The artistry of discovery, and the shocking beauty of God's creation

Chris Staecker

Fairfield University

Huntington United Methodist Church, Oct 18 2012

Words used last week which I will not use tonight

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- kantianism

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Words used last week which I will not use tonight

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- kantianism
- meta-ethical
- hermeneutical ← actually nobody said that
- normative
- xanalogical ← not a real word
- de jure

You're not going to talk about math, are you?

You're not going to talk about math, are you?

It's all I know.

You're not going to talk about math, are you?

It's all I know.

My understanding of mathematics is a key motivator in my faith.

What's interesting about this number?

$$107104871093467290872 3598151$$

What's interesting about this number?

$$107104871093467290872358 8151$$

Actually I'm not too interested in numbers.

What's interesting about this number?

$$10710487109346729087235981511$$

Actually I'm not too interested in numbers.

I'm interested in beautiful ideas.

What's interesting about this number?

$$1071048710934672908723598151$$

Actually I'm not too interested in numbers.

I'm interested in beautiful ideas. In discovering them,

What's interesting about this number?

1071048710934672908723598151

Actually I'm not too interested in numbers.

I'm interested in beautiful ideas. In discovering them, creating them,

What's interesting about this number?

$$107104871093467290872 3598151$$

Actually I'm not too interested in numbers.

I'm interested in beautiful ideas. In discovering them, creating them, thinking them,

What's interesting about this number?

$$107104871093467290872359815 1$$

Actually I'm not too interested in numbers.

I'm interested in beautiful ideas. In discovering them, creating them, thinking them, describing them.

What's interesting about this number?

$$1071048710934672908723598151$$

Actually I'm not too interested in numbers.

I'm interested in beautiful ideas. In discovering them, creating them, thinking them, describing them.

It is the deepest level of God's created world that is accessible to us.

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Actually I'm not too interested in numbers.

I'm interested in beautiful ideas. In discovering them, creating them, thinking them, describing them.

It is the deepest level of God's created world that is accessible to us.

This is worthwhile.

Creation and discovery

Creation vs discovery.

Creation and discovery

Creation vs discovery.

Creation is about making things which did not exist before

Creation and discovery

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Discovery is about revealing and describing preexisting truths

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They seem like different concepts, but:

Creation and discovery are on a spectrum

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Creation is about making things which did not exist before

Discovery is about revealing and describing preexisting truths

They seem like different concepts, but:

Creation and discovery are on a spectrum

There is a sort of discovery in artistic creation, and an artistry in discovery

More creative

More discoverive

A made up spectrum

More creative

abstract visual arts, music, dance

More discoverive

A made up spectrum

More creative

abstract visual arts, music, dance

representational visual arts, drama

More discoverive

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More creative

abstract visual arts, music, dance

representational visual arts, drama

photography, documentary cinema, journalism

More discoverive

A made up spectrum

More creative

abstract visual arts, music, dance

representational visual arts, drama

photography, documentary cinema, journalism

physics, chemistry, biology

More discoverive

But even the most abstractly creative of these has elements of discovery and revelation to them

But even the most abstractly creative of these has elements of discovery and revelation to them

It makes a lot of sense to say things like:

But even the most abstractly creative of these has elements of discovery and revelation to them

It makes a lot of sense to say things like:

"Jimi Hendrix discovered how to play electric guitar"

But even the most abstractly creative of these has elements of discovery and revelation to them

It makes a lot of sense to say things like:

"Jimi Hendrix discovered how to play electric guitar"

"Walt Whitman discovered a new way to write poetry"

Monumental acts of creativity seem in retrospect like discoveries.

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It's hard to imagine a world without novels.

Monumental acts of creativity seem in retrospect like discoveries.

It's hard to imagine a world without novels. Without rock and roll music.

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Music itself was created.

Monumental acts of creativity seem in retrospect like discoveries.

It's hard to imagine a world without novels. Without rock and roll music.

Music itself was created.

But it seems like it was always bound to be created.

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Perhaps it's more proper to say music was discovered.

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But it seems like it was always bound to be created.

Perhaps it's more proper to say music was discovered.

It was both.

One of the greatest creative achievements of humanity:

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$$
\begin{array}{r}
344 \\
+ \quad 217 \\
\hline
\end{array}
$$

One of the greatest creative achievements of humanity:

$$
\begin{array}{r}
^{1} \\
344 \\
+\quad 217 \\
\hline
1
\end{array}
$$

One of the greatest creative achievements of humanity:

$$
\begin{array}{r}
\scriptstyle 1 \\
344 \\
+\quad 217 \\
\hline
61
\end{array}
$$

One of the greatest creative achievements of humanity:

$$
\begin{array}{r}
{\scriptstyle 1} \\
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$$

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344 \\
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\end{array}
$$

You could probably even do this in your head, the same way.

One of the greatest creative achievements of humanity:

$$\begin{array}{r} {}^{1} \\ 344 \\ +217 \\ \hline 561 \end{array}$$

You could probably even do this in your head, the same way.

Awesome!

This method for adding numbers did not always exist.

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If you traveled in the Roman empire and did this, you would amaze people.

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The method was invented by a person less than 1500 years ago.

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If you traveled in the Roman empire and did this, you would amaze people.

The method was invented by a person less than 1500 years ago.

And we know his name.

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It makes ordinary people capable of computing in their heads things which were impossible before.

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Our advantage today is a creative way of thinking

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Our advantage today is a creative way of thinking

But we feel like the method is universal or eternal, not Al-Kwarizmi's creation.

In a sense things like this are eternal.

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God already knew about rock and roll before Chuck Berry played it.

In a sense things like this are eternal.

God already knew about rock and roll before Chuck Berry played it.

Maybe God already thought of numbers in the Hindu-Arabic system.

In a sense things like this are eternal.

God already knew about rock and roll before Chuck Berry played it.

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In this sense, all of our artistic and creative works are discoveries.

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This doesn't diminish our creativity!

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Maybe God already thought of numbers in the Hindu-Arabic system.

In this sense, all of our artistic and creative works are discoveries.

This doesn't diminish our creativity!

It's the same paradox as free will vs predestination.

I don't try to resolve the paradox one way or another- this is a theological black hole.

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The paradox itself is beautiful to me.

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It is inspiring to me to know that God desires us to be intensively creative, and also knows and forms the objects of our creation.

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The paradox itself is beautiful to me.

It is inspiring to me to know that God desires us to be intensively creative, and also knows and forms the objects of our creation.

It is a privilege that God allows us to participate in this sort of "co-creation".

Artistry in Math?

Where we're headed:

- ▶ Beauty and creativity in mathematics

Artistry in Math?

Where we're headed:

- ▶ Beauty and creativity in mathematics
- ▶ Unexpected complexity in mathematics

Artistry in Math?

Where we're headed:

- ▶ Beauty and creativity in mathematics
- ▶ Unexpected complexity in mathematics
- ▶ So what?

An example from my own research:

An example from my own research:

My lunch box.

The area should fit, but it's the wrong shape.

How to make it fit?

How to make it fit?

Here's one method:

How to make it fit?

Here's one method:

We can do better.

A better solution:

A better solution:

A better solution:

A better solution:

Better.

A creative and elegant solution:

A creative and elegant solution:

A creative and elegant solution:
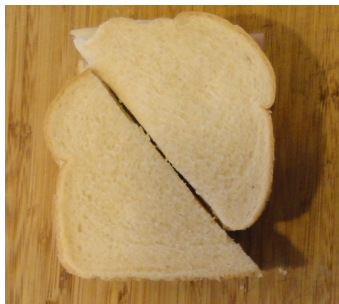
It works!

It's creative, but really it's just a solution to a certain geometry problem.

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New research in mathematics is similar in character- hard problems which require creative solutions.

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New research in mathematics is similar in character- hard problems which require creative solutions.

Many of the answers to the deepest questions turn out to be more complicated than we thought.

Beauty and complexity in numbers

Prime numbers:

$$2, 3, 5, 7, 11, 13, 17, 19, 23, 27, 31, 37, 41, 43, \ldots$$

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One of the oldest and hardest themes in number theory has been to describe the distribution of prime numbers.

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Prime numbers:

$$2, 3, 5, 7, 11, 13, 17, 19, 23, 27, 31, 37, 41, 43, \ldots$$

One of the oldest and hardest themes in number theory has been to describe the distribution of prime numbers.

There's still major unsolved problems in this area– *The Riemann Hypothesis* is one which gets you $1 million.

Make a line with dots on the prime numbers, gaps for the nonprimes.

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■■ ■ ■   ■ ■   ■ ■   ■   ■ ■   ■   ■ ■   ■   ■   ■ ■   ■   ■ ■   ■   ■

Zoom out:

■ ■

Make a line with dots on the prime numbers, gaps for the nonprimes.

Zoom out:

Zoom out:

Make a line with dots on the prime numbers, gaps for the nonprimes.

Zoom out:

Zoom out:

Hard to find any patterns at all- they seem almost randomly distributed.

One day (1950s), Ulam was bored and wrote the numbers in a spiral like
this:

```
37—36—35—34—33—32—31
 |                    |
38  17—16—15—14—13  30
 |   |            |   |
39  18   5 —4 —3  12  29
 |   |   |     |  |   |
40  19   6   1—2  11  28
 |   |   |     |  |   |
41  20   7 —8 —9—10  27
 |   |                |
42  21—22—23—24—25—26
 |
43—44—45—46—47—48—49...
```

One day (1950s), Ulam was bored and wrote the numbers in a spiral like this:

One day (1950s), Ulam was bored and wrote the numbers in a spiral like this:

Ulam did not expect any patterns- this was just doodling.

With the numbers in a spiral, this is what you see:
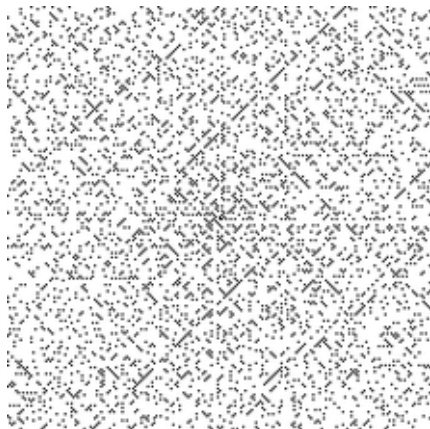
Black dots are primes, white dots are non-primes.
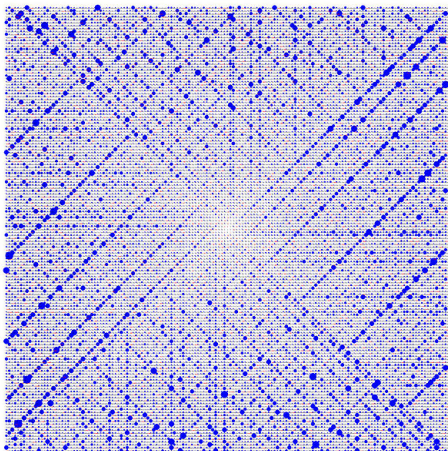
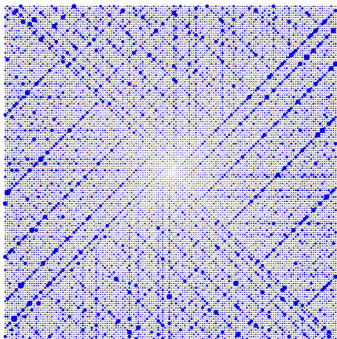Clearer if we put dots on the non-primes, bigger dots for more factors:

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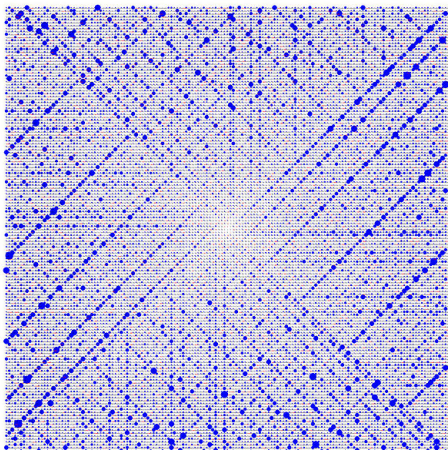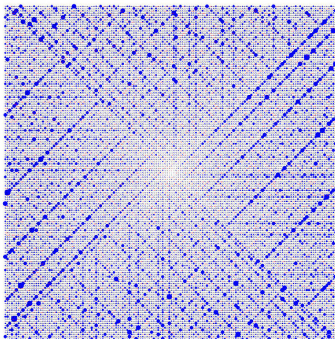
Clearer if we put dots on the non-primes, bigger dots for more factors:

Most definitely not random!

The patterns here are still not fully understood.

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We'd go a long way toward explaining them if somebody could prove:

$$P(n) \sim A \frac{1}{\sqrt{a}} \frac{\sqrt{n}}{\log n}$$

This is Hardy & Littlewood's "Conjecture F" (1923).

A big question:

A big question: Why should there be structure where we expect only randomness?

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Numbers serve a very specific and fairly simple purpose.

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Numbers serve a very specific and fairly simple purpose.

But why is there so much to say about them?

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Numbers serve a very specific and fairly simple purpose.

But why is there so much to say about them?

They turned out to be more complicated than we thought.

But we invented them, didn't we?

If we created mathematics, then how could it surprise us?

If we created mathematics, then how could it surprise us? Maybe we didn't really create it.

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The feel of "intelligent design" is inescapable for mathematicians.

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Science offers no alternative here– the question of why mathematics exists in the way it does is unanswerable to science.

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The feel of "intelligent design" is inescapable for mathematicians.

Science offers no alternative here– the question of why mathematics exists in the way it does is unanswerable to science.

These mysteries are beautiful for mathematicians.

One other example of unexpected complexity and beauty:

One other example of unexpected complexity and beauty: truth itself.

A fact about ordinary language:

A fact about ordinary language: not every statement is absolutely either "true" or "false".

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Like: "Methodists are better than Catholics." (subjective, ambiguous)

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"You never know when I'm hammering, because I'm hammering now" (nonsensical)

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This is the difference between mathematics and ordinary language: mathematical statements are always either provably true or provably false.

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This is the difference between mathematics and ordinary language: mathematical statements are always either provably true or provably false.

Students love this.

"Mathematical statements are always either provably true or provably false."

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Any consistent logical system has statements which cannot be proven true or false.

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This turns out to be incorrect.

In 1930s, Gödel proved that some mathematical statements are unprovable.

Turns out this is a basic feature of any logical system.

Any consistent logical system has statements which cannot be proven true or false.

Logical statements can be true, false, or "undecidable".

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Erdős:

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Erdős: "When I meet God, the first thing I'll ask him is: is the continuum hypothesis true?"

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Erdős: "When I meet God, the first thing I'll ask him is: is the continuum hypothesis true?"

Some things are simply inaccessible with the tools of pure logic.

!

Start paying attention again!

Recap

God participates with us in creating and discovering our complex world

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There is surprising beauty and complexity at the foundations of our natural world

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God participates with us in creating and discovering our complex world

There is surprising beauty and complexity at the foundations of our natural world even in the nature of truth itself

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There is surprising beauty and complexity at the foundations of our natural world even in the nature of truth itself

Complexity is the norm, not the exception

So What?

The big idea:

God loves complexity

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God has made things complex which might as well have been simple.

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God has made things complex which might as well have been simple.

- ▶ Our environment

God loves complexity

God has made things complex which might as well have been simple.

- Our environment
- The structure of physical laws

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God loves complexity, and we should too.

God loves complexity

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- ► Our environment
- ► The structure of physical laws
- ► Mathematics
- ► People

God loves complexity, and we should too.

But this is hard.

Complexity confuses us:

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A picture is painted of Jesus as a complex human being with sometimes obscure motivations.

This is the kind of Jesus I want to follow.

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But what does that really mean?

It is deep and mysterious and beautiful.

My favorite Bible verse:

Jn 1:1: "In the beginning was the Word, and the Word was with God, and the Word was God."

Apparently "the Word" is Jesus.

But what does that really mean?

It is deep and mysterious and beautiful. What more do you need?

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This is tragic.

Even in our faith, embrace complexity.

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This is misunderstood, so be careful.

We must fully embrace the truth, whatever it may be.

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But the truth sets us free.

One more verse:

1 Cor 13:11: "When I was a child, I used to speak like a child, think like a child, reason like a child; when I became a man, I did away with childish things."

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This is what God wants from us.

Last words

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Never be afraid:

▶ to look more closely

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Never be afraid:

- ► to look more closely
- ► to turn from easy answers

Last words

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- ▶ to look more closely
- ▶ to turn from easy answers
- ▶ to ask bigger questions

Last words

Never be afraid:

- ▶ to look more closely
- ▶ to turn from easy answers
- ▶ to ask bigger questions
- ▶ to embrace the unknowable

Last words

Never be afraid:

- ▶ to look more closely
- ▶ to turn from easy answers
- ▶ to ask bigger questions
- ▶ to embrace the unknowable
- ▶ to dream deeper dreams

The end!