Final Exam Question

Learning Discrete Mathematics and Computer Science via Primary Historical Sources

Funded by the National Science Foundation

`http://www.cs.nmsu.edu/historical-projects/`

Instructions for Instructors: An alternative final exam question is a crucial part of the evaluation of our NSF-funded program for teaching with student projects based on primary sources. In any course in which a historical project is used, we kindly request you to make a small modification to your final exam, and report the results to us, as follows.

Please select one standard textbook-based question on the final exam, and offer students a choice between that question and an alternative question that is project-based. Each student should answer one or the other question (not both) on the exam. At the end of this document we offer an example of how we have done something like this.

Please send us a copy of the exam, mark which option is the textbook-based question and which is project-based, and write next to each of the two questions the number of students who chose each option.

Please also fill out the remainder of this cover sheet as below and mail it with the marked exam to our NSF evaluation consultant

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If you have any questions please feel free to contact Dr.Trafimow (`dtrafimo@nmsu.edu`) or any of us. Thank you so much for your help.

1. Date the exam was administered:

2. Academic semester/quarter and year:

3. Instructor name and email address:

4. Institution name:

5. Course title, number, and section:

6. Academic department of instructor:

7. Academic department of course:

8. Is this a cross listed course between departments? Yes No
If yes, which?

9. Approximate enrollment:

10. What are the approximate percentages of student majors in your course?

11. Which historical project was used in the course?

12. Add any other useful information about the project or the exam questions.

Illustration of alternative exam question

For the final exam in a sophomore level discrete mathematics course,
with a project based on *Pascal's Treatise on the Arithmetical Triangle*

Choose exactly **ONE** of the following two questions.

1. Let $r \geq 0$ be a fixed integer. Show that for all $n \geq r+1$,

$$\sum_{i=r}^{n-1} \binom{i}{r} = \binom{n}{r+1}.$$

2.

   (a) Read Pascal's Fourteenth Consequence below and state it as an equality using our $T_{i,j}$ notation.

   (b) Write a careful proof of Pascal's Fourteenth Consequence in full generality. Hint: Follow Pascal's generalizable example (in the text you have in your project from his *Treatise on the Arithmetical Triangle*) as your guide. Or, if instead you wish to use the factorial formula for the values $T_{i,j}$ of the cells in Pascal's triangle that we derived from Pascal's *Problem*, you may do that.

FOURTEENTH CONSEQUENCE

In every arithmetical triangle, of two contiguous cells in the same parallel row the greater is to the lesser as the exponent of the base of the lesser is to the exponent of its perpendicular row.

Let two cells in the same parallel row, F, E, be taken. I say that

F	:	E	::	5	:	2
The greater		the lesser		the exponent of the base of E		the exponent of the perpendicular row of E .

For $E : C :: 2 : 3$.

Therefore $\underbrace{E+C}_{F} : E :: \underbrace{2+3}_{5} : 2$.