Write a program to show that randomly selected bits of random numbers generated by `rand()` function is also random and that the probability of 1 is approximately equal to the probability of 0. In order to do that generate N random numbers (N is selectable by user), count the number of ‘1’s in each number and find the total number of ‘1’s. If it is approximately half of the total number of bits, than our hypothesis holds. So, after generating N numbers, display the number of 1’s and its percentage. Print also the message “hypothesis holds” if it does according to your own measures.

Output should look like:

Number of 1’s = 454 out of 900
Percentage of 1’s = 50.44 percent (hypothesis holds)

Answer:

```c
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    int N, i, N_oness=0, Nmx=0; unsigned int rx, Mask; float oran;
    for(Mask=1;Mask!=0;Mask<<=1) if(RAND_MAX&Mx) Nmx++;
    printf("Enter N: "); scanf("%d", &N);
    for(i=0;i<N;i++){
        rx = rand();
        for(Mask=1;Mask!=0;Mask<<=1) if(rx&Mx) N_oness++;
    }
    printf("Number of l’s = %d out of %d\n", N_oness, N*Nmx);
    oran = (float)N_oness/(float)(N*Nmx);
    printf("Percentage of l’s = %f percent ", 100*oran);
    if((oran>0.45)&&(oran<0.55)) printf("(hypothesis holds)\n");
    printf("\n");
    return 0;
}
```
**Possibility of additional points:** Let us assume that $N_X$ is the number of 1’s in a randomly generated number. Calculate and display the histogram values of the distribution of $N_X$. That is the percentage of random numbers that has no 1, the percentage of random numbers that has single 1, the percentage of random numbers that has two 1’s, ..., the percentage of random numbers that has all 1’s. These will add 20 points to your next assignment. Be careful, however. If you include code for this operation and it does not work then your grade will be halved.

Histogram output:

1 : 1.1
2 : 0.9
3 : 1.2
...
16 : 2.0
...
31 : 1.2
32 : 1.1

(if `rand()` generates 32 bit integers, of course)

**Answer:**

```c
#include <stdio.h>
#include <stdlib.h>

int main(void){
    int N, i, N_ones=0,r=0,Nmx=0,Nhit;
    unsigned int rx, Mask;
    for(Mask=1;Mask!=0;Mask<<=1) if(RAND_MAX&Mask) Nmx++;
    printf("Enter N: "); scanf("%d", &N);
    for(r=0;r<Nmx;r++){
        srand(0);
        Nhit = 0;
        for(i=0;i<N;i++){
            rx = rand();
            N_ones = 0;
            for(Mask=1;Mask!=0;Mask<<=1) if(rx&Mask) N_ones++;
            if(N_ones==r) Nhit++;
        }
        printf("%2d : %f\n",r+1,(float)Nhit/(float)N);
    }
    return 0;
}
```