



Universität Hamburg

DER FORSCHUNG | DER LEHRE | DER BILDUNG

TAMING AND MACHINE LEARNING EFFECTIVE FIELD THEORIES

Stefano Lanza

ABOUT MYSELF...



ABOUT MYSELF...

Born in **Agropoli**
(Southern Italy)



ABOUT MYSELF...



Bachelor's and
Master's in Pisa

Born in Agropoli
(Southern Italy)



ABOUT MYSELF...

Ph.D. in **Padua**



Bachelor's and
Master's in **Pisa**



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Brief Postdoc
at Harvard



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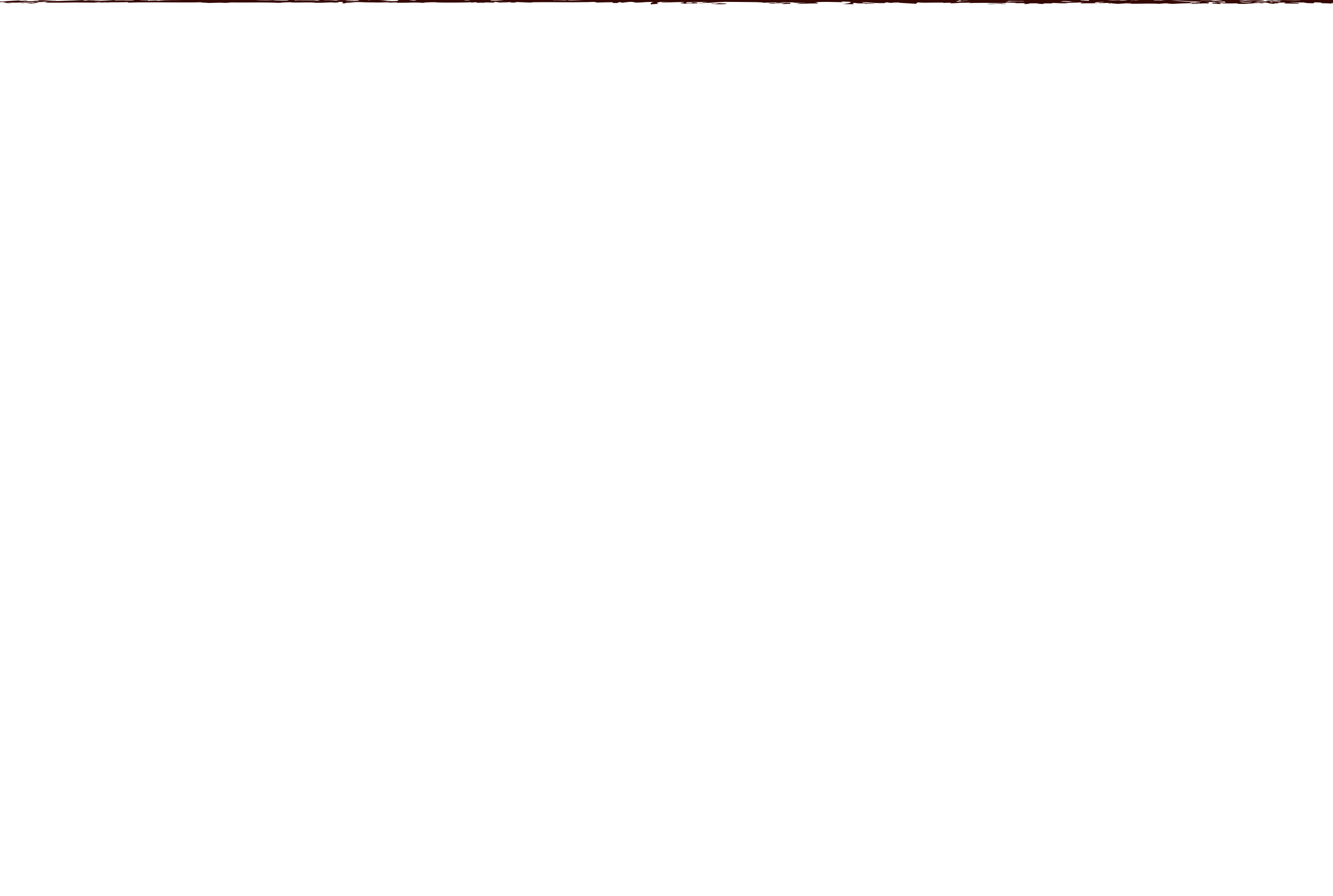
Brief Postdoc
at **Harvard**



Postdoc at
Utrecht University



My RESEARCH



MY RESEARCH

String Theory

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String Theory

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graph TD; A[String Theory] --> B[It unifies Quantum Mechanics and General Relativity]; A --> C[It tells which are the deep geometrical structures that govern the Physics]
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the structure of our Universe

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My research aims at answering aspects of these issues

OUR UNIVERSE, FROM STRING THEORY

How to get 4D Universes from String Theory

Start with string, M- or F-theory,
in 10D, 11D or 12D

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Arrive at 4D effective field theories

**Which common features
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How can we distinguish the **Landscape
of consistent theories from the
Swampland?**

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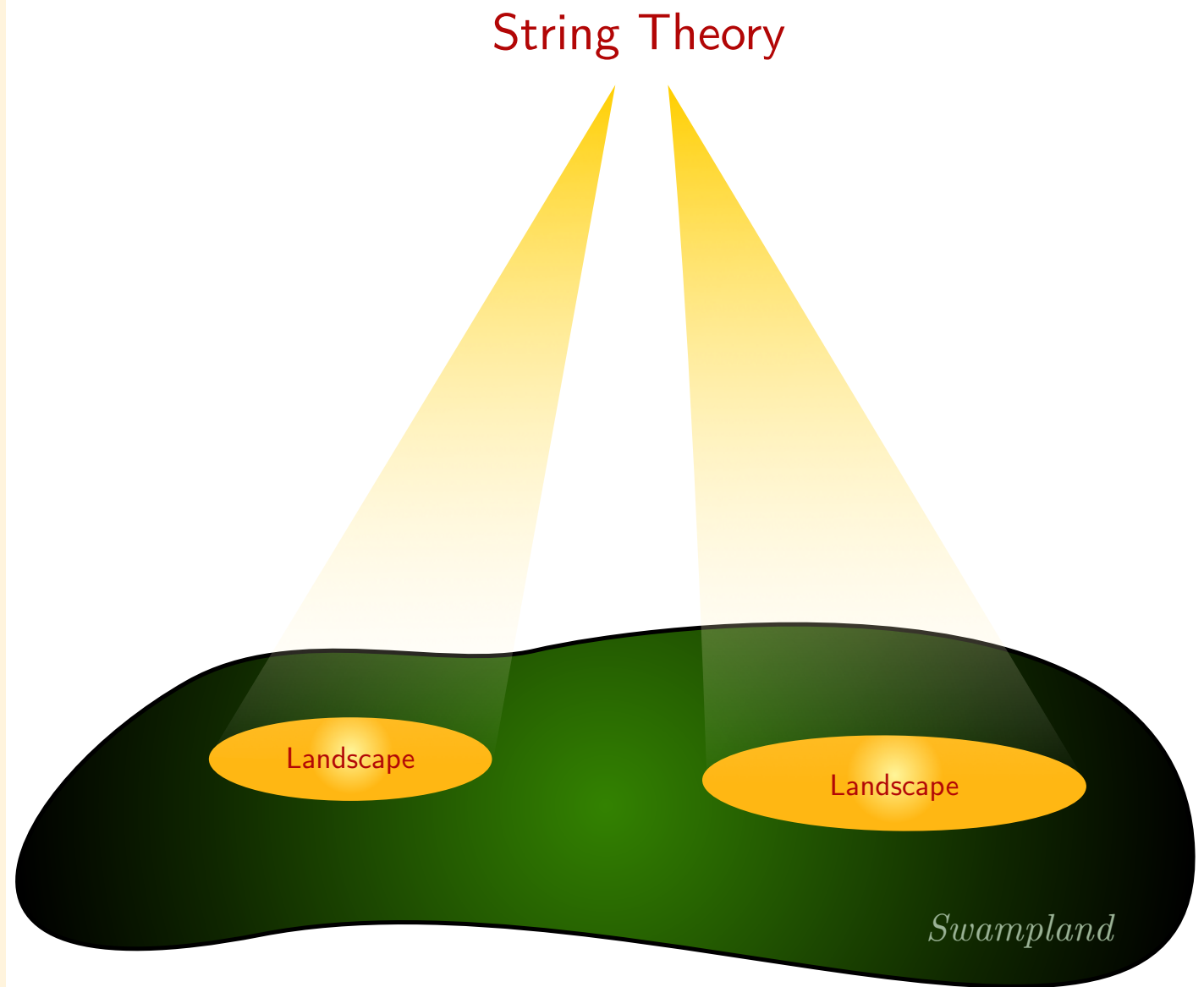
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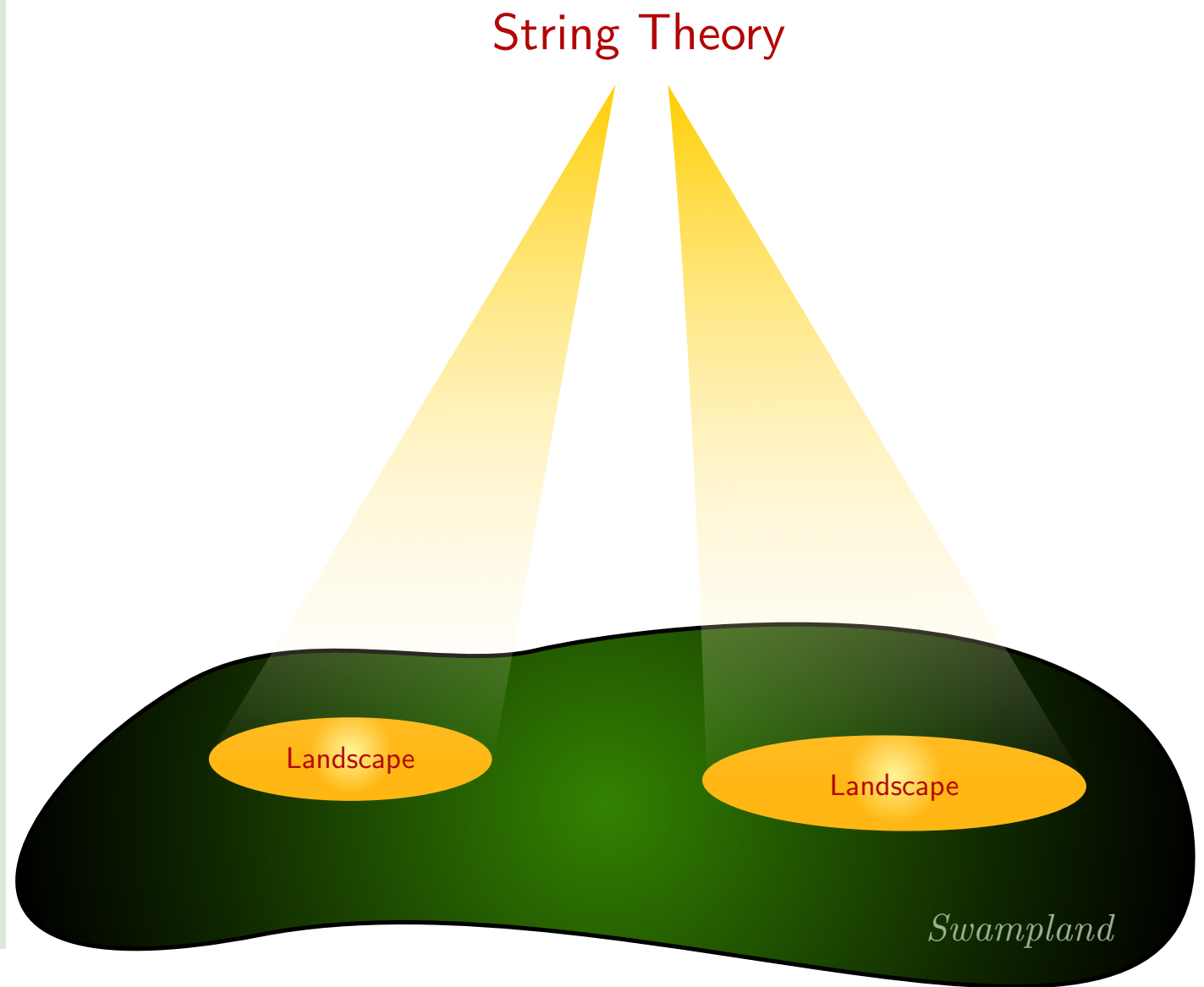
Phenomenology within the String Landscape

Some simple questions need to be answered:

- *Is gravity always the weakest force?*
- *Is a positive cosmological constant allowed?*

Or more complicated ones:

- *Can we retrieve inflation?*
- *Do we have a mechanism that explains why the cosmological constant is so small?*
- *Can we obtain the Standard Model?*



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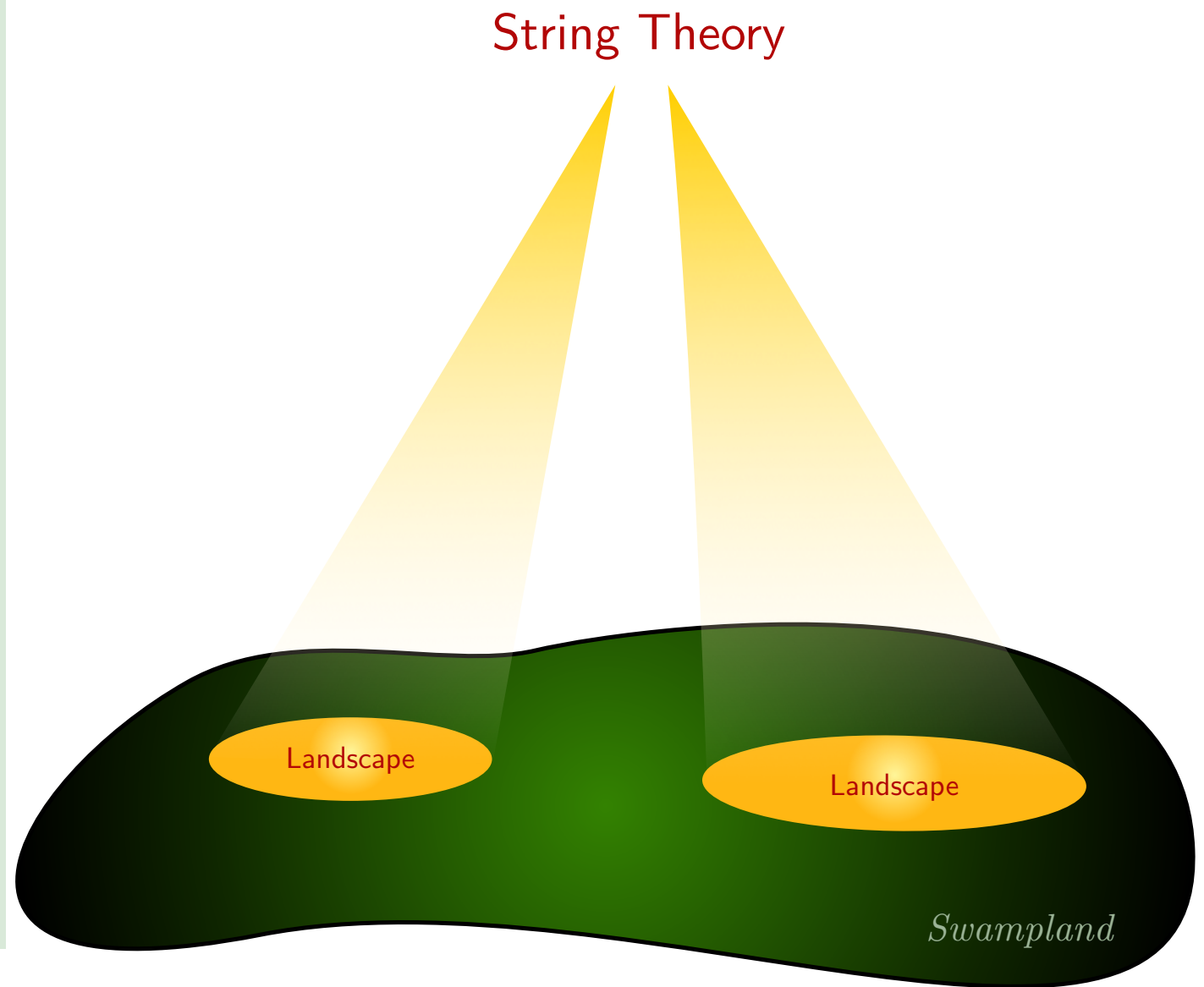
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But these problems are very **hard** to be answered!

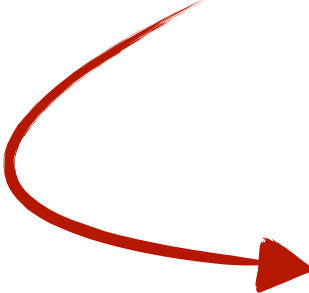
⇒ Use a two-fold approach: **Advanced Math** and **Machine Learning**

I. ADVANCED MATH TO UNDERSTAND PHYSICS

The geometrical structures String Theory predicts are very complicated!
What are the general features that stringy effective field theories exhibit?

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o-minimal Theory



*To which set of functions the couplings of
consistent theories belong?*

II. MACHINE LEARNING TO INVESTIGATE PHYSICS

The effective theories in the Landscape are too many!
How can learn the common features that they exhibit?

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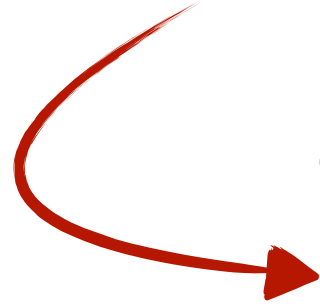
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What are the mechanisms that break down effective theories?

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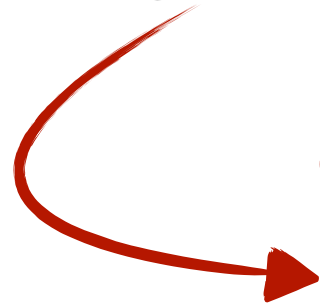
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What are the mechanisms that break down effective theories?

*How can we learn effective theories that
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Examples:

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*How can we learn effective theories that
accommodate inflation?*

*How can we learn geometric data about the
internal manifold?*

Thank you!