

Project Tracks

Detailed Track Descriptions for Capstone Project



Project Tracks (Choose One or Propose Your Own)

Track 1: Ideation and Realization Engine

The Problem: LLM by default provides overall generic ideas not grounded with actual evidence.

Goal: Build a system (e.g., generator-evaluator framework or any other method) that produces realistic, evidence-based ideas with demonstrated novelty

Sub-domains (Choose One)

Option A: Patent Ideation and Writing

- Generate patent-worthy ideas in specific domains (e.g., blockchain, IoT, healthcare)
- Evaluate novelty against existing patents
- Produce the essential portions of patent idea (highlighted below, not the full lawyer-written patent)

What We're Looking For: We're not asking for a full legal patent document (those are written by lawyers). Instead, focus on generating **the core patent idea** with essential components: the problem being solved, the novel solution, key technical details, and claims.

Patent Example Structure:

- **Title:** "Method for Real-Time Inventory Prediction Using Satellite Imagery and Seasonal Attention Mechanism"
- **Problem:** Traditional inventory systems rely on historical sales data, missing environmental factors affecting demand
- **Solution:** System combines satellite imagery analysis (weather, traffic patterns) with a novel seasonal attention mechanism to predict product demand
- **Key Technical Details:** Specific architecture for image-to-demand correlation, temporal weighting system
- **Claims:** Method claims for the attention mechanism, system claims for the integrated prediction pipeline
- **Novelty:** This combination of satellite imagery + seasonal attention mechanism for inventory prediction has no prior art in existing patent databases (verified through Google Patents, USPTO search). While satellite imagery for agriculture exists and attention mechanisms are common in ML, their specific application to retail inventory prediction with seasonal weighting is novel
- **Target Company:** Potential licensees include major retailers (Walmart, Amazon, Target), logistics companies (FedEx, UPS, DHL), and supply chain software providers (SAP, Oracle, Blue Yonder). These companies have existing inventory management systems that could integrate this technology and would benefit from improved demand forecasting accuracy
- **Strategic Value (for e.g., NTU):** This patent could generate revenue through licensing to retail chains and logistics companies. It increases business value by: (1) Creating a new revenue stream through patent licensing, (2) Positioning NTU as a leader in AI-driven supply chain innovation, (3) Potential cost savings if implemented internally for campus facility management (predicting cafeteria supplies, bookstore inventory)
- **Detectability:** High detectability. If a competitor uses this method, it would be evident in their system outputs—correlations between satellite data and inventory predictions would be observable. The specific attention mechanism's behavior can be reverse-engineered from API responses or system demonstrations, making infringement detectable and enforceable

Important Note: You don't need to score high on all three aspects. If your patent has **high novelty** and **high strategic value** but **low detectability**, that's still valuable—it represents genuine innovation even if enforcement is challenging. Focus on demonstrating strong performance in at least two of the three criteria.

The Challenge: LLM-generated patent ideas are typically either **not novel enough** or **too abstract to be patented**. For example, an LLM might suggest "using AI to optimize supply chains" (too broad and already extensively patented) or "a blockchain-based voting system" (generic idea with thousands of prior art).

Three Essential Criteria for Patent Ideation:

1. **Novelty (Subject Matter Eligibility):** The idea must be genuinely novel and not obvious given existing patents. Your system should verify this against actual patent databases.
2. **Strategic Value:** Consider institutional and business context (e.g., for NTU). The patent scope can't be too narrow (e.g., "only works for Singapore taxi bookings on rainy Tuesdays"). It should have broad applicability while being specific enough to be defensible.
3. **Detectability:** Can you actually detect if someone is infringing on your patent? If your patent is about an internal algorithm that competitors can implement differently, it may have low strategic value.

Good vs. Bad Examples:

✗ **Bad Example:** "AI-powered recommendation system using collaborative filtering"

- Why bad: Extensively patented, thousands of prior art, no specific innovation claimed

✗ **Bad Example:** "Quantum AI for supply chain optimization"

- Why bad: Too abstract, no concrete implementation, buzzword combination

✓ **Good Example:** "Method for real-time inventory prediction using satellite imagery and historical weather patterns, with specific attention mechanism for seasonal products"

- Why good: Specific technical approach, clear implementation, verifiable novelty scope

Grounding Requirement: Patent ideas must be grounded in actual facts. Research existing patents in your domain (use Google Patents, USPTO, EPO databases) to understand what has been filed and what gaps still exist. For established fields like recommendation systems, be aware that even with one good idea, there could be 1000 other ways to implement it—explain why someone would specifically want to use your patented method.

Option B: Paper Ideation and Writing

- Generate research paper ideas with clear contributions
- Identify research gaps in specific fields
- Produce structured research drafts (not just proposals)
- The writing needs to provide a draft for Abstract, Introduction, Methodology, Related Papers, Experimentation, Conclusion sections
- References: [AI-Scientist](#) [AI-Scientist-v2](#)

Grounding Requirement: You may not need to follow a fully experimental-directed method. What we need is a paper idea grounded with actual facts from existing published papers or arXiv papers. Research what's currently being published in your target venues (e.g., NeurIPS, ICML, ACL, CVPR) and identify what gaps still exist. Your system should demonstrate understanding of the current research landscape and generate ideas that build upon or diverge from existing work in meaningful ways.

Option C: Startup Ideation and Planning

- Identify low-concentration, high-potential market opportunities
- Generate business models and go-to-market strategies
- Validate against market data and competitive landscape
- Produce investor-ready pitch decks
- The planning needs to include startup idea with target audiences, MVP, business model (how to make money), marketing methods, competitors, market, market size and timeline

Grounding Requirement: Startup ideas must be grounded in customer needs or actual evidence of pain points. Don't just generate ideas from thin air—validate them with real data such as Google search volume trends, Reddit discussions, Twitter/X threads, Product Hunt launches, or customer reviews on platforms like G2 or Trustpilot. Your system should demonstrate that there's genuine market demand for the proposed solution before generating the full business plan.

Aspect	Details
Core Capabilities	<ul style="list-style-type: none">• Generate realistic and evidence-based ideas• Demonstrate novelty through systematic comparison• Optionally implement or prototype the idea• Provide validation metrics and evidence
Example Data	<ul style="list-style-type: none">• Option A: Patent databases• Option B: https://www.semanticscholar.org/• Option C: Reddit, Twitter/X Advanced Search, Product Hunt, G2 etc.
Example Business Impact	10x faster ideation cycles with valid ideas
Skills Gained	Agentic workflows, evaluation frameworks, domain knowledge extraction

Reference: [A Review of LLM-Assisted Ideation](#)

Track 2: Intelligent Slides Generation

Goal: Generate professional presentation slides with well-structured content and visual design (like Gamma.ai)

Key Challenges to Address:

1. **Text Overflow Management:** How do you ensure text fits within slide boundaries without overflowing? Content generated by LLMs can be verbose—your system needs to intelligently truncate, summarize, or reflow text.
2. **PPTX Output Quality:** The output must be an actual **PowerPoint file (.pptx)** that looks professional when opened in PowerPoint or Google Slides. This is harder than generating HTML slides—you need to handle layout engines, font sizing, and element positioning programmatically.
3. **Template Leverage:** How do you leverage existing PowerPoint templates to make slides visually appealing? Consider building a system that can work with various professional templates (corporate, academic, startup pitch) and apply them consistently.

Aspect	Details
Core Capabilities	<ul style="list-style-type: none">• Generate clean, professional slide layouts as .pptx files• Intelligently manage text length and layout constraints• Apply professional templates and maintain design consistency• Handle various slide types (title, content, comparison, data visualization)

Example Business Impact	80% reduction in slide creation time, consistent branding
Skills Gained	Content structuring, visual design automation, template generation, layout constraint handling

Track 3: Intelligent Knowledge Base with Auto-Clustering

Goal: Search and organize personal knowledge efficiently (like Cursor.com + Obsidian)

Scalability is Key: As your knowledge base grows to thousands of notes (you can consider it as a set of .md files), scalability becomes critical. Consider how Cursor.com handles large codebases—it uses `grep` for exact text matching because it scales well. Cursor.com also leverages Semantic search, though Semantic search is powerful but computationally expensive; it works best as a **complement** to traditional search methods, not a replacement.

The Clustering Challenge: Imagine you have 50 notes about "Transformer architecture" scattered across different folders and dates. How do you automatically organize them under a unified "Transformer" category? Your system should provide an **opinionated way to cluster related content**—for example:

- All notes mentioning attention mechanisms → "Attention & Transformers" cluster

Approach: You can reference the "Text clustering with LLM" series of papers for inspiration, or devise your own clustering method. The key is demonstrating that your system can intelligently group related knowledge at scale.

Aspect	Details
Core Capabilities	<ul style="list-style-type: none">• Scalable search: Combine traditional search (grep-style) with semantic search• Auto-clustering: Automatically organize notes into meaningful categories• Context-aware suggestions and connections• Support for Markdown notes format like in Obsidian, support for OneNote formats (e.g., OneNote) is a plus
Example Business Impact	5x faster knowledge retrieval, automatic organization of growing knowledge bases
Skills Gained	Scalable search architecture, text clustering methodologies

References: Text clustering with LLM papers, or devise your own clustering approach based on embeddings and hierarchical organization.

Track 4: One-Click Application Builder

Goal: From UI sketch to deployed application with authentication, payments, and analytics

The Challenge: If we are launching an application, we need to repeat the same manual flow: design UI → write code → integrate auth → add payments → add analytics → deploy. The key here is to support autocode generation to enable **UI generation → Application → Deployment**.

Implementation Approach:

- If it can't be fully automated, you can provide instructions with partially automated steps
- Example workflow: Use [v0.app](#) for initial UI generation, then copy the UI to your application framework
- **It's totally fine to have some manual steps** for this process because it will typically help you reduce the time for application development from **days to under two hours**

- Of course, **the more automated, the better**—but don't let perfect be the enemy of good

Aspect	Details
Core Capabilities	Manual Flow (Minimum Viable): <ul style="list-style-type: none">• Generate UI design from descriptions or sketches• Create functional code with authentication (e.g., Auth0, Clerk)• Integrate payment systems (e.g., Stripe)• Add analytics (Plausible, Microsoft Clarity)• Deploy application automatically Automated Flow (Stretch Goal): <ul style="list-style-type: none">• Fully automated: UI sketch → Application → Deployment
Example Business Impact	90% reduction in MVP development time, rapid prototyping
Skills Gained	Full-stack automation, system integration, deployment automation

Track 5: Propose Your Own

Got a unique idea? Submit your proposal including:

- Problem statement and target users
- Core capabilities your system should demonstrate
- Technical approach and feasibility assessment
- Expected business impact

Approval required: Send an email to your instructor for approval.
