Think it Over

This section of Resonance is meant to raise thought-provoking, interesting, or just plain brain teasing questions every month, and discuss answers a few months later. Readers are welcome to send in suggestions for such questions, solutions to questions already posed, comments on the solutions discussed in the journal, etc. to Resonance, Indian Academy of Sciences, Bangalore 560 080, with "Think It Over" written on the cover or card to help us sort the correspondence. Due to limitations of space, it may not be possible to use all the material received. However, the coordinators of this section (currently A Sitaram and R Nityananda) will try and select items which best illustrate various ideas and concepts, for inclusion in this section.

From : S K Ghoshal, Indian Institute of Science, Bangalore.

Discussion of question raised in *Resonance*, Vol 1, No 4.

1 Self-Copying Program

Can you write a program in C which prints its own source code? How about writing such a program in other languages like Fortran? This is one solution that opens the file (the file can have any name) containing the source code and prints out the program character by character. The program has been verified to work correctly on a number of architectures, C compilers and operating systems.

/* This program, when compiled and executed, prints out its own source code */

Figure 1: A C program that prints its own source code

```
#include <stdio.h>
main() {FILE *fp; int c; fp=fopen(_ _FILE_ _,"r"); if (fp=
= NULL){fprintf(stderr,"Unable to open% \n\n",_ _FILE_
_);exit(1);} while ((c=fgetc(fp)) !EOF) putchar(c);}
```

2 To Switch, or not to Switch

You are a winner in the preliminary round of a TV game show and the host gives you a chance to win the super prize: a fancy car. You are shown three doors numbered 1, 2 and 3. Behind one of them is the car. You are asked to choose a door. If the chosen door is the one hiding the car, you win the prize.

You choose, say, door number 2. The host of the show then says: "First, let us see what is behind door number 1" He opens it and you see that the car is not there. Now he asks you: "Do you want to stay with your initial choice (number 2), or would you like to switch to door number 3?" What would you do?

Does this have a familiar ring to it? May be the 'Prisoner's dilemma' has the same logic.

Answer: As in the 'Prisoner's dilemma', we need to model the behaviour of the game show host before we can tell whether the player should switch or not.

If our model for the game show host is that he doesn't know the location of the car and he just picks one of the two remaining doors at random and opens it, then finding that the door so opened doesn't have the car behind it doesn't give any information intuitively - and thus it doesn't matter whether the player switches or not. To see this, let A denote the event "the car is behind the door chosen", B denote the event "the car is behind the door opened by the host" and C denote the event "the car is behind the third door". Then under the model made above, $P(A)=1/3$, $P(B)=1/3$ and $P(C)=1/3$. Further, writing D to be the complement of B, one has $P(A$ and $D)=1/3$, $P(C$ and $D)=1/3$ and hence $P(A|D)=1/2$; $P(C|D)=1/2$.

However, if one has seen the show in the past and has observed

that the game show host always gives the player this choice and always the door opened by him doesn't have the car behind it, then it is reasonable to assume that he knows where the car is and always opens a door which doesn't have the car behind it. In this case, the allocation of probabilities made above is not valid. Here again $P(A)=1/3$, and writing E as the complement of A, $P(E)=2/3$. A moment's reflection would convince the reader that the event that one gets the car by switching is the same as the event E! Thus one should switch and increase one's chance of winning the car.

So, in either of the cases considered above, one won't be worse off if one switches, and in the second case, one would indeed be much better off.

On the other hand, if one has observed in the past that the game show host didn't give the choice always to the player, and whenever he gave the choice, the car really was behind the door originally chosen by the player, then clearly one should never switch.

So the conclusion in this example is that the problem as stated doesn't have a single answer. In the language of mathematics, it is ill posed. To answer it, we must model the behaviour of the game show host. The model could be based on our past observations or on our intuition.

From : J V Shreyas, a II PUC student from Bangalore, sends us the following very interesting questions relating to the frictional forces on the wheels of a bicycle. These may help to enliven classroom discussions of otherwise dry topics.

? Which Direction Does the Frictional Force Act

Consider a bicycle moving from the West to East. What is the frictional force acting on each wheel, when

a) The cycle is being pedalled? and

b) When it is moving freely (without being pedalled)?

! Factors Stabilizing the Ionic Hydrocarbon, $C_{115}H_{90}$

Photon Rao,
Answer to the question posed in the March 1996 Issue of *Resonance*

The first example of an ionic hydrocarbon was mentioned in the 'Think It Over' section of *Resonance*, 1996, 3, pg 115. What factors prevent the formation of a C–C single bond between the carbocation and carbanion components of A?

There are both thermodynamic and kinetic reasons which let the compound remain ionic. The two ionic units are individually stabilized by delocalization. A cyclopropenium carbocation is a Hückel aromatic system. Further delocalization of the positive charge in the electron rich, non–benzenoid aromatic azulene moiety provides added stability to it. Similarly, the carbanion is highly delocalized, especially since the negative charge would make the cyclopentadienyl units aromatic. The substituents play another role to keep the ionic pieces apart. They are bulky and act as a shield preventing C–C bond formation.

A

Believe me, Papa! it is an
OPTICAL ILLUSION !