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Challenges, Choice, & Change: Experiences and Reflections From the First Semester of a Technology and Human Futures Course

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ABSTRACT

Society's rapidly increasing reliance on technology has created urgency for future leaders to understand these technologies' potential impacts. News of technical and algorithmic concerns in society are frequent, highlighting the real impacts to real people.

Learners may approach computing in order to feel prepared for careers and life in modern society. These learners benefit from understanding the many ways technology may be part of their future careers, their lives, and the lives of others. Beyond this, many wish to use computing to solve problems - but complex societal problems may feel too overwhelming to solve. Greater understanding of the technologies involved and the ways humans, society, and technology interact may help learners feel more confident in exploring and navigating these problem spaces for better tomorrows.

This experience report describes the first semester of a new course developed to explore the intersection of technology and human futures. This course centered cultural competency themes alongside technologies and sectors to better understand not only how technology is applied in society, but how these factors can have different results across distinct identity facets.

The perspectives shared in this report include the instructor (author) and students - gathered through a survey co-designed with the students. The experience was overall positive for both students and instructor. Learner sentiments suggest that more course offerings like this are valuable by providing new and engaging material as well as new tools and considerations for their future careers.

CCS CONCEPTS

• **Social and professional topics** → **Computing education.**

KEYWORDS

computer science education, human factors, sociotechnical design, futurism, ethics, upper level course, cultural competency, experience report, communication, engagement

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1 INTRODUCTION

Courses within computer science departments have traditionally centered technical concepts such as programming, systems, and algorithmic theory. Given our society's increasing reliance on digital technologies, a critical need is growing for computing education which centers the human and societal impacts of software.

Technology's societal impacts require greater consideration of the humans who will be affected by our code, as well as those who are (or are not) in the room developing it. Culturally responsive pedagogy [10, 13, 22, 28] promotes activities and practice recognizing how a student's lived experiences and culture impact learning experiences and goals. These approaches also present diverse perspectives, examples, and practices to promote greater cultural competency, which has been found to be lacking within computer science education [31]. "Disruptive pedagogies" can aid in not only presenting diverse perspectives, but encourage interruption and interrogation of marginalization [21, 27]. These "disruptive" approaches align with critical and engaged methods (such as Freire [12] and hooks [16], and may link through resulting cultural activism to historically marginalized college student persistence [19].

Concerns of computing's impact on historically marginalized communities [3, 5, 6, 23, 25, 30] are being identified and explored at explosive rates. These concerns grow the calls for more responsible computing research [24], and design of sociotechnical systems [1]. Efforts to approach the design of sociotechnical systems with greater emphasis on human impacts and social justice have risen to the call [2, 8, 9, 11, 29], but there is ever more work to be done.

Efforts to create and incorporate social impacts and ethics more broadly into curricula and assignments are on the rise [15, 26], including calls to reframe CS curricula entirely in ways centering critique and social impacts [18, 33]. Computing education programs centering people have also been found more likely to appeal to women [7, 14, 20], highlighting the impacts these approaches can have on the landscape of computing student demographics.

The Cultural Competency in Computing (3C) Fellows program [32] helps prepare faculty to advocate for and create cultural competency change in computing education. 3Cs asks fellows to implement some deliverable relating to the program themes.

This paper describes experiences from a Spring 2022 course pilot, which as a 3Cs deliverable drew inspiration, material, and themes from the program. The course design is part of a growing efforts in this space, especially over the past two years. The course centers human futures and identity in the design of sociotechnical systems, using themes of design justice alongside culturally responsive and disruptive styled approaches to promote cultural competency and critical analysis of technology design among students.

2 INSTITUTIONAL CONTEXT

Our university is a public university, located in a rural midwestern area of the United States. The institution is STEM-focused, with a student body that is majority white and majority male. Bachelor’s degree enrollment figures from 2020 for our institution indicate 87.3% white and 71.5% male. Computing accounts for approximately 12% of the university’s enrollment, with similarly trending metrics.

3 COURSE DESIGN

The course was offered by our Computer Science department for the first time in Spring 2022 as Special Topics. This allows for new courses to be piloted without significant overhead.

“Technologists in this course will reimagine the future of computing in ways that center people and communities. Connecting cultural competency and computing innovations requires us to consider not just what is created, but who it serves. By critically paralleling diverse human experiences to technological applications and ideas, we will recognize disconnects in “the way things are” and reimagine through redesign and analysis how they could be. The future of technology is not written in stone – we can imagine and create a new and better tomorrow for all.” - Course Description

The course was listed at the graduate level, however, upper level undergraduates were also welcome. Students enrolled in our upper level Computing Ethics course were encouraged to join if they were interested in continuing ethics-based conversations. A pitch to humanities students was also made at an evening event focusing on data and misinformation put on by our humanities department.

The course was designed to be interdisciplinary. Students from Cognitive and Learning Sciences and Humanities were particularly encouraged to join. The course did not require any programming expertise, instead centering as requirements a desire to explore these technologies and design considerations with care and respect.

Course activities largely focused on writing to express and analyze technical design considerations. Students reflected weekly on course material, engaged in discussions with their peers in class and online (An analysis of the online discussion prompts in this course has been previously published [4]), and investigated how certain technologies such as machine learning categorization and accessible web design work through exploratory modules.

Required course materials were openly available research-based texts, news articles, and videos to promote equitable access. Our “core textbooks” were: “Design Justice” by Sasha Costanza-Chock [8] and “Data Feminism” by Catherine D’Ignazio and Lauren Klein [11]. Weekly material often included a chapter alongside articles, research papers, interviews, and seminar recordings. Students were given about three hours worth of material to review for each week. Optional materials for further exploration were also provided.

3.1 Topics

Students explore the course in two distinct portions. The first portion centered exploring cultural competency and identity facets. Specific facets such as race, ethnicity, (dis)ability, gender, sexuality, and class are investigated, as well as ideas such as intersectionality and the matrix of domination. This portion of the course which

looks at “specific” identity and human concepts pairs each topic with a technological “big idea”, such as Privacy or Accessibility.

In the second portion (starting Week 8), the “roles” of technology and human concepts are flipped. Students have at this point gained breadth in considering many facets and concepts of identity. They now are expected to apply these to “big ideas” in humanity, such as Freedom and Choice. These humanity “big ideas” are each paired with a specific technology or sociotechnical arena, such as cryptocurrency or healthcare. Students are expected to consider the impact to humans and the “big idea” across identities for these specific technologies and technologically impacted spaces. The topic focuses for the course in Spring 2022 can be seen in Table 1.

Week	“Big Idea”	Specific Concept
1	Design and Development	Welcome & Onboarding
2	Accessibility	Disability & Presence
3	Use Cases	Race & Ethnicity
4	Privacy and Security	Gender & Sexuality
5	AI and Machine Learning	Class & Poverty
6	Data Set Curation and Use	Systems of Power & Marginalization
7	Computing Artifacts	Toward Cultural Competency & Decolonization
8	Sustainability	NFTS & Cryptocurrency
9	Representation	Facial/Voice Recognition & Sentiment Analysis
10	Choice	Consumer Wearable & “Public Utili-Tech”
11	Wellness	Healthcare IT & Child Welfare Technologies
12	Prosperity	Mortgage/Loan Technologies & Hiring Screening
13	Freedom	Policing Technologies & Surveillance Systems
14	Innovation	Imagining & Realizing New Technological Futures

Table 1: Spring 2022 Weekly Topic Schedule

3.2 Final Project

The final course product is a project proposal for reimagining some sociotechnical design by specifically centering a currently marginalized group within that space. Students choose an area to explore and a group to center. A pre-proposal is required in order to ensure the area they wish to explore meets the requirements and to prompt some initial investigation into the space and centered group.

This project allows students freedom to more deeply explore areas they are interested in, but requires them to specifically consider some group currently marginalized within this space. Students research the problem space, their centered group, and the gaps which exist for those individuals. They then propose alternative designs and how they feel these designs would better center those

marginalized. Students are also expected to turn a critical lens to their own reimaginings, acknowledging limitations and including methods for involving those they have centered into the design process. Students also identify plans for what the next steps might be, should they move forward with developing these projects.

While the final project does not require programming, students must still communicate about technical and system design in a way which suggests a well-researched plan with potential to succeed if developed. By not centering on development in this course project, students focus on what *could be possible* given time and resources, rather than narrowing their scope to solutionism approaches of *what is feasible to build in a semester*. This also provides students a meaningful artifact in the form of a “preliminary funding proposal” to springboard efforts on their projects after they leave the course (in graduate studies, industry, or otherwise).

4 STUDENT PERSPECTIVES

Seven out of ten students (70%) responded to our survey relating to course experiences with informed consent. This survey was deemed non-research activity by our institutional IRB.

To emphasize the identity-focused nature of the course, and to respect the voice and experience of the students in feedback analysis, significant use of quotes will be used. All survey responses were in plain text. Emphasis in quotes (i.e., bold or italics) is added to highlight key points within the quote relating to response analysis.

4.1 Co-Creation of Feedback Survey

Students assisted in co-designing the survey in order to provide feedback on the course that extended beyond traditional end-of-course surveys. Classroom discussions were had which centered concerns surrounding data transparency, safety, and consent with regard to their experiences and classroom work.

Based on these discussions a survey was chosen, students helping to select and design questions they felt best reflected the experiences they wanted to share. Students assisted through a separate survey on potential questions which asked their thoughts on proposed questions and provided space to share concerns or add additional questions. The finalized survey design was shared with students prior via a course announcement to ensure transparency.

4.2 Demographics

Students self-identified demographic information via the following prompt: *Would you like to share any additional identity information that you feel would help others understand the perspectives you bring to this course? (Race, culture, gender identity, ability, etc.)*

This prompt allowed students to self select the identity facets which were most meaningful to them to share, in terms that they felt most reflected them. This is a limitation for data analysis, but ultimately provided the students with greater agency to self-describe. Six of the seven respondents provided details for this question.

4.2.1 Gender. All students responding indicated gender identity, with three identifying as male and three identifying as female. Three students (two female, one male) indicated being cis / cisgender, while the other three did not include an identifier of this nature.

4.2.2 Additional “Common” Demographic Facets. Four students indicated being white (two female, two male) and one student identified as Indian. Three students shared major information, all indicating a connection to our computer science department. Two students (who had also shared major information) indicated being undergraduates. Two students indicated ability, with one indicating they are able-bodied and the other indicating having a “mostly-invisible” disability. Two students identified where they grew up, with both indicating our state. One student indicated socioeconomic status (upper middle class). One student indicated sexual orientation (bisexual). One student specifically indicated age (21).

4.2.3 Student Positionality. Three students shared how life and personality shaped perspectives. One shared they may be “in an openly very bad mood” when not feeling well (due to a “mostly-invisible” disability). One indicated family encouraged higher education and cited previous gender studies pursuits as investment in “considering issues of bias and marginalization”. Another said travel created “diverse experiences”, important “in shaping my thought processes” - citing visiting “over 15 countries across 3 continents”.

4.3 Topics of Interest

All seven students responded to the prompt: *What topics were most interesting to you from the course materials? Were there any specific materials or ideas that stood out?*

Three students showed interest in data set bias, especially with regard to AI and machine learning (one specifically indicates facial recognition). Disability also appeared in three responses, with one specifying the concept of “curb cuts” and another explaining how these conversations tied into their courses on user experience design. The student who identified curb cuts also mentioned the week covering the topic of race, and shares:

“The week about race helped me see **just how strong people can be and how important hope is**. The week about curb cuts **gave me the hope that I personally can make a small difference** with everything I create.”

Sustainability, Cryptocurrency, and NFTs were in two responses - both indicated that their relevance resonated, as one shares:

“Especially because **they’re “timely”** and helped me actually articulate the feelings I had about those topics but couldn’t explain other than “bad vibes.” So **it helped me feel more informed and empowered** to think about those topics.”

One student indicated digital colonialism/imperialism, alongside notions of “tech creep” and surveillance/policing technologies - suggesting interest in what might broadly be characterized as “technosolutionism and power”.

4.3.1 Un(der)explored Topics. There were five responses to *Which topic(s) would you like to have seen explored further? Do you have any recommendations for materials or ideas to explore on those topics?*

Two students identified ways to better ground and position the course material. One suggested topics can start to overlap, and so some “oddball” cases may be of interest, but did not have an example. Another suggested the historical perspectives were valuable, and more of them could provide useful context.

Another two students identified topics they wanted to pursue more deeply. One suggested greater exploration of additive design, which is relevant across contexts beyond media. The other indicated the course breadth posed a limiting factor, and that they wished for more discussion on sustainability and renewable energies.

The last response centered new framing of course topics, suggesting “privacy” and “identity” might form new conversations. Specifically, the student suggests new discussion paths for targeted advertising, demographics, data collection, and privacy. Their response also ponders “default” demographic assumptions:

“Maybe **the prevalence of demographic data collection in account creation for web services**. What’s necessary and what isn’t [...] something that just popped into my head, **how weird it is that entering your gender is the norm for so many online services/social media as opposed to any other demographic information**. I suspect this is due for advertising purposes but also wouldn’t be surprised if, for example, race isn’t asked because people are presumed to be white by default. I always think **the ‘commodification’ of demographic characteristics for social or advertising purposes** is interesting [...]”

4.4 Impacts

4.4.1 Future Trajectory. Six of the seven students responded to: *How, if at all, do you anticipate what you learned in this course might influence your future trajectory (career, education, etc.) ?*

Three students indicated that they do not feel their trajectory changed, but they can see possible future value from the course:

“[...] **If I decide to go grad school** though it did give some interesting ideas to study.”

“I do not think that the course learning would necessarily change my career trajectory for the time being. However, **I know for a fact that I will be thinking about how my contributions to the technological world will be impacting users at every step.**[...]”

“I don’t know that this course will impact my trajectory, but it will give me **useful lenses for design**”

Discussing careers, one student indicated “More than ever I feel motivated” regarding a UX design career trajectory. Two discussed futures in academia, with the first sharing how this course may change their CS classroom approach, and more immediate impacts:

“I expect it will impact my future career (eventually as a professor) by causing me to think more deeply about 1) how to **incorporate some level of design justice awareness** into ordinary CS lessons, 2) the backgrounds and **potential locations on the matrix of domination that students are coming from**. More immediately, **the course has me questioning most things in the built environment.** [...]”

The second academia-bound student echoed value in their psychology research and education, as well as identifying value generally as a citizen within an increasingly digital society:

“**As a digital citizen I think a lot of this is just good to know in practice**, and can influence how I

engage with my own digital privacy and how I interact with systems. I can better identify what’s more or less biased and where those biases might have arisen and what their effects might be. I think the accessibility and data-collection/use/proliferation information is most useful to me as a research-based grad student and future professor, so **I would definitely want to incorporate discussions on bias in every step of the data process into psych research education.**”

4.4.2 Impactful Moments. Five students responded to the prompt: *Are there any specific, impactful experiences or connections with the course material that you would like to share in more detail?*

Two students responses indicated nothing specific to share.

One student requested their response be summarized or redacted (noted in our survey design by placing information within square brackets). At a high level protecting this student’s privacy, they had a very personal connection to one of the topics and appreciated being able to consider and think about this in the course.

Another respondent felt greater awareness of diversity’s impact in what we build and how it affects others. They specifically cited the course as useful in helping a friend navigating scholarship essays by centering the perspectives they might be able to bring:

“[...] I thought about this course quite a bit and **pulled a few of our articles to give him ideas to talk about the diversity he could bring.**”

The final respondent was impacted by gender identity discussion:

“[...] **It made me realize how much the world forces a binary image onto people** and assumes that you’ll be safe if you just stay with a group matching your birth gender. It stood out that **social norms don’t really consider the concept of thriving** or even someone being good at a task that is traditionally the job of the other gender, so tools needed are often not designed for universal use. [...]”

This student further discussed finding impact in our lecture discussions on Dr. Ko’s RESPECT keynote [17], and how it helped them recognize the need to care for themselves within academia:

“[...] **It was a wake-up call for me** watching Dr. Amy J Ko’s talk when she discussed **the pressures to ignore one’s body** (i.e. dismissing the need for sleep, food, and exercises) in favour of academic pursuits. **It got me thinking about the need to restructure education** so that people have time to sleep whether they are CS students or medical interns.”

4.4.3 Additional Comments. Two students responded to the prompt: *Please feel free to leave any additional comments or thoughts you would like to share that were not explored in the questions above.*

One simply indicated they had nothing else they wanted to mention. The other indicated a positive classroom environment:

“It was really nice to be in a class with **open discussion where everyone was very respectful of each other**. I always felt very safe to express my views and opinions.”

4.5 Project Choices

Six of the seven students shared their final project concepts via the following prompt: *Please describe briefly some aspect(s) of your final project. What sociotechnical area did you choose to investigate? Which marginalized group did you center in your proposed reimagining? If you are willing to share any additional thoughts regarding your project design, please feel free to include them as well.*

Area	Group	Concept Space
Medical	Low Socioeconomic Minoritized Individuals	Harmful AI Care Designations
Digital Privacy	Transgender Individuals	“Zombie” Datasets containing Facial Images
Education	Rural (Typically Low Socioeconomic) Individuals	Design of Distance Learning
Digital Gaming	Disabled Individuals	Physical Components and Industry Standards
Transportation	Lower Wealth Individuals and Countries	Obstacles to Electric Car Sustainability
Utilities	Low Socioeconomic Communities and Countries	Access to Electricity

Table 2: Summary of Responses to Project Choice Prompt

Table 2 gives an overview of the respondents’ project descriptions. While low socioeconomic status appears among four of the projects as the group being centered, all had distinct sociotechnical areas and concept spaces. Further, “socioeconomic status” was also differently explored among these contexts, even if not apparent from the student response. For example, the “Medical” project specifically centered *Black* low socioeconomic individuals. The “Utilities” and “Transportation” projects both explored marginalized and exploited *countries*. Here, lower socioeconomic status refers to country wealth rankings. These two projects additionally investigated impacts to individuals: both within these countries, and (especially in the case of “Transportation”) beyond.

4.6 Expectations

Understanding student expectations in a new course can help better recognize motivations and perceptions surrounding the material. All seven respondents shared their thoughts on the following prompt: *Why did you choose to take this course? Did the course meet your expectations in choosing to take it?*

Responses indicated overall that the course had met expectations. The one response which indicated the course *did not* meet expectations highlights how this was actually positive for the student:

“I chose this course because I was interested in taking a graduate-level ethics-based course that would combine computing with other disciplines. It also sounded

interesting. **The course did not meet my expectations** – I’d expected to be in a class with a 50/50 split between CS and humanities grad students and no undergrads. I’d also expected there to be some programming aspects to the course. **Reflecting back, I’m VERY glad the course did not meet my expectations:** having no programming aspects forced me deeper into introspection about the material. Having a mixture of juniors, seniors, and grad students for classmates made it much more enjoyable because of our different life stages (and therefore worldviews).”

Two students indicated that the course fulfilled a requirement for a higher level computing course in their major. Both also indicated that the course appeared interesting to them:

“**I needed a tech elective**, but even if I didn’t, I probably still would have taken it if my schedule allowed because the name and topic sounded interesting”

“I took the course to **meet requirements for graduation**, and to also explore ethical concerns involved with modern software development. The course met both of these expectations.”

Following curricular requirements, another student shares interest in continuing conversations from our general Computing Ethics course, which is required for CS majors. This course introduces and explores ethical topics, often centering general professional ethics with less exploration into identity as a factor:

“I took this course after enjoying my time in [CS Ethics] and hearing that this course was **an evolution** of some of the questions proposed in that class.”

One student found the course description while browsing the course catalog, and shares that their request for a syllabus furthered their interest. In terms of expectations they continued with:

“[...] I believed that the course would allow me to expand my grasp over the domain of computer science **through a point of view that I had not previously considered**. Overall, the course met and exceeded my expectations [...]”

Another shared how current events shaped their interest, citing hearing about the course after the Facebook Congressional Hearings. They indicated finding value in the course description:

“[...] I wanted to discuss and learn more about this element of computing **which doesn’t feel covered anywhere else**. [...]”

A student referred to the class by their department chair shares the course met expectations and was among their most interesting:

“I took this course because **my department chair recommended it to me specifically**, and said it sounded like something I would be really interested in. It definitely met my expectations, **it’s one of the most interesting classes I’ve ever taken** [...]”

4.7 Recommendation

All seven students provided answers to the prompt: *Would you recommend this course to other students? Why or why not?* Each

indicated unequivocally that yes, they would recommend the course. Students also provided justifications for their “yes” in all responses.

Two respondents suggest this course should be a requirement:

“Yes. **I honestly think it should be required for more developers** to take courses that address the importance of how they design and build”

“I would recommend this course to other students **without a doubt in mind**. It is an excellent course to grow one’s mind in all areas as we grow to become technological contributors. **In fact, I believe that an undergraduate version of this course should become a part of the required course schedule**, like [Our first year computing explorations course]. **Without courses like these, we could end up designing technologies with only a select few audiences centered instead of everyone.**”

Similarly, one student also noted despite the course being graduate level, these topics would be beneficial in undergraduate studies:

“Absolutely, I think this course is a very informative course. Despite it being in the Master’s curriculum, I feel that a lot of the **learning about recentring design to account for the disenfranchised should be taught in the undergrad program** for [Our Computing College] majors.”

Three other responses centered the need for computing professionals to recognize the impacts of what they build, and how they feel this is lacking in traditional computing curricula:

“Yes absolutely. In the CS program, **we are always focused on the programming and numbers side. We never/rarely consider the human side of the work that we do**. It is important to understand how the programs and algorithms that are made impact the people who use them. ”

“Yes. **This course offered unique perspectives in development that were not included in any of my other classes. Tech fields have a powerful impact on the world**, and it is necessary that those entering these fields understand how their contributions may effect [sp] already disparaged communities. ”

“Yes, I would recommend it to other students. It’s a good course to broaden experiences and **consider how your seemingly small choices impact everyone else** when writing software. [...]”

This student’s recommendation extended beyond content - they felt able to bring their “full self” and have their identity respected:

“[...] I’d also recommend it because **the class environment was somewhere where I felt I was safe to be fully myself**, not just a thinking machine.”

Finally, one indicates general value in a growing digital society:

“Yes - even if a student doesn’t think this material is relevant to their major or career, it will be **relevant to them as a person** who uses technology and is more than likely being represented as data in some way,

and who can make even a small difference by **being able to recognize biases** in the tech/the world.”

5 DISCUSSION

As both instructor and author, the sheer variety of student engagement from this pilot offering was surprising and motivating. Interdisciplinary synergy kept each conversation vibrant as perspectives built “across academic silos” and in relation to peer ideas. I expected some level of general interest and engagement, but marvel at how much the students consistently exceeded my expectations. From diverse discussion examples to a breadth of project directions - the students not only grappled with the complex and vast space, but seemed to enjoy “tackling” such depth in some meaningful way.

The course also surprised me as a “launch site” for student researcher interest and support. Several students (including undergraduates and students without apparent prior research interest) expressed desire to explore sociotechnical research, including commitments to continuing course project research. Other students have made thesis committee selection choices to prioritize inclusion of critical design perspectives. Even students currently pursuing industry showed interest in these areas were they to return.

This course challenged me as an instructor to meet the hunger and passion these students had. Allowing the students’ passions and interests to shape and pivot the course material was a challenge worth pursuing for the outcomes gained. Ways I approached lecture, course activities, and community building all grew as a result of this course. I learned alongside and from my students in this course as they did from our classroom community. This is one of the many reasons I center their voices over mine in this experience report. I would certainly recommend that more courses like this be adopted despite the challenges - and despite the fear or reservations that one may have in discussing potentially “sensitive” topics.

6 CONSIDERATIONS AND FUTURE WORK

The course is being offered again in Spring 2023. There is also discussion of permanent inclusion into our course catalog.

Course refinement will continue in subsequent offerings, with student experiences continuing to (re)shape the topics and approaches taken. Future work may include new modules and concepts, as well as post-course support pathways for final projects.

This is the first time offering this course, so a second semester may provide new perspectives. Other institutions may likely have novel experiences and obstacles. If the course becomes a permanent and/or required offering, scaling the creation of a positive, inclusive space for difficult conversations must be prioritized.

7 CONCLUSION

This report centered the experiences, in their own words, of students from the first semester of a technology impacts on human futures course. The instructor (as author) facilitates sharing while also offering their own perspectives. Overall, the course reached a perceived computing curricula gap for students, one they were passionate to explore and engage with. Increased human impacts research interest/awareness was also identified. The instructor would recommend others adopt courses like this, and students unanimously indicated recommending the course to others.

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