

Optimization

AGENTIC SCHEDULER.

OPTI-A

Artificial
Intelligence





Optimization Problems.

Linear Programming

Optimization problems involve finding the best solution by maximizing or minimizing a linear objective, subject to certain constraints.

OBJECTIVE FUNCTION



Maximize the value of
items within my budget

DECISION VARIABLES



4kg

\$60



2.5kg

\$40



0.3kg

\$15



1.5kg

\$30



1kg

\$20



0.2kg

\$10

CONSTRAINTS



$\leq 10\text{kg}$



$\leq \$150$



Needed



Needed

Problem Description.

You are going on a backpacking trip and can only carry up to 10 kg of gear. You have \$150 to spend. Two items are essential: a tent and a sleeping bag. Together, they weigh 6.5 kg and cost \$100, leaving you with 3.5 kg of space and \$50 to spend.

Now, you need to decide what extra items to bring. You can choose from a stove that weighs 1.5 kg and costs \$30, a water filter that weighs 1 kg and costs \$20, a first aid kit that weighs 0.5 kg and costs \$25, a flashlight that weighs 0.3 kg and costs \$15, and a map that weighs 0.2 kg and costs \$10.

What's the best combination of items you can pack without exceeding your budget and maximum weight?

Problems Types.

**Product
Mix**

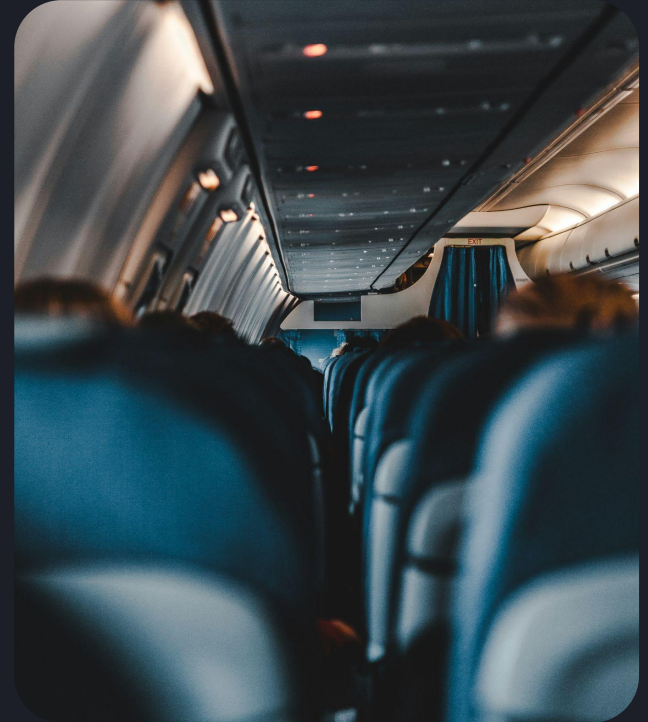
Blending

**Crew, Staff
& Scheduling**

**Game Theory
Models**

**Financial
Portfolio
Models**

**Network,
Distribution
Models**



AI Agents.

A system or program that is capable of autonomously performing tasks on behalf of a user or another system by designing its workflow and utilizing available tools.

IBM, July 2024



LLM Timeline



Architecture Overview.



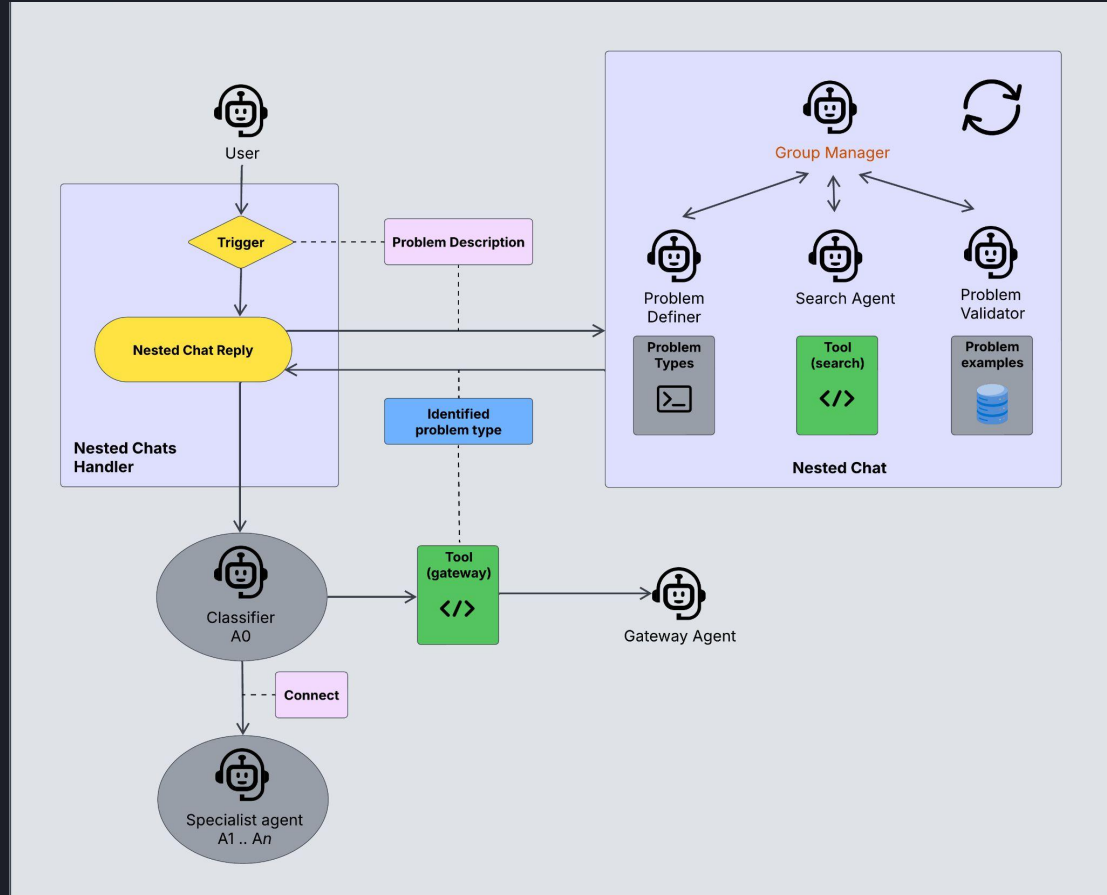
Optimization

Opti-A Live Demo.

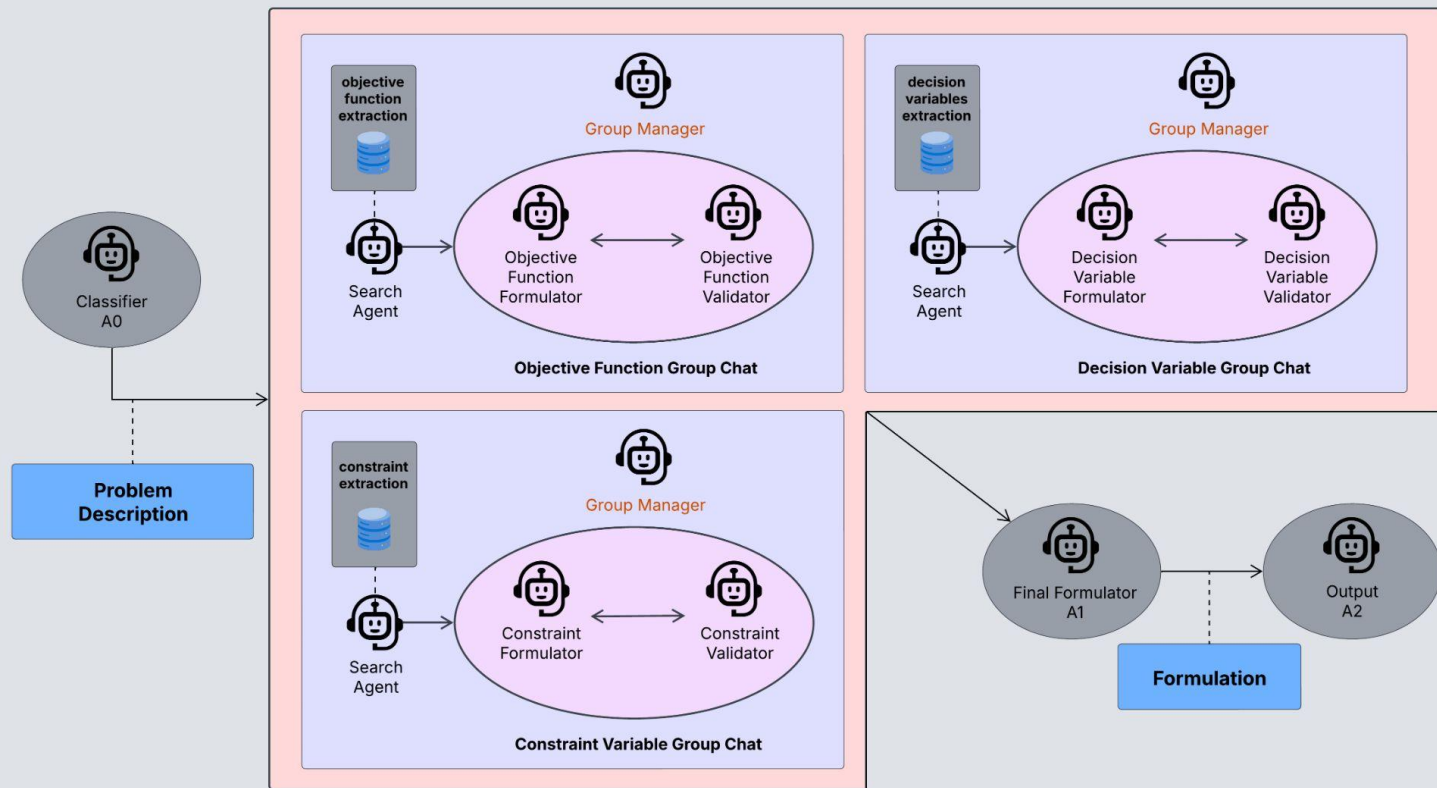
Artificial
Intelligence



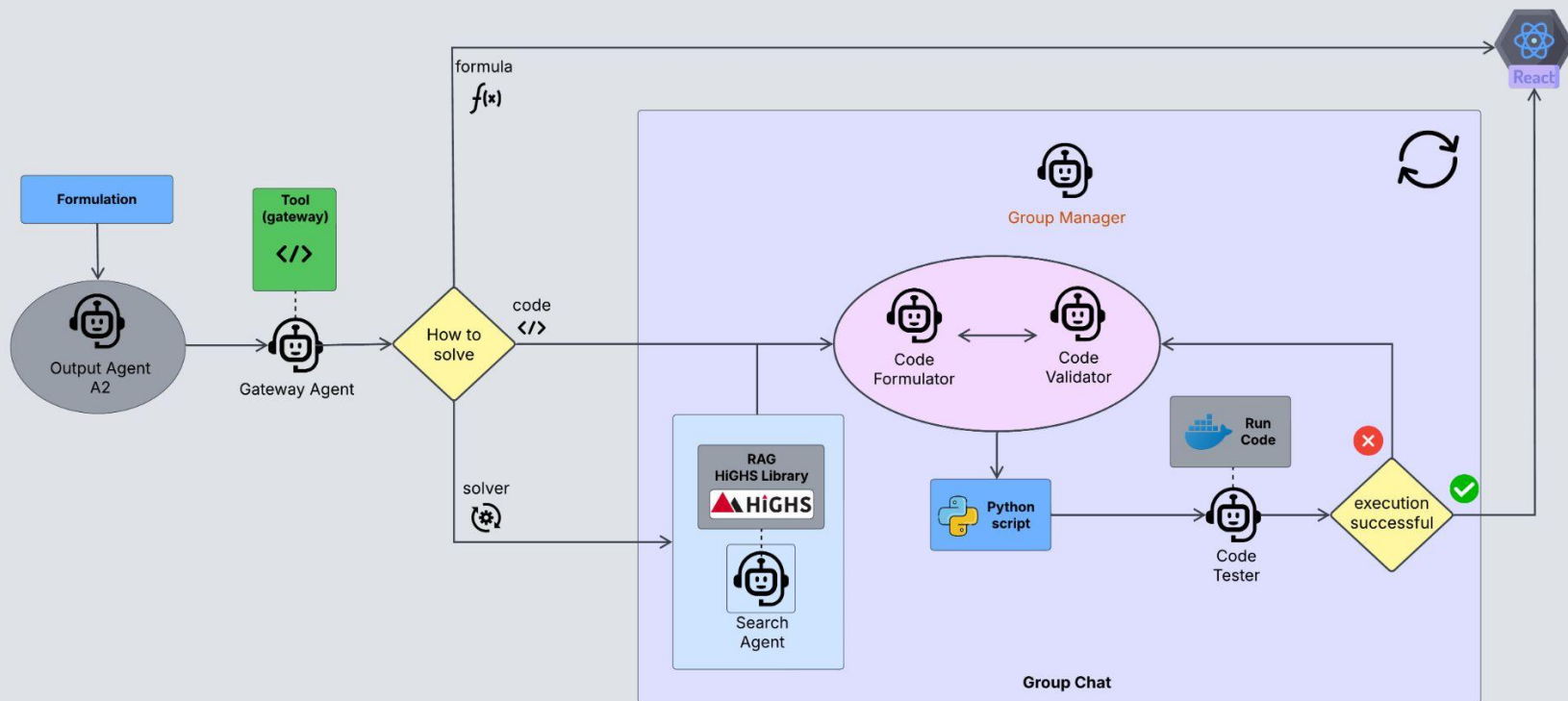
Classifier.



Formulation.



Output.



Problem Description On Steroids.

The Anderson family is embarking on a month-long camping and hiking adventure through the rugged wilderness of the Alps. The trip promises breathtaking views, exciting challenges, and memories to last a lifetime. However, they have to carefully plan their gear since they can only carry a limited amount of weight and have a strict budget. There are five family members: John and Sarah, the parents, their two kids, Emily and Jack, and their golden retriever, Max. They will each need some gear, and together they need to figure out how to carry everything they need without exceeding their weight limit and budget. The total weight limit for their gear is 60 kg, and they have a budget of 700€ to spend. John and Sarah, being the adults, will carry a larger portion of the load, but they also have to be mindful of the kids and Max. They've already agreed that some gear is essential for everyone's safety and comfort, but there are many options for additional items, and they must make decisions that will maximize their trip's success. John and Sarah will each need a tent and a sleeping bag, but since they're a family, they could share one large family tent or take two smaller ones. The family tent weighs 10 kg and costs 150€, while two smaller tents would weigh 4 kg each and cost 100€ each. The sleeping bags, which are 2.5 kg each and cost 40€, are necessary for everyone, so that's 10 kg and 200€ for the four sleeping bags. Max, the dog, doesn't need a sleeping bag, but he will need his own special dog carrier, which weighs 3 kg and costs 40€. Now, Sarah and John have to figure out what other items to bring, balancing weight and budget. They'll need cooking equipment for the trip. A large stove that feeds up to 6 people weighs 2.5 kg and costs 50€, but there's also a smaller stove that only feeds 4 people, weighing 1.5 kg and costing 30€. The family will also need water filters to purify water from the streams they'll hike by. One filter weighs 1 kg and costs 20€, but there's also a larger, more powerful filter that weighs 1.5 kg and costs 40€. Food storage is another key concern. Sarah is considering bringing two food containers, each weighing 0.8 kg and costing 15€, which will help keep their food safe from animals. There's also a set of cooking pots that weighs 1.2 kg and costs 25 €, along with an emergency first aid kit that weighs 0.5 kg and costs 30€. Additionally, there's a heavy-duty backpack that Sarah would love to use, which weighs 3 kg and costs 70€, but John has an older, lighter backpack that weighs 1.5 kg and costs 40€. For their navigation, they'll need a good map and compass. The map is available in two sizes: a small one weighing 0.2 kg and costing 10€, and a large one that weighs 0.5 kg and costs 20€. They can also purchase a GPS device that weighs 0.3 kg and costs 100€, but this could take up a lot of their remaining budget. They'll also need a flashlight for each person, and Emily and Jack are both quite particular about the brightness of their lights. There are two kinds available: one that weighs 0.3 kg and costs 15€, and a stronger one that weighs 0.4 kg and costs 25 €. Since the kids will each need their own flashlight, Sarah and John will need to decide whether to buy the more expensive models for them. John is considering buying a pair of walking poles, which are known to help with stability on rough terrain. These weigh 0.5 kg and cost 20€. Finally, there's a portable hammock, which could be a great addition for relaxation after a long day of hiking. It weighs 1 kg and costs 40€, but John wonders if it's worth the extra weight when they already have a tent for resting. The Anderson family has to choose the best combination of items to bring, ensuring that they stay within the 60 kg weight limit and their 700€ budget. They must also account for the fact that Max, their dog, will need some special items as well, and they can't forget the essentials for safety and comfort. The decisions are tough, and there are many options to consider. Each member of the family has different preferences, and they need to balance everyone's needs while making sure they don't carry too much weight or overspend. What should they pack, and how will they prioritize?

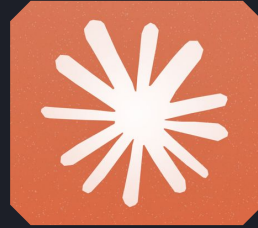
Tech Stack.



AI Environment
Azure AI Foundry



LLM Model
GPT 3.5 turbo



LLM Model
Claude 3.7 Sonnet



Agent Orchestration
Autogen

Key Takeaways



Promising Technology



Testing & Evaluation



Reliability



Azure AI Foundry



LLM Model Capability



Are we there yet?

Thank You.

Q&A



OPTI-A Team

Ayodeji Alli-Smith

Dean Terneu

Inês Bastos



.01

Architecture

- Problem Classifier
- Formulation
- Output

.02

Optimization

- Decision Variables
- Constraints
- Objective Function

.03

AI agents

- Searcher Agent
- Formulator Agent
- Critic Agent
- Group Manager