

# Question 1

## A.

*i. What is the definition Oscar gives for "ethics" during the training session, and what does he argue is specifically not ethics? What is Andy's "ethics bomb"?*

Oscar says that “Ethics is a real discussion of competing conceptions of the good”, arguing that what is being discussed (stealing others’ pens/pencils at the office) isn’t ethics but instead just “The corporate anti-shoplifting rule”. Andy’s ethics bomb is “Would you steal bread to feed your family?”

*ii. How would you say Oscar's viewpoint relates to the following analysis by philosopher Deni Elliott: "The people who inhabit case studies are the scientists who fabricate data. Other cases focus on engineers and managers who decide that the number of lawsuits that will result from avoidable fatal car crashes costs the company less than replacing a problematic part or issuing a recall... As long as case studies are morality tales that end with the recognition of the villains, their evil motives, and their harmful actions, there is little to recommend the study of practical ethics, except perhaps as a remedial course for the bad guys. Practical ethics education needs to change its focus from fraud and fabrication to fluency and facilitation. The most interesting ethical problems occur when good people are trying hard to do the right thing."*

Oscars claim that discussions around behaviors like stealing office supplies are not actually ethics implies that ethics is more about emphasizing what it means to be good, instead of how compliant one is with societal norms. Elliott expands on Oscar’s view, proposing that ethics should concern not only the wrongdoers, but also with people contending with grey areas of the world. She argues that, without focusing on real ethical questions like how good people navigate hard/tough situations, ethics has little to no meaning. Her push for practical ethics education aligns with Oscar’s view, calling out surface level and borderline meaningless ‘ethical’ questions like the one posed about stealing office supplies.

## B.

*i. Does Holly follow a consequentialist or deontological approach in dealing with Meredith's ethical issue? Explain your reasoning.*

Meredith’s ethical issue is that she has been sleeping with a company rep (named Bruce) for the past 6 six years in exchange for discounts on supplies and for outback steakhouse gift certificates. Holly responds by saying that it is a serious issue, being both a conflict of interest

and an exchange of goods. Holly takes a deontological approach to this issue, as she is more concerned with the actions themselves than the outcome of said actions. If she were to take the consequentialist approach, then she would not be as appalled as the consequences of Meredith's actions result in both discounts on supplies (cheaper for the office) and steak certificates (cheaper, good food). Holly's deontological approach is why she is so upset, as a deontologist would be more concerned with the right vs. wrong concerning the action itself.

*ii. Did Kendall follow a consequentialist or deontological approach in resolving Meredith's ethical issue (Kendall was on a phone call)? Explain your reasoning.*

Kendall said that Meredith's actions don't seem to require any action and are a grey area. This is because the company is getting a discount as a result which is nice as the company is going through a rough patch. This is the clear consequentialist approach, examining the consequences of the actions rather than the actions themselves. He supports the actions due to the positive consequences/effect it has on the company, even if the actions themselves are questionable.

*iii. Do Phyllis and Stanley follow a consequentialist or deontological approach in addressing Meredith's ethical issue (near end of show)? Explain your reasoning.*

They both take the stance that they don't care where the steak is coming from just that it's there. This is the same as Kendall, where they are both taking the consequentialist approach. This is because they are caring more about the consequences (free steak) than they are how it is getting there. Stanley and Phyllis both agree that "they don't care where it's coming from... just keep it coming".

## C.

*What were the students' ideas about Andy's "ethics bomb"?*

The two male students being interviewed both agree that it is wrong. One of their arguments is that the benefits of stealing do not outweigh the wrongdoing of stealing/violating someone's well-established 'property rights'. The woman being interviewed says that she is okay with it (even from a libertarian standpoint). She says that it's okay to take from those who have a lot in order to benefit those who have very little/nothing at all.

## Question 2

A.

*i. In the first iteration of the "real-life" trolley car experiment, what decision did Chidi make? What decision would you have made?*

If the first iteration refers to the very first time he rode the trolley, Chidi killed 5 people instead of 1. I would not have done this as I place an inherent value in a human life and  $1 < 5$ . If the first iteration is when Michael says 'lets try this again', Chidi now has enough time to make a choice, deciding to kill only one person. This is what I would do as well, as I place more value in 5 peoples lives than 1. Even though I must make the effort to switch tracks, I would still make this choice as I wouldn't be able to pretend to be ignorant of the choice to switch the direction of the car.

*ii. In the second iteration of the "real life" trolley car experiment, there was a different scenario. What would you make in this scenario, and why would it be the same or different than the choice in part i.*

What is referred to as the first and second iteration is unclear. If the second iteration refers to having the one person be your best friend, I would not pull the lever as I would place more value in someone I've known all my life than three strangers. I wouldn't be able to contend with my actions if I deliberately killed my best friend to save 5 random people. If the scenario is instead what Michael refers to as "the 7th iteration", then Chidi chose to kill 5 William Shakespeares instead of one Santa Clause. I would kill the one Santa clause, as neither of the groups presented here have any more value to me than the other, so I would revert to my answer in A.

*iii. In the "real life" conflicted doctor experiment, does Chidi make the consequentialist or deontological choice (and how do you know this)? What is the extra factor added to this experiment that made Chidi feel somewhat badly about his choice?*

Chidi makes the deontological choice to not kill his healthy patient to save 5 dying people. This is deontological because he makes his decision based on the action itself, going back to his hippocratic oath as a doctor. The consequentialist approach would be to kill the person to save the 5, as this results in the best consequences, but Chidi values the moral code/oath he accepted which is a sign of deontology. The twist is that Chidi now must now tell the families about what choice he made, with one of them being someone Chidi ran over in the trolley. This man's daughter says that the person driving the trolley was a really bad man, making Chidi feel bad about his choice.

B.

*i. What was the goal of the research study? Describe the experiment. What did the control group do?*

The goal of this study was to determine whether subjects' hypothetical moral judgements are predictive of the actual behavior that they would display in the same real-life situation. A first group of students completed a real life version of the mouse dilemma, while a second group completed a hypothetical version of the same dilemma. This second group was the reference/control group. The mouse dilemma is similar to the trolley problem, where a group of 5 mice will be struck by a very painful but nonlethal shock at the end of a timer, but the subject can divert this shock to a cage containing one mouse to receive that same shock.

*ii. What was their result about consequential vs deontological decisions in real life vs. hypotheticals? Give your answer quantitatively, along with the statistical significance (the statistical significance is given by the p value; it is usually taken to be that  $p < 0.1$  means a result is statistically significant, and the smaller the p is the stronger the statistical significance).*

The researchers concluded that participants were more than twice as likely to make a deontological decision when faced with a hypothetical situation (34% of decisions were deontological) than they were when presented with a real-life version (16% of decisions were deontological). The reported p-value was  $p=0.017$ , which is statistically significant.

*iii. Before the experiment, all subjects completed a questionnaire that assessed whether they were "consequentialist-inclined" or "deontological-inclined". In the actual experiment, who acted more quickly and seemed more sure of themselves, the "consequentialist-inclined" or "deontological-inclined" subjects? What are the relevant p values?*

They found that those that were "consequentialist-inclined" made their decision significantly quicker ( $p=0.015$ ) when compared to others. These people were also found to have less self-doubt when it came to their decision, showing more conviction in their choice ( $p=0.001$ ). They also found that those who are "deontological-inclined" had reasoning unrelated to reaction time ( $p=0.341$ ). These people were found to have more self-doubt, showing a slight trend that they're less confident, even though the p-value does not indicate as much significance ( $p=0.98$ ).

## Question 3

A.

*i. Consider the main idea from the article by Langdon Winner "Do Artifacts Have Politics?", which was discussed in lecture. How do the ideas from the Winner article relate to the central story in this episode? I.e., what is the "artifact" and what is the "politics"?*

The artifacts in this case are the new “state-of-the-art” motion sensors that detect light reflecting off the skin. The politics of said object are the inherent racism they carry which prevents them from seeing black people. The company who produces them says it's the opposite of racist as it isn't targeting black people. They also praise their product for seeing “Hispanics, Asians, Pacific Islanders, and Jews”. This specific targeting of a group by technology (or any artifact) connects to the article by bringing the question, is it the products fault or the designers.?

*ii. In lecture, it was discussed that ethical issues can be considered to have factual, conceptual and moral components. In this episode, Ted and Veronica differ on a conceptual component, specifically about whether a certain circumstance is "racist". How do Ted and Veronica each interpret whether the circumstance is "racist".*

The issue is regarding the new sensors that turn on based on skin reflectiveness which Veronica knows doesn't see black people. Veronica says that it's just weird, while Ted says that it's racist. Veronica takes the stance of the company saying that it's not racist because it's not targeting black people but instead just ignoring them. She says the worst people can call it is indifferent. Ted ultimately says it is racist because it is ignoring black people, while Veronica says it cannot be because it isn't targeting black people. She uses this fact as a shield, highlighting societal issues that have specifically targeted black people in the past. Ted is emphasizing the factual component of the technology, while Veronica emphasizes the conceptual component. As discussed in lecture, it is difficult to get the conceptual component right if the factual component is false.

*iii. The issue is ultimately resolved by Veridian's board of directors. Do they use a consequentialist or deontological approach in deciding how the company will deal with the issue? Explain your answer.*

Veridian places a drinking fountain next to the new one that says “for blacks” underneath it. This was complained about, so then the company decided to have white people to follow around all of the black employees to have things work for them. This is a consequential solution, as they want to result in the best consequence which is allowing everyone to use the drinking fountains. They do not care about the action itself, which is inherently racist and follows patterns of racial segregation. Their second solution follows the idea of a ‘white savior’, where there is a white person going around with all the black people to make doing their job possible. The

deontological approach would be to fix the problem itself, without segregating the office. At the end of the episode, they revert to the old system. They do this not because of the morality of the old system, but instead because of the financial outcome if they were to stay with the new system. This still highlights the consequential approach, focusing on the consequences of the action rather than the ethics of the actions themselves.

B.

*i. Read the American Lung Association webpage on pulse oximeters. What does a pulse oximeter measure, what is a "good value" for the saturation number, and how long does it take to get a measurement?*

A pulse oximeter gathers information about the oxygen saturation level in your body without needing to use a needle or take a blood sample. When working correctly, this measurement takes place over just a few seconds. The saturation number is considered good if it is between 90 and 92%.

*ii. Read Racial bias in pulse oximetry measurement. Note that "occult hypoxemia" basically means "the pulse oximeter is saying the saturation number is okay when really it isn't". What is the finding of this article, and what is the scientific evidence in support of this?*

They found that 11.7% of the black patients from the University of Michigan study had reported occult hypoxemia, while only 3.6% of the white patients from the University of Michigan study reported this issue. In the Multicenter group, 17.0% of the black patients and 6.2% of the white patients exhibited occult hypoxemia. They ultimately found that across the two large cohorts, black patients had nearly 3 times the frequency of occult hypoxemia than white patients.

C.

Read the abstract and Introduction (including the footnote) of Novel Electrodes for Reliable EEG Recordings on Coarse and Curly Hair.

*i. Where is the problem that the article is addressing, and how did the authors say they discovered the problem? How does this lead to accidentally-biased scientific studies?*

They are addressing the issue that EEG machines are not as effective on people with coarse and curly hair, specifically those of African descent. The authors say they discover the problem with the help of EEG technicians, neurologists, and their own 'extensive experience' on recording individuals with coarse and curly hair. They cite the current paper as well as two previous works of theirs. Due to the difficulty of performing EEG studies on curly and coarse hair due to its tendency to push up against the cap, bad data (too noisy) was recorded in the study and that data

had to be thrown out. The throwing out of this data during preprocessing resulted in inherently biased data and as a result leads to a biased study.

*ii. What is this solution to this problem put forth by the authors (you just need to get your answer from the abstract; note that higher impedance leads to worse data)?*

The authors state that they can combine braiding the patients hair into cornrows with novel electrodes that better harness this braided hair to fix the problem. They claim that these two solutions in conjunction lower impedance by up to 10x, resulting in better data for patients, less uncomfortable visits, and fewer misdiagnoses.

D.

*In 100 words, describe whether or not you think the issues with the technologies in parts B and C support Langdon Winner's main idea in the article "Do Artifacts Have Politics?"*

The artifact's in Winner's article are political due to their intended function being designed in such a way to be discriminatory. I do not think that the topics discussed in parts B and C align with this main idea as the intended use of the pulse oximeter and EEG machine is not to impede on the treatment of black individuals. While there could be some underlying motive behind the products' original inventors, I think the 'racism' is just an unintentional consequence of the device's function. If the companies manufacturing and designing them knew of the issue and deliberately chose to not address it, then they would be political.

**1. This video shows an interview with a former drone pilot, in which he describes the psychological impact of this work. Please watch this video, and answer the questions below.**

*(A) Bryant says, “I felt like it destroyed my soul”. Why did he feel this way?*

He didn't think he'd actually have to kill someone, and he was looked down upon for not being comfortable killing people. He says that the job itself is inherently cowardly and makes you feel weak automatically, but you're forced to feel the opposite resulting in psychological trauma. He was called a traitor and threatened for speaking out, and it haunted him and stuck with him in his personal life.

*(B) What was the constitutional issue that Bryant was concerned about?*

He was told to kill the “internet’s Bin Laden” using an unarmed drone. He was concerned about the constitutionality of this because, even though Anwar was a traitor, the constitution states that even a traitor “deserves a trial in front of a jury of his peers”. Remotely striking someone down in this manner violates that right.

**2. This article describes some of the difficult issues that arise with drone warfare. Please read sections I, II and V of this article, and answer the questions below.**

*(A) What were the emotions of the drone pilot after his successful attack? What still bugged him months later?*

The pilot says he was a little freaked out, with his whole body shaking and that he felt bad about it. He remembers it being difficult to take someone's life like that, even if the people around him were giving him positive reinforcement and saying he did the right thing. He said he didn't feel worthy of the safety he had. What bugged him was that he had killed these people without putting himself in any danger whatsoever. He had protected some Marines that were actually on the battlefield while he was just sitting in his office building.

*(B) The author says, "The dazzling clarity of the drone's optics does have a downside". What is this downside? How does this situation compare with that for a traditional bomber pilot?*

The downside of the drone's optics is that the pilot sees the impact of their weapon immediately. The pilot of the drone sees the carnage in high definition, seeing "the blood and severed body parts" and the anguish of the target's friends and family. Due to drones being used to spy on target before attack, pilots also develop an almost intimate connection with them. For a traditional bomber pilot, they don't hear about the effects of their weapons until a post-mission briefing.

*(C) As discussed in the article, in contrast to ground-assault raids, drones target and kill people without giving these people the chance to surrender. Do you think this is ethical (and why)?*

No, I do not think this is ethical (usually). I tend to take the more consequentialist take here, where I think it is only ethical if the target has a well-known and highly accurate/documentable track record of harming innocent civilians. Even then, I think immediate strikes on these people are only ethical if they are alone (i.e., no innocent people will be injured). Assuming that this person would continue to cause more harm, which is reasonable given their track record, letting them surrender may allow them to escape and cause more harm than good, as someone would have to come take them in on foot. When these criteria are not met, then the consequences of killing them without giving them an option are too severe to perform the strike. Surrender should be a right for most targets, and violating that right potentially puts you on the same level as your target.

**3. This scholarly article, by CWRU professor Prof. Shannon French, addresses the ethics of drone warfare. Please read pages 3-11, 15-17 and 23, and answer the questions below.**

(A) *"Soldiers are asked to overcome the most basic lessons of their moral development and kill fellow human beings." What is the "armor" that protects soldiers as they carry out this task?*

The warrior's code provides soldiers with the mental and emotional armor needed to carry out these tasks. This code provides the soldier with rules on how to interact with their fellow soldiers, other members of society, enemies, and conquered peoples. It sets boundaries on behavior and enforces others as honorable.

(B) *What are the two core principles of jus in bello?*

The first is proportionality, meaning that the magnitude of the response to the threat should be proportional to the threat itself. This requires a response to be only enough to neutralize a threat, and not to act vengefully. The second is discrimination, requiring that those attacking take care to target only those who pose a legitimate threat, not killing innocent civilians.

(C) *Why is face-to-face combat less problematic to process and evaluate than distance warfare?*

In face-to-face combat, both parties have been ordered to kill the other, and so if the two parties fight face-to-face, then it feels fair. There's some sort of mutual risk or shared respect present, where it is just two parties struggling to survive. Distance warfare removes the kill-or-be-killed mentality, making it very difficult for the pilot to reconcile with intentionally ending someone's life while there was no threat to their own.

(D) *What is the dehumanizing effect of drones, and what is its consequence on enemy morale?*

The dehumanizing effect comes from the implication that the attacker does not believe the conflict is worth risking people's lives for, but still believes it reasonable to kill the enemy forces. This dehumanizes the enemy, making them feel like objects, which results in less/non-existent empathetic reasoning. It results in the attacker being able to recognize the target as a human, but not that they are truly feeling and living in the same world as them. This is amplified by the targets not being able to see the attackers at all, resulting in an "impassioned resistance" where the enemy may rally behind any means necessary to overthrow the attacker. Their morale may be temporarily crushed, but the feelings of vengeance and anger prevails.

(E) *The conclusion says, "Civilian and military leadership owe it to the troops who operate these technologies to take additional care to provide...". What is it that they should provide, and why is the "additional care" needed towards drone operators and not combat troops?*

The conclusion says that they should provide "clear and compelling justifications for their missions" and should allow troops to resist authority and group dynamics to reject any targets that don't seem like they should be targets. This additional care is needed for drone pilots as their targets are not seen in person, and they cannot tell the exact intent of their targets through a screen alone. Extra information and ability to backout is necessary for that reason.

**4. This video is science fiction, but may not be far from becoming reality. Please watch this video, and answer the questions below.**

(A) What is the weapon in the video and how does it use AI?

It is an explosive drone that is navigating entirely with AI. It uses AI to stabilize itself in the air, sense its surroundings, identify targets using facial recognition, and also jitter to prevent snipers from shooting it down. The AI drone is entirely autonomous (no pilot whatsoever), and will target and attack on its own. In groups, they work together to attack with ‘surgical precision’.

(B) What is the point that the Berkeley professor makes at the end of the video?

He says that it has the potential to benefit humans and defense systems, but that allowing machines to choose to kill humans would be devastating to security and freedoms. His final remark is that there is an opportunity to prevent what happened in the video, but that the opportunity is closing fast.

**5. [This video](#) addresses the state-of-the art of autonomous weapons, and discusses the rationale for their use. Please watch the first 7:30 of this video, and answer the questions below.**

*(A) What weapon did Dmitry Litovkin sell to the Russian government?*

Dmitry sells driverless tanks to the Russian government called T-14s. It is fully robotic and operates in automatic mode. It fires and drives on its own.

*(B) What is the definition given in the video for “killer robot”?*

They define killer robots with 3 objectives, as something that locates, selects, and attacks human targets.

*(C) What are the drawbacks of human soldiers described in the video that machines can overcome?*

The video says that human soldiers get tired and are emotional. They miss targets and get traumatized. They follow this up with the statement “machines do not”. Saying machines can react at machine speed, and could sense threats much faster than humans. The last part of the 7:30 video segment says that autonomous machines can save lives.

**6. This scholarly article, by CWRU professor Prof. Shannon French, addresses the ethics of using AI in the military. Please read sections 1 and 2, and answer the questions below.**

*(A) What is automation bias, and what is its relevance regarding AI in the military?*

Automation bias is present when people are in fully automated spaces, where they are forced to be observers instead of agents. Here, people have an increased trust in the automated systems, and will not attempt to confirm nor deny the decision made by the systems. With AI systems in the military, an environment is created where military members and soldiers will be more likely to trust the judgements of the AI systems over their own and over their other human peers. It has also been shown that humans in these situations will not notice anything wrong other than what the system reports, and will not check if a problem actually exists if it is reported.

*(B) Why are the games chess and Go mentioned, and what is the relevance to automation bias?*

Chess and go are mentioned because they are strictly rule based games, where there are a set number of moves that can be played, and an algorithm can be used to find the quickest route to the desired outcome, like with chess bots. It is mentioned alongside artificial intelligence, where the author states that even though there are tons of documented errors and failures, people tend to focus on reports that suggest that artificial minds are superior to human ones. While computers can win strategy games like chess and go, these games are exclusively algorithmic and require no ethical backing of decision making. People singling out these good scenarios results in people concluding that the AI is more able in general, resulting in even stronger and more potent automation bias.

*(C) According to the author, which type of ethical framework (consequentialist, deontological, or virtue ethics) is most prevalent in militaries?*

The author says that virtue ethics is the most prevalent in militaries, where there is a code promoting particular virtues which is instilled in all new recruits until it becomes a part of the identity of every serving person. Troops are encouraged to act according to the military virtues instilled in them, and should be an intrinsic part of every decision made.

*(D) What is the quote by Aristotle related to ethical deskilling, and how does this relate to using AI in the military?*

Aristotle, in his *Nicomachean Ethics*, says that ‘...moral virtue comes about as a result of habit’. This is relevant here because it reminds us that virtue ethics is more than just skill or know-how, being a state where know-how is *reliably* put into action when called for and is done with moral concern for what is good. Use of AI anywhere in the military takes away a person’s ability to practice their virtues in that role, and will become weaker over time as a result.

*(E) In 100 words, what are your views on the use of drones and AI in the military, taking into account the real need for national security and the lives of US soldiers (often people your age)*

I think the use of drones is acceptable if it becomes used by a higher percentage of armies. As suggested in a response to a previous article this assignment, the targets MUST be chosen correctly (prevent civilian targeting), and people MUST be able to back out of missions if they do not believe it is right (without consequence). I do not think AI should be used, as it is really just machine learning and is often predictive, which means hallucinations are frequent and detrimental. My opinion may change as AI develops.

**1. The talk in this [video](#) describes the CRISPR technology for gene editing. Note this talk is from 2015, which is prior to the events in subsequent parts of this module and before the speaker won the Nobel Prize for developing this technology. Please watch this video, and answer the question below.**

*A. To edit the DNA the DNA is first broken and then repaired. The CRISPR technology controls just one of these steps; how does the other step happen?*

The CRISPR technology controls just the breaking of the DNA. Cells have the ability to detect broken DNA and repair it. When a plant or animal cell detects a ‘double-stranded’ break in its DNA, it can fix it by either pasting the two cleaved ends together, or by integrating a new piece of DNA at the site of the cut.

*B. What type of molecule is Cas9? What type of molecule binds with Cas9 to form a “sentinel” that finds desired sites in the cell’s DNA and then cleaves the DNA at these sites? How does the “sentinel” identify the desired sites? Does Cas9 help identify the site or carry out the cleaving?*  
Cas9 is a protein. Little bits of RNA from the CRISPR locus bind to the protein to act as a sentinel, finding the desired DNA. To find this, it searches through all the DNA in the cell and finds the sites that match the sequences in the bound RNA. The RNA allows the locating of the site, while the Cas9 cleaves the DNA.

*C. The key advantage of CRISPR over previous genome editing technologies is explained in terms of an analogy to computers—what is this analogy?*

Engineers can program these complexes to recognize specific DNA sequences, and make a break in the DNA at the site. Can allow cells to make a very precise change, just as we use word processing with computers to find spelling errors and find exactly where they occur. It is easily programmable, without having to completely rewrite anything entirely.

*D. To use CRISPR to edit a desired gene, what type of molecule is “programmed” so that the DNA is broken at the location of the desired gene, and how does an engineer “program” this molecule?*

The RNA is the programmed molecule. An engineer would determine the DNA that they would like to target, and would craft/find a strand of RNA that is the complement (or is compatible with) of this DNA to package with the Cas9 protein. This RNA will then be able to find the DNA through the sentinel, and then the Cas9 can cleave/break the specific location. Once the DNA is cleaved, the cell will heal it. Engineers will primarily target mutations and ‘bad DNA’ in order to make use of the technology and cells’ inherent healing factor.

*E. One of the slides refers to “perfect pitch”. What is the speaker referring to, and what ethical question is the speaker addressing here?*

She shows perfect pitch when showing a baby with ‘ideal features’. Perfect pitch refers to the ability to hear a note or chord and immediately recognize it, just as regular people do with color

recognition. The ethical question involves both safety and the idea of creating ‘designer humans’. She is worried about the various implications with creating the ideal human, especially regarding social norms. She urges us to think of the unintended consequences of doing such a thing so early in the technology's development with respect to human testing.

**2. This [article](#) describes research at CWRU that uses the CRISPR technology as part of a novel biosensor. Please read the article and answer the following questions.**

*A. This research at CWRU addresses a new “universal biosensing” point-of-care medical device. What does this biosensor detect?*

This device would detect ‘troublesome’ viruses like HPV or parvo. It would detect them rapidly and accurately, eliminating the need for the existing tests which are expensive and take a long time to get an accurate result (3 to 5 days for the old vs under an hour for the new).

*B. How does this biosensor make use of the CRISPR technology?*

They modified the CRISPR technology into E-CRISPR, which uses an ‘electrochemical platform’ to identify and quantify viruses present in blood by making use of the accuracy of the CRISPR technique. They will program the CRISPR complex so that it looks for a specific target (virus) and to probe any activity electrochemically. If the Cas9 protein starts to cut, the probe will pick up on it indicating that a virus is present.

**3. This news article reports the use of CRISPR to edit a gene in an embryo. Please read the article and answer the questions below.**

*A. What gene was edited and why was this gene chosen to be studied?*

The researchers targeted a mutation in a gene called MYBPC3, which causes the heart muscles to thicken (a condition called hypertrophic cardiomyopathy) resulting in sudden death in young athletes. It is a dominant gene, so just one copy is required for the mutation to be present.

Because of its dominance and that it's the leading cause of sudden death in these athletes, they chose this gene to study.

*B. What are the two key safety hurdles to applying CRISPR technology? How successful was this study in these regards?*

They had to tackle 1) the risk of making additional, unwanted, genetic changes called off-target mutations and 2) the risk of generating mosaics, where different cells in the embryo contain different genetic sequences. They have been largely successful, finding no evidence of off-target genetic changes, and having generated only a single mosaic in an experiment involving 58 total embryos.

*C. What did Keith Joung say about the safety claims of this work?*

Keith Houng said that just because the team didn't find any off-target changes to the genome doesn't mean that they aren't present. In other words, don't be fooled by our apparent success in eliminating the risk of our first key safety hurdle.

**4. This science news article describes the response of the scientific community to the announcement of the first genome-edited baby. Please read the article and answer the following questions.**

*A. When and where were the world's first genome-edited babies born?*

The twin girls were born in China during the month when the article was published, so sometime in November 2018.

*B. What were the steps in the process that starts with a prospective mother and father and ends with a baby born with its genome having been edited?*

He first found a couple that was affected by HIV so that they could have a child protected from a similar fate. Then, he impregnated the woman with her fertilized egg (embryos) that have been edited to disable the genetic pathway HIV uses to infect cells. The babies are then born healthy, having only the target gene changed/disabled.

*C. What was the goal of editing this gene? Was it to correct a mutation that would lead to health problems?*

The gene, called CCR5, encodes a protein that allows HIV to enter a cell. Editing the gene was done to disable it, hence attempting to prevent HIV from entering the person's body. It wasn't to correct a mutation, but to disable the gene entirely to prevent infection.

*D. What did Paula Cannon say about the decision to edit this gene?*

She noted that some strains of HIV don't even use that gene's passageway to get into cells, and just because CCR5 is disabled doesn't mean that the person is immune entirely from HIV. She also says it makes no sense that He found a family HIV-positive *father* because there is no real risk of transmission to the children. Her final remark is that the experiment exposes otherwise healthy and normal children to the risks of gene editing without any realized benefit.

**5. This [video](#) shows the statement of the engineer who led the genome-edited baby project. The Ethical Decision Making Primer is a brief description of the key theories of ethics. Please watch the video and read the article, and answer the following questions.**

*A. What was Dr. He's explanation for why he believes he did the right thing?*

Dr. He thinks he did the right thing because he was able to give the family another chance to have kids, and was able to allow the husband to be a part of society again, as HIV is widely shunned. He emphasized that his actions provided a chance for families to have healthy children and that his work is a continuation of advancements in reproductive technologies that have already benefited millions of families. Without the treatment, the children would have to live with a fatal disease all their lives.

*B. Do you agree or disagree with Dr. He's analysis regarding the right thing to do, and why?*

Yes, I think his analysis is correct. There is little to no downside to allowing families to have healthy children when they usually wouldn't be able to through conventional methods. Some families need this technology in order to lead happy lives, and I don't think there is anything wrong with this. This is exactly what Dr. He argues in his analysis as well. While the risks may be detrimental, I think the current short term gain is worth it. With more information about the negative side effects, I am almost positive that my feelings towards his analysis would change from positive to negative.

*C. Would you consider Dr. He's explanation to follow a virtue ethics approach (and why)?*

Yes, but I think there's a lot of consequentialism in his explanation. His virtue ethics comes through when talking about how wholesome it is that he can give this family a new beginning. He seems to be acting truly out of what he believes is virtuous, bringing in his personal life and mentioning his children that he holds dear. I think the consequentialism comes through when he acts out of the best interest for the family without really considering the long term consequences of the treatment. His lack of discussion about the negative side effects leads me to believe he follows a more virtuous approach, as a true consequentialist would be skeptical due to any unintended consequences.

**6. This [news article](#) describes the legal consequences for the engineer who led the genome-edited baby project. Please read the article and answer the following questions.**

*A. What crimes was Dr. He convicted of?*

A court in Shenzhen found that He and two colleagues forged ethical review documents and misled doctors into unknowingly implanting gene-edited embryos into two women. The court ruled that the defendants had deliberately violated national regulations on BME research and medical ethics. He was also fined, as were his two collaborators.

*B. What did Guandong province's investigation conclude regarding the ethics of Dr. He's work? Do you agree with their conclusions (and why)?*

Their investigation concluded that "He had defied government bans and conducted the research in the pursuit of personal fame and gain". I agree with their conclusions. He clearly acted out of self interest, and knew that there were consequences he was not considering due to the secrecy of his research. While he was trying to better the lives of his subjects, he would've found out about the lack of full coverage of the treatment if he was interacting with other scientists. He also forged ethical review documents, which means he knew that what he was doing wasn't going to be considered ethical. Making the decisions he made seems purely out of fame and gain, as if the procedure was 100% successful he would be leading the cutting-edge research into gene modifications. His denial of government regulations has little to do with ethics, as sometimes laws are not ethical and should not be used as an ethical compass. Ultimately, He acted unethically, and I agree with the conclusion of both Guandong province's investigation and the court's ruling.

**7. Read the section “What about the other scientists implicated?” of this article.**

*In 100 words, describe your view on the ethical responsibilities of scientists, such as Mello and Porteus, who were informed by Dr. He about his plans to edit the genomes of babies?*

I think it's particularly challenging to criticize the lack of action exhibited by the scientists who were in the know. From what I can gather, Mello and Porteus both tried to dissuade He, and tried to advise him against proceeding. If the research was in the US, reporting the malpractice would've been easier due to regulations, but I don't think there's much the scientists could've done as the research was in China, which makes it harder to find avenues for reporting things like this. Without sufficient precedent, criticising these onlookers is hard for me to do in good faith.



**1. This [video](#) discusses the statistical measures TPR ("true positive rate"; the video calls this "sensitivity") and PPV ("positive predictive value"), which are commonly used to assess the accuracy of facial recognition AI. Please watch the video and answer the questions below.**

(A) *Apply this analysis to a (made-up) scenario where AI examines 125 actual M (male) faces and of these finds 110 to be M and 15 to be F (female), and it examines 95 actual F faces and of these finds 65 to be F and 30 to be M. (hint: "+" in video □ "F"). Write the appropriate matrix for this scenario, and calculate the TPR and PPV for F faces.*

See attached spreadsheet. Briefly, TPR = 68.42% (predicted female/actual female, PPV = 81.25% (actual female/predicted female)

(B) *Explain, in a non-technical way, the conceptual difference between TPR and PPV in the scenario described in Problem 1 (you should understand this, as you'll need to use this in answering a subsequent question).*

TPR is the amount (as a percentage) of actual females in the sample that were correctly identified as female, while PPV is the amount (also as a percentage) of identified females that are actually female. An important distinction is that TPR only analyzes the correct identification given that the person is female (the person being female is a **requirement**), while PPV analyzes the correct identification given that the test believes the person to be female while they may not be. In other words, TPR asks: "Out of all the actual females in the sample, how many did the AI correctly recognize as female?", and PPV asks: "Out of all the faces the AI predicted as female, how many were actually female?".

**2. This journal article presents the results of one of the most well-known and impactful studies on the accuracy of facial recognition AI. Please read sections 3.2 and 3.3 and page 10, and examine Tables 3, 4 and 5.**

*(A) What was the profession of the subjects chosen, and why was this choice made? What countries were chosen, and why was this choice made?*

They chose “images of parliamentarians”, or members of parliament as they are public figures with known identities, and they have “photos available under non-restrictive licenses posted on government websites”. In other words, they could legally use the images without violating people’s privacy. They chose 3 African Countries (Rwanda, Senegal, and South Africa) as well as 3 European Countries (Iceland, Finland, and Sweden). The countries were chosen due to their ranking in gender parity. Rwanda has the highest proportion of women in parliament, the Nordic regions (Iceland, Finland, and Sweden) are in the top 10 of the same proportion while having lighter skin, and next two highest ranking (in terms of gender parity) African countries (Senegal and South Africa) were chosen to balance for darker skin.

*(B) What does Table 3 show, and what is the significance of this data?*

Table 3 shows the proportion (distributions) of lighter and darker skin subjects in the 3 datasets (PPB - their's, IJB-A - NIST's, and Adience - a 2014 set). The table shows the skewed nature of the tests that aren't the author's, suggesting more bias/worse results from the IJB-A and Adience studies. The point of this table is to show that their dataset is more evenly distributed between lighter and darker skins at a roughly 50:50 split.

*(C) From Table 4, what is the probability that the IBM algorithm correctly identifies a dark-skinned female as female? a light-skinned male as male? Note you must figure out which is the correct data in the table to use... only one type of data is correct to use (see Question 1).*

We are investigating the probability that the model identifies F given that the subject is DF, this is the True Positive Rate. Table 4 reports this as 82.3% for the IBM model. For a light-skinned male, the TPR is 94.8%.

*(D) In Table 5, the analysis is carried out for only the South African subjects. Why did they do this analysis for only one country, and why did they choose South Africa as this country?*

They did a closer look at images from one country to see if differences in the algorithm's performance is mainly due to the image quality from each country's parliament. They chose South Africa as the European countries seemed to have higher resolution images, while the African country's parliament had lower image quality. Specifically, South Africa had similar image quality to the other African Countries while also maintaining relative skin-type diversity within their parliament.

*(E) What is the statement the authors make in the last sentence of the conclusion, and do you agree with this statement and do you think engineers working with AI have an ethical obligation to do as they suggest?*

The authors say that their data supports the idea that artificial intelligence facial recognition algorithms require increased “demographic and phenotypic transparency and accountability”. What they mean by this is that AI models need to be upfront about their performance and how it varies with different demographics, and that these models should be specific about different physical traits they struggle with. I agree with this, and believe that engineers have an ethical obligation to do this. This is because these models are becoming more and more mainstream, and have been used for more than just presenting data. As facial recognition becomes used in ways that can impact people's lives greatly, developers should take care to ensure that parties making use of the technology are aware of its shortcomings and adapt accordingly.

**3. This [video](#) features interviews with scientists about detecting people's emotions from their facial expressions. Please watch the video and answer the questions below.**

*(A) What was the hypothesis developed by the researcher named Sylvan?*

His hypothesis was that everyone around the world scowls when angry, smiles when happy, and that everyone around the world can recognize these facial expressions of emotion.

*(B) Do the scientists in the video agree with this hypothesis? Explain why or why not.*

Not necessarily. They say that it is highly variable, highly contextual, and ever changing patterns. They say that facial expressions are a result of everything going on around them (i.e., who they are with, where they are, what is happening around them). They also emphasize the need for context when it comes to deciphering facial expressions, whereas earlier scientists were just focusing on the face itself. Another reason for the doubt is that there is a distinction between Western and Eastern faces, where people in the west express themselves with their mouths while people in the east express themselves with their eyes. This cultural difference is what makes people present their facial expressions and decipher others differently.

*(C) What are the specific reasons given by scientists in this video for why doubt that AI exists that can detect emotion?*

They say that people often make facial expressions to show an emotion without actually feeling that emotion inside. An example given is smiling out of politeness or welcoming, but it doesn't mean you're experiencing the emotion itself. The other reason is that people can use false expressions to trick the detection systems, tricking the system into believing they are sad or happy. Regarding this, they say it'd be very easy for a person to generate a realistic, but false expression with their face (which could then trick the system).

**4. This journal article presents a study by researchers at George Mason University and the University of Nebraska. Please read the abstract and the associated retraction note, and then answer the questions below.**

*(A) What is the “new level of image understanding” the researchers are exploring?*

This “new level of image understanding” is inferring criminal tendency from facial images via deep learning (neural networks). They are researching using these models to reach the first milestone in inferring personality traits from facial images.

*(B) Why was the paper retracted?*

The paper was retracted because the authors did not seek approval from their ethics committee before undertaking the study as it uses human biometric data. It is stated that both authors of the paper agree with the retraction.

*(C) Do you consider the research topic to be ethical? E.g., should CWRU allow this type of research to be carried out by our faculty, even if all applicable rules are followed?*

No, I do not find this to be ethical as there is such variation in human facial expressions. As discussed in previous parts of this week’s homework, people’s facial expressions vary across regions of the world, and these facial expressions are not necessarily the actual emotion the person is experiencing. Moreover, most models do not assess certain demographics accurately, so certain groups may be targeted incorrectly as the models have unintentional underlying biases. While I wouldn’t riot if I found CWRU to be conducting this type of research, as I think the only way to make it better and improve it is to test it, I do not find it ethical in the grand scope of the topic. AI is notoriously biased, specifically towards its creators, so using it to identify potential criminals off of something as variable as facial expressions is very unethical in my opinion.

**5. This journal article presents a study by researchers at Stanford University. Please read the abstract, the Method section for Study 1a, and the last two paragraphs of the article, and then answer the questions below.**

(A) How were the images of the subject's faces obtained? How was the "correct answer" for their sexuality known?

They obtained the images from profiles posted on a US dating website, and the sexuality of the subjects was determined by what their profiles reported as the gender they were looking for in a partner.

*(B) How successful is the AI for determining sexual orientation? And how successful were humans?*

Given one image of the subject's face, the AI could determine whether or not a man was gay 81% of the time, and could discern if a woman was lesbian 71% of the time. Humans were able to predict 61% for men and 54% for women, less than the AI's proportion. They note that this proportion (success rate) increases when given more images to use per person, but only quantitatively describe this for the AI (91% for men, 83% for women).

*(C) How might the authors respond to the accusation that their findings would help governments and companies build accurate sexual orientation classifiers? Do you agree with the authors' justifications for making their findings public, and why?*

They would respond by saying, "Yes, that is a real concern and we agree with you, but making the public and affected communities aware of these risks is more important than allowing these governments to continue these studies behind closed doors and out of the public eye". I agree with this justification for making this public, especially as a member of the affected community and as someone with many people around me who would also be affected. While it is very well known that the government is doing hundreds of things behind closed doors, seeing this study go public makes the threat of something like this becoming public much more real. Putting people in the know is much more important than hiding something already hidden from them. The authors also note how AI is degrading the privacy of intimate traits, and making this public seems entirely reasonable. I would find myself outraged if I had found something like this was deliberately kept from the public eye, as it would seem to be done out of malicious intent in my opinion.

**6. This journal article presents a study by researchers at Dalian University (China). Please read the abstract and the first paragraph of Section 5.4, and examine Fig. 8 and Table 2, and then answer the questions below.**

*(A) The goal of this research is AI ethnicity recognition. What ethnicities does this study focus on?*

This study focuses on (1) Chinese Uyghur, (2) Tibetan, and (3) Korean ethnic groups.

*(B) The authors define an “O” region and three “T” regions. What are these regions and which region do the authors find works best for ethnicity recognition?*

The T region has 3 types of regions denoted T1, T2, and T3. The T1 region includes the eyes and nose; the T2 region contains the eyebrows, eyes, and nose; and T3 contains eyebrows, eyes, nose, and mouth. The O region is defined as the entire face. They found that the T3 region is the best among all regions for ethnicity recognition.

*(C) What is the TPR for determining ethnicity (in the best implementation of their method)?*

The best implementation of their method was with the T3 region. This region yielded the highest TPR of 0.865, being around 0.10 higher than the T1 and T2 regions, and over double the TPR of the O region.

*(D) Do you consider this research to be ethical, and why?*

I take a deontological stance here, believing this research to not be ethical. This is because conducting this research violates the privacy of not only the subjects but also those affected by any future technology developed that makes use of this. If this research leads to something mainstream, then the people originally in the study will be part of a baseline for identification, where their facial features will be used to identify others in potentially malicious ways.

Ultimately, the ethical obligation of those conducting this research comes down to respecting people's rights, and I think that, if these ethical considerations are taken to heart, then the research should not be conducted at all. Performing this research solidifies peoples facial image in the ‘minds’ of AI systems that will prevail for years to come.

		Gender				Sensitivity (TPR)	PPV
		F	M	Total			
AI Examination	F	65	15	80		68.42%	81.25%
	M	30	110	140			
Total		95	125	220			

**1. The [CNBC news story](#) “Peter Thiel-backed psychedelic start-up’s shares pop in Wall Street debut” describes the huge investor interest in a start-up company based on psychedelic pharmaceuticals (note that Peter Thiel’s father is a CWRU alum, with his degree in chemical engineering). The webpage also includes a video interview with the founder of the start-up company. Please read the article and watch the video, and then answer the following questions.**

*(A) What types of illnesses is the company aiming to treat, and what recent discoveries regarding psychedelic compounds have caused investor interest in psychedelic therapies to grow?*

Treating mental health issues (e.g. anxiety, depression, PTSD, brain injuries, schizophrenia) is the company’s main goal. Recent studies of MDMA reveal its efficacy in treating post-traumatic stress disorder, and psilocybin has recently been seen treating drug-resistant depression. Johns Hopkins University, Yale University, the University of California, Berkeley, and the Icahn School of Medicine have all contributed to these studies, further legitimizing the field and heightening interest among investors.

*(B) What is the major regulatory/legal hurdle that must be overcome before the treatment can be used?*

They are currently illegal in the West. They are aiming to bring them back into the MEDICAL world, so during therapy or during hospital visits. To make them legal for these applications, they must battle the Schedule 1 drug classification (no accepted medical use and a high potential for abuse) of psychedelics in the United States, undergo rigorous clinical trials, and get approval from the FDA.

**2. This journal article presents a research study on the medical use of psychedelic pharmaceuticals. Please read the first page of this article, and answer the following questions.**

*(A) Where was the study carried out and what year was the paper published?*

The study was carried out at the Center for Psychedelic and Consciousness Research in the Department of Psychiatry and Behavioral Sciences at the John Hopkins University School of Medicine. It was published in the Journal of Psychopharmacology in 2022.

*(B) What was the disease being addressed, and what was the treatment that was being studied (was it just administering a drug, or was there more to it?)*

They were treating Major Depressive Disorder (MDD). The treatment was having patients assigned to a treatment condition where they received two doses of psilocybin with supportive psychotherapy. This study took place over a 12 month period.

*(C) What was the key finding from this study?*

They found that there were no serious adverse events related to psilocybin in the long-term follow-up period. Participants reported increased ratings of personal meaning, spiritual experience, and mystical experience but did not predict improvements in depression. The study's findings "demonstrate that the substantial antidepressant effects of psilocybin-assisted therapy may be durable at least through 12 months following acute intervention in some patients."

*(D) The first paragraph of pg 157 addresses a potential issue with the medical use of psychedelic pharmaceuticals. What is this issue, what did this paper find in regard to this issue and how did this finding relate to previous findings in regard to this issue?*

The issue they brought up is patients' desire to use psilocybin outside of the research setting. They seem to be concerned about opening this door up to people, who may then seek out the drug in a less than legal setting. This paper's study found that none of their participants reported any psilocybin or psychedelic drug use during the follow-up period. This contrasts a previous study in which 5 of 19 total participants reported the use of psilocybin outside of the research setting by the end of that study's 6-month follow-up period.

*(E) Read the declaration of conflicting interests on pg 157. One of the authors of the article may be working in an ethical "gray area". Which author is this, why is this author in an ethical gray area, and how might this affect how one should trust the findings of this article?*

Matthew W Johnson (MWJ) has multiple financial and advisory relationships with companies involved in psychedelic drug development. This results in an ethical gray area, as the author is driven by these companies to produce positive results, but should be performing this study from a neutral, unbiased, and scientific point of view. MWJ's financial relationships are benefited by positive conclusions, so readers should be very critical of the data presented and the methods

used. While disclosures like this increase transparency, they do not eliminate bias, so conclusions and findings should be viewed with caution.

**3. This patent covers some of the intellectual property pertaining to the current interest in psychedelic pharmaceuticals. Please read the Abstract and Column 1 (first column of text after the figures), and answer the following questions.**

*(A) A patent must be for one of the following: a process, machine, manufacture, or composition of matter. Which category of invention is this patent, and how do you know this?*

This patent seems to be most directed towards composition of matter, but an argument for manufacturing can be made as well. In terms of composition of matter, the ‘Background’ section clearly emphasizes the synthesis of the drug, discussing how this new process is efficient for batch productions of psilocybin and its intermediates. Due to the discussion of chemical compounds and synthesis techniques/analysis, this patent falls most aptly under composition of matter. One might argue for manufacture, as this patent relates to large-scale production of psilocybin, but this production requires an altered synthesis process, and hence composition of matter seems most fitting.

*(B) Who owns the patent, and how do you know this?*

As discussed in lecture, the Assignee is the one who owns the patent. While there are multiple investors, the assignee is the ultimate owner. In this case, it is listed as COMPASS Pathways Limited, London (GB).

**4. This article is a first-hand account of how psychedelic mushrooms were first "discovered" by westerners. Please read this article, and answer the following questions.**

*(A) The author says he made a “cultural discovery of importance” – what was this discovery?*

The author's significant cultural discovery was the ritual use of hallucinogenic mushrooms by the indigenous people of Huautla, Mexico. He was the first outsider to partake in the ceremony led by the indigenous priestess María Sabina.

*(B) Who was María, and what was her role in regard to this “cultural discovery”?*

María Sabina was a “priestess of the rite” who guided the author through the sacred mushroom ritual. She was the key figure who introduced him to the traditional use of psilocybin mushrooms for spiritual and healing purposes.

*(C) The author questions whether he should have suppressed his discovery. Does the author follow a consequentialist, deontological or a virtue ethics approach (and why)?*

The author takes a consequentialist approach to his discovery. This is because he reflects on the unintended negative effects of his revelation (commercial exploitation). He expresses regret, indicating that he evaluates his actions based on their outcomes rather than adhering to an absolute moral rule (deontology) or focusing on personal virtue. He believes his actions should be judged by their long-term impact, which aligns with consequentialist reasoning.

**5. This [article](#) is a first-hand account of the scientific discovery of the active component in psychedelic mushrooms. Please read the section “Teonanácatl, the ‘sacred mushroom’ of the Aztecs” in the article “Teonanácatl and Ololiuqui, two ancient magic drugs of Mexico.”, and then answer the following questions.**

*(A) Psilocybin is the active chemical in the mushrooms—how does this article say that the chemical was discovered, and by whom?*

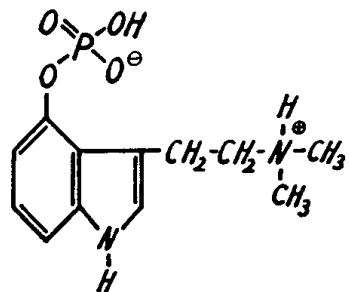
Use of Psilocybin is dated back to the Indians of Mexico, who consumed the mushrooms and hence Psilocybin for feasts, religious ceremonies, social events, and through witchdoctors.

Mycologist Roger Heim is reported to have first identified and classified these mushrooms as part of the genus *Psilocybe*. Psilocybin was discovered chemically by Albert Hoffman (the author) through chemical analysis of the mushroom material in the Pharmaceutical Chemical Research Laboratories of Sandoz Ltd. in Basle.

*(B) Who was used for the first human testing of the extracted psilocybin, and what was this person's relationship to the scientist who first extracted psilocybin?*

The first human test was the author of this article, Albert Hoffman. He took thirty-two dried specimens of *Psilocybe mexicana* weighing 2.4 g to settle whether or not the mushrooms were still psychoactive after testing and extraction. So, the first test was performed by the author who is the one who first extracted the chemical.

*(C) Upload a picture of the chemical structure of psilocybin*



*Psilocybin*  
= 4-phosphoryloxy-N,N-dimethyltryptamine

*(D) Psilocybin can be obtained by extraction from mushrooms, but also by another method which is “much more rational than obtaining it from the mushrooms”. What is this other method?*

Synthesis. Being a chemical, the synthesis of psilocybin is most likely doable. Hoffman studied synthesis techniques for producing synthetic psilocybin, leading to him reporting that “the synthetic production of psilocybin is much more rational than obtaining it from the mushrooms”.

**6. This journal article addresses the ethics of patents covering psilocybin-based pharmaceuticals. Please read this article and answer the following questions.**

*(A) What is the ethical concern brought up by the authors?*

The ethical concern raised by the authors is that the commercialization and patenting of psilocybin-based treatments have occurred without recognition of the indigenous Mazatec communities who have traditionally used these mushrooms for centuries. Furthermore, the financial benefits from introducing these methods into the medical sphere will not be shared with the ‘founding’ communities.

*(B) The authors discuss *Psilocybe semilanceata*, which is native to Europe. Why do the authors feel that the situation with *Psilocybe semilanceata* strengthens their argument?*

They believe that this example strengthens the argument because there was no reported evidence of people being interested in the medical properties of these mushrooms, while the Mazatec were interested primarily in medicinal use. This supports their argument that the Mazatec played a fundamental role in bringing psilocybin to medicinal attention and deserve recognition and compensation.

*(C) Do the authors appear to follow a consequentialist, deontological or a virtue ethics approach as they consider this question, and what is your reasoning for this answer?*

The authors appear to follow a deontological approach, as their argument is centered on the inherent rights of the Mazatec people rather than the consequences of psilocybin commercialization. They emphasize the indigenous people’s right to protect, preserve, and develop their traditional medical practices. This contrasts a consequentialist approach which would praise such developments as the ultimate benefit would be for society. They also are more in line with rights and obligations than virtues or moral character, so they wouldn’t necessarily follow a virtue ethics approach either.

*(D) Describe your view on this ethical concern.*

My view aligns with the author’s perspective. Time and time again, influential and overpowering forces have taken advantage of indigenous peoples without giving them any recognition or fair compensation. While medical advancements in psilocybin research could bring significant benefits to mental health treatment (as discussed in previous questions), this progress should not come at the expense of the indigenous communities. It is for this reason that I also take a deontological approach, as these indigenous peoples have a right to the knowledge that they have curated across generations. If we are to commercialize such treatments in the medical sphere, then it should involve careful ethical consideration including collaboration, fair compensation, and acknowledgement.

**1.**

i. Please read this article and answer the questions below:

*A. At what types of companies do the authors say most pharmaceutical innovation takes place, and what about this environment leads to the innovation?*

They found that emerging start-ups with low annual sales discover more than half of all newly approved drugs. The environment in these smaller companies attracts top scientific talent, where the most creative scientists work with more freedom. This results in increased innovation that is further encouraged (monetarily) through stock options as opposed to modest end of year bonuses.

*B. What do the authors say is the real barrier to innovation in pharmaceuticals, and how does this impact the way that big pharmaceutical companies get many of their products?*

They say that the real barrier is the FDA's high regulatory costs, as these innovative smaller companies can't always afford to conduct the large billion-dollar clinical trials required for approval. This positively impacts bigger companies who treat these smaller companies like 'farm teams', buying off their best drugs. The FDA's costs for approval result in big pharmaceutical companies getting many of their products from the innovative emerging start-ups discussed in part (i).

ii. Read these two articles and answer the questions below:

*C. According to the article, how much does a single pill cost, and how much does the full treatment cost (note the full treatment cost isn't explicitly given, but the pill must be taken daily for the duration of treatment, which is given)? How much income did the hepatitis C pill generate for Gilead in just a three month period (a "quarter")?*

They report that the list price is about \$1000 a day for a 12-week long treatment plan. This totals to \$84,000 total for the treatment. For the second quarter, the pill itself generated \$3.5 billion, and Gilead reported a total profit of \$3.66 billion for the quarter.

*D. Who is Pharmasset, and what is their relationship to Gilead and the hepatitis C pill?*

*Describe how the hepatitis C pill story either supports or goes against the main argument in "No, Big Pharma's High Prices Don't Drive Innovation"*

Pharmasset is a small company with no commercial products that developed the drug that Gilead was interested in. Gilead acquired the company for around \$11 billion. The main argument in "No, Big Pharma's High Prices Don't Drive Innovation" is that high drug prices are not necessary for innovation because many breakthrough drugs are developed by smaller companies, not large corporations. This argument is clearly supported by Pharmasset's story, as Gilead literally bought the company and its innovation to be able to produce the Hepatitis C drug. This story also supports the argument as Gilead charges so much for the drug, prioritizing profit. The buying of an innovative company for pharmaceutical progress supports the main argument from the first presented article.

**2. Please read this article and answer the following questions:**

*A. What do "high upfront costs" and "low incremental costs" mean, and how is this relevant to the authors' ideas regarding international disparities in pharmaceutical prices?*

High upfront costs refers to large initial investments required before a drug can be made available. This includes the R&D phase, patenting, trials, and other approval costs. These costs must be incurred before any revenue is generated. Low incremental costs refers to the relatively small additional cost needed to produce each unit. This includes manufacturing the actual drugs. Wealthier countries like the US lack strict price controls, leading to higher drug prices, but low incremental costs make it economically viable to sell drugs at lower prices in poorer countries. This maximizes revenue while maintaining access across different income levels.

*B. The authors argue that the lower prices of pharmaceuticals in other countries are due to the certain actions of other countries. What are these actions taken by the other countries, and what do the authors say would happen with pharmaceutical innovation if the US took these same actions (and why)?*

They say that these countries have 'monopsonistic government agencies' that negotiate drug prices with pharmaceutical companies, forcing them to accept lower prices. These agencies have the attitude that if they can't afford it, then their citizens can do without it. Less investment in research and development would lead to fewer medical breakthroughs worldwide as drug companies recoup R&D costs primarily through high US prices. Specifically, they say "If we pay, we get new lifesaving medicines. If we don't, we don't".

*C. Describe how the authors' argument aligns with Immanuel Kant's universality formulation of moral theory: "I ought never to act except in such a way that I could also will that my maxim should become a universal law". Hint: Kant is saying that the test to see if an action is immoral is to see what would happen if everyone did this action; an action is immoral if the benefit obtained by doing the action only occurs if other people are NOT doing the action. An example of this is cheating in school -- if it were well known that everyone cheats, then no one would pay consideration to grades and there would be no benefit from cheating.*

The author's argument aligns with this by suggesting that if every country imposed strict price controls on pharmaceuticals, then the system of drug innovation would collapse, making such actions immoral under Kant's framework. Under Kant's formulation, price controls are immoral if they rely on others not doing the same. Just as cheating in school only benefits a student because most others don't cheat and grades are valued, price controls in one country only work because other countries pay full price. Ultimately, the authors argue that U.S. high drug prices are necessary for global medical progress, and that universal price controls would create a self-defeating system.

**3.**

*A. What are the factors the authors list that favor taking into account patient views in drug approval decisions? What are the factors the authors list that oppose taking into account patient views in drug approval decisions?*

The authors say that patient input is most valuable in close cases where data and regulatory frameworks fail to indicate whether or not a drug should be approved. They also say that taking patient opinion will avoid making false generalizations about patient preferences. Next, they argue that the urgency of current patients will result in the FDA pushing immediate access to drugs, benefiting future patients as well. Finally, they say that using patient views will help with risk analysis, and can also give context to patients' clinical trial data. In opposition, they say that patient desperation means nothing in the face of crushing reality. Also, they mention that patient choice can result in high risk with low reward, and that giving them choice gives patients hope which is then exploited for commercial benefit.

*B. Describe how the authors' approach can be considered to follow Aristotle's Golden Mean approach to ethics. Hint: Aristotle's Golden Mean is the most influential version of virtue ethics. In this approach, virtues lie on a golden mean in between two extremes which are vices. As examples, courage is a virtue that lies as a golden mean between cowardice and recklessness, and generosity is a virtue that lies as a golden mean between stinginess and extravagance.*

The authors advocate for a balanced approach to drug approval. Their opinion lies between cowardice (Ignoring patient perspectives entirely) and recklessness (Relying solely on patient separation without scientific rigor). In the former extreme, the patient could lose their life due to closed mindedness, while in the latter the patient could lose their life due to unforeseen consequences. The Golden Mean in this context is a middle path, where the FDA listens to patients but still upholds high scientific standards to ensure drugs are both safe and effective.

*C. What do the authors say in regard to the "something is better than nothing" point of view?*

The authors say that the FDA should resist the urge to follow this approach. It is understandable for desperate individuals to want this approach, but they say that the FDA following this affects the drugs and clinical information. Having the FDA act as a 'gatekeeper' encourages manufacturers to establish that their drugs are safe and effective before they can be marketed.

**4.**

*A. How many different prices, on Medicare plans, were found for the generic version of the breast cancer drug Tykerb? What were the low and the high prices? What was the range of prices for CVS Caremark alone?*

There were 460 prices found for the drug. The prices range from a low of \$1,392 to a high of \$12,145. The average low is \$4,817, and the average high is \$6,504. The price range for CVS Caremark is from ~\$3,100 to ~\$7,000.

*B. What is the reason given in the article for these big drug price variations?*

They say that medicare divides coverages into 34 regions around the US and that health plans have to submit separate bids for each region. They also say that PBM's inconsistent way of arriving at drug prices makes medicare look less trustworthy and more like a gamble. Taking into account dispersed medicare regions and PBM practices, the article sums up these variations by stating that the reason for such huge differences is "America's complicated drug-reimbursement system which uses middlemen to negotiate prices".

**5. Please watch [this video](#) and answer the following questions:**

*A. Consider a customer buying soda in a store like CVS. Describe the supply chain, including all parties involved and the transfer of goods and payments between parties.*

The parent company manufactures the soda and sends it to a retailer who then sells it to a customer. The retailer then uses the money the customer paid for the beverage to pay the parent company back for manufacturing the goods.

*B. Now consider a customer buying a prescription drug in a store like CVS. Who are the parties in this supply chain?*

Those involved in the supply chain are pharma companies (drug makers), wholesalers (distributors) who sell to pharmacies, insurance companies, and pharmacy benefit managers (middle men; PBM).

*C. Who does a pharmacy benefit manager work for, and what is their job role?*

They work for insurance companies, big employers, and government agencies. Their job is to bring down the cost of drugs for their employers by negotiating with pharma companies with rebates.

*D. What is the formulary, and how do its tiers relate to the co-pay that a customer must pay? How does the rebate affect the tier? What tier do pharma companies want their drug on, and why?*

A formulary is the list of drugs the insurance company covers. Each tier represents what portion of the list price the patient pays versus what the insurance company pays. The highest tier is the lowest amount the patient pays, and the lowest tier is the highest copay for the patient. Higher rebates result in higher tiers for the drug on the formulary. Companies want high placement on the formulary (higher tier) as more people will buy it so that they make more money on average for large needed groups.

*E. What reason did the pharma companies give for raising list prices, and what did they say was the role of the pharmacy benefit manager in this regard? What was the response from the pharmacy benefit managers?*

They say that they need to raise the list prices to meet the demands of the higher rebates imposed by the PBMs. They say you get no uptake and poor finances from not raising the list prices.

Ultimately this is to protect their sales and profits. The PBMs say that the companies don't have to raise drug prices to boost bottom lines and that rebates reduce costs, not inflate them. They say that rebates reduce insurance payments and thus customers don't need to pay large premiums.

*F. Data is shown in the video that the average price paid for some drugs has not really been increasing, even though the list price is increasing. But some people are nonetheless adversely affected by this system -- who are these people and why are they adversely affected?*

The patient ultimately ends up being affected by this adversely, where they have to pay closer to the list price, not the price that the insurance company is responsible for after the rebates.

Specifically, patients without (good) insurance or those that have high deductibles sometimes have to pay the entire list price due to insurance companies' role in pricing. Different people with different insurance plans pay different amounts for different drugs.

**6. This [press release](#) from the Federal Trade Commission in July 2024, claims that prescription drug middlemen are "squeezing Main Street pharmacies". Describe how these drug middlemen are doing this.**

The report found that PBMs (the middlemen) have enormous power over accessibility and cost of drugs, as well as having large influence over independent pharmacies by imposing unfair, arbitrary, and harmful contractual terms. They can do this because they are well integrated with the nation's largest health insurers and specialty and retail pharmacies. This vertical integration and high degree of consolidation in the market results in a significant increase in power.

Integrated PBMs have the ability and incentive to prefer their own affiliated businesses, creating conflicts of interest that can disadvantage unaffiliated pharmacies which increases prices. The report also finds that PBMs use harsh contracts to disadvantage smaller, unaffiliated pharmacies. Finally, PBMs negotiate rebates conditioned on limiting access to lower-cost generic competitors. These issues compound in the PBMs effectively squeezing Main Street pharmacies, increasing prices and punishing patients nationally.

**7. Which of the factors mentioned above do you find most convincing in explaining the high drug prices in the US, and why do you think that is?**

I think the most convincing factor is the supply chain combined with PBMs. According to the report discussed in number 6, this factor seems most compelling. PBMs are reported to have widespread influence over availability and pricing. Availability is a driving economic force when it comes to driving up prices. Moreover, PBMs act out of self interest to drive the profits of their supervising companies up. They act with disregard to the patients and consumers, and do everything in their power to increase profits. This, combined with the supply chain scenario described in number 5 leads to the high drug prices in the US, in my opinion. Ultimately, PBMs are ultimately forcing pharmacies and drug manufacturing into corners where prices need to go up in order to keep profits high. This is at the cost of people's wallets.

**For each of the following concepts, explain the meaning of the concept in the context of this course and and how an example used in lecture demonstrates the concept:**

a. Normalization of deviance

The normalization of deviance means taking actions that were typically established as societally deviant or unacceptable, and doing them so regularly that they become the norm and are widely accepted by a group or population. An example of this is Bhopal India's Industrial Disaster, where all of the control systems in place were either out of service or disabled for months prior, and it was simply accepted that this is the way things should be in the plant. This deviance was normalized to the point where those working didn't think anything was wrong with what they were doing, leading to a large malfunction.

b. Management of change review

Management of change review is the idea that, with any small change, you must bring in a group of people of different backgrounds to analyze the risks of making even the slightest of changes. This is relevant to the Chernobyl disaster discussed in class, where the engineers working on the test of the reactor on the night of the disaster didn't know the consequences of the test they were doing. The test (done to improve safety) involved running the reactor at 700-1000 MW, but the power dropped too much (30 MW) and the control rods were all pulled out resulting in the reactor melting down. With management of chain review, they would've had to get their test and its changes cleared with a board of people with different backgrounds. They did not have this and, since they didn't understand the risks, resulted in a disaster.

c. Safety Controls (address one of: Engineering vs Administrative; **Preventive vs Mitigative**; Active vs Passive)

Mitigative controls are safety controls which are in place to minimize the residual effect of an incident. Preventative controls, on the other hand, are safety controls that are in place to prevent an incident from occurring altogether. An example of this from lecture is the wine vat in Qhevri, people need to go in and clean the inside between batches. This is dangerous as fermentation causes CO<sub>2</sub> to build up in the vat, so if someone goes in there might not be enough O<sub>2</sub> in there. The safety control in this example is having the person inside the vat sing, and having someone outside listening. This person outside and the signing are a mitigating safety control, where they listen out for the person to stop singing which indicates they have fallen unconscious and need to be returned to O<sub>2</sub>. A preventative control would be equipping the person with some sort of breathing apparatus, or automating the process somehow, but then the process would lose its cultural significance.

d. Do/can engineers act objectively?

In lecture, we discussed infrastructure choices, like highway construction, and how it applied to engineering decisions. Highways have historically benefited for some and negative consequences for others. The highway department built the highway in not 'improved' places. The power and

status held by certain communities affects their ability to influence the decisions made that will impact their community. Shaker Heights was able to prevent the highway, while Alabama could not. Engineers claimed that interstate locations were decided based on the distribution of the urban and rural population, motor vehicle ownership, and irrespective of bias. This is not the only factor, as underlying bias regarding race most definitely played a role. Ultimately, engineers cannot act objectively as any situation that requires one to use their judgement, makes it impossible to ignore your own biases.

e. Balance of public vs private rights

The motives of private organizations, including the government in most cases, are largely profit driven. These large private organizations have 'more rights' than the general public, and can act disregarding public rights and opinion. An example of this is the construction of opportunity corridor in Ohio, where the government decided to go forward with the construction of the road despite the community outcry. This brings another question of if the government should always listen to community outcry, as some members of the public have more influence than others, despite having 'public' rights.

f. Disproportionate impact on certain groups

Due to the nature of how communities are built and how people have been divided into specific regions based on their status over time, some decisions made can have a tremendous impact on specific groups. An example of this is the opportunity corridor as well. Here, 76 million families and 16 businesses were displaced. Community members argued that the road's width encourages speeding and that there would be pollution Problems due to high traffic. The neighborhood affected has lower class citizens who cannot really make use of the road due to not being able to afford cars, relying on public transit. As a result, they would be greatly negatively affected, while people who could afford to use the road would benefit greatly.

g. Trademarks can become generic

A company can place a trademark on any product they deem fit. This marks the product as the company's intellectual property and thus they have the right to use that name freely. That being said, if the general public uses the trademarked name in place of the generic name too frequently, then the trademark becomes void. An example discussed in lecture is PTFE, more commonly referred to as Teflon. Professor Lacks referred to PTFE as Teflon in one of his articles without using the trademark symbol, calling the chemical by a 'generic', but trademarked, name. The engineers were concerned about his lack of clarification of the trademark of the name, as they did not want to lose the Patent that Dupont has on PTFE as Teflon. Similar things have happened to Velcro, Yo-Yo, Pilates, and Granola. All of these names used to be brand names, but became so wide spread so it became the generic name and the trademarks for these products were lost.

#### h. Virtue Ethics – Aristotle's Golden Mean

Aristotle's Golden Mean is an influential branch of virtue ethics that suggests virtues lie on a golden mean in between two extremes which are vices. The most ethical approach is thus the stance that lies at the mean of these extremes. An example of this discussed in the first lecture is allowing people with a prosthetic foot to compete in the olympics. The extremes in this case are to either prevent anyone with a prosthetic foot from competing, or to freely allow them to compete with no rules or restrictions. The golden mean in this situation is to set specific rules and regulations for the athletes, or another alternative is the paralympics.

#### i. Professional codes of ethics

Professionals are expected to adhere to a code of ethics or rules for conduct for their profession. Ethical questions are much more black and white under a code of ethics, eliminating the questions coming from questions like "should you steal to help your family". An example of this is the high school football coach who boosted some of the grades of one of his students so that they could make it to college and be successful. The coach was acting out of the interest of his players, and had personal ethics guiding his decision. He consequently violated his professional code of ethics, which is inappropriate when the reason is purely based on personal ethics. The coach lost his job and thus his great reputation was tarnished.

#### j. Do artifacts have politics?

Philosophers have argued the "value neutrality thesis" which says that technologies are inherently neutral - they are mere things that don't care how they're used. Philosophers overwhelmingly reject value neutrality, rejecting the idea that if technologies are used for malicious purposes, we should blame the user rather than the tech itself. An example of this is the politics of technologies that redistribute resources. In terms of the Aral situation discussed in lecture, the river diversion resulted in drying up the rivers, which benefited the USSR as a whole, but hurt the people in the Aral region. They took advantage of a large source of water, specifically feeds to the Aral sea, with no respect to the land they were taking from. This resulted in people growing up there having an almost deserted homeland. These canals/diversions were inherently political due to these targeted effects on people's livelihood.

#### k. Factual vs. conceptual vs. ethical components of ethical issues

The factual aspect of ethical issues are facts that could potentially influence our answers. The conceptual component deals with key ideas that have ambiguous definitions, and the moral component deals with any distinctly moral issues. An example of this is vaccination, more specifically if it is ethical to require vaccinations. For this example, the factual component is the analysis of health risks of vaccination, needing real and accurate scientific evidence. The conceptual component is dealing with what it means for a vaccine to be safe, and what acceptable risk should be defined as. Finally, the moral component to this issue concerns personal freedom and liberty. The choice to get a vaccine not only affects your health but the

health of others in the community. These 3 key components make up this largely contested ethical question.

**Some advice for the AI art part of this assignment:**

- You can use any tool you'd like. I found Google ImageFX to work best. It is free.
- It may take many tries and experimenting in order to find a prompt that generates an image that meets your needs.

**Choose one of the concepts listed in Question 1, and use an AI art tool to create an image that illustrates a meaningful and specific example of the concept. The image must include a person (or people) who clearly displays emotions related to the concept (no credit will be given for any part of this question if the image does not clearly display people with emotions related to the concept). The example for the image does not have to be related to the example used in Question 1, and it does not have to be related to an example discussed in lecture.**

- a. Upload the image



- b. Give the prompt used to generate the image and the AI tool you used to create the image  
Prompt given to Google ImageFX: "surgeon entering an operating room eating a burger with colleagues around the operating table smiling and not caring"

- c. Explain how the image illustrates an example of the concept, and how emotions of people in your AI-generated image help illustrate the concept

This illustrates **normalization of deviance** as the surgeon is in the OR eating food and not being sterile at all, even though there are tools used for the surgery being prepped on the table. The emotions illustrate the concept as the surgeon's colleagues are all smiling and laughing, showing a lack of care for the violation of the standard operating procedure. They are also not being sterile and no one is saying anything to keep the area clean, despite one person having gloves on.

**Repeat Question 2 with a second concept from the list in Question 1.**

- Upload the image



- Give the prompt used to generate the image and the AI tool you used to create the image  
Prompt given to Google ImageFX: "three slides total generated, first slide should show a person sleeping at 12:00pm shown on a clock, the second should show the same person drinking a cup of coffee at 12:00pm, and the third image should be someone sitting in a graveyard of coffee cups and coffee pots again at 12:00pm"

- Explain how the image illustrates an example of the concept, and how emotions of people in your AI-generated image help illustrate the concept

This shows **Aristotle's Golden Mean** by showing a man sleeping through the day as the lower extreme, the same man being addicted to coffee at the other extreme, and him being awake with only one cup of coffee at the golden mean. In the first slide, the AI shows emotion through the sleeping man by showing him slightly saddened as a result of sleeping through the day. At the other extreme, the man is more distraught than sad, as he has a crippling coffee addiction and is surrounded by it 24/7. In the golden mean, he is still tired, but looks more content as he has his pick-me-up and can thus be more productive without having an addiction to caffeine.

**Repeat Question 2 with a third concept from the list in Question 1.**

- a. Upload the image



b. Give the prompt used to generate the image and the AI tool you used to create the image  
Prompt given to Google ImageFX: "doctor accepting a bribe from a patient under the table. the briber should hold one finger up to his lips, and the doctor should look agreeable and smile. In exchange for the money, the doctor should give the patient a prescription bottle. show full faces"

- c. Explain how the image illustrates an example of the concept, and how emotions of people in your AI-generated image help illustrate the concept

This shows a doctor violating their **professional code of ethics**. The doctor is accepting the bribe from the patient, invalidating their practice as they should not be taking money to prescribe a seemingly unneeded medication. The briber knows what they are doing is wrong, that's why they look secretive covering their lips with the 'hush' finger. The doctor, like the football coach example, wants to make the patient happy and is thus taking the money in exchange for violating his medical license. Professionally, the doctor shouldn't agree to this, but his emotion presented by the AI is happy and seems very agreeable.

1.

A. Find [Apollo the Python-Slayer](#). Upload a selfie in front of the statue.



**B. Read this short NY Times article: Cleveland Museum of Art Apollo with intriguing past. Why does the museum consider this sculpture to be particularly important? Why was the museum's acquisition of the structure controversial?**

The sculpture is considered particularly important because it is believed to be the world's only original work by the ancient Greek sculptor, Praxiteles. The museum's acquisition of the structure was controversial due to the ownership history of the work. Not all of the information about how the sculpture was collected has been shared by the museum, and many scholars say that sketchy dealers were involved in the transaction. The roots of the purchase can be traced back to looters and smugglers who have since been convicted, implying that the museum's acquisition was unjust due to the poor history.

**2.**

**A. Find the Egyptian Statue of a Man. Upload a selfie in front of the statue.**



**B. Read this short NY Times article: Cleveland Museum of Art to Return. Why is the Cleveland Museum of Art planning to return the statue to Libya, and why are they not doing it immediately?**

The statue is very rare and was smuggled to the CMA by thieves in 1991. Recently, curators received strong evidence that the item was stolen from Libya, and thus the museum agreed to transfer ownership rightfully to Libyan officials. Libya consequently allowed the museum to keep the work on a loan, which CMA hopes to do for around 5 more years. The CMA also is trying to set a good example by not having to be pressured by law enforcement to return stolen art.

3.

A. Find the [Benin Ancestral Commemorative Head](#). Upload a selfie in front of this object.



**B. Watch from 6:00 to 12:00 of the movie [Invasion 1897](#). What is the argument made by the defendant in the trial, and how does it relate to the Ancestral Commemorative Head in the Cleveland Art Museum?**

The defendant in the trial pleads innocent, arguing that he was attempting to return lost/stolen property. He asks if the judge would try to take back her wig and robe if she found them to be in the possession of another. The judge stands by her ownership of her belongings, and the defendant attempts to use this to argue that the artwork is his and belongs to his people. The Ancestral Commemorative Head was taken from Benin altars many years ago, and thus someone could make the same argument as the man in the movie. Just because the CMA has the work in their museum doesn't mean it rightfully belongs to them.

4.

A. Find the [Time \(from Chateau de Chaumont set\) tapestry](#). Upload a selfie in front of the tapestry.



B. Read the highlighted text (12 sentences, on pages 1 and 2), and look at Figs 1 and 6 of the article below. What is the key protein that provides structural integrity of wool tapestries, what bonds does this protein form that are important for this structural integrity, and what does Figure 6 demonstrate in this regard?

Wool fibers are reinforced by wool keratin proteins which are high in cystine content. These amino acids have di-sulfide crosslinks (which form through disulfide oxidation - and whose mechanism is unknown) which are important for their structural integrity. Ultimately, the integrity of the protein backbone and crosslinks are the most important factors in the integrity of the wool. Figure 1 suggests that ultraviolet light breaks down disulfide bonds and creates cysteic acid. Figure 6 uses this idea to show the difference between unaged, artificially aged, and historically aged wools. The presence of Cysteic acid in the historic wool compared to the other variants shows the important effect the acid has on the longevity of the fibers. Moreover, it reinforces the proposed mechanism discussed both in the highlighted section and in Figure 1.

5.

A. Find [El Greco's Christ on the Cross](#). Upload a selfie in front of the painting.



**B. Read the highlighted paragraphs of this article (on pages 2, 9 and 11): PATCH a deep learning method to assess heterogeneity. What question are they exploring regarding Christ on the Cross, what data do they use as input for the machine learning analysis (see last highlighted paragraph on page 2), and what conclusion do they reach about Christ on the Cross?**

The researchers are exploring whether Christ on the Cross was created by a single artist or involved contributions from multiple hands. They used data gathered from optical profilometry, a technique that creates a topographic image at microscopic resolution over the entire painting. These data included the surface topography and the topography of pigmented layers beneath the transparent varnish layer. Despite possible effects of damage on the work, the researchers concluded that *Christ on the Cross* is the work of a single artist who may have had some variation in practice over time.

6.

A. Find Jeptha Wade's portrait of Nathaniel Olds. Upload a selfie in front of the painting.



**B. Jeptha Wade was one of the founders of Western Union, which dominated the telegraph system in the U.S. throughout the late 1800s and continues to operate today as a financial institution. Wade became one of the wealthiest people in the country and is the eponym of Wade Park, Wade Oval, Wade Lagoon, Wade Commons, etc. Read the short excerpt of his biography: jh wade autobiography excerpts**

**i. Why did Wade leave his previous job to become a portrait painter, and why did he leave his job as a portrait painter to go into the telegraph industry?**

Wade originally left his previous job as his health was rapidly failing and he couldn't do much more than oversee and give directions, which he did not feel suited him. He then tried to become a portrait painter under Randall Palmer, who was visiting for a short period. He then worked as a painter, but became unhappy with his health as it was being negatively impacted by not being able to get exercise or go outside. Another important factor was the prospects he saw in the telegraph industry, saying "I had never seen such a good thing". Thus, he gave up being a painter and accepted a job in the telegraph industry. This proved good for his health, neither too strenuous nor boring, and was economically viable.

**ii. What are the two inventions Wade mentioned that he did not patent but later wished he had?**

One of the inventions was a lightning arrestor which prevents lightning from coming in without interrupting the telegraph current or the lines' functionality. The other invention was covering cables with reinforced wires (to solve an issue where storms would lay waste to many cables), which allowed the lines to cross rivers and large bodies of water previously thought to be impossible.

7.

A. Find [Van Gogh's Two Poplars in the Alpilles near Saint-Rémy](#). Upload a selfie in front of the painting.



*Two Poplars in the Alpilles near Saint-Rémy*  
1889  
Oil on fabric

Vincent van Gogh  
(Dutch, 1853–1890)

Vincent van Gogh painted this landscape while he was a patient at the asylum at Saint-Rémy in southern France. Although restricted to painting in his room, he soon mastered the brushwork of his new style, and this painting shows the full power of his mature style. Even rural architecture, such as the simple stone walls applied with charged impasto, conveys emotional reaction to the subject.

Begun at Leonard C. Hanna Jr. 1998.2

**B. Read the four highlighted paragraphs of this article (on pages 112 and 121): Weave matching and dating of Van\_Goghs. What is the technology used in this study, what information does the technology give, and how did this analysis of this Two Poplars painting help settle the controversy of when and where Van Gogh created his "Wheat Stacks in a Cloudy Sky" painting?**

The technology used in this study is Fourier spectral analysis, applied to X-radiographs of paintings on canvas. This technology gives thread density maps across the canvas (horizontal and vertical), weave matching information (tells researchers if canvases have originated from the same roll), and dating/location information from any found matches in the weave analysis.

"Wheat Stacks in a Cloudy Sky" had long debated if Van Gogh painted it in Saint-Rémy or in Arles. The technology found a weave match with the Two Poplars painting, which is known from historical letters to have been created before the beginning of October 1889. Furthermore, "Wheat Stacks in a Cloudy Sky" depicts a wheat stack inside the asylum walls, confirming that it was created in Saint-Rémy rather than Arles or Auvers. Ultimately, the technology helped end the debate and placed the origin of the work around 1889 in Saint-Rémy.

8.

A. Find [Andy Warhol's Marylin x100](#). Upload a selfie in front of the picture.



B. Read [this short NPR article](#) about a different one of Warhol's works. What is the relevant intellectual property issue in this article, how was it decided by the US Supreme Court, and how does it relate to the Marylin x 100 picture?

The relevant intellectual property issue in this article is copyright infringement and the scope of the fair use doctrine in the context of transformative works. The case concerns whether Andy Warhol's use of Lynn Goldsmith's 1981 photograph of Prince in his series of silk screen images was transformative enough to qualify as fair use. In a 7-2 ruling, the U.S. Supreme Court ruled Andy Warhol infringed on photographer Lynn Goldsmith's copyright and that it did not qualify as fair use. This case is related to the "Marylin x 100 picture", raising questions about whether the work would be considered copyright infringement under the same reasoning. The case sets a precedent for artists who have produced transformative works believing them to fall under fair use.

9.

A. Find the Vessel with Ballplayer. Upload a selfie in front of the vessel.



**B. Read the three highlighted paragraphs of the article: Prehistoric polymers rubber processing in ancient mesoamerica-1.**This article explains how ancient Mesoamericans were the first "polymer scientists". They developed a chemical process to transform the mechanical properties of dried latex, turning it from a brittle solid into a flexible rubber (which was used to create the ball shown on the vessel). What process did they use to alter the mechanical properties, and what chemical changes were involved in these transformations?

To alter the mechanical properties, they mixed the latex with liquid extracted from *Ipomoea alba* (a species of morning glory vine), significantly enhancing the elasticity and durability of the resulting rubber. About 50 ml of the *I. alba* liquid extract was mixed with about 750 ml of the latex for about 15 minutes, which then turned into a white solid mass which could be molded and shaped into the desired product. Chemically, organic components in *I. alba* resulted in purification of the polymer component and an increase in the strength and number of interchain interactions. Also, the process resulted in a much less brittle product when compared to the dried latex they used as a raw material.

**10.**

A. Find [Krishna Lifting Mount Govardhan](#). Upload a selfie in front of the statue.



**B. Watch this [video about the Krishna sculpture](#). What was the technology used to determine that the hand belonged to the Cleveland Krishna, and what generated the goodwill that led to the hand being sent from Cambodia to Cleveland?**

To determine that the hand belonged to the Cleveland Krishna, conservations used 3D imaging technology from CWRU, combined with 3D printing technology to generate a model of the hand. They also used petrographic studies to originally speculate the ownership of the hand. It was 3D printing that allowed the team to finally connect the dots, however. The CMA director made arrangements to return the sculpture of the Monkey God to Cambodia, as it was found to have been looted in its original acquisition. This gesture, reunifying the Monkey God to its rightful owner, resulted in Cambodia giving the hand to the CMA.