

PDH Academy

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INTEGRATING GENERATIVE AI INTO THE ARCHITECTURAL WORKFLOW

Course # AIAPDH276
4 LU | HSW Hours

INTEGRATING GENERATIVE AI INTO THE ARCHITECTURAL WORKFLOW

FINAL EXAM (25 QUESTIONS)

- Generative AI is designed to do what?**
 - Redesign existing photos from social media only
 - Produce new, original outputs that mimic the data it has been trained on
 - Send text messages to random phone numbers
 - Make sandwiches
- Who doesn't train the data for Generative AI?**
 - Researchers & Engineers
 - Human Labelers / Annotators
 - Takers
 - Domain Experts
- Large Language Models (LLMs) are designed to do what?**
 - To understand, generate, and manipulate human language
 - To reword existing text
 - To never manipulate human language
 - To teach English and spread the language
- _____ % of companies leverage AI for managing customer relationships.**
 - 25%
 - 0%
 - 46%
 - 100%
- When entering text into a Generative AI it is important to use what?**
 - Numbers only
 - Natural language
 - Symbols only
 - Unnatural language
- Which prompt will yield a more detailed image using a Text-to-Image Generative AI?**
 - "Design a modern office headquarters."
 - "Design a modern office headquarters inside a strip mall with separate zones for a CEO office, sales offices, a unisex restroom, a break room, storage, a modern butt-glazed conference room, and a showroom. The overall aesthetic should be minimalist, using natural materials like wood and stone, complemented by sleek glass partitions and open spaces. Include biophilic design elements with plenty of natural light."
 - "Show me an office."
 - "Design a strip mall inside an modern office headquarters."
- What is the definition of Latent-Space Modeling?**
 - It allows you to explore design variations by not sampling from a trained model's latent space.
 - It does not allow you to explore design variations by sampling from a trained model's latent space.
 - It allows you to explore design variations by sampling from a trained model's latent space.
 - It allows you to explore variations by sampling from a untrained model in outer space.
- Which generative AI is great for generating detailed design briefs?**
 - Image-To-Image
 - Text-To-Image
 - Latent-Space Modeling
 - Large Language Models (LLMs)
- What is a shot-based prompt?**
 - A prompt that has an example for the AI to follow
 - A prompt with a basketball reference
 - A prompt that you only get one shot for it to work
 - A prompt that is assigned a persona
- With prompt chaining, you take a _____ task and break it up into _____ tasks to reach your answer.**
 - Simple, complex
 - complex, simpler
 - complex, complex
 - simple, simple
- Regarding _____ automation, can AI automate tracking changes between specification versions?**
 - elevation drawings
 - drawings
 - specification writing
 - sketch
- Regarding Code & Zoning summaries, what can AI automate?**
 - Drawing a grease trap detail specific to a certain jurisdiction
 - Summaries of applicable IBC sections
 - On-Site Dead, Dying, Hazardous report for a specific parcel
 - Write a perfect general notes section without human oversight

13. **Regarding cost-estimating first passes, what can AI automate?**
 A. Three-Point Estimates
 B. Rough-order-of-magnitude (ROM) cost estimates
 C. Parametric Estimates
 D. Bottom-Up Estimates
14. **Regarding RFI and Submittal automation, what can AI automate?**
 A. Sketch quick, detailed solutions
 B. Draw enlarged details for RFIs
 C. Suggest standard approval or denial language
 D. Provide detailed written responses reference sheets with no human oversight
15. **What steps should be followed for integration of an AI strategy for an architecture firm (in order from start to finish)?**
 A. 1) Standardize inputs, 2) Centralize Prompts, 3) Human-in-the-loop QA
 B. Draft schedules & work plans
 C. 1) Human-in-the-loop QA, 2) Standardize inputs, 3) Centralize Prompts
 D. 1) Centralize Prompts, 2) Standardize inputs, 3) Human-in-the-loop QA
16. **What is the stance of NCARB on AI and its use?**
 A. Keeping homes facing public streets in good condition only
 B. AI is a tool – it is not a replacement for professional judgement
 C. Keeping semi-private spaces in communities in good condition only
 D. AI is a tool – it is a replacement for professional judgement
17. **What is the stance of ASME on AI and its use?**
 A. ASME does not require authors to fully report their use of AI tools
 B. AI tools are considered acceptable authors
 C. AI tools are not considered acceptable authors
 D. ASME does not have a stance on AI yet
18. **Regarding Professional Liability Insurance (PLI) and AI a firm should have _____?**
 A. a clear and well-thought out usage policy
 B. nothing in place
 C. AI administer policy with no human oversight
 D. a clear usage policy for non-related AI matters
19. **What was the punishment given to the solicitor in Australia who used an AI generated false citation?**
 A. None
 B. No longer entitled to practise (sic) as a principal lawyer
 C. Expelled from Australia
 D. Given the death penalty
20. **What is considered the landmark case regarding AI hallucinations?**
 A. Chiefs v. Bills
 B. IBC v. ICC, Inc.
 C. Castel v. GenAI
 D. Mata v. Avianca, Inc.
21. **What is a core principle regarding the AEC industry and AI-generated content? The design professional is _____.**
 A. Not responsible at all since they did not create the Generative AI
 B. Fully responsible for the final output or work product, regardless of the amount of AI assistance
 C. Fifty percent responsible for the final input and output
 D. Partially responsible for the final output or work product
22. **Regarding professional oversight, AI is a tool and in no way a substitute for _____ and _____.**
 A. Justice and Liberty for all
 B. Generative AI and Traditional AI
 C. Licensed oversight and Professional judgement
 D. Hand drafting and Building Information Modeling
23. **What is Human-in-the-Loop AI?**
 A. A closed-loop system where human judgement is embedded at key points in the AI lifecycle
 B. A open loop system where AI judgement monitors key points in the AI lifecycle
 C. A blended loop system where human judgement is not included in the AI lifecycle at all
 D. A geothermal open loop system for residences
24. **What are the 4 key points in the AI lifecycle where human judgement is embedded?**
 A. Training, Validation, Deployment, and Engineering
 B. Training, Validation, Deployment, and Architecture.
 C. Training, Non-Validation, Deployment, and Architecture
 D. There are none as human judgement is not needed
25. **What does “deployment” mean in relation to the Human-in-the-Loop and it being a key embedment point?**
 A. Arrival at a military drop point
 B. AI monitors live predictions and overrides when necessary
 C. Humans monitor live predictions, override when necessary, and feed corrections back into the loop.
 D. No action is to be taken by any humans at any point and time

END OF FINAL EXAM

INTEGRATING GENERATIVE AI INTO THE ARCHITECTURAL WORKFLOW

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Course Summary

This 4-hour LU/HSW course introduces AEC professionals to Generative AI fundamentals, effective prompting techniques, practical AEC applications, and key ethical, legal, and professional responsibility considerations.

Learning Objectives

1. **Learn** how Generative AI differs from Traditional AI and **Understand** how Generative AI works.
2. **Understand** the different prompting strategies and the main types of Generative AI.
3. **Identify** Generative AI tools and their use for AEC related tasks.
4. **Analyze** the legal landscape regarding use of AI-generated content.

Course Structure

- ✓ **PART 1** – Generative AI vs. Traditional AI and Generative AI Fundamentals
- ✓ **PART 2** – Generative AI Prompting Strategies, Types, and Exercises
- ✓ **PART 3** – Generative AI for AEC: AI for Automation and Business Efficiency
- ✓ **PART 4** – Ethics, Intellectual Property (IP), and the Future

PART 1 – GENERATIVE AI vs. TRADITIONAL AI AND GENERATIVE AI FUNDAMENTALS

Learning Objective No. 1:

Learn how Generative AI differs from Traditional AI and Understand how Generative AI works.



AI has taken the world by storm and while everyone is getting drenched, some are running for shelter, some are opening umbrellas while others learn to dance in the rain. AI isn't going anywhere – and as the quote goes “If you can't beat ‘em, join ‘em”.

So, consider this training an introduction to Generative AI with an additional view through the lens of the AEC industry and how you can make it an ally and an asset and not a subject for verbal punishment in the break room.

GENERAL: TRADITIONAL AI VS. GENERATIVE AI

First, let's look at how Traditional AI differs from Generative AI.

TRADITIONAL AI	GENERATIVE AI
Follows rules	Creates new content
Uses structured data	Needs large datasets
Solves specific problems	Focus on creativity
Rigid and predefined	Flexible and Diverse
Simpler models	High computational needs
Automates tasks	Enhances creativity
Risks biased decisions	Risk of misleading content
Advances problem-solving	Revolutionizes content creation

Traditional AI versus Generative AI through an AEC lens. See below:

DIFFERENCES BETWEEN TRADITIONAL AI AND GENERATIVE AI	
TRADITIONAL AI	GENERATIVE AI
PURPOSE	PURPOSE
Traditional AI: <i>Classifies, predicts, or decides.</i> Example: "Is this email spam or not?"	Generative AI: <i>Creates.</i> Example: "Write an email in a friendly tone."
OUTPUT TYPE	OUTPUT TYPE
Traditional AI: Numeric labels, categories, yes/no answers.	Generative AI: Text, images, code, videos, sounds, new content that didn't exist before.
DATA USAGE	DATA USAGE
Traditional AI: Learns to recognize patterns.	Generative AI: Learns to replicate and recombine patterns creatively.
ANALOGIES	ANALOGIES
Blueprint Reader vs. Blueprint Creator Traditional AI is like an <i>engineer</i> who looks at a blueprint and says, "This is a kitchen" or "This is a load-bearing wall."	Blueprint Reader vs. Blueprint Creator Generative AI is like an <i>architect</i> who designs a brand-new blueprint based on requirements.
Building Inspector vs. Building Designer Traditional AI is the inspector who checks a building and reports, "This tenant spaces complies with code."	Building Inspector vs. Building Designer Generative AI is the designer who imagines and sketches a whole new building concept.

DIFFERENCES BETWEEN TRADITIONAL AI AND GENERATIVE AI	
TRADITIONAL AI	GENERATIVE AI
ANALOGIES (continued)	ANALOGIES (continued)
Furniture Cataloger vs. Interior Stylist Traditional AI labels objects: "This is a chair... this is a sofa."	Furniture Cataloger vs. Interior Stylist Generative AI creates a unique room layout or style never seen before.
Material Classifier vs. Material Inventor Traditional AI identifies materials: "This is concrete; this is steel."	Material Classifier vs. Material Inventor Generative AI invents new material combinations or proposes new material types.
City Map Reader vs. City Planner Traditional AI reads and classifies parts of a city map.	City Map Reader vs. City Planner Generative AI imagines and drafts a new urban district with streets, parks, and buildings.
Engineer Traditional AI is like a structural engineer checking if a beam can carry a load.	Engineer Generative AI is like software that proposes an entirely new beam shape or truss design optimized for strength and cost.
General Contractor Traditional AI is like a contractor identifying what tasks need to be done on-site.	General Contractor Generative AI is like a tool that automatically creates a full construction schedule and workflow plan from scratch.

GENERATIVE AI

What is Generative AI?

Generative AI is a type of artificial intelligence that can create new content – such as text, images, music, or even videos – all based on patterns learned from existing data.

Unlike traditional AI systems that perform tasks like classification, generative AI is designed to produce new, original outputs that mimic the data it has been trained on.

"Generative artificial intelligence (AI) tools use machine learning models trained on massive pools of information to learn patterns from data to create novel content like text, images, audio, or video in response to a prompt. Unlike internet searches, generative AI tools do not use algorithms to locate and curate existing sources. Instead, they create new content by predicting what word, sound, or pixel would come next in a pattern."

– Teaching.Pitt.edu

DATA TRAINING

Who "trains" the data for Generative AI?

Several groups are involved such as researchers & engineers for AI companies, Human Labelers / Annotators, Domain Experts for specialized models, and Users such as professionals in the AEC industry.

"...AI trainers teach AI assistants to understand human language. They do this by feeding examples of real utterances to help the AI assistant better understand the meaning of peoples (sic) speech, or written language."

AI trainers analyze common topics discussed by users and how they ask for certain information while talking to your chatbot or voice assistant. These insights are used to continuously improve the cognition of your AI assistant and require a structured AI training workflow consisting of testing, updating, and measuring again..."

– Conversation Design Institute

Find the tasks for each user group shown in more detail below, you have probably come across these roles on job boards, et. cetera – there is a high demand.

Researchers & Engineers

- collect large datasets
- clean and organize them
- design the model architecture
- run the training on large clusters of computers

Human Labelers / Annotators

- rating responses
- labeling examples
- correcting model mistakes
- providing feedback on quality and safety

Domain Experts

For medical, legal, financial, building code or scientific models, subject-matter experts (SMEs) help validate and curate datasets. We have even participated in this before, it was very interesting and very time-consuming.

Users

When a company allows it, user feedback or opt-in data helps improve future training – but only if the user explicitly consents.

"AI is helping disaster response teams predict and respond to natural disasters. Tools like IBM's Watson Decision Platform for Agriculture are used to predict the impact of hurricanes and floods, aiding governments and NGOs in preemptive action."

– Vellum AI

HOW IS THE TRAINING DONE?

Step 1: Data Collection

AI companies gather large amounts of publicly available or licensed text, images, audio, etc. including but not limited to books, articles, websites, code repositories, and other datasets.

Step 2: Scrub (Clean and filter)

Engineers use tools and rules and sometimes human reviewers to remove:

- duplicate content
- personal data
- harmful or low-quality information
- spam, broken text, etc.

A digital colander if you will.

Step 3: Train the model

Massive GPU/TPU clusters run algorithms that teach the model to predict the next word, pixel, or token. This is the "heavy lifting" part:

- trillions of examples
- huge compute power
- days or weeks of continuous training

Step 4: Fine-tuning

After the base model is trained, human experts refine it by:

- giving it example conversations
- correcting mistakes
- rating answers
- guiding tone, style, and safety

This step teaches the model to follow instructions and behave usefully.

Step 5: Continuous improvement

After release, the model may be improved using:

- new data
- safety testing
- evaluation from human reviewers
- user feedback (only when users opt in)

Again, Generative AI models learn patterns and structures from large datasets. After training, they can generate new outputs that resemble the examples they learned from.

For example:

- A text model can write essays, answer questions, or create stories.
- An image model can generate pictures from a description. *(helpful for when a prospective client is trying to share their vision with you)*
- A music model can compose melodies in a certain style.

"46% of companies leverage AI for managing customer relationships." - Vellum AI



INTERACTING WITH GENERATIVE AI TO SPEAK TO AI YOU NEED TO SPEAK "PROMPT".

What is a prompt? Simply put, it is what you type (your input) into the textbox of whatever AI you are using to obtain specific results.

Think of your input as "ice breakers" or conversation starters. Basically "junk in and junk out" i.e. your results or AI output are only as good as your input or text you type in the textbox. Thus, learning how to write a quality prompt is essential.

AI PROMPT EXAMPLES	
BAD PROMPT EXAMPLE "Make a website look fantastic."	GOOD PROMPT EXAMPLE "Design an intuitive and responsive navigation menu for a mobile travel app."

WRITING A PROMPT

Before we get into the different types of prompts/prompting that you use to speak to AI, here is some information you can use to assist you in writing an effective prompt that yields the results you desire. Here are questions that should be answered and addressed when creating your first prompt. See the table above and the text below:

- **What result do you want?** ("Write an email...")
- **Who is your audience?** ("...to my client...")
- **Specify the tone of your input.** ("...with a professional yet friendly tone as I have known them and worked with them for 2 years...")
- **What keywords or phrases are important?** ("...the topic of the email is to see find out if they need my services or if there is anything my firm can help them with...")
- **How do you want the output presented?** ("...the email must be less than 23 words or more...")
- **Provide examples if able so you can teach the AI** ("...here is an example copied and pasted below from an email I received and liked...")
- **Refine, refine, and refine until the desired output is received.**

The final prompt that we input into ChatGPT:

Write an email to my client with a professional yet friendly tone as I have known them and worked with them for 2 years the topic of the email is to find out if they need my services or if there is anything my firm can help them with the email must be less than 23 words or

more here is an example copied and pasted below from an email I received and liked

"Hi [Client Name], hope you're well! I was thinking about our work on [Project], and wanted to see if you have any upcoming needs where [Your Service] could help. Let me know if you'd like to chat!"

AI Output:
Here's a draft for your email:

Subject: Checking In

Hi [Client Name], hope you're doing well! I wanted to touch base and see if there are any upcoming projects where [Your Service] could support you. Let me know if you'd like to catch up!

Best regards,
[Your Name]

This keeps it friendly, professional, and leaves the door open for future collaboration.

"...Using natural language is one of the most critical parts of effective AI prompting. Think of it like having a conversation with AI. You should write your prompts in a way that mimics everyday speech. That way, AI tools can better understand what you're asking for. The words you use and the way you phrase things can significantly impact the output you receive..."

- "Tips for Effective Prompting" Atlassian

YOUR TURN TO WRITE A PROMPT

So, as you can see below, we did not quite get a top score for our email prompt but hey we received a "Good" along with a breakdown on how the prompt can improve. So now it is YOUR turn, so let's see how you fare.

Click on any of the links below and visit any of the following prompt evaluation websites. You will receive free feedback and even a score (like the one below) on the quality and effectiveness of your prompt along with a detailed breakdown.

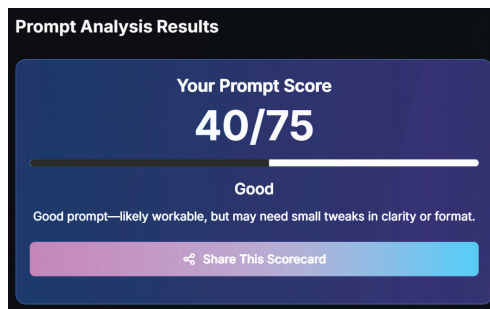


Figure 1.1 The score for the email prompt above, what was your prompt score? © agenticworkers.com, Prompt Engineering Scorecard

PROMPT EVALUATION WEBSITES

ChatGPT Prompt Evaluator 5.2

by Mickael Lherminez

Prompt Engineering Scorecard (100 characters minimum)

by Agentic Workers Tool

How did you do? We are guessing 75 out of 75!

You made it to the finish line!

This concludes Part 1 of the course.

Next up is your Part 1 Quiz!

PART 1 – GENERATIVE AI VS. TRADITIONAL AI AND GENERATIVE AI FUNDAMENTALS

KNOWLEDGE CHECK (5 QUESTIONS)

- 1. What is the primary difference between Traditional AI and Generative AI?**
 - A. Traditional AI creates new content, while Generative AI classifies data
 - B. Traditional AI focuses on creativity, while Generative AI automates tasks
 - C. Traditional AI solves specific problems, while Generative AI creates new content
 - D. Traditional AI uses large datasets, while Generative AI uses structured data
- 2. Which of the following is an example of Generative AI in the AEC industry?**
 - A. Identifying whether a material is concrete or steel
 - B. Designing a new urban district with streets, parks, and buildings
 - C. Checking if a building complies with local code
 - D. Predicting the energy consumption of a building
- 3. What is the role of Human Labelers in training Generative AI models?**
 - A. Designing the model architecture
 - B. Providing feedback on quality and safety
 - C. Collecting and organizing large datasets
 - D. Running training on large clusters of computers
- 4. What is the purpose of the “fine-tuning” step in Generative AI training?**
 - A. To collect and clean large datasets
 - B. To teach the model to predict the next word or pixel
 - C. To refine the model’s behavior, tone, and safety
 - D. To evaluate the model using user feedback
- 5. Which of the following is an example of a well-written AI prompt?**
 - A. “Make a website look fantastic.”
 - B. “Design an intuitive and responsive navigation menu for a mobile travel app.”
 - C. “Write something creative about architecture.”
 - D. “Create a design that is good.”

*This concludes Part 1 of the course.
Let’s continue to Part 2!*

PART 2 – GENERATIVE AI PROMPTING STRATEGIES, TYPES, AND EXERCISES

Learning Objective No. 2:

Understand the different prompting strategies and the main types of Generative AI.



There are many different approaches one can take when looking to extract a response from Generative AI. In our research, we have found up to 10 different prompting types so let’s look at all of them as they should all be in your tool kit when engaging AI and using prompting. They are as follows:

1. Zero-Shot (Shot = Example, thus no examples)

1.1. The prompt is clear, concise, and direct. Example below:

1.1.1. Prompt: Convert this to the future tense: I went to the store.

Output: The future tense version would be: “I will go to the store.”

2. One-Shot or Few-Shot or Shot-Based (Shot = Example)

2.1. Along with the prompt, provide example(s) for the AI to follow when it delivers the output. An example of a few-shot prompt is below:

2.1.1. Prompt:

Classify the food below as typically served hot or cold.

Food: I have a milkshake. Typically served: Cold

Food: I have pizza. Typically served: Hot

Food: I have chargrilled oysters. Typically served:

Output: Typically served: Hot



Figure 2.0 Fresh and hot pizza! © Jonathan Hidalgo, pexels.com

3. System

3.1. This prompt technique defines the AI’s role it is to play, task, style, and constraints. Example below:

3.1.1. Prompt: You are a friendly travel agent (role). Recommend a sunny vacation spot for adventure travelers, focusing on activities (task). Keep descriptions under 150 words (constraints) and use a numbered list. (style)

4. Role

4.1. Assign a persona to AI, context, and a point of view.

4.1.1. Prompt: Act like Patrick Mahomes. I am a superfan and asking him how many superbowls he has won with the Chiefs.

Output:

Yo, what’s up, man! I appreciate the love. Seriously, the support from the Kingdom is what keeps us going every single Sunday.

To answer your question, as of right now, we've been blessed to bring three Super Bowl championships back to Kansas City!

It's been an incredible journey so far:

- Super Bowl LIV against the Niners.
- Super Bowl LVII against the Eagles.
- Super Bowl LVIII back-to-back against the Niners again.

But you know me – I'm never satisfied. The job isn't finished. We're always chasing that next one because we want to keep making history for the best fans in the world.

See you at GEHA Field at Arrowhead! Let's go!

Would you like me to break down my favorite play from one of those championship runs?

5. Contextual

5.1. Add context or specific background information to the prompt, create the state of mind that AI has and is answering from. Example below:

5.1.1. Prompt: You are an architect alive in 1894 practicing architecture in London. You are from a well-off family. Share the style of architecture you design in and name 3 of your clients. Be brief. Give their name, title, and one sentence regarding what they do.

Output:

I find myself most devoted to the Queen Anne Revival style, blending the warmth of red brick with the elegance of terracotta ornamentation and Dutch gables to create a look that is both stately and charmingly asymmetrical.

Here are three patrons who have recently engaged my services:

- Lord Arthur Penthaligon, Earl of Pembroke
A distinguished member of the House of Lords who manages vast ancestral estates and seeks a modern hunting lodge in the Scottish Highlands.
- Dr. Silas Whitby, Chief Surgeon at the Royal London Hospital
A pioneer in antiseptic surgical techniques who has commissioned a private laboratory and residence in Bloomsbury.
- Miss Helena Sterling, Director of the Sterling School for Girls
An advocate for women's higher education who requires a new dormitory designed with ample light and proper ventilation.
Would you like me to describe the specific ornamental details I am planning for Miss Sterling's facade?

6. Step-Back

6.1. A technique where you ask AI to identify and solve a broad, fundamental concept before asking a specific, complex question. This approach is ideal for complex, open-ended, creative writing, theme exploration, breaking down tasks requiring a lot of logic, or abstract problems. This is multi-step process, example below:

6.1.1. The Hard Question: "Will a car fit inside a standard 20-foot shipping container?"

The "Step-Back" Prompt:

Step Back Prompt: "What are the standard dimensions of a car and a 20-foot shipping container?"

Output: "A car is approx. 14ft long; a container is 20ft long."

The Original Question Prompt: "Based on those dimensions, will the car fit inside?"

AI Output: "Yes, with 6 feet of clearance."

7. Chain of Thought (CoT)

7.1. This approach improves AI reasoning by asking questions that force the AI to break problems into steps before reaching a final output. This is typically used with mathematics, computer

coding, or complex decision making. Example below:

Prompt: When I was 5 years old, my partner was 4 times my age. Now I am 20. How old is my partner?

Output:

To find out your partner's current age, we can follow these steps:

1. Determine the partner's age in the past: When you were 5 years old, your partner was 4 times your age: $5 \times 4 = 20$ years old
2. Calculate the age difference: The difference in your ages is constant: $20 - 5 = 15$ years old Your partner is 15 years older than you.
3. Determine the partner's current age: Now that you are 20, we add the 15-year difference to your current age: $20 + 15 = 35$
4. Your partner is 35 years old.

8. Self-Consistency

8.1. We call this the "Best out of 3" prompt as you are asking the AI the same question multiple times (or "running the prompt" multiple times) and selecting the answer that is returned by the AI the most.

Refer to the image below for an example.

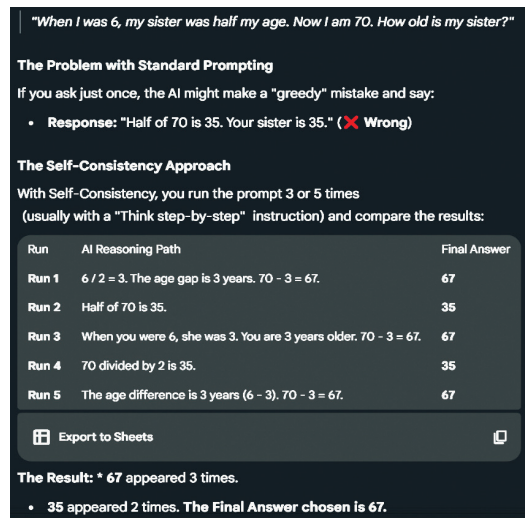


Figure 2.1. Example of Self-Consistency Prompt. © gemini.google.com

9. Tree of Thought (ToT)

9.1. This is a prompt type that is more creative and provides more well-reasoned outputs because it can explore multiple well-reasoned paths at once which allows it to perform as an expert problem solver.

Refer to the illustration below:

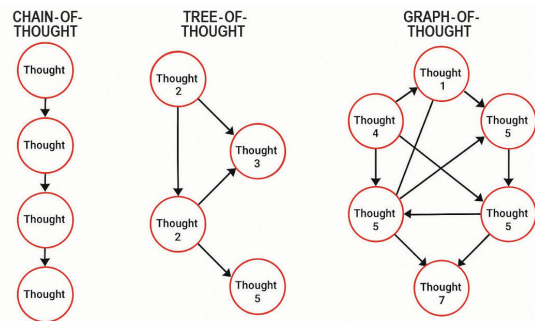


Figure 2.2. Example of Tree of Thoughts (ToT) Prompt. © Abduldattijo of pub.towardsai.net

10. ReAct (Reason + Act)

10.1. This prompt allows AI to solve real-world problems in real time. How? By following a thought-action-observation loop. This high-level prompt requires an understanding of programming as the AI would need to make API calls, search the internet, or running code. It basically mimics the way we humans approach a problem.

Prompt Chaining

Finally, we have Prompt Chaining, which is somewhat self-explanatory. You basically take a complex task or prompt and break it up into little simpler tasks or prompts to reach the answer to your initial complex task or prompt. See below:

“Here our complex prompt is: “Consider the given text in Spanish. Translate it into English. Find all the statistics and facts used in this text and list them as bullet points. Translate them again into Spanish.”

To convert this complex prompt into simple prompts, we can break down the main goal into smaller actions or tasks, and we can create a chain of prompts as below:

1. “Read the given Spanish text.”
2. “Translate the text into English language.”
3. “Fetch the statistics and facts from the text.”
4. “Create a bullet point list of all these facts.”
5. “Translate them in Spanish language.” – IBM

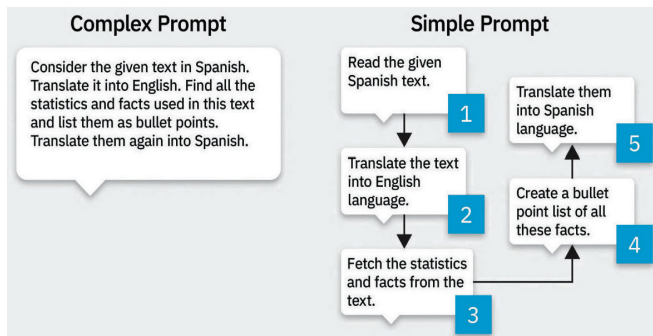
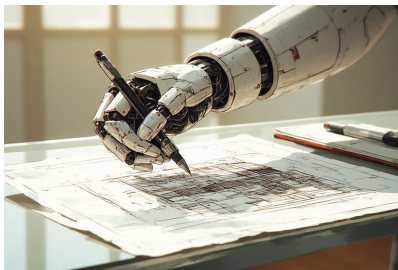


Figure 2.3 Prompt Chaining Example © IBM.com

We found this great resource that covers the prompting techniques we mentioned also: [PromptingGuide.ai](https://www.promptingguide.ai)



THE THREE TYPICAL GENERATIVE AI TYPES

Now that you are familiar with prompts and the different prompt techniques available to you – let’s look at the 3 Generative AI types. They are all involved in creating *new content* based on learned patterns in data as stated earlier. See below:

1. Text-to-Image AI
2. Latent-Space Modeling
3. Large Language Models (LLMs)

TEXT-TO-IMAGE AI

Text-to-image refers to the process of generating images based on textual descriptions using artificial intelligence models. These models take input in the form of a text prompt (e.g., “A futuristic cityscape at sunset”) and generate an image that matches or reflects the content of the description.

It is built using deep learning techniques, specifically architectures like generative adversarial networks (GANs) or diffusion models. The model is trained on large datasets of images paired with descriptive text to learn the relationships between words and visual elements. Once trained, the model can generate new images based on any given text prompt.

Attributes

- **Generates new content:** These models produce new images from scratch.
- **Edits existing content:** These models allow you to edit existing images based on your text prompt.
- **Unsupervised learning:** They often learn patterns in data (e.g., text-image pairs) without explicit human labeling.
- **Creative generation:** The ability to generate unique outputs (images) that didn’t exist before.

AI Models: Models like Stable Diffusion, DALL·E 2, Google Gemini (also an LLM), and MidJourney.



Figure 2.4 Black Cat with Sunglasses © Perchance.org

EXERCISES

Exercise 1: If you input the text “A black cat wearing sunglasses sitting on a beach,” the model will generate an image that visualizes this scene page right. We used Perchance ai text to image generator to create this image and we applied an “Art Style” of “1990s Photo”. (See Figure 2.4 above)

Exercise 2 for you: Click the hyper link and go to PerChance.org and type in the prompt below:

“Architect dressed in a snow suit standing on the top of a high-rise building”

Exercise 3: We went more in-depth and explored images you would typically find produced in the office of an AEC professional. We believe that the Text-to-Image Generative AI is great for quickly visualizing design concepts, spatial relationships, and interior or exterior renderings of architectural projects. *PerChance was used to produce the images below, unless noted otherwise.*

Scope: Conversion of a vacant shell to a business office headquarters. Business occupancy classification, total occupant load of 25 occupants, and modern style design.

1. **Concepts** – These prompts generated high-level architectural ideas and visual themes for the office space.

Modern Office Headquarters Prompt

“Design a modern office headquarters inside a strip mall with separate zones for a CEO office, sales offices, a unisex restroom, a break room, storage, a modern butt-glazed conference room, and a showroom. The

overall aesthetic should be minimalist, using natural materials like wood and stone, complemented by sleek glass partitions and open spaces. Include biophilic design elements with plenty of natural light.”

Output



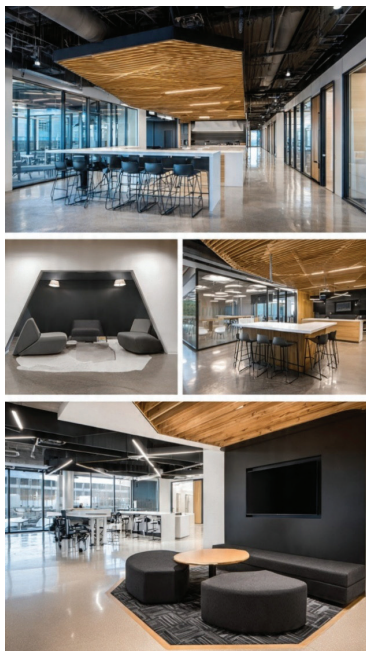
The Good: The modern office feel is there; you can clearly identify the conference room and the very spacious showroom. The minimalism is acknowledged, as are the wood and glass partitions. The biophilic design elements are represented across all images but in varying quantities.

Areas for Improvement: The strip mall aspect is not represented, nor are the sales offices, restroom, breakroom, storage, and a completely established showroom. Bearing in mind that different text-to-images (TTI) can produce different outputs, we are curious as to whether or not another TTI would output a mix of floor plans and interior renderings.

Innovative Workplace Design Prompt

“Create a detailed conceptual image for a modern office headquarters that encourages collaboration and productivity, including a flexible layout for meeting rooms, break areas, and the integration of modern technology.”

Output



The Good: We like the creation of a collaged image all with different types of “collab” spaces, you can clearly see the modern aesthetic with the floating ceiling and exposed piping, floor to ceiling glass with no visually intrusive mullions. We see the technology portion acknowledged slightly with the wall mounted flatscreen in the seating area. We like the “conversation nook” and the breakroom. Nice use of the finishes.

Areas for Improvement: You cannot really see a true conference room, you actually see more offices or what appears to be offices.

2. **Massing Studies** – These prompts focus on conceptualizing the volume and massing of the office building or tenant space. *Open.Art AI Architecture Generator* was used.

Open, Transparent Massing with Glass Walls Prompt

“Generate a massing study for a modern office headquarters located in a strip mall, with a focus on transparency and openness. The exterior should feature large glass facades for the showroom and conference room, with sleek, angular volumes for private office areas. The design should be simple, clean, and efficient, with modern materials like steel and glass.”

Output



The Good: Does a decent job of showing massing and placing proper focus on the proposed design. A loose definition of “strip mall” is represented and the openness and transparency are conveyed very well. This is due to the prompt mentioning the exterior wall and large glass facades. The images easily convey visually what is glass and what is not. Everything is crisp and clean with no curves represented.

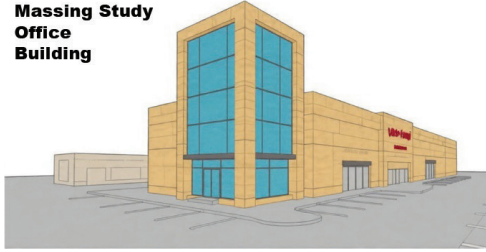
Areas for Improvement: Really difficult to get a “true” massing model feel since the images are so close up on the proposed project. It is not easy to see that the non-glass portions of the structural steel, honestly it looks more like concrete. Also, it is difficult to see the interior spaces, we are thinking may the TTI AI had to find a happy medium between the massing study (bird’s eye view outside) portion and the interior space (inside the building) requests of the prompt.

Volume and Height Variations Prompt

“Describe a massing study that uses different volumes and heights to create an interesting interplay between open and private spaces in a modern office headquarters.”

Output

**Massing Study
Office
Building**



**Massing
Study**



Central Open Space

The Good: Did a great job expressing different volumes and matching datum lines. Both images look like they are the results of renderings from a high dollar conceptual rendering program that has been on the market for 20 plus years. This looks like something that could be quickly generated to convey an idea from a prospective client or a schematic design rendering for a 15% schematic design set.

Areas for Improvement: On the early side of a schematic design and the scene is not full of life sans the white car behind the building to the right. The text is misspelled on the left and “General open space” is misspelled on the image at the right.

Building Form Exploration Prompt

“Generate volumetric studies of the office headquarters, focusing on efficient massing that separates private and public zones (e.g., CEO office, showroom, conference room).”

Output



The Good: Visually stunning and gives that architectural sketch appeal that so many expect. We were going to say the output missed the mark with the interior spaces but looking more closely at the prompt and what the TTI was instructed to focus on, we agree that the public and private zones are distinctly separate. Nice play with volume.

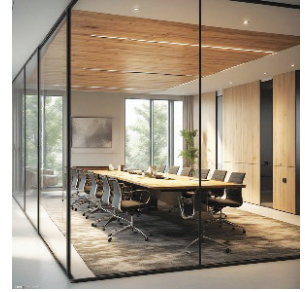
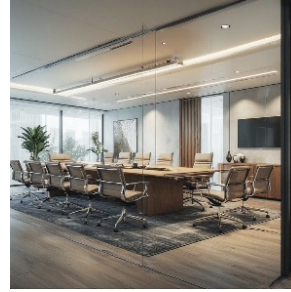
Areas for Improvement: Not as realistic as we would like.

3. **Interior Renderings or Visualizations** – These prompts focus on generating detailed interior scenes with realistic materials, furniture, and spatial arrangements.

Modern Conference Room with Glass Walls Prompt

“Create a detailed interior rendering of a modern conference room with butt-glazed glass walls. The room should have a long, wooden conference table with high-end chairs, integrated AV equipment, and soft LED lighting. Include modern decor elements and ensure the space feels open, bright, and collaborative.”

Output



The Good: Everything is represented and accounted for. We just noticed the mention of “collaborative” in the prompt, but it is only one space so there was not much to do with that adjective.

Areas for Improvement: The request for soft lighting is not represented as strongly as we would like but we recognize that the description of the space also mentions it being bright. So there was a bit of conflict there. That is something that can be quickly remedied.

Break Room Prompt

“Visualize a relaxed and functional break room with seating, a coffee station, light wood finishes, and plants integrated into the space for a wellness-focused environment.”

Output



The Good: All items mentioned in the prompt are represented, even the coffee station and other elements expected in a break room. Even the background of a major city is shown but not overpowering.

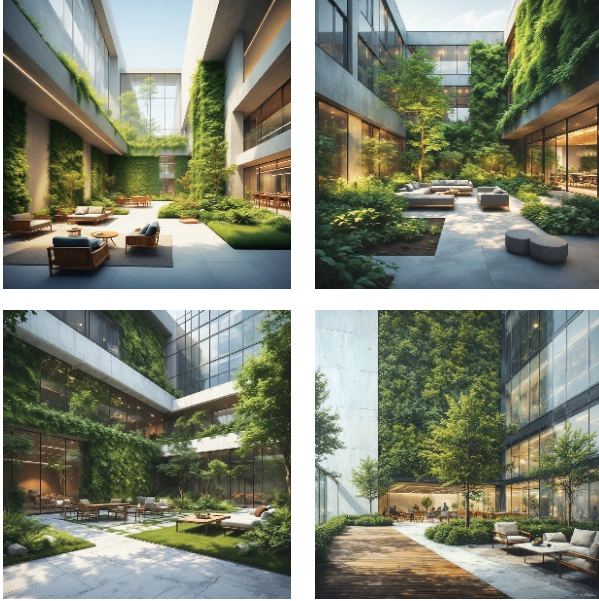
Areas for Improvement: None. If we had to choose one item, it would be the ceiling looking odd.

4. **Exterior Renderings or Visualizations** – These prompts focus on generating realistic exterior views of the building.

Courtyard and Outdoor Area Prompt

“Exterior rendering of a modern office headquarters with a landscaped courtyard or outdoor seating area. Include green walls, modern outdoor furniture, and ample lighting. The design should highlight the connection between the interior and exterior spaces, enhancing the overall office experience.”

Output



The Good: Most of the images capture the full prompt.

Areas for Improvement: The first image on the left and last image on the right match one another in lack of landscaping and more emphasis on the sitting areas and hardscape.

Integration with Context Prompt

“Visualize how the office headquarters integrates with a strip mall environment in North Carolina, with a sleek, modern facade that distinguishes it from the surrounding buildings but fits the overall context.”

Output



The Good: This is a really beautiful 3D proposed site plan, the ruralness of portions of North Carolina are represented as well as the new development. You can distinctly see different buildings along with parking spaces/lots lined by trees. Any arborist would love this proposed site design.

Areas for Improvement: No acknowledgement of distinguishing the buildings and the image of a strip mall was loosely interpreted.



LATENT-SPACE MODELING

Latent-space modeling refers to the process of learning a latent space, a lower-dimensional representation of data, where complex high-dimensional data (like images, sounds, or text) can be encoded into a simpler, more abstract form. These models work by mapping real-world data points (such as images or text) into this “latent space” and then manipulating or generating new data points from it.

Latent Space Modeling = The “Room of Sketches”

Imagine an AI that takes thousands of building sketches and compresses each one into a tiny dot inside a big room.

Each dot represents the essence of a building – its height, shape, style, window layout, and materials – all packed into a small code.

- When you pick a dot, the AI turns it back into a full building sketch.
- When you pick a spot between two dots, you get a sketch that looks like a blend of both buildings.
- When you pick a new spot, the AI generates a brand-new building sketch based on the patterns it learned.

Simply put, latent space is like a big room where every spot represents a different kind of building design. Moving around the room lets the AI generate new buildings without starting from scratch.

Attributes:

- **Generates new content:** These models can create new data from latent representations.
- **Unsupervised learning:** The models typically learn to map data into latent space without explicit human labeling. They identify patterns and structures in the data and use this knowledge to encode and decode information.
- **Creative generation:** The ability to explore and manipulate latent space allows for the generation of unique and creative outputs. The model can generate new data points that are like the training data but never seen before, such as new faces, scenes, or ideas.

AI Models: Models like *OpenAI* and *Stable Diffusion* use latent-space techniques to generate new content.

EXERCISES

Exercise 1: We ran the following prompt with *OpenAI* “Which of his projects did Frank Lloyd Wright hate or dislike the most?” Output received (abridged): “...Larkin Administration Building in Buffalo (1904) – He admired the design concept but later resented some of the functional compromises imposed by the client...”

Exercise 2: Click the following link and go to *OpenAI* and type in the prompt below: “Who is the most well-known architect worldwide?”

You will notice that it asks for more context, all the same do you agree with the output?

Applications:

- **Image generation:** Sampling from latent space to create new images (e.g., in GANs).
- **Data interpolation:** Blending features from different data points, like blending two faces.
- **Dimensionality reduction:** Reducing high-dimensional data (like images) to a lower-dimensional representation for easier processing.



LARGE LANGUAGE MODELS (LLMS)

A large language model (LLM) is a language model trained with self-supervised machine learning on a vast amount of text, designed for natural language processing (NLP) tasks, especially language generation. The largest and most capable LLMs are generative pre-trained transformers (GPTs) and provide the core capabilities of modern chatbots.

LLMs are trained on massive datasets of text (such as books, websites, articles, etc.) to learn the patterns, structure, grammar, and meaning behind language. LLMs can generate text, complete sentences, answer questions, summarize content, translate languages, and more.

While they're traditionally associated with text generation, they are also generative models because they can create new, coherent text based on given prompts.

GPT (Generative Pretrained Transformer) models like GPT-3 and GPT-4 are state-of-the-art LLMs capable of generating text in response to prompts, completing text, and answering questions.

GPT-3 can generate essays, poems, code, and even answers to questions by understanding the statistical properties of language and predicting the next word or phrase.

BERT (Bidirectional Encoder Representations from Transformers): typically used for tasks like sentiment analysis, question answering, and other classification tasks.

Attributes:

- **Generates new content:** LLMs generate text that has never been seen before (even though they're based on training data).
- **Creativity:** They can write stories, craft poetry, or solve complex problems by generating new text based on context.
- **Probabilistic generation:** The model predicts the next word in a sequence based on patterns it has learned, generating new sentences, paragraphs, or entire articles.

AI Models: LLMs like GPT-3, GPT-4, and BERT are designed to understand, generate, and manipulate human language.

EXERCISES

Exercise 1: If you input the text “Why do architects need to be familiar with AI?” We used GPT-4 and received the following output:

“Architects need to be familiar with AI because it is changing how buildings are designed, analyzed, and delivered.

AI helps generate design options, analyze performance (energy, daylight, cost), and automate repetitive tasks, allowing architects to focus more on creativity and decision-making.

It also supports sustainable, data-driven design and improves collaboration with engineers and clients. Understanding AI ensures architects remain relevant, efficient, and ethically responsible as the profession evolves.”

Exercise 2: Go to GPT-4, and type in the prompt below:

“How long does it take to develop an AI usage policy for a small to medium sized architecture firm?”

AEC ANALOGIES FOR LLMS

For Architects – “The Intern Who Has Read Every Design Book”

Imagine you have an intern who has read every architecture book, magazine, spec sheet, website, and design guideline on the planet.

They've seen so many drawings, narratives, and design discussions that they start recognizing patterns – how architects describe space, style, form, and intent.

Now when you ask:

- “Write a design narrative,”
- “Describe a façade concept,”
- “Summarize the program,”

They can instantly create organized, thoughtful text because they've learned how architectural language works.

That's an LLM – it generates text using patterns it learned from massive amounts of language.

For Engineers – “The Assistant Who Has Read Every Technical Manual”

Picture an engineering assistant who has read every structural, mechanical, electrical, and civil engineering document: codes, specs, textbooks, manuals, calculations, diagrams, and reports. Because they've absorbed so much information, they understand how engineers talk – precise, technical, and logical.

Ask them to:

- explain a concept,
- outline a system,
- summarize a calculation,
- or write part of a report –

and they can produce it instantly based on the patterns they've learned.

For General Contractors – “The Foreman Who Has Read Every Project Document Ever”

Imagine a foreman who has read every schedule, RFI, submittal, daily log, safety manual, and project spec ever created. They know how construction information is usually written – short, clear, and practical.

So, when you ask:

- “Draft a site instruction,”
- “Write a safety reminder,”
- “Summarize today's work,”
- “Explain a sequencing step,”

They can immediately produce it because they've learned the patterns behind construction communication.

For Inspectors – “The Notebook That Has Every Inspection Report Ever Written”

Imagine a magical notebook that contains every inspection report, code reference, violation example, and safety guideline ever written.

It doesn't memorize all of it – it learns the patterns of how inspectors describe issues, cite codes, and write recommendations.

When you ask it to:

- describe a violation,
- summarize a site visit,
- explain a code in plain language,
- or draft a corrective action –

It produces professional text instantly based on those learned patterns.

Applications for LLMs:

- **Text generation:** Writing essays, articles, or even creative stories.
- **Chatbots:** Conversational AI that can respond to user queries.
- **Language translation:** Automatically translating text between languages.
- **Summarization:** Condensing long articles or documents into shorter summaries.

IN SUMMARY

- **Text-to-Image:** Generating images from textual descriptions.
- **Latent-Space Modeling:** Learning and manipulating compressed, abstract representations of data (latent space) to generate new samples.
- **Large Language Model (LLM):** AI models trained on massive text datasets to understand and generate natural language, capable of tasks like text completion, translation, and summarization.

Generative AI techniques have revolutionized creative and professional workflows across multiple industries and professions.

This concludes Part 2 of the course.

Next up is your Part 2 Quiz!

PART 2 – GENERATIVE AI PROMPTING STRATEGIES, TYPES, AND EXERCISES

KNOWLEDGE CHECK (5 QUESTIONS)

1. **What is the key characteristic of a Zero-Shot prompt?**
 - A. It provides examples for the AI to follow
 - B. It defines the AI's role and constraints
 - C. It is clear, concise, and does not include examples
 - D. It asks the AI to solve a problem in multiple steps
2. **Which prompting strategy involves assigning a persona or role to the AI?**
 - A. Contextual prompting
 - B. Role prompting
 - C. Chain of Thought prompting
 - D. Step-Back prompting
3. **What is the purpose of the “Chain of Thought” (CoT) prompting strategy?**
 - A. To provide multiple examples for the AI to follow
 - B. To break down complex problems into smaller, logical steps
 - C. To define the AI's role and constraints
 - D. To generate multiple outputs and select the best one
4. **Which of the following is an example of a Text-to-Image AI model?**
 - A. GPT-4
 - B. BERT
 - C. Stable Diffusion
 - D. OpenAI Codex

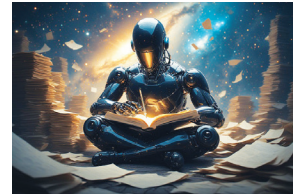
5. **What is the primary function of Latent-Space Modeling in Generative AI?**
 - A. To generate text based on learned language patterns
 - B. To create images from textual descriptions
 - C. To encode and manipulate data in a lower-dimensional abstract space
 - D. To provide step-by-step reasoning for complex problems

You made it to the finish line!
This concludes Part 2 of the course.
Continue to Part 3.

PART 3 – GENERATIVE AI FOR AEC: AI FOR AUTOMATION AND BUSINESS EFFICIENCY

Learning Objective No. 3:

Identify Generative AI tools and their use for AEC related tasks.



AEC professionals and firms can use Generative AI to streamline production, reduce errors, accelerate decision-making, and more as there appears to be no limits when it comes to AI. Remember to always review anything AI generated prior to its release.

TOOLS

TEXT TO IMAGE (TTI) AI

AI Models: Models like Stable Diffusion, DALL-E 2, Google Gemini (also an LLM), and MidJourney.

Text-to-image AI uses for AEC professionals:

Architects

1. Conceptual façade design visualization.
2. Interior layout exploration from programming requirements.
3. Landscape and site design concepts from prompts.
4. Material and finish visualization for client presentations.
5. Mood boards or style concepts for design meetings.
6. Historical or futuristic building style simulations.
7. Visualization of sustainable design features (green roofs, solar panels).
8. Marketing renderings for proposals and portfolios.



Figure 3.0. Solar Panels on a Single Family Residence © Perchance.org



Figure 3.1. Visualization of a green roof located in the downtown area of a major city © Perchance.org

Inspectors

1. Simulating potential code violations for training purposes.
2. Visualizing common safety hazards from descriptions.
3. Creating inspection scenario examples for staff education.
4. Generating imagery for fire safety, egress paths, or emergency situations.
5. Illustrating environmental risks (flooding, erosion, etc.) from site descriptions.
6. Creating before-and-after visuals of corrections or repairs.
7. Virtual inspection walkthroughs using AI-generated environments.
8. Producing illustrations for inspection reports or public awareness campaigns.



Figure 3.2. Environmental risks in high flood areas illustrated © Perchance.org

Engineers

1. Visualizing structural systems from text prompts.
2. Exploring different bridge or truss configurations.
3. Illustrating infrastructure in urban planning projects.
4. Generating diagrams for presentations or client approvals.
5. Communicating engineering ideas visually without full CAD models.

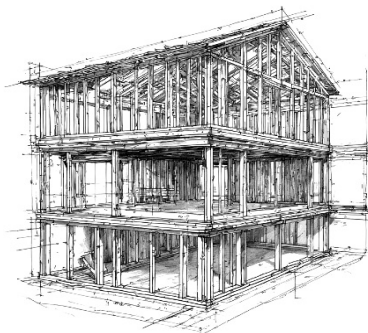


Figure 3.3. Residential framing for a 3 story SFR © Perchance.org

General Contractors

1. Simulating on-site safety hazards or best practices.
2. Creating visuals for client progress updates.
3. Communicating sequencing of multi-trade workflows.
4. Producing marketing visuals for new projects or bidding proposals.

FREE AND PAID TEXT-TO-IMAGE TOOLS

FREE

1. **Stable Diffusion Online** – “Stable Diffusion is a latent text-to-image diffusion model capable of generating photo-realistic images given any text input, cultivates autonomous freedom to produce incredible imagery, empowers billions of people to create stunning art within seconds.”
2. **PerChance** – “Perchance is a platform for creating and sharing random generators.”
3. **Playground AI** – “Playground AI is an online AI-powered image generation tool that creates images from text prompts or existing images. The platform provides image-to-image capabilities, styles, filters, and refinement options.”
4. **BlueWillow** – “From logos and characters to digital artwork and photos, just describe the image you want and our AI image generating tool will create the perfect graphic for your project.”
5. **LimeWire AI Image Generator** – “LimeWire’s free AI image generator brings your ideas to life within seconds. Simply enter your text-to-image prompt and transform your creative ideas into images. With the power of our AI Image generator, the possibilities are truly endless.”
6. **Hugging Face Spaces – Text-2-Image Collection**– Includes a variety of Stable Diffusionbased models that you can run in-browser (plus different model versions).
7. **Midjourney** – AI image generator, paid subscription (free to use through Meta).

PAID

1. **Midjourney** – AI image generator, paid subscription (free to use through Meta).
2. **Stability AI (Dream Studio)** – “Stability AI is unlocking the power of open-source generative AI to expand human creativity. We build world-class models that are accessible, adaptable, and designed to empower creators, developers, and enterprises everywhere.”
3. **NovelAI** – “Play with your own imagination using an interface tailored towards making generating imagery simple and fast.”
4. **Adobe Firefly** – Generate images, video, audio, and designs using top AI models from Adobe, Google, OpenAI, Runway, and more.”
5. **Imagiyo AI** – “Create stunning and unique images with ease using our AI generation.”

LATENT SPACE MODELING AI USES FOR AEC PROFESSIONALS

Architects

1. Generating building massing variations

AI explores different points in latent space to produce dozens of massing options that meet site, height, and density constraints.

Massing Studies for a lot in Kansas City, Missouri

Façade style blending

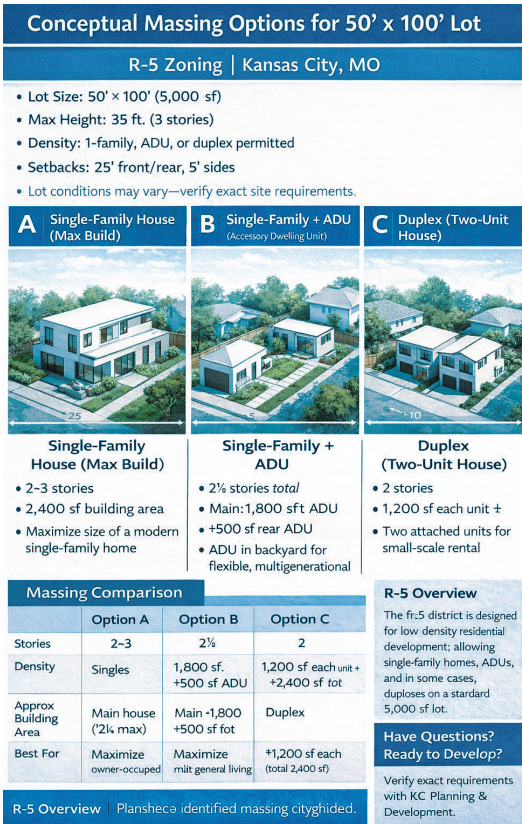


Fig 3.4. Massing Options for a lot in Kansas City, Missouri © Open AI chatgpt.com

By interpolating between points – e.g., “brick warehouse” and “glass tower” – the AI creates hybrid façade options.



Figure 3.5. Façade style blending between a brick warehouse and glass tower © Stable Diffusion



Figure 3.5.1. Façade style blending between a brick warehouse and glass tower © Stable Diffusion

Interior design mood variations

Latent space lets AI produce multiple lighting, material, or furniture styles from one base concept.



Figure 3.6. Interior Design Mood Board © Open AI chatgpt.com



Fig 3.7. Interior Design Mood Board © Open AI chatgpt.com

Engineers

1. Structural system exploration

AI generates variations of truss patterns, column grids, or framing layouts by sampling structural latent space.

2. MEP routing concepts

Latent-space models create early HVAC or plumbing routing suggestions based on thousands of learned layouts.

3. Failure scenario simulation

AI generates visualizations of bending, cracking, or buckling by sampling latent patterns of known failures.

General Contractors

1. Site logistics alternatives

AI produces different staging, crane locations, and material yard layouts by moving through latent space.

2. Phasing and sequencing visuals

Latent-space timelines help generate multiple construction sequence images from one baseline plan.

3. Safety scenario illustrations

Contractors can generate visuals of potential hazards (fall risks, blocked exits) based on safety latent patterns.

Inspectors

1. Before-and-after remediation images

Interpolating between two points shows unsafe → corrected conditions.

Urban Planners

1. Neighborhood massing blends

AI blends urban forms (rowhouses → mid-rise → high-rise) by traversing latent space.

2. Landscape + architecture integration

Latent models generate coordinated site plans where terrain, planting, and building forms naturally match.

3. Parking and circulation layouts

AI samples learned circulation patterns to suggest parking lot or road configurations.

4. Climate-adaptive design concepts

AI generates building/site configurations suited for heat, snow, or flood conditions based on learned patterns.



Figure 3.8. 3D Aerial of Proposed Site Plan for a Townhome Development © Stable Diffusion

FREE AND PAID TEXT-TO-IMAGE TOOLS

FREE & PAID

- OpenAI
- Stable Diffusion

LARGE LANGUAGE MODELING (LLMs) USES FOR AEC PROFESSIONALS

Architecture (AEC Design)

1. Exercise 1: Concept Development & Design Ideation

Converting a transcribed telephone call from a quick conversation with a very busy and high-dollar prospective client into a building program and project approach.

The Prompt We Used: “Hey I’m sorry I can’t give you more time, but I wanted to make sure we had this call. So, we basically want a retail store that caters to middle aged women with no kids. The location is downtown; our biggest concerns are safety and parking. There are numerous parking garages around, but we cannot afford to validate for all of the garages. The space is not that large, maybe like 2500 square feet, and we just need space for retail, the cash wrap, storage, an office, 2 or 3 fitting rooms, and a unisex bathroom if we can keep the occupant load under 100. let me know what you think talk to you soon.” We are an architecture firm, provide a building program and project approach for this project in a table format and be brief

LLM Output (GPT-4) we added the color:

Building Program (Approx. 2,500 SF)



Figure 3.8.1 Busy prospective client on the phone © Perchance.org

SPACE	APPROX. SF	NOTES / CONSIDERATIONS
Sales Floor	1,450	Clear sightlines for safety, flexible fixtures, welcoming layout for middle-aged clientele
Fitting Rooms (2-3)	220	Near sales floor, generous sizing, good lighting, seating/hooks
Cash Wrap / POS	150	Visibility to entry + sales floor for security
Storage / Back of House	300	Inventory, deliveries, seasonal stock
Office	150	Admin, staff use, visual connection to store preferred
Unisex Restroom	130	Single-user to support low occupant load
Circulation / Walls	100	Efficient planning to maximize retail area
TOTAL	≈ 2,500 SF	Target occupant load < 100

Project Approach

PHASE	KEY ACTIONS
Site + Code Review	Confirm occupant load, restroom requirements, egress, ADA, and local retail code constraints
Safety Strategy	Maximize transparency, lighting, passive surveillance, controlled entry, CPTED principles
Parking Strategy	Wayfinding signage, partnerships with 1-2 nearby garages (non-validated), staff parking plan
Space Planning	Optimize small footprint, flexible merchandising, minimize back-of-house area
Design Development	Brand-driven interior, warm materials, comfortable fitting rooms, clear circulation
Permitting + Coordination	Early AHJ coordination to maintain unisex restroom and occupant load goals

Now we took this same prompt and placed it into Google Gemini

LLM Output (Google Gemini) we added the color:

It sounds like you have a clear demographic and some specific urban constraints to navigate. For a 2,500 sq. ft. space, staying under an occupant load of 100 is very doable (usually calculated at 30–60 sq. ft. per person for retail), which will simplify your life regarding egress and plumbing requirements.

Here is a streamlined building program and project approach tailored for your client’s needs.

Building Program

SPACE	ESTIMATED SQ. FT.	KEY FEATURES & REQUIREMENTS
SALES FLOOR	1,500 – 1,700	Open plan; high-end lighting; focus on security and sightlines.
FITTING ROOMS	150 – 200	2-3 oversized stalls; high-quality mirrors and “flattering” lighting.
CASH WRAP	100 – 150	Point of Sale (POS); integrated security/camera monitors; wrapping station.
BACK OF HOUSE/STORAGE	300 – 400	Inventory shelving; receiving area; kitchenette nook for staff.
PRIVATE OFFICE	100 – 120	Desk space; secure file storage; window to sales floor for oversight.
UNISEX RESTROOM	60 – 80	ADA compliant; high-end finishes to match the brand aesthetic.
CIRCULATION/WALLS	100 – 150	Efficient flow to maximize “selling” square footage.

Project Approach

PHASE	STRATEGY & FOCUS
1. SITE & CODE ANALYSIS	Verify occupant load to ensure single-exit/unisex bathroom compliance. Analyze proximity to the most “secure” feeling parking garage.
2. SECURITY-FIRST DESIGN	Implement “Defensible Space” principles: clear sightlines from the cash wrap to the entrance and no “hidden” corners in the sales floor.
3. PARKING MITIGATION	Since you can’t validate everywhere, design a digital “Parking Guide” for the store’s website/app to direct clients to the safest, closest garages.
4. INTERIOR CONCEPT	Create a “Sanctuary” vibe—sophisticated, quiet, and clutter-free—to appeal to the child-free, middle-aged demographic.
5. LIGHTING & TECH	Use smart lighting for safety after dark and integrated security systems (EAS gates) that don’t look overly industrial or intimidating.

EXERCISES – A TALE OF TWO LLMs

Comparing the output of both LLMs you will notice the following:

- **Building Program**
- **Occupant Load:** They both repeat what the prospective client said was their goal but only one LLM mentions the occupant load factors of 30-60 square feet per person.

Let’s take it a step further, if you consult the 2024 NCSBC: BC (North Carolina State Building Code: Building Code) and go to Chapter 10> Table 1004.5. You will see that the occupant load factor for Mercantile use is **60 gross square feet/per person**. The LLM was somewhat accurate, and this is where it is important to use your professional judgement to verify the output information. 60 gross sf/pp is the correct factor.

Now if you are familiar with the code then having this information immediately at your fingertips during the call can help you quickly determine a rough estimate of how many occupants you will have.



Figure 3.9 Mercantile Use (not occupancy classification) OLF = 60 gross sf/pp © Perchance.org

- **Square Footage:** They both acknowledge the square footage limitation but only one LLM gives a total sum of 2,500 SF in the program confirming its accuracy, while the other gives a range with no total sum.
- **Notes:** Both LLMs account for the programming requirements and take note of the number of fitting rooms mentioned by the prospective client. One LLM does a slightly better job of really understanding and emphasizing the importance of safety by mentioning “integrated security/camera monitors” at the cash wrap. And an ADA compliant unisex restroom was also mentioned by one LLM and not mentioned in reference to a restroom by the other. This is important as the ADA is a civil rights law and requires it to be adhered to on all projects unless an exception or exemption is met.
- **Project Approach**
- **Site & Code Analysis:** One LLM mentions ADA but even better another mentions the single exit exception which is directly tied to the occupant load. There is also a mention of locating “... proximity to the most secure feeling parking garage.” which was a concern of the prospective client.
- **Safety Strategy:** We like that both LLMs combined mentioned CPTED and Defensible Space, both principles when followed are very valuable at creating a safe space and area.
- **Parking:** Both LLMs mentioned different strategies to approach the parking problem. One LLM gives a more traditional approach while another LLM mentions phone “apps” and a digital parking guide.
- **Interior Design:** One LLM provided more detail and current language by mentioning the “vibe” the space needed to have to appeal specifically to the demographic shared by the prospective client.
- **Lighting:** Surprisingly one LLM makes no specific mention of lighting, which as we all know goes hand and hand with a secure location and space. The LLM that mentioned lighting, even mentioned EAS gates which are “Electronic Article Surveillance gates” which prevent theft of property from a retail store.



Figure 3.10 Electronic Article Surveillance Gates (EAS) at a Retail Store © Perchance.org

- **Suggestions:** One LLM suggests that the AEC professional should meet with the Authority Having Jurisdiction (AHJ) to ensure as much as possible a smooth permitting process regarding the way the occupant load was calculated and ensuring that only one unisex restroom is required. The other LLM makes mention of specific items to watch out for with the prospective client, even going so far as to recommend impact-resistant glazing at the storefront as well as tying parking validation to the dollar amount of goods purchased by the store patron.
- **Exercise 2: It is now your turn. Find past meeting minutes from a prospective client initial meeting and copy and paste them into the GPT-4 LLM and Google Gemini LLM with a directive to generate a building program and project approach.**

What were the results? Does the program resemble the program your team created? What about the project approach?

General Contractor (Construction)

2. Exercise 1: Construction Costs

What is the question every general contractor hears constantly? (even some architects oddly enough) How much will it cost to build this? And how long will it take?

So, we will use the project from earlier and for a location we will say the Southeastern United States of America, in an A+ class tenant space located in the downtown area of major city. We will ask for a rough order-of-magnitude (ROM) given the few details provided by the 3 prospective client.

For the sake of brevity, we will only showcase the output from one LLM, we invite you to enter the prompt in Google Gemini and see how similar or dissimilar they are.

The Prompt We Used: “The project location is in an A+ class tenant space located in the downtown area of a major city in the Southeastern United States of America.

The project scope is the buildout of a retail store that is 2500 square feet and has a cash wrap area, storage and an office and 2 or 3 fitting rooms with a unisex bathroom if we can keep the occupant load under 100. This is the program we received from the architect: Sales Floor, Fitting Rooms, Cash Wrap, Back of House / Storage, Private Office, Unisex Restroom, and

Circulation / Walls. We are a general contractor and want to know the cost per square foot and the total cost (rough order of magnitude). A step-by-step breakdown of how the total cost was arrived at, the escalation factor, and how long it will take from beginning to end when the certificate of occupancy is received.”

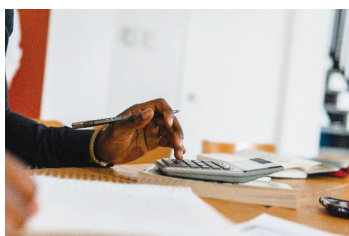


Figure 3.11. Money always matters © Pexels.com, PNW Production

LLM Output (GPT-4):

“Here’s a realistic **general contractor-level rough order of magnitude (ROM) estimate** for your **2,500 sq ft retail buildout in a downtown A+ tenant space** in a major Southeastern U.S. city (e.g., Atlanta, Nashville, Charlotte, Miami, etc.). Costs vary widely by market, finishes, and landlord conditions – these numbers are *industry ranges* you can use for budgeting and proposals. (Cost Now)

1. Estimated Cost Per Square Foot

For a **full retail tenant build-out** (from shell or vanilla space) with cash wrap, storage, office, fitting rooms, basic finishes, and bathroom:

COMPONENT	TYPICAL RANGE (SOUTHEASTERN U.S.)
Mid-Range Retail TI Build-out	\$150 – \$320 PER SQ FT
Higher-End Retail / Custom Finishes	\$320 – \$420+ PER SQ FT
Average Practical Estimate for A+ Downtown	\$260 – \$350 PER SQ FT

This includes hard costs for walls, ceilings, floors, lighting, basic MEP (mechanical/electrical/plumbing), restroom plumbing/fixtures, partition walls for fitting rooms/office, and typical finishes. It excludes expensive custom millwork (e.g., premium display systems), tenant-furnished equipment, and inventory.

- If the landlord provides a **Tenant Improvement Allowance (TIA)** in your lease, subtract that from your cost to determine tenant-borne expenses. Typical TI in retail can range roughly **\$40 – \$100 per sq ft** depending on landlord negotiation and space condition. (Flavor365)

2. Total Cost (ROM)

For your **2,500 sq ft** space:

Scenario A – Mid-Range (typical finishes)

- Cost/SF: **\$260**
- **Total Estimate: ~\$650,000**

Scenario B – Higher-End Finishes & Systems

- Cost/SF: **\$350**
- **Total Estimate: ~\$875,000**

Scenario C – Premium Retail Build-out

- Cost/SF: **\$420**
- **Total Estimate: ~\$1,050,000**

3. Step-by-Step Cost Breakdown

Here’s how the estimate is typically built up for a project like yours:

Hard Costs (70–75% of total)

CATEGORY	% OF TOTAL	ESTIMATED \$ (OF \$650K)
Framing & Interior Walls	~15%	~\$97,500
Flooring & Ceilings	~15%	~\$97,500
MEP (HVAC, electrical, plumbing)	~25%	~\$162,500
Restroom & Fixtures	~8%	~\$52,000
Fitting Rooms / Cash Wrap Structure	~8%	~\$52,000

Soft Costs (15–20%)

CATEGORY	%	~\$650K ESTIMATE
Design & Engineering	~7%	~\$45,500
Permits & Inspections	~4%	~\$26,000
Contractor Overhead & Profit	~10%	~\$65,000

Contingency (5–10%)

Allowance for unknown conditions or scope changes:

- ~5 – 10% of total project → **\$32k–\$65k**

Note: Tenant allowance, furniture/fixtures/equipment (FF&E), and inventory are separate and not included here.

4. Escalation / Market Factors

Construction pricing is rising nationally due to labor shortages, supply volatility, and metropolitan demand. Expect an **annual escalation factor of ~3–6%** on base pricing if your project starts >6–9 months after current pricing. This is a general trend observed industrywide. (Cost Now)

5. Typical Timeline (From Received Certificate of Occupancy)

Here's a step-by-step schedule:

A. Pre-Construction Phase

- **Architectural design & coordination:** 2–4 weeks
 - **Permit submission & review:** 3–6 weeks*
(Local authority reviews can vary widely by jurisdiction)
- Pre-construction total:** ~5–10 weeks

B. Construction Phase

- **Demolition (if required):** 1–2 weeks
 - **Rough-in MEP:** 2–4 weeks
 - **Interior partitions & framing:** 1–3 weeks
 - **Finishes (flooring, ceilings, painting):** 2–4 weeks
 - **Restroom and fixtures installation:** 1–2 weeks
 - **Inspections and final punch walk:** 1–2 weeks
- Construction total:** ~8–14 weeks

Total Timeline

~13 – 24 weeks (3–6 months typical from CO to final turnover) assuming no major redesigns or permit delays.
(Hartford Building Co.)

Notes for Your Negotiations

- **TIA negotiation matters** – higher TI significantly reduces tenant cash outlay. (Flavor365)
- **Market conditions vary by city** – NYC or Miami may be at the high end; many Southeastern cities fall closer to Mid-Range. (Cost Now)
- **Landlord-provided shell condition** (shell vs. vanilla) changes costs dramatically. (jaacontractors.com)
- **Contingency is required** – always hold 5–10% for unforeseen conditions.

If you want, I can tailor this estimate more specifically with **finish level assumptions, landlord allowance scenarios**, or break the costs down into **hard vs soft vs GC fee categories** for your internal proposals. Just tell me your priorities!"

Observations

You notice how with what little information the LLM still provides you with a very detailed breakdown. The output ensures that it is understood that the numbers used are industry ranges. Also it assumes the worst-case scenario, that the space is currently in a shell or white box status versus being a retail space currently.

In addition, mention is made of the landlord and what role they play in the calculation of the costs. No mention was made of this in the prompt mind you. What is really great is how the LLM holds itself accountable and cites its sources (in the form of a weblinks), this allows you to execute your professional judgement and see if what details are found at the various websites are legitimate.

- **Exercise 2: It is now your turn again. Find a recently completed project and write a prompt with all the information needed to calculate total construction costs as accurately as possible. Next, input this information into GPT-4 LLM and Google Gemini LLM with a directive to provide you with the total construction costs using the year the project was started and to direct the LLM to provide a step-by-step breakdown.**

What were the results? Did the LLMs come close to what your total construction cost was? What was similar and what was different?

AI Models: LLMs like GPT-3, GPT-4, Google Gemini and BERT are designed to understand, generate, and manipulate human language.



HOW AI IS CHANGING THE AEC INDUSTRY

Time is money. Thanks to Generative AI the time-consuming tasks can be addressed by AI and all that is left for the AEC professional to do is exercise their professional judgement against the output, look for any hallucinations and irregularities, et cetera. Here are ways that the AEC industry is already changing. See below:

Automating Time-Consuming Tasks

1. Automated code compliance checks

AI scans drawings/models for ADA, fire safety, egress, and zoning compliance, flagging issues instantly. Mind you, you will have to confirm its accuracy and exercise your professional judgment (more about that in Part 4).

"InQI today announced the official release of Codes.IQ, the first AI-native foundation-level code compliance engine designed specifically for architects, designers, and builders. Codes.IQ debuts exactly two years after InQI filed its foundational patent, a milestone that marked the company's long-term mission to redefine how AI can automate the design-to-permit lifecycle across the built environment"

- Street Insider

2. Automatic quantity takeoffs

Systems extract material quantities from BIM models without manual measurement.

"BIM EstiMate harnesses the power of AI and ENG's extensive project history to deliver accurate and timely estimates. To achieve this, we used insights from thousands of estimates completed at ENG, categorized by Building Type, Trades, Total Area, and Level of Development (LOD). Then, using this comprehensive dataset, we trained an advanced AI algorithm capable of predicting BIM services costs with a high degree of accuracy."

- ENGBIM

3. Automated drafting & documentation

AI generates plans, sections, details, and schedules from a single prompt or conceptual model.

"Our intuitive platform allows you to turn your vision into reality with just a few clicks. Whether you're planning a cozy studio or a sprawling estate, our AI technology can generate detailed floor plans tailored to your preferences and spatial requirements. Simply input your desired dimensions, style, and special features, and watch as our system crafts a comprehensive layout that maximizes both aesthetics and functionality."

- Planner5d

4. Model cleanup and standardization

AI fixes naming conventions, fills missing metadata, and organizes BIM elements to office standards.

5. Automated submittal and RFI creation

AI reads specifications and models, then drafts initial RFIs or submittal logs to reduce admin load.

"...Procore Agent Builder allows customers to automate workflows by building custom AI agents to meet the unique needs of their business. Now in open beta and available to all customers, this solution enables teams to create agents from scratch using natural language prompts. Users can also leverage a collection of pre-built Procore Agents – like the RFI Creation Agent, which instantly generates RFI content and searches project documents for answers, reducing the time it takes to get critical information from days to seconds, preventing costly delays on the jobsite. In addition, the Daily Log Agent can help automate jobsite reporting, ensuring real-time, accurate documentation needed to manage progress, resources, and compliance..."

– ProCore

1. SPECIFICATION WRITING AUTOMATION

Specification writing is a very important and time-consuming task for any AEC firm. Using Specifications writing software plus Generative AI Workflows allows you to reduce that time. The goal would be to find an effective and efficient balance between AI generated specifications and human generated specifications.

What AI Can Automate

- First-draft specification sections (CSI-based)
- Editing office master sections
- Comparing Specifications writing software to project-specific requirements
- Tracking changes between versions
- Summarizing conflicts across consultant specifications
- Extracting requirements from manufacturer product sheets and placing them into the specifications

Typical Workflow

1. Gather Inputs

- Specifications writing software section
- Office standard specification
- Manufacturer product data sheets
- Project requirements

2. Feed to Generative AI with a structured prompt:

“Combine the Specifications writing software section and our office master into a clean project-specific section. Highlight deviations, missing info, and items needing designer confirmation.” And then copy and paste in the “Specifications writing software” section and the “Office Master”

Real World/Real Time Benefits

- “AI can streamline specification creation by establishing a ‘brilliant baseline,’ automating the project manual’s table of contents (TOC) and generating pre-selected options based on project requirements... Since around 80% of specification content is often consistent across projects, AI can streamline the creation of baseline documents... saving time and reducing time-consuming tasks.” – *How AI can transform your specifications, AIA.org*
- “AI ensures that approved clauses and preferred language are used consistently, regardless of which team member is drafting the agreement... AI can enforce organizational standards automatically, preventing the use of outdated or non-preferred language.” – *Icertis*
- “AI provides project-wide access to a Specification Q&A tool that gives instant, direct answers from the documents... reducing misinterpretations and errors caused by an inability to find information.” – *AllGanize*

2. CODE + ZONING SUMMARIES

ICC Model codes (like the IBC, IMC, IPC, IFC, etc.), ADA, NFPA, local zoning code, et. cetera

What AI Can Automate

- Summaries of applicable IBC sections
 - Copy and paste the IBC section and request a summary
- Occupancy classification analysis
 - If you ever have a question as to which occupancy classification your project is, place both competing occupancy classification definitions into AI and then type in, in a very detailed way, the scope of work of the project. If you want to take it a step further, tell AI the state the project is in (if in the US) and add a link to the local ordinance of the jurisdiction being worked in just in case there are any nuances. For example, in some jurisdictions an A-2 with 49 or less occupants is a Business occupancy classification but in another AHJ it is a Mercantile occupancy classification.
- Egress requirements (widths, distances, exits)
 - This would be a quick way to learn your minimums and maximums while drafting a conceptual design. Be very careful with this and always have a human confirm that what is being stated is accurate.
- ADA / accessibility summaries
- Zoning envelope extraction (FAR, height, setbacks)
 - Feeding a zoning ordinance into AI, can be as simple as adding a link and then asking your question.
 - For example, we went to ZoningBot.com where it “...lets residents and planning staff chat with their zoning ordinance. Look up zoning by address, ask follow-up questions, and get clear answers backed by your city’s code.”

This is a much more exciting and efficient way to quickly obtain your limitations, especially for feasibility studies.

Typical Workflow

1. Input site address, occupancy, and proposed use.
2. Upload zoning ordinance excerpts or IBC sections. Or depending on the AI being used provide the website URL.
3. Request structured outputs:
 - “Zoning envelope summary”
 - “Code path diagrams”
 - “Applicable sections + exceptions”
4. AI returns a formatted, checked version that humans verify. (mission critical step)

“Need quick insights? Review the brief AI-powered overview of your doc. Then select a suggested question or ask your PDF any question to streamline document research and analysis.”

– Adobe PDF

3. COST-ESTIMATING FIRST PASSES

(Rough Order of Magnitude (ROM) pricing, feasibility studies, conceptual budgets)

What AI Can Automate

- Rough-order-of-magnitude (ROM) cost estimates
- Breakdown by trades, CSI divisions, or building systems
- Cost-driven design option comparison
- Historical cost data analysis
- Assumption sheets for estimators to refine

(Note: Always verified by a qualified cost estimator.)

“While traditional estimating methods rely on time-intensive manual work with the potential for error, AI tools can produce estimates faster and more accurately.”

– ConstructConnect

4. RFI + SUBMITTAL AUTOMATION

What AI Can Automate

- Draft RFI responses
- Extract relevant sheets/details
- Identify conflicts between drawings + specifications
- Suggest standard approval/denial language
- Create tracking logs + summaries
- Draft Architect Supplemental Instruction / Proposal Request narratives

Typical Command

“Based on sheet A5.1 detail 03 and Section 07 27 00, draft an RFI response including required coordination notes and confirm if this requires an ASI.”

5. MARKETING + PROPOSAL AUTOMATION

(Request For Proposal responses, project write-ups, resumes, graphics support)

What AI Can Automate

- Project descriptions tailored to the Request For Proposal
- Firm qualifications summaries
- Team member resumes (formatted to Owner requirements)
- Cover letters & executive summaries
- Proposal narratives (approach, innovation, sustainability)
- Draft schedules & work plans
- Past project comparisons

Workflow

1. Upload the Request for Proposal (RFP) + the firm’s boilerplate material.
2. Ask AI to:
 - Extract requirements
 - Create a compliance matrix
 1. Another step would be analyzing the RFP using AI against the firms’ Go / No Go determination document
 - Draft tailored proposal sections

Real World/Real Time Benefits

- Faster turnaround on proposals
- Reduced staff burnout during pursuits
- More consistent messaging across submissions

“AI-powered automation can drastically reduce the hours spent on crafting proposals. That means more time to focus on closing deals, driving growth, and staying competitive... you can automate the proposal writing process while maintaining top-notch quality and personalization.”
- DataGrid

6. SUMMARY: WHERE AI DELIVERS THE HIGHEST RETURN ON INVESTMENT (ROI) IN AEC AUTOMATION

TASK	WHY IT WORKS
Specification writing	Highly repetitive, structured data
Code + zoning summaries	Pattern-based interpretation and formatting
RFI responses	Relies on extracting information from drawings and specifications
Marketing proposals	Standardized structure and reusable content
Cost-estimating first passes	Ideal for early conceptual direction

7. Integration Strategy for Firms

To adopt these automations successfully do the following:

A. Standardize Inputs

- Office master specifications
- Template narratives
- Code summary formats
- Proposal boilerplates

B. Centralize Prompts

Create a shared library:

- **AEC Specification-writing prompts**
 - Project Information & General Conditions
 - Prompt: “For the architect’s specifications for XYZ firm write an introductory section that outlines the project, including the name, location, and scope of work. Provide the names of the parties involved (owner, architect, contractor) and state the general conditions, such as compliance with North Carolina building codes and environmental regulations.” Depending on your approach you can have AI pull from your knowledge base or just copy and paste the information it requires.
 - Summary of Work (Division 1)
 - Prompt: “In Division 1, Section 01 10 00 – “Summary of Work,” describe the overall scope of the project, including key milestones, site conditions, and any specific requirements, such as permits, environmental considerations, or stormwater management in compliance with North Carolina laws, specifically for the jurisdiction of Raleigh, North Carolina.”
- **Code interpretation prompts**
 - Prompt” Would a cafe with less than 30 occupants be considered a business ibc?”



Figure 3.12. A lovely couple enjoying a meal on the back deck of a cafe © Photo by David Crypto, Pexels.com

- The output from Google’s “AI Overview” was the following with multiple supporting links: “Yes, under the International Building Code (IBC), a cafe with an occupant load under 50 (like under 30) is often classified as a **Group B (Business) Occupancy**, even though it serves food, because it’s a smaller assembly space accessory to the main business, avoiding stricter Assembly (Group A) rules. This “50-person rule” reclassifies small coffee shops, bakeries, or pizza places with limited seating into the less stringent Business category.”
- Prompt: “I have a client who wants our architecture firm to design a retail store in downtown Providence, Rhode Island, the space is 5,000 square feet with 2,000 square feet for storage how many occupants can it hold per the applicable codes of that jurisdiction? Give us a short one paragraph summary.”

- LLM Google Gemini output:
“For your 5,000 square foot retail space in Providence, Rhode Island, the maximum occupant load is calculated using the Rhode Island-adopted **2021 International Building Code (IBC) Section 1004.5**, which requires separate calculations for distinct functions: the **3,000 sq ft sales area** (5,000 total minus 2,000 storage) utilizes the Mercantile OLF of 60 Gross sq ft/person for **50 occupants** (3,000/60), while the **2,000 sq ft storage area** utilizes the Storage OLF of 300 Gross sq ft/person for **7 occupants** (rounding up 2,000/300 = Approx 6.67); therefore, the total maximum calculated occupant load for the space, which is the figure required for designing the means of egress and life safety systems, is **57 people**.”

- **As stated previously, we fact checked everything starting with the applicable model code and edition and then the specific code sections cited to ensure occupant load factor accuracy. This is very convenient for random prospective client calls. Remember that all AI output must be qualified by a human design professional prior to use or release.**

- **RFQ Proposal prompts**

- Prompt: “We are an architecture firm submitting a RFQ proposal. What is the best approach to win a roof replacement public project in Boise, Idaho? What standard forms do we need to complete? Provide response in the form of one short paragraph with any pertinent links”

- LLM Google Gemini output:
“The best approach to win a public RFQ for a roof replacement project in Boise, Idaho, is to focus on demonstrating superior, relevant qualifications under the state’s Qualifications-Based Selection (QBS) process (Idaho Code § 67-2320). Your submission must clearly outline your specific experience with similar public or commercial roofing projects, particularly those involving public works, historic properties, or complex membranes, while highlighting the qualifications of the key personnel who will be on the project team. Since you are an architectural firm, you will primarily need to provide a Statement of Qualifications (SOQ), and while the specific forms depend on the procuring agency (e.g., City of Boise, Ada County, or Idaho Division of Public Works), they frequently require forms detailing firm experience, personnel résumés, and references, often using standard formats similar to the Idaho Division of Public Works documents available on their website.

Idaho Division of Public Works Forms & Documents:

<https://dpw.idaho.gov/docs-forms-guides/>

Would you like me to search for a sample City of Boise or Ada County Request for Qualifications (RFQ) document to identify their standard submittal forms?”

C. Human-in-the-loop QA

AI output must be validated by a design professional, i.e. licensed architect or licensed engineer. (This is a Mission Critical Step)

1. Specification Sections (CSI Format Editing with LLMs)

AEC firms commonly use GPT-4o with structured prompts to merge Specifications writing software sections, office masters, and project-specific requirements. This produces a clean first draft in less time than

manual editing. Human specifiers are to always review for liability, code compliance, and accuracy.

Specification Person Prompt Template

“You are an expert architectural specifier with 15+ years writing CSI MasterFormat specifications for healthcare and education projects.”

2. Code/Zoning Compliance Deficiency Reports & Summaries

LLMs excel at extracting and tabulating code requirements when fed current IBC/zoning text plus project parameters. (this can easily be done if you are a member of the ICC or NFPA and have access to the “Copy” function which the free public versions do not allow)

Typical Prompt

Project: Mixed-use podium building, Seattle, Washington, USA

Occupancy: R-2 above, A-2/B below

Stories: 7 total (1 podium + 6 residential)

Site address: 123 Example St (upload current Seattle Land Use Code excerpts)

Tasks for the Generative AI:

1. Code Compliance Matrix (table format) for IBC 2021 + Seattle amendments covering: allowable height/area, type of construction required, fire separation, egress, accessibility.
2. Highlight any non-compliances or exceptions needed.
3. Provide one-paragraph design narrative summary acceptable for early submittal.

Before (Manual Summary – Fragmented & Verbose)

Per IBC Table 506.2, R-2 is 11 stories / 285ft in Type IA... but Seattle limits wood-frame to 85ft... need Type III or better for podium... two exits required above 10 occupants... etc.

After (AI-Generated Clean Report – Ready for Human Verification)
(we added the colors in)

PARAMETER	REQUIREMENT (IBC 2021 + SEATTLE AMENDMENTS)	PROPOSED DESIGN	COMPLIANCE STATUS	NOTES / EXCEPTIONS REQUIRED
ALLOWABLE HEIGHT	85 ft / 6 stories for Type VA wood-frame (SMC 23.54.030)	78 ft / 7 stories total	Non-compliant	Seek height exception via Design Review
ALLOWABLE AREA	48,000 sf (Type VA, NS, 3 stories above podium)	42,000 sf per floor	Compliant	—
CONSTRUCTION TYPE	Type IIIA minimum for mixed-use podium separation	Type IIIA proposed	Compliant	2-hr podium separation required
NUMBER OF EXITS	2 minimum for floors > 10 occupants (IBC 1006)	2 scissor stairs provided	Compliant	—
ACCESSIBILITY	20% Type A units (Seattle amendment)	22% provided	Compliant	Exceeds requirement

Narrative: The proposed 7-story mixed-use building complies with IBC 2021 and Seattle amendments in all areas shown *except maximum height*, which exceeds the 85-ft limit for Type VA construction by 3 ft. A design-review departure is requested based on superior urban design and public-benefit features.

3. Proposal/RFP Narrative Language

Firms paste the RFP requirements + firm boilerplate and ask the LLM to generate tailored sections.

Typical Prompt

RFP Requirement: “Describe your firm’s approach to sustainable design and provide three relevant project examples demonstrating LEED Platinum outcomes.”

Firm boilerplate attached + sustainability statement attached.

Write a 400-word response in first-person, professional tone that exactly matches our firm voice (confident but collaborative). Include metrics and client names where approved.

Before (Generic Boilerplate)

Our firm is committed to sustainability. We pursue LEED certification on most projects and have achieved Platinum on several.

After (AI-Tailored Winning Language)

At [Firm Name], sustainable design is not an add-on – it is the foundation of every decision we make. We integrate passive-first strategies, life-cycle carbon analysis, and circular-economy principles from pre-design onward, consistently delivering projects that exceed client ESG goals while reducing operational costs by 25–40%.

Three recent LEED Platinum projects demonstrate this rigor:

1. Northwest Community Hospital Expansion (2023, 480,000 sf) – Achieved LEED v4 Platinum (82 points) through 100% on-site renewable energy, 62% water-use reduction via greywater reuse, and salvaged materials exceeding 20%. The owner reports 38% lower energy bills than code baseline.
2. Cascade Tech Campus (2024, 1.2M sf) – First net-zero-ready office campus in the Pacific Northwest to earn Platinum. Features include mass-timber structure reducing embodied carbon 45% vs. concrete, triple-glazed façade, and a 2.1 MW solar array. Microsoft reports 41% energy savings.
3. Riverside Mixed-Use (2022, 320 units) – Urban infill project achieving Platinum through adaptive reuse of an existing warehouse (55% embodied-carbon reduction), all-electric systems, and biophilic design that improved occupant satisfaction scores by 28% (post-occupancy survey).

These outcomes stem from our proprietary “Carbon-First Charrette” process, conducted with owners and contractors on Day 1 to lock in aggressive but achievable targets. We bring the same discipline to this project, targeting LEED v4.1 Platinum while prioritizing health, resilience, and community benefit.

4. RFI Response Drafting

Typical Prompt

Sheet A2.01 Detail 4 shows waterproofing terminating at foundation wall but Section 07 13 00 calls for continuous membrane under slab. Draft a professional RFI response proposing which detail governs, no cost/time impact, and requesting confirmation.

Before (Rough Internal Note)

The drawing and spec conflict on waterproofing termination. We think detail is correct. No extra money.

After (AI-Generated Professional Response) RFI No. 012 – Waterproofing Termination Clarification

Question: Sheet A2.01 Detail 4 depicts the sheet waterproofing terminating at the interior face of the foundation wall with sealant joint, while Section 07 13 00 Article 3.4 appears to require the membrane to extend continuously beneath the slab-on-grade. Please advise which condition governs.

Recommended Resolution: The project intent is for the waterproofing to follow the published detail (continuous under footing, turned up foundation wall, terminated with sealant). Extending the membrane continuously under the slab would require additional material and labor not contemplated in our bid. We propose proceeding per Detail 4/ A2.01 at no additional cost or time. Please confirm or provide revised direction.

These real-world examples show AI delivering first-draft efficiency while preserving professional tone, accuracy, and liability awareness – provided a licensed professional always performs final review and sign-off.

**You made it to the finish line!
This concludes Part 3 of the course.
Next up is your Part 3 Quiz!**

PART 3 – GENERATIVE AI FOR AEC: AI FOR AUTOMATION AND BUSINESS EFFICIENCY KNOWLEDGE CHECK (5 QUESTIONS)

1. **Which of the following is a use case for Text-to-Image (TTI) AI for architects?**
 - A. Generating inspection scenario examples for staff education
 - B. Visualizing structural systems from text prompts
 - C. Conceptual façade design visualization
 - D. Creating visuals for client progress updates
2. **What is a key benefit of Latent-Space Modeling for architects?**
 - A. Generating diagrams for client presentations
 - B. Exploring façade style blending and massing variations
 - C. Simulating on-site safety hazards
 - D. Creating visuals for marketing proposals
3. **Which of the following is an example of a Large Language Model (LLM) use case for architects?**
 - A. Drafting RFI responses and tracking logs
 - B. Generating building programs from client conversations
 - C. Visualizing common safety hazards from descriptions
 - D. Creating before-and-after remediation images
4. **What is a common workflow for automating specification writing with Generative AI?**
 - A. Uploading zoning ordinances and requesting summaries
 - B. Generating visuals for fire safety and egress paths
 - C. Creating marketing visuals for proposals and portfolios
 - D. Combining office master specifications with project-specific requirements

5. **How can AI assist in automating code and zoning summaries?**
- A. By extracting zoning envelopes and egress requirements from ordinances
 - B. By generating diagrams for presentations or client approvals
 - C. By creating visuals for urban planning projects
 - D. By simulating potential code violations for training purposes

This concludes Part 3 of the course.
Continue to Part 4.

- Reassessment of responsible control parameters to determine whether they appropriately address the use of AI tools.
- Identification of best practices for ethical AI usage, including determining whether, when, and how the use of AI and its supporting datasets should be declared...”
 – Abridged Version; Full Statement

ASME Position Statement on the Use of Artificial Intelligence (AI) for ASME
 – Link

“...External content is considered to be any materials produced for publication, distribution, or integration by ASME. An Author is a person creating external content; AI tools are not considered acceptable Authors. ASME requires Authors to fully report their use of AI tools, at any stage of the process of creating external content, in an appropriate place within the content itself...”
 – *ASME Condensed Position Statement on AI Use in External Content; Full Version*

NFPA

“The NFPA has reported the findings of its third annual industry survey conducted during the NFPA 2025 Conference & Expo in the United States.

The organisation explained that the survey provides insights into how skilled trade workers view technological change, training needs, and workforce pressures.

- According to the NFPA, **ninety-five percent of respondents said AI has a role in some part of daily job functions.**
- It stated that 31 percent of those surveyed view AI as a way to improve efficiency during labour shortages.
- The NFPA added that 39 percent believe AI could drive industry growth and help attract younger workers.
- It noted that one quarter of respondents remain sceptical of AI’s role, though many still report benefits from using advanced technologies.
- The survey also found that 64 percent of participants had experienced better workflows and collaboration since adopting digital tools...”
 – *Article; Full Survey*

ICC (International Code Council)

ICC Evaluation Service

“Automated product evaluation streamlines many components of the certification process; decreasing the turnaround time for new building product listing reports even further. ICC-ES has utilized AI software for a number of standards to date, and will be expanded in 2021 and beyond. AI has also been utilized for application processing for evaluation service reports, for building and plumbing products. “AI software is an extremely valuable resource for ICC-ES and, in turn, our clients,” said ICC-ES President Shahin Moinian, P.E. “We are excited to fully realize the potential of this AI application in the evaluation service sector and further our innovative product offerings.”
 – ICC Evaluation Service News Release

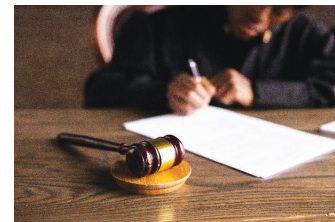


Figure 4.1 It is very important to know the stance of governing bodies on AI © Ekaterina (Katrin) Bolovtsova, Pexels.com

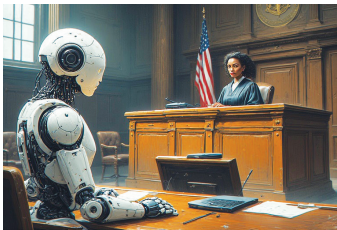
ICC Safe

“The building safety industry is experiencing a new era of efficiency and innovation thanks to emerging technology such as artificial intelligence. The International Code Council’s Digital Codes Premium®

PART 4 – ETHICS, INTELLECTUAL PROPERTY (IP), AND THE FUTURE

Learning Objective No. 4:

Analyze the legal landscape regarding use of AI-generated content.



Lastly, we answer what the stance of the AEC industry is on AI and its use.

AI USE AND THE RESPONSE OF THE AEC INDUSTRY ARCHITECTS ENGINEERS AND INSPECTORS

NCARB’s Position on the Use of Artificial Intelligence in the Architectural Profession
 – Source

“...Although the ABM (*NCARB’s June 2024 Annual Business Meeting (ABM)*) participants’ opinions were divided on how regulators should engage with AI, NCARB and its regulatory community approached consensus on several points:

- Regulators should not limit the use of technological advances that support the profession’s ability to improve the health, safety, and welfare of the public.
 - It falls outside of NCARB’s mission and expertise to evaluate or provide opinion on specific AI tools and their application, nor is there precedence for enforcing limitations on a tool’s use.
- Any proposed regulation that addresses AI usage in practice **must ensure the licensed practitioner remains in responsible control and continues to be accountable for all technical submissions under their seal.**
- **AI is a tool – it is not a replacement for professional judgement. Regardless of AI tools used, it remains the architect’s responsibility to provide services in conformance with the standard of care.**
- NCARB is committed to staying apace with the profession and to ensuring that licensure requirements consider both current practice methods and the overarching responsibility that rests with the architect.

In evaluating perspectives from the regulatory community, NCARB plans to work with its licensing board members to further explore two areas regarding guidance and best practices for the architect’s use of AI:

platform has recently introduced two new code intelligence tools that harness the power of this cutting-edge technology.

The new features, ICC Premium Answers and ICC AI Navigator have been added to the Code Council's suite of innovative and easy-to-use digital solutions to help users access information faster.

The AI Navigator and Premium Answers signify a major milestone in the Code Council's Digital Transformation Strategy.”
– ICC Safe, Building Safety Journal

GENERAL CONTRACTORS

Associated General Contractors (of America) The Construction Association

“AGC of America has released the new 2025 AI Resource Guide for Construction Professionals (members only content), a practical roadmap to help construction companies of all sizes confidently integrate artificial intelligence into daily operations.” – Article

Current Professional Liability Risks

“...As far as architects and engineers professional liability is concerned, Black said that the main risks are hallucinations, data privacy and confidentiality, all of which can be minimized with appropriate diligence, oversight and robust quality assurance and control. However, he added that there are also larger enterprise risks associated with the evolution of the design process enabled by AI...” – Full Article

“...As attorneys, we have empathy skills. People don't want to sit in front of a computer and talk about really difficult, hard things. They want to look you in the eyes,” Doughty explained.

AI is just a tool, and fears over being replaced may be overblown. Doughty is using the technology on a daily basis. Along with using it to edit her presentation into bullet points for experienced in-house attorneys, she uses it to draft legal scenarios.

Doughty advises not to use a person's real name because of privacy. “I also use it when I am frustrated with someone, so I draft how I really feel, then ask the AI to make it more professional,” noted Doughty.

AI can quickly write an article if provided with a topic, a target audience, and a few links. The speed and accuracy are astonishing, but many believe it is difficult, if not impossible, to determine whether the copy was plagiarized. This is likely to be the subject of ongoing litigation.” – Full Article

Construction Professionals:

“How AI impacts your PLI cover – PLI claims are often long-tail, meaning there can be a substantial gap between when an incident occurs and when a claim is made. While AI-related PII claims haven't yet emerged, these technologies are still new – and the risk of future claims cannot be dismissed. Underwriters are taking notice, increasingly asking questions around how firms are using AI and, in many cases, requesting to review any existing AI policies.

It is highly recommended that firms who are incorporating AI into their operations draw up a clear usage policy – to set out protocols, ensure human oversight, and establish accountability should something go wrong...” – Full Article

The AEC industry faces heightened exposure when incorporating AI-generated content into client deliverables or regulatory submissions. The core principle remains as it always has: the design professional (i.e. licensed architect or licensed engineer) is fully responsible for the final output or work product, regardless of the amount of AI assistance.

Key risks and Real-World implications:

- **Standard of Care Violations:** If AI introduces errors (e.g., hallucinations in code interpretations, inaccurate daylight simulations, or non-compliant details), the firm can be liable for negligence. Governing bodies view over-reliance on AI without

rigorous human verification as a breach of the duty to exercise professional judgment. For example, a consulting firm issuing reports with fabricated citations from AI tools, leading to client disputes.

- For example, in our drafting of this course we asked AI what the occupancy classification would be for an A-2 occupancy classification with an occupant load of 38 occupants in Bend, Oregon. The output we received was A-2, even after we introduced the code section which permits it to be classified as a Business occupancy classification. Again, professional judgement.

- **Insurance Coverage Gaps:** Professional liability (E&O/PL) policies may now contain “silent AI” exclusions or require disclosure of AI use during renewal.

“...‘Silent AI’ refers to AI-driven risks that are neither explicitly included nor excluded in insurance policies, leaving room for potential coverage gaps. This ambiguity can lead to significant financial losses for insurers. Avoiding these unforeseen claims should be to be a priority for PL underwriters...” – Article

Risks that generative AI pose for professional service providers include liability for mistakes, data breaches and regulatory challenges. This equates to insurers adding clauses limiting coverage for AI-generated outputs, algorithmic bias, or failures in AI-assisted decisions.

Regarding AI on the international errors & omissions market the expectation is that, should an architect or engineer (or any professional) rely on Generative AI in the delivery of their service it is understood that they are still bound to their standard of care (for architects), laws, and rules & regulations of their respective jurisdiction and/or regulatory body. Thus, the design professional providing the service would be liable if Generative AI produces erroneous outputs which are later relied upon as fact.

- **Regulatory Scrutiny and Disciplinary Action:** As mentioned previously, licensing boards (via NCARB for architects, NCEES/NSPE for engineers) emphasize that AI is a tool and in no way a substitute for licensed oversight and professional judgement.

Submitting unverified AI content to authorities having jurisdiction could possibly trigger complaints for not meeting one's standard of care. *At the time of the drafting of this course, no board had revoked any professional's license to practice architecture, engineering, or general contracting solely for AI use/misuse.*

But in Australia a solicitor (lawyer) was stripped of their ability to practise (sic) as a principal lawyer after using AI generated false citations and not verifying their case list.

The Crime

“...the anonymous solicitor representing a husband in a dispute between a married couple provided the court with a list of prior cases that had been requested by Justice Amanda Humphreys in relation to an enforcement application in the case.

When Humphreys returned to her chambers, she said in a ruling that neither herself nor her associates were able to identify the cases in the list. When the matter returned to court the lawyer confirmed that the list had been prepared using legal software that utilised (sic) AI. He acknowledged he did not verify the accuracy of the information before submitting it to the court.”

The Punishment

“...the lawyer had his practicing (sic) certificate varied on 19 August as a result of the investigation, meaning he was no longer entitled to practise (sic) as a principal lawyer, not authorized (sic) to handle trust money, would no longer operate his own law practice, and would only practise (sic) as an employee solicitor.

The lawyer will undertake supervised legal practice for a period

of two years, with the lawyer and his supervisor reporting to the board on a quarterly basis in that time...” – Source

- **Emerging Bodily Injury/Strict Liability Exposure:** For performance-critical outputs (e.g., AI-optimized structural grids or egress calculations), failures could lead to property damage or bodily injury claims or worse. Authorities having jurisdiction are developing legal frameworks specifically for AI. These are rules or laws that would determine who is legally responsible when AI systems cause harm or issues.
- For example, the Artificial Intelligence Task Force (an advisory committee) in California:
 - “The task force’s charge is to:
 - Oversee development of AI policy recommendations;
 - Coordinate development of proposals and branch actions;
 - Develop proposals regarding use of AI in the judicial branch; and
 - Work with other government or branch entities on AI policy developments

Because generative AI has the potential to affect the judicial branch in numerous ways, the task force decided to identify some specific issues to direct their initial focus. Those areas are:

1. Developing a generative AI model use policy for courts, as well as other rules and guidance related to the use of generative AI for court-related work;
2. Identifying ways that generative AI can be used to improve self-help services for court users;
3. Evaluating generative AI’s impact on evidentiary submissions in court proceedings, such as the risk that generative AI will be used to create false evidence; and
4. Identifying the ways that generative AI might impact legal research both within the courts and by court users.” – Learn More

Example of an Insurance Exclusion:

“...any insured’s actual or alleged statements, disclosures, or representations concerning or relating to artificial intelligence, including, but not limited to:

- a) *the use, development or integration of artificial intelligence in the company’s business operations;*
- b) *any assessment or evaluation of threats, risks or vulnerabilities to the company’s business or operations arising from artificial intelligence, whether from customers, suppliers, competitors, regulators, or any other source; or,*
- c) *the company’s current or anticipated business plans, capabilities and opportunities involving artificial intelligence”* – Source

Mitigation:

- Mandatory “human-in-the-loop” (HITL) protocols with documented verification.
 - A great article titled “Human-in-the-Loop AI: Balancing Autonomy with Oversight” from Medium.com, excerpts below:

Human-in-the-Loop AI is a closed-loop system where human judgment is embedded at key points in the AI lifecycle:

Training: Humans label data, define ground truth, and correct model missteps.

Validation: Humans evaluate model outputs, especially edge cases.

Deployment: Humans monitor live predictions, override when necessary, and feed corrections back into the loop.

Architecture: This cyclical integration of oversight ensures AI remains accurate, auditable, and aligned with enterprise goals.

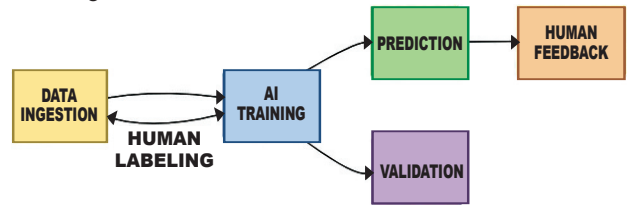


Figure 4.2. HITL Architecture Diagram © Medium.com

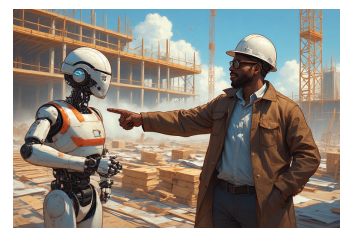
- **Every firm or business should have AI policies that include requiring disclosure to clients and insurers.**
 - Per Clio.com, a professional practice (in this case a law firm) AI policy should address factors including but not limited to:
 - AI ethics, including potential discrimination and bias
 - Guidelines for data collection and usage
 - Expectations for transparency
 - Data protection and cybersecurity best practices
 - Future risk assessment as AI develops
 - User experience and accessibility
 - Legal framework and industry standards
 - Governance, oversight, and adaptation
 - Employee training
 - Adaptation to new legal innovations

• **Specialized AI endorsements on PL policies**

- Example of an Affirmative AI endorsement use in the Technology sector for Errors & Omissions Insurance – Full Article

“An Affirmative AI Insurance Endorsement is a clause in a Tech E&O or Cyber insurance policy that expressly grants coverage for liabilities tied to AI use, development, or outputs. Common examples of covered risks include:

- Algorithmic decision errors (e.g., hiring, lending)
- Copyright claims from AI-generated content
- Regulatory actions tied to automated services
- Training data misuse
- Model hallucinations or consumer misguidance”



INTELLECTUAL PROPERTY AND COPYRIGHT CONCERNS

Key Excerpts from Part 2 of the U.S. Copyright Office Policy on Artificial Intelligence – Full Report:

- **Human Authorship Requirement:** Copyright protection in the U.S. requires human authorship. *AI-generated material that lacks sufficient human contribution is not eligible for copyright protection.*
- **Assistive AI Use:** Using AI as a tool to assist human creativity does not affect the copyrightability of the resulting work. Human authorship remains protected when AI is used *to enhance or modify human-created works.*

- **Prompts and Copyright:** Prompts alone, even if detailed, do not provide sufficient human control to claim authorship of AI-generated outputs. *Prompts are considered instructions that convey unprotectible ideas.*
- **Expressive Inputs:** Human-authored inputs, such as illustrations or text, that are perceptible in AI-generated outputs can be protected by copyright. The protection applies to the human-authored elements and their arrangement, but not to the AI-generated elements alone.
- **Modifications and Arrangements:** Human authorship can be claimed if AI-generated material is creatively selected, arranged, or modified. Copyright protection applies to the human contributions and the overall work, but not to the AI-generated elements in isolation.
- **International Approaches:** Most countries agree that copyright requires human authorship, though some jurisdictions are exploring or have implemented sui generis rights for AI-generated works. The U.S. Copyright Office is monitoring these developments.
- **No Need for Legal Change:** The U.S. Copyright Office concludes that existing copyright law is sufficient to address questions of copyrightability for AI-generated works. Legislative changes are not recommended at this time.
- **Impact on Human Creativity:** Extending copyright protection to AI-generated works *could discourage human authorship and creativity*, potentially leading to a decline in human-created works.
- **Empowering Creators with Disabilities:** AI tools can empower creators with disabilities by assisting them in expressing their creativity. *Copyright protection remains available for works where AI is used as an assistive tool.*
- **Clarity and Guidance:** The U.S. Copyright Office aims to provide ongoing guidance and updates to clarify copyrightability issues related to AI-generated content.
- **No Sui Generis* Rights Recommended:** The Office does not find the policy arguments for additional sui generis protection for AI-generated material persuasive, as existing legal frameworks provide sufficient incentives for innovation.
 - **“Sui generis is a Latin term meaning “a special kind”. In intellectual property rights discourse (IPRs) the term refers to a special form of protection regime outside the known framework. It can also be viewed as a regime especially tailored to meet a certain need.” – Source*
- **Monitoring Developments:** The U.S. Copyright Office will continue to monitor technological and legal developments to evaluate whether its conclusions should be revisited in the future.

Implications for AEC submissions:

- **Client Deliverables:** Firms cannot claim full copyright over AI-heavy content (e.g., concept renderings). Clients may demand ownership warranties that are now risky to give without heavy human modification.
- **Infringement Risk from Training Data:** Tools like Midjourney/Stable Diffusion were trained on vast datasets including architectural images. Outputs resembling existing copyrighted designs (e.g., a “Zaha Hadid-style” façade) could trigger claims. While no AEC-specific infringement suits have succeeded yet, parallel cases (e.g., artists vs. Stability AI/Midjourney) show courts allowing claims where outputs are “substantially similar.”
- **Regulatory Submissions:** Plans/specifications submitted to authorities having jurisdiction become public record. Using uncopyrightable AI elements weakens the firm’s Intellectual Property (IP) protection if copied by others.

Best practices:

- Consider having an AI Firm Policy state that all AI outputs are viewed as “inspiration only” and have all employees sign and date said policy stating that they understand and will abide.
- Create and uphold a “human first” template for all instruments of services leaving the office, with AI being a tool used after the human generated content is created.
- Use the Liability Checklist to pair with all documents using AI that are leaving the office.

ETHICAL ISSUES

PROFESSIONAL ORGANIZATIONS IN THE AEC INDUSTRY (NSPE, AIA, ASCE, NCARB)

- **NSPE Position Statement No. 03-1774 (Sunset Date June 2026)** – Source
 - “1. Ethical and Environmental Responsibility: NSPE emphasizes the ethical responsibility of engineers and AI professionals in the design, development, and deployment of trustworthy AI systems. Engineers and AI professionals must prioritize ethical considerations to ensure that AI technologies are designed and used in ways that do not harm individuals, society, or the environment. Ethical guidelines should be at the forefront of AI development to address issues such as bias, transparency, accountability, and environmental sustainability.”
- **AIA: Ethical challenges of generative AI in architectural practice** – Source
 - “...the duties required by the AIA Code of Ethics and Professional Conduct (2024 edition) involving competence, candor and truthfulness, confidentiality, proper attribution, and your supervisory responsibility over others should be carefully managed as they relate to use of GenAI...”
 - “...A good rule of thumb to prevent avoidable perils is to treat GenAI outputs as you would work produced by a new associate: take the time to identify the underlying assumptions, verify their work, and put it through the appropriate quality control processes...
...By taking these steps you can ensure the accuracy and conformity of all outputs with project requirements and any ethical and legal obligations that may apply, such as those involving confidentiality or proper attribution. Remember, at the end of the day, whether your work product is generated using assistance from a GenAI tool or a human associate, you are ultimately responsible for that work...”
- **ASCE – Artificial Intelligence in Civil Engineering | ASCE** – Source
 - “...engineers must ensure that AI models are created with unbiased data, creating outputs that favor inclusivity, and ensuring that AI is used to aid in work, not fully complete projects for them.”
 - Key Excerpts:
 - The key takeaways from the document are:
 - Ethical Challenges: The adoption of AI in civil engineering introduces ethical concerns, such as ensuring unbiased data, inclusivity, and maintaining human autonomy in decision-making.
 - ASCE Code of Ethics: Civil engineers must adhere to the ASCE Code of Ethics, particularly sections 1A, 1B, 1G, and 5F, which emphasize public safety, enhancing humanity’s quality of life, inclusivity, and professional development.
 - Unbiased AI Models: Engineers must ensure AI models are trained on diverse and unbiased data to avoid project failures and societal harm. Professional

organizations like ASCE should define standards for unbiased AI models.

- **Inclusivity:** AI can help bridge educational gaps among engineers from diverse backgrounds, fostering inclusivity in the workplace. Engineers should also ensure AI-generated solutions *consider the social, cultural, and financial needs of communities.*
- **AI as a Tool, Not a Replacement:** AI should be used as an aid rather than a replacement for human judgment. Engineers must combine AI-generated solutions with human consciousness to ensure ethical and effective decision-making.
- **Human Autonomy:** Over-reliance on AI could diminish engineers' ability to think independently, which is a fundamental human trait. Engineers must balance AI usage to maintain their autonomy and creativity.
- **Future Guidelines:** As AI adoption grows, it is crucial to establish guidelines for ethical AI usage and development in civil engineering to ensure safety, inclusivity, and adherence to ethical standards.

• **NCARB – Ethics** – Source

- “NCARB is committed to promoting the highest standards of ethics and integrity within the architecture profession. Ethical behavior is a fundamental requirement of practicing architecture and ensuring each licensed professional upholds their duty to protect the health, safety, and welfare of the public.”
- “To help each of the 55 U.S. architectural licensing boards uphold ethical standards within their individual jurisdictions, NCARB has developed our *Model Rules of Conduct*. The document serves as a national framework that can be adapted by each jurisdiction. In addition, architects who hold the NCARB Certificate are required to certify that they are aware of the *Model Rules of Conduct* when they renew their Certificate each year. Learn more about the development of the *Model Rules of Conduct*.”

Ethical Challenges in the AEC Industry when using/integrating AI – Source:

- Disclosing to clients Generative AI was used in any capacity
- Representing AI outputs as fully “human-designed” in marketing/submissions (Remember simply providing the prompt doesn’t count)
- Potential bias in AI tools which can compromise safety (e.g., datasets under-representing certain macro and microclimates, building typologies, or not applying building code exceptions)
- Data Privacy and Security
 - “Data sharing security (42%) alongside cost and complexity (33%) were the top integration challenges reported by respondents.” – Source
- Professional Integrity and Compliance

FUTURE IMPACT: STAFFING, LICENSURE, AND “AUTHORSHIP” IN DESIGN

- **Staffing**
 - “Employee tenure in architecture and engineering positions has plummeted since 2012 (from 7.1 years to 4.9 years – a decline of more than 30%)” – Source
 - “...we’re already seeing clients look out over the next 3-5 years in their strategic plan, and consider supplementing or even replacing staff with AI in production. So AI has the very real potential to help make up for the talent shortage facing AEC firms in the short term...” – Source

- “56% of respondents say AI helps offset skilled labor shortages.” – Source

- **Licensure:** During our research we saw no Generative AI specific training requirements nor any indication that it would be included on the ARE 6.0 administered and released by NCARB.
- **Definition of Authorship:** HUMAN. That is the beginning and the end. Everything stated above continues to point to human authorship and AI being used as a tool.

ISSUE	CURRENT STATUS	PRIMARY RISK TO AEC FIRMS	RECOMMENDED MITIGATION
PROFESSIONAL LIABILITY	If human authorship is proven, then covered under existing copyright laws (in USA) Dependent upon insurer: - Full responsibility on licensed professionals - AI endorsements added for coverage - or AI exclusions added into Professional Limited Liability (PLI) policies	Not meeting the standard of care and thus endangering the health, safety, and welfare of the public Not showing human authorship	Documented human review Disclose AI use to insurers/clients
COPYRIGHT/INTELLECTUAL PROPERTY	AI outputs not protectable without majority human authorship	Weakened Intellectual Property (IP) in deliverables; potential infringement suits; Little to no copyright protection	Massive human intervention during the editing process Avoid direct submission of raw AI (remember “inspiration only”)
ETHICS/LICENSURE	Human oversight and authorship are mandatory; AI cannot seal and release instruments of service	Probation, suspension, or loss of ability to practice as determined by board	Firm AI policy + consistent training; transparency with clients
FUTURE STAFFING	Possible shift to oversight roles or a position all to itself (Generative AI Specialist)	Skill atrophy in juniors; Reduced entry-level jobs	Balanced training: Use AI as an accelerator, not a crutch

Landmark Case: Mata v. Avianca, Inc. (2023, S.D.N.Y.) – The “AI Hallucination” Precedent – Source

Given the prevalent use of Generative AI throughout all industries coupled with the relatable nature of this case across all industries this case is considered as a landmark case by legal professionals.

The Association of Corporate Counsel has a great article along with 3 steps that can be followed to prevent your firm from becoming a landmark case. The steps are geared towards lawyers but general enough to where they can apply to all professionals.

Remember that generative AI creates original content so always fact check and have a human confirm what is claimed is actually true and in existence.

Background: In a personal injury lawsuit filed against airline Avianca, the plaintiff’s lawyers used ChatGPT to generate a legal motion, which contained fake legal cases involving fictitious airlines with fabricated quotations and internal citations.

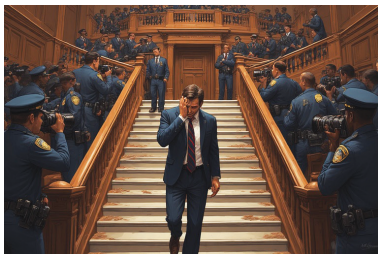
Neither Avianca’s lawyers nor the Court could locate the legal cases cited in the legal motion and demanded the plaintiff’s lawyers provide copies of the cited legal cases. The plaintiff’s lawyers provided copies of most of the legal cases, after ChatGPT reassured them, they existed on reputable legal databases in the law industry.

Landmark Case Outcome (June 2023, Judge P. Kevin Castel):

- Dismissed the personal injury case against Avianca and ordered the plaintiff’s attorneys to pay a \$5,000 fine.
- The judge held that the plaintiff’s lawyers had acted with “subjective bad faith” sufficient for sanctions under Federal Rule of Civil Procedure Rule 11. \$5,000 fine (jointly).
- Over a year later, the American Bar Association issued its first formal ethics opinion on the responsibilities of lawyers using generative AI (GAI). The 15-page opinion outlines how the Rules of Professional Conduct apply to the use of GAI in the practice of law

Key Lessons for AEC Firms:

- Over-reliance on unverified AI outputs = breach of duty of competence.
- Parallels in design professions: Submitting AI-drafted code summaries or specifications with hallucinated local, state, and federal code references could lead to licensing board punishment or claims.



Emerging Analogous Cases in Professional Services (2024–2025), see below:

Note: Again, no public AEC-specific liability judgments have been made to date, also note that the option is available to parties to settle quietly or trigger insurance denials pre-claim.

CASE / INCIDENT	YEAR	PROFESSION	AI ERROR	AEC RELEVANCE
Park v. Kim (2d Cir., related to NY state cases) Case in Detail	2024	Law	Attorney cited an opinion that was fake and generated by ChatGPT	Direct parallel: Using GenAI for zoning summaries without verification.
Outcome/Status of Park v. Kim	“...For this GenAI briefing misstep, the Court of Appeals ordered that counsel be referred the Second Circuit’s Grievance Panel for investigation (and for possible further referral to the Committee on Admissions and Grievances[22]), that counsel supply a copy of the Court of Appeals’ admonishing ruling to her client (translating it into Korean, if necessary for her client to understand it), and then file a docketed certification attesting that she had done so.[23]...” – Food & Drug Law Institute			
Johnson v. Dunn (N.D. Ala. July 23, 2025) Case in Detail	2025	Law	Five hallucinated citations of AI-generated errors in this case	Have AI policies & training in place and always verify the validity of any AI generated anything.
Outcome/Status of Johnson v. Dunn	“...Judge Manasco crafted sanctions designed to deter future misconduct while recognizing the distinction between institutional policies and individual failures. The three sanctioned attorneys received public reprimand, disqualification from the case, and referral to the Alabama State Bar. To ensure the deterrent effect, they must provide copies of the sanctions order to their clients, opposing counsel, every attorney in their firm, and presiding judges in all pending cases where they serve as counsel...” – Source			

CASE / INCIDENT	YEAR	PROFESSION	AI ERROR	AEC RELEVANCE
Character. AI Wrongful Death Suits (Garcia v. Character Technologies, M.D. Fla. 2025) Case in Detail	2024 – 2025	Tech/Product Liability	“the chatbot, operated by the defendant company, manipulated the teenager through hyper-realistic role-play, including romantic and sexual themes, encouraging self-harm and fostering a dependency that blurred the boundaries between human and machine.” – Source	If AI design tools (e.g., ARCHITEChTURES) generate non-compliant life safety plans leading to egress issues, could face a similar lawsuit or claim.
Outcome/Status of Character.AI Wrongful Death Suits	None to date.			

This concludes Part 4 of the course.
Next up is your Part 4 Quiz!

PART 4 – ETHICS, INTELLECTUAL PROPERTY (IP), AND THE FUTURE
KNOWLEDGE CHECK (5 QUESTIONS)

- What is NCARB’s stance on the use of AI in the architectural profession?**
 - AI tools should replace professional judgment in technical submissions
 - AI tools must be evaluated and approved by NCARB before use
 - Licensed practitioners must remain in responsible control and accountable for all technical submissions
 - AI tools are prohibited from being used in architectural practice
- Why is human oversight critical when using AI in AEC deliverables?**
 - AI tools are fully reliable and require no verification
 - Licensing boards require human authorship and professional judgment
 - AI tools are exempt from liability in case of errors
 - AI tools automatically meet all regulatory standards
- What is a key risk of using AI-generated content in client deliverables?**
 - AI outputs may contain hallucinations or fabricated information
 - AI outputs are automatically copyrighted
 - AI-generated content is always accurate and reliable
 - AI tools eliminate the need for professional liability insurance

4. **According to the U.S. Copyright Office, what is required for copyright protection of AI-generated works?**
- AI-generated works are automatically copyrighted
 - Human authorship and creative contribution are required
 - Prompts alone are sufficient for copyright protection
 - AI-generated works are protected under sui generis rights
5. **What is a recommended best practice for AEC firms using AI in their workflows?**
- Submit raw AI outputs directly to clients without review
 - Avoid disclosing AI use to clients or insurers
 - Use AI to replace all junior staff positions
 - Implement “human-in-the-loop” protocols and verify AI outputs

You made it to the finish line!
This concludes the final part, Part 4 of the course.
Continue to the Final Exam.

3. **What is the role of Human Labelers in training Generative AI models?**
- Designing the model architecture; Incorrect.*
 - Providing feedback on quality and safety; Correct. Human Labelers play a critical role in training Generative AI by rating responses, labeling examples, correcting mistakes, and providing feedback to improve the model's quality and safety.**
 - Collecting and organizing large datasets; Incorrect.*
 - Running training on large clusters of computers; Incorrect.*
4. **What is the purpose of the “fine-tuning” step in Generative AI training?**
- To collect and clean large datasets; Incorrect.*
 - To teach the model to predict the next word or pixel; Incorrect.*
 - To refine the model's behavior, tone, and safety; Correct. Fine-tuning involves refining the base model by providing example conversations, correcting mistakes, and guiding its tone, style, and safety.**
 - To evaluate the model using user feedback; Incorrect.*
5. **Which of the following is an example of a well-written AI prompt?**
- “Make a website look fantastic.”; Incorrect.*
 - “Design an intuitive and responsive navigation menu for a mobile travel app.”; Correct. A good AI prompt is specific, clear, and provides context. Option B specifies the task (design a navigation menu), the audience (mobile travel app users), and the desired outcome (intuitive and responsive), making it an effective prompt.**
 - “Write something creative about architecture.”; Incorrect.*
 - “Create a design that is good.”; Incorrect.*

OUTLOOK AND CONCLUSION

As shown in each part of this course on Integrating Generative AI into the Architectural Workflow, it has been shown that AI is a benefit for any AEC firm. Human involvement is still a must and there must be effort involved no matter what Generative AI type is used.

It has been a joy producing this course for you and us here at MRA Architecture & Design wish you a great day and everlasting success!

INTEGRATING GENERATIVE AI INTO THE ARCHITECTURAL WORKFLOW

KNOWLEDGE CHECK ANSWERS | PARTS 1 – 4

PART 1 – GENERATIVE AI VS. TRADITIONAL AI AND GENERATIVE AI FUNDAMENTALS | KNOWLEDGE CHECK (5 QUESTIONS)

1. **What is the primary difference between Traditional AI and Generative AI?**
- Traditional AI creates new content, while Generative AI classifies data; Incorrect.*
 - Traditional AI focuses on creativity, while Generative AI automates tasks; Incorrect.*
 - Traditional AI solves specific problems, while Generative AI creates new content; Correct. Traditional AI is designed to classify, predict, or decide based on structured data, while Generative AI focuses on creating new content, such as text, images, or videos, by learning patterns from large datasets.**
 - Traditional AI uses large datasets, while Generative AI uses structured data; Incorrect.*
2. **Which of the following is an example of Generative AI in the AEC industry?**
- Identifying whether a material is concrete or steel; Incorrect.*
 - Designing a new urban district with streets, parks, and buildings; Correct. Generative AI is capable of creating new designs, such as an urban district layout, by combining and recombining patterns creatively. The other options are examples of Traditional AI, which focuses on classification and prediction.**
 - Checking if a building complies with local codes; Incorrect.*
 - Predicting the energy consumption of a building; Incorrect.*

PART 2 – GENERATIVE AI PROMPTING STRATEGIES, TYPES, AND EXERCISES | KNOWLEDGE CHECK (5 QUESTIONS)

6. **What is the key characteristic of a Zero-Shot prompt?**
- It provides examples for the AI to follow; Incorrect.*
 - It defines the AI's role and constraints; Incorrect.*
 - It is clear, concise, and does not include examples; Correct. A Zero-Shot prompt is direct and does not provide any examples for the AI to follow. It relies solely on the clarity of the input to generate the desired output.**
 - It asks the AI to solve a problem in multiple steps; Incorrect.*
7. **Which prompting strategy involves assigning a persona or role to the AI?**
- Contextual prompting; Incorrect.*
 - Role prompting; Correct. Role prompting assigns a specific persona, context, or point of view to the AI, such as asking it to act like a travel agent or a historical figure, to tailor its responses accordingly.**
 - Chain of Thought prompting; Incorrect.*
 - Step-Back prompting; Incorrect.*
8. **What is the purpose of the “Chain of Thought” (CoT) prompting strategy?**
- To provide multiple examples for the AI to follow; Incorrect.*
 - To break down complex problems into smaller, logical steps; Correct. Chain of Thought prompting improves AI reasoning by asking it to solve problems step-by-step, which is particularly useful for tasks like mathematics, coding, or decision making.**
 - To define the AI's role and constraints; Incorrect.*
 - To generate multiple outputs and select the best one; Incorrect.*
9. **Which of the following is an example of a Text-to-Image AI model?**
- GPT-4; Incorrect.*
 - BERT; Incorrect.*
 - Stable Diffusion; Correct. Stable Diffusion is a text-to-image AI model that generates images based on textual descriptions.**
 - OpenAI Codex; Incorrect.*

10. What is the primary function of Latent-Space Modeling in Generative AI?

- A. To generate text based on learned language patterns; *Incorrect.*
- B. To create images from textual descriptions; *Incorrect.*
- C. **To encode and manipulate data in a lower-dimensional abstract space; Correct. Latent-Space Modeling compresses high-dimensional data into a simpler, abstract representation (latent space) and generates new outputs by exploring and manipulating this space.**
- D. To provide step-by-step reasoning for complex problems; *Incorrect.*

PART 3 – GENERATIVE AI FOR AEC: AI FOR AUTOMATION AND BUSINESS EFFICIENCY | KNOWLEDGE CHECK (5 QUESTIONS)

11. Which of the following is a use case for Text-to-Image (TTI) AI for architects?

- A. Generating inspection scenario examples for staff education; *Incorrect.*
- B. Visualizing structural systems from text prompts; *Incorrect.*
- C. **Conceptual façade design visualization; Correct. Text-to-Image AI is particularly useful for architects in visualizing conceptual designs, such as façades, interiors, and sustainable features, based on textual descriptions. The other options are more relevant to inspectors, engineers, or contractors**
- D. Creating visuals for client progress updates; *Incorrect.*

12. What is a key benefit of Latent-Space Modeling for architects?

- A. Generating diagrams for client presentations; *Incorrect.*
- B. **Exploring façade style blending and massing variations; Correct. Latent-Space Modeling allows architects to explore creative design options, such as blending façade styles or generating massing variations, by sampling from patterns in the latent space.**
- C. Simulating on-site safety hazards; *Incorrect.*
- D. Creating visuals for marketing proposals; *Incorrect.*

13. Which of the following is an example of a Large Language Model (LLM) use case for architects?

- A. Drafting RFI responses and tracking logs; *Incorrect.*
- B. **Generating building programs from client conversations; Correct. LLMs are highly effective for architects in tasks like converting client conversations into building programs and project approaches, helping streamline the early design process.**
- C. Visualizing common safety hazards from descriptions; *Incorrect.*
- D. Creating before-and-after remediation images; *Incorrect.*

14. What is a common workflow for automating specification writing with Generative AI?

- A. Uploading zoning ordinances and requesting summaries; *Incorrect.*
- B. Generating visuals for fire safety and egress paths; *Incorrect.*
- C. Creating marketing visuals for proposals and portfolios; *Incorrect.*
- D. **Combining office master specifications with project-specific requirements; Correct. Generative AI can streamline specification writing by merging office master specifications with project-specific requirements, producing a clean first draft that is later reviewed by a human professional.**

15. How can AI assist in automating code and zoning summaries?

- A. **By extracting zoning envelopes and egress requirements from ordinances; Correct. AI can automate code and zoning summaries by extracting zoning envelopes, egress requirements, and other relevant details from ordinances or building codes, providing quick insights for feasibility studies and early design phases.**
- B. By generating diagrams for presentations or client approvals; *Incorrect.*
- C. By creating visuals for urban planning projects; *Incorrect.*
- D. By simulating potential code violations for training purposes; *Incorrect.*

PART 4 – ETHICS, INTELLECTUAL PROPERTY (IP), AND THE FUTURE | KNOWLEDGE CHECK (5 QUESTIONS)

16. What is NCARB's stance on the use of AI in the architectural profession?

- A. AI tools should replace professional judgment in technical submissions; *Incorrect.*
- B. AI tools must be evaluated and approved by NCARB before use; *Incorrect.*
- C. **Licensed practitioners must remain in responsible control and accountable for all technical submissions; Correct. NCARB emphasizes that AI is a tool, not a replacement for professional judgment. Architects must remain in responsible control and ensure all technical submissions meet the standard of care.**
- D. AI tools are prohibited from being used in architectural practice; *Incorrect.*

17. Why is human oversight critical when using AI in AEC deliverables?

- A. AI tools are fully reliable and require no verification; *Incorrect.*
- B. **Licensing boards require human authorship and professional judgment; Correct. Licensing boards, such as NCARB and NSPE, mandate that professionals exercise oversight and verify AI outputs to ensure compliance with ethical and legal standards, as AI cannot replace human judgment.**
- C. AI tools are exempt from liability in case of errors; *Incorrect.*
- D. AI tools automatically meet all regulatory standards; *Incorrect.*

18. What is a key risk of using AI-generated content in client deliverables?

- A. **AI outputs may contain hallucinations or fabricated information; Correct. AI-generated content can include hallucinations (fabricated or inaccurate information), which, if unverified, can lead to errors, liability claims, or breaches of the standard of care.**
- B. AI outputs are automatically copyrighted; *Incorrect.*
- C. AI-generated content is always accurate and reliable; *Incorrect.*
- D. AI tools eliminate the need for professional liability insurance; *Incorrect.*

19. According to the U.S. Copyright Office, what is required for copyright protection of AI-generated works?

- A. AI-generated works are automatically copyrighted; *Incorrect.*
- B. **Human authorship and creative contribution are required; Correct. The U.S. Copyright Office states that copyright protection requires significant human authorship. AI-generated elements alone are not eligible for copyright protection unless creatively modified or arranged by a human.**
- C. Prompts alone are sufficient for copyright protection; *Incorrect.*
- D. AI-generated works are protected under sui generis rights; *Incorrect.*

20. What is a recommended best practice for AEC firms using AI in their workflows?

- A. Submit raw AI outputs directly to clients without review; *Incorrect.*
- B. Avoid disclosing AI use to clients or insurers; *Incorrect.*
- C. Use AI to replace all junior staff positions; *Incorrect.*
- D. **Implement “human-in-the-loop” protocols and verify AI outputs; Correct. AEC firms should adopt “human-in-the-loop” protocols to ensure AI outputs are verified by licensed professionals, maintaining compliance with ethical and legal standards while reducing risks.**