

# **Playing at Engineering Education: The Dirty Dozen Puzzle Contest**

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## **Abstract**

Beginning in 2000, the author has run an annual online puzzle contest for engineering students as one of UTA's Engineering Week activities. The goal of developing this tradition has been to show that problem solving can be both fun and profitable. The contest has been humorously dubbed the Dirty Dozen Puzzle Contest from the challenging nature of its thirteen problems. The winner of each year's contest receives a \$1000 scholarship, which also gives in-state tuition for up to three semesters for a non-Texas resident. As a result, approximately 10% of all engineering students participate. This paper provides details of the contest's philosophy and administration, as well as past contest puzzles. Moreover, other engineering schools are invited to participate in an intercollegiate competition.

## **Introduction**

Students learn best when they enjoy doing so. Thus the illusory goal of engineering education has always been to make technical material entertaining. Unfortunately it is usually not. The subject matter is always demanding and frequently dull. Therefore, the author has established the more realistic goal of showing that problem solving can sometimes be both fun and profitable.

Beginning in 2000, he has run an annual online puzzle contest for engineering students as one of UTA's Engineering Week activities. The contest has been humorously dubbed the Dirty Dozen Puzzle Contest from the challenging nature of its thirteen problems. Some of these puzzles are original; others are variations of well-known ones. The thirteen problems are arranged roughly according to difficulty and designed so that most good undergraduate students can get six or seven of them. The contest winner averages 12 correct answers and receives a \$1000 scholarship for his problem-solving skills. The scholarship also gives in-state tuition for up to three semesters where applicable, a waiver that could save a non-Texas graduate student up to \$8000

in tuition beyond the \$1000 scholarship itself. As a result, approximately 10% of all engineering students participate. This paper provides details of the contest's administration and gives a link to both puzzles and answers for 2000-2003. In addition, it invites other engineering schools to participate in an intercollegiate competition.

### **Contest Administration**

The money for the scholarship is raised by the author during the fall semester preceding the February contest. Funds come from both industry and individuals. In previous years The Beck Group, UPS, and TD Industries have provided support. Two weeks before the contest, a two-page poster similar to the 2002 edition shown in Appendix 1 on pages 4-5 is posted around the engineering buildings to announce the contest. The colorful chimpanzee version of the famous Rodin sculpture *The Thinker* attracts students to the posters. It has become the unofficial Dirty Dozen logo. Finally, a week before the contest the UTA student newspaper *The Shorthorn* publishes a short front-page article about the contest as part of its Engineering Week coverage.

The contest itself is administered exactly as stated in the rules. For example, during the 2002 contest, a student would reach pages 6–10 in Appendix 2 after clicking on the link [2002 Puzzle Contest](#) on the IMSE home page and rereading the rules. The author scores the participants' answers over the duration of the contest. He prints all submissions in case of a dispute and also saves the e-mails in a computer file. The winner is awarded the scholarship at the annual Engineering Awards Banquet on the Friday night following the contest. PDF files of the puzzles and answers for the 2000-2003 contests may be found on the IMSE website at the URL in Reference 1.

The issue of collaboration is a significant one for the contest. As previously noted, a winning non-Texas graduate student could save approximately \$8000 in tuition beyond the \$1000 scholarship. This amount is large enough to entice a team of students to submit a single entry under one name with the intent of sharing this sum. For this reason, the author interviews the winner and discusses the solutions (without warning) to check if collaboration might have occurred. In no contest so far has this possibility seemed likely.

### **Intercollegiate Challenge**

The author invites other engineering schools to participate in an intercollegiate competition. Students anywhere could access the UTA puzzles online and submit them to a local coordinator, who would score them. Of course, any local scholarships would be provided by the local engineering school. UTA would provide a rotating trophy for the school with the winning entry. Alternately, each school could have a three-person team in a separate contest with different puzzles. Anyone interested in discussing such a competition for 2004 should contact the author.

## Summary and Conclusions

It is not financially rewarding to solve the mathematical puzzles in the *Scientific American* or *Discover Magazine* puzzle columns, in the “Ask Marilyn” column of *Parade* magazine, on the “Puzzler” segment of the NPR radio show *Car Talk*, or in the “Problems and Solutions” section of *The American Mathematical Monthly*, for example. In UTA’s annual Dirty Dozen Puzzle Contest, however, cleverness can sometimes be profitable. More importantly, the author hopes to encourage playfulness in engineering, to develop problem-solving skills in students, and to illustrate various technical principles.

In particular, a playful attitude can enhance creativity. Physicist Richard Feynman told the story<sup>2</sup> that as an Assistant Professor at Cornell in 1946 he suffered from a complete mental block in his research. His department chairman finally told him to stop being so serious. Forget the pressure. Have fun at research. Play. If hiring Feynman had been a mistake, it was the department’s fault, not Feynman’s. So Feynman vowed to make physics a game. It certainly could not hurt his productivity. Two days later he observed a plate being sailed across a Cornell cafeteria by some student. Watching its wobbly spin, Feynman had an epiphany that led to his winning the Nobel Prize in 1965 for the theory of quantum electrodynamics (QED). While it is doubtful that the Dirty Dozen Puzzle Contest will stimulate such profundity, having fun at one’s profession will surely produce a better engineer.

## References

1. URL: <http://ie.uta.edu/index.cfm?fuseaction=researchdescription&researchid=64&userid=85>.
2. Gleick, James, 1992, *Genius: The Life and Science of Richard Feinman*, Vintage Books, New York.

### H.W. (BILL) CORLEY

Dr. Corley is Professor and Graduate Advisor of the Industrial and Manufacturing Systems Engineering Department at The University of Texas at Arlington. With Ph.D.’s in both Systems Engineering and Mathematics, his research interests include optimization theory, multiple criteria decision making, statistics, network analysis, game theory, fuzzy sets, discrete mathematics, stochastic processes, and functional analysis. Further information can be found at the URL in Reference 1.

## APPENDIX 1

# WIN \$1000 SCHOLARSHIP AND IN-STATE TUITION FOR A YEAR !!



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# RULES AND INSTRUCTIONS

1. Any currently enrolled UTA engineering student (undergraduate or graduate) is eligible except a previous winner of the contest.
2. The puzzles will be placed on the IMSE website <http://ie.uta.edu> at 5:00 p.m. Thursday, February 14, 2002. On the right side of the home page, the link [2002 Puzzle Contest](#) will take you to them.
3. Print the puzzles, which will be in a pdf file, and solve as many as you can.
4. No puzzle will be clarified for any individual, and no partial credit will be given. All parts of a puzzle must be answered correctly (in the required units) to receive credit for its solution. In all matters, the decision of the contest coordinator is final.
5. No collaboration with other persons is permitted. Anyone discovered collaborating will be disqualified, and appropriate action will be taken.
6. Submit only your answers (with your name, graduate or undergraduate status, and major) via e-mail to Dr. Bill Corley at [corley@uta.edu](mailto:corley@uta.edu) so that your submission will have an electronic time assigned to it. Use numerical bullets for your 13 answers, leaving a blank beside the number of a question not attempted. Single space. No attachments will be opened.
7. No student can submit more than one set of answers.
8. No answers will be accepted after 5:00 p.m. Monday, February 18, 2002.
9. The winner will be the student correctly solving the most puzzles (see #4 and #5 above). In case of a tie, the student with the earliest submission will be declared the winner. If someone solves all puzzles correctly, then this information will immediately be put on the IMSE website. The winner will be announced at 5:00 p.m. Tuesday February 19, 2002, on the IMSE website. At that time the answers will be given.
10. The winner will be awarded a \$1000 scholarship (minus taxes) at the Engineering Awards Banquet at 7:00 p.m. Friday, February 22, 2002, in Nedderman Hall. For an out-of-state winner, this scholarship also grants in-state tuition either for Spring and Summer, 2002, or else for all three semesters of the 2002-2003 academic year. The winner chooses the time period. However, if the academic year 2002-2003 is selected, the scholarship money will not be available until Fall, 2002.

**APPENDIX 2****SCHOLARSHIP  
SPONSORED BY****BECK****THE BECK GROUP:  
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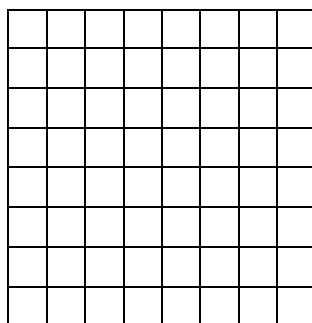
# PUZZLES

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1. Dr. Frank N. Stein of the CSE faculty is teaching a course in fuzzy logic this semester. The eminent AI guru is notorious for his difficult tests, so the students have begged him repeatedly for a multiple choice quiz. Finally, with a devious smile, he agrees. On the next test, he asks the first question in Swahili, which no one can read. However, the following answer choices are in English.
  - (a) All of the below
  - (b) None of the below
  - (c) All of the above
  - (d) One of the above
  - (e) None of the above
  - (f) None of the above

Select the correct answer and submit only the corresponding letter.

2. A bored ME named Jason sits in his TTh 11:00 a.m. – 12:20 p.m. class checking his watch, which is not digital. As he waits impatiently for class to end, Jason formulates the following problem. From exactly noon, how long will it take the minute hand and the hour hand of his watch to be precisely 90 degrees apart for the first time? State your answer in minutes to three decimal places.
3. An EE named Nguyen Li likes to study with scented candles burning. She has two new candles of different scents that have equal lengths but burn at different rates. One is consumed uniformly in four hours, the other uniformly in five hours. If she lights them at the same time, in how many hours will one candle be exactly three times as long as the other? State your answer as a reduced fraction.
4. The nation of Griddonesia consists of eighty-one equally-spaced islands represented by intersections of the lines in the grid below. Each island is connected to all its adjacent islands by horizontal and vertical bridges. There are no diagonal bridges.

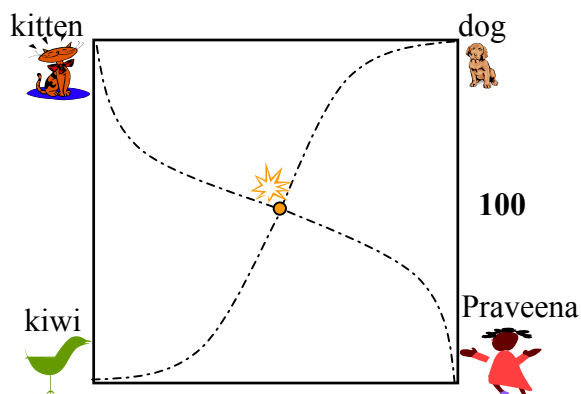


Griddonesia has a presidential election this year. In the nation's presidential politics there are exactly two parties, the Yins and the Yangs. In a presidential election, each eligible Griddonesian can vote for either the Yin or the Yang candidate. For each island, the candidate receiving the most popular votes on the island gets that island's one electoral vote. The candidate with the most electoral votes then becomes president. For this year's election, each island in Griddonesia has exactly 1001 eligible voters.

- (a) The Yin candidate is the incumbent female president. What is the largest number of popular votes that she can receive and still lose the election?
  - (b) The male Yang candidate intends to campaign by car. He will begin and end at the center island with no interim stops there. Using only the bridges, he will proceed from island to island without going to any island more than once (other than the center island). What is the maximum number of islands (with the center one counted exactly once) on which the Yang challenger can campaign during this trip?
5. A small nanotech laboratory is housed in a 38-foot long, 20-foot wide, and 10-foot high rectangular room whose walls are kept "clean" by a tiny dust-eating robot. One morning the dustbug, as it's called, sits halfway up a  $20 \times 10$  end wall, 1 foot from the closest  $38 \times 10$  side wall. On the opposite  $20 \times 10$  end wall, halfway up and 1 foot from the other  $38 \times 10$  side wall, lies a speck of dust. What is the shortest distance in feet to two decimal places that the dustbug can crawl along the room's surfaces to reach this dust?
  6. Five biomedical engineering students decide to meet in the lobby of Nedderman Hall at noon to discuss a class project. Each student, independent of the others, is equally likely to arrive between 11:52 a.m. and 12:04 p.m. What is the probability that at least 3 of the students arrive by noon? Express your answer as a reduced fraction.



7. A materials science student named Chen Feng has developed a new alloy called tico from the elements titanium and cobalt. He stacks 1000 one-inch cubes of tico into a perfect ten-inch cube. Obviously this stack forms 1000 one-inch cubes and 1 ten-inch cube. How many cubes of any size are contained in the  $10 \times 10 \times 10$  stack?
8. Civil engineers George and his wife Laura give a dinner for 5 other married couples. At least one person in each invited couple is acquainted with either George or Laura (or both). During the introductions, no one shakes hands with someone he or she has previously met (including his or her own spouse). After the introductions, Laura realizes that each of the other 11 people shook a different number of hands. Furthermore, no one shook the same person's hand more than once, and no one shook his or her own hand. How many hands did George shake?
9. An orbiting astronaut, an AE graduate from UTA named Naresh, simultaneously fires two projectiles A and B along two straight-line trajectories forming an angle of 100 degrees. Assume that the projectiles instantaneously attain a constant velocity, with A traveling twice as fast as B. If they are separated by a distance of 334 miles after 4 minutes, how fast is B traveling in miles per hour to the nearest tenth?
10. One spring afternoon an environmental engineering student named Praveena takes her dog and flightless kiwi bird to Square Park, which has 100-meter sides. When she is ready to leave, it so happens that Praveena, her two pets, and a stray kitten are standing at the four corners of Square Park as shown in the figure below. Praveena sees her dog's reaction to the kitten and begins running directly toward her dog. At that exact instant, the dog runs directly toward the kitten, the kitten runs directly toward the kiwi, and the kiwi runs directly toward Praveena for protection. Assume that Praveena, the dog, the kitten, and the kiwi instantaneously attain the same constant running speed. Hence, they reach the center of Square Park at precisely the same time, each following a curved path. To two decimal places, how many meters does each run?



11. A CSE student has developed a program to randomly generate  $(x, y)$  points in the first quadrant of a Cartesian coordinate system. Determine the probability that such a randomly generated point lies below the curve  $y = e^x$ . In other words, what portion of the first quadrant lies below  $y = e^x$ ? Round off to three decimal places.
12. Two fraternal twins Bob and Sue, both IE students, inherit a ranch from their West Texas grandfather. Both have taken engineering economy, so they decide to do some low-tech wheeling and dealing. They sell a herd of cattle and receive as many dollars for each animal as there are cattle in the herd. Using all the proceeds of the sale, they buy a flock of sheep at \$10 a head and then a less expensive lamb with the rest of the money (less than \$10). Finally, the twins divide up the sheep and the lamb between them. For each twin to receive the same monetary value, Bob gets an extra sheep, while Sue gets both the lamb and her brother's old calculator. What is the value of this calculator in dollars rounded off to the nearest cent?
13. (Remember, it's a dirty dozen.) A chemical engineer is taking an EE course in information theory, where he's currently studying codes. For a homework assignment he numerically encrypts a seven-word sentence in the following table.

<b>5</b>	<b>88</b>	<b>23</b>	<b>8</b>
<b>53</b>	<b>95</b>	<b>16</b>	<b>8</b>
<b>62</b>	<b>18</b>	<b>73</b>	<b>60</b>
<b>16</b>	<b>1</b>	<b>18</b>	<b>15</b>

Decode this message. If your answer is correct, you should know immediately.