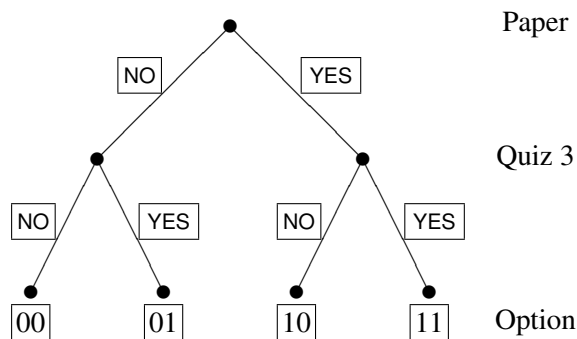# Choose your own adventure course final (by noon Friday June 22th via email).

Refer to the above *decision tree* when deciding on your course final options. You'll have two choices to make: whether or not to write a final paper and whether or not to take the third quiz. Your two decision will naturally lead to four different options, expressed in binary as 00, 01, 10, and 11.

Based on which option you choose, your final course grade will be calculated via the following table (here, HW, A, Qx, and P stand for homework, activity, quiz x, and paper, respectively):

	HW	A	Q1	Q2	Q3	P	Total
00	40%	20%	13%	13%	0%	0%	86%
01	40%	20%	13%	13%	14%	0%	100%
10	40%	20%	10%	10%	0%	20%	100%
11	40%	20%	best 2 of 3, 10% each			20%	100%

Options. Below is a description of the options:

00 You neither write a paper nor take the quiz. This option is not advised. You do the minimal amount of work, but your final grade can be at most an 86%, which *cannot* guarantee you an A in the course.

01 You don't write the paper but take the quiz. If you prefer quizzes to papers, this is your option. All three of your quizzes together make up 40% of your grade, and your don't write a paper.

10 You write the paper but don't take the quiz. If you prefer papers to quizzes and you are more or less happy with your first two quiz scores, then this is your option. Your first two quizzes each make up 10%, and your paper 20%, of your grade.

11 You both write the paper and take the quiz. If you are an overachiever, or really enjoy math, or just prefer papers to quizzes but weren't quite happy with your first two quiz scores, then this is your option. Of your three quizzes, you get to keep the two highest scores, each then make up 10%, and your paper 20%, of your grade.

Paper. If you choose to write a final paper, here are some guideline to follow.

- The final paper should be 2-3 pages type written, 12 pt font, 1.5 line spacing, plus diagrams as needed.

- The final paper will be due at the beginning of the last day of class, Thursday June 28th.

- The final paper should be on one of the following topics. You must email me your topic selection along with your final adventure option by noon Friday June 22nd. In the event that you don't send an email in time, you will be graded according to option 01! I'll be available to meet the following Monday and Tuesday, June 25-26th, to discuss paper topic specifics, answer any questions you might have, and to suggest references. You might think about making an appointment during this time.

  - Ancient number systems. Research some more about ancient number systems. For a few ancient civilizations that we didn't describe in class, identify what kind of system they use (tally, positional, etc.), how they write fractions, and some historical or cultural notes about how or why this system developed. You should include some additional (i.e. non internet) sources.

  - Penn ID numbers. Research the system behind assigning Penn ID numbers. In particular, how is your Penn ID number assigned, are there any check digits, and what are the reasons for the University to choose this particular system. You may have to conduct some interviews to get this information.

  - Cryptography. Research the RSA public key cryptography system, which uses modular arithmetic. Explain how the system works: what the idea is behind it and also how the modular arithmetic is used in encryption and decryption.

  - Traveling salesman problem. Discuss some of the algorithms for solving the traveling salesman problem (TSP). Include discussion of the brute force search algorithm, greedy algorithm, the shortest edge algorithm, the Christofides algorithm, and the insertion algorithm. Choose at least 10 cities, and run each of the algorithms on the resulting complete weighted graph, compare your results with the optimal solution. If you choose US cities, the website
    `members.pcug.org.au/~dakin/tspbb.htm`
    can do much of the work for you.

  - William Morris patterns. William Morris was a 19th century English artist and activist, famous for his decorative tile and wallpaper patterns. Check out a book on William Morris decorative patterns, and analyze at least a dozen wallpaper patterns. Which of the 17 types of wall paper patterns does he utilize and why do you think that's the case?

  - Non-periodic tilings. Research the history and theory of nonperiodic tilings and the Penrose tiling in particular. You may want to discuss the unexpected 5-fold "quasi" symmetry displayed by the Penrose tiling. This is related to the surprising appearance of quasicrystal materials in nature, specifically in an aluminum-manganese alloy, discovered in 1984 by Dan Shechtman.

  - Phyllotaxis. Research the subject of phyllotaxis, or the arrangement of leaves or seeds on a plant. Include a comprehensive description of where Fibonacci numbers and the golden ratio come into the story, and some of the hypotheses (both mathematical and biological) for why.

  - Golden ratio in history and culture. Research the golden ratio's use in a specific historical or cultural context. Ancient Greek art and/or architecture, modern architecture (Le Corbusier), contemporary art, classical and/or contemporary music, are examples. You may also want to survey articles arguing against many of the claims made about the golden ratio's use. You might use
    `www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/`
    as an initial survey and collection of links.

  - Extended or deviant logic. Select a particular *extension* of the system of 1st order logic, such as modal logic, or a deviant logic, such as trivalent logic, and discuss its basic rules (axioms), the "problem" with 1st order logic it's trying to overcome, and its advantages and shortcomings. Choose a few English phrases to translate into 1st order logic (as best as you can) and your choice of logic, that particularly highlight the differences.

  - Write on a topic of your choice as long as you clear it with me beforehand.