



AI Brainstorming Kit

A design resource to explore what to build with AI

aidesignkit.github.io

AI innovation is failing

Despite the hype, AI innovation is failing because teams select the wrong things to build.

This brainstorming kit blends user-centered and tech-centered innovation to simultaneously consider both AI capabilities and user needs.

Broadly exploring AI's design space

Effective ideation can reduce the risk of developing unwanted AI products and services.

This kit includes an overview of AI capabilities and 40 AI product examples to inspire ideation.

How to use this?

Review AI capabilities and a subset of examples at the beginning of an ideation session.

You can also use this resource for educational purposes within your organization or classroom.

Learn more

This resource was created by researchers at Carnegie Mellon University's HCI Institute.

Visit aidesignkit.github.io to learn more about this project.



AI Capabilities

Detect

(Monitor, Sense, Notice, Classify, Discriminate)

Notice if a kind of a thing is in a data set
or if it shows up in a sensor stream.

Detect face in image (camera)

Detect human voice in audio (smart speaker)

Detect people, objects and vehicles in sensor stream
(autonomous parking)

Identify

(Recognize, Discern, Find, Classify, Perceive)

Notice if a specific item or class of items shows up in a set of like items.

Identify if Jane's face (security)

Identify if message is spam (email)

Identify the type of cancer (medical imaging)

Estimate

(Rate, Grade, Measure, Assess)

Infer a value (e.g., position, size, duration, risk) to make an inference about what's happening now.

Estimate driving time (navigation planner)

Estimate chances this is spam (email)

Estimate direction sound came from (smart speaker)

Forecast

(Predict, Guess, Speculate)

Infer a value that will be true or some attribute of a future situation that may or may not happen (e.g., prices, sales, weather).

Forecast best time to buy stock (financial planner)

Forecast tomorrow's weather (weather app)

Forecast max price for my house (real estate app)

Compare

(Rank, Order, Find Best, Find Cheapest, Recommend)

Compare a collection of like items based on a metric. Allows services to select, rank, or curate a collection of things.

Compare items by likelihood of purchase (online store)

Compare posts by likely engagement (social media)

Compare movies by likelihood of watching (media)

Discover

(Extract, Notice, Organize, Cluster, Group, Connect, Reveal)

Analyze a dataset and notice a pattern that allows clustering of similar things or identification of outlying entities.

Discover unusual bank transactions (fraud detection)

Discover person's routine (energy optimization)

Discover how people use this website (web usage mining)

Generate

(Make, Compose, Construct, Create, Author)

Generate something new (message, image, sound)
based on knowledge of similar things.

Generate conversational responses (chat agent)

Generate detail in image (photo retouching)

Generate synthetic medical records (medical data)

Act

(Do, Execute, Play, Go, Learn, Operate)

Execute a strategy to achieve a specific goal and continue to update the strategy based on advance towards the goal.

Act: Park the car (autonomous parking)

Act: Play poker (gambling agent)

Act: Fly drone to location (drone pilot)

Capability + Synonyms

Estimate

Rate, Grade, Measure, Assess

Forecast

Predict, Guess, Speculate

Compare

Rank, Order, Find Best, Recommend

Detect

Sense, Notice, Classify, Discriminate

Identify

Recognize, Discern, Find, Classify

Discover

Notice, Organize, Cluster, Reveal

Generate

Make, Compose, Construct, Author

Act

Do, Execute, Play, Go, Learn, Operate

Definition

Infer a value (e.g., position, size, duration, risk) to make an inference about what's happening now.

Infer a value that will be true or some attribute of a future situation that may or may not happen.

Compare a collection of like items based on a metric to select, rank or curate a collection of things.

Notice if a kind of a thing is in a data set or if it shows up in a sensor stream.

Notice if a specific item or class of items shows up in a set of like items.

Notice a pattern that allows clustering of similar things or identification of outlying entities.

Generate something new (message, image, sound) based on knowledge of similar things.

Execute a strategy to achieve a specific goal and continue to update the strategy based on advance towards the goal.

Examples

Estimate driving time (navigation maps)
Estimate chances this is spam (email)
Estimate direction sound came from (smart speaker)

Forecast best time to buy stock (financial planner)
Forecast tomorrow's weather (weather app)
Forecast max price for my house (real estate app)

Compare items by likelihood of purchase (online store)
Compare posts by likely engagement (social media)
Compare movies by likelihood of watching (media)

Detect human voice in audio (smart speaker)
Detect face in image (camera)
Detect step in motion sensor stream (smartwatch)

Identify if message is spam (email)
Identify if Jane's face (security)
Identify the type of cancer (medical imaging)

Discover how people use this site (usage mining)
Discover unusual bank transactions (fraud detection)
Discover relationships between drugs and diseases

Generate chat response (chat agent)
Generate detail in image (photo retouching)
Generate synthetic medical records (medical data)

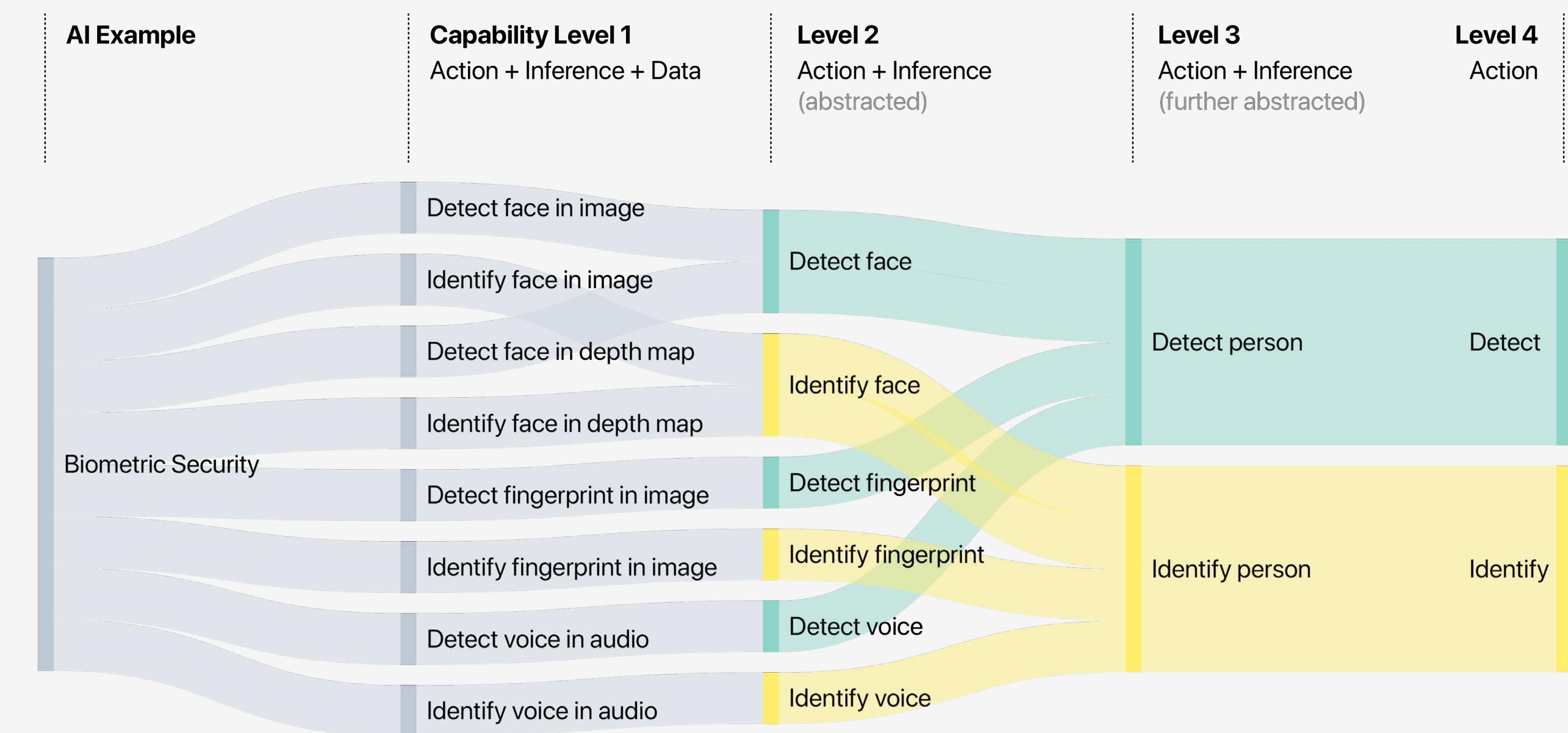
Act: Park the car (autonomous parking)
Act: Play poker (gambling agent)
Act: Fly drone to location (drone pilot)

AI Examples

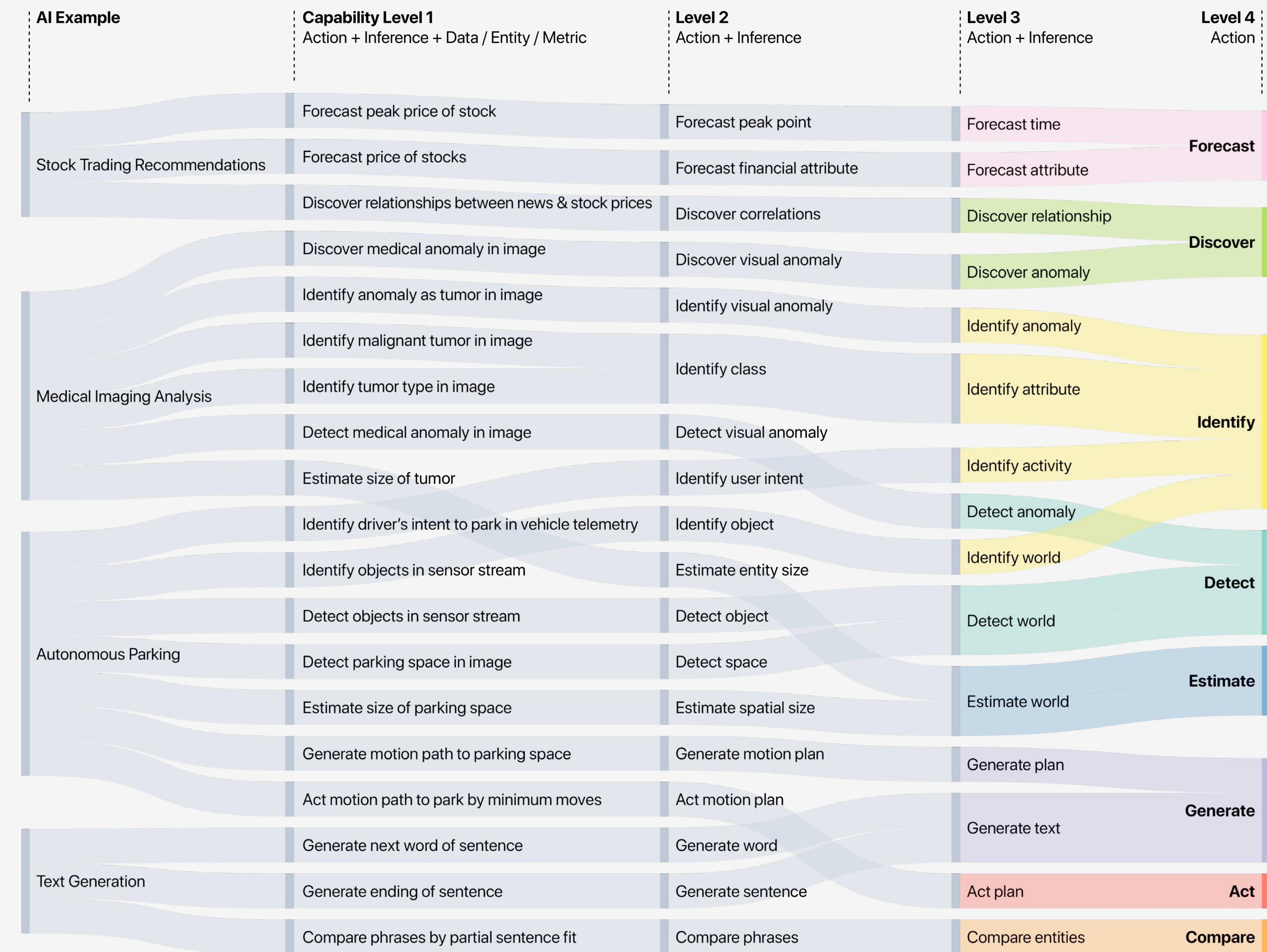
40 AI examples from 14 domains

Aerial Wildlife Monitoring	Meeting Summarization
Automated Essay Scoring	Mobile App Face Filter
Autonomous Parking	Navigation Route Planner
AR Item Viewer	Personalized Advertisements
Biometric Security	Personalized Lesson Plans
Child Welfare Risk Assessment	Predictive Maintenance
Crop Monitoring	Resume Screening
Deepfakes	Review Analytics
Defect Detection	Robotic Invoice Processing
Drug Discovery	Robotic Pick and Place
Fraudulent Transaction Detection	Smart Pricing
Game Player	Smart Speaker Question Answering
Home Energy Optimization	Smartwatch Workout Detection
HR Chatbot	Spam Filter
Image Style Transfer	Stock Trading Recommendations
Infectious Disease Forecasting	Synthetic Health Data Generation
Lane Departure Prediction	Text Generation
Language Translation	Weather Prediction
Media Feed	Web Usage Analytics
Medical Imaging Analysis	Workforce Scheduling

AI examples contain unique capabilities



AI capabilities derived across examples



Anatomy of an AI example

	Domain
Name	Risk Mitigation & Security
Description	Ensures secure access through the verification of biological signals from a user.
Capabilities	<ul style="list-style-type: none">Detect face and fingerprint in imageIdentify face and fingerprint in imageDetect face in depth mapIdentify face in depth mapDetect voice in audioIdentify voice in audio



Human-
Computer
Interaction
Institute

AI Brainstorming Kit v1.0

Selecting examples for brainstorming

Curate 10-15 examples that demonstrate a broad range of capabilities.

Aerial Wildlife Monitoring

Allows tracking animal species for environmental research and wildlife preservation.

Detect animal in image

Identify animals in image

Estimate number of animals

Discover animal movement patterns in image

Discover animal habitats in image

AR Item Viewer

Allows users to visualize online products in their physical space using their mobile devices, such as previewing a couch in a living room.

Detect room and room objects in depth map

Identify room objects in depth map

Detect virtual-physical collision in AR

Estimate object size and location in room

Estimate size of room

Generate room with virtual and physical objects

Automated Essay Scoring

Assigns grades to essays by identifying text attributes such as style, coherence, and organization.

Identify style in text

Identify organization in text

Identify coherence in text

Estimate grade of essay

Autonomous Parking

Enables vehicles to autonomously move from a traffic lane into a parking spot.

Identify driver's intent to park in vehicle telemetry

Detect objects in sensor stream

Identify objects in sensor stream

Detect parking space in image

Estimate size of parking space

Generate motion path to parking space

Act motion path to park by minimum moves

Biometric Security

Ensures secure access through the verification of biological signals from a user.

Detect face and fingerprint in image

Identify face and fingerprint in image

Detect face in depth map

Identify face in depth map

Detect voice in audio

Identify voice in audio

Child Welfare Risk Assessment

Assesses the likelihood of current or future maltreatment to a child or adolescent to help welfare workers assess families.

Forecast maltreatment risk for child

Forecast likelihood of repeated maltreatment

Discover relationships between child maltreatment and locations

Crop Monitoring

Monitors and tracks crop health using aerial images.

Detect crop stress in image

Identify crop stress type in image

Estimate growth of crop

Forecast yield of crops

Forecast yield impact of resource plans

Deepfakes

Allows producers to generate synthetic content that replaces a person in the content with someone else's likeness.

Detect face in reference image

Detect eye, mouth, and face landmarks in reference image

Detect human body in reference image

Identify body pose in reference image

Detect face in target image

Identify face in target image

Estimate similarity of images

Generate image of target person

Identify voice in target audio

Estimate similarity of audio

Generate voice of target person

Defect Detection

Used in manufacturing to continuously monitor manufactured goods for quality control and assurance.

Detect product defect in image

Identify defect type in image

Identify defect cause in image

Estimate defect likelihood in product

Discover product defect in image

Drug Discovery

Learns the relationships between current drugs' protein structures and their effect on people, diseases, and medical conditions.

Discover relationships between drugs & treatment outcomes

Generate protein structure of drug

Generate protein interaction of drug

Generate physio-chemical reaction of drug

Generate bioactivity of drug

Estimate toxicity of drug

Estimate promise of drug

Discover new uses of drug in drug-treatment relationships

Fraudulent Transaction Detection

Monitors for suspicious transactions in services like banking and healthcare.

Identify fraud in transaction

Estimate fraud likelihood of transaction

Discover fraud in transactions

Game Player

Enables an AI agent to play against an opponent in games such as chess or poker.

Compare game moves by game impact

Generate game strategy for game

Act game moves to win by minimum moves

Home Energy Optimization

Optimizes energy use at home based on users' schedule and temperature preferences.

Detect human presence in sensor stream

Estimate preferred temperature of user

Discover person's routine in temperatures

Discover group routines in temperatures

Identify person's routine in temperatures

Forecast peak usage of energy

Generate temperature plan for user

HR Chatbot

Assists employees in the workplace by answering frequent questions about their work, such as requesting PTO balance.

Identify subject in user query

Generate response to user query

Compare responses to query fit

Image Style Transfer

Allows users to apply a visual style of an image to another image, such as recreating a photo in a famous painter's style.

Identify content in target image

Identify style in reference image

Estimate content similarity of images

Estimate style similarity of images

Generate stylized version of target image

Infectious Disease Forecasting

Predicts characteristics of epidemics or pandemics to inform preparation and mitigation efforts.

Identify words in user query

Estimate symptom-relevance of user query

Discover relationship between queries and infections

Estimate number of infected people

Forecast rate of infection

Forecast peak of infection

Lane Departure Prediction

Alerts the driver of a vehicle when they may be unintentionally leaving their lane.

Detect lane in image

Estimate lane position of vehicle

Estimate lane departure likelihood of vehicle

Identify driver's intent to depart in vehicle telemetry

Detect objects in sensor stream

Estimate collision likelihood of lane departure

Language Translation

Generates machine translations for text.

Detect text in image

Identify language in text

Identify word translation in text

Identify phrase translation in text

Compare phrases by partial sentence fit

Generate translation of sentence

Media Feed

Curates a list of media elements users can select or that might autoplay.

Identify person's name in text

Identify content in image

Generate description of image content

Identify company, organization, or product in text

Identify place-of-interest in text

Identify sentiment in text

Identify bullying in text

Identify inappropriate content in audio, image, text

Identify copyrighted content in audio, image, text

Estimate user engagement of media post

Compare media posts by engagement

Medical Imaging Analysis

Looks for cancer in medical images to assist clinicians in making decisions.

Detect medical anomaly in image

Identify anomaly as tumor in image

Identify malignant tumor in image

Estimate size of tumor

Identify tumor type in image

Discover medical anomaly in image

Meeting Summarization

Automatically generates a meeting transcript,
and a meeting summary based on the transcript.

Detect voice in audio

Identify words in audio

Identify phrase in text

Identify sentence in text

Compare words by partial sentence fit

Generate summary of transcript

Mobile App Face Filter

Allows users to create virtually augmented visual content using their mobile devices.

Detect background in image

Detect eye, mouth, hair, face, and face landmarks in image

Detect hand in image

Detect human body in image

Identify body pose in image

Identify hand gesture in image

Identify face gesture and expression in image

Generate virtual effects on user face and body

Navigation Route Planner

Generates users an optimal route to a destination based on the provided criteria and constraints, such as weather, traffic, and road closures.

Estimate street and direction of vehicle

Forecast traffic impact of route

Estimate travel time of route

Compare routes by driver preferences

Personalized Advertisements

Analyzes user behavior data to determine the best match between an ad and a set of users to allow services reach their audiences more effectively.

Discover user similarities from user behavior

Discover ad similarities from user behavior

Compare ads by will-user-click

Compare users to ad fit

Personalized Lesson Plans

Allows students to follow a personalized learning plan, particularly in massive open online courses.

Estimate skill level of student

Estimate skill acquisition of student

Compare math problems by skill acquisition

Compare unknown skills by learning impact

Discover student stereotypes from student behavior

Generate learning plan for student

Predictive Maintenance

Builds a model that describes the conditions under which a system breaks down.

Detect machine sound in audio

Identify machine breakdown in audio

Estimate breakdown likelihood of machine

Forecast breakdown point of machine

Estimate breakdown duration of machine

Estimate breakdown cost of machine

Forecast repair impact of machine

Resume Screening

Assists hiring managers of companies by prescreening candidate resumes.

Identify skills in text

Identify competence in text

Identify specialization in text

Compare resumes by job fit

Review Analytics

Analyzes customer reviews for services to provide insights on customer behavior and service breakdowns.

Identify subject in text

Identify sentiment in text

Identify user intent in text

Identify context in text

Discover topics in documents

Robotic Invoice Processing

Digitizes and validates data from purchase orders to speed up invoice processing.

Identify document type in image

Detect document structure in image

Identify document structure in image

Identify paired content in image

Identify handwritten words in image

Robotic Pick and Place

Speeds up the process of picking up items and placing them in other locations, typically in industrial contexts such as manufacturing or recycling.

Detect objects in image

Identify object in image

Estimate location and orientation of object

Generate motion and grasping path to object

Act motion and grasping path to pick by minimum moves

Smart Pricing

Predicts an optimal price for a rental property based on changing demand to assist property owners in setting prices.

Forecast demand for listing

Forecast maximum price for listing

Smart Speaker Question Answering

Assists users by responding to their verbal questions.

Detect voice in audio

Identify voice in audio

Identify words in audio

Identify user query in text

Identify subject in text

Compare responses to query fit

Generate human speech from response

Smartwatch Workout Detection

Automatically detects and records the workout activities users perform, such as walking, running, and cycling.

Detect motion in sensor stream

Identify workout in sensor stream

Detect step in sensor stream

Detect hard fall in sensor stream

Estimate energy expenditure of user

Spam Filter

Filters spam emails by identifying words associated with spam emails, as well as other characteristics such as the sender.

Estimate spam likelihood of email

Identify spam in email

Identify spam words in text

Stock Trading Recommendations

Provides insights on profitable stocks to help stock market traders, investors, and fund managers make trading decisions.

Discover relationships between news and stock prices

Forecast peak price of stock

Forecast price of stocks

Synthetic Health Data Generation

Examines a corpus of data to generate new data that is different, but highly similar to the source data.

Generate new patient data from patient data

Generate missing elements of patient data

Generate missing view for medical image

Generate detail for occluded area of medical image

Generate high-res detail for low-res medical image

Generate new medical images from medical image

Text Generation

Generates guesses for the word or sentence users are typing as part of searching, messaging, and word processing services.

Compare phrases by partial sentence fit

Generate ending of sentence

Generate next word of sentence

Weather Prediction

Predicts weather conditions for a given location and time based on current conditions and historic data.

Estimate weather condition for location

Estimate intensity of weather condition

Forecast temperature for location

Web Usage Analytics

Provides an analysis of web usage data to assess and improve websites.

Compare products by will-user-click

Compare users to product fit

Discover navigation patterns from user behavior

Discover user interests from user behavior

Discover user similarities from user behavior

Identify content in web page

Workforce Scheduling

Generates a schedule for employees by assigning them to shifts or to customers, typically in contexts such as hospitality, maintenance and healthcare.

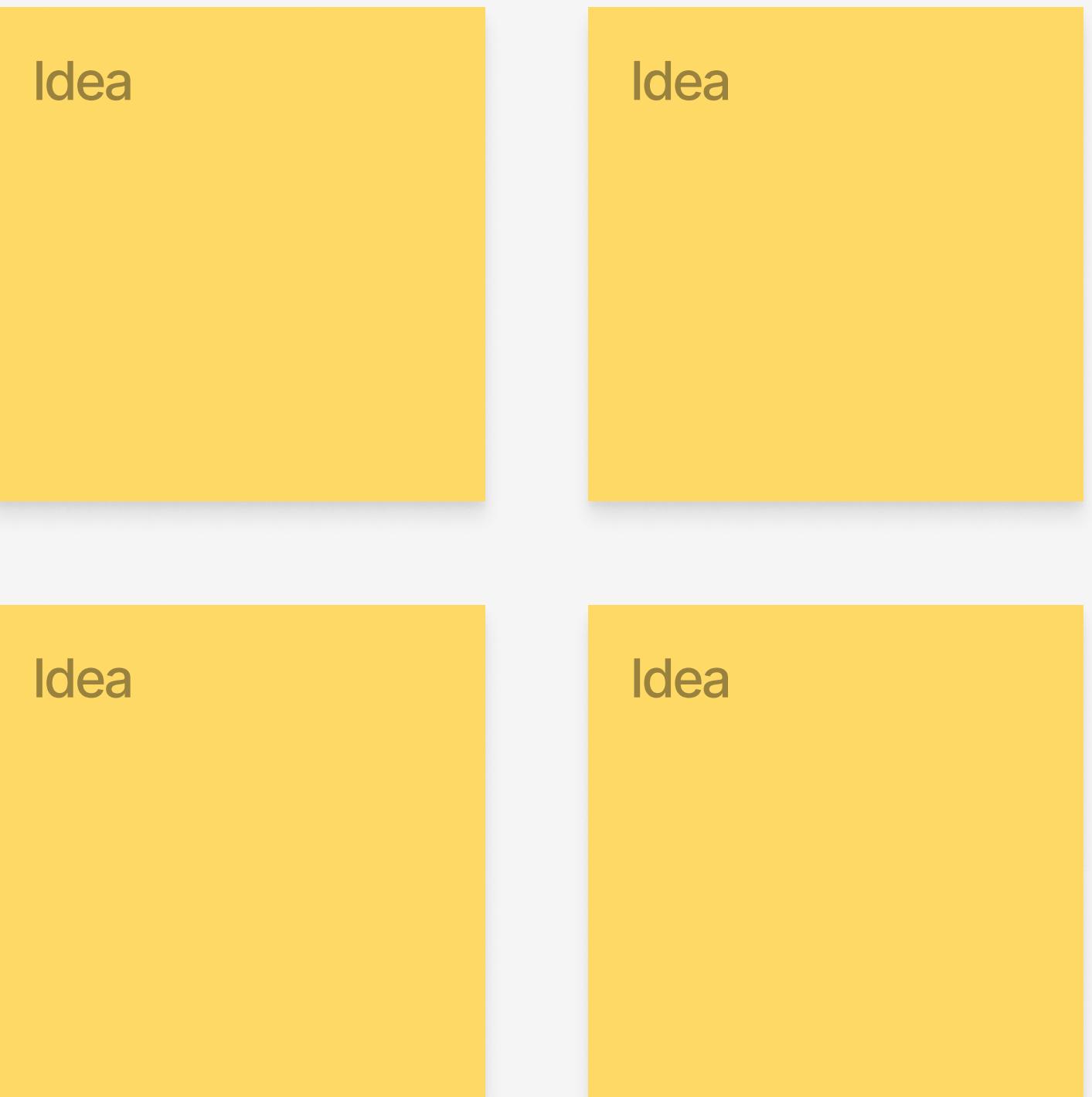
Forecast demand for staffing

Estimate priority of cases

Generate schedule for employees

Ideation

Review a subset of AI examples with your team to seed ideation. Then run a targeted ideation session, probing domain experts if a capability might be useful.



Start with individual brainstorming.
Then ideate with teammates.

Concept Name

One line description here.

Template for detailing ideas
into concepts.

Target user need

Who is the user? What is the need you are addressing?

AI Capability

What is the system reasoning about?

Data

What information does the system need to know?

Action

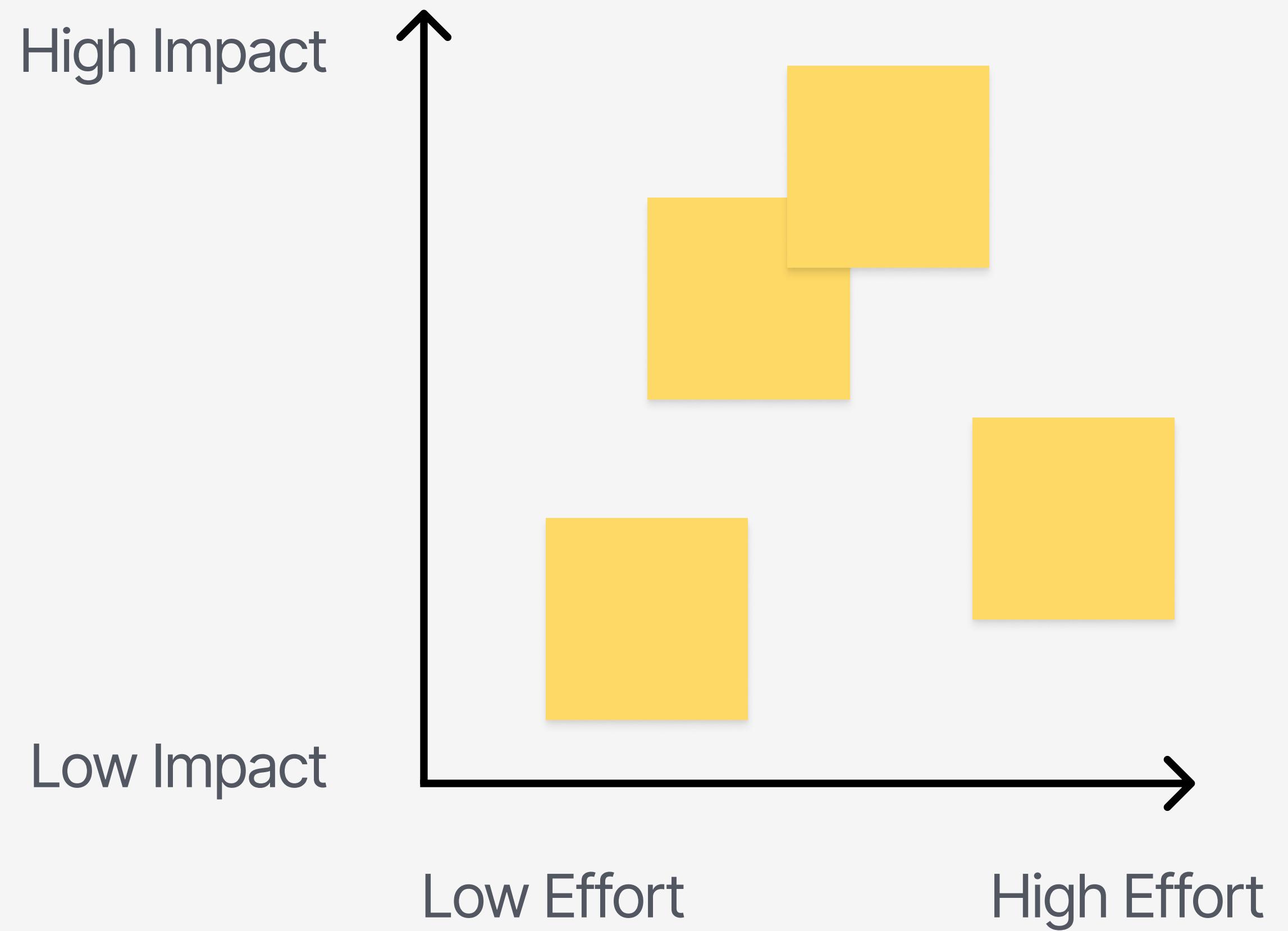
What action does the system take with the AI output?

Prioritization & Assessment

Assess and prioritize ideas using the matrices in the following slides. Aim for a broad coverage of the design space.

Impact-Effort Matrix

Map your ideas based on their potential value for customers and services, and the effort required to build it.



Impact-Effort Matrix

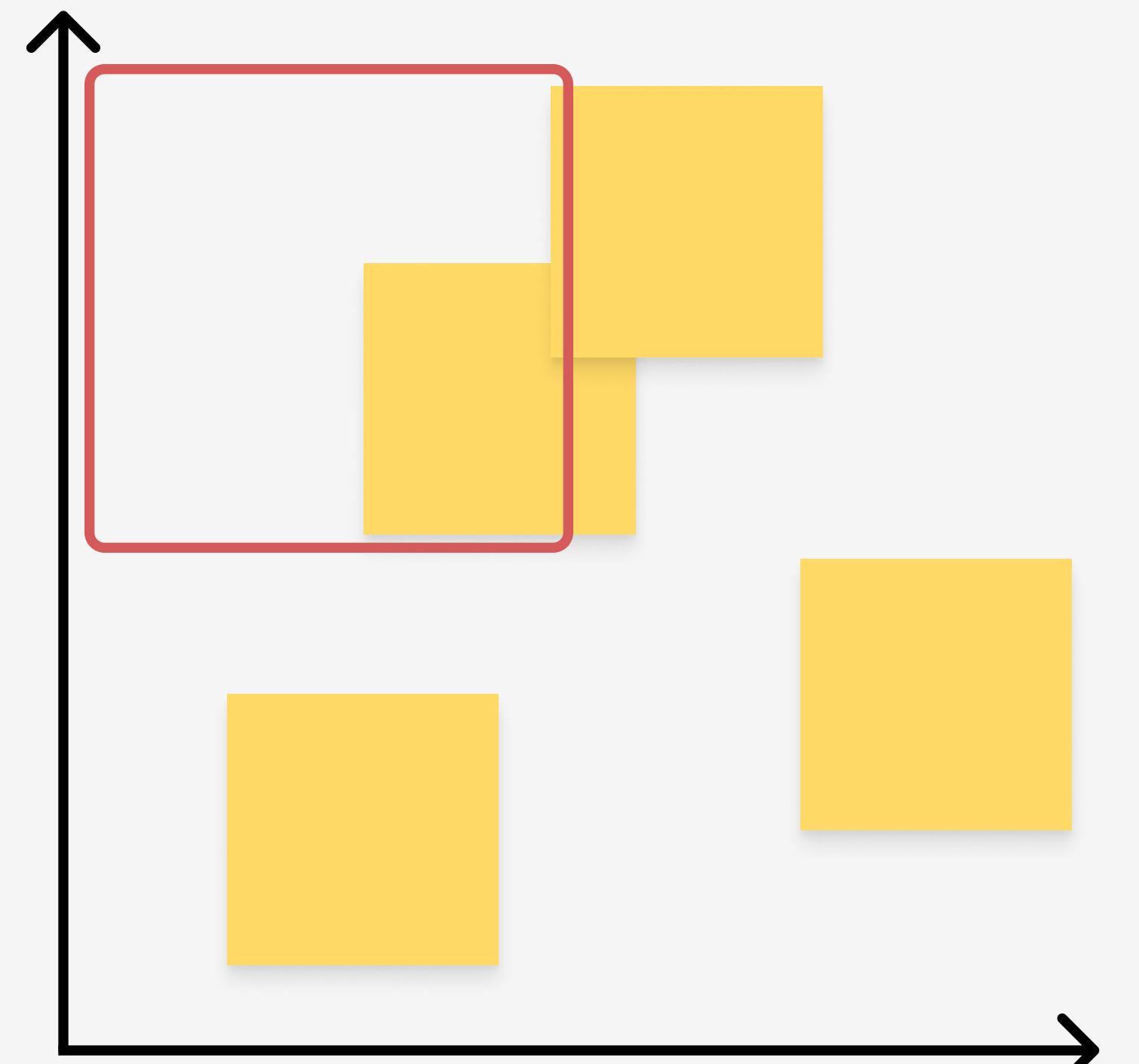
Look for high impact, low effort ideas.

High Impact

Low Impact

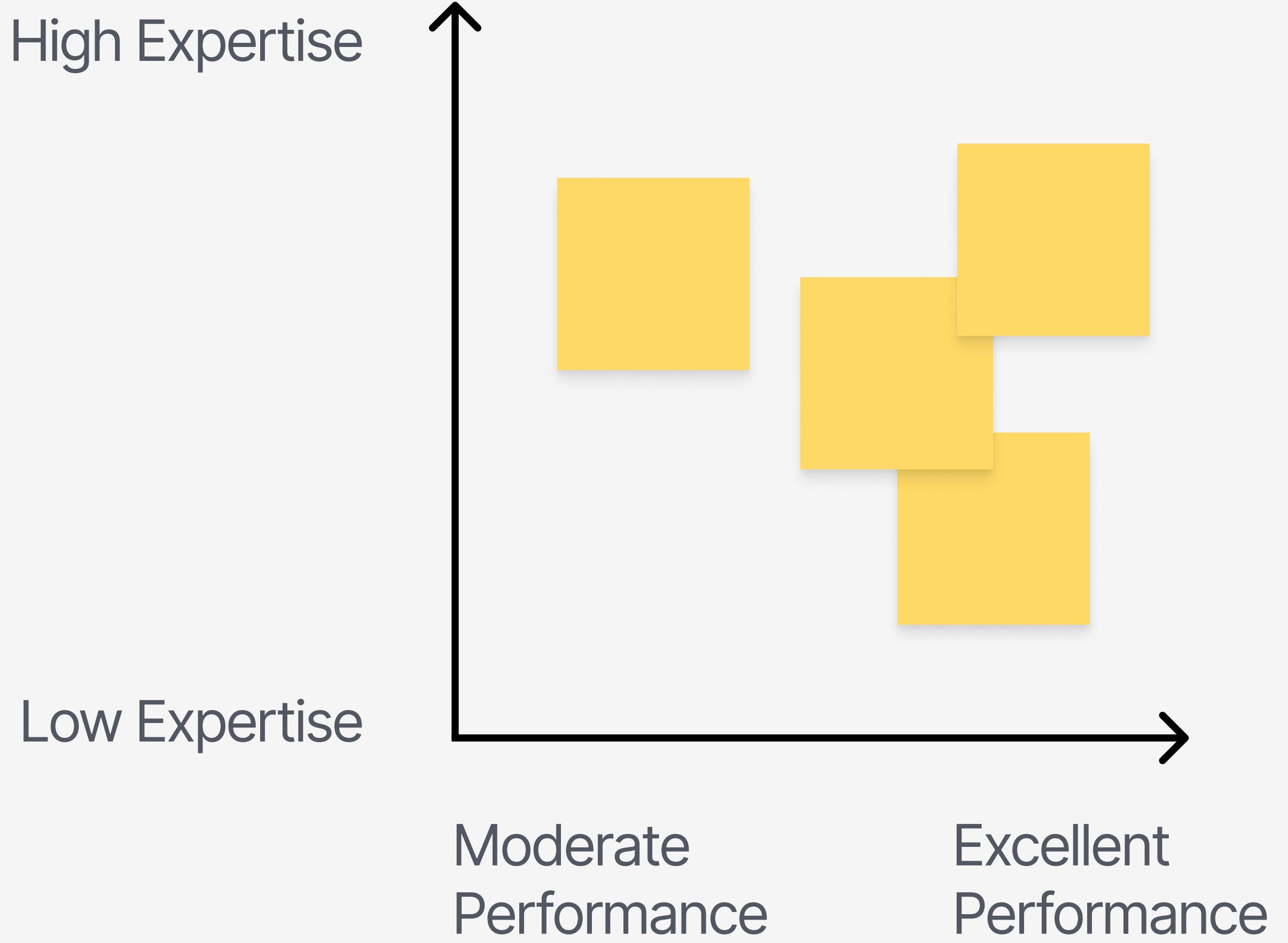
Low Effort

High Effort



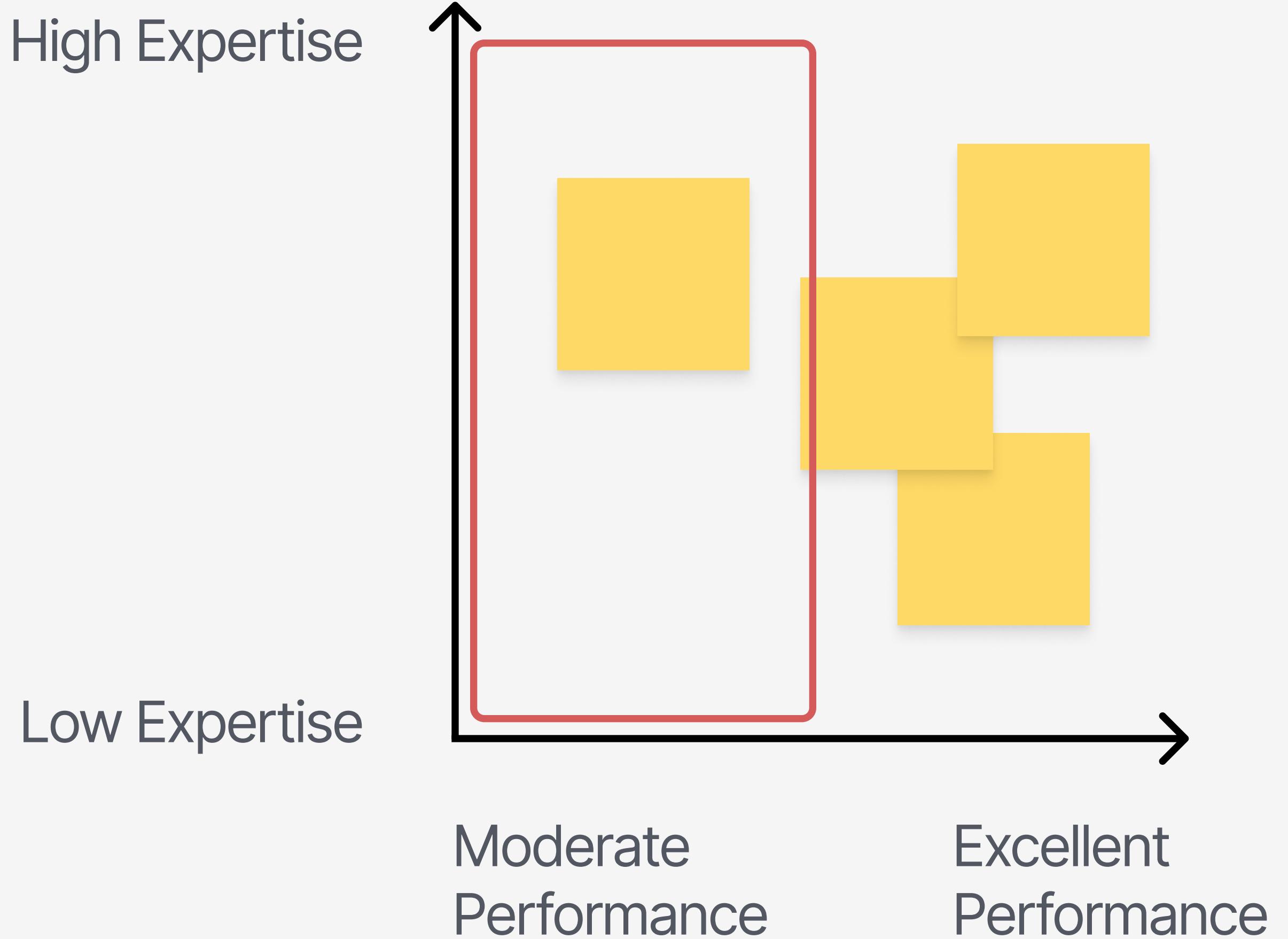
Task Expertise-AI Performance Matrix

Map your ideas based on how well the AI system needs to perform, and the level of expertise required for the task.



Task Expertise-AI Performance Matrix

Look for use cases where moderate AI performance can create value.



What's Next

Sketch out solutions to think further think about feasibility, desirability, viability, and risks.



Drop us a line at yildirim@cmu.edu – we would love to hear your feedback.

aidesignkit.github.io