D-branes and Deep Learning

Theoretical and Computational Aspects in String Theory

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Polyakov's Action

$$S_P[\gamma, X, \psi] = -\frac{1}{4\pi} \int_{-\infty}^{+\infty} d\tau \int_0^{\ell} d\sigma \sqrt{-\det \gamma}\, \gamma^{\alpha\beta} \left(\frac{2}{\alpha'} \partial_\alpha X^\mu \partial_\beta X^\nu + \psi^\mu \rho_\alpha \partial_\beta \psi^\nu \right) \eta_{\mu\nu}$$

Symmetries:

- Poincaré transf. $X'^\mu = \Lambda^\mu{}_\nu X^\nu + c^\mu$
- 2D diff. $\gamma'_{\alpha\beta} = \left(J^{-1}\right)_{\alpha\beta}{}^{\lambda\rho} \gamma_{\lambda\rho}$
- Weyl transf. $\gamma'_{\alpha\beta} = e^{2\omega} \gamma_{\alpha\beta}$

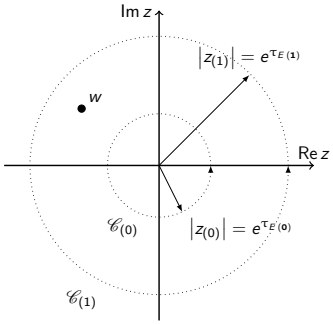
Conformal symmetry:

- vanishing stress-energy tensor: $\mathcal{T}_{\alpha\beta} = 0$
- traceless stress-energy tensor: $\mathrm{tr}\, \mathcal{T} = 0$
- conformal gauge $\gamma_{\alpha\beta} = e^{\Phi} \eta_{\alpha\beta}$

Action Principle and Conformal Symmetry

Let $z = e^{\tau_E + i\sigma} \Rightarrow \overline{\partial}\mathcal{T}(z) = \partial\overline{\mathcal{T}}(\overline{z}) = 0$:

$$T(z)\,\Phi_\omega(w) \overset{z\to w}{\sim} \frac{\omega}{(z-w)^2}\Phi_\omega(w) + \frac{1}{z-w}\partial_w\Phi_\omega(w)$$



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