# **CS 499 Module Five Journal:**

**Computer Science Trends and Artifact Update**

Andrew Emilio DiStefano

SNHU

Professor Neil Kalinowski

June 8, 2025

**Part One:**

**What is the significance of each trend?**  
 The two computer science trends which I would like to discuss in this journal are artificial intelligence and digital twins in robotics.

Artificial Intelligence refers to the ability for machines to approximate human thought and behavior (Stryker, 2024), often in situations which require complex problem-solving. This trend has become incredibly significant to every aspect of everyday life. Common search engines, video and movie recommendations, and even a variety of household appliances use AI to improve performance or achieve smart functionality. AI is used in diverse fields such as “finance, national security, health care, criminal justice, transportation, and smart cities” (Allen & West, 2018), and virtually everyone on the planet is affected by artificial intelligence in some way.

The phrase *digital twin* refers to a digital sprite in a customized simulation which approximates the real world as closely as possible in terms of earth physics (Nvidia, 2025). The practice of creating a digital twin for a robot meant to interact with the physical world adds several significant benefits. These include the ability to test their systems without risking damage to equipment, and the ability to perform simulations at incredibly accelerated speeds which dramatically decrease the amount of time which it takes for an AI model to optimize its behavior to achieve specific goals.

**How will each trend change the field of computer science?**  
 Artificial intelligence has been changing the field of robotics for the past few decades (Tableau, n. d.) and will almost certainly continue to do so for the foreseeable future. The introduction of AI innovations such as artificial neural networks and reinforcement learning have become so complex that developers do not always have a firm grasp of what is actually taking place within their systems. Modern AI systems are capable of complex problem-solving in applications like warehouse optimization and autonomous mobile robot navigation and localization.

Digital twins have been helping modern companies to revolutionize the field of robotics by making the testing and training processes less resource intensive and dangerous to the hardware components of robotics systems. Virtual environments can be set up on relatively low-capability consumer-grade computers, and many industry standard virtualization software packages such as Gazebo are even available for free to anyone who is able to install them (Gazebo, n. d.). As a robotics recruiter I have certainly seen experience in robotics simulation as a common requirement among many of the positions which I have filled for my clients, many of whom are at the cutting edge of robotics innovation.

**How will each trend change the experience of consumers, workers, or citizens?**  
 AI has changed and will continue to change the experience of virtually everyone on earth. AI is used in the fields of law enforcement and forensic science to keep our communities safe. AI algorithms assist in investigations (NYU School of Law, 2025) and help forensic labs to identify suspects based on evidence such as DNA and surveillance videos (NYU School of Law, 2025). AI algorithms in our search engines influence the content that we are exposed to (whether for better or for worse), which has a significant effect on how we view the world.

While the use of digital twins in robotics development provides a series of significant benefits to developing organizations, this trend will also contribute to safer interactions between robotics systems and human beings. Extensive testing in virtual environments leads to less unintended behavior in the real world, and extensive learning in virtual environments makes robotics systems able to more effectively solve problems for humans.

**How will each trend fit in with your career interests or aspirations?**  
 Each of these trends is certainly relevant to my interests and career aspirations. The use of AI in robotics systems enhances the ability for these systems to approximate human thought and problem solving. This results in dramatic improvements to system functionality and the ability for one system to solve several different types of problems.

The use of digital twins is also incredibly important in robotics development. Using virtualization in robotics projects during development is a necessity in the robotics industry, especially for robotics systems which use machine learning to achieve some level of autonomy. My ability to leverage robotics simulation tools will help me to keep resource expenditure as low as possible while developing robotics systems.

**Which course outcomes have you achieved so far, and which ones remain?**  
 I have touched on all of the stated outcomes for this course, and the final changes which will be implemented over the next few weeks will help me to achieve these outcomes even more extensively and deeply. My consistent update schedule to GitHub in both projects and my use of open-source libraries in my MemoryBot project shows my ability to employ strategies for building collaborative environments that enable diverse audiences to support organizational decision-making in the field of computer science. My documentation of setup instructions and my thorough citations in the corresponding *ReadMe* file show my ability to design, develop, and deliver professional-quality oral, written, and visual communications that are coherent, technically sound, and appropriately adapted to specific audiences and contexts. My use of inverted indexing in the MemoryBot project shows my capacity for designing and evaluating computing solutions that solve a given problem using algorithmic principles and computer science practices and standards appropriate to its solution while managing the trade-offs involved in design choices. The implementation of the inverted index, which is the same data structure used by popular search engines like Google (Slawski, 2021), also demonstrates my ability to use well-founded and innovative techniques, skills, and tools in computing practices for the purpose of implementing computer solutions that deliver value and accomplish industry-specific goals. My setup of a ReductStore database within a Docker container, and my use of networking to visualize the database from my laptop while the database is hosted from the device itself also contributes to my achievement of this course outcome. My use of security practices, such as limiting user input to as few variations as possible and using type conversion functions to assure the use of correct variable types used throughout both projects, show my capacity for developing a security mindset that anticipates adversarial exploits in software architecture and designs to expose potential vulnerabilities, mitigate design flaws, and ensure privacy and enhanced security of data and resources.

**Part Two:**

**Software design and engineering**  
 I have successfully gotten two LCD screens up and running on my Raspberry Pi circuit, though I still have to do some fine tuning to assure correct output onto these screens. Unfortunately, something happened with the shipment of my soil sensors. I originally ordered two pairs to prepare for this possibility, but the pair which did arrive ended up having the wrong configuration for connection to a 5 volt Raspberry Pi connection (three input lines rather than the four necessary to connect via the qwiic shim). I suppose I could have figured out a way to squeeze this sensor into my GPIO breakout board inputs, but the board is already incredibly claustrophobic and the required pins are already being used for other system functionality. I actually have an air humidity sensor here on hand, and since air humidity is definitely something that needs to be monitored and controlled in a greenhouse setting (perhaps even more judiciously than soil humidity), I will be adding air humidity control rather than soil humidity control to the PlantSitter system.

I have also improved the output of the MemoryBot conversation loop, though I still need to do some fine tuning here as well to get the most accurate functionality from the program.

**Algorithms and data structures**  
 The inverted index is still able to run without error, but I am still getting some logical errors in edge cases. I have focused most of my energy this week on the PlantSitter application, but I have done some refining of the MemoryBot program to keep the project in my mind. I added some security functionality to convert user input (which should already be strings) to a string data type.

**Databases**

I have successfully run a ReductStore database from a Docker container on my Raspberry Pi. I have also been able to view the contents of ReductStore databases from a browser window on my laptop by referencing the device's IP address via port *8383*. The function which I have written to record temperature data to the ReductStore database still needs to be implemented in such a way that the database receives information, which is something that I am very close to doing but which still requires some additional development.

### **Status Checkpoints for All Categories**

| Checkpoint | Software Design and Engineering | Algorithms and Data Structures | Databases |
| --- | --- | --- | --- |
| Name of Artifact Used | PlantSitter | MemoryBot | PlantSitter |
| Status of Initial Enhancement | All enhancements have been made, but some require modifications in order for the program to run 100% as intended. | All enhancements have been made, but some require modifications in order for the program to run 100% as intended. | All enhancements have been made, but some require modifications in order for the program to run 100% as intended. |
| Submission Status | 90% Finished | 80% Finished | 75% Finished |
| Status of Final Enhancement | FOme formatting needs to be done in order to correctly print humidity and temperature data to the display screens. Other than that, the system runs as intended based on requirements. | Output needs to be formatted differently to avoid duplicate output. Other than that, the software engineering and design for the system is finished. | The database server is able to run on the Raspberry Pi, and I am able to establish a connection via the local area network for the visualization of data stored on the Pi via my laptop. The database still needs to be correctly configured in order for data to be sent from the sensors to the RedustStore database. |
| Uploaded to ePortfolio | Yes, several times every week | Yes, several times every week | Yes, several times every week |
| Status of Finalized ePortfolio | Complete upon version release of the PlantSitter system. | Complete upon version release of the MemoryBot system. | Complete upon version release of the PlantSitter system. |

**Sources:**

Allen, J. R., & West, B. M. (2018, April 24). *How artificial intelligence is*

*transforming the world*. The Brookings Institution. [https://www.brookings.edu/articles/how-artificial-intelligence-is-](https://www.brookings.edu/articles/how-artificial-intelligence-is-transforming-the-world/)

[transforming-the-world/](https://www.brookings.edu/articles/how-artificial-intelligence-is-transforming-the-world/)

Gazebo. (n. d.). *Simulate before you build*.

<https://gazebosim.org/home>

Nvidia. (2025). *What Is a Digital Twin?*

<https://www.nvidia.com/en-us/glossary/digital-twin/>

NYU School of Law. (2025). *How Policing agencies use AI.*

[https://www.policingproject.org/ai-explained-](https://www.policingproject.org/ai-explained-articles/2024/9/6/how-policing-agencies-use-ai)

[articles/2024/9/6/how-policing-agencies-use-ai](https://www.policingproject.org/ai-explained-articles/2024/9/6/how-policing-agencies-use-ai)

Slawski, B. (2021, July 9). *Google’s Inverted Index of the Web*. Seo by the Sea.

<https://www.seobythesea.com/2021/07/inverted-index-of-the-web/>

Stryker, C. (2024). *What is artificial intelligence (AI)?* IBM.

<https://www.ibm.com/think/topics/artificial-intelligence>

Tableau. (n. d.). *What is the history of artificial intelligence (AI)?*

<https://www.tableau.com/data-insights/ai/history>