



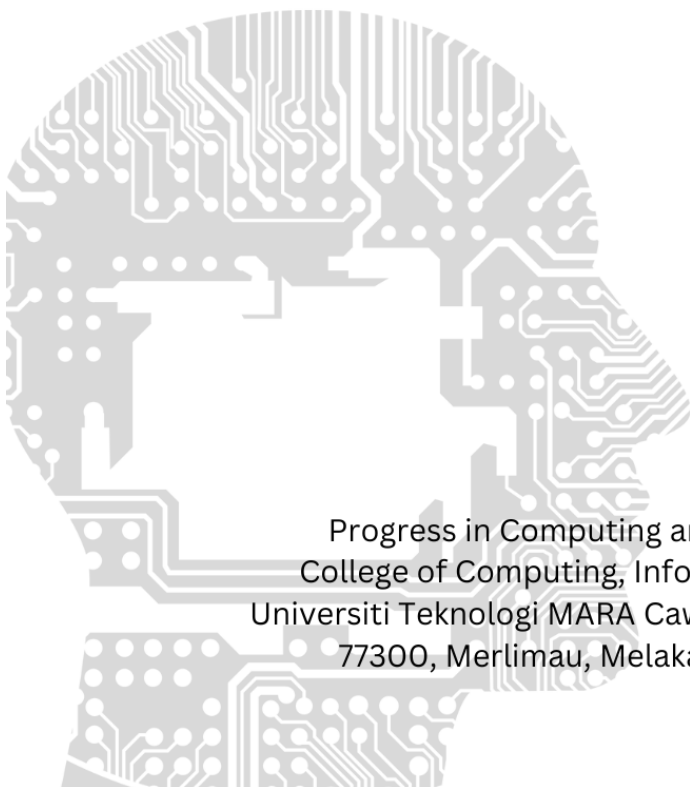
Cawangan Melaka

# PCMJ

Progress in Computing and Mathematics Journal

**volume 1**

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Progress in Computing and Mathematics Journal  
College of Computing, Informatics, and Mathematics  
Universiti Teknologi MARA Cawangan Melaka, Kampus Jasin  
77300, Merlimau, Melaka Bandaraya Bersejarah

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Progress in Computing and Mathematics Journal  
**volume 1**



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# **PCMJ**

**Progress in Computing and Mathematics Journal**

## **volume 1**

# PREFACE

Welcome to the inaugural volume of the **Progress in Computing and Mathematics Journal (PCMJ)**, a publication proudly presented by the College of Computing, Informatics, and Mathematics at UiTM Cawangan Melaka.

This journal represents a significant step in our commitment to fostering a vibrant research culture, initially providing a crucial platform for our undergraduate students to showcase their intellectual curiosity, dedication to scholarly pursuit, and potential to contribute to the broader academic discourse in the fields of computing and mathematics. However, we envision PCMJ evolving into a beacon for researchers both nationally and internationally. We aspire to cultivate a space where groundbreaking research and innovative ideas converge, fostering collaboration and intellectual exchange among established scholars and emerging talents alike.

The manuscripts featured in this first volume, predominantly authored by our undergraduate students, are a testament to the hard work and dedication of these budding researchers, as well as the guidance and support provided by their faculty mentors. They cover a diverse range of topics, reflecting the breadth and depth of research interests within our college, and set the stage for the high-quality scholarship we aim to attract in future volumes.

As editors, we are honored to have played a role in bringing this journal to fruition. We extend our sincere gratitude to all the authors, reviewers, and members of the editorial board for their invaluable contributions. We also acknowledge the unwavering support of the college administration in making this initiative possible.

We hope that PCMJ will inspire future generations of students and researchers to embrace research and innovation, to push the boundaries of knowledge, and to make their mark on the world of computing and mathematics.

## **Editors**

**Progress in Computing and Mathematics Journal (PCMJ)**  
**College of Computing, Informatics, and Mathematics**  
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## GAME BASED LEARNING FOR FIRE SAFETY AWARENESS AMONG PRIMARY SCHOOL CHILDREN

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### Article Info

### Abstract

In response to the prevalent threat of fire incidents in Malaysia, particularly affecting elementary school students, this project focuses on enhancing children's preparedness for fire situations. Employing the Game Development Life Cycle (GDLC) methodology, the initiative aims to create a web-based game that efficiently imparts crucial knowledge and skills related to fire safety. The primary objective is to empower children with the tools they need to effectively respond to fire challenges, bridging the gap between education and enjoyment. By fostering an engaging learning environment, the project seeks to equip elementary school students with the resilience and preparedness necessary to navigate unexpected fire events. Ultimately, the goal is to contribute to the creation of resilient communities that can effectively address and overcome the challenges posed by fire incidents in Malaysia for children.

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## INTRODUCTION

The background of the study underscores the critical need for fire safety education among children, especially in Malaysia where a significant number of fire incidents occur annually. Traditional methods, like yearly fire drills, may not effectively engage children. Game-based learning emerges as a promising approach, offering an interactive and enjoyable way to impart essential fire safety knowledge. Studies have shown the effectiveness of game-based modules like "APi fire safety game" and "Kemahiran Asas Pencegahan Kebakaran" in improving children's understanding and awareness of fire safety measures (Zaini, N. A., Fadzilah, S., Noor, M., Meriam, T. S., & Wook, T, 2019).

The problem statement identifies key issues driving the necessity for this project. Firstly, there's a lack of preparedness in preventing and managing fires, evident in rising fire

incident statistics (Sinar Harian, 2023). Secondly, fire prevention skills are often neglected in educational curricula, leaving individuals ill-equipped to handle fire emergencies. These gaps highlight the urgency of implementing comprehensive fire safety education, especially considering the potential consequences of inadequate preparedness (Syamimi, N., Razali, M., Atiqah, N., Sidek, R., Nur, &, Farhanah, F., & Rosli, M., 2020).

The project aims to address these issues by developing a web-based game, "Fire Xcape," specifically tailored for primary school children in Malaysia. Through this initiative, the goal is to enhance children's understanding of fire safety awareness, design an engaging 2D game for learning, and evaluate its effectiveness in teaching fire safety. By targeting primary school children and incorporating game-based learning, the project seeks to empower young learners with essential fire safety knowledge, ultimately contributing to the prevention and preparedness for fire incidents.

## LITERATURE REVIEW

In Malaysia, raising awareness about fire safety is a top priority for both the government and relevant organizations, aiming to equip the public with the necessary knowledge and skills to prevent fires and mitigate their impact. Various initiatives, including public service announcements, workshops, and community involvement activities, target individuals, families, businesses, and schools, emphasizing fire detection, safe handling of combustible materials, and implementation of preventive measures. Regular fire drills and enforcement of safety laws ensure adherence to construction codes and installation of safety equipment like fire alarms and extinguishers (Sulaiman et al., 2012).

However, challenges such as limited access to information, apathy, and misinformation hinder the effectiveness of awareness campaigns, particularly in marginalized communities (UNESCO, 2021). Addressing these challenges through targeted communication strategies and collaborative efforts is crucial to enhancing the impact of fire safety awareness initiatives and fostering a safer environment for Malaysians.

### Overview of Game-Based Learning

Game-based learning (GBL) has emerged as a prominent teaching method, particularly in education, offering unique advantages in fostering skills like creativity, problem-solving,



cooperation, and communication. Research indicates a significant increase in student motivation, engagement, and interest over the past few years (Hussein et al., 2019). GBL surpasses traditional methods like textbooks by providing a more engaging learning environment where professors can teach effectively and students can learn interactively.

However, GBL also presents challenges, such as the potential time commitment and difficulty in predicting the duration of game sessions, which can lead to students spending more time gaming than studying (Boghian., 2019). These drawbacks impact both students and teachers when GBL becomes the primary method of instruction.

## Games Genre

Two types of games commonly utilized for educational purposes are video games and serious games. Video games primarily aim to entertain, though they may include educational content, while serious games are specifically designed to educate players. Serious games are described as amusing learning aids where players develop their knowledge and practice their skills by overcoming multiple challenges while playing (BCampus, 2021). Action games emphasize puzzle-solving and exploration, requiring skills like reasoning, creativity, and curiosity. Although their popularity has decreased over the years, action games encompass various subgenres such as platform, fighting, and shooting games. Simulation games focus on realism, incorporating elements like resource management and strategic decision-making to mimic real-world challenges. Examples include sandbox and virtual reality games. For this project, the chosen genre is action-adventure games, known for their immersive environments and story-driven experiences. Action-adventure games offer benefits such as enhanced perceptual decision-making, improved information processing speed, and sustained concentration, which extend beyond gaming into real-world learning contexts. Based on Figure 1, it shows game genres that are available in the market.



Figure 1: Context of Game Genres

## Game Platform

Video games have evolved significantly over the years, with new gaming systems introduced annually, providing players with a wider range of options. Each player typically has a preferred platform, whether console, PC, or mobile, depending on their gaming style. Consoles like Xbox, PlayStation, and Nintendo Wii are widely popular, offering simplicity and convenience but lack customization options (PCMag, 2020). Conversely, PCs offer extensive customization and modding capabilities, allowing players to enhance their gaming experiences, albeit at a potentially higher upfront cost (Sacramento Bee, 2023). Mobile gaming has seen a surge in popularity, with smartphones offering accessibility and convenience, but drawbacks include limited screen size, controls, and memory consumption (GameNGadgets, 2022). Each platform has its advantages and disadvantages, catering to different preferences and gaming needs.

## Existing Game/Application

The wide array of evaluated games emphasizes their shared goal of offering immersive learning experiences, allowing players to explore historical events and gain insights into past lifestyles. These commonalities play a vital role in the evolution of gaming, providing a foundation for developing shared objectives and messages that resonate with all players. Table 1 provides a thorough comparison of existing games, analyzing their objectives, genre, platform, operating system, and potential shortcomings, facilitating a deeper understanding of their similarities and differences.

Table 1: Comparison of Each Games

Games	BlazeXCape	Fire Trap	Baby Panda's Fire Safety
Content and Goals	To teach the player what to do if a house on fire ever catches on fire.	To gain experience based on user exploration throughout the game.	To educate and spread awareness about the danger of fire
Genre	3D FPS Simulation	3D Simulation	2D Simulation
Approach	Gamification Learning	Gamification Learning	Gamification Learning
Platform	Mobile	Mobile	Mobile
Operating System	iOS and Android	iOS and Android	iOS and Android
Lack Features	UI is too simple for a simulation game	Lack of another additional gameplay	Lack of other platform support

## Overview of Game Methodologies

Game methodologies encompass various approaches used in game development to craft engaging and immersive experiences, including gameplay design, storytelling, mechanics, and player interactions. Among the multitude of methods, three have been selected for comparison: the Game Development Life Cycle (GDLC) methodology, Rapid Application Development (RAD) methodology, and Agile methodology. GDLC, akin to the Software Development Life Cycle (SDLC), aims to create high-quality games within budget and time constraints, following a structured process. RAD, widely adopted in the software industry, emphasizes rapid project completion through minimized planning and accelerated prototype development (Lucidchart, 2020). Agile methodology, an iterative and adaptable approach, prioritizes teamwork, client satisfaction, and continuous development, dividing projects into short periods known as iterations or sprints (Krasamo, 2022). After careful evaluation, the GDLC approach was deemed the most effective for the game development process due to its streamlined framework, making it the optimal choice among the three methodologies discussed.

## METHODOLOGY

As educational games have gained prominence in educational settings, the study of learning through video games has emerged as its own academic discipline. Educational computer applications, or games, aim to educate users while providing entertainment. While

the Software Development Life Cycle (SDLC) is widely recognized and utilized in game creation, it comes with drawbacks such as complexity and design iterations. In response, the Game Development Life Cycle (GDLC) methodology has been embraced as a solution, comprising six stages outlined in Figure 2. These stages include concept and plot establishment, pre-production, production, testing, beta, and release. The GDLC approach was chosen for its structured framework tailored for game development, offering smoother and more efficient processes compared to the traditional SDLC method (Rido Ramadan & Yani Widyani, 2013). It enables the creation of high-quality educational games by addressing the unique requirements and challenges of game-based learning.

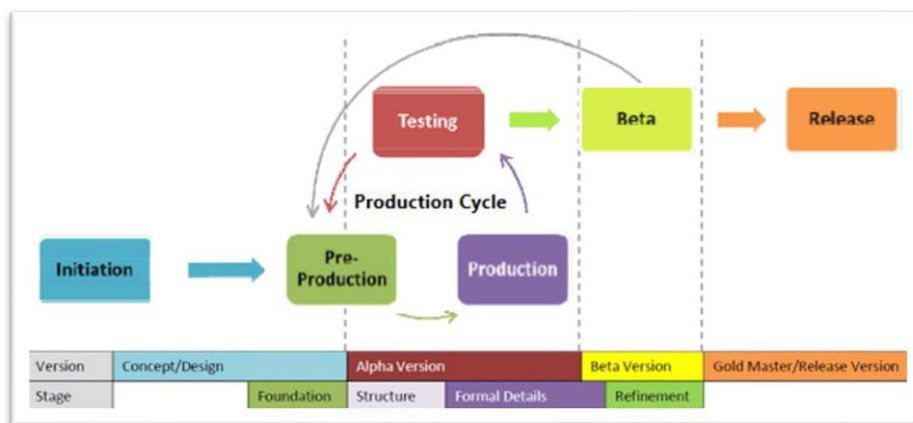


Figure 2: Phase of Game Development Life Cycle

## Initiation Phase

The initial step in creating the video game involves developing a concept, which yields the game's concept and a synopsis. The game's protagonist, Amani, finds himself in a building engulfed in flames, facing various fire-related obstacles and tasks across three distinct stages. Each stage presents unique enemies related to fire, requiring Amani to defeat them to progress. The game adopts a 2D platform and RPG genre, incorporating multimedia components to offer an engaging learning experience for students. By playing the game, children can acquire valuable knowledge about fire safety, enhancing their ability to survive in fire situations. The game's primary objective is to provide students with an interactive and immersive approach to learning about fire safety, ensuring effective and enjoyable learning experiences through careful consideration of techniques, platforms, and genres.

## Pre-production Phase

The developer will choose the flowchart and storyboard methods since they are more straightforward and suitable for making the game.

### *Flowchart*

Flowcharts serve as simple diagrams outlining the steps involved in a procedure, often utilizing standard symbols to represent transitions between stages or operations. In this context, a flowchart is employed to illustrate the functionality and progression of the game. Figure 3.2 depicts the flowchart for the game, which comprises three stages. To win the game, the player must complete all three objectives. The game commences when the user initiates it by pressing the start button, followed by the unfolding of the game's story. Subsequently, the player progresses through each stage, facing various tasks and decisions, with the outcome contingent upon their choices. If the player exhausts their lives, the task cannot be completed. The game allows the player to retry from their current stage or return to the main menu by pressing the "retry" or "menu" buttons, respectively. As the player advances through different levels, the tasks presented to them vary accordingly. The third level, serving as the game's finale, requires the player to defeat a formidable enemy after completing their mission. If unsuccessful, the player must restart their mission from the beginning of the final level. Figure 3.2 provides a visual representation of the game development flowchart, delineating the progression of the game's stages and player interactions.

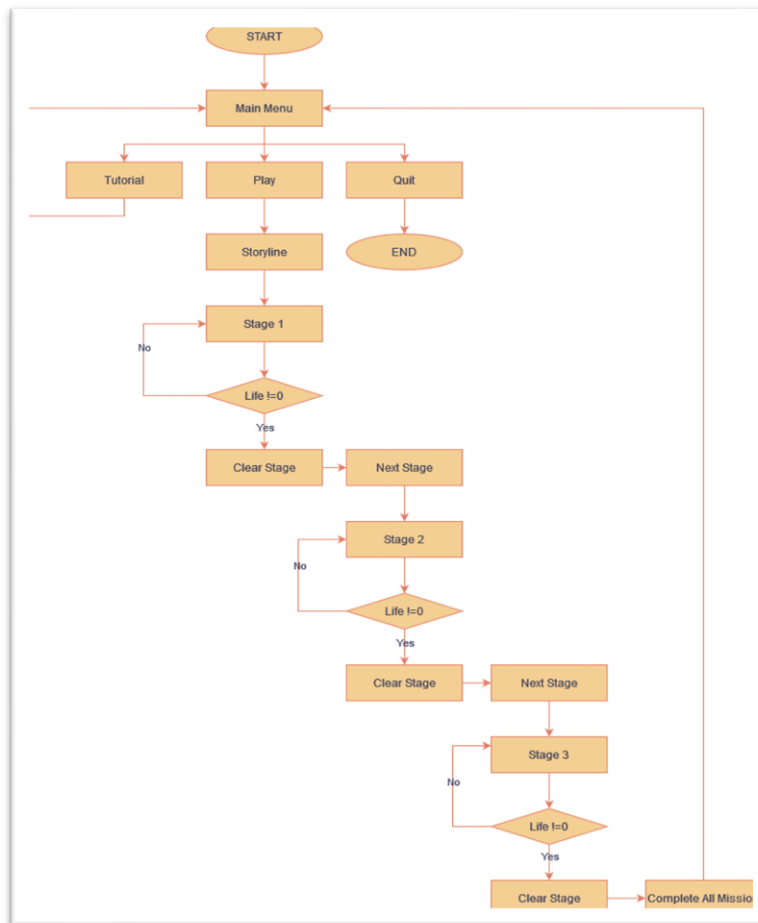


Figure 3: Game Development Flowchart

### *Low-Fidelity Storyboard*

Incorporating multiple stages and a unique visual presentation into the game design offers significant benefits for players. Before proceeding with production and development, it's essential to have a comprehensive overview of the game's design. This can be achieved through the creation of a storyboard, which will outline both written and visual descriptions of the game. Utilizing a computer-based sketching website for the storyboard allows for easy addition and removal of elements as they are integrated into the scenario, providing flexibility and efficiency for developers throughout the design process.

## Production Phase

A few software tools and technical analysis were discussed in this phase before the project was built.

### *Technical Analysis*

A software requirement is a necessity, whether functional or non-functional, that must be incorporated into a system. This shows that the feature offers the user a certain service. Various software applications were employed in the development of this project, encompassing Construct 3 as the game engine, Aseprite for design tools, and Photoshop for editing tools. Table 2 displays the project's software needs.

Table 2: Software Requirements

Software	Requirements
Aseprite	Designing Tools
Photoshop	Editing Tools
Construct 3	Game Engine

The hardware specifications for the programme ensure that it runs efficiently. Failure to meet the requirements may lead to potential issues with installation and performance. On a laptop, the project's hardware was constructed. Table 3 displays the features of the laptop based on the CPU, OS, installed RAM, and display adapter.

Table 3: Hardware Requirements

Parts	Specification
Processor	Intel Core i5 11 <sup>th</sup> Gen
Operating System	Windows 11
RAM	16GB
Graphic Card	GeForce RTX 2050 Ti

## Testing Phase

During the testing phase of game development, a prototype is created to allow developers to evaluate real-time outcomes against expected results. This internal testing, known as playtesting, assesses various aspects of the game at different stages. Formal Details Testing focuses on evaluating features' functionality and game complexity through playtesting, ensuring functional quality standards are met. Playtesting identifies defects or issues and categorizes gameplay treatments as too challenging, too easy, or balanced. Refinement testing assesses enjoyable and accessible qualities by observing tester behavior and gathering direct

input, determining whether the experience is engaging, frustrating, or accessible. Bug reports, change requests, and development decisions arise from testing, guiding whether to iterate the production cycle or proceed to the next phase, beta.

## **Beta Phase**

During the beta testing phase, external or third-party testers evaluate interconnected prototypes to scrutinize both formal aspects and refinements, employing similar testing techniques as previous stages. Tester selection methods include closed beta, inviting specific individuals, and open beta, allowing anyone to participate. Testers aim to identify bugs during formal detailed testing, while refinement testing focuses on gathering input, granting testers more freedom to enjoy the game. Bug reports and user feedback result from beta testing, leading to closure based on either the end of the beta period or sufficient tester submissions. Favorable outcomes may prompt further production iterations to enhance the product or proceed with game release.

## **Release Phase**

Once a game is completed and ready for release to the public, developers utilize various visual mediums like trailer-style videos, still photos, or montages to gather customer feedback on gameplay, functionality, quality, and graphics. These tools, including brief videos and select images, help developers elicit valuable insights from their audience before the game's public availability. Additionally, the release phase involves planning for maintenance, game expansion, project documentation, knowledge sharing, post-mortems, and product launch, ensuring a comprehensive approach to the game's introduction to the market.

## **RESULT AND DISCUSSION**

The data collection process was carried out efficiently using Google Forms, employing a Likert scale for mean calculation. Various questions corresponding to each factor in the EGameFlow model were carefully explained and assessed independently. This section elucidates the game elements that contributed to superior data collection. Table 5.9 presents the overall mean value and percentage of effectiveness for Fire Xcape, derived from the completed calculations.



Table 4: Overall Total Mean Value and Percentage of Effectiveness

Factor	Total Mean
Concentration	3.96
Goal clarity	3.93
Feedback	4.00
Challenge	4.00
Autonomy	4.06
Immersion	3.98
Knowledge improvement	4.03
Total average mean	4.00
% of overall total mean	80 %

The table above shows that Fire Xcape has a high proportion of effectiveness (80%), with an average mean of 4.00 across all factors. The results indicate that Fire Xcape is a pleasant game, meeting the project's third objective.

Fire Xcape proves to be an outstanding tool for promoting fire safety awareness. This 2D action game effectively illustrates the hazards of household fires by engaging players in interactive gameplay. The game's objective is to entertain while also educating players on crucial safety topics. Deploying this instructional game successfully requires meticulous planning, collaboration between educators and game developers, and ongoing assessment to ensure alignment with educational objectives and current scientific findings on fire safety. However, there is still untapped potential to further enhance the game's effectiveness and reach new heights in educating players about fire safety.

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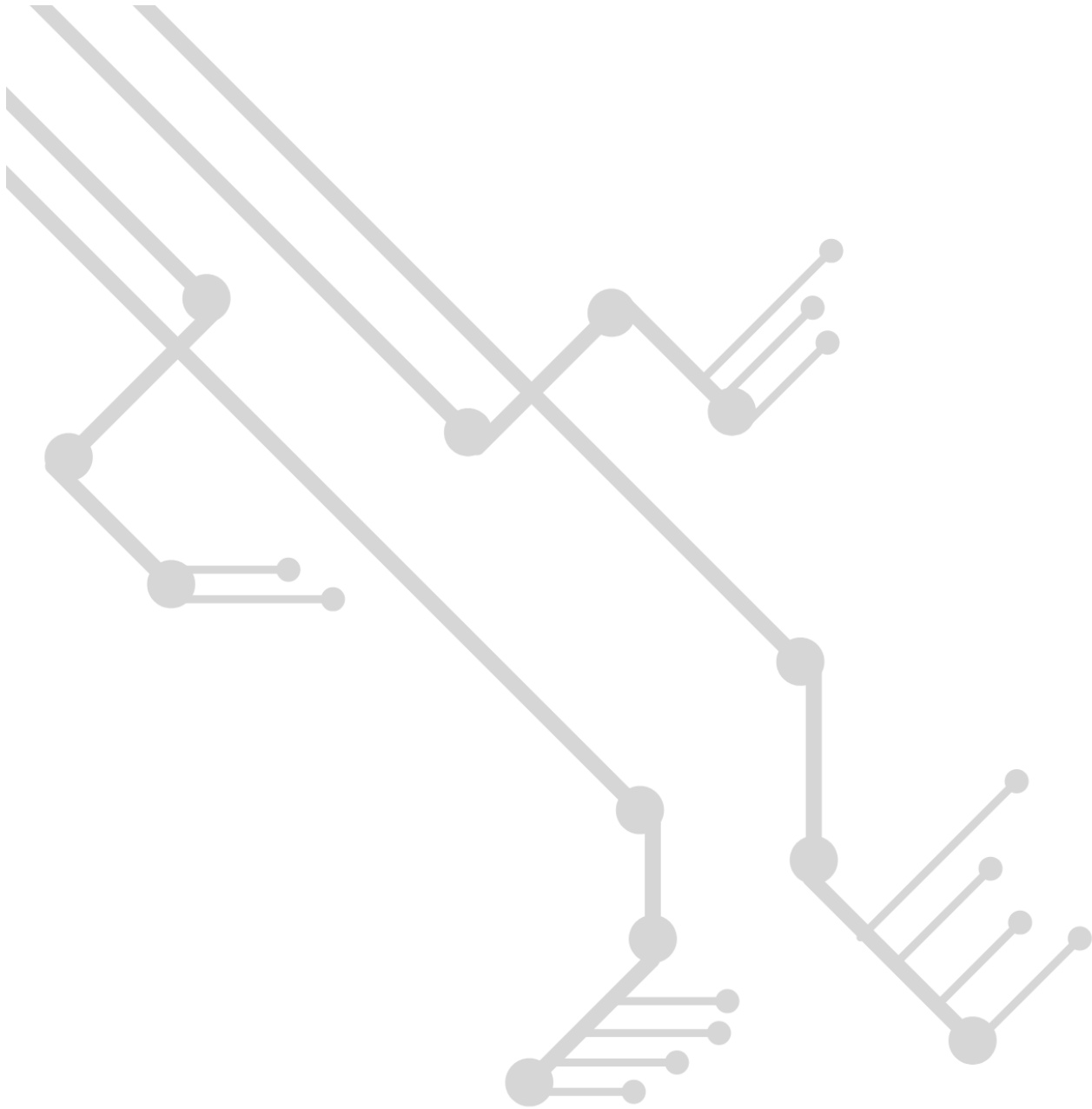
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