo.edu/policies/audience.html/#students) (http://www.utoledo.edu/policies/audience.html/#students).

### Academic Accommodations\*

The University of Toledo embraces the inclusion of students with disabilities. We are committed to ensuring equal opportunity and seamless access for full participation in all courses. For students who have an accommodations memo from Student Disability Services, I invite you to correspond with me as soon as possible so that we can communicate confidentially about implementing accommodations in this course. For students who have not established affiliation with Student Disability Services and are experiencing disability access barriers or are interested in a referral to healthcare resources for a potential disability or would like information regarding eligibility for academic accommodations, please contact the [Student Disability Services Office](http://www.utoledo.edu/offices/student-disability-services/index.html) (http://www.utoledo.edu/offices/student-disability-services/) by calling 419.530.4981 or sending an email to StudentDisability@utoledo.edu.

## ACADEMIC AND SUPPORT SERVICES\*

Please follow this link to view a comprehensive list of [Student Academic and Support Services](http://www.utoledo.edu/studentaffairs/departments.html) (http://www.utoledo.edu/studentaffairs/departments.html) available to you as a student (please refer to the face-to-face syllabus guidelines for more guidance/details).

## SAFETY AND HEALTH SERVICES FOR UT STUDENTS\*

Please use the following link to view a comprehensive list [Campus Health and Safety Services](http://www.utoledo.edu/offices/provost/utc/docs/CampusHealthSafetyContacts.pdf) available to you as a student (please refer to the face-to-face syllabus guidelines for more guidance/details).

COURSE EXPECTATIONS

Students are expected to attend lectures and participate in class discussions, successfully complete all assignments and projects, and pass all quizzes and exams

OVERVIEW OF COURSE GRADE ASSIGNMENT\*

Will include performance in assignment and quizzes

**Quizzes**  30%

There are 10 quizzes in this course. Each quiz will cover the material presented in that particular week. Few questions from previous quizzes may also be included. Students have to upload their answers before the next class. Further instructions will be supplied for each particular quiz.

**Project**  40%

A project will explore a topic of the course in greater depth. A written report, along with a power point presentation, is required. A project that addresses a question through data analysis with a written report and summary of conclusions would be sufficient. More detailed descriptions of the project along with suggested topics will be discussed at the appropriate times during the term.

**Final examination** 30%

The final exam will be a take-home exam. The exam will cover all the materials presented in the course.

Final Grading
≥ 90 A, 87-89 A-, 84-86 B+, 80-83 B, 77-79 B- , 74-76 C+, 70-73 C, < 70 D, < 50 F.

COURSE SCHEDULE\*

| WEEK | DATES | Instructors | TOPIC | LEARNING OUTCOME(S) | ASSIGNMENTS |
| --- | --- | --- | --- | --- | --- |
| 1 | 5/18/22 | Shukla | Transcriptomics (course introduction) | L1 | Q1, P1 (Discussion) |
| 2 | 5/25/22 | Khuder | Microarray technology | L2 | Q2 |
| 3 | 6/1/22 | Khuder | Statistics for Transcriptomics data science | L1 | Q3 |
| 4 | 6/8/22 | Shukla + Fedorov | Meta data and ontologies and gene annotation | L3, L4 | Q4 |
| 5 | 6/15/22 | Shukla  | Working with Sequence data | L3, L4, L5 | Q5 |
| 6 | 6/22/22 | Shukla | Design of RNAseq experiment | L6, L7 | Q6, P1 (Assignment) |
| 7 | 6/29/22 | Shukla + Zhang | RNA editing + miRNA | L8 | Q7 |
| 8 | 7/6/22 | Shukla | Single cell RNA sequencing | L9, L10 | Q8 |
| 9 | 7/13/22 | O’Donovan + Yang | Metagenomics | L11 | Q9 |
| 10 | 7/20/22 | Khuder | Network analysis [WGCNA] | L12 | Q10 |
| 11 | 7/27/22 | Smith | Genomics and drug discovery and The Library of Integrated Network-based Cellular Signatures (LINCS) Program Overview | L13, L14, L15 | P1(Presentation)  |
| 12 | 8/3/22 |  | Final Exam |  | E1 |