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Working Paper

From Helping Hand to Stumbling Block: The ChatGPT Paradox in Competency Experiment

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From Helping Hand to Stumbling Block: The ChatGPT Paradox in Competency Experiment

Abstract

We ran a controlled laboratory experiment to examine whether ChatGPT's aid can increase the participants' performance in three different—reading and writing, mathematical problem-solving, and computational thinking—tasks. We find that the math score significantly decreases with ChatGPT's assistance. This result is mainly because the low-ability subjects couldn't discern the hallucinated answers with the correct ones, and it contests the general idea that ChatGPT can complement the workers with less expertise.

JEL-Codes: C910, J240, O330, D830.

Keywords: laboratory experiment, ChatGPT, labor productivity.

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From Helping Hand to Stumbling Block: the ChatGPT Paradox in Competency Experiment*

Introduction

It is crucial to explore the possibilities and circumstances in which generative AI can be utilized in the labor market, not only for simple automation, but also for augmenting human capacities. Automation, underpinned by technologies ranging from software to robots and AI, progressively extends its scope from routine tasks to more complex and non-routine activities. Automation technologies replacing routine tasks lead to job displacement (Autor et al., 2003; Acemoglu and Autor, 2011; Goos et al., 2014) and create new jobs and higher labor productivity, triggering reinstatement effect (Acemoglu and Restrepo, 2019). Social intelligence and creativity are traditionally considered as bottlenecks to automation, but the advent of generative AI applications such as ChatGPT may ease these bottlenecks (Frey and Osborne, 2024). Thus, the impact of such AI on the labor market depends on its developmental and adoption pathways, and the quantitative changes in employment will rely on the relative magnitude of these effects. In essence, generative AI might lead to job displacement or reinstatement depending on whether it augments human capabilities or merely automates repetitive tasks.

Would ChatGPT's aid increase the performance of skills relevant to labor productivity? If so, would the high-ability (low-ability) workers get benefited more because ChatGPT supplements the skill (complements the low ability)?

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To answer these questions, we conducted a controlled laboratory experiment examining the treatment effect of ChatGPT’s assistance on three—reading and writing, mathematical problem-solving, and computational thinking—tasks. Those three task domains represent core competencies for labor productivity. The treatment group was asked to use ChatGPT to perform the provided tasks, while the control group was not allowed to use it.

We found that the reading and writing task score in the treatment group is not statistically different from that in the control group, but the score distribution is more left-skewed with the same support, suggesting that the intermediate-ability subjects get benefited, but the high or low-ability subjects don’t. However, ChatGPT’s assistance significantly decreases the average score of the math task. This result is mainly because the subjects with low math ability couldn’t discern ChatGPT’s plausible (but incorrect) responses with the correct ones. The subjects lacking the ability to check the validity of ChatGPT’s responses are likely to rely more on them, leading to lower performance. The average computational thinking task score of the treatment group is statistically insignificant compared to the control group. Overall, ChatGPT’s assistance was not beneficial, and sometimes harmful, for low-skilled participants. It can be paradoxical that those who need ChatGPT’s assistance the most should rely less on it, contesting the widespread belief that ChatGPT can augment the labor force with less expertise.

Our study contributes to the fast-growing literature on the economic applications of ChatGPT. Studies exploring rationality of machines and potentials for human–machine collaboration through generative AI indicate that the advancement of Large Language Models shows capabilities for rational decision-making and reasoning (Webb et al., 2023; Kim et al., 2023). Applications to cognitive and knowledge-intensive tasks such as writing and counseling seem to improve overall productivity and reduce productivity disparities (Noy and Zhang, 2023; Brynjolfsson et al., 2023). Emerging research also identifies the functional limitations of generative AI. Chen et al. (2023) report that ChatGPT’s level of rationality varies by context, highlighting the limitations of it. Dell’Acqua et al. (2023) confirm productivity can be hindered by GPT utilization patterns. Our study stands out by contemplating whether the rationality of ChatGPT can support fundamental human skills, rather than focusing on job-oriented tasks.

Experimental Design

Figure 1 summarizes the process of the experiment. The participants, Korean-speaking university students aged 19 or older with diverse academic disciplines, were randomly divided into one of two groups and asked to solve problems designed to assess their competence in two of the three—reading and writing (W-task hereinafter), mathematical problem-solving (M-task), and computational thinking (C-task)—tasks. The control group was allowed to use the Internet except for ChatGPT, while the treatment group was instructed to utilize ChatGPT actively. To give a common experience with ChatGPT, the treatment group participants copied and pasted the prepared three prompts into ChatGPT before performing the required task. To symmetrize the control group’s experimental procedure, the control group participants practiced advanced search functions by copying and pasting the prepared three queries into the Google search bar. To measure the participant’s competency, we consciously created test questions using existing competency assessment tools for college students and adults. For the C-task, we asked participants to complete natural language algorithms, pseudo codes, and logic flowcharts, to ensure that participants without programming language experience could write their

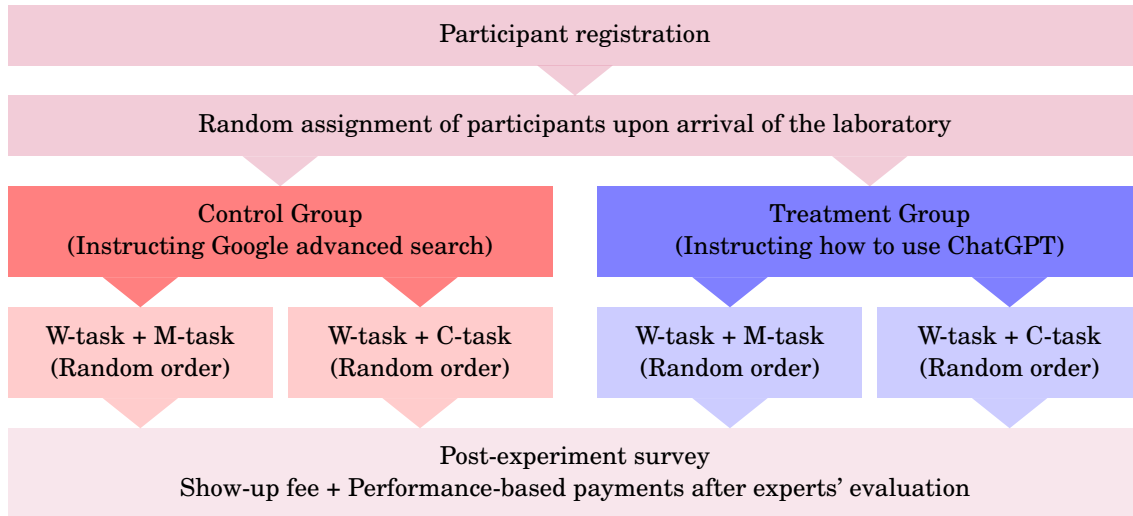


Figure 1: Experimental Design

responses. Participants received performance-based payments which vary from 13,500KRW (about 10.24USD as of September 1, 2023) to 27,000KRW. The experiment was conducted in September–October 2023. See the Appendix for detailed descriptions of the experiment and the test questions.

Results

This section reports the results of our experiment which involved a total of 349 participants, focusing on how much the task scores improved with ChatGPT’s assistance. Figure 2 shows the average scores of three tasks in each control and treatment group.

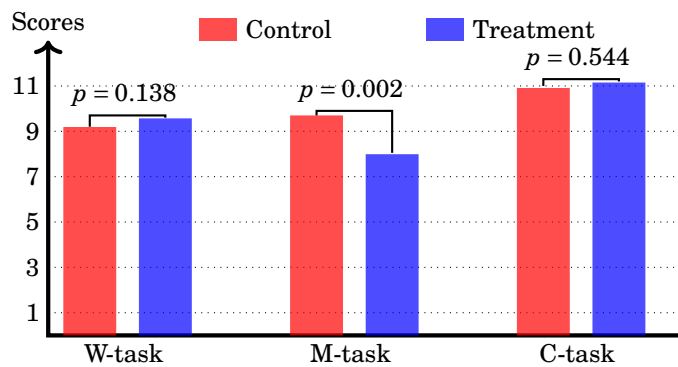


Figure 2: Average Scores of Each Task

In the W-task, the null hypothesis that the average score of the treatment group is the same as the control group cannot be rejected (t-test, p-value=0.138), but the null hypothesis that the score distribution of the control group and the treatment group is the same is rejected at the 5% significance level (Wilcoxon rank-sum test, p-value=0.0489). It implies that using ChatGPT did not lead to an overall improvement in reading

and writing scores, but a shift in the distribution. The first panel of Figure 3 shows the empirical cumulative distributions of the W-task scores for the control and treatment groups. In the interval between the bottom 40% and 95%, the distribution of the control group (dashed line) is to the left of the treatment group (solid line), suggesting that participants with competence in this interval achieved better scores with ChatGPT’s assistance.

Result 1. *Using ChatGPT weakly improves performance in the reading and writing task for participants with intermediate-level proficiency.*

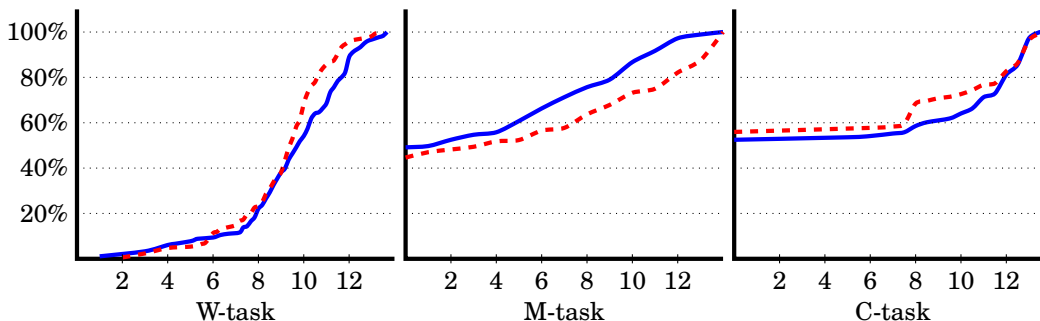


Figure 3: Empirical CDFs of Each Task

For the M-task, the average score of the treatment group is also significantly lower than the control group (p-value=0.002). This suggests that the average score *decreased* when the participants used ChatGPT to solve mathematical problems.

We claim this is because ChatGPT generates natural language responses that *seem* to fit the question, rather than analytically solving the problem, which often leads to incorrect answers. Participants with weaker mathematical problem-solving skills are less able to discern ChatGPT’s hallucinated answers from the correct ones, and this inability can adversely affect their performance. To support this claim, Figure 4 illustrates how ChatGPT can adversely affect the M-task. When one M-task question was typed, ChatGPT generated the correct sequence of steps but produced an erroneous answer. The wrong answer is deceptively persuasive, so low-skilled participants, believing ChatGPT’s answers are convincing, lack the incentive to reevaluate them. ChatGPT provided a correct response (on the right of Figure 4) on the same date, but the fundamental issue—whether the users can discern the hallucinated responses from the correct ones—remains. It implies that the users with less expertise—who might need generative AI’s aid more—should not rely on it unless they become capable of evaluating the validity of its responses.

Result 2. *Using ChatGPT decreased participants’ performance in the mathematical problem-solving task.*

Regarding the C-task, no significant difference was found between the control and treatment groups. The null hypothesis that the data were drawn from the same population is not rejected (p-value=0.482), and the mean score difference is statistically insignificant (p-value=0.544). When assessing participants’ computational thinking skills, many of the questions required them to complete pseudo-code or natural language algorithms making their performance less dependent on previous programming languages exposure. These questions are not in a format that one can merely copy and paste into ChatGPT, so an ideal user would need to

ChatGPT 3.5 ▾



You

You paid 6,600 KRW for kiwis that cost 300 KRW each and apples that cost 700 KRW each. What is the maximum number of kiwis and apples that can be purchased together if more than one of each is purchased?



ChatGPT

To find the maximum number of kiwis (k) and apples (a) that can be purchased together, considering the given constraints, we can set up an equation based on the cost:

You paid 6,600 KRW for kiwis that cost 300 KRW each and apples that cost 700 KRW each.

The total cost (C) can be expressed as follows:

$$C = 300k + 700a$$

Given that $C = 6,600$, the equation becomes:

$$300k + 700a = 6,600$$

Now, we want to find the maximum values for k and a such that the equation is satisfied.

To simplify, we can divide the entire equation by 100:

$$3k + 7a = 66$$

Now, we need to find integer values for k and a that satisfy this equation.

The maximum values for k and a occur when $k = 22$ and $a = 0$. This is because if $k = 23$, the left side of the equation would exceed 66.

So, the maximum number of kiwis and apples that can be purchased together, given the constraints and that more than one of each is purchased, is $k = 22$ and $a = 0$. In this case, only kiwis are purchased.



ChatGPT 3.5 ▾



You

You paid 6,600 KRW for kiwis that cost 300 KRW each and apples that cost 700 KRW each. What is the maximum number of kiwis and apples that can be purchased together if more than one of each is purchased?



ChatGPT

Let's denote the number of kiwis as x and the number of apples as y . The cost equation can be expressed as:

$$300x + 700y = 6600$$

Now, we want to find the maximum values of x and y that satisfy this equation. One way to approach this is to find the greatest common divisor (GCD) of 300 and 700, and then see if the total cost, 6600, is divisible by the GCD.

The GCD of 300 and 700 is 100. So, we divide both sides of the equation by 100:

$$3x + 7y = 66$$

Now, we need to find integer solutions for x and y that satisfy this equation and maximize their values. One solution is $x = 15$ and $y = 3$. This satisfies the equation, and it's a valid solution because both x and y are positive.

So, the maximum number of kiwis and apples that can be purchased together is 15 kiwis and 3 apples.



Figure 4: Different Answers to the Same Query
Used the default GPT-3.5. The same prompt was queried on the same day, Jan 14, 2024.

modify the question to make it easier for ChatGPT to process.¹ However, according to the post-experiment survey, only 6.8% of the treatment group participants answered they "modified and typed the question into ChatGPT, checked that ChatGPT's answer was correct, and submitted it". It is well known that proper prompts are necessary for proper ChatGPT's responses, and without mastering effective prompts, ChatGPT's aid doesn't significantly enhance competency.

Result 3. *Using ChatGPT without proper prompts does not improve performance in the computational thinking task.*

Concluding Remarks

Reading and writing, mathematical problem-solving, and computational thinking are core competencies for labor productivity. We conducted a controlled experiment to examine whether ChatGPT helps in those skills. Ultimately, this study is part of the broader examination about whether generative AI apps can positively affect labor productivity and a more flexible labor market.

We found using ChatGPT improved reading and writing performance of the participants with intermediate skills, consistent with [Noy and Zhang \(2023\)](#). However, in the mathematical problem-solving task, ChatGPT *hampered* participants' performance. This suggests that when ChatGPT's responses appear to be plausible but incorrect, using ChatGPT can be detrimental unless the user can validate ChatGPT's responses. Paradoxically, if a low-skilled person is incompetent to evaluate ChatGPT's outputs, she might consider not relying on them. Also, if one has already possessed adequate skills to perform the relevant tasks, the benefits of using ChatGPT may be negligible. In the computational thinking task, ChatGPT's assistance was limited. One clear takeaway is that similar challenges could arise in several other domains if the abilities to subjectively judge the quality of ChatGPT's responses and to properly compose prompts are not equipped beforehand. Overall, these results contest the widespread idea that generative AI applications' aid can positively affect labor productivity.

References

- Acemoglu, Daron and David Autor**, "Chapter 12 - Skills, Tasks and Technologies: Implications for Employment and Earnings," in David Card and Orley Ashenfelter, eds., *Handbook of Labor Economics*, Vol. 4, Elsevier, 2011, pp. 1043–1171.
- **and Pascual Restrepo**, "Automation and New Tasks: How Technology Displaces and Reinstates Labor," *Journal of Economic Perspectives*, May 2019, 33 (2), 3–30.
- Autor, David, Frank Levy, and Richard Murnane**, "The Skill Content of Recent Technological Change: An Empirical Exploration," *The Quarterly Journal of Economics*, 11 2003, 118 (4), 1279–1333.
- Brynjolfsson, Erik, Danielle Li, and Lindsey Raymond**, "Generative AI at Work," Working Paper 31161, National Bureau of Economic Research April 2023.
- Chen, Yiting, Tracy Xiao Liu, You Shan, and Songfa Zhong**, "The emergence of economic rationality of GPT," *Proceedings of the National Academy of Sciences*, 2023, 120 (51), e2316205120.

¹We ensure that ChatGPT generates correct answers to all questions when using proper prompts.

Dell’Acqua, Fabrizio, Edward McFowland, Ethan Mollick, Hila Lifshitz-Assaf, Katherine Kellogg, Saran Rajendran, Lisa Kraye, François Candelon, and Karim Lakhani, “Navigating the jagged technological frontier: field experimental evidence of the effects of AI on knowledge worker productivity and quality,” *Technology & Operations Mgt. Unit Working Paper 24-013*, Harvard Business School 2023.

Frey, Carl Benedikt and Michael Osborne, “Generative AI and the Future of Work: A Reappraisal(forthcoming),” *Brown Journal of World Affairs*, 2024.

Goos, Maarten, Alan Manning, and Anna Salomons, “Explaining Job Polarization: Routine-Biased Technological Change and Offshoring,” *American Economic Review*, August 2014, *104* (8), 2509–2526.

Kim, Jeongbin, Matthew Kovach, Kyu-Min Lee, Euncheol Shin, and Hector Tzavellas, “Learning to be Homo Economicus: Can an LLM Learn Preferences from Choice Data?,” 2023. Working Paper.

Noy, Shakked and Whitney Zhang, “Experimental evidence on the productivity effects of generative artificial intelligence,” *Science*, 2023, *381* (6654), 187–192.

Webb, Taylor, Keith Holyoak, and Hongjing Lu, “Emergent analogical reasoning in large language models,” *Nature Human Behaviour*, 2023, *7* (9), 1526–1541.

A More details on the experimental design

Participant registration We recruited Korean-speaking students aged 19 or older. In order to diversify participants’ academic backgrounds, we recruited participants from two universities—Sungkyunkwan and Yonsei—that offer various majors in humanities, social sciences, engineering, and natural sciences. At the time of registration, participants provided personal information including gender, age, and major, without knowing whether they would be in the control or treatment group. (Ex post, we confirm that there are no significant differences in gender (two-sample Kolmogorov-Smirnov test, $p=0.917$), age ($p=1.000$), and major ($p=0.998$) between the control and treatment groups.) Also, participants were asked to rank their strengths in reading and writing, mathematical problem solving, and computational thinking. Participants voluntarily selected their preferred session among the list of sessions with multiple dates and time slots.

Randomization of experimental conditions After subjects register for participation, we randomly divided the participants into two groups: half of the participants were allowed to actively use ChatGPT to perform the requested task, and the other half of the participants were not allowed to use ChatGPT or a similar generative AI application based on a large language model. This randomization led to 181 subjects being in the treatment group and 168 in the control group. To control for the potential experimenter demand effect, participants were blinded to whether they were in the control or treatment group. All other conditions were controlled to be identical except for the use of ChatGPT. The experiment began with each participant sitting down at a pre-arranged table with a laptop, and all laptops used in the experiment were of the same model to avoid any effects due to differences in equipment. For both the control and treatment groups, the assigned tasks were presented on the right half of the screen, and on the left half, either Google search page (control group) or ChatGPT (treatment group) were presented.²

Providing the same form of information Participants in the treatment group were introduced how to use ChatGPT by copying and pasting the prepared three prompts into ChatGPT before performing the required task.

It served two purposes. The first is to give participants a common experience with ChatGPT. Although we expect that many participants have been aware of ChatGPT, some participants might have not used any form of generative AI app, so the common exercises can control for unobservable heterogeneity in prior experience. The second purpose is to actively promote the use of ChatGPT. Merely telling participants the availability of ChatGPT may not be enough to ensure their active use. The process of getting the responses from ChatGPT and pasting them would ease access. On the other hand, we asked the control group participants to practice advanced search functions by copying and pasting the prepared three queries into the Google search bar. The exercise serves to make the control group’s experimental procedure symmetrize that of the treatment group.

Tasks on three domains Both control and treatment group participants took the reading and writing task (hereinafter W-task), and they were randomly assigned to take either the mathematical problem-solving task (M-task) or the computational thinking task (C-task). The time limit of each task was 20 minutes, so that if a

²Each ChatGPT account was logged into before the beginning of the session, so subjects in the treatment group was able to use ChatGPT regardless of having their account. Each ChatGPT account history is cleared at the beginning of the new session to ensure that participants in the next session were not affected by the previous session’s history.

participant did not complete the task within the time limit, the experiment proceeds to the next section. All subjects took two tasks and the order of the tasks was randomized as well to control for unobserved learning effects or cumulative fatigue effects. Because participants were randomized and the type and order of the tasks were also randomized, we can expect the treatment effects we observe to be unbiased.

To test competency of each task, we consciously created test questions using existing competency assessment tools for college students and adults, such as the OECD Programme for the International Assessment of Adult Competencies and the Korea Collegiate Essential Skills Assessment. Especially for the C-task, we asked participants to complete natural language algorithms, pseudo codes, and logic flowcharts, so we were careful to ensure that participants unfamiliar with programming languages did not face any barriers to participation in writing their responses.

Evaluation and performance-based compensation Participants were informed that in addition to receiving a fixed fee of KRW 13,500 (about 10.24 USD as of September 1, 2023) for completing the participation, they would receive additional compensation based on the results of the tests, up to a maximum of KRW 13,500. The 20%, 30%, 30%, and 20% of participants in each treatment group received total payments worth 13,500, 18,000, 22,500, and 27,000 KRW, respectively. Since some of the questions in the tests required short-answer or narrative responses, we hired three experts to evaluate the participants' answers.

B Test questions (Translated in English)

Reading and Writing Task

[Q1–4] You are a college student at Sikyung[*fictional] University. Please read the announcement and respond to the following questions.

Announcement

We are forming a committee to develop a plan for the ethical and effective use of generative AI in education. The committee, which is composed of professors, students, administrators, and other members of the school, will examine the advantages and disadvantages of generative AI, its use cases and limitations, and its usefulness in university education, and come up with countermeasures to utilize generative AI in compliance with learning ethics.

- What is Generative AI?
 - Generative AI is a technology that generates new content using a large language model. It generates new content such as text, images, audio, 3D graphics, and video by understanding the user's intentions through the commands input by the user.
 - Examples of services that have applied generative AI include ChatGPT, Bard, and DALL-E. ChatGPT, a conversational AI model developed by OpenAI, the most representative generative AI service, carries on a conversation with the user, generating sentences and responding to them.
 - Similarly, Google's Bard is an AI that generates text in response to user questions.
 - DALL-E, Stable Diffusion, and Midjourney are examples of AI applications that generate images based on text input. Other generative AI applications include speech synthesis and models that predict protein structures.
- The positive impact of generative AI on education
 - You can easily generate a variety of content, including documents, images, sounds, and videos.
 - You can ask questions like a human and get the answers you want right away, saving you time for searching.
 - Human and generative AI can also collaborate on creative tasks, such as composing music or creating art.
 - It can also be used for document translation, document summary, speech synthesis, and more.
 - It can enhance the learning experience by providing personalized and interactive content.
- Negative effects of generative AI on education
 - Relying on generative AI can lead to decreased critical thinking skills, creativity, and problem-solving skills.
 - It can lead to academic integrity violations such as plagiarism and cheating.
 - It can produce inaccurate answers or content.
 - If generative AI were trained on biased data, the use of it can lead to biased information and reinforce existing inequalities.
- How to apply to the committee: Members of Sikyung University who are interested in joining the committee can submit an application to the committee by emailing the Office of Academic Affairs. There is no particular application form, but your application should include all of the following. Emails should be 500 words or less, including spaces.
 - Why you think this committee is needed
 - Why you think you can contribute to this committee
 - Your ideas for running this committee

Q1. Please select all of the following that do not match the content of the announcement.

1. ChatGPT, a generative AI application, was developed by OpenAI.

2. Stable Diffusion is an AI model that generates images.
3. ChatGPT and Bard are generative AIs that provide similar services.
4. Generative AI always produces correct and correct answers.

Q2. Please select all of the following that is not true about the committee according to the announcement.

1. The committee will review examples of how generative AI is being used.
2. The committee aims to create specific guidelines for the use of AI in the classroom.
3. To participate in the committee, you must be affiliated with Sikyung University.
4. The committee will vote for and against the use of AI in the classroom.

Q3. Please name the committee satisfying the following conditions.

- Be at least 5 words and no more than 10 words, excluding "The Committee for."
- Fully reflect the composition and purpose of the committee
- Include the key words 'Generative AI.'

Q4. Supposed that you would like to email your application to join a committee as outlined in the announcement. In the space below, please compose a formal email application for the committee. Your application should include all of the following: 1) why the committee is needed, 2) why you think you can contribute to the committee, and 3) your ideas for running the committee. Your email should be 500 words or less.

Mathematical Problem-Solving Task

Q1. You paid 6,600 KRW for kiwis that cost 300 KRW each and apples that cost 700 KRW each. What is the maximum number of kiwis and apples that can be purchased together if more than one of each is purchased?

- 18
- 16
- 14
- 10

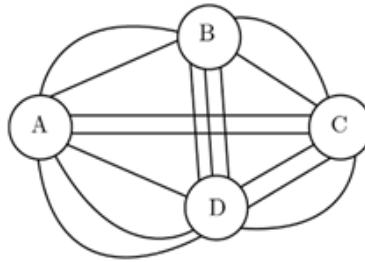
Q2. Mr. S wants to open a term deposit at Sikyung Bank with 30,000,000 KRW. Sikyung Bank offers the following deposit products.

Product Type	Term	Interest Rate
Compound	2 years	5% per annum
Simple	2 years	7% per annum%

What is the amount Mr. S will receive at maturity if he makes a deposit at a simple interest product and at a compound rate product?

- Simple interest: 31,500,000 KRW // Compound interest: 32,100,000 KRW
- Simple interest: 34,200,000 KRW // Compound interest: 34,347,000 KRW
- Simple interest: 34,200,000 KRW // Compound interest: 33,075,000 KRW
- Simple interest: 33,000,000 KRW // Compound interest: 33,075,000 KRW

Q3. An electrical company has four branches as shown in the figure below. There are two direct routes from branch A to branch B and two direct routes from branch B to branch C. In addition, there are three direct routes from branch A to branch D, three direct routes from branch D to branch C, and two direct routes from branch B to branch D. How many ways are there to get to branch C from branch A without passing through branch B? (Note that once a route is passed, it is not passed again.)



- 9 ways
- 11 ways
- 18 ways
- 29 ways

Q4. The following table shows the number of male and female applicants and the number of hires for an entry-level position at Foundation D. Which of the following is incorrect?

Gender	#Applicants	#Hires
male	10,891	1,699
female	3,894	624

- The hiring rate is greater than or equal to 15% of total applicants.
- The hiring rate for female applicants is less than 20%.
- Less than 30% of total applicants are female.
- The proportion of men hired is approximately 80%.

[Q5-6] The following data shows the economically active population by gender in Korea as of November 2020.

<Economically Active Population by Gender in Korea as of November 2020>

(Unit: thousands, %)

Category	Total	Male	Female
Population aged 15 and over	46,957	22,378	()
Employed	26,038	15,397	10,641
Unemployed	893	()	427
Labor force participation rate	()	70.9	45.0
Unemployment rate	()	()	3.9

※ Labor force participation rate = [#Economically Active Population] / [Population aged 15 and over] * 100

※ Economically active participants = [#Employed] + [#Unemployed]

※ Unemployment rate = [#Unemployed] / [#Economically Active Population] * 100

Q5. How many times is the labor force participation rate equal to the unemployment rate? Please round your answer to zero decimal places.

Q6. What is the ratio of male to female unemployment?

Q7. The following figure shows the morning temperatures in 17 regions of South Korea on one day in May 2022. What are the mean($^{\circ}C$) and median($^{\circ}C$) morning temperatures in those 17 regions? Please round your answer to two decimal places.



Q8. Below are numbers listed according to a specific rule. What is (A) that follows the listed numbers?

1 1 2 3 5 8 13 21 (A)

Computational Thinking Task

Q1. You work in the product planning department of XY Electronics. The department has designed a new scale that adds a function to the existing scale that indicates both the weight and the obesity level of the consumer. When the consumer inputs his/her height before weighing, the scale displays the current weight and the obesity level based on the body mass index (BMI) on the screen after weighing.

In order to prototype this scale, you need to communicate your product idea to the development department using a ‘natural language algorithm.’

A natural language algorithm is a sequence of steps to solve a problem using the ordinary language we use everyday.

Example: The idea of taking two natural numbers as input and outputting the smaller of the two can be expressed in a five-line natural language algorithm as follows.

[Idea]	Input: two natural numbers Output: the smaller of the two natural numbers
[Natural Language Algorithm]	<ol style="list-style-type: none"> 1. Take two values A and B as input. 2. Terminate if neither A nor B are natural numbers. 3. Compare the two numbers A and B, and if $A \geq B$, then B is called the ‘smaller number,’ otherwise A is called the ‘smaller number.’ 4. Print the ‘smaller number.’ 5. Exit the program.

Referring to the description of natural language algorithms above, please write down your idea for the new scale as a natural language algorithm in 10 lines or less.

[Idea]	Input: Height and weight Output: Body Mass Index (BMI)*
* $BMI = \text{weight} / (\text{height} * \text{height})$	
BMI	Obesity Level
Less than 18.5	Underweight
More than 18.5 and less than 22.9	Normal
More than 23.0 and less than 25.0	Overweight
25.0 or more	Obese

Q2. You work in the service management team of an AI startup, and you have received complaints from customers that the recently launched chatbot uses a lot of slangs. You want to write a pseudocode to ask the development team to create a program that finds the word "fuuu" in the text file that generates the chatbot’s responses and replaces all of them to the word "upset".

Pseudocode is code that describes the behavior or algorithms of a computer program in a human language. Because it is not written in a specific programming language, it can be understood by people who use different programming languages.

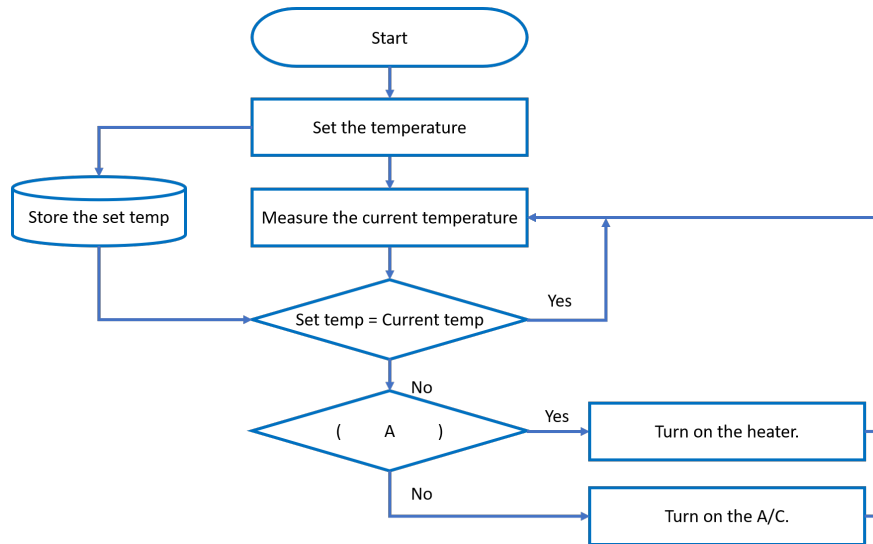
Example: Pseudocode for a program that finds an error where the number 0 is written incorrectly as the letter O and corrects it back to the number 0.

- Open a file.
- For each line of the file,
 - to find the error, process the following steps.
 - Read each character.
 - If the character matches the letter O,
 - check if the string immediately before or after the character is a number.
 - If so, it found an incorrectly written letter O instead of the number 0.
 - Replace the letter O with the number 0 for those that meet the above conditions.
- Close the file.

Referring to the above explanation of pseudocode, you want to create the following pseudocode for a program that finds the word "fuuu" in the text file that generates the chatbot's responses and replaces all of them with the word "upset." Fill out the blank spaces of the relevant pseudocode.

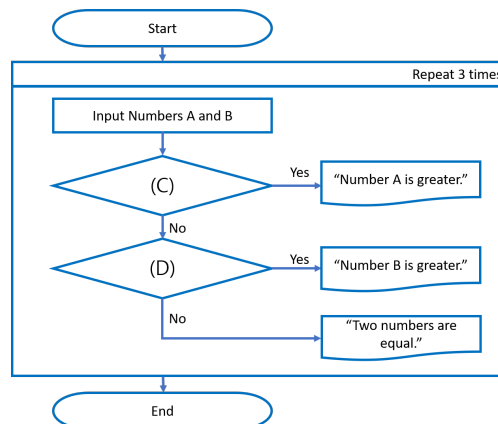
- Open the file.
- For each line of the file,
 - to find the slang, process the following steps.
 - Read each character.
 - If the character matches [A],
 - check if the three characters following that character match [B].
 - If so, it found the slang.
 - Replace such a slang with [C].
- Close the file.

Q3. The diagram below is a flowchart representing the process of an air conditioner. Choose the appropriate statement for process (A).



- Set temperature > Current temperature
- Set temperature ≥ Current temperature
- Set temperature < Current temperature
- Set temperature ≤ Current temperature

Q4. In the flowchart for the algorithm below, select the appropriate statements for (C) and (D), respectively.



[Algorithm]

1. If the input in variable 'Number A' is strictly greater than the input in variable 'Number B', declare that "Number A is greater." Otherwise, compare them again.
2. If the input in variable 'Number A' is strictly less than the input in variable 'Number B', declare that "Number B is greater.". Otherwise, declare that "the two numbers are equal."
3. Repeat steps 1 and 2 three times.

- (C) Number A < Number B (D) Number A < Number B

- (C) Number A < Number B (D) Number A > Number B
- (C) Number A > Number B (D) Number A < Number B
- (C) Number A > Number B (D) Number A > Number B