Mπ

The Mathematics and Physics Institute **NEWSLETTER**

Director: Richard Waring
Mathematics Coordinator: Richard Delaware

December 1, 1991

Vol. 6, No. 3

OPEN HOUSE 1991

A total of sixty seven people attended our 1991-92 open house. This included parents, school administrators, and students, teachers and staff of the MPI. The thirty six parents in attendance were able to see their sons or daughters in action. Some solved calculus problems or explained problem solving sessions recorded on video tape. Some performed and explained a number of physics demonstrations which included an air track, free fall & projectile motion, collisions and holograms. Others were involved with the physics laboratory where they explained no fewer than twelve different physics experiments. A new feature of this year's open house was the calculus lab using P.C.'s and the DERIVE program. Students were able to plot graphs of functions, take derivatives and display them in a small fraction of a second. Much of this work is too difficult or time consuming to do by hand.

I want to thank our guests who braved the inclement weather along with the students, teachers and staff who worked very hard in preparing for and participating in our seventh annual open house. We hope you all had some fun and enjoyed the afternoon.

Richard Waring

CALCULUS LABS REPORT

This report concerns technical lessons learned:

1) Next year we'll spend 1-2 entire weeks learning and practicing with DERIVE, and any other software we use. Even at this late date a good third of our students aren't at ease with the programs. Part of the problem was a weak beginning--our naive hope that two 50 min. introductory sessions would be enough.

2) Students need at least one assignment using the software EACH WEEK to maintain their skills in the face of all the other activities pressing upon high school seniors.

3) Each of the five high school sites must themselves provide access to the software on appropriate machines. Even though the PC lab we use is open until 9 pm M-F, some students do not have transportation and cannot return to the MPI to use it.

ENRICHMENTS

FOLLOW UP

On Oct. 18, when Ed Kiker spoke to us on Moon Base Design, he began his argument for a moon base by reminding us that our global need for energy will be the force that drives us to the moon, and elsewhere. The only two long term sources of energy are solar power and nuclear fusion, and it so happens that Helium 3, a prime fuel for fusion, is abundant in the moon's crust. On the other hand, if we opt for solar power, building the necessary collectors would be much easier on the moon, with its abundant resources and one-sixth gravity. He then examined many of the details of moon base life, and even mentioned two large companies interested in building on the moon: Hilton Hotels, and McDonalds!

Some student responses were:

--Definitely the best presentation we've had thus far this year.

--He explained something that I thought I would not see in my lifetime; the possibility blew my mind.

--It was very enlightening and interesting. It seemed like something from a science fiction book.

UPCOMING

On Dec. 13, Frank Booth, a chemist with the Kansas City Regional Crime Center will be our guest again to speak on SCIENCE IN THE CRIME LAB. His discussion of actual crime scene investigations, blood stains, bullets, DNA, etc. never fails to engage us.

The seventh annual MPI PANEL DISCUSSION and REUNION will be held on Jan. 3, in Room 207 (where the library used to be) on the Truman Campus. We'll have an 8 person panel of former MPI students, with time for donuts and talk.

On Jan. 17, Dr. David Wieliczka from UMKC's Physics Dept. will speak on LASERS AND HOLOGRAMS, a perennial favorite.

Jan. 31 will see a visit from Dr. David Frayer, Chairman of the Dept. of Anthropology at KU. The talk will be: AUSTRALOPITHECUS: AFRICA AND THE ORIGIN OF HUMANS. His discussion of Neandertal man last year was fascinating, and this new subject about the early evolution of our species will no doubt also be enthralling.

PAST STUDENTS WRITE TO US

PAT LIANG (86-87)
(Medical School)

"Greetings from Central Indiana! I just received the October 1, 1991, issue of Mπ and enjoyed reading the letter written by my classmate, Cindy Gillespie. I occasionally wonder how some classmates are doing since I can't ever seem to attend the "College Panel Enrichment/Reunion", as of late. I want to take some time from my busy schedule to let you all know what I am currently doing and where I am... Well, here goes!

The Indiana University School of Medicine (IUSM) is a family legacy: my father and uncle both graduated from there and it was once a dream for me. Now, it is <u>reality</u>. I am currently a first year student in the combined MS/MD program at IUSM where I am pursuing a Master's degree in Pharmacology and the Doctorate in Medicine.

My father and uncle always told me how tough medical school is and let me tell you...if you think college is hard, medical school is much worse. Time management skills I learned at MPI are being stretched to the limit here. Days begin with leaving Nobleville in time to be at a 7:30 class. I study between classes. I leave campus about 5:00 in the afternoon and go home to eat and study until about midnight or beyond if necessary. I study an average of six-seven hours a day including Saturdays and Sundays. This experience has taught me to budget time to where I can still have time to myself every so often, to keep from going insane and burning out. It is a program that is working because I am doing very well in classes thus far. This increases confidence in myself not just as a student, but as a professional Without this, I don't think I would be doing as well...

Words of wisdom: The road which we travel to reach our goals is not easy. It's filled with hills and curves to slow things down or stop them, but keep the positive, straight path in mind. Keep your goals in mind and work hard to attain those goals. Take advantage of advancement opportunities. Above all, <u>BELIEVE:</u>

HAVE FAITH IN YOURSELF!

Thanks for all you did to help me on my path to medical school. Your program helped me realize what I had to do to achieve levels of education necessary to become the doctor I always dreamed of becoming."

MORE 1991-92 STUDENT IMPRESSIONS

"Going to the Institute has been great. Although the classes are challenging, the teachers work with you to help you understand. They give you respect and are always fair. I am very glad I chose to be a part of something that I have personally found so great."

Lorain Gosling
Truman High School
Independence School District

"There is so much to do but so little time to do it in! Take the time that you do have and use it wisely! The main thing you have to do is study outside of MPI. Ask questions in class in order to go over problems outside of class. Don't give up...it will come to you eventually!"

Janelle McRae
Van Horn High School
Kansas City School District

"Senioritis is just beginning to set in at this point for most of us here at the Institute. Although it's a struggle for me to keep my brain to the grindstone, I feel that my study habits have greatly improved."

Laura Dilley
Wm Chrisman High School
Independence School District

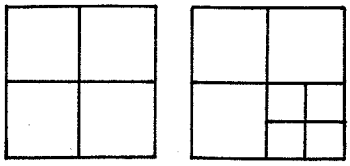
"MPI is (a) basic way (to) help me understand how I (should) work at college. MPI is "fun"--class, lab and problem solving. The problems sometimes are easy to me, but most of them make me crazy by (being) hard. So, I have to work hard because my English is not very (good) and I always remind myself "you can never (have) success unless you try."

Nha Truc Nguyen
Northeast High School
Kansas City School District

A SOLUTION TO MATHEMATICS CHALLENGE #20

Recall the problem statement:

By drawing line segments inside a square parallel to the sides, we can partition a square into 4 smaller squares, or 7 smaller squares, as illustrated below.



For WHICH integers among 2, 3, 4, ..., 100 can we partition a square in this way into that number of smaller squares? EXPLAIN your answer.

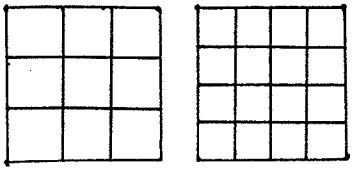
[From the AMP-LINE Newsletter, Winter 1991]

SOLUTION:

Let n stand for the number of subsquares into which we can partition a square using the procedure outlined above.

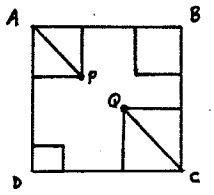
First notice that if we have a square partitioned into k subsquares, we can immediately get a partition into k+3 subsquares, by dividing any one of the subsquares into 4 smaller squares as illustrated above. So, a square can be partitioned into any of n = 4, 7, 10, ..., 97, 100 subsquares.

Next, we can partition a square into 9 congruent subsquares in the obvious way, using two vertical and two horizontal lines. (See below) If we group 4 of the subsquares in one corner into a single square, we get a partition of the original square into 6 subsquares. So, a square can be partitioned into any of n = 6, 9, 12, ..., 96, 99 subsquares.



Similarly, we can partition a square into 16 congruent subsquares (see above), and group 9 of the subsquares in one corner into a single square, to get a partition of the original square into 8 subsquares. So, a square can be partitioned into any of n = 8, 11, 14, ..., 94, 95, 98 subsquares.

The only integers left are 2, 3, and 5. Now, ANY partition of a square has a subsquare in each corner, hence contains a minimum of 4 subsquares. So, 2 or 3 subsquares is impossible. As for the n=5 case, consider a square ABCD with subsquares in each corner, and let AP, CQ be the diagonals as shown:



If P=Q, we have symmetry about the line AC, and 5 squares cannot be fitted into this symmetric diagram.

If P≠Q, then the region outside the 4 corner squares (the 5th region) is certainly not square.

Thus, only n=4, and n=6, ..., 100 satisfy the conditions of the problem.

A SOLUTION TO PHYSICS CHALLENGE #11

Recall the problem statement:

If you had a stack of new $100 bills as high as Mt. Everest, how much would this stack be worth (in dollars)?

[The object here is to estimate the amount to the nearest power of 10 (order of magnitude.)]

SOLUTION:

A stack of new bills one inch high would certainly contain more than 100 (10^2) bills but much less than 10,000 (10^4) bills so a good estimate would be 10^3 bills or $10^3(10^2)=10^5$ dollars/in. A stack 1 ft. tall would contain approximately 10^6 dollars/ft. Mt. Everest is certainly higher than 1,000 ft. (10^3) but much less than 100,000 ft. (10^5) so a good estimate would be 10,000 ft. (10^4). Thus the number of dollars in a stack of $100 bills as high as Mt. Everest would be approximately (10^5 dollars/ft.)(10^4 ft.) = 10^9 dollars.

MATHEMATICS CHALLENGE #21

A student thinks of five numbers. She adds them in pairs to get the sums 14, 18, 22, 24, 25, 29, 31, 33, 35, and 39. Find the five numbers.

[From the AMP-LINE Newletter, Spring 1990.]

PHYSICS CHALLENGE #12

How many revolutions would a 14 inch (diameter) tire make during a trip across the continental U.S.?

[The object here is to estimate the amount to the nearest power of 10 (order of magnitude.)]

Editor/Writer: Richard Delaware

Contributing Writer: Richard Waring

The MPI Newsletter is published five times a year on the first of the month during the months of August, October, December, February, and April at The Mathematics and Physics Institute, 600 W. Mechanic, Independence, MO 64050, phone (816) 235-1272. Please address all correspondence concerning this newsletter to 'MPI Newsletter'.