1- Five Recent and Relevant Sources.

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=5101269
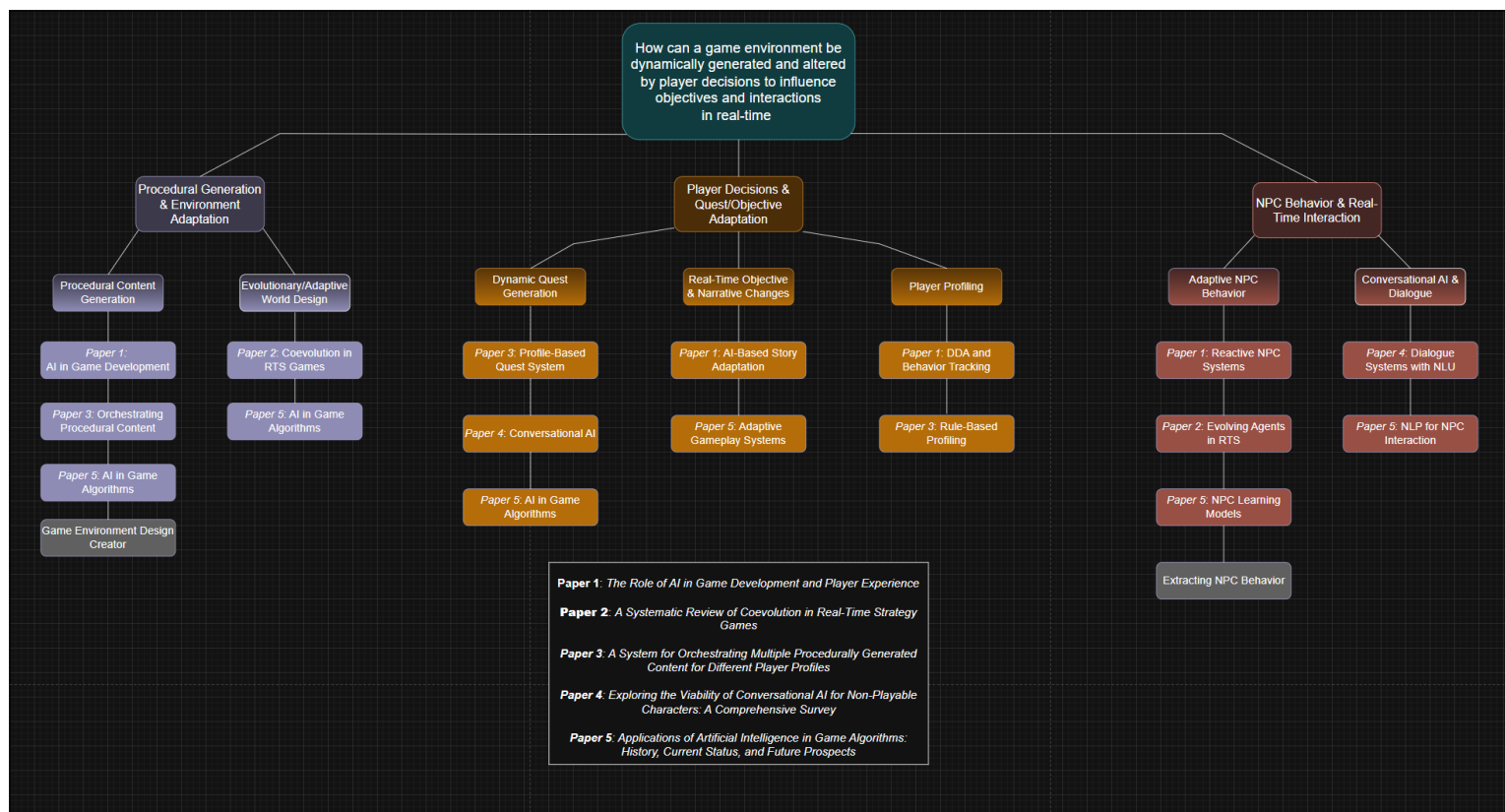
https://ieeexplore.ieee.org/document/9548932

https://ieeexplore.ieee.org/abstract/document/9917383

https://www.researchgate.net/publication/377735347_The_Application_of_Artificial_Intelligence_in_Game

https://ieeexplore.ieee.org/document/9782047

2- Literature Map.

3- Literature Review.

Paper 1: The Role of AI in Game Development and Player Experience

- **Research Aim**

   Investigates how AI technologies enhance player engagement by enabling adaptive gameplay, dynamic environments, and personalized storytelling through intelligent systems. It focuses on using AI to make game worlds more reactive to player behaviour.

- **Dataset**

   A literature review of 30 peer-reviewed sources spanning from 2010 to 2024. No original experiments were conducted.

- **Algorithm**

   Key techniques include machine learning for behaviour adaptation, GANs and noise functions for procedural content generation (PCG), neural networks for lifelike NPC behaviour, and A* for pathfinding. Dynamic Difficulty Adjustment (DDA) adapts game difficulty in real time. Reinforcement learning and emotional AI are used to personalize interactions and evolve narratives.

- **Evaluation**

   Case studies such as *The Last of Us Part II* and *Red Dead Redemption 2* illustrate how NPCs respond to player input with emotional and tactical realism. The *Nemesis System* in *Shadow of Mordor* dynamically tracks and evolves enemy encounters. These examples show that AI enables nuanced, personalized interactions and emergent narratives.

- **Limitations**

   Primarily focused on AAA titles, limiting generalization to smaller games. No new experimental data. Advanced AI systems require heavy computational resources, making real-time application difficult. Ethical concerns around player manipulation are noted but not deeply explored.

- **Recommendations**

   Suggests developing AI that supports persistent personalization across play sessions. Advocates for integration of emotional AI to reflect subtle player actions and recommends democratizing these tools for use by indie developers.

Paper 2: A Systematic Review of Coevolution in Real-Time Strategy Games

- **Research Aim**

  Provides a comprehensive review of how coevolutionary algorithms contribute to strategy evolution, real-time adaptation, and personalized gameplay in RTS games. Focus is placed on enabling emergent behaviour and decision-making that evolves with player input.

- **Dataset**

  Analyses 53 peer-reviewed papers from 1994–2021 focused on coevolution in RTS environments. Only studies applying coevolutionary techniques were included.

- **Algorithm**

  Highlights both competitive and cooperative coevolution models. Genetic Algorithms (GAs), NeuroEvolution of Augmenting Topologies (NEAT), and Genetic Programming (GP) are key methods. Fitness evaluation approaches include victory-based and dynamic metrics. Memory techniques like Hall of Fame and LAPCA help prevent knowledge loss.

- **Evaluation**

  Organized across three chronological stages: early micromanagement tasks, evolving NPCs and map navigation, and later applications in dynamic scenario and environment generation. These show coevolution's ability to develop strategies and content that adjust based on player actions over time.

- **Limitations**

  Lack of standard testbeds hinders performance comparison. Many models are tested in custom-built or simplified environments. Missing source code and inconsistent definitions reduce reproducibility and clarity.

- **Recommendations**

  Encourages creation of unified RTS benchmarks, improved use of memory mechanisms, and more focus on coevolutionary techniques in real-time, player-responsive content and strategy generation.

Paper 3: A System for Orchestrating Multiple Procedurally Generated Content for Different Player Profiles

- **Research Aim**

  Presents a system that procedurally generates and aligns multiple game elements—quests, enemies, levels—based on distinct player profiles. The goal is to enable real-time personalization and deeper engagement.

- **Dataset**

  Empirical gameplay data from 83 participants who completed over 200 levels. Data includes behavioural metrics and psychometric survey responses.

- **Algorithm**

  The system uses MAP-Elites for generating diverse levels and enemies, a grammar-based generator for customized quests, and a rule-based profile classifier. A content orchestrator aligns the outputs for a coherent gameplay experience tailored to user preferences.

- **Evaluation**

  Participants were split into groups receiving either matching or mismatched profile content. Players who received personalized content reported significantly higher enjoyment, balance, and engagement. This confirms the effectiveness of profile-aligned procedural systems.

- **Limitations**

  Offline content generation restricts real-time adaptation. Player profiles are static and predefined. The system currently only supports three content facets, which may limit depth and variety.

- **Recommendations**

  Suggests incorporating adaptive profiling using machine learning and extending generation to additional facets like music and character dialogue. Recommends evolving quests with branching structures and dynamic NPC responses.

Paper 4: Applications of Artificial Intelligence in Game Algorithms

- **Research Aim**

  Explores whether conversational AI can enable NPCs to interact with players more dynamically, allowing real-time quest generation, narrative evolution, and personalized responses.

- **Dataset**

  Theoretical literature survey referencing NLU/NLP frameworks and examples from commercial games and research prototypes.

- **Algorithm**

  Describes FSMs, Behaviour Trees, and GOAP for structuring NPC behaviour. Natural Language Understanding (NLU) components include NER and intent classification. Dialogue systems use DMS architectures and reinforcement learning for adaptive conversations. Text generation is driven by T5 and DLGNet models.

- **Evaluation**

  Argues that conversational AI unlocks open-ended, player-driven dialogue that directly influences game objectives and world states. Context-aware conversations allow NPCs to shape story arcs based on player decisions, enabling dynamic quest creation and branching narratives.

- **Limitations**

  No empirical testing or benchmark data provided. Scalability remains a challenge, and real-time context tracking is still limited. Pretrained language models often require extensive domain tuning.

- **Recommendations**

  Proposes building NPCs with emotion tracking, memory, and continuity across sessions. Recommends testing hybrid models that blend scripted logic with AI-generated responses to enhance reliability.

Paper 5: Exploring the Viability of Conversational AI for Non-Playable Characters

- **Research Aim**

  Reviews AI's development and application in game environments, including content creation, adaptive difficulty, real-time decision-making, and player modelling.

- **Dataset**

  Synthesizes case studies and AI frameworks from both academic research and commercial games, including AlphaGo, OpenAI Five, and MOBA titles.

- **Algorithm**

  Details FSMs, neural nets (DNNs/CNNs), GANs, fuzzy logic, and reinforcement learning techniques like Q-learning and PPO. Procedural content generation and NLP support adaptive game narratives, while DDA systems tune difficulty based on behaviour analysis.

- **Evaluation**

  Highlights applications in MOBAs, RPGs, and strategy games. AI is shown to help with dynamic difficulty tuning, context-based storytelling, motion planning, and strategic suggestions. Examples include NPC AI in *Dota 2* and decision guidance in *StarCraft II*.

- **Limitations**

  Real-time AI increases performance overhead. Naive self-play can stagnate without new opponents. Player behaviour remains complex and hard to predict. Ethical concerns around fairness and manipulation are mentioned.

- **Recommendations**

  Recommends shifting to GPU-based scaling for AI algorithms, enabling real-time feedback and adaptation. Calls for richer sentiment and behaviour-aware systems in VR/AR environments and long-term ethical guidelines for dynamic personalization.

4- Comparison Table.

The Comparison Table was split into 4 tables, so that it can fit in a word document

	Study	Source
1	The Role of AI in Game Development and Player Experience	SSRN, 2024 Burelli, Hunicke et al.
2	A Systematic Review of Coevolution in RTS Games	IEEE Access, 2021 Marsh et al.
3	Orchestrating Procedural Content for Player Profiles	IEEE Transactions on Games, 2024 Leonardo P., Breno V., Claudio T.
4	Conversational AI for Non-Playable Characters	arXiv, 2024 Multiple authors
5	Applications of AI in Game Algorithms	Springer, 2024 H. Jiang

	Research Focus	Techniques / Algorithms
1	Adaptive gameplay, dynamic difficulty, personalized storytelling	ML, GANs, DDA, RL, Neural Nets, A*, Emotional AI
2	Coevolution in strategy learning, adaptive NPC behavior	Genetic Algorithms, NEAT, Competitive & Cooperative Coevolution
3	Procedural content generation based on player profiles	MAP-Elites (for levels/enemies), Grammar-based quest generation, Rule-based profiling
4	Natural language interaction with NPCs	FSMs, Behavior Trees, Reinforcement Learning, T5, DLGNet, NLU/NLG
5	General AI for game systems, procedural design, personalization	Q-learning, PPO, GANs, CNNs, REAs, DDA

	Adaptation to Player Decisions	Game Environment or Content Affected
1	Yes – Real-time difficulty & story changes	NPC behaviour, difficulty, story progression
2	Yes – Adaptive strategy in real-time RTS	NPC strategies, enemy behaviour, map scenarios
3	Yes – Content matched to player profile	Quests, levels, enemy mechanics
4	Yes – Player dialogue affects quests	NPC dialogue, story branches
5	Yes – Adaptive systems across game types	Environments, items, NPCs, objectives

	Evaluation Method
1	Case studies: The Last of Us II, Cyberpunk 2077, Shadow of Mordor
2	Systematic review of 53 papers using coevolution in RTS games
3	83 participants tested across 204 levels; player engagement evaluated
4	Survey of technologies and theoretical implementation proposals
5	Yes – Comparative framework; examples like Left 4 Dead, Dota 2 used systems across game types