First Project for Math 377, fall, 2003
Part 1: due Friday, September 26

This portion is worth 25% of the first project grade

The following *Mathematica* program will enable you to calculate the partial sums of a rearranged alternating harmonic series in which you take the first r positive summands followed by the first s negative summands and then alternate: the next r positive summands followed by the next s negative summands.

```
rearrange[r_, s_, iterations_] := Module[{}, Clear[summand];
    summand[k_] :=
      Simplify[Sum[1/(2*k*r - 2r - 1 + 2i), {i, r}] -
          Sum[1/(2*k*s - 2s + 2i), {i, s}]];
    Return[NSum[summand[k], {k, iterations}]]]
```

For example, if $r = 1$ and $s = 2$, this would return the partial sums of the series

$$1 - \frac{1}{2} - \frac{1}{4} + \frac{1}{3} - \frac{1}{6} - \frac{1}{8} + \frac{1}{5} - \frac{1}{10} - \frac{1}{12} + \cdots. \tag{1}$$

The command `rearrange[r,s,n]` returns a list of the first $(r + s) \cdot n$ partial sums. This program will work up to about `iterations` $= 10^7$, at which point you can trust the first seven digits to the right of the decimal.

The Inverse Symbolic Calculator (ISC), located at
`http://www.cecm.sfu.ca/projects/ISC/ISCmain.html`,
takes a decimal and returns the exact numbers (like $\log 2$) that agree with that decimal to the number of places given. Use the ISC to find the probable limit of `rearrange[n,1,2]`.

Given any pair of positive integers, (r, s), there is a formula for the limit of `rearrange[n,r,s]`. Using `rearrange[n,r,s]` and the ISC, see if you can guess the formula.

Keep track of your experiments and then write a description of what you tried, what you discovered, what you believe to be the case, what you tried to prove and any cases that you were able to prove.