Regulated Research Institutional/Industrial Setting Form (1C)

This form must be completed AFTER experimentation by the adult supervising the student research conducted in a regulated research institution, industrial setting or any work site other than home, school or field.

Student's Name(s) Preethi Krishnamoorthy

Title of Project A Comparison of Machine Learning Methods in the Analysis of Lymphocyte Patterns in C

To be completed by the Supervising Adult in the Setting (NOT the Student(s)) after experimentation:

(Responses must be on the form as it is required to be displayed at student's project booth; please do not print double-sided.)

The student(s) conducted research at my work site:

1. Did you or your proxy (e.g. graduate student, postdoc, employee) mentor or provide substantial guidance to the student researcher? ☑ Yes ☐ No
   a. If no, describe your and/or your institution's role with the student researcher and his/her project (e.g. supervised use of equipment on site without ongoing mentorship and sign below.

   b. If yes, complete questions 2–5.

2. Is the student's research project a subset of your ongoing research or work? ☑ Yes ☐ No
   Use questions 3, 4 and 5 to detail how the student's project was similar and/or different from ongoing research or work at your site.

3. Describe the independence and creativity with which the student:
   a. developed the hypotheses or engineering goals for the research project

   The core scientific goals of the project are aligned with the larger scientific research conducted in our group at my work site. In collaboration with me, the student developed goals that extend analyses of data extracted from whole slide tissue images to classification and clustering for correlation with clinical data (such as immune subtypes).

   b. designed the methodology for his/her research project

   The student developed deep learning networks to carry out classification and clustering of data generated from whole slide tissue image analyses. The student developed the deep learning (DL) methods using the Jupyter notebook framework and Keras. She built the DL networks either from scratch or as extensions to existing, pre-trained models.

   c. analyzed and interpreted data

   She analyzed and interpreted data obtained from methods in 3.b in order to evaluate the analysis performance of different deep learning models.

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Student's Name(s) Preethi Krishnamoorthy

4. Detail the student's role in conducting the research (e.g. data collection, specific procedures performed). Differentiate what the student observed and what the student actually did.

The student carried out an implementation and evaluation of deep learning methods for additional analysis of data extracted from whole slide tissue images. This data is extracted from lymphocyte classification methods that process whole slide tissue images and generate heatmaps representing a probability distribution of lymphocytes in tissue specimens. These heatmaps are converted to images and spatial statistics that can be used for correlation of lymphocyte patterns with other types of data (e.g., clinical and genomic signatures of patients). The student developed and experimentally evaluated several deep learning models to classify or cluster the heatmap images with respect to the immune subtypes of patients (from which the whole slide tissue images were obtained). The student observed how our group carries out analyses of whole slide tissue images to generate heatmaps representing lymphocyte patterns. She then developed the deep learning models using the Jupyter notebook framework and the Keras library to classify and cluster heatmap images with repsect to the immune subtypes. She then evaluated the implementations using a de-identified dataset of breast cancer cases from the Cancer Genome Atlas repository.

5. Did the student(s) work on the project as part of a group? ☑ Yes ☐ No
If yes, how many individuals were in the group and who were they (e.g. high school students, graduate students, faculty, professional researchers)?

Yes, the student worked as part of a group. Our group consists of 5 faculty members including myself, 15 graduate students, and several collaborating scientists from the Pathology department as well as other institutions. The student attended our group meetings and worked in the student lab area when she was here in the department.

I attest that the student has conducted the work as indicated above and that any required review and approval by institutional regulatory board (IRB/IACUC/IBC) has been obtained. Copies are attached if applicable.
I further acknowledge that the student will be presenting this work publicly in competition and I have communicated with the student research regarding any requirements for my review and/or restrictions of what is publicized.

Tahsin Kurc		Research Assoc. Prof.
Supervising Adult's Printed Name	Signature	Title
Biomedical Informatics Department, Stony Brook University		09/29/2019
Institution		Date Signed (must be after experimentation) (mm/dd/yy)
HSC L3-043, School of Medicine, Stony Brook, 11794		tahsin.kurc@stonybrook.edu
Address		Email/Phone