The correspondence

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We can now formulate the AdS/CFT correspondence as

$$Z_{CFT}\left[J^i = \phi_i^{(0)}\right] = Z_{AdS}\left[\phi_i|_{\partial AdS} = \phi_i^{(0)}\right]$$

$$\| \qquad \hookrightarrow \text{partition function in gravitational side}$$

$$\left\langle e^{\int d^d x\, \phi_i^{(0)} \mathcal{O}^i} \right\rangle_{CFT}$$

We know how to define the left-hand side: it's QFT in a fixed background.

The right-hand side is trickier. The best we can do is define it using string theory in AdS, which we can do (in some cases) in a perturbative way.

More generally, we can do perturbative quantum gravity calculations around saddle points of the bulk action.

Then

$$\boxed{\left\langle e^{-\int \phi_i^{(0)} \mathcal{O}^i} \right\rangle_{CFT} \approx e^{-I_{AdS}\left[\phi_i|_\partial = \phi_i^{(0)}\right]}}$$

The correspondence can be viewed as defining Z_{AdS} in terms of Z_{CFT}. But often, one can do

calculations of Z_{AdS} in the saddle-pt approx which correspond to very difficult calculations for the CFT at very strong coupling

We also saw (and will see again) that the CFT must have large number of local degrees of freedom: large N (for a gauge theory), large central charge