Welcome to Stanford

I love Stanford. It is the only university with a cell phone tower in its logo.
Double, Deep, Sudden Impact

Reflections on Stan50 and GHG75

Charlie Van Loan
Cornell University
44 Comic Sans

In French this means “Middle-Aged Without Funny”. PowerPoint forces after-dinner speakers to use this font.
History is Nonlinear

Let’s walk the surface.
In the beginning there was...
Gottfried Leibniz

1646--1716

\[
\frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}.
\]

It took 300+ years for his “Let Us calculate” to become “Let you calculate”. We owe grad students big time!
Jacob Bernoulli

1654--1705

\[
\frac{x}{e^x - 1} = \sum_{n=0}^{\infty} B_n \frac{x^n}{n!}
\]

who begat ...
Johann Bernoulli

\[ y = a \cdot \cosh\left(\frac{x}{a}\right) = \frac{a}{2} \cdot \left(e^{x/a} + e^{-x/a}\right) \]

1667--1748

who begat ...

(He had higher GRE scores.)
Leonhard Euler

\[ y_{n+1} = y_n + h \, f(x_n, y_n) \]

1707--1783

who begat ...
\[ Y_{n+1} = Y_n + h f(x_{n+1}, Y_{n+1}) \]

... *tageb ohw*
Joseph Lagrange

1736--1813

who begat ...

\[ \nabla \left[ f(x, y) + \lambda (g(x, y) - c) \right] = 0 \]
Jean-Baptiste Fourier

$X(\omega) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} x(t)e^{-i\omega t} \, dt$

1768--1830

who begat ...
Gustav Dirichlet

$y(x) = f(x) \quad \forall x \in \partial \Omega$

1805--1859

who begat
Rudolf Lipschitz

$|f(x) - f(y)| \leq \delta |x - y|$
C. Felix Klein

1849--1925

who in five generations begat ...

Felix “The Bottle” Klein
Who are the dots?
George Forsythe was a student of ... Let us reverse the direction of our search.

Gene Golub was a student of ...
The Tamarkin ancestry ends in Russia. So we trace the origin of Feller, Forsythe’s “second” advisor.
Richard Courant

1888--1972

was a student of ...

Howard P. Robertson

1903--1961

was a student of ...

Courant is a “smoke-free” Institute.
David Hilbert

1862--1943

was a student of ...

Eric Temple Bell

1883--1960

was a student of ...

In the Humanities Hilbert is often referred to as the “Little Gatsby”.
C.L.F. Lindemann  
1852--1939  
was a student of ... 

Frank Cole  
1861--1926  
was also a student of ...
C. Felix Klein

1849--1925

Great-Great-Great-Grandfather Klein. George and Gene are 5th cousins.
“If I have seen further it is by standing on the shoulders of giants.”

-- Newton

Thank you George and Gene.
By honoring our Stanford heroes we honor those who came before.
Incidentally, the 3-by-3 Hair transform is diagonally dominant. Proof: Just use the Gerschgorin Toupee Theorem.
Double Impact
The Personal Legacy

Two Sides of the Numerical Mathematics Coin
Two Great Papers


“Some Modified Matrix Eigenvalue Problems.” (1973)
Double Impact
Muscles from Brussels. Notice that the American release focuses on the “mind” of the hero.
Idea For a Sequel !!!

Starring Van Damn Van Loan
We Need a Better Title !!!
Deep Impact
The Student Legacy


Impossible to top this.
You Get Another Movie !!!

Year’s Worst—The New Yorker

Smart, Hilarious, Technically Sound - SIAM Journal of Applied Mathematics
But It’s Based On a Great Paper !!!


Their only joint Paper.
Still Need a Better Title !!!
Sudden Impact
The Research Legacy

Ratio of blue to red is converging to 0.28.
It is always important to confirm experimental results.
Numerical Mathematics has a 4300+ Year History

4300 Years → 365 Days

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1957</td>
<td>GF Arrival</td>
</tr>
<tr>
<td>1965</td>
<td>SVD</td>
</tr>
<tr>
<td>1973</td>
<td>Met GHG</td>
</tr>
<tr>
<td>1983</td>
<td>GVL1</td>
</tr>
<tr>
<td>1998</td>
<td>Google</td>
</tr>
</tbody>
</table>

Dec 27  
Dec 28  
Dec 29  
Dec 30  
Dec 31  

Fifty years is but five days when we compress computational history down to a calendar year. A very sudden impact.
Sudden Impact
You Get a Movie and a Car !!!
And an Idea for a Car Movie!
Double Deep Sudden Impact

Reflections on Stan50 and GHG75

Charlie Van Loan
Cornell University
More Forsythe Papers

Cyclic Jacobi method for computing the principal values of a complex matrix. (with Henrici, 1960)

Let’s Not Discriminate against good work in design or experimentation. (1969)

The Role of Numerical Analysis in an Undergraduate Program (1959)
My first mentor is the quintessential Stanford graduate.
“As teacher, Ph.D. advisor, and force behind Matlab, Cleve has defined the way I look at mathematics and computing.”
You may be surprised to learn that Gene and I have parallel careers.
While Gene was Coding the Illiac 1..
I was cutting my teeth on...

A present on my 13th birthday.
New 1960 German Adding Machine Adds & Subtracts to ONE BILLION!
Now with 9 NEW exclusive features--Still Only $1.98

Pocket for Coins and $1, $5, $10 Bills!
200 Year Perpetual Calendar!
Fine Grain Fitted WALLET!
Easy-Flow Clearing Lever!
Magic Reckoner for Multiplying & Dividing!

50-by-50 times table
Rip-Off

I learn early that few machines achieve peak performance.
While Gene Was Playing Around with puny 2-by-2 Block matrices...

\[
Q^T \begin{bmatrix}
O & A^T \\
A & O
\end{bmatrix} Q = T
\]
I Was Out in the Real World Solving Problems

Hey! That’s a Rank-1 Matrix!

\[ A(i,j) = i \times j \]
I learn that there is no need to store the matrix explicitly.
In Closing

A Few Comments About the GVL Collaboration

What is It Like?
Halloween 1997

Fun because we complement each other in the spirit of Sonny and Cher!
Partitioning is Overrated

A More Technical Explanation: A nonconformable matrix product can work!

I associate a number or two with each edition.

7 and 9
The Summer of 1978

7 Chinese Restaurants in 9 days

171
There Were 171 Episodes of L.A. Law. One with GVL2...

Plot = Pair of mathematicians getting divorced. Discovered by Jack Dongarra during an early 1990’s channel surf!

30,000,000
Is it Really “The Bible”?

Hmmm. 30,000,000 Hotel Rooms. $$$$$$$$$$$$$$$$$$
Yes, there will be a Fourth Edition!
Many New Applications!

Unique connections between problems and solutions.
Gene, You Are the One
Max Toast

The Titan’s Goblet

Thomas Cole
1833

The usual white wine Napa Valley salute is just not good enough. You deserve the biggest and best.