(1) Equating RZF & IZF - Rederived 24/10/2014

29 March Saturday — 29-03-2014

$$\frac{Z_1(s)\det(I - Aq_1^{-s} + q_1^{1-2s} I)}{(1+q^{-s})^{|V|-|E|}} = (1-q^{-s})^{|V|-|E|}$$

$\Rightarrow$

$$\frac{\left(Z_1(s)\det(I - Aq_1^{-s} + q_1^{1-2s} I)\right)^{\frac{1}{|V|-|E|}}}{(1+q_1^{-s})^{\frac{|V|-|E|}{|V|-|E|}}} = (1-q^{-s})$$

$$\frac{(1+q_1^{-s})}{Z_1(s)\det(I - Aq_1^{-s} + q_1^{1-2s} I)^{\frac{1}{|V|-|E|}}} = \frac{1}{(1-q_1^{-s})}$$

For all prime regular graph products in LHS = RZF

30 Sunday — Amavasya, 30-03-2014

$$\frac{(1+q_1^{-s})(1+q_2^{-s})\ldots}{Z_1(s)Z_2(s)\ldots(I - Aq_1^{-s} + q_1^{1-2s} I)^{\frac{1}{|V|-|E|}}(I - Aq_2^{-s} + q_2^{1-2s} I)^{\frac{1}{|V|-|E|}}\ldots} = RZF = \frac{1}{(1-q_1^{-s})}\frac{1}{(1-q_2^{-s})}\ldots$$

If RHS = 0

then $(1+q_1^{-s})(1+q_2^{-s})\ldots = 0$

February 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | |

$s = a+ib$ is a zero of RZF in RHS. (2)

31-03-2014 Telugu New Year's Day — March Monday 31

$\Rightarrow$ for some $s$ and some prime $q_t$

$$(1+q_t^{-s}) = 0$$

$$-1 = q_t^{-s}$$

$$q_t^{s} = -1$$

$$q^{a+ib} = -1$$

$$q^{a} q^{ib} = -1$$

$$q^{ib} = \frac{-1}{q^a}$$

$$e^{ib\log q} = \frac{-1}{q^a}$$

$$n\pi = -b\log q$$

$$n = \frac{-b\log q}{\pi}$$

$$\cos\left(b\log q - \frac{b\log q}{2}\right) = \frac{-1}{q^a}$$

$$\cos\left(\frac{b\log q}{2}\right) = \frac{-1}{q^a}$$

$$\cos\left(b\log q + (2n+1)\tfrac{\pi}{2}\right) = \frac{-1}{q^a}$$

$$\cos\left(b\log q + \left(\frac{-2b\log q}{\pi}\times\frac{\pi}{2} + \frac{\pi}{2}\right)\right)$$

$$\cos(b\log q) + i\sin(b\log q) = \frac{-1}{q^a}$$

$Im()$:

$$b\log q + n\pi = 0$$

$$\cos(b\log q + (2n+1)\tfrac{\pi}{2}) = \frac{-1}{q^a}$$

$$\cos\tfrac{\pi}{2} = \frac{-1}{q^a}$$

$$\frac{-1}{q^a} = 0$$

$$q^a = \infty$$

April 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | | | |

Continued from 31/3/2014 (3)

3 April Thursday — 03-04-2014 ★ Kritikai

$$b\log q + n\pi = 0$$

$$\frac{b\log q}{\pi} = -n$$

$$\cos\left(b\log q + (2n+1)\tfrac{\pi}{2}\right) = \frac{-1}{q^a}$$

$$\cos\left(b\log q + \left(\frac{2b\log q}{\pi}+1\right)\tfrac{\pi}{2}\right) = \frac{-1}{q^a}$$

$$\cos\left(b\log q - b\log q + \tfrac{\pi}{2}\right) = \frac{-1}{q^a}$$

$$\cos\left(\tfrac{\pi}{2}\right) = \frac{-1}{q^a}$$

$$0 = \frac{-1}{q^a} \qquad \boxed{q^a = \infty}$$

$\Rightarrow a = \infty$

If denominator is infinity

$$[Z_1 Z_2 \ldots \det()\det()\ldots]^{\frac{1}{|V|-|E|}} = \infty$$

or $[Z_1 Z_2 \ldots \det()\det()\ldots]^{|E|-|V|} = 0$

March 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 31 | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |

(4)

04-04-2014 — April Friday 4

$\Rightarrow Z_1 Z_2 \ldots \det()\det() \ldots$

25/10/2014 If RH is true:

$$q^{ib} \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$ for some $q$-regular graph ($q$ prime)

$$e^{ib\log q} \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$

$$\cos b\log q + i\sin b\log q \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$

$$\sin(b\log q + n\pi) = 0$$

$$b\log q = -n\pi$$

$$n = \frac{-b\log q}{\pi}$$

$$\cos\left(b\log q + (2n+1)\tfrac{\pi}{2}\right) \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$

$$\cos\left(b\log q + \left(\frac{-2b\log q}{\pi}\times\frac{\pi}{2} + \frac{\pi}{2}\right)\right) \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$

$$\cos\left(\tfrac{\pi}{2}\right) \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$

$$0 \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$

May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

5

$$q^{a+ib} \le \frac{q \pm \sqrt{q^2-4q}}{2}$$

$$q^{a+ib} \le \frac{\sqrt{q}(\sqrt{q}) \pm \sqrt{q(q-4)}}{2}$$

$$q^{a+ib} \le \frac{\sqrt{q}\left(\sqrt{q} \pm \sqrt{q-4}\right)}{2}$$

$$\frac{q^{a+ib}}{q^{1/2}} \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$

$$q^{a-\frac{1}{2}+ib} \le \frac{\sqrt{q} \pm \sqrt{q-4}}{2}$$



$$\left(a-\frac{1}{2}+ib\right)\log q \le \log\left(\frac{\sqrt{q} \pm \sqrt{q-4}}{2}\right)$$

$$\left(a-\frac{1}{2}+ib\right) \le \frac{\log\left(\sqrt{q} \pm \sqrt{q-4}/2\right)}{\cancel{2}\log q}$$

~~RHS (Im())~~ $\ne$ ~~$a < \frac{1}{2}$~~

$a < \frac{1}{2}$ For $q < 4$ $(2, 3)$

above has imaginary part

March 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 31 | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |



$\boxed{q=2}$

6

~~$a-\frac{1}{2}+ib \le \frac{q \pm \sqrt{q-4}}{2\log q}$~~

~~$\le \frac{2 \pm i\sqrt{2}}{2\log q}$~~

$$\left(a-\frac{1}{2}+ib\right)\log q \le \log\left[\frac{\sqrt{q} \pm \sqrt{q-4}}{2}\right]$$

$$a-\frac{1}{2}+ib \le \frac{\log\left(\frac{\sqrt{q} \pm \sqrt{q-4}}{2}\right)}{\log q}$$

$\boxed{\text{if } q = 2}$:

$$a-\frac{1}{2}+ib \le \frac{\log_2\left(\frac{\sqrt{2} \pm i\sqrt{2}}{2}\right)}{\log_2 2}$$

$$\boxed{a-\frac{1}{2}+ib \le \log\left(\frac{1 \pm i}{\sqrt{2}}\right)}$$

$\boxed{\text{if } q = 3}$:

$$\boxed{a-\frac{1}{2}+ib \le \frac{\log\left(\frac{\sqrt{3} \pm i}{2}\right)}{\log 3}}$$

May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |



For $q \ge 5$

7

$$a-\frac{1}{2}+ib \le \frac{\log\left[\frac{\sqrt{q} \pm \sqrt{q-4}}{2}\right]}{\log q}$$

$$a-\frac{1}{2} \le \frac{\log\left[\frac{\sqrt{q} \pm \sqrt{q-4}}{2}\right]}{\log q}$$

$$a \le \frac{\log\left[\frac{\sqrt{q} \pm \sqrt{q-4}}{2}\right]}{\log q} + \frac{1}{2}$$

$$q^{s} + q^{1-s} \le q$$

$$q^{s} + \frac{q}{q^{s}} \le q$$

$$q^{2s} + q \le q^{s+1}$$

$$q^{2s} + q - q^{s+1} \le 0$$

March 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 31 | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |

8 (∵) Re-Re derived differently [25/10/2014 12:45 p.m



$$q^{2a+2ib} + q - q^{a+1+ib} \le 0$$

$$e^{(2a+2ib)\log q} + q - e^{(a+1+ib)\log q} \le 0$$

$$e^{2a\log q} \times e^{2ib\log q} + q - e^{(a+1)\log q} \times e^{ib\log q} \le 0$$

$$\boxed{e^{2a\log q}\left(\cos(2b\log q) + i\sin(2b\log q)\right) + q + e^{(a+1)\log q}\left(\cos b\log q + i\sin b\log q\right) \le 0}$$

Re()

$$e^{2a\log q}\cos(2b\log q) + q + e^{(a+1)\log q}\cos b\log q \le 0 \quad -(1)$$

Im()

$$e^{2a\log q}\sin(2b\log q) + e^{(a+1)\log q}\sin b\log q \le 0 \quad -(2)$$

Removing e;

Re()

$$q^{2a}\cos(2b\log q) + q + q^{(a+1)}\cos b\log q \le 0$$

Im()

$$q^{2a}\sin(2b\log q) + q^{(a+1)}\sin b\log q \le 0$$

May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

Dividing Real and Imaginary (9)

10-04-2014

10 April Thursday

$$q^{2a}\sin(2b\log q) = -q^{(a+1)}\sin b\log q$$

$$q^{2a}\cos(2b\log q)+q = -q^{(a+1)}\cos b\log q$$

$$\boxed{\frac{q^{2a}\sin(2b\log q)}{q^{2a}\cos(2b\log q)+q} = \tan b\log q} \quad -(3)$$

if RH is true $a=\tfrac{1}{2}$ for all $s=a+ib$

From (3) $q^{2a}=q$

$$\boxed{\frac{q\sin(2b\log q)}{q\cos(2b\log q)+q} = \tan b\log q} \quad -(4)$$

$$\boxed{\frac{\sin(2b\log q)}{\cos(2b\log q)+1} = \tan b\log q} \quad -(5)$$

March 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 31 | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |

$$e^{ix} = \cos x + i\sin x \quad (10)$$

11-04-2014

April Friday 11

$$e^{ix}\times e^{ix} = (\cos x + i\sin x)^2$$

$$e^{i2x} = \cos^2 x + 2i\sin x\cos x + \sin^2 x$$

$$\cos 2x + i\sin 2x = \cos^2 x - \sin^2 x + i(2\sin x\cos x)$$

$$\sin 2x = 2\sin x\cos x$$

$$\sin(2b\log q) = 2\sin(b\log q)\cos(b\log q)$$

$$\cos(2b\log q) = \cos^2 b\log q - \sin^2 b\log q$$

From (5)

$$\frac{2\sin(b\log q)\cos(b\log q)}{\cos^2 b\log q - \sin^2 b\log q + 1} = \tan b\log q = \frac{\sin b\log q}{\cos b\log q} \quad -(6)$$

$$\frac{2\cos(b\log q)}{\cos^2 b\log q - \sin^2 b\log q + 1} = \frac{1}{\cos b\log q} \quad (7)$$

$$\frac{2\cos^2(b\log q)}{\cos^2 b\log q + \cos^2 b\log q}$$

May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

(11)

12-04-2014

12 April Saturday

$$\frac{2\cos^2(b\log q)}{2\cos^2(b\log q)} = 1$$

$\Rightarrow a=\tfrac{1}{2}$ for all $s=a+ib$

from $\det(I - Aq^{-s} + q^{1-2s}I) = 0$

and using $q^s + q^{1-s} \le q$

(or) $q^{2s} + q - q^{s+1} \le 0$

$\boxed{\text{Pages } 8,9,10,11}$ 9/4/2014 to 12/4/2014

Assumption of $a=\tfrac{1}{2}$ for all $s=a+ib$ (non-Ramanujan graphs) doesn't give any contradiction.

K. Shrinivasan.

13 Sunday

Mahaveer Jayanthi, 13-04-2014

Ramanujan graphs have RZF as zeros

for $a\neq\tfrac{1}{2}$ : $\dfrac{q^{2a}\sin(2b\log q)}{q^{2a}\cos(2b\log q)+q}$

would not be equal to RHS as $q$ would not be common in num & denom

March 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 31 | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |

For numerator product $= 0$. (12) (page 1 29/3/2014)

14-04-2014

Tamil New Year's Day, Dr.Ambedkar Jayanthi, Pournami

April Monday 14

$1+q^{-s} = 0$ for some $s=a+ib$

when RZF in RHS is zero.

$$q^{-s} = -1$$

$$q^{s} = -1$$

$$q^{a+ib} = -1$$

$$e^{(a+ib)\log q} = -1$$

$$e^{a\log q}\times e^{ib\log q} = -1$$

$$e^{a\log q}(\cos b\log q + i\sin b\log q) = -1$$

$$e^{a\log q}\cos b\log q = -1$$

$$e^{a\log q}\sin b\log q = 0$$

$$\tan b\log q = 0$$

$\Rightarrow b=0$ or $\log q = 0$ both are incorrect. Thus numerator never vanishes.

May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

Thus denominator product of (13)



Ihara identities for all prime regular graphs $\Rightarrow \infty$ and only $a = \frac{1}{2}$ satisfies it for non-ramanujan graphs. Thus Riemann Hypothesis is TRUE (or is it?)

K. Shrinivasan
25/10/2014 1pm.

March 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 30 | 31 | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | 29 |



May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |



$$RZF = \left[ \frac{\left(Z_1 \times \det\left(I - Aq_1^{-s} + q_1^{1-2s} I\right)\right)}{\left(1+q_1^{-s}\right)} * \frac{\left(Z_2 \times \det\left(I - Aq_2^{-s} + q_2^{1-2s} I\right)\right)}{\left(1+q_2^{-s}\right)} * \right]^{\frac{|V|-|E|}{|E|-|V|}}$$

If $|V| > |E|$

Number of edges of a $q$ regular graph is

$$\frac{|V| \times (|V|-1)}{2}$$

$$\begin{array}{c c} & V \\ \checkmark & \begin{bmatrix} q\,1's \\ q\,1's \\ q\,1's \\ \vdots \end{bmatrix} \end{array}$$

$|E| = |V| \times q - [\,|V| + \quad]$

~~Regular~~

$q$-regular graph with $|V|$ vertices is of size ($|E|$) $\frac{q|V|}{2} = |E|$ (Handshake Lemma)

February 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | | | 1 |
| 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| 16 | 17 | 18 | 19 | 20 | 21 | 22 |
| 23 | 24 | 25 | 26 | 27 | 28 | |

$$\frac{q|V|}{2} = |E|$$



$$|E| - |V| = \frac{q|V|}{2} - |V|$$

$$|E| - |V| = |V|\left(\frac{q-2}{2}\right) = \frac{|V|(q-2)}{2} = |E| - |V|$$

$$\frac{|V| - |E|}{|E| - |V|} = -1$$

$RZF = 0 \Rightarrow RHS = \infty$

(or) $$\frac{z_1 z_2 \cdots \det(\,)\det(\,)\cdots}{(1+q_1^{-s})(1+q_2^{-s})\cdots} = \frac{1}{0}$$

$$\Rightarrow (1+q_1^{-s})(1+q_2^{-s}) \cdots = 0$$

$$\Rightarrow \boxed{\left(1+\frac{1}{2^s}\right)\left(1+\frac{1}{3^s}\right)\left(1+\frac{1}{5^s}\right) \cdots = 0\ ?}$$

$\Rightarrow$ for some $q_t$, $1 + \frac{1}{q_t^s} = 0$

(or) $-1 = \frac{1}{q_t^s}$

$$q_t^s = -1$$

$$q^a q^{ib} = -1 = i^2 = e^{i\pi}$$

April 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | | | |

25 March Tuesday

RZF =

If |M|>

27 March Thursday

$q^a q^{ib} = e$

if for all s=

$\sqrt{q}\, q^{ib} = e$

$\sqrt{q}\, e^{ib\log q} =$

$\Rightarrow \sqrt{q} = e^{i(\pi}$

$\sqrt{q} = \cos(\pi -$

$\Rightarrow \sqrt{q} = \cos(\pi -$

$0 = \sin(\pi -$

(or) $\frac{\pi}{b} = \log q$

contradict

if $a \neq 1/2$ for

$q^a = e^{i\pi} \times$

$q^a = e^{i(}$




$$q^a q^{ib} = e^{i\pi}$$

$\boxed{\text{if for all } s = a+ib \quad a = 1/2,}$

$$\sqrt{q}\, q^{ib} = e^{i\pi}$$

$$\sqrt{q}\, e^{ib\log q} = e^{i\pi}$$

$$\Rightarrow \sqrt{q} = e^{i(\pi - b\log q)}$$

$$\sqrt{q} = \cos(\pi - b\log q) + i\sin(\pi - b\log q)$$

$$\Rightarrow \sqrt{q} = \cos(\pi - b\log q)$$

$$0 = \sin(\pi - b\log q)$$

(or) $\frac{\pi}{b} = \log q$ again some contradiction if $a = 1/2$ for all $s = a+ib$

if $a \neq 1/2$ for some $s = a+ib$

$$q^a = e^{i\pi} \times e^{-ib\log q}$$

$$q^a = e^{i(\pi - b\log q)}$$

February 2014



$$q^a = \cos(\pi - b\log q) + i\sin(\pi - b\log q).$$

$$q^a q^{ib} = -1$$

$$q^{ib} = -q^{-a}$$

$$e^{ib\log q} = -q^{-a}$$

$$\cos b\log q + i\sin b\log q = -q^{-a}$$

$$\cos b\log q = -q^{-a}$$

$$\log \cos b\log q = -a\log(-q)$$

$$\boxed{\frac{\log(\cos(b\log q))}{\log(-q)} = a}$$

if $a = 1/2$ for all $s = a+ib$

$$-\frac{\log(\cos(b\log q))}{\log(-q)} = \frac{1}{2}$$

$$\log(-q) = -2\log(\cos(b\log q))$$

$$+q = -\cos(b\log q)^{-2}$$

$$q = \frac{-1}{[\cos(b\log q)]^2}$$

$$\cos b\log q = \sqrt{\frac{-1}{q}}$$

$$\cos b\log q = \frac{i}{\sqrt{q}}$$

April 2014

Text files <u>EventNet Edges.txt</u> and

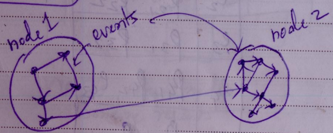


<u>Event Net Vertices.txt</u> are read by Python scripts.

Event Net is needed in AsFer, VIRGO Linux and KingCobra.

Event Net in AsFer can be python and C/C++ in VIRGO Linux and KingCobra (eg boost::graph)

4/12/2014




<u>partaker id format:</u>

<ipaddress>:<threadid>

Id(s) of the events in node2 are > the cause event in node1

Each conversation requires ~~an~~ a log message being sent to EventNet service which updates the input edges & vertices text input files. Python script in a loop recomputes the ordering & graph.

April 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | | | |

10/12/2014 25/4/70 470/BN 4B7N0/ 42750



① <u>Circuit Value Problem is P-Complete</u> (whether given input satisfies a circuit) only if input is known (verifying a certificate – not finding it) (Continued from page 16/1/2014). (Certificate complexity?)

SAT circuit for each voter is just CNF formulae which is NP-Complete. It is like ~~each~~ ~~voter~~ searching solution space is superpolynomial or exponential (or) finding a certificate assignment.

Philosophically, candidate "<u>tried hard</u>" to convince voters – each voter to be precise.

Number of voters is infinite theoretically. <u>Is infinite majority decidable?</u> This is like a streaming algorithm to find heavy hitter in an online voting – finding majority in a stream of binary digits!

The uniform distribution in page 16/1/2014 cannot be ruled out – for example if the voters are equally "rational" or "intelligent" as in the case of nodes in a cloud which have same software installed.

P can be equal to NP when above converges & in uniform distribution & undecidable if majority is undecidable in infinite case.

or if Arrow's Theorem for infinite case is undecidable.

June 2014

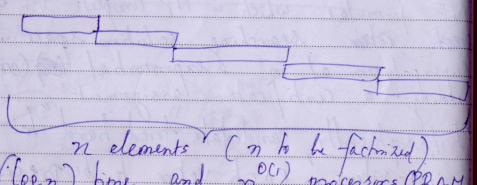
| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | | | | | |

470/BN BNF 470/BN 15



② <u>Discrete Hyperbolic Factorization:</u>

Berkman Schieber Vishkin & Others ANSV algorithms using PRAM algorithms are NC algorithms by PRAM ≡ NC equivalence.



n elements (n to be factorized)

$O(\log n)$ time and $n^{O(1)}$ processors (PRAMs) reduced to $\log n$ depth & $n^{O(1)}$ size NC circuit. Each PRAM cell is of size $\leq \log n$. Thus factorization ∈ NC



③ graphs are ramanujan or non-ramanujan. RZF is represented as infinite set of (prime+1)-regular graphs – product of their Ihara identities.

$Re(a+ib) = 1/2$ $(a = 1/2)$

for both ramanujan & non-ramanujan graphs (thus RZF)

April 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | | | |

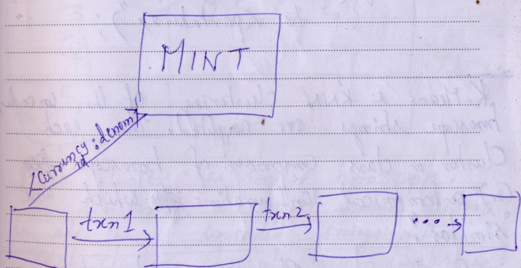
All 3 results seem to be big and if correct (which they look) are unbelievable.



Ka. Shrinivaasan.

Continued from 19/3/2013 page of Diary ② 10B

<u>EventNet unique id for KingCobra MAC currency (MINT)!</u>




12/12/2014

Money trail

each transaction creates eventlog message.

<u>An example transaction for MAC</u>


2-way or 3-way handshake with MAC-ACK-ACK

June 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | | | | | |

Some expansion on notes from UBI diary

15 May Thursday

15-05-2014

$${}^nC_0 = \frac{n!}{0!\,n!}$$

(1) 11/4/2014

for P(good) binomial Coeff Summation Convergence

Special Case for even $n$

though very minor

$${}^nC_n = \frac{n!}{n!\,0!}$$

$${}^nC_x = {}^nC_{n-x}$$

$$\frac{n!}{x!\,(n-x)!} = \frac{n!}{(n-x)!\,x!}$$

$${}^nC_{\boxed{n/2}} = {}^nC_{n-n/2}$$

$$\frac{n!}{(n/2)!\,(n-n/2)!} = {}^nC_{n/2}$$

$$\frac{n!}{\left(\frac{n}{2}+1\right)!\,\left(n-\frac{n}{2}-1\right)!} = \frac{n!}{\left(\frac{n}{2}+1\right)!\,\left(\frac{n}{2}-1\right)!}$$

$${}^4C_0 + {}^4C_1 + {}^4C_2 + {}^4C_3 + {}^4C_4 = 2^4$$

$${}^5C_0 + {}^5C_1 + {}^5C_2 + {}^5C_3 + {}^5C_4 + {}^5C_5 = 2^5$$

$$\frac{5!}{2!\,3!} = \frac{5!}{3!\,2!}$$

April 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | | | |

16-05-2014

May Friday 16

Special case of ~~B~~ for even "n":

$$2x + {}^nC_{n/2} = 2^n$$

$$2x = 2^n - {}^nC_{n/2}$$

$$x = \frac{2^n - {}^nC_{n/2}}{2}$$

$x + {}^nC_{n/2}$ to get ${}^4C_3 + {}^4C_4$

$$\frac{2^n - {}^nC_{n/2}}{2} + {}^nC_{n/2}$$

$$= \boxed{\frac{2^n + {}^nC_{n/2}}{2}} = 2^n \equiv \left({}^4C_3 + {}^4C_4\right)$$

$$\frac{2^n + {}^nC_{n/2}}{2 \cdot 2^n} \Rightarrow {}^4C_3 + {}^4C_4 = 2^n\left(\frac{2^n + {}^nC_{n/2}}{2}\right)$$

$$= \frac{1}{2} + \frac{{}^nC_{n/2}}{2^n}$$

June 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | | | | | |

17 May Saturday

17-05-2014

For even population,

$$P(good) = \frac{1}{2} + \epsilon$$

where
$$\epsilon = \frac{\dfrac{n!}{(n/2)!\,(n/2)!}}{2^n}$$

Stirling approximation:

$$n! \simeq \sqrt{2\pi n}\left(\frac{n}{e}\right)^n$$

$$\left(\frac{n}{2}\right)! \simeq \sqrt{\pi n}\left(\frac{n}{2e}\right)^{n/2}$$

18 Sunday

18-05-2014

$$\epsilon = \frac{\sqrt{2\pi n}\left(\frac{n}{e}\right)^n}{\left(\sqrt{\pi n}\right)^2 \left(\frac{n}{2e}\right)^{n/2+n/2}}$$

$$= \frac{\sqrt{2\pi n}\,\cancel{(n)^n} \times (2e)^n}{e^n\,(\pi n)\,\cancel{n^n}} = \frac{\sqrt{2}}{\sqrt{\pi n}} \times \frac{2^n \cancel{e^n}}{\cancel{e^n}}$$

$=$

19-05-2014

May Monday 19

$$\frac{\dfrac{\sqrt{2} \times \cancel{2^n}}{\sqrt{\pi n}}}{\cancel{2^n}} = \epsilon$$

$$= \frac{\sqrt{2}}{\sqrt{\pi}\sqrt{n}}$$ for $n = 1$, ${}^nC_{n/2}$ is not valid (must be ignored).

$$\sqrt{2/3} = \frac{1.414}{1.732}$$

$$\epsilon = \sqrt{\frac{2}{\sqrt{\pi}}} \simeq \sqrt{0.6} \simeq = \frac{14}{17} =$$

$$0.75 \times 0.75 =$$

for large $n$
$$\lim_{n\to 0} \frac{\sqrt{2}}{\sqrt{\pi}\sqrt{n}} \Rightarrow 0$$

$\epsilon$ tends to zero for large $n$

for $n \geq 4$ ( ~~odd~~ even $n$)

$$\frac{\sqrt{2}}{\sqrt{\pi}\sqrt{4}} \simeq \sqrt{\frac{2}{12.5}} \simeq \sqrt{\frac{1}{6}} = \sqrt{0.16} \simeq 0.4$$

This implies that for even population

20 May Tuesday 20-05-2014

$n \geq 4$

$$\frac{4C_0 + 4C_1 + 4C_2 + 4C_3 + 4C_4}{2^4}$$

$$= \frac{2^4 + 4C_2}{2} = \frac{16 + \frac{24}{2\cdot 2}}{2}$$

$$= \frac{16+6}{2} = 11$$

$$\frac{11}{2^4} = \frac{11}{16}$$

$4C_0 = \frac{4!}{0!\,4!} = 1$ $\quad 4C_4 = 1$

$4C_1 = \frac{4!}{1!\,3!} = 4$ $\quad \sum_{i=0}^{4} 4C_i = 16$

$4C_2 = \frac{4!}{2!\,2!} = 6$

$4C_3 = \frac{4!}{3!\,1!} = 4$ $\quad \frac{1}{2} + \frac{5}{16} = \boxed{\frac{13}{16}}$

April 2014

But for large $n$ ($\to \infty$). Both even & odd populations converge to $1/2$

21-05-2014 May 21 Wednesday

For P vs NP only infinite population electorate voting is needed.

$$2^n - \frac{2^n}{2} - \frac{nC_{n/2}}{2}$$

$$= \frac{2^n - nC_{n/2}}{2 \times 2^n}$$

$n = 4$ $\quad \frac{16-6}{2\times 2^4} = \frac{10}{2\times 16} = \frac{5}{16}$

$$\boxed{\frac{1}{2} + \frac{2^n - nC_{n/2}}{2\times 2^n}} = P(\text{good}) \text{ for even number of electorate}$$

$\frac{1}{2} + \epsilon = P(\text{good})$ for even number of electorate. (for small number) $\epsilon \to 0$ for infinite

June 2014

$\boxed{22/12/2014}$ for even $n$ (e.g $n = 4$) Special case for even electorate Pr(good)

27 May Tuesday 27-05-2014

$$\underbrace{4C_0 + 4C_1}_{x} + 4C_2 + \underbrace{4C_3 + 4C_4}_{x} = 2^4$$

$4C_0 = 1$

$4C_1 = 4$ $\quad nC_x = nC_{n-x}$

$4C_2 = 6$

$4C_3 = 4$ $\quad 2x + 4C_2 = 2^4$

$4C_4 = 1$ $\quad x = \frac{2^4 - 4C_2}{2}$

$(+)\ 16 = 2^4$

$$4C_3 + 4C_4 = -(x + 4C_2) + 2^4$$

$$= -\left(\frac{2^4 - 4C_2}{2} + 4C_2\right) + 2^4$$

$$4C_3 + 4C_4 = -\left(\frac{2^4 + 4C_2}{2}\right) + 2^4$$

for any even $n$:

$$nC_{n/2+1} + \dots + nC_n = -\left(\frac{2^n + nC_{n/2}}{2}\right) + 2^n$$

$$= 2^n - \frac{2^n}{2} - \frac{nC_{n/2}}{2}$$

April 2014

28-05-2014 Amavasya, Kritikai

May 28 Wednesday

$$= \frac{2^n}{2} - \frac{nC_{n/2}}{2}$$

$$= \boxed{\frac{2^n - nC_{n/2}}{2} = nC_{n/2+1} + nC_{n/2+2} + \dots + nC_n}$$

RHS Pr(good) for democracy circuit, above $/2^n$

$$\boxed{\frac{2^n - nC_{n/2}}{2\times 2^n} = \frac{1}{2} - \frac{nC_{n/2}}{2^n}}$$

$$\frac{nC_{n/2}}{2^n} = \epsilon = \frac{\frac{n!}{(n/2)!\,(n/2)!}}{2^n}$$

$$\simeq \frac{\sqrt{2\pi n}\left(\frac{n}{e}\right)^n}{2^n\left[\sqrt{\pi n} \times \left(\frac{n}{e}\right)^{n/2}\frac{1}{2^{n/2}}\right]^2} = \frac{\sqrt{2\pi n}\,\frac{n^n}{e^n}}{\cancel{2^n}\,\pi n\,\frac{n^{2n/2}}{e^{2n/2}}}$$

June 2014

$$\sqrt{2\pi n}\,\frac{n^n}{e^n} = \frac{\sqrt{2\pi n}\,\frac{n^n}{e^n}\times e}{\pi n\; n^n}$$

$$\simeq \frac{\frac{2^n}{2^n}\,\pi n\;\frac{n^{2n/2}}{e^{2n/2}}}{e} = \frac{\sqrt{2}}{\sqrt{\pi n}}\times 2 = \sqrt{\frac{2}{\pi n}}$$

$$\simeq \frac{\sqrt{2\pi n}\,\frac{n^n}{e^n}\times 2^n\times e^{2n}}{\pi n\; n^{2n/2}}$$

$$\simeq \frac{\sqrt{2\pi n}\;n^n\times 2\times e^n}{\pi n\; n^{2n}\; n^n}$$

$$\simeq \frac{\sqrt{2\pi n}\times 2^n\times e^n}{\pi n\times n^n}$$

$$\simeq \frac{\sqrt{2}}{\sqrt{\pi n}}\times\left(\frac{2e}{n}\right)^n$$

April 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | | | |



$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$$

$$\boxed{\lim_{n\to\infty}\frac{\sqrt{2}}{\sqrt{\pi n}}\times\left(\frac{2e}{n}\right)^n = 0 = \epsilon}$$

For finite even electorate, $\epsilon$ doesnot vanish and always less than $\frac{1}{2}$ (?) and thus pseudorandomness is better than majority voting for non-uniform distribution.

But for infinite RHS, $\epsilon$ is still zero.

Is infinite majority circuit decidable?

for $n=4$

$$4C_3+4C_4 = \frac{2^4-4C_2}{2} = \frac{16-\frac{4\times 3\times\cancel{2}}{2\times\cancel{1}}}{2}$$

$$=\frac{16-6}{2} = 5$$

Thus Pr(good) RHS $= \frac{5}{2^4} = \frac{5}{16}$

June 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 8 | 9 | 10 | 11 | 12 | 13 | 14 |
| 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 29 | 30 | | | | | |



| | |
|---|---|
| 0 | 0000 |
| 1 | 0001 |
| 2 | 0010 |
| 3 | 0011 |
| 4 | 0100 |
| 5 | 0101 |
| 6 | 0110 |
| 7 | 0111 |
| 8 | 1000 |
| 9 | 1001 |
| 10 | 1010 |
| 11 | 1011 |
| 12 | 1100 |
| 13 | 1101 |
| 14 | 1110 |
| 15 | 1111 |

$$\cancel{\frac{4C_3\times 4C_4}{2^4}}$$

$$\frac{5}{16}$$



Even electorate, when finite is puzzling (uniform distribution)

For Odd electorate (e.g. $n=5$)

$$\underbrace{5C_0+5C_1+5C_2}_{x}+\underbrace{5C_3+5C_4+5C_5}_{x} = 2^5$$

$$2x = 2^5$$

$$x = 2^4$$

April 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | | | |



Thus Pr(good) RHS is

$$\frac{2^4}{2^5} = \frac{1}{2}$$

in uniform distribution.

Thus Odd electorate has no issues at all.

For even $n$ uniform distribution:

$$\text{RHS Pr(good)} = \frac{1}{2} - \frac{nC_{n/2}}{2^n}$$

$$= \frac{1}{2} - \frac{\frac{n!}{\left(\frac{n}{2}\right)!\left(\frac{n}{2}\right)!}}{2^n}$$

$$\frac{n!}{\left(\frac{n}{2}\right)!\left(\frac{n}{2}\right)!} \simeq \frac{\sqrt{2\pi n}\left(\frac{n}{e}\right)^n}{\sqrt{\frac{2\pi n}{2}}\left(\frac{n}{2e}\right)^{n/2}\times\sqrt{\frac{2\pi n}{2}}\left(\frac{n}{2e}\right)^{n/2}}$$

$$\simeq \frac{\sqrt{2\pi n}\left(\frac{n}{e}\right)^n\times(2e)^n}{\sqrt{\pi n}\sqrt{\pi n}\;n^n} = \frac{\sqrt{2\pi n}\,(n^n)\times 2^n\cancel{e^n}}{\cancel{e^n}\;\pi n\; n^n}$$

$$\simeq \frac{\sqrt{2\pi n}\;n^n\times 2^n}{\pi n\times n^n} \simeq \sqrt{\frac{2}{\pi n}}\times 2^n$$

July 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | | |

Thus RHS P(good)

3 June Tuesday 03-06-2014

$$\frac{\frac{1}{2} - \sqrt{\frac{2}{n\pi}} \times \cancel{2^n}}{\cancel{2^n}}$$

$$= \boxed{\frac{1}{2} - \sqrt{\frac{2}{n\pi}}} \qquad \lim_{n\to\infty} \sqrt{\frac{2}{n\pi}} = 0$$

Special case of even number of voters:
For even electorate democracy Choice can be worse than pseudorandom Choice (uniform distribution) when finite and thus democracies with even number of electors are failures (?)

Ka. Shrinivaasan.

$n=2$

$$\frac{2^2 - 2C_1}{2^3} = \frac{4-2}{8} = \frac{2}{8} = \frac{2}{8} = \frac{1}{4}$$

0 00
1 01
2 10
3 11

$$\frac{1}{2} - \sqrt{\frac{2}{2\pi}} = \frac{1}{2} - \sqrt{\frac{1}{3.14}}$$

May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

Lemma: Infinite majority is undecidable

04-06-2014 June Wednesday 4

Proof:
Hypothetical turing machine computing majority of infinite bit stream would be looping always without an "yes", "no" output. Thus TM is not in recursive but recursively enumerable languages. As RE ~~~~ Recursive are undecidable, infinite majority is undecidable. Thus Arrow's theorem for infinite number of candidates should also be undecidable.

23/12/2014

Arrow's theorem for 3-candidate Condorcet election proves that there is non-zero error in voting. Does this imply that 2 candidate Condorcet election has non-zero error also?
If yes, the RHS of P(good) binomial coeff summation for democracy circuit with finite SAT inputs for voters (i.e finite ~~~~ odd number of electors) can never be 1 ~~~~ by Arrow's theorem.
For 2 candidates the ranking by Condorcet is trivial
The counter example is there exists a

July 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | | |

democracy circuit (Maj + SAT) with Odd number of finite voters (Sat ckt per voter) with uniform distribution

5 June Thursday 05-06-2014

which converges to 1/2 (same as LHS pseudorandom choice).

This counterexample is tantamount to saying that there exists a PTIME algorithm using a PRGenerator for an NP-complete democracy problem (LHS = RHS in P(good) binomial coeff summation)

Infinite version seems to be undecidable.

Ka. Shrinivaasan.
23/12/2014

24/12/2014

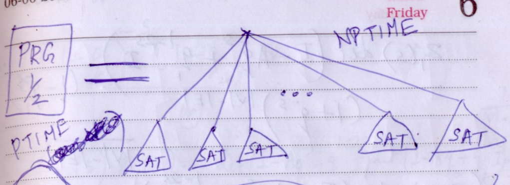
SAT+ Maj with Odd number of voter SAT inputs to majority circuit when finite, with uniform distribution converges to 1/2 same as LHS for pseudorandom choice.
This is the counter example when P = NP.

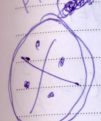
May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

P(good) LHS     P(good) RHS

06-06-2014 June Friday 6



Finite Odd number of voters with SAT in uniform distribution (P(good) = P(bad) = 1/2) Converge w.r.t. P(good) binomial coeff summation to 1/2

[Counter example for P Vs NP] if P=1 Also 1 = 1

Philosophically this implies that there are scenarios where hard problems are easy due to "Chance" - lucky guesses?

As mentioned above: Ka. Shrinivaasan
If there is no error in both LHS and RHS P=1 and hence,
LHS is 1
RHS is $nC_n (1)^n = 1$

July 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | | |

Complement Function, Ihara ZF, Riemann ZF



$$\frac{Z_1(s)\det\left(I - Aq_1^{-s} + q_1^{1-2s} I\right)}{(1+q^{-s})^{|V|-|E|}} = (1-q_1^{-s})^{|V|-|E|}$$

$$\frac{\left(Z_1(s)\det\left(I - Aq^{-s} + q^{1-2s} I\right)\right)^{\frac{1}{|V|-|E|}}}{(1+q^{-s})^{\frac{|V|-|E|}{|V|-|E|}}} = (1-q_1^{-s})$$

$$\frac{(1+q_1^{-s})}{\left(Z_1(s)\det\left(I - Aq_1^{-s} + q_1^{1-2s} I\right)\right)^{\frac{1}{|V|-|E|}}} = \frac{1}{(1-q_1^{-s})}$$



$$\frac{(1+q_1^{-s})(1+q_2^{-s})\cdots}{\left(Z_1(s)Z_2(s)\cdots\det\left(I - Aq_1^{-s} + q_1^{1-2s} I\right)\det\left(I - Aq_2^{-s} + q_2^{1-2s} I\right)\cdots\right)^{\frac{1}{|V|-|E|}}}$$

$$= \frac{1}{(1-q_1^{-s})}\frac{1}{(1-q_2^{-s})}\cdots$$

$$= RZF$$

May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

If RHS is zero, either denominator is zero or numerator is $\infty$



case (i) $(1+q_1^{-s})(1+q_2^{-s})\cdots = 0$

(or)

case (ii)

$$\left(Z_1(s)Z_2(s)\cdots\det\left[I - Aq_1^{-s} + q_1^{1-2s} I\right]\det\left(I - Aq_2^{-s} + q_2^{1-2s} I\right)\cdots\right)^{\frac{1}{|V|-|E|}} = \infty$$

(or)

$$\left[Z_1(s)Z_2(s)\cdots\det\left[I - Aq_1^{-s} + q_1^{1-2s} I\right]\det\left(I - Aq_2^{-s} + q_2^{1-2s} I\right)\cdots\right]^{\frac{1}{|E|-|V|}} = 0$$

$\Rightarrow$ either $Z_1(s)Z_2(s)\cdots = 0$

which implies that zeros of RZF in RHS are zeros of Ihara ZF also. Thus the graph must be Ramanujan. (a known result)

(or)

$$\det\left(I - Aq_1^{-s} + q_1^{1-2s} I\right)\det\left(I - Aq_2^{-s} + q_2^{1-2s} I\right)\cdots = 0$$

Thus for some $q_i$

$$\det\left(-Aq_i^{-s} + I + q_i^{1-2s} I\right) = 0$$

July 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | | |

multiplying by $q_i^s$



$$\det\left[-A + Iq_i^s + q_i^{1-s} I\right] = 0$$

$$\det\left[-\left[A - Iq_i^s - q_i^{1-s} I\right]\right] = 0$$

$$\det\left[-\left[A - I\left(q_i^s + q_i^{1-s}\right)\right]\right] = 0$$

eigen value is $q_i^s + q_i^{1-s} = \nu$

$$q_i^{2s} + q_i = \nu q_i^s$$

$$q_i^{2s} - \nu q_i^s + q_i = 0$$ (from this onwards derivation is same as page 17/4/2014)

$$q_i^{2a+2ib} - \nu q_i^a q_i^{ib} + q_i = 0$$

$$q^{2a} q^{2ib} - \nu q^a q^{ib} + q = 0$$

$$q^{2a} e^{2ib\log q} - \nu q^a e^{ib\log q} + q = 0$$

May 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |



$$q^{2a}\left(\cos(2b\log q) + i\sin(2b\log q)\right) - \nu q^a\left(\cos(b\log q) + i\sin(b\log q)\right) + q = 0$$

equating to $0 + i0$

$$q^{2a}\cos(2b\log q) - \nu q^a\cos(b\log q) + q = 0$$

$$q^{2a}\sin(2b\log q) - \nu q^a\sin(b\log q) = 0$$

$$\frac{q^{2a}\cos(2b\log q) + q}{q^{2a}\sin(2b\log q)} = \frac{\nu q^a\cos(b\log q)}{\nu q^a\sin(b\log q)}$$

$$\Rightarrow \frac{q^{2a}\sin(2b\log q)}{q^{2a}\cos(2b\log q) + q} = \tan(b\log q)$$

$$\Rightarrow \frac{q^{2a}\, 2\,\cancel{\sin b\log q}\,\cos b\log q}{q^{2a}\cos^2 b\log q - q^{2a}\sin^2 b\log q + q} = \frac{\cancel{\sin b\log q}}{\cos b\log q}$$

July 2014

| S | M | T | W | T | F | S |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | | |

12 June Thursday 12-06-2014 Pournami

$$2q^{2a}\cos^2 b\log q =$$

$$q^{2a}\cos^2 b\log q - q^{2a}\sin^2 b\log q + q$$

$$q^{2a}\cos^2 b\log q = -q^{2a}\sin^2 b\log q + q$$

$$q^{2a}\left(\cos^2 b\log q + \sin^2 b\log q\right) = q$$

$$q^{2a} = q$$

$$\boxed{a = 1/2}$$

for any eigenvalue which implies for non-ramanujan graphs also.

Thus infinitely many (prime+1) regular graphs (both ramanujan & non-ramanujan) represent Riemann Zeta Function as infinite graph. Since above

| May 2014 | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| | | | | 1 | 2 | 3 |
| 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| 25 | 26 | 27 | 28 | 29 | 30 | 31 |

13-06-2014 June Friday 13

derivation is irrespective of eigen values of graph adj matrix, both ramanujan & non-ramanujan graphs (prime+1 regular) have $Re(s) = 1/2$.

K. Srinivasan
24/12/2014

| July 2014 | | | | | | |
|---|---|---|---|---|---|---|
| S | M | T | W | T | F | S |
| | | 1 | 2 | 3 | 4 | 5 |
| 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 | 31 | | |