

Python #2

String Theory

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$$G_m \equiv R_m - \frac{1}{2} R g_m = \frac{8\pi G}{c^4} T_{mm}$$

$$\Psi(x) = \frac{1}{\sqrt{K_0}} (A_+ e^{ixx} + A_- e^{-ixx}) \quad x < 0$$

$$K_0 = \sqrt{2mE/\hbar^2}$$

$$R_m - \frac{1}{2} R g_m + \Delta g_m = \frac{8\pi G}{c^4} T_{mm}$$

$$\sigma = \frac{24\pi^3 L^2}{T^2 c^2 (1-e^2)}$$

$$S_B = \frac{k_B 4\pi G}{\hbar c} M^2$$



$$S = \frac{c^3 k A}{4 \hbar G}$$

$$H = \frac{P^2}{2m} + V(r)$$

$$P = -i\hbar\nabla$$



$$S = \frac{1}{2k} \int R \sqrt{-g} d^4x$$

$$L = \Gamma \left\{ \frac{i}{g^2} F_{IJ} F^{IJ} - i\lambda \Gamma^I D_I \lambda \right\}$$

$$H|\psi(t)\rangle = i\hbar \frac{\partial}{\partial t} |\psi(t)\rangle$$

$$e \quad \frac{\delta(k_1+k_2)}{k_1^2} \quad e'$$

$$E = mc^2$$

$$E^2 = (pc)^2 + (mc^2)^2$$

$$r = \frac{\theta}{2\pi} + \frac{4\pi}{g^2}$$

$$I = \int e^{-\alpha x^2/2} dx = \sqrt{\frac{2\pi}{\alpha}}$$

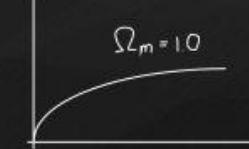
$$E^2 = p^2 c^2 + m^2 c^4 \quad \frac{1}{c^2} \frac{\partial^2}{\partial t^2} \psi - \nabla^2 \psi + \frac{m^2 c^2}{\hbar^2} \psi = 0$$

$$p = \hbar k = \frac{\hbar v}{c} = \frac{\hbar}{\lambda}$$

$$A_{ij} = \frac{8\pi \hbar v^3}{c^3} B_{ij}$$

$$e^z \quad S_f = \langle f | S | i \rangle \quad e^z$$

$$S = \frac{1}{2} \int d^4x \left(R + \frac{R^2}{6M^2} \right)$$



$$\frac{d}{dt} \langle A \rangle = \frac{1}{i\hbar} \langle [\hat{A}, \hat{H}] \rangle + \left\langle \frac{\partial \hat{A}}{\partial t} \right\rangle$$

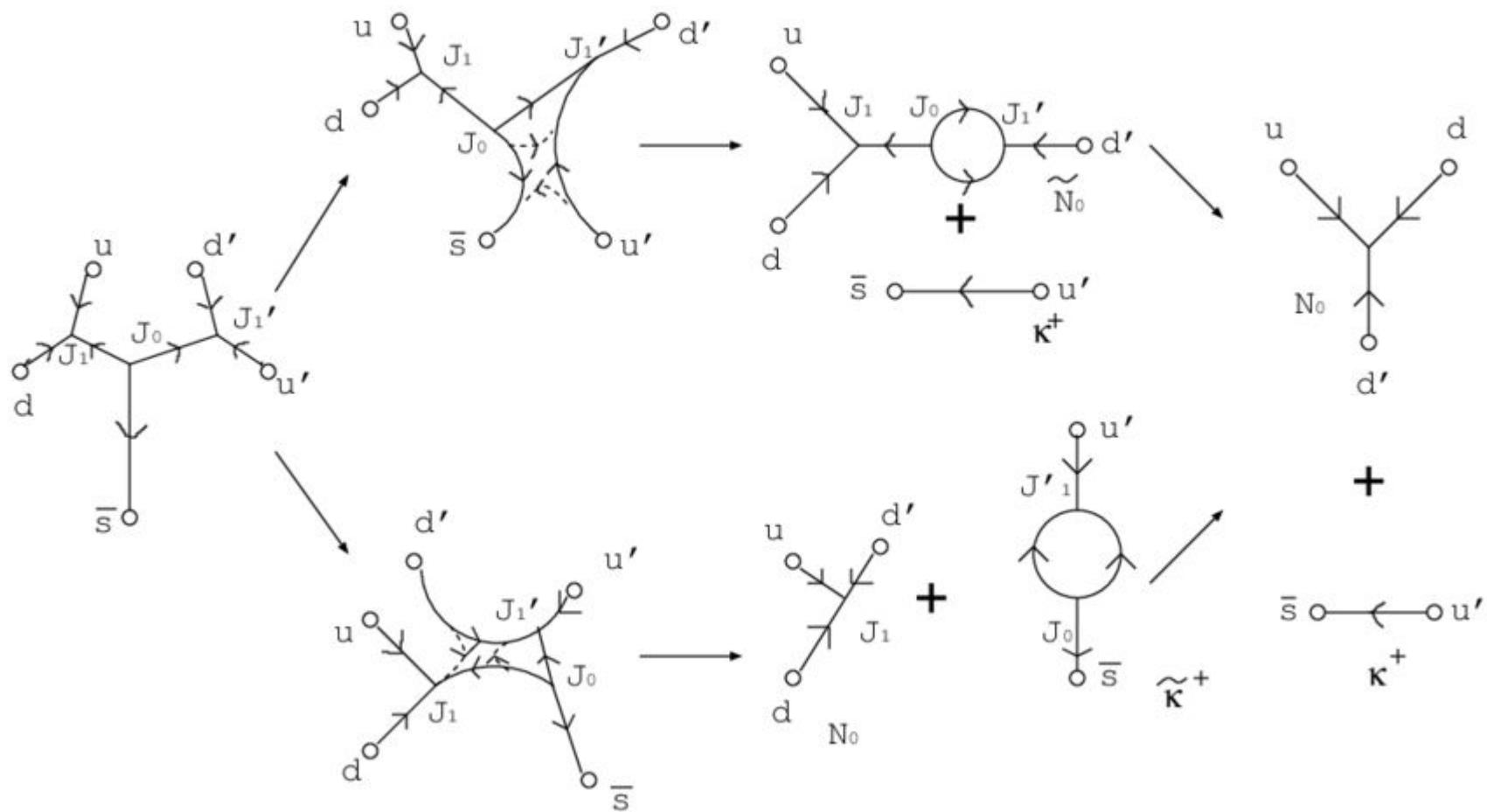
$$i\hbar \frac{\partial}{\partial t} \psi = -\frac{\hbar^2}{2} \sum_{n=1}^N \frac{1}{m_n} \nabla_n^2 \psi + V\psi$$

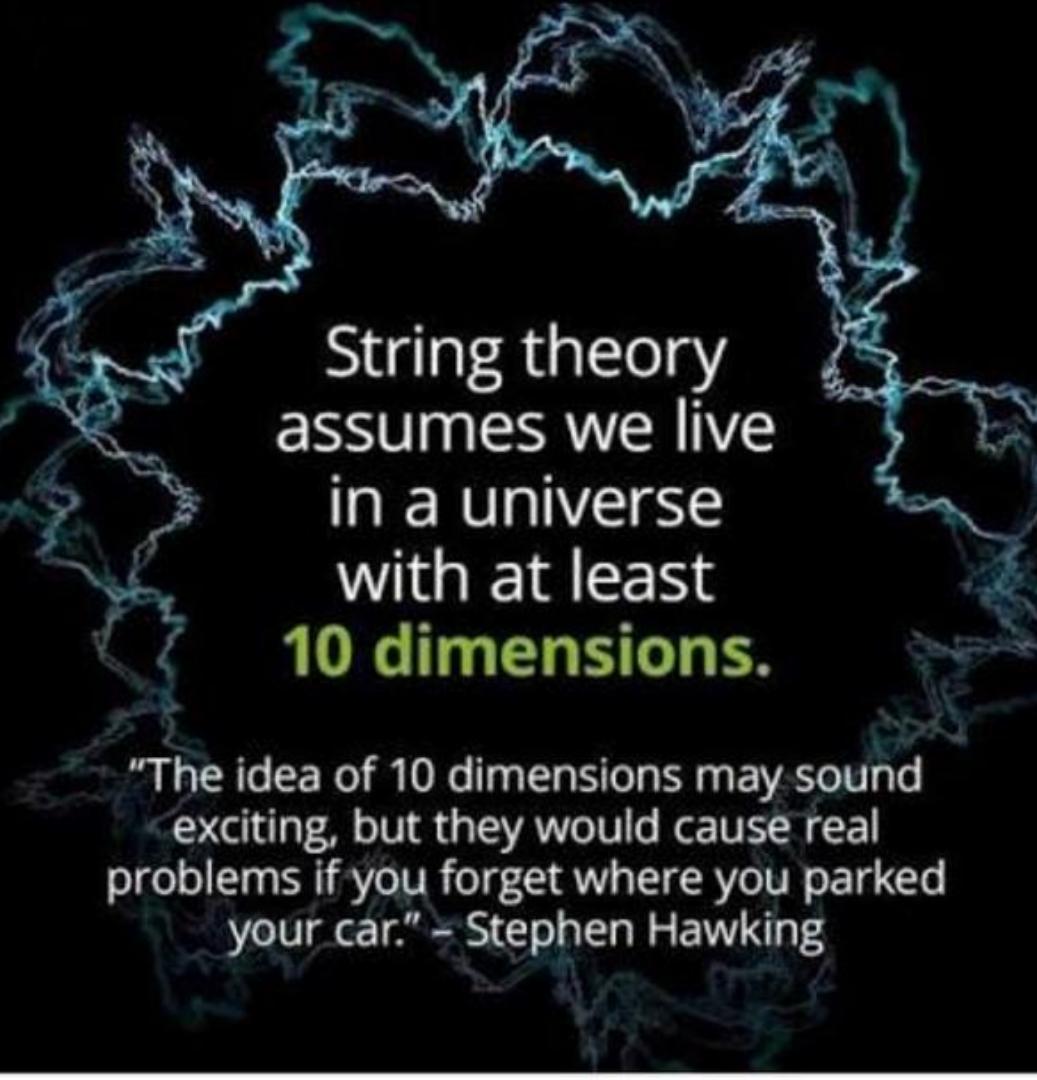
$$\Delta x \Delta p \geq \frac{\hbar}{2}$$

$$dV = e^{-\int_t^s V(X_{\tau,r}) d\tau} \phi(X_{s,t}) \frac{\partial u}{\partial X} d\omega$$



STRING THEORY RESEARCH





String theory
assumes we live
in a universe
with at least
10 dimensions.

"The idea of 10 dimensions may sound exciting, but they would cause real problems if you forgot where you parked your car." – Stephen Hawking

Types (so far)

- int
- float
- str

Some basic string theory

- Use 'single quote' or "double quote" or ""triple quotes""
- Python strings are immutable
- Strings are not necessarily one character per byte - they are Unicode
- Strings may contain "escape" characters with backslash: \n, \", ...
- Determine length via function `len()`
- String methods: `upper()`, `lower()`, `replace()`, `find()`,
`startswith()`, `split()`, `strip()`...
- Use `+` to concatenate strings
- String interpolation
- String slicing

String interpolation

1. In functions like `print()`, include arguments as comma separated values.
 - a. `print('the value of', 'myvar', 'is', a)`
2. Classic method: using % entities in a string, followed by % and a list
 - a. `'The value of %s is %s' % ('myvar', a)`
3. Using `.format()`
 - a. `'The value of {} is {}'.format('myvar', a)`
 - b. `'The value of {0} is {1}'.format('myvar', a)`
 - c. `'The value of {varname} is {varval}'.format(varname='myvar', varval=a)`
4. f-strings (Python 3.6 and later)
 - a. `f'The value of {"myvar"} is {a}'`
5. Template strings

Unicode

- Strings are arrays of Unicode characters (“code points”)
- Unicode code points: 0 through 0x10FFFF (1,114,112) (21 bits)
- *Encoded* into smaller *bytes* for efficient transmission and storage
- Common encoding: utf-8
- ASCII characters (< 128) are valid utf-8 characters (1 byte)
- Other characters in utf-8 can take 2, 3 or 4 bytes
- **Always use Unicode internally. *Decode* what you receive, and *encode* what you send.**

Unicode character codes examples

4E78

CJK Unified Ideographs

HEX	C	J	K	V	HEX	C	J	K	V
4E78	乸	乸	乸	乸	4E8C	二	二	二	二
4E79	軋	軋	軋	軋	4E8D	二	二	二	二
4E7A	𠂇	T3-2823	J1-3038	K0-2143	4E8E	二	二	二	二
4E7B	𠂉				4E8F	二	二	二	二
4E7C	𠂊				4E90	二	二	二	二
4E7D	𠂋				4E91	云	云	云	云
4E7E	乾	乾	乾	乾	4E92	互	互	互	互
4E7F	亂	亂	亂	亂	4E93	开	开	开	开
4E80	龜	龜	龜	龜	4E94	五	五	五	五
4E81	乾	乾	乾	乾	4E95	井	井	井	井
4E82	亂	亂	亂	亂	4E96	三	三	三	三
4E83	麌	麌	麌	麌	4E97	山	山	山	山
4E84	𠂔				4E98	亘	亘	亘	亘
4E85	𠂔				4E99	瓦	瓦	瓦	瓦
4E86	了	了	了	了	4EA0	亚	亚	亚	亚

4E9F

0x1f921
0x4e7e

1F900

Supplemental Symbols and Pictographs

1F9FF

0	1F900	1F910	1F920	1F930	1F940	1F950	1F960	1F970	1F980	1F990	1F9A0	1F9B0	1F9C0	1F9D0	1F9E0	1F9F0
1	1F901	1F911	1F921	1F931	1F941	1F951	1F961	1F971	1F981	1F991	1F9A1	1F9B1	1F9C1	1F9D1	1F9E1	1F9F1
2	1F902	1F912	1F922	1F932	1F942	1F952	1F962	1F972	1F982	1F992	1F9A2	1F9B2	1F9C2	1F9D2	1F9E2	1F9F2
3	1F903	1F913	1F923	1F933	1F943	1F953	1F963	1F973	1F983	1F993	1F9A3	1F9B3	1F9C3	1F9D3	1F9E3	1F9F3
4	1F904	1F914	1F924	1F934	1F944	1F954	1F964	1F974	1F984	1F994	1F9A4	1F9B4	1F9C4	1F9D4	1F9E4	1F9F4
5	1F905	1F915	1F925	1F935	1F945	1F955	1F965	1F975	1F985	1F995	1F9A5	1F9B5	1F9C5	1F9D5	1F9E5	1F9F5
6	1F906	1F916	1F926	1F936	1F946	1F956	1F966	1F976	1F986	1F996	1F9A6	1F9B6	1F9C6	1F9D6	1F9E6	1F9F6
7	1F907	1F917	1F927	1F937	1F947	1F957	1F967	1F977	1F987	1F997	1F9A7	1F9B7	1F9C7	1F9D7	1F9E7	1F9F7
8	1F908	1F918	1F928	1F938	1F948	1F958	1F968	1F978	1F988	1F998	1F9A8	1F9B8	1F9C8	1F9D8	1F9E8	1F9F8
9	1F909	1F919	1F929	1F939	1F949	1F959	1F969	1F979	1F989	1F999	1F9A9	1F9B9	1F9C9	1F9D9	1F9E9	1F9F9
A	1F90A	1F91A	1F92A	1F93A	1F94A	1F95A	1F96A	1F97A	1F98A	1F99A	1F9A0	1F9B0	1F9C0	1F9D0	1F9E0	1F9F0

Unicode examples

- Pyဗ္နဗ္နဗ္န
- áccéñtéð téxt fóř téštíng
- jooł lnjæsn si umop-əpısdn
- Hello, World!

String Slicing

s = 'abcd'

s[0]

s[-1]

s[2:]

s[:]

s[1:2]

s[0:100]

s[1:-1]

s[-2:]

s[:n] + s[n:] is always a

Functions can be Fun

Function domains

- Built-ins
- User-defined in current file
- User-defined in another file (module)
- Standard library (module)

Fun Function Facts

- Function is a type (like int, float, str...)
- Functions may contain parameters (arguments), passed in
- Functions may return a value, or multiple values
- Arguments and return values can be any type, including function
- A function can call other functions, (including itself)
- A function may contain definitions of new functions
- Scope of variables inside a function are local to that function, and invisible from outside the function
- Functions may expect a specific number of arguments, or allow a variable number of arguments
- The value of some function arguments may have defaults
- Object references are passed by value.