Thesis

A Critical Study on Batman

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Abstract

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magnam aliquam quaerat voluptatem. Ut enim aeque doleamus animo, cum corpore dolemus, fieri tamen permagna accessio potest, si aliquod aeternum et infinitum impendere malum nobis opinemur. Quod idem licet transferre in voluptatem, ut postea variari voluptas distinguique possit, augeri amplificarique non possit. At etiam Athenis, ut e patre audiebam facete et urbane Stoicos irridente, statua est in quo a nobis philosophia defensa et collaudata est, cum id, quod maxime placeat, facere possimus, omnis voluptas assumenda est, omnis dolor repellendus. Temporibus autem quibusdam et aut officiis debitis aut rerum necessitatibus saepe eveniet, ut et voluptates repudiandae sint et molestiae non recusandae. Itaque earum rerum defuturum, quas natura non depravata desiderat. Et quem ad me accedis, saluto: 'chaere,' inquam, 'Tite!' lictores, turma omnis chorusque: 'chaere, Tite!' hinc hostis mi Albucius, hinc inimicus. Sed iure Mucius. Ego autem mirari satis non queo unde hoc sit tam insolens domesticarum rerum fastidium. Non est omnino hic docendi locus; sed ita prorsus existimo, neque eum Torquatum, qui hoc primus cognomen invenerit, aut torquem illum hosti detraxisse, ut aliquam ex eo est consecutus? – Laudem et caritatem, quae sunt vitae.. Very bland verbiage here. Will add some interesting stuff once I actually figure out how to write.

Contents

1. Introduction

If you have started reading this document, I have successfully lured you in to reading about batman. Spoiler Alert: Batman is awesome, and he cannot be studied because he is AWESOME. Anyways, there are just some sample examples of different usages of some stuff here.

2. Math

Definition 2.1 (Kolmogorov Smirnov Test):

The one sample Kolmogorov Smirnov test is defined as follows: The empirical distribution function F_n for n independent and identically distributed (i.i.d.) ordered observations X_i is defined as

$$F_n(x) = \frac{\text{number of elements in sample} \leq x}{n} = \left(\frac{1}{n}\right) \sum_{i=1}^{n} I_{[-\infty,x]}(X_i) \tag{2.1}$$

where $I_{[-\infty,x]}(X_i)$ is an indicator function that is 1 if X_i is in the interval $[-\infty, x]$ and 0 otherwise.

The Kolmogorov Smirnov statistic D_n is then defined as

$$D_n = \sup_x |F_{n(x)} - F(x)| \tag{2.2}$$

where F is the cumulative distribution function of the reference distribution being tested against.

Theorem 2.1 (Glivenko-Cantelli Theorem): Suppose that the observations $X_1, X_2, ..., X_n$ used in Definition 2.1 in are independent and identically distributed with cumulative distribution function F. Then, the empirical distribution function F_n converges uniformly to F almost surely, i.e.,

$$\|F_n - F\|_\infty = \sup_{x\in\mathbb{R}} |F_n(x) - F(x)| \longrightarrow 0 \text{ as } n \longrightarrow \infty \tag{2.3}$$

Here is a really interesting paper, where this test was used [1], and the code for generating the same is below.

```typst
#definition("Kolmogorov Smirnov Test")[

  The one sample Kolmogorov Smirnov test is defined as follows:
```

```
  The empirical distribution function $F_n$ for n independent and identically distributed (i.i.d.) ordered observations $X_i$ is defined as
  $
    F_n (x) = ("number of elements in sample"<= x)/n = (1/n) sum_(i=1)^n I_([-infty, x])(X_i)
  $
  where $I_([-infty, x])(X_i)$ is an indicator function that is 1 if $X_i$ is in the interval $[-infty, x]$ and 0 otherwise.

  The Kolmogorov Smirnov statistic $D_n$ is then defined as
  $
    D_n = sup_x |F_n(x) - F(x)|
  $
  where $F$ is the cumulative distribution function of the reference distribution being tested against.
]<KStest>
// labelling the definition for later referencing
#theorem("Glivenko-Cantelli Theorem")[
  Suppose that the observations $X_1, X_2, ..., X_n$ used in @KStest in are independent and identically distributed with cumulative distribution function $F$. Then, the empirical distribution function $F_n$ converges uniformly to $F$ almost surely, i.e.,
  $
  norm(F_n - F)_infty = sup_(x in RR) |F_n (x) - F(x)| --> 0 "as" n --> infty
  $
]
```

2.1. Unnumbered Math

A random lagrangian as given by Github Copilot is,

$$\mathcal{L} = -|(\psi)(i\gamma^\mu D_\mu - m)\psi - \left(\frac{1}{4}\right) F_{\mu\nu}F^{\mu\nu} + |D_\mu \varphi|^2 - V(\varphi)$$

where $D_\mu = \partial_\mu + ieA_\mu$ is the covariant derivative, $F_{\mu\nu} = \partial_\mu A_\nu - \partial_\nu A_\mu$ is the electromagnetic field strength tensor, ψ is the Dirac spinor field representing the electron, A_μ is the electromagnetic four-potential, φ is the complex scalar field, and $V(\varphi)$ is the potential energy term for the scalar field.

Below is the code for generating the above lagrangian without equation numbering.

```typst
#nonum($
  cal(L) = -bar(psi)(i gamma^mu D_mu - m)psi - (1/4) F_(mu nu) F^(mu nu) + |D_mu phi|^2 - V(phi)
$)
```

3. Fun CS stuff

Here is some ChatGPT generated Python code that prints the first 10 terms of the Fibonacci sequence:

```python
n = 10  # number of terms

a, b = 0, 1

for _ in range(n):
    print(a, end=" ")
    a, b = b, a + b   # swapped & updated without third variable
```

A program which prints out its own source code is called a quine. A polyquine is a program that can output its own source code when compiled or interpreted in multiple programming languages. The following is polyquine called the Ouroubourous quine that works in 128 different programming languages. The github repo is here Ouroubourous Quine.

As a refresher on this and more fun stuff is an NDC conference talk by Dylan Beattie, The Art of Code. For now, the whole source code is pasted below:

4. Conclusion

This is the conclusion. Batman is still awesome. Anways, here is a joke.

> See, there were these two guys in a lunatic asylum...and one night, one night they decide they don't like living in an asylum any more.
>
> They decide they're going to escape! So, like, they get up onto the roof and there, just across this narrow gap, they see the rooftops of the town, stretching away in the moonlight...stretching away to freedom. Now, the first guy, he jumps right across with no problem. But his friend, his friend daren't make the leap.
>
> Y'see...y'see, he's afraid of falling. So then, the first guy has an idea...
>
> He says 'Hey! I have my flashlight with me! I'll shine it across the gap between the buildings. You can walk along the beam and join me¡

B-but the second guy just shakes his head. He suh-says… he says

'What do you think I am? Crazy? You'd turn it off when I was half way across!

— Alan Moore

References

[1] N. Neave, K. McCarty, J. Freynik, N. Caplan, J. Hönekopp, and B. Fink, "Male dance moves that catch a woman's eye," *Biology Letters*, vol. 7, no. 2, pp. 221–224, Sep. 2010, doi: 10.1098/rsbl.2010.0619.